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Executive Summary

Background and Purpose

This report examines economic and policy issues related to wild and farmed salmon in North America. These issues have received a great deal of attention in recent years, reflecting the environmental, economic and cultural importance of salmon to Americans—and the fact that salmon issues span many important policy debates ranging from environmental protection to trade policy.

The salmon industry has experienced dramatic change over the past two decades. Two major trends gave rise to many of the issues discussed in this report. The first trend is the rapid and sustained growth in world farmed salmon and salmon trout production, from two percent of world supply in 1980 to 65 percent of world supply in 2004 (Figure 1). This development has fundamentally transformed world salmon markets—not only because of the dramatic growth in total supply, but also because of changes in the kinds of salmon products which are available, the timing of production, market quality standards and organization of the industry.

The second trend is a steep decline in the value of North American wild fisheries, as seen in the decline in the value of annual Alaska salmon catches from more than $800 million in the late 1980s to less than $300 million for the period 2000-04 expressed in 2005 dollars (Figure 2). Most of this decline in value was due to a decline in prices (rather than catches), and much of the decline in prices was due to competition from farmed salmon.

![Figure 1](https://via.placeholder.com/150)

**Figure 1** World Salmon and Trout Supply 1980-2004

Source: All data are FAO Fishstat+ data except that data (used to calculate North American wild salmon catches) for Alaska are CFEC Alaska Salmon Summary Data 1980-2005 and data for the Pacific Northwest are NMFS catch data. “Farmed trout” includes only farmed rainbow trout raised in salt water.
The growth of farmed salmon and the decline in the value of wild salmon has given rise to two broad sets of questions:

• How has salmon farming affected wild salmon resources and the wild salmon industry?
• What should be done to protect wild salmon resources and strengthen the wild salmon industry?

Inherent within these questions are numerous, wide-ranging and complex issues. These issues are often oversimplified and misunderstood, leading to ill-conceived policy recommendations. The primary purpose of this report is to inform people who care about these issues—particularly policymakers, the environmental community, and the fishing industry—about the wild and farmed salmon industries and the economic relationships between them, to provide a sound basis for achieving environmental and economic goals.

Readers seeking simple answers about salmon issues will be disappointed. Nothing is simple about salmon, salmon fisheries or salmon markets. An understanding of salmon biology, fisheries management, hatcheries and aquaculture is fundamental to understanding relationships between wild and farmed salmon. An understanding of salmon products, markets, consumers and the distribution chain is fundamental to understanding how and why prices have changed.

This report consists of twenty chapters. The table below summarizes major questions addressed by each chapter.

The remainder of this executive summary reviews selected major conclusions of the report. Readers are strongly encouraged to refer to the full report for the detailed analyses on which these conclusions are based.
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North American Wild Salmon Resources

Wild salmon are very important to many different people in North America. For well over a century, the commercial wild salmon industry has provided a living—and a way of life—to fishermen, processors, and coastal communities from California to Alaska. Sport fishermen are passionate about sport fishing for salmon, and sport fishing has become a big business for many coastal communities. Native Americans have relied upon salmon for thousands of years, and continue to actively participate in subsistence and commercial fisheries. The general public—including those who do not fish for salmon—are stirred by the annual return of the salmon and derive values simply from the fact that these salmon continue to be found in our rivers. All of these stakeholders wish for sustainable wild salmon fisheries.

Pacific and Atlantic salmon are members of a large family of fish known as salmonidae. Salmon are anadromous: they spawn in fresh water and the young migrate to the sea where they mature. Most salmon return to the stream of their birth, although some may stray to other streams.

Five species of Pacific salmon (genus Onchorhynchus) are fished commercially: Chinook salmon Onchorhynchus tshawytscha; sockeye salmon Onchorhynchus nerka; coho salmon Onchorhynchus kisutch; pink salmon Onchorhynchus gorbuscha; and chum salmon Onchorhynchus keta. Atlantic salmon Salmo salar spawn in limited numbers in New England and the Canadian maritime provinces; however, there are currently no North American commercial fisheries for Atlantic salmon.

Wild salmon return or formerly returned to thousands of streams over very large areas of northeastern and northwestern North America. The status of salmon resources varies widely across this vast area, not only between regions but also between individual watersheds within regions. Imperfect data are available on the status of wild salmon resources. While what matters for the health of the resource is the number of fish returning and spawning, most of the available data are for salmon catches, which do not necessarily correspond to the number of fish returning or spawning. Changes in catches may reflect not only changes in the number of fish returning, but also changes in the ocean environmental conditions, technology of fishing and commercial fishing regulations.

There is increasing realization of the importance of genetic diversity within a given salmon run. The long-run survival of the population depends on the presence of some fish able to survive environmental shocks such as particularly cold or hot water temperatures. But it is only very recently that techniques have been devised to measure the extent of genetic diversity within salmon populations; very little information is available about the extent to which there may have been changes over time in genetic diversity of wild salmon stocks. It is also unclear what the effect of hatchery production has been on the genetic diversity of salmon.
In studying the North American wild salmon industry, it is useful to distinguish between four salmon producing regions: Alaska, British Columbia, the U.S. Pacific Northwest, and Maine and maritime Canada. There are important differences between these regions in the condition of wild salmon resources, the scale of catches, the economic importance of the industry and the scale of salmon farming (Figure 3).

The conventional wisdom is that Alaskan salmon stocks are abundant and healthy, and that strong salmon returns since the 1980s reflect a commitment to protect salmon habitat and conservative resource management. Unlike more settled parts of North America, over vast areas of Alaska, there has been relatively little human disturbance to the environment—no roads, dams, farming, logging or mining. The absence of disturbance to the freshwater environment has been an important factor in the relative health of Alaskan salmon resources.

Because of the relative abundance of the resource, Alaska dominates the North American commercial wild salmon industry. For that reason, much of the emphasis in this body of this report is on Alaskan salmon.

In British Columbia, after record catches in many commercial salmon fisheries during the mid-1980s, wild salmon catches fell dramatically during the 1990s. Some stocks of coho and sockeye salmon also experienced large declines in spawning escapements during the 1990s, leading to a ban on coho fishing along the entire coast of the province in 1998 and closures of directed fisheries for some sockeye stocks. Changing ocean conditions, leading to poor ocean survival, may have been key factors in this decline. More favorable ocean conditions since 1999 have led to improved ocean survival, although some stocks are still...
considered to be depressed. In general, most British Columbia chumoo, sockeye and pink salmon stocks are considered “healthy,” while the status of coho and chum salmon stocks is considered “mixed.”

The status of individual salmon stocks in the U.S. Pacific Northwest region varies widely. Efforts to rebuild stocks face daunting technical, economic and political challenges. How to rebuild Pacific Northwest salmon stocks is a complex debate of national importance which has drawn significant attention. From the point of view of commercial wild salmon fisheries, however, Pacific Northwest salmon catches are much smaller than those of Alaska, and of relatively limited and local economic significance.

In the Northeast Atlantic region, wild Atlantic salmon were historically found in rivers in New England, Quebec, the Maritime Provinces and Newfoundland. In the U.S. Atlantic salmon were once native to nearly every major coastal river north of the Hudson River. Currently, Atlantic salmon are extinct in 84 percent of historically salmon-bearing rivers of New England and in critical condition in the remaining 16 percent. Atlantic salmon in Maine were listed as endangered under the federal Endangered Species Act in 2000.

In eastern Canada, wild Atlantic salmon populations have declined by more than 75 percent since the 1970s, when about 1.5 million Atlantic salmon returned to Canadian rivers. Since then returns have fallen to about 350,000 while the proportion of small salmon (grilse) has increased from about 45 percent in the 1970s to about 75 percent. In general, rivers in the north are relatively healthy whereas those in the south (New Brunswick and Nova Scotia) are considered to be in serious trouble.

North American Wild Salmon Fisheries

North American wild salmon fisheries may be generally divided into three broad types of fisheries: commercial, sport, and aboriginal. All three types of fisheries are important, but their relative importance varies widely between different regions.

In this report, our focus is entirely on commercial wild salmon fisheries. In 1999, commercial fisheries accounted for about 98 percent of Alaska catches, 89 percent of British Columbia catches, and 96 percent of Pacific Northwest catches. While commercial fisheries account for almost all sockeye, pink and chum salmon catches, the share of commercial fisheries is lower for chinook and coho salmon, for which sport fisheries account for about one-fifth of total catches.

Although commercial fisheries dominate wild salmon catches, sport and subsistence salmon fisheries are also very important in all regions. Salmon sport fishing is prized by anglers from Atlantic Canada to the Pacific Northwest, British Columbia and Alaska—and providing guiding, lodging and other services to sport fishermen is a major economic activity that in some areas rivals or exceeds commercial fisheries in value and economic impact. “Subsistence” catches—primarily aboriginal—are very important for food and cultural traditions in some regions.

Management of North American Commercial Salmon Fisheries

Similarities and differences exist in the management of commercial wild salmon fisheries in Alaska, British Columbia and the U.S. Pacific Northwest states of Washington, Oregon and California. In part, these reflect variations in the relative scale and status of salmon runs and the mix of commercial, sport and aboriginal uses, as well as differences in regulatory institutions resulting from different political, legal, economic and social conditions.

Alaska’s commercial salmon fisheries are managed under a “limited entry” program, which was established in the 1970s to limit growth in the number of people fishing in the salmon industry. Alaska has twenty-six different salmon fisheries, defined by fishing area and the type of fishing gear which may be used. Major gear types include purse seine, drift gillnet, set gillnet, and power troll. For each fishery, there are a fixed number of “limited entry permits.” Only holders of these permits (and their crew) are allowed to operate fishing gear. There are also numerous restrictions on boats and gear. Individuals may hold more than one salmon permit, but they may participate in only one salmon fishery per season.

Alaska has “in-season, abundance-based management” of commercial salmon catches. Each year, the overriding goal for salmon fishery managers is to assure that enough salmon reach the spawning grounds to ensure healthy future generations of salmon. Managers have target goals for optimal “escapements,” or numbers of fish that “escape” commercial, sport and subsistence fisheries to reach the spawning grounds. Only “surplus” fish in excess of this escapement goal are available to be caught.

There is wide variation between Alaska salmon fisheries in volume harvested, earnings, number of permits and average permit prices. While prices and catches were high, most Alaska fishermen and fishery managers were not concerned about overcapacity or inefficiency in these salmon fisheries. However after the value of catches began to decline in the 1990s, many fishermen experienced an economic squeeze as their fishing revenues were no longer sufficient to cover their costs. For many permit holders, the loss in fishing profits was aggravated by a sharp decline in the

The Great Salmon Run: Competition Between Wild and Farmed Salmon
asset value of their limited entry permits. In some fisheries a significant share of permits are no longer being fished, as permit holders have concluded that they cannot make enough money fishing to cover their costs. In many fisheries the number of boats remains well above the levels needed to catch the available fish. The relative decline has not been the same for all fisheries.

As the economic difficulties of the Alaska wild salmon industry increase, there is growing awareness of how the management system adds to costs and lowers quality, thereby adding to the difficulties Alaska salmon faces in competing with farmed salmon. At the same time, there is strong resistance to changes in management, because of the economic and social disruption that such changes might mean.

In British Columbia, the Canadian federal government has sole responsibility for management of salmon fisheries. The fisheries are managed by the Department of Fisheries and Oceans (DFO). DFO implemented limited entry licensing for British Columbia salmon fisheries in 1969. Currently, licenses are issued for three gear groups: seine, gillnet and troll vessel.

In British Columbia, consecutive poor salmon seasons in 1995 and 1996, during which incomes and profits fell to record lows, as well as ongoing concerns for conservation of salmon, led the federal government to introduce a Pacific Salmon Revitalization Strategy in 1996. The plan implemented area and gear licensing for

the salmon fleet which limited license holders to fishing with a single gear type in a specified area. It also allowed “stacking” of more than one license on a single vessel. British Columbia further provided for the voluntary purchase or retirement of commercial salmon licenses. A $280 million buyback program resulted in a decline in the number of commercial salmon licenses from approximately 4,400 to 2,200 between 1995 and 2000.

In the U.S. Pacific Northwest, non-treaty fisheries are also managed under limited entry systems. Catches are restricted by restrictions on fishing times, areas and gear types. Permit numbers have been significantly reduced by buyback programs. Commercial salmon fisheries in the region include both in-river and ocean fisheries using troll, gillnet, seine and several other kinds of gear. Management of these fisheries is greatly complicated by widely varying conditions of wild salmon stocks, the fact that many commercial fisheries are mixed stock fisheries (catching fish returning to different river systems), the presence of interception fisheries (in which fish are caught by a series of different groups as they return from the ocean to spawning grounds) and the importance of salmon to many different user groups. There are also a large number of institutions involved in fishery management and a diversity of commercial fishing user groups. For example, sport catches play a significant role of in total salmon catches, and hatchery fish play a major role in commercial and sport catches.

North American Commercial Salmon Catches

Hundreds of millions of Pacific salmon are caught each year in commercial salmon fisheries. Alaskan salmon catches dwarf those of other regions, and increased dramatically during the 1980s and early 1990s to record levels. Alaska fishery managers and politicians generally attribute the increase to conservative state management of salmon resources, the end of high-seas catches and production from the Alaska salmon hatchery program.

During the five-year period 1996-2000, combined Alaskan catches of chinook, sockeye, coho, pink, and chum salmon averaged more than 350,000 mt per year. British Columbia catches of the same species during this period totalled slightly less than 30,000 mt, and U.S. Pacific Northwest catches were less than 10,000 mt. Alaska accounted for 90 percent of the total harvest volume; British Columbia accounted for 8 percent, and the Pacific Northwest accounted for only 2 percent (Figure 4).

During 2000-2005, pink salmon accounted for the largest share of Alaska catch volume (47 percent), followed by sockeye (26 percent), chum (20 percent), coho (5 percent) and chinook (1 percent) (Figure 5). In British Columbia, chum salmon accounted for the largest share of the catch.
Figure 4  
**North American Commercial Salmon Catches, by Region, 1980-2005**


Figure 5  
**Average Commercial Salmon Catches, 1996-2000, by Species and Region (metric tons)**

(35 percent), followed by pink (33 percent), and sockeye (26 percent). In the U.S. Pacific Northwest, chinook salmon accounted for the largest share (41 percent), followed by chum salmon (31 percent), and coho (17 percent). Thus, while Alaska accounted for 94 percent of pink salmon catches it accounted for only 34 percent of chinook salmon catches.

Alaska catches set all-time records during the mid 1990s and remain strong for chinook, coho, pink, and chum salmon. Alaska sockeye salmon catches fell by more than half between 1995 and 2002, but have since rebounded significantly. The decline in catches of sockeye salmon—which typically command the second highest price per pound and constitute more than half of the ex-vessel value of Alaska salmon catches—has been a significant factor contributing to the economic difficulties of Alaska salmon fishermen in recent years. It is uncertain what has caused this decline in sockeye, but ocean conditions, stream conditions, and other environmental changes are the most likely causes.

Importance of Sockeye Salmon in Commercial Catches

As discussed above, between 1988 and 2002 there was a steep decline in the real ex-vessel value of Alaska commercial salmon catches (“ex-vessel value” is the value paid to fishermen). British Columbia salmon fishermen have experienced an even more dramatic decline. More than half of this decline was in the value of sockeye salmon catches. The decline in value of sockeye catches resulted from a decline in both sockeye prices and sockeye catches. The modest rebound in value since 2002 has also resulted primarily from an increase in sockeye catches and prices.

In most years, sockeye salmon accounts for well over half of the value of Alaska salmon catches—the result of a combination of high catches and high prices. For this reason, Alaska fishermen sometimes refer to sockeye salmon as “money fish.”

This role of sockeye salmon is important to emphasize, because until recently almost all Alaska sockeye salmon was either frozen and sold in Japan or canned. Only a very small share was sold in the U.S. fresh and frozen market. Thus much of the decline in sockeye catch value (and the total Alaska catch value) had very little to do with competition between farmed and wild salmon in the U.S. fresh and frozen salmon market—but resulted rather from changes in other markets.

Wild Alaska Salmon Prices

Different species command dramatically different prices, and the relative ranking of different species tends to stay the same in most (but not all) years. Chinook salmon command the highest ex-vessel prices—well over $1.00 per pound. Ex-vessel prices for sockeye and coho salmon are in a middle range—generally between $0.50 and $1.00 per pound in recent years. Prices for chum and pink salmon are significantly lower, generally less

![Figure 6](attachment:Figure6.png)

Average Real Ex-Vessel Prices for Alaska Salmon, 1980-2005 (adjusted for inflation)

than $0.30 per pound for chum and less than $0.15 per pound for pink salmon in recent years.

After rising during the 1980s, there was a significant downward trend in prices for all species from 1988 to 2002. Since 2002, inflation-adjusted price trends have differed between species. Real prices for chinook and coho salmon, in 2005 dollars have risen significantly, prices for sockeye salmon have risen slightly, and prices for pink and chum salmon have stayed about the same (Figure 6).

The causes of the decline in prices are complex, and they vary between species. A different mix of products is produced from each species, which sell into different markets. However, for most species the single most important factor contributing to the decline in prices has been growing competition from farmed salmon.

**Contribution of Hatcheries to Wild Salmon Catches**

A large share of salmon returning to North American streams is released from hatcheries. Sometimes referred to as “ranched salmon,” hatchery fish contribute significantly to North American wild salmon catches (Figure 7). More than two billion Pacific salmon were released in 2000 by North American hatcheries. Alaska accounted for 69 percent of total releases, while Canada and the Pacific Northwest each accounted for about 16 percent.

Hatcheries recreate the early portion of the life cycle of the species in a protected environment and consist of both a freshwater and a marine phase. The freshwater phase encompasses the spawning cycle, egg production, hatching and first-feeding stages.

Alaska’s salmon hatcheries, originally developed with substantial state funding, are now operated primarily by private non-profit associations funded in part by taxes on fishermen and in part by special “cost-recovery” fisheries conducted by the hatcheries. In recent years, hatchery fish have accounted for about 38 percent of total Alaska “wild” salmon catches, including about 40 percent of Alaska pink salmon catches and 69 percent of Alaska chum salmon catches.

The relative importance of hatcheries varies between different areas of Alaska. In 2002, Southeast Alaska and Prince William Sound accounted for about 80

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**Figure 7**

*Alaska Commercial Salmon Catches Since 1960: Natural Wild Salmon and Hatchery Salmon*

percent of hatchery catches. In other major fisheries, such as western Alaska sockeye salmon fisheries and the Southeast Alaska pink salmon fishery, hatchery fish account for only a small share of total catches.

Although hatcheries have clearly increased Alaska salmon catches, they have not stabilized catches. Salmon catch by region and in the state as a whole still vary greatly from year to year, because hatchery fish are subject to the same ocean conditions as wild salmon.

A number of issues have arisen with regard to Alaska’s salmon hatchery program. During the 1990s, fishermen in regions of Alaska without hatchery production—in particular areas of interior and western Alaska dependent on chum salmon—argued that increased hatchery catches were responsible for the disastrous decline in prices which they had experienced. More generally, the question began to be raised whether Alaska salmon hatcheries were actually increasing the total value of Alaska salmon catches, or whether the value of the increased harvests was being offset by corresponding negative effects on prices. As prices declined during the 1990s, hatcheries’ operating costs came to represent an increasing share of the value of hatchery fish, raising further questions about the net economic benefits and economic viability of hatcheries.

Some critics question whether the Alaska salmon hatchery program may adversely affect Alaska’s natural wild salmon runs. One concern relates to the potential for competition for food between hatchery salmon and natural wild salmon, both for juvenile fish in near-shore waters as well as in the open ocean. Another set of issues relate to the management of commercial fisheries in which fishermen are catching mixed stocks of hatchery and natural wild salmon. If large returns of hatchery fish are mixed with depleted runs of natural wild fish, there is the likelihood for over-harvests of natural wild fish runs. Finally, an issue which may grow in importance over time is the effect of Alaska’s salmon hatchery program on the “wild” image of Alaska salmon fisheries.

In British Columbia, the Canadian Department of Fisheries and Oceans launched a Salmonid Enhancement Program (SEP) in 1977. The program included both the construction of hatchery facilities as well as a variety of other habitat enhancement projects such as spawning channels, incubation boxes and lake enrichment. DFO estimates that about 10-20 percent of the province’s sport and commercial salmon catch originates from SEP projects, and about a dozen terminal fisheries at hatchery release sites are dependent on enhanced stocks (DFO 2000).

There is, however, significant doubt about whether the SEP is succeeding. A 2000 review concluded that it was difficult to say whether the SEP had produced any net gain of salmon, and that there was evidence to suggest that it had contributed to a net loss of wild salmon abundance, partly because of competition of juvenile hatchery fish with wild juvenile fish, and partly because of unsustainably high harvest rates on co-migrating wild salmon (Pacific Fisheries Research Council 2000).

In the U.S. Pacific Northwest, depending on species and area, salmon enhancement programs produce as much as 70 to 90 percent of salmon harvested in commercial and recreational fisheries. Between the mid-1950s and early 1970s, scientists found increasing evidence that hatchery salmon were harming remaining wild salmon runs. It seems clear now that hatcheries have had demographic, ecological and genetic impacts on wild salmon populations, including the reduction of genetic diversity within and between salmon populations, creation of mixed-population fisheries, altered behavior of fish, ecological imbalances due to the elimination of the nutritive contribution of carcasses of spawning salmon from streams and the displacement of the remnants of wild runs (NRC 1996). As a result, academic, environmental and salmon advocate groups have proposed a redesign of the traditional objectives of hatchery management, from producing more fish for harvest towards providing a means for the recovery and conservation of wild salmon populations (LLTK 2004; NRC 1996).

Overall, hatcheries add another dimension of complexity and ambiguity to the environmental, economic and social issues related to wild and farmed salmon. Once thought of as a way to restore and enhance natural wild salmon runs, hatchery salmon are now recognized as potentially harmful to natural wild salmon runs because of genetic interactions and competition for food and habitat in freshwater and marine environments. Particularly in the U.S. Pacific Northwest, there is an active debate among scientists, commercial fishermen and the public as to the appropriate role and scale of salmon hatcheries.

**Farmed Salmon Production**

Commercial salmon farming began in the 1970s. During the 1980s and 1990s, commercial salmon farming became well established in many temperate countries around the world. Global farmed salmon production exceeded the world’s total commercial harvest of wild and ranched coho and chinook salmon by the mid-1980s, and it exceeded all commercial harvests of wild salmon by 1996 (Figure 8).

Of the several salmonid species cultured for commercial purposes worldwide, Atlantic salmon is by far the most important. Its potential for farming is excellent since it is relatively easy to handle, grows well under culture conditions, has a relatively high...
commercial value and adapts well to farming conditions outside its native range. Of the Pacific salmon that are caught in North America, only chinook, coho and steelhead (salmon trout) are farmed in substantial quantities.

About three-fourths of the fresh and frozen salmon consumed in the United States is now farmed. As production costs of farming salmon have declined, farmed salmon production has continued to grow. Prices for both wild and farmed salmon have trended downwards—creating problems for both wild and farmed salmon producers.

It should be noted, however, that while most U.S. salmon consumption derives from farmed product, the U.S. salmon farming industry, mostly in Washington and Maine, in 2002 accounted for less than 1 percent of world farmed salmon production, and it is likely to continue to decline in market share. Alaska has a permanent moratorium on salmon farming. Competitiveness of U.S. farmed salmon producers has been seriously eroded in recent years by the escalating cost of regulatory compliance covering almost all aspects of production, including disease control, feed additives, effluent discharges, marine mammals, navigation and control of predatory birds and endangered species.

Canadian salmon farming takes place primarily in British Columbia and New Brunswick. In British Columbia, growth in recent years has been hampered by conflicts with commercial and recreational salmon fisheries as well as First Nations and environmental groups. The industry is heavily regulated. It has been claimed that farm installations may spread diseases and escaped Atlantic salmon may negatively affect wild Pacific salmon populations. In New Brunswick, although the industry benefits from proximity to large eastern U.S. markets, expansion is limited by a shortage of suitable sites, low ocean temperatures in the winter and growing controversies over disease control and effects of farming on native wild Atlantic salmon. Despite these constraints, Canadian farmed salmon production increased steadily until 2002, but has since declined.

Outside of North America, commercial salmon farming takes place in nations as diverse as Norway, the Faroe Islands (Denmark), Japan, Ireland, Scotland (the United Kingdom) and Chile, with multinational corporations often controlling operations in several nations. Norway and Chile have become the dominant farmed salmon-producing countries, in part because the regulatory environment has generally been supportive. Norway became an important producer of farmed salmon in 1984 (Figure 9).
Chile became the second largest producer of salmon in the world in 1992, and now produces at a level commensurate with Norway. The average growth rate of the industry for the period 1984-2002 was 52 percent per year. The presence of numerous unpolluted freshwater sources and the fact that most lakes do not freeze in winter provide favorable conditions for smolt production throughout the year. In addition, Chile’s salmon farming industry has benefited from easy access to fishmeal for feed, low-cost skilled labor, minimum interference from commercial and recreational fishermen, a favorable regulatory climate and less pressure from environmental groups than elsewhere (Hicks 1995).

Many factors have contributed to the success of salmon aquaculture operations worldwide. These include relatively inexpensive and easily replicated technology, widely available sites with ideal environmental and topographical conditions, favorable culture traits of Atlantic salmon, increases in production efficiency, and growing market demand for salmon. The growth of salmon aquaculture was motivated by several factors. On the demand side, salmon farmers realized an opportunity to provide a consistent (size, availability, high quality) fresh salmon at a relatively high price year-round. They recognized significant market growth potential and that wild salmon fisheries could not adequately supply the market with uniform fresh salmon of consistently high quality year round. As a result, farmed salmon created a market in the United States and Europe that wild salmon could not supply. As a fresh product, farmed salmon received a price premium compared to most frozen wild salmon.

The growth in farmed salmon was also stimulated by production and institutional factors. Over the past twenty-five years, broodstock quality, feed quality, disease management techniques and processing have all improved. Through consolidation, economies of scale have occurred. These factors resulted in a steady decline in production costs, providing the means for increasing production even with a fall in salmon prices. Figure 10 shows inflation-adjusted production costs contrasted with export prices in Norway, in 2004 Norwegian kroner, with a distinct downward trend.

The largest cost component of production costs is feed. In the 1980s, feed conversion ratios (FCR) in Norway were around 3 kilograms of feed per kilogram of salmon. In 1999, the average feed conversion ratio was...
1.19 kilograms of feed per kilogram of salmon (Guttormsen 2002). The reduction in production costs and FCR was made possible through consolidation and vertical integration of the industry, better broodstock, technology and improvements in nutrition, disease management and farm production systems (Asche et al. 2003). Undoubtedly, the many efforts conducted by the industry since 1989 to expand and broaden the market have been instrumental in dealing with the downward pressure on prices.

Critiques of Salmon Farming

Some scientists and NGOs have expressed concerns about environmental impacts of salmon farming and the safety of farmed salmon, which have received significant press coverage. These issues are the subject of significant scientific debate with many scientists disputing the critiques which have been raised. This report addresses these issues only in the context of the economic implications of this ongoing debate.

Salmon is a carnivore and requires a diet with a high protein content to promote and sustain growth rates throughout the entire life cycle. The dependence of salmon farming on the availability of high-quality proteins such as fishmeal and fish oil has raised some concern among environmental groups about potentially negative effects on wild fish stocks. The concern over the sustainability of the stocks of fish from which fishmeal are derived is partly based on a concern that as aquaculture production grows, there is increased pressure on these stocks with several economic, environmental and social implications.

Although the share of fishmeal going to aquaculture is increasing (Delgado et al. 2003), the majority of the fishmeal produced worldwide goes to developing nations and is used as feed for livestock, primarily poultry and pigs. In 1986 only 8 percent of fishmeal produced worldwide was going to aquaculture (Wijkstrom and New 1989). By 1995, 25 percent was going to aquaculture (Tacon 1998), and in 2002 it was up to an estimated 34 percent (Barlow 2002).

As demand for fishmeal has increased, the cost of fishmeal is generally increasing. The resulting economic incentive has been to undertake a significant amount of research to reduce the dependence of salmon feeds on fishmeal and fish oil. Improved feed conversion ratios and reduced amount of fishmeal in salmon diets indicate success in these research efforts, as do the reduction in farmed salmon production costs (Guttormsen, 2002; Asche, Bjørndal, and Sissener, 2003).

A recent report published in Science claims that farmed salmon contain higher levels of PCBs than their wild counterparts, that 8 ounces of farmed salmon should not be consumed more than once per month, and the

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Figure 10

Export Price and Production Cost of Norwegian Atlantic Salmon (1985-2004)

Source: Norwegian Directorate of Fisheries 2006 (provided by Frank Asche, University of Stavanger, Norway).
The source of the PCB contamination is the fish feed (Hites et al. 2004). The study also indicated that farmed salmon from northern Europe had higher concentrations of contamination than farmed salmon from South America. The study was based on salmon taken from the water in 2001 and has not been replicated since. This study was highly controversial and has been challenged by the medical community and food scientists who have argued that the benefits of eating fish rich in fatty acids are more clearly proven than the risk of PCB exposure (SOTA 2004; Santerre 2004; Willett 2005).

There are two critical issues in this controversy: a) public health, and b) impact on the farmed and wild salmon industries. Claims that farmed salmon pose health risks are often assumed to have a positive impact on the wild salmon industry and a negative impact on the farmed salmon industry. However, as press coverage often fails to distinguish between farmed and wild salmon, these claims may negatively affect demand for both farmed and wild salmon, and more generally misinform and confuse consumers.

Recent advances in biotechnology may hold the key for future expansion of the salmon aquaculture industry. Transgenic technology in particular could provide the means for the development of genetically superior broodstocks exhibiting faster growth rates, improved feed conversion efficiencies, disease resistance, the ability to utilize vegetable protein diets and tolerance to low oxygen levels and water temperatures.

Environmental organizations and consumer groups have already expressed their concerns on the potential deleterious effect of escaped transgenic salmon on wild salmon populations (Reichhardt 2000). Members of the salmon farming industry have also expressed an unwillingness to pursue transgenic salmon production. The controversy surrounding genetically modified salmon will likely continue well into the foreseeable future.

**World Salmon Production and Markets**

The tremendous growth in salmon farming has had a dramatic effect on world salmon production, markets, and prices. Between 1980 and 2004, world salmon supply more than quadrupled from less than 550,000 mt to more than 2.4 million mt. Major sources of supply include wild salmon from the United States, Canada, Japan and Russia and farmed salmon and salmon trout from Norway, Chile, Canada, Scotland and elsewhere. (Salmon trout is also known as steelhead or sea-run rainbow trout. It is not caught commercially.)

North American wild salmon catches increased from about 300,000 mt in 1980 to a peak of more than 500,000 mt in 1990, and then declined to about 400,000 mt in 2004 (Figure 11). During this period, primarily because of the growth of farmed salmon production, North American wild salmon declined from more than one-half to about one-sixth of world production. The declining share of North American wild salmon in world salmon production is reflected in similarly dramatic declines in the share of North American wild salmon in all major salmon markets except for canned markets and salmon roe markets.

Japanese and Russian wild salmon catches more than doubled from less than 250,000 mt in 1980 to more than 500,000 mt in 1996, and have remained at about that level. Since 1996, Japanese and Russian wild salmon catches have exceeded North American wild salmon catches. Japanese catches are generally ranched chum salmon.

Farmed salmon and trout production in 2001 totalled 1,500,000 mt. In 2004, farmed salmon and trout accounted for five-sixths of world supply.

World salmon consumption may be generally divided among five major markets: the Japanese fresh and frozen market, the European Union fresh and frozen market, the U.S. fresh and frozen market, canned salmon markets, and numerous other smaller markets. ¹

Until recently, the Japanese fresh and frozen salmon market was the world’s largest market. Japan consumes very large volumes of wild salmon, including both Japanese ranched salmon as well as wild salmon imported from North America and Russia. Since the late 1980s, Japanese imports of North American wild salmon have declined dramatically, reflecting lower North American sockeye salmon catches and changing markets. In contrast, Japanese imports of Russian salmon increased, as an increasing share of Russian production was exported following the collapse of the USSR.

The rapidly growing EU fresh and frozen market now consumes more salmon than Japan. Almost all of the salmon sold in the EU market is farmed salmon.

Total U.S. fresh and frozen salmon consumption has been rising rapidly with increasing imports of farmed salmon. However, in 2004, U.S. fresh and frozen salmon consumption was only about half that of Japan or the European Union.

World canned salmon production, which fluctuates from year to year, has been gradually declining. Most canned salmon is North American wild salmon.

All four major salmon markets are important for North America.

¹ The estimates of salmon consumption in major markets are based on numerous data sources (some of which are incomplete or conflicting) and other assumptions documented in the report. Estimates may very slightly between graphs because of differences in assumptions for different levels of aggregation across countries and species.
American wild salmon. Canned salmon markets account for the largest share of North American salmon production, followed by the U.S. fresh and frozen market. The Japanese fresh and frozen market, which formerly accounted for the largest share of North American wild salmon production, now accounts for the third largest share, followed by the European fresh and frozen market.

Consumption of farmed salmon grew dramatically between 1989 and 2004 in all markets except for canned salmon. In both relative and absolute terms, the growth in consumption was greatest in the European fresh and frozen market. The European Union accounted for about 50 percent of the increase in world farmed salmon consumption during this period, the United States accounted for 20 percent and Japan accounted for 11 percent.

It is important to note that the U.S. fresh and frozen market ranks behind other markets in importance for both wild and farmed salmon. Competition between North American wild salmon and farmed salmon is occurring in multiple markets, which are subject to different trends in both supply and demand. The effects of this competition can only be understood by

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*Note: estimates of consumption in other markets are highly sensitive to yield assumptions and are less reliable than other estimates shown.*
examining all of these markets, not just the U.S. fresh and frozen salmon market.

Wholesale price trends differ in different major markets. In general, in both the United States and the European fresh and frozen markets, prices for both farmed and wild salmon declined significantly from the early 1990s until 2002 or 2003, after which prices began to rise. In the Japanese fresh and frozen market and in the canned salmon market, prices also fell during the 1990s, but have not recovered in recent years.

Salmon prices are affected by many different factors in complex ways. Prices vary widely for different products, species and markets. For example, U.S. wholesale prices for fresh farmed Atlantic salmon fillets are typically higher than for fresh whole farmed Atlantic salmon, because of the greater cost of processing and greater convenience to consumers. In turn, fresh whole farmed Atlantic salmon command higher wholesale prices than frozen wild chum salmon because they are considered a higher quality product.

Within any given year, there is significant variation in prices from month to month, reflecting seasonal variations in demand and supply. Within any given year, U.S. wholesale prices of fresh farmed salmon may vary by as much as $0.50/lb or more. Prices for fresh wild salmon prices typically fall during the season as catches increase.

In general, longer-term trends in wholesale prices reflect longer-term trends in demand and supply for different markets. Prices have tended to decline when supply was growing faster than demand, and to rise when demand was growing faster than supply.

**North American Wild Salmon Products and Markets**

North American wild salmon are processed into four major primary products: canned salmon, frozen salmon, fresh salmon and salmon roe (eggs). Of these, canned and frozen salmon account for most of the production volume, while a much smaller share of production is sold fresh. Although the total volume of roe production is relatively low, in recent years roe has accounted for about one-quarter of the total first wholesale value of Alaska salmon products (Figure 12).

There are important differences between species in the volume of production and the relative importance of different end-markets (Table 2). Pink, sockeye and chum salmon account for the largest shares of total production. The most important market for the pink salmon is the U.S. canned salmon market. The most important market for sockeye salmon is the Japanese frozen salmon market. The most important market for chum salmon is the U.S. frozen market.

Less than one fifth of U.S. wild salmon is sold fresh or
frozen in the U.S. domestic market, where it is subject to direct competition from U.S. imports of fresh farmed salmon (Table 3). More than twice as much U.S. fresh and frozen wild salmon is exported than sold in the U.S. domestic market. Thus, much of the competition between U.S. wild salmon and farmed salmon is occurring in Japan rather than the U.S. market. More than two-fifths of U.S. wild salmon is sold in canned salmon markets where it has faced relatively little competition from farmed salmon.

The mix of products produced from wild salmon represents an important difference between wild and farmed salmon, which is mostly sold as a fresh product in the United States, Europe and Japan. Although significant volumes of frozen farmed salmon are sold to Japan, very little is sold to Japan in canned form. There is very little roe production from farmed salmon.

United States Salmon Consumption

Between 2000 and 2004, the United States consumed about 284,000 mt of salmon annually.\(^2\) Fresh salmon accounted for about 63 percent of total U.S. consumption, frozen salmon accounted for about 21 percent, and canned salmon accounted for about 16 percent. About two-thirds of U.S. salmon consumption was imported and about one third was domestic. About two-thirds was farmed and about one-third was wild. Almost all of the farmed salmon was Atlantic salmon; almost all of the wild salmon was Pacific salmon.

Estimated total U.S. salmon consumption more than doubled from less than 150,000 mt in 1989 to more than 300,000 mt in 2004 (Figure 13). Most of the growth in U.S. salmon consumption was due to rapid and sustained growth in consumption of fresh salmon.

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\(^2\) No data are collected on U.S. salmon consumption. The report presents estimates of U.S. salmon consumption derived from data for U.S. salmon production, imports and exports. These estimates are more reliable for longer term trends than for consumption of specific species in specific years.
Figure 13  Estimated United States Salmon Consumption: Canned, Frozen & Fresh

Source: Estimated using the United States Salmon Market Database described in Appendix C.

Figure 14  Estimated United States Fresh and Frozen Salmon Consumption: Wild & Farmed

Source: Estimated using the United States Salmon Market Database described in Appendix C.
Most of the growth in U.S. consumption of fresh and frozen salmon was driven by rapidly rising imports of farmed salmon. Between 1989 and 2002, estimated U.S. annual average consumption of farmed salmon increased eight-fold, from less than 25,000 mt to more than 200,000 mt (Figure 14). During this period U.S. wild salmon consumption also increased. Thus the growth in farmed salmon consumption was not driven by substitution by consumers of farmed salmon for wild salmon. Rather, it was driven by expansion in the fresh and frozen salmon market, in particular by introducing fresh farmed salmon to markets in which wild salmon had not been available, such as the U.S. Midwest and Southeast.

Canned salmon is also an important part of U.S. salmon consumption. Consumption is mostly canned pink salmon, and varies from year to year, usually between 30,000 and 60,000 mt, reflecting variation in wild salmon catches. Canned salmon sells into a very different market than fresh and frozen salmon; it is bought by different consumers at different prices for different uses. Until recently, very little farmed salmon was canned, and farmed salmon has had relatively little effect on canned salmon prices.

There are important differences between the five species of wild Pacific salmon in total volume consumed and the mix of products consumed. For example: frozen salmon accounted for the largest share of consumption of sockeye salmon, coho salmon, and chum salmon; fresh salmon accounted for the largest share of chinook salmon consumption. These differences between consumption patterns for different species are important. Not all wild salmon is the same: different species are sold in different product forms and compete in different ways with farmed salmon in the U.S. market.

**United States Salmon Trade**

Between the late 1980s and 2003, the United States transitioned from being a net exporter of salmon products to a net importer of salmon products. In 1989, the United States had a salmon trade surplus of just over $650 million. This surplus disappeared in a two-year period; between 1995 and 1997 the net trade balance in salmon products changed from a $500 million surplus to a $14 million trade deficit (Figure 15). The deficit grew nearly 40 times larger between 1997 and 2003 to a value of $530 million. Because of declining salmon prices, the deficit decreased in 2004 to nearly $440 million but it grew again in 2005 to reach $494 million.

The changing trade balance is attributable to long-term

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Species included are Atlantic, Chinook, Chum, Coho, Pink, and Sockeye. Products forms include Fresh, Frozen, Canned, Salted, Smoked, Preserved, and Roe.

trends in both U.S. exports and imports of salmon products. In general, foreign salmon producers initiated this shift through the creation of inexpensive, consistent, high-quality farmed salmon products. In particular, growth in U.S. imports of salmon has been primarily driven by the surge in imported quantities of fresh and frozen fillets. In 1994/1995, Chilean farmers introduced salmon fillets with the pin bones removed (PBO), a technological innovation that set the stage for the explosive growth in salmon imports seen in recent years. Fillets were priced lower than whole fish before the introduction of the PBO technology. Today, boneless fillets command a price premium over whole fish. The traditional wild salmon industry in the United States has been slow to adapt and has found itself relegated from having a dominant market share to a secondary position.

Another underlying factor influencing both exports and imports is the limitation and variability of North American wild salmon production. Salmon import data reflect smooth steady increases each and every year since 1992. Salmon exports, by contrast, show yearly variability. With imports steadily increasing and U.S. landings varying around a relatively stable mean, the total U.S. supply of fresh and frozen salmon products has been increasing.

Canada and Chile hold dominant positions in overall quantity and value of U.S. imports. In value terms, these countries accounted for 34 percent and 51 percent of imports, respectively, in 2005. However, each country specializes in exporting a different product to the United States. Canada dominates the U.S. import market for whole salmon, while Chile dominates the U.S. market for Atlantic salmon fillets.

On average, fresh salmon and salmon trout products account for 80 percent of total imports in terms of both quantity and value. Fresh products comprised most of the increase in salmon imports over the last 10 years, but imports of frozen salmon as well other product forms such as smoked and canned salmon have also increased. In 2003 and 2004, declines in imported quantities of fresh products were compensated with increases in imports of frozen products. Only a relatively small share of salmon are sold directly from fisherman to consumers, usually in fishing ports or nearby. Selling directly to consumers is not a practical option for most fishermen, because most salmon fishing occurs in remote locations hundreds or thousands of miles away from most potential consumers, and because fisherman are busy fishing during salmon season.

In recent years, this distribution system for both wild and farmed salmon has evolved in many ways, the most important involving business consolidations. For example, the retail and food service industries are becoming more concentrated, with large retail and food service chains accounting for a larger share of total sales to consumers. These large buyers are able to reduce costs through economies of scale, including buying in large volumes. The salmon distribution system is similarly becoming more concentrated, with fewer and larger distributors handling an increasing share of total volume, and an increasing share of salmon being sold directly to large retail and food service chains by large fish-farming companies and large wild salmon processors.

As salmon moves through the distribution system from fisherman or fish farmers to the consumer, prices increase. A consumer may pay $15.99 per pound for a final salmon product for which the fisherman was paid $0.59 per pound. Many fishermen and many consumers cannot understand why the price should not be higher for the fisherman, lower for the consumer, or both. One factor contributing to the markup in price per pound is loss in weight during processing: the weight purchased by consumers may be less than half the weight delivered by fishermen. Other factors include the numerous labor-intensive steps in the distribution system, all of which add costs; the financial risks in handling fresh fish with limited shelf lives and in selling to markets in which prices can change rapidly, and the fact that a relatively small share of a fisherman’s catch is likely to go to the highest quality markets commanding premium retail prices.

The United States Salmon Distribution System

Salmon are distributed from fisherman or fish farmers to U.S. consumers in many ways. Participants in the salmon distribution system include primary processors, importers, secondary processors, broadline distributors, specialty seafood distributors, brokers, traders and many different kinds of retail and food service companies. Many companies perform multiple distribution functions.

United States Salmon Consumers

There is no comprehensive source of information about U.S. salmon consumers. The report reviews eight consumer surveys which provide insights about U.S. salmon consumers. The surveys were conducted by different organizations for different purposes in different parts of the United States over a 15-year period. They differed in how they screened for respondents, so the responses reflect consumption, preferences and opinions of different kinds of consumers. They asked different kinds of questions. While these factors make it difficult to compare responses across the surveys, certain broad conclusions may be drawn.
American consumers vary widely in their frequency of salmon consumption. Some consumers—probably less than 20 percent of all Americans—eat salmon frequently (more than once a month). Other consumers—at least 30 percent of all Americans—never eat salmon. The remainder are somewhat evenly divided between those who eat salmon somewhat frequently (twice per year or more) and rarely (less than twice per year).

American consumers eat salmon both at home and in restaurants. It is likely that the frequency of salmon consumption increased during the 1990s both at home and in restaurants, but that at-home consumption may have increased relatively more rapidly.

According to several surveys, the frequency of salmon consumption increases with income. Rates of fresh and frozen salmon consumption tend to be higher in Pacific Coast states than they are in other parts of the country; the Northeast is a close second. Growth in farmed salmon consumption has been relatively greater in the South Atlantic region than in other regions, perhaps because this region is closer to Miami, where much of the farmed salmon imported from Chile enters the United States. These survey results indicate that farmed salmon created markets which had previously not existed to any large extent.

Survey results—now several years old—suggest that just under one-fifth of American salmon consumers have heard of farmed salmon, are aware that farmed and wild salmon are different, and consider wild salmon preferable. Of the remaining four-fifths of consumers, a small segment considers farmed salmon specifically preferable to wild. But most salmon consumers either have not heard of farmed salmon or do not have an opinion about differences between farmed and wild salmon. (Consumer knowledge and opinions may have changed somewhat since these surveys were conducted.)

Clearly, there is no “typical” American salmon consumer. Consumers vary widely in how much salmon they buy, what they buy, where they buy it, and why they buy it. Information about wild and farmed salmon is likely to affect consumers’ purchase decisions in different ways. This suggests that there is no single best marketing strategy for wild or farmed salmon. Different strategies will have different effects on different consumers in different markets.

Salmon Marketing

Since wild and farmed salmon prices began to decline in the early 1990s, fishermen, processors, policy makers and consultants have debated how to address the problems facing the wild salmon industry. A series of task forces, industry forums and reports have examined the issues and made recommendations about strategies for the industry. In general, they have concluded that the wild salmon industry has been a production-driven commodity industry, overly dependent on the canned salmon market and the Japanese frozen market, which has devoted insufficient attention to quality, development of new products and marketing. Therefore, to compete effectively with farmed salmon in a changing market, the wild salmon industry needs to improve quality, develop new products to respond to new market demand and opportunities, devote significantly more resources to marketing (particularly in the U.S. fresh and frozen market), reduce harvest and processing costs and market in more effective ways.

Although the industry has made progress in recent years, significant quality problems remain in many North American wild salmon fisheries, such as net-marks, external and internal bruising, and softness or mushiness. These problems typically result from lack of careful handling or temperature control after fish are caught. While there has been general agreement about the goal of improving quality, there has not been agreement about how to achieve this goal, and whether quality standards should be voluntary or mandatory. More recently, some producers have established their own quality standards, which are monitored and certified by external certifying organizations.

However, as with improving quality, there has not been agreement about how to improve the marketing of Alaska wild salmon or how to fund such efforts. The industry continues to debate this issue, and to experiment with new approaches to marketing, such as regional marketing organizations.

Adding to the challenges of marketing wild salmon is the fact that the wild salmon industry is a highly competitive industry. Within the wild salmon industry, salmon sellers compete for customers, and salmon buyers compete for suppliers. On a broader scale, competition occurs between species, regions and countries. Different Alaska regions, such as Copper River and Cook Inlet, compete to create reputations and brands for their products. Canadian wild salmon competes with Alaska wild salmon in the United States and abroad. Salmon from Washington, Oregon and California compete against each other and against salmon from British Columbia and Alaska.

Natural wild salmon further competes with hatchery wild salmon. Some fishermen in regions without hatcheries, such as interior and western Alaska, have argued that Alaska salmon hatcheries have depressed prices for Alaska pink and chum salmon by producing too many fish. Some argue their markets would be better if hatcheries produced less fish.

Beyond competition in the marketplace, there are many other conflicts within the wild salmon industry which...
make it more difficult to achieve cooperation in marketing. One set of conflicts is between fishermen and processors over prices paid to fishermen. In many wild salmon fisheries, fishermen believe that they are not paid fairly by processors. A long-standing history of mistrust has included fishermen’s strikes and lawsuits alleging price-fixing by salmon processors. This conflict hampers cooperation among fishermen and processors over how to market wild salmon effectively.

Marketing costs money, and effective marketing requires sustained funding over multiple years. The dramatic decline in the value of wild salmon catches and production has made it harder for the wild salmon industry to fund marketing efforts. In Alaska, a decline in state oil revenues contributed to a decline in state funding for salmon marketing. However, in recent years substantial federal funding has been provided to Alaska wild salmon marketing efforts.

The farmed salmon industry has also engaged in marketing campaigns, and is increasingly doing so in reaction to negative publicity regarding their product. Negative campaigns against farmed salmon do not necessarily bode well for wild salmon products, as press reports do not always distinguish between farmed and wild products, and may serve to convey a negative image of “salmon” to consumers.

**Effects of Farmed Salmon on Wild Salmon Prices**

It is difficult to quantify specific effects of farmed salmon on wild salmon prices over time, because of the variety and complexity of salmon markets, as well as the rapidity of changes that have occurred in these markets. Different wild salmon species and markets have been affected in different ways by farmed salmon. Generalizations about effects of farmed salmon on “wild” salmon prices risk being overly simplistic and misleading.

The most important factor driving change in world salmon prices has been rapid and sustained growth in world farmed salmon and salmon trout production. This has fundamentally transformed world salmon markets—not only because of the dramatic growth in total supply, but also because of the changes that it has represented in the kinds of salmon products which are available, the timing of production, market quality standards and organization of the industry.

During the 1990s the rapid growth of farmed salmon supply depressed prices not only for farmed salmon but also in most traditional wild salmon markets. More recently, prices for farmed and wild salmon have stabilized or increased. Wholesale price trends for farmed and wild salmon appear less closely correlated than formerly, suggesting that differentiation is occurring in markets for wild and farmed salmon. Some wild salmon products sell for lower prices than farmed salmon, while others command price premiums.

Many other factors besides farmed salmon have also affected wild salmon prices. These include:

- Increasing concentration in the retail and food service industries
- Increased world pink and chum salmon harvests
- Following the collapse of the Soviet Union, the emergence of Russian wild salmon as a significant competitor to North American wild salmon in the Japanese frozen market and world canned salmon and salmon roe markets
- Declining consumer demand for canned salmon
- The end of the Japanese “bubble” economy of the 1980s and a stubborn economic recession in Japan, historically the most valuable market for North American fresh and frozen wild salmon.

The introduction of salmon farming has also changed salmon market dynamics in several important ways. As farmed production becomes an ever-larger share of total supply, wild salmon prices are driven more and more by farmed salmon supply rather than by wild salmon supply because wild salmon becomes a small player in the market. This has meant that wild salmon fishermen can no longer count on a low catch being offset in part or in full by higher prices. Although an inverse relationship between wild catch and prices still exists, it is muted by the larger market.

**Economic and Social Effects of Changes in Wild Salmon Markets**

Commercial salmon fishing, tendering and processing contribute to the economic livelihoods of tens of thousands of people and dozens of coastal communities from California to Alaska. Salmon fishing is also a way of life, defined in part by independence, tradition and the beauty and wildness of the environment in which people work and live.

The decline in value of wild salmon catches beginning in the early 1990s had wide-ranging economic and social effects on people and communities dependent on wild salmon fisheries. Many fishermen experienced a dramatic decline in income, as well as losses in the value of permits and boats and difficulties in loan payments for permits and boats. Many stopped fishing.

Many salmon processing plants have closed, resulting in job losses for plant workers, lost markets for fishermen, and declining tax bases for communities. Communities have also lost revenues from salmon business taxes based on the value of catches.

Other wide-ranging economic and social effects
include increased difficulty in finding experienced fishing crew; migration of young people and fishing families out of fishing communities in search of other work; and political pressures for reallocation of fishery resources from commercial to sport fisheries.

The nature and significance of these effects vary widely between regions, fisheries and individuals. In some areas, economic and social stresses caused by loss in value of salmon catches have been exacerbated by other factors, such as changes in prices and catches for other fisheries, changes in fisheries management and, in parts of Alaska, the Exxon Valdez oil spill.

**Effect of Salmon Farming on North American Wild Salmon Resources**

How salmon farming may affect wild salmon resources is a complex and uncertain topic. Salmon farming may have both direct and indirect effects on wild salmon resources. Direct effects may result from interactions in the environment between farmed salmon operations and wild salmon. Indirect effects may result from changes in market conditions, which may in turn affect wild salmon catches, commercial hatchery releases and political support for fisheries management and habitat protection.

There is little evidence that salmon farming has had significant direct effects to date on North American wild salmon resources. Most effects which may have occurred to date have likely been localized effects on wild salmon migrating near salmon farms. Much of the public debate about the effects of salmon farming has focused on the nature of potential risks to wild salmon populations, and acceptable levels of risk. The evidence related to many of these potential risks is inconclusive because of insufficient data and research.

Potential direct effects that salmon farming might have on wild salmon resources also depends on the proximity of salmon farms to wild salmon migration routes. North American salmon farming operations are concentrated in relatively small areas compared to the range of North American wild salmon resources. The largest wild salmon runs, in Alaska, are located great distances from any salmon farms where there exists a permanent moratorium on salmon farming.

There is also little evidence to suggest that salmon farming may have indirectly benefited wild salmon resources, by reducing prices and thus economic incentives to “overharvest” wild salmon. Lower prices have not necessarily led to lower catches of wild salmon. Where some fishermen have quit fishing, those who remain have caught more fish at lower average cost. Nor would lower catches necessarily benefit wild salmon resources, since most commercial wild salmon fisheries are managed sustainably and are not being “overharvested.”

**Salmon Trade Policy**

Trade policy has not been used extensively to limit the importation of farmed salmon into the U.S. market, with the exception of two legal actions brought against Chile and Norway by U.S. farmed salmon producers. The primary exporter of salmon to the United States (Canada, Chile, Scotland and Norway) are all signatories to the General Agreement on Tariffs and Trade (GATT), and members of the World Trade Organization (WTO). Canada is part of the North American Free Trade Agreement (NAFTA), and the United States has recently signed a free trade agreement with Chile. There has been relative trade harmony amongst these nations with respect to salmon. Most salmon products imported by the United States enter free of any harmonized tariffs, although some processed salmon carry tariffs, and some farmed salmon enter under countervailing or anti-dumping duties.

As mentioned above, over the past two decades, the U.S. farmed salmon industry has twice petitioned the U.S. International Trade Commission (ITC), under the Department of Commerce to impose trade restrictions in the form of anti-dumping and countervailing duties. The intent of these duties is to increase the price of salmon imports and limit ‘unfair’ competition from imports. In 1989, falling prices of salmon in the U.S. market led the Coalition for Fair Atlantic Salmon Trade, a U.S. farmed salmon industry group, to file a petition alleging that Norwegian producers had received unfair subsidies and were also dumping salmon in the U.S. market. The ITC investigated the practices of the Norwegian salmon producers and agreed, ruling in 1990 that Norwegian Salmon farmers were dumping salmon and receiving a countervailable subsidy (Anderson 1997). These relatively high duties caused Norwegian salmon products to become uncompetitive in the U.S. market. Farmed salmon from Chilean and Canadian producers rapidly took Norway’s place. Norwegian shipments to Japan also increased, reducing the market share that traditionally corresponded to U.S. exporters. U.S. salmon prices did not change appreciably.

In 1997, the Coalition filed another petition alleging that Chilean exports of Atlantic salmon products to the United States were injuring the U.S. farmed salmon industry because they were subsidized and being sold at less than fair value. The ITC again investigated and determined that there was evidence of both countervailable subsidies and salmon product dumping (Federal Register 1997a). The margins were determined to be quite small, and the companies received duties ranging between 2.24 percent and 10.91 percent. These duties had little effect on the growth of U.S. imports of Chilean salmon, especially fresh fillets.
As in the Norwegian case, prices did not improve; in particular, the price of whole fresh salmon continued to trend downward. Both the Norwegian and Chilean cases were time consuming and costly, and did little to enhance price.

Although trade measures have been discussed within the wild salmon industry from time to time as a potential measure to increase prices, the wild salmon industry has not initiated any petitions.

**MSC Certification of Alaska Salmon**

Eco-labeling programs evaluate the production process of a fishery with regard to established environmental standards set by an independent third party. If the process meets these standards, the producer or marketer may buy a license to use a specific eco-label in marketing efforts. In effect, the label conveys to the consumer information concerning a product's environmental impact. The consumer is then able to choose among product alternatives, eco-labeled and not. In theory, if the consumer perceives benefits from seafood from sustainable fisheries, then the consumer will pay a premium for that product, creating a market-based incentive for the fishery to become and remain certified, and for other fisheries to do the same.

The Marine Stewardship Council (MSC) was created in 1996 through a cooperative effort of the World Wildlife Fund (WWF) and Unilever, a multi-national corporation. The goal of the partnership was to provide a standardized mechanism for certifying and labeling sustainable seafood products from wild fisheries worldwide, thereby providing a market-based incentive to maintain sustainable fish stocks. The MSC has been independent from WWF and Unilever for several years.

The Alaska salmon fishery was originally assessed as a test case, with funding for the assessment provided by the Alaska Department of Fish and Game, and became certified in 2000. The evaluation and certification included the entire fishery, with all species and gear types in all of Alaska as one fishery. Among the primary concerns raised by stakeholders was the environmental and genetic impact of the use of extensive hatchery programs in Alaska to enhance salmon populations. Certification is only in place for five years, after which the fishery must go through a re-certification process. Alaska is currently pursuing re-certification by the MSC, although certification is now being processed for 16 separate management areas, in contrast to the earlier assessment.

The British Columbia salmon fishery is also being assessed for potential certification, but the process has moved forward on a river-by-river, species-by-species, gear-by-gear basis. This assessment is expected to be of long duration. In California, in 2002, the California Department of Food and Agriculture awarded the California Salmon Council a grant for a pilot project seeking to certify California king (chinook) salmon fishery under the MSC program. A full assessment began in April 2004 for the troll-caught chinook salmon fishery.

The market impact of the MSC certification on Alaskan salmon markets remains uncertain. In part because the program remains new, there are no existing studies of the price impacts of MSC labeling on product prices. Estimates are that less than 10 percent of Alaska’s total salmon catch is being marketed globally with the MSC label. Initial anecdotal evidence and evaluations of market impacts indicate that MSC-certified Alaskan salmon is being sold in many European markets, although less appears to be sold in the U.S. market.

**Seafood Labeling Programs**

In addition to eco-labels, seafood consumers are being introduced to other new labeling. Labeling is an example of how industries in increasingly competitive global markets look for new ways to differentiate themselves from the competition.

New mandatory labels identifying country-of-origin and whether the salmon was farmed or wild were in place as of April 2005. Restaurants are exempt. To obtain a “U.S. Product” label, farmed seafood must be hatched, raised, harvested and processed in the United States. Wild-caught seafood must be caught in the waters of the United States or by a U.S.-flagged vessel, and also must be processed in the United States or aboard a U.S.-flagged vessel. Under this definition, hatchery salmon are considered wild.

Costs to producers of supplying country-of-origin labeling are non-trivial and uncertain. The major cost comes from maintaining traceability of the product from production to the retail outlet. Several sources of costs to retailers apply particularly to the seafood industry.

Other labeling standards that may affect the wild and farmed salmon industries include a U.S. Food and Drug Administration (FDA) requirement that retailers label food containing color additives, and organic standards for wild fish and farmed fish being drafted by the USDA. The organic standards will be created within an environment of significant controversy, as the organic agricultural producers and the National Organic Standards Board are strongly opposed to certification of wild fish as organic.

It is not easy to predict how U.S. consumers will react to increased labeling of salmon, whether country of origin, farmed versus wild, organic, eco-labeled or color-added. Unless consumers have strong regional preferences, country-of-origin of salmon should not have much of an impact, especially if consumers believe that U.S. authorities are doing their job ensuring that imported salmon, regardless of country of origin, meet or exceed safety standards. In addition, the most important foreign sources of salmon
(Norway, Chile, Scotland, Canada and Ireland) are not viewed as nations with poor hygienic standards. On the contrary, there are many very favorable views of these countries. However, “Buy American” continues to pull in many consumers.

Country-of-origin and organic labeling are unlikely to change the methods by which wild salmon are caught or harvested in the United States or any of the nations which are major suppliers of imported salmon. Neither are likely to improve management policies for wild salmon or are likely to make wild salmon more sustainable. Rather, the primary positive impacts of such labeling programs may occur in supplies of farmed salmon. As the EU continues to certify organic farmed salmon, fewer antibiotics and other chemicals will be used in the farmed salmon industry. As more focus is put on the country-of-origin of farmed salmon, there may be more effort on the part of farmed salmon exporting nations to ensure that the environment around farming areas are pristine, and to perform better in ratings of environmental groups.

However, the label “wild” salmon appears to be very important in the market at the moment. While producers, wholesalers and retailers are generally not using the MSC logo in their marketing materials for wild salmon, they are highlighting the fact that their product is wild. Restaurants and supermarkets, both chains and independents, are also emphasizing that Alaska salmon is a wild product. This is likely contributing to higher prices for the higher-valued wild salmon species: chinook, coho and sockeye.

**Future of Salmon Aquaculture in North America**

Based on observed trends, future growth in worldwide demand for salmonid products will be satisfied by modern aquaculture rather than increased harvests of wild salmon stocks. Salmon aquaculture is predicted to continue to develop in Northern Europe as well as North America (particularly Canada), but currently Chile has the greatest potential for growth. Aquaculture offers great advantages over capture fisheries, such as consistency of supply, year-round availability, greater quality control and the possibility of longer-term contracts. In addition, the aquaculture industry is more attentive to and has a greater capacity to respond to market demands. As such, large restaurant chains and supermarkets will increasingly source their salmon from aquaculture. Over time, wild salmon is likely to be sold increasingly either in relatively small but growing higher-end niche markets which emphasize the salmon’s “wild” characteristics or in lower-end markets, such as canned fish and frozen portions, for which wild salmon enjoys a cost advantage over farmed salmon.

Although farmed salmon is likely to extend its dominance over global supply, ocean-pen salmon aquaculture in North America will continue to face numerous obstacles. Low-cost foreign producers (e.g., Chile) will present formidable competition for U.S. salmon farmers. The industry will also be subject to increased regulatory oversight (e.g., Endangered Species Act on the East Coast) and confrontation from environmental organizations on issues such as fish escapes and transfer of diseases to wild populations. Conflicts with other coastal resource users will continue to arise. Given continued strong opposition to salmon farming, Alaska’s moratorium on “for-profit” ocean-pen aquaculture will not be lifted in the foreseeable future. This will limit aquaculture in Alaska to the hatcheries which are used to enhance the harvest of commercial salmon fisheries. While the U.S. ocean-pen salmon aquaculture industry could see some growth (possibly offshore or land based), it will more likely contract in the near future.

The Canadian ocean-pen aquaculture industry may see some growth in the future, but farmers will continue to struggle with stringent government regulations and opposition from environmental groups, particularly in British Columbia (PricewaterhouseCoopers 2003). Salmon pricing cycles will cause further consolidation of the industry, putting some companies out of business and forcing reorganization in the surviving firms. Currently, most Canadian salmon is exported as whole fish but more value-added processing such as PBO fillets is likely to occur in the future.

**Outlook for the Future**

As noted at the beginning of this Executive Summary, the report addresses numerous, wide-ranging and complex issues. The primary purpose of the report is to inform people who care about these issues—particularly policymakers, the environmental community and the fishing and fish farming industries—to provide a sound basis for achieving environmental and economic goals. Among the most important things to understand about these issues are the following:

- Historically, most North American wild salmon has been canned or exported frozen. A relatively small share has been sold fresh or frozen in the U.S. market, although this share is growing. Thus the market challenges and opportunities facing North American wild salmon cannot be understood or addressed by only thinking about the U.S. fresh and frozen market.

- High-quality fresh farmed salmon—mostly Atlantic, with smaller volumes of chinook and coho—was introduced in the 1980s into a U.S. market that primarily sold high-valued wild chinook and coho salmon in the West and low-valued wild chum and pink salmon throughout the rest of the country. Fresh farmed salmon imports
year-round drove the expansion of the market for fresh salmon and the resulting rapid growth in farmed salmon imports.

- Inherent characteristics of wild salmon fisheries—short seasons, variable and uncertain catches and remote locations—create challenges for wild salmon in meeting demands of the new world market created by fresh farmed salmon. The laws and regulations governing how salmon are harvested add to these challenges.
- The market challenges faced by North American wild salmon producers go beyond competition from farmed salmon and include other factors such as declining demand for canned salmon and the slowdown in the Japanese economy.
- U.S. trade policies are not likely to be effective tools for addressing the challenges wild salmon producers face.
- The benefits of MSC labelling to the Alaska salmon industry have not yet been clearly demonstrated. Although use of the MSC label is significant in marketing relatively small volumes of Alaska salmon in the EU, the industry has made relatively little use of the MSC label in marketing much larger volumes of Alaska salmon in the United States.
- Although farmed-versus-wild labeling appears to have benefited some Alaska salmon, the benefits to wild salmon of other labeling programs such as country-of-origin labeling, and organic labeling are less certain. Country-of-origin labeling may benefit farmed salmon as well as wild salmon. Organic labeling is more likely to benefit farmed salmon as there is minimal likelihood of the creation of U.S. organic standards for wild fish. While organic labeling may provide incentives for the farmed salmon industry to address environmental concerns related to farmed salmon production, labeling programs are unlikely to create new incentives for better management of wild salmon.
- Negative publicity regarding farmed salmon may have a short-run negative impact on farmed salmon, but will not necessarily benefit wild salmon. Negative publicity may paint both wild and farmed salmon with the same brush, especially among the majority of potential consumers who eat relatively little salmon and know little if anything about differences between farmed and wild salmon. The farmed salmon industry is working actively to address environmental and health issues raised by critics and over the longer term comparisons may not be in the interest of wild salmon.
- To date salmon farming appears to have had little effect on commercial wild salmon resources, either negative or positive. Most significant commercial salmon fisheries are located great distances from salmon farms. Lower prices caused by competition have not necessarily reduced wild salmon catches because the main limiting factors are regulatory rather than economic.

Among the most important conclusions of the report about the outlook for the future of the salmon industry are the following:

- Most future growth in world salmon supplies will occur because of aquaculture. Chile has the greatest potential for growth, although salmon aquaculture will continue to develop somewhat in northern Europe.
- Almost every imaginable aspect of salmon farming (breeding, feeding systems, disease management) will see improvements through continued investment in technology. Overall costs of production will continue their downward trend. Feed may become a greater share of total cost, leading to incentives for improvements in farmed salmon feeding systems and feed management will help to offset potential increases in feed costs simultaneously addressing some other issues of concern to some related to salmon farming.
- Although world farmed salmon production is likely to expand, ocean-pen salmon aquaculture in North America will continue to face numerous obstacles. Low-cost producers, particularly Chile, will present formidable competition for U.S. salmon farmers, who will face increased regulatory oversight and confrontation from environmental organizations on issues such as fish escapes and other issues. Conflicts with other coastal resource users will continue to arise. The moratorium on ocean-pen aquaculture in Alaska will not be lifted in the foreseeable future.
- Larger restaurant chains and supermarkets—dependent on a large, consistent, year-round supply of product—are likely to increasingly source their salmon from aquaculture. As the global salmon market grows and diversifies, wild salmon is likely to be sold increasingly both in higher-end niche markets to consumers who specifically prefer wild salmon, and in canned, frozen and value-added markets where wild salmon can compete on lower costs of production.
- In the United States, niche markets for chinook, coho and sockeye will primarily develop in high-end restaurants in major cities. An important regional market will continue to develop in the U.S. Pacific Northwest states. However, these niche and regional markets will remain relatively small in comparison with total wild salmon supply.
- The highest sales volume North American outlets for wild salmon, particularly chum and pink salmon, may become valued-added processed salmon products such as salmon burger and microwavable convenience meals, and in restaurants such as fast-
food and mid-price range chains.

- The Japanese market will continue to be an important export market for North American wild salmon. In Japan, North American wild salmon will face increasing competition from farmed salmon and Russian wild salmon, and will have to meet that challenge with outstanding quality.
- Emphasis on the wild and sustainable attributes of Alaska salmon may help to expand the European market for Alaska salmon.

**Recommendations:**

The report offers nine recommendations to policymakers, the environmental community and the fishing and fish farming industries. These recommendations are based on the assumption that multiple goals are important in the consideration of salmon issues and policies. These goals include protection and sustainability of wild salmon resources and the marine environment; providing consumers with a wide variety of healthy, appealing and economic opportunities to consume salmon; maximization of economic, social and cultural benefits derived from North American wild salmon resources, particularly for individuals and communities traditionally dependent on wild salmon; and realizing the potential for responsible salmon farming to promote economic development both in the North America and other countries.

- **Provide accurate and balanced information about salmon.** Government, scientists, the wild and farmed salmon industries, non-governmental organizations and the press have a responsibility to provide the public with accurate and balanced information about salmon issues. Misinformation—including overly simplifying complex issues, or overstating the degree of certainty of scientific knowledge—is ultimately counter-productive, serving to confuse consumers and undermine confidence in all parties to policy debates.

- **Harmonize regulatory food safety standards.** Governments have a responsibility to provide consumers with clear information about food safety on which they can make informed choices. There are significant discrepancies between the U.S. Food and Drug Administration (FDA) and the U.S. Environmental Protection Agency (EPA) with regard to acceptable levels of contaminants in fish. These contribute to consumer confusion over the healthfulness of salmon and work against the long-term interest of both the wild and farmed salmon industries.

- **Collect better data about seafood markets and consumers.** Existing data are insufficient to measure or analyze how and why North American fish consumption is changing, or how factors such as price, labeling, certification and origin affect fish consumption, including wild and farmed salmon. Given the importance of fish in North American diets—from not only an economic but a health perspective—the U.S. government and the seafood industry should commit to improved data collection and analysis related to fish consumption and markets. In particular, better data should be collected on wholesale and retail prices in the U.S. for seafood, much as the U.S. Department of Agriculture routinely collects for agricultural products. In addition, routine USDA household surveys on food consumption should focus more on households’ seafood consumption, including the species, product forms and quantities of seafood that households are consuming. Only a Federal agency, such as the USDA, has the capability to collect this information consistently over time, across different regions of the U.S. and with appropriate representation of different segments of the U.S. population.

- **Recognize and mitigate environmental impacts of fish production.** Recognizing and addressing environmental impacts (known as “externalities” by economists) is essential for of sustainable resource management. Possible negative environmental impacts of salmon farms include disease transmission from hatcheries and farms to wild stocks, pollution (e.g., from waste feed), competition with wild stocks and the consumption of chemical residues potentially found in salmon by humans or other organisms. Hatchery release programs may have similar effects. All of these potential effects should be recognized and addressed. To reduce potential negative effects of biological interactions between wild salmon and farmed salmon, including disease, pollution and inter-/intra species competition, polices and regulations should be employed that reduce the likelihood of direct interaction between wild and farmed salmon, such as appropriate farm siting and cage construction standards. There should be strict compliance with chemical and antibiotic use protocols.

- **Recognize the role of hatcheries.** Salmon hatcheries account for a significant share of North American “wild” salmon catches, particularly of pink and chum salmon. There are important issues related to the effects of hatcheries on salmon ecosystems, as well as on the economic role of hatcheries in commercial salmon fisheries and markets. These issues should be explicitly recognized in analysis and policy discussions about North American “wild” fisheries.

- **Expand marketing efforts.** Marketing wild salmon as ‘wild’ has been successful in the U.S. market in 2005, particularly for the higher quality
species — chinook, coho and sockeye — and has contributed to increases in ex-vessel prices paid to fishermen for these species. However, it has had no clear impact on ex-vessel prices for pink and chum salmon — which comprise 66 percent of Alaskan salmon landings. Achieving sustained increases in ex-vessel prices for pink and chum salmon will require expanding demand for the products made from these species (or, alternatively a reduction in supply through changes in management).

- **Recognize that the choices are not between wild and farmed salmon.** It is essential to move away from the simplistic perspective that policy makers and consumers face a choice between wild salmon and farmed salmon. Salmon farming is a major world industry which is here to stay. Wild salmon is incapable of supplying the much larger domestic and world salmon market which has been created by farmed salmon. Natural wild salmon, hatchery salmon, and salmon farming all offer potential economic opportunities and benefits to consumers. All also have inherent risks. The real issues are how to take responsible advantage of the potential economic opportunities and benefits to consumers from both wild and farmed salmon.

- **Work to ensure wild salmon is a competitive product.** A competitive strength of farmed salmon is consistent high quality that can be delivered to the market when the buyer demands it. To improve market conditions for wild fresh or frozen salmon the wild salmon industry must provide buyers with product which meets the higher quality standards established by farmed salmon. For wild salmon to compete effectively with farmed salmon, it is not enough for it to be ‘wild.’ The fish must also be handled very carefully when caught and processed and delivered where and when the buyer demands it.

- **Take advantage of potential benefits of MSC certification for Alaska wild salmon.**

  Sustainability, and the traceability proving sustainability provided by a certification program such as the MSC, are becoming increasingly important to many in the seafood market chain in the U.S. and Europe. Wild salmon enjoys potential market advantages as a “sustainable” product. To fully recognize these potential advantages the Alaska salmon industry should seek to make more use of the MSC label, and to develop and promote its importance to buyers and consumers as a measure of sustainability and traceability.
References


Introduction

Salmon has been an important part of the human diet since prehistoric times, as attested by prehistoric paintings in France and North America. The name Salmo was introduced for the first time by Pliny the Elder in his *Historia Naturalis*, written in the 1st Century AD.

Wild salmon are very important to many different people in North America. Native Americans in the United States and First Nations peoples of Canada have relied upon salmon for thousands of years and continue to actively participate in subsistence, and sometimes commercial, fisheries. For well over a century, the commercial wild salmon industry has provided a living—and a way of life—to fishermen, processors and coastal communities from California to Alaska. Sport fishermen are passionate about sport fishing for salmon, and sport fishing has become a big business for many coastal communities. The general public—including those who do not fish for salmon—are stirred by the annual return of the salmon and derive value simply from the fact that these salmon continue to be found in our rivers. All of these stakeholders wish for sustainable wild salmon fisheries.

Commercial wild salmon fisheries are economically very important. The value of Alaska salmon catches exceeded $300 million in 2005, and the wholesale value of salmon products derived from these catches exceeded $500 million. The value of U.S. exports of salmon products was $694 million in 2005, which is almost entirely made up of products derived from wild-caught salmon. These exports accounted for 18 percent of the value of total U.S. seafood exports.

While commercial wild salmon fisheries remain important, over the past two decades wild salmon catches have been surpassed in the U.S. market—and worldwide—by farmed salmon production. Because of growing imports of farmed salmon from Chile and Canada, the United States has had a trade deficit in salmon since 1997—when farmed salmon imports began to exceed wild salmon exports. U.S. imports of salmon, primarily farmed salmon, were valued at $1.2 billion in 2005.

Because of wild salmon’s importance as a commercial fishery in North America, many questions and concerns have been raised around the issue of farmed versus wild salmon in recent years. Concerns have been related to the impact of the tremendous growth in farmed salmon production on the markets for wild salmon, and in turn, the economic incentives for ensuring sustainability of the wild resource and the salmon fishing industry.

Commercial salmon farming began in the 1970s. During the 1980s and 1990s, commercial salmon farming was well established in many temperate countries around the world including Norway, Scotland, Chile and Canada. By 1996, salmon farming production surpassed worldwide wild salmon catches. By 2002, global production of farmed salmon exceeded wild harvests by more than one million metric tons.

Many factors have contributed to the success of salmon aquaculture operations worldwide: relatively inexpensive and easily replicated technology, widely available sites with ideal environmental and topographical conditions, favorable culture traits of Atlantic salmon, increases in production efficiency and growing market demand for salmon.

As farmed salmon production has grown, prices for all salmon—farmed and wild—have fallen. The lower prices have created problems for the industries and communities associated with both wild and farmed salmon production. Farmers have managed to reduce production costs, and develop new products and markets, but the traditional wild salmon sector has been slower to adjust. Restructuring is ongoing in both the wild and the fish farming industries, with some fishermen, processing firms and fish farms shutting down or going bankrupt.

The primary economic impact of increased farmed salmon production on wild salmon markets has been lower prices. Recent increases in prices during 2005 for the premium species of wild salmon - chinook and coho – may lead some to believe that the downward trend in wild salmon prices are being reversed. Chinook and coho prices did rebound during 2004 and 2005, however, these species comprise only 6 percent of total Alaska catch volume. Prices for the largest proportion of salmon catches—sockeye, pink and chum salmon—have not. This report will show that farmed
salmon are not the only reason for the decline in wild salmon prices.

Objectives of the Report

The purpose of this report is to educate policymakers, the environmental community, fishermen and the fishing industry about the real dynamics in the North American salmon market. In particular, the report hopes to increase the understanding of the economic relationships between U.S. markets for North American wild salmon and domestic and imported farmed salmon. These relationships are often oversimplified and misunderstood, leading to ill-conceived recommendations for changing policies and the structure of the market.

The most important factor driving change in world salmon markets and prices has been rapid and sustained growth in world farmed salmon and salmon trout production. This has fundamentally transformed world salmon markets—not only because of the dramatic growth in total supply, but also because of the changes it has represented in the kinds of salmon products which are available, the timing of production, market quality standards and organization of the industry.

The decline in salmon prices has caused a series of ripple effects that spread through the entire market chain—consumer to fishermen. To describe and explain these changes, the report examines the economics of the market for salmon globally and domestically. At the top of the chain, we review studies which have analyzed U.S. consumers’ preferences for salmon. The ‘middleman,’ or the distribution chains for wild and farmed salmon is closely examined to account for changes in prices that occur along the market chain. We then look at the indirect effects of farmed salmon on the wild salmon industry, including economic and social changes resulting from changes in markets.

Another important goal of the report is to examine the extent to which market-based incentives lead to a sustainable resource. For example, does certification by the Marine Stewardship Council (MSC) that the Alaska wild salmon fishery is well managed translate into higher prices and stronger competitiveness with fresh farmed salmon? Exclusive of the MSC, are there any marketing efforts being utilized to reverse the downward trend of salmon prices?

We warn readers who are looking for simple answers to questions about interactions between wild salmon and farmed salmon that they will be disappointed. Nothing is simple about salmon, salmon fisheries, or salmon markets. The causes of the longer-term downward trend in salmon prices, as well as shorter-term price fluctuations, are varied and complex. Different factors have different effects on different markets and prices of different species.

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<td>The five major wild Pacific salmon species differ significantly in characteristics which affect their suitability for different products and markets. Wild Pacific salmon are harvested in three major regions: Alaska, British Columbia, and the U.S. Pacific Northwest. What are important differences between species? What is the status of wild salmon resources in different regions?</td>
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<tr>
<td>III</td>
<td>There are important regional differences in the relative scale and status of salmon runs; the environmental conditions for salmon habitat; the mix of species harvested; the mix of commercial, sport and aboriginal uses; the regulatory framework for salmon fishing; and economic, social and political conditions. What are these differences?</td>
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<td>What role do hatcheries play in salmon fisheries management, and to what extent do commercial salmon fisheries rely on hatchery production? What issues are raised by salmon hatcheries?</td>
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<td>V</td>
<td>What is the history of salmon farming, what is its status, and how are current events and market conditions shaping the future of farmed salmon production worldwide?</td>
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1We use the term “fishermen” in this report because we have found that that is what most people engaged in commercial salmon fishing—including women—prefer to call themselves.
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Methodology

This report was initiated by TRAFFIC North America, the wildlife trade monitoring program of WWF and IUCN, in January 2003. TRAFFIC strives to ensure that commercial trade in wild flora and fauna is carried out sustainably and in a manner that is consistent with the conservation of nature.

This is an extensive report, relying on a broad array of government (secondary) data and a review of some survey-based (primary) data. The report gathers data from state, provincial, Federal and international sources. Data cover quantities and prices at several market levels.

Available data for analysis of salmon markets and the salmon industry are limited. Different data sources are often inconsistent. For example, different government sources report different data for wild salmon harvests. Industry and government sources report different data for farmed salmon production. Data for exports from one country to another do not necessarily match the corresponding import data. Some countries’ reported exports exceed their reported total salmon production. We have used our best judgment about which data sources are most reliable, and have attempted to explain data limitations and inconsistencies.

In some cases the data can be re-produced in tables and graphs as they are presented in their original form. However, for chapters that deal with salmon consumption by product form, in particular, Chapters VI, VII and VIII, data from a variety of sources must be combined. Therefore, due to the sheer number of sources, we have created Appendix A to provide detailed descriptions of the major data sources used in this report and information on how to directly access the data. Appendix B provides explanations of how data for Chapters VI and VII were calculated, and Appendix C provides explanations of how data for Chapter VIII were calculated. We believe that it is easier for the reader to refer to the appendices rather than put all the material from the appendices into a methodological section here in the introduction.

Prices are reported in US dollars per pound unless specified otherwise. Generally, prices are not adjusted for inflation. In most cases, it is not an individual price itself that is of interest, but the trend in prices or the price of one species relative to another that is the point of the discussion. Thus inflation-adjusted (real) versus not adjusted for inflation (nominal) is generally unimportant. Only in those cases where adjustment for inflation helps emphasize a point will this be done. In those cases it is specifically noted, and nominal prices are adjusted for inflation by using the Anchorage Consumer Price Index with a base year of 2005, except where noted otherwise.

For Chapter XI, to learn more about U.S. salmon consumers, we reviewed the results of eight consumer surveys done over a 15-year period by different organizations, for different purposes, in different parts of the United States, using different methodologies. Rather than put more information here, such a distance away from the chapter which deals with these surveys, we instead refer the reader to that chapter for the methodology.

Timing of the Analysis for this Report

The North American salmon industry has been changing rapidly for the past two decades. Partly because of the variability in wild salmon runs, every wild salmon season is different. This makes it difficult to stay fully up-to-date when writing about the salmon industry: by the time a report is written, published and read, important new developments may have occurred.

Adding to the difficulty of depicting the current state of the salmon industry is the fact that data about the industry become available only with a lag of weeks or months or sometimes years, after the data are collected, coded and published by government and industry sources.

The report was written during the fall of 2003 and winter of 2004, however, much of the report underwent a significant update during the spring of 2006, just prior to publication. As it stands, the report largely reflects the most up-to-date information and knowledge of the North American salmon markets available.
North American Wild Salmon Resources

Key Points

- North America may be divided into four distinct salmon producing regions: Alaska, British Columbia, the U.S. Pacific Northwest, and the Northeast:
  - Alaska has healthy wild salmon stocks, large-scale salmon ranching (hatchery production), high wild catches and no salmon farming.
  - British Columbia has much lower and declining wild salmon catches, some hatchery production, and large and growing farmed salmon production.
  - U.S. Pacific Northwest salmon stocks are greatly reduced from historic levels. Wild salmon catches are very small relative to Alaska and British Columbia; farmed salmon production is also small. Hatchery production is significant.
  - The Northeast has very low wild Atlantic salmon populations and no commercial wild salmon fisheries; there is a significant salmon farming industry.
- Seven species of salmon return to spawn in North America: Atlantic salmon and five species of Pacific salmon (chinook, sockeye, coho, pink, chum) and steelhead trout (also known as salmon trout or sea-run rainbow trout). Only Pacific salmon, exclusive of salmon trout, are caught commercially.
- Wild salmon returns and catches vary widely from year to year and over longer periods of time due to natural factors such as ocean conditions.
- Catches of North American salmon are regulated by managers to achieve “escapement” goals for the number of fish reaching the spawning grounds. Catch is determined primarily by the number of fish returning, rather than by economic conditions.

Introduction

In this chapter we provide a brief overview of North American wild salmon resources. We begin by describing and contrasting four salmon producing regions of North America: Alaska, British Columbia, the U.S. Pacific Northwest and the Northeast. Next we briefly review the biology of wild salmon and differences between species of wild Pacific salmon. We then discuss challenges in assessing the health of salmon stocks, including short-run and long-run variation in natural conditions. Finally, we review the status of salmon resources in different salmon producing regions.

North American Salmon Producing Regions

In thinking about North American wild salmon it is useful to divide North America into four salmon producing regions: Alaska, British Columbia, the U.S. Pacific Northwest (Washington, Oregon and California), and the Northeast (Maine, the Maritime Provinces, Quebec and Newfoundland) as in Figure II-1. There are very significant differences between these regions in:

- status of their wild salmon stocks,
- management of salmon fisheries,
- scale of commercial fishing for wild salmon,
- scale of sport and subsistence fishing for wild salmon,
- scale of hatchery production,
- scale of salmon farming,
- issues that they face related to wild and farmed salmon,
- type of data that are available about the salmon fisheries.

1 In this report, we use the terms “hatchery salmon” to refer to salmon released by hatcheries, “natural wild salmon” to refer specifically to wild salmon not released from hatcheries, and “wild salmon” to refer to all salmon that are not farmed. Hatchery salmon are sometimes referred to as “ranched” or “ocean-ranched” salmon. Natural wild salmon are sometimes referred to as “wild stocks” or sometimes simply as “wild salmon.”
Alaska has healthy wild salmon stocks, wild catches that dwarf those of other regions, and no salmon farming. Hatchery production (discussed further in Chapter IV) accounted for 69 percent of Alaska chum salmon caught and 40 percent of Alaska pink salmon caught during 2000-2002, or 38 percent of the total number of salmon caught. Alaska has banned salmon farming.

British Columbia’s wild salmon industry has experienced a dramatic decline in catches. British Columbia’s farmed salmon production is now more than double its wild salmon catches.

U.S. Pacific Northwest wild salmon catches are tiny compared to those of Alaska. As in British Columbia, the wild salmon industry has experienced a decline in catches. The region is struggling to restore salmon stocks greatly reduced from historical levels by dams, pollution and other factors—including changing ocean conditions. There is a small salmon farming industry in Puget Sound.

Northeast wild Atlantic salmon stocks are extinct in southern New England, severely endangered in Maine, and have fallen dramatically in most of eastern Canada. There are no commercial catches of wild Atlantic salmon. While pollution, stream blockage, fishing and other human factors caused much of the historic decline in wild Atlantic salmon catches, unexplained changes in ocean survival have played a role in the more recent decline. There is significant salmon farming in Maine and New Brunswick (further discussed in Chapter V).

Wild Salmon Biology

Pacific and Atlantic salmon are members of a large family of fish known as salmonidae. Besides Pacific and Atlantic salmon, other species of salmonidae are found in North America, including Arctic char and all the trout species. Wild commercial catches of char and trout are insignificant.
Salmon are anadromous: they spawn in fresh water and the young migrate to the sea where they mature. Most salmon return to the stream of their birth, although some may stray to other streams.

Seven species of salmon return to spawn in North America. Five species of Pacific salmon (genus *Oncorhynchus*) return to streams from Northern California to Alaska: chinook, sockeye, coho, pink and chum. Steelhead (also known as salmon trout or sea-run rainbow trout) was recently added to the genus *Oncorhynchus* (*Oncorhynchus mykiss*) but is not commercially caught.

Hundreds of millions of Pacific salmon are caught each year in commercial, sport and aboriginal salmon fisheries. Pacific salmon are also known by a variety of other names, of which red salmon (sockeye), king salmon (chinook), dog salmon (chum) and silver salmon (coho) are the most common. Table II-1 provides the scientific names and common names of each species.

Atlantic salmon (genus *Salmo*) return in limited numbers to streams in New England and the Canadian maritime provinces. An extremely large amount of money has gone into trying to re-establish stocks of Atlantic salmon on the Eastern coast of North America, with little success. There are no North American commercial fisheries for Atlantic salmon.

There are significant differences among Pacific salmon species in freshwater habitat, life history, average harvest weight, roe content and other physical characteristics. These differences play an important role in how salmon of each species are harvested, how they can be processed, recovery rates in processing (edible weight as a percentage of unprocessed or “round” weight), the suitability of the fish for different processes such as the taste and appearance of the fish and the prices they command in different markets. As shown in Table II-2, these factors are reflected in significant differences between species in prices paid to fishermen and the mix of products made from the fish.

### Table II-1 North American Wild Salmon Species

<table>
<thead>
<tr>
<th>Species</th>
<th>Other common names</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Salmon</td>
<td>Chinook salmon; Spring salmon</td>
<td><em>Oncorhynchus tshawytscha</em></td>
</tr>
<tr>
<td>Sockeye salmon</td>
<td>Red salmon; Blueback salmon</td>
<td><em>Oncorhynchus nerka</em></td>
</tr>
<tr>
<td>Coho salmon</td>
<td>Silver salmon</td>
<td><em>Oncorhynchus kisutch</em></td>
</tr>
<tr>
<td>Pink salmon</td>
<td>Humpback salmon</td>
<td><em>Oncorhynchus gorbuscha</em></td>
</tr>
<tr>
<td>Chum salmon</td>
<td>Dog salmon; Keta salmon</td>
<td><em>Oncorhynchus keta</em></td>
</tr>
<tr>
<td>Atlantic Salmon</td>
<td>Atlantic salmon</td>
<td><em>Salmo salar</em></td>
</tr>
</tbody>
</table>

### Table II-2 Comparison of Alaska Salmon Species in 2002

<table>
<thead>
<tr>
<th></th>
<th>Chinook</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average weight (lbs)</td>
<td>16.6</td>
<td>6.1</td>
<td>7.7</td>
<td>3.4</td>
<td>8.6</td>
</tr>
<tr>
<td>Average price paid to fishermen ($/lb)</td>
<td>$1.38</td>
<td>$0.60</td>
<td>$0.36</td>
<td>$0.10</td>
<td>$0.20</td>
</tr>
<tr>
<td>Share of product volume</td>
<td>Canned</td>
<td>1%</td>
<td>34%</td>
<td>9%</td>
<td>73%</td>
</tr>
<tr>
<td></td>
<td>Fresh</td>
<td>27%</td>
<td>7%</td>
<td>12%</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>71%</td>
<td>59%</td>
<td>79%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Note: Share of product volume is the relative share of each of these in the total processed weight, not the share of the fish used to make a particular product.

Source: CFEC Alaska Salmon Summary Data 1980-2005 for average weight and average price paid to fishermen; ADFG COAR Data for share of product volume.
The timing of spawning and migration varies among the five species of Pacific salmon. Chinook, coho and sockeye will spawn in the headwaters of a river or lake system and so arrive earlier in the summer than do the pink and chum which spawn closer to tidewater. Because returning salmon do not eat after they have entered fresh water, they leave the ocean heavy with the fats and nutrients on which they subsist during their freshwater phase.

The longer and more rigorous the freshwater trip, the more fat a fish will carry as it leaves the ocean. Fat content, which affects taste, varies not only between species but also between different “runs” of the same species returning to different rivers—giving fish of different runs distinctive tastes.2 Table II-3 shows the differences in fat content among species.

As salmon approach and enter fresh water, they undergo pronounced physical changes, becoming darker and softer. These changes tend to lower the commercial quality of the fish.3

When they reach the spawning grounds, the female excavates a nest in the gravel stream bottom, and the male fertilizes her eggs as she deposits them in the gravel. Both then die within a few days, and their decomposing bodies provide an important source of nutrients for the ecosystem.

Five to seven months after spawning, the young salmon fry emerge from the gravel where the spawning pair deposited and fertilized the eggs the fall before. The time spent in fresh water varies widely between species. Pink salmon fry go to sea almost immediately, while sockeye stay in freshwater lakes for a year or more. These differences in the freshwater part of the life cycle mean that different kinds of river systems are relatively more favorable for different species, resulting in different relative mixes of species caught in different river systems.

Similarly, the time spent at sea varies from one year for pink salmon to as long as five years for chinook salmon. In general, the longer the time spent at sea, the larger the fish when they return.

<table>
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<tr>
<th>Table II-3</th>
<th>Comparison of Fat Content of Salmon Species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wild Chinook</td>
</tr>
<tr>
<td>Total fat content</td>
<td>10.4</td>
</tr>
<tr>
<td>Fatty acids</td>
<td></td>
</tr>
<tr>
<td>Saturated</td>
<td>3.1</td>
</tr>
<tr>
<td>Monounsaturated</td>
<td>4.4</td>
</tr>
<tr>
<td>Polyunsaturated</td>
<td>2.8</td>
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</tbody>
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Note: Data are reported in grams per 100 gram edible portion. Data are for raw (uncooked) fish.


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2 Salmon connoisseurs can identify salmon from different rivers, similar to the way wine connoisseurs can identify wines from different vineyards.

3 Commercially harvested chum salmon are graded as “brite,” “semi-brite,” or “dark,” depending on the extent to which they have changed color prior to harvest.
Chinook Salmon. Chinook salmon may become sexually mature from their second through seventh year, and as a result, fish in any spawning run may vary greatly in size. For example, a mature 3-year-old will probably weigh less than four pounds, while a mature seven-year-old may exceed 50 pounds. Females tend to be older than males at maturity. In many spawning runs, males outnumber females in all but the six- and seven-year age groups. Small chinooks that mature after spending only one winter in the ocean are commonly referred to as “jacks” and are usually males. Alaska streams normally receive a single run of chinook salmon in the period from May through July. The natural range of chinook in North America ranges from the Venture River in California to Kotzebue Sound in Alaska.

Sockeye Salmon. Freshwater systems with lakes produce the greatest number of sockeye salmon. In systems with lakes, juveniles usually spend one to three years in fresh water before migrating to the ocean in the spring as smolts. However, in systems without lakes, many juveniles migrate to the ocean soon after emerging from the gravel. Sockeye salmon return to their natal stream to spawn after spending one to four years in the ocean. While returning adults usually weigh between four and eight pounds, weights in excess of 15 pounds have been reported. Most populations show little variation in their arrival time on the spawning grounds from year to year.

Coho Salmon. Adults usually weigh eight to 12 pounds and are 24 to 30 inches long, but individuals weighing 31 pounds have been landed. Coho salmon enter spawning streams from July to November, usually during periods of high runoff. They spend one to three winters in streams and may spend up to five winters in lakes before migrating to the sea as smolt. Time at sea varies. Some males (called jacks) mature and return after only six months at sea at a length of about 12 inches, while most fish stay 18 months before returning as full-size adults. The natural range of coho is tributaries from the San Lorenzo River in Monterey, California to Point Hope, Alaska, and throughout the Aleutian Islands. They are most abundant from central Oregon to southeast Alaska.

Pink Salmon. The pink salmon is the smallest of the Pacific salmon found in North America with an average weight of about three and a half to four pounds and average length of 20-25 inches. Adult pink salmon enter Alaska spawning streams between late June and mid-October. Different races or runs with differing spawning times frequently occur in adjacent streams or even within the same stream. Most pink salmon spawn within a few miles of the coast, and spawning within the intertidal zone or the mouth of streams is very common. Pink salmon mature in two years which means that odd-year and even-year populations are essentially unrelated. Frequently in a particular stream the other odd-year or even-year cycle will predominate, although in some streams both odd- and even-year pink salmon are about equally abundant. Occasionally cycle dominance will shift, and the previously weak cycle will become most abundant.

Chum Salmon. Chum salmon often spawn in small side channels and other areas of large rivers where upwelling springs provide excellent conditions for egg survival. They also spawn in many of the same places as do pink salmon, i.e., small streams and intertidal zones. Some chum in the Yukon River travel over 2,000 miles to spawn in the Yukon Territory. These have the brightest color and possess the highest oil content of any chum salmon when they begin their upstream journey. Chum do not have a period of freshwater residence after emergence of the fry as do chinook, coho, and sockeye salmon. Chums are similar to pink salmon in this respect, except that chum fry do not move out into the ocean in the spring as quickly as pink fry. By fall they move out into the Bering Sea and Gulf of Alaska where they spend one or more of the winters of their three- to six-year lives. In southeastern Alaska most chum salmon mature at four years of age, although there is considerable variation in age at maturity between streams. Chum vary in size from four to over 30 pounds, but usually range from seven to 18 pounds, with females usually smaller than males.

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<th>Table II-4</th>
<th>Notes on the Life Histories of Pacific Salmon</th>
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<tr>
<td><strong>Chinook Salmon.</strong></td>
<td>Chinook salmon may become sexually mature from their second through seventh year, and as a result, fish in any spawning run may vary greatly in size. For example, a mature 3-year-old will probably weigh less than four pounds, while a mature seven-year-old may exceed 50 pounds. Females tend to be older than males at maturity. In many spawning runs, males outnumber females in all but the six- and seven-year age groups. Small chinooks that mature after spending only one winter in the ocean are commonly referred to as “jacks” and are usually males. Alaska streams normally receive a single run of chinook salmon in the period from May through July. The natural range of chinook in North America ranges from the Venture River in California to Kotzebue Sound in Alaska.</td>
</tr>
<tr>
<td><strong>Sockeye Salmon.</strong></td>
<td>Freshwater systems with lakes produce the greatest number of sockeye salmon. In systems with lakes, juveniles usually spend one to three years in fresh water before migrating to the ocean in the spring as smolts. However, in systems without lakes, many juveniles migrate to the ocean soon after emerging from the gravel. Sockeye salmon return to their natal stream to spawn after spending one to four years in the ocean. While returning adults usually weigh between four and eight pounds, weights in excess of 15 pounds have been reported. Most populations show little variation in their arrival time on the spawning grounds from year to year.</td>
</tr>
<tr>
<td><strong>Coho Salmon.</strong></td>
<td>Adults usually weigh eight to 12 pounds and are 24 to 30 inches long, but individuals weighing 31 pounds have been landed. Coho salmon enter spawning streams from July to November, usually during periods of high runoff. They spend one to three winters in streams and may spend up to five winters in lakes before migrating to the sea as smolt. Time at sea varies. Some males (called jacks) mature and return after only six months at sea at a length of about 12 inches, while most fish stay 18 months before returning as full-size adults. The natural range of coho is tributaries from the San Lorenzo River in Monterey, California to Point Hope, Alaska, and throughout the Aleutian Islands. They are most abundant from central Oregon to southeast Alaska.</td>
</tr>
<tr>
<td><strong>Pink Salmon.</strong></td>
<td>The pink salmon is the smallest of the Pacific salmon found in North America with an average weight of about three and a half to four pounds and average length of 20-25 inches. Adult pink salmon enter Alaska spawning streams between late June and mid-October. Different races or runs with differing spawning times frequently occur in adjacent streams or even within the same stream. Most pink salmon spawn within a few miles of the coast, and spawning within the intertidal zone or the mouth of streams is very common. Pink salmon mature in two years which means that odd-year and even-year populations are essentially unrelated. Frequently in a particular stream the other odd-year or even-year cycle will predominate, although in some streams both odd- and even-year pink salmon are about equally abundant. Occasionally cycle dominance will shift, and the previously weak cycle will become most abundant.</td>
</tr>
<tr>
<td><strong>Chum Salmon.</strong></td>
<td>Chum salmon often spawn in small side channels and other areas of large rivers where upwelling springs provide excellent conditions for egg survival. They also spawn in many of the same places as do pink salmon, i.e., small streams and intertidal zones. Some chum in the Yukon River travel over 2,000 miles to spawn in the Yukon Territory. These have the brightest color and possess the highest oil content of any chum salmon when they begin their upstream journey. Chum do not have a period of freshwater residence after emergence of the fry as do chinook, coho, and sockeye salmon. Chums are similar to pink salmon in this respect, except that chum fry do not move out into the ocean in the spring as quickly as pink fry. By fall they move out into the Bering Sea and Gulf of Alaska where they spend one or more of the winters of their three- to six-year lives. In southeastern Alaska most chum salmon mature at four years of age, although there is considerable variation in age at maturity between streams. Chum vary in size from four to over 30 pounds, but usually range from seven to 18 pounds, with females usually smaller than males.</td>
</tr>
</tbody>
</table>

Source: Adapted from the Alaska Department of Fish and Game Wildlife Notebook Series. Available at www.cf.adfg.state.ak.us/geninfo/finfish/salmon/salmhome.htm#species.
Challenges in Assessing the Status of Wild Salmon Resources

Before reviewing the status of North American wild salmon resources, it is useful to review why it is difficult to generalize about the status of wild salmon.

First, wild salmon return or formerly returned to thousands of streams over very large areas of northeastern and northwestern North America. The status of salmon resources varies widely across this vast area, not only between regions but also between individual watersheds within regions.

Second, only limited and imperfect data are available for assessing the status of salmon resources. What matters for the health of the resource is the number of fish returning and spawning. However, data for salmon catches, which do not necessarily correspond to the number of fish returning or spawning. Changes in catches may reflect changes in the number of fish returning, but also changes in ocean environmental conditions, technology of fishing, economic profitability of fishing and commercial fishing regulations.

Third, because of the natural short-run and long-run variation in salmon returns to any given river system, it is not easy to define what constitutes a healthy salmon resource. In any given year or decade, higher or lower salmon returns may reflect more or less favorable natural conditions for salmon survival.

As illustrated in Figure II-2, wild salmon catches (including hatchery fish) fluctuate significantly from year to year. This is mainly due to annual variation in the multiple natural environments which wild salmon experience during their complex migratory life-cycle. Variations in stream temperature, current and turbidity affect salmon survival in freshwater environments. Variation in ocean temperature and currents affect the abundance of salmon predator and prey species and salmon survival in marine environments. Variation in the number of salmon which survive to return to spawn—partly reflecting commercial catches—affects the number of eggs which are laid for future generations. A low or high number of salmon returning to spawn in any given year may be echoed in two to five years (depending upon the species) when the next generation hatched from those eggs return to spawn.

In addition to this annual variation, a growing body of scientific evidence suggests that the oceans are subject to longer-term changes in physical conditions such as temperature and currents, known as “regime shifts,” which affect nutrient upwelling and availability of feed for salmon and their prey and predator species and in turn the ocean survival rates of salmon. The causes of regime shifts are not well understood, nor the mechanisms by which they affect ocean survival of wild salmon. Changes in ocean conditions may be favorable for salmon in some parts of their range and unfavorable in other parts of their range. However, it is increasingly recognized that they may play an important role in long-term increases or decreases in salmon abundance.

As shown in Figure II-3, there were significant fluctuations in average decadal catches of wild Pacific salmon (including hatchery salmon) during the twentieth century. While part of these long-term fluctuations may be attributed to changes in the commercial fishing effort and high-seas interception, they are also correlated with multi-decadal regime shifts in North Pacific Ocean temperatures and currents.

Put generally, a healthy salmon resource—or more broadly, a healthy ecosystem—has high natural variability. It is difficult to determine the extent to which changes in the number of salmon returning or spawning reflect this natural variability or are caused by “un-natural” human-related factors, such as over-fishing, pollution or alteration of stream environments.

As our understanding of salmon biology improves, there is increasing realization that the health of salmon populations depends not only on the number of fish but also on variation within salmon populations. Salmon are uniquely adapted to return to particular river systems at particular times and to survive the particular temperature ranges and water conditions associated with those river systems. For a given species in a given river, there may be several different “runs” which return at different times. What matters is not the total number of salmon returning to any given river, but the returns of each “run.”

Further, there is increasing realization of the importance of genetic diversity within a given salmon run. The long-run survival of the population depends on the presence of some fish able to survive environmental shocks such as particularly cold or hot water temperatures. But it is only very recently that techniques have been devised to measure the extent of genetic diversity within salmon populations, and we have very little information about the extent to which there may have been changes over time in genetic diversity of wild salmon stocks. It is also unclear what the effect of hatchery production has been on the genetic diversity of salmon.

In summary, assessing the environmental status of salmon resources, and the causes of change over time, is difficult. This poses a dilemma for resource managers and for the policy debate over how to rebuild and/or sustain wild salmon resources. Higher catches do not necessarily mean stocks are healthier or that we are doing better in managing salmon resources; lower catches do not necessarily mean stocks are less healthy or that we are doing worse.4,5

4 In an August 2003 speech, President Bush stated “the good news is that salmon runs are up. We can have good, clean hydroelectric power and salmon restoration going on at the same time.” United States Senator and Presidential candidate Joseph Lieberman responded that “George Bush taking credit for increased salmon populations is like a sailor taking credit for the tides” (Geranios 2003).

5 The Atlas of Pacific Salmon (Augerot 2005) provides an excellent and beautifully illustrated overview of factors affecting Pacific salmon resources and their status across their historical range in North America and Asia.
**Figure II-2** Alaska and British Columbia Annual Commercial Catches of Sockeye and Pink Salmon, 1980-2005


**Figure II-3** Alaska and British Columbia Average Decadal Commercial Catches of Sockeye and Pink Salmon, 1900-2005

**Alaska Wild Salmon Resources**

Figure II-4 shows total Alaska commercial salmon catches, including hatchery salmon, since the beginning of commercial salmon fishing during the 1880s, as measured in thousands of fish. Total catches increased rapidly in the four decades after 1880 and remained high during most of the 1920s and 1930s, reflecting increasingly intensive and extensive exploitation of Alaska salmon resources. The primary product produced from salmon in the 1920s and 1930s was canned salmon. Large canneries dotted the coast from California up to Alaska, and the workers along the processing lines in the canneries were often Chinese and Japanese. The amount of canned salmon produced was referred to as the ‘salmon pack.’

Cooley (1963) described this process as follows:

*During the early years when the industry was developing at a rapid rate the supply of fish presented no obstacles to expansion. Only the most productive areas and the species of highest quality were being exploited. Lack of markets was the main limiting factor. As depletion occurred in a particular area the industry was able to expand into other regions and to the production of the lower grade species as market conditions warranted. As a result, the total output continued to rise.*

*From the 1920s onward, the physical limitations of supply became a factor of growing importance. By this time markets were well established. All species were being exploited heavily, but there were fewer and fewer opportunities to offset depletion by expanding operations into new fishing areas. The trend in the total pack continued upward, but the rate of growth was decreasing and there were extreme oscillations in the pattern of output as a result of heavy fishing pressures. After the peak packs in the 1930s, there was a continuous decrease in the supply of fish in every region of Alaska.*

This scouring process tended to mask the seriousness of depletion in specific instances, especially during the period when the total pack of canned salmon was increasing. By the time the total pack began to waiver and show definite signs of decline, the resource had already been seriously depleted in many areas and some of the major salmon producing streams had been all but wiped out. (Cooley 1963, p. 41-42)

During the 1940s and 1950s, Alaska experienced a long period of decline in salmon catches. Alaskans bitterly attributed this decline to federal mismanagement and over-fishing by the Seattle-based salmon canning companies which owned most of the fishing boats as well as the salmon traps which caught a large share of the fish. Resentment against the canneries and a desire to gain control of the salmon fisheries played an important role in the drive for Alaska statehood during the 1950s.

After Alaska became a state in 1959, it assumed management responsibility for Alaska salmon, and immediately banned the use of salmon traps. The state adopted a conservative “abundance-based”

![Figure II-4 Alaska Commercial Salmon Catches, 1880-2005 (all species, thousands of fish)](image-url)

management approach, as described below, with the goal of rebuilding salmon stocks. However, after recovering slightly in the 1960s, catches fell even lower in the 1970s, partly because of growing high-seas catches of Alaska salmon by foreign fleets.

Foreign catches of Alaska salmon within 200 miles of Alaska ended after the United States, along with other nations, claimed jurisdiction over fishing within a 200-mile exclusive economic zone during the 1970s. Subsequently the United States, Canada, Japan and Russia negotiated agreements to end all high-seas fishing for Pacific salmon.6

Alaska salmon catches increased dramatically during the 1980s and early 1990s to record levels. Alaska fishery managers and politicians generally attribute the increase to conservative state management of salmon resources, the end of high-seas catches and production from the Alaska salmon hatchery program (discussed in Chapters III and IV). Part of the decline in catches after 1940 was probably due to less favorable ocean conditions following a regime shift in ocean conditions. Similarly, part of the dramatic increase in catches after 1980 was probably due to more favorable ocean conditions following another regime shift.

The conventional wisdom in Alaska is that Alaska salmon stocks are “abundant and healthy,” and that strong salmon returns since the 1980s reflect a commitment to protect salmon habitat and conservative resource management. These arguments are reflected in the Alaska Department of Fish and Game (ADFG) “Alaska’s Salmon Management” brochure on the following two pages.

Unlike more settled parts of North America, over vast areas of Alaska, there has been hardly any human disturbance to the environment—no roads, no dams, no farming, no logging, no mining. Clearly the absence of disturbance to the freshwater environment has been an important factor in the relative health of Alaska salmon resources compared with other areas. It is a different issue how much of the credit for the protection of salmon habitat should go to the State’s strongly-stated commitment to habitat protection, and how much is due simply to the absence of pressure for economic development over much of Alaska due to remoteness and high costs.

As described in the ADFG “Alaska Salmon Management” brochure, Alaska utilizes “in-season, abundance-based management” of commercial salmon catches. Each year, the overriding goal for salmon fishery managers is to assure that enough salmon reach the spawning grounds to ensure healthy future generations of salmon. Managers have target goals for optimal “escapements,” or numbers of fish that “escape” commercial, sport and subsistence fisheries to reach the spawning grounds. Only “surplus” fish in excess of this escapement goal are available to be caught.

As noted by Scientific Certification Systems (2000), to reach escapement goals, throughout the fishing season commercial fishery managers monitor the number of fish entering river systems after passing the commercial fisheries. They allow fishermen to fish only when escapement goals for a particular time period have been met. The amount of time fishermen have to fish thus varies depending upon the strength of the salmon run. If the run is strong, fishermen may be allowed to fish continuously; if the run is weak, fishing may be closed for many days at a time or even for an entire season. Because managers’ overriding goal is to achieve escapement targets, and managers can and do completely close salmon fishing unless and until escapement goals are met, escapement targets are usually achieved except in years of very weak salmon runs.

Some observers have commented that Alaska should not be complacent about the condition of its salmon resources. A 2000 review of Alaska salmon fisheries commissioned by Trout Unlimited (Konigsberg 2000) concluded:

“The State of Alaska has demonstrated leadership in salmon management and conservation. Fortunately, the freshwater and coastal marine habitats upon which Alaska salmon production depends have been relatively unimpaired physiographically, except for some of those watersheds in Southeast Alaska and the Gulf of Alaska that have been extensively logged. Good habitat, in conjunction with what had apparently been a period of favourable marine conditions, resulted in exceptionally high salmon production from the late 1970s through the mid-1990s. In other words, the apparent success of Alaska’s salmon management has been due, in large part, to fortuitous circumstances. . .

While total salmon harvests in the 1990s have been extremely high, it would be a mistake to treat abundance as a proxy for healthy salmon populations. High returns can mask diminished and diminishing genetic diversity among salmon stocks. . . . Fisheries management that seemed relatively effective during periods of high productivity and/or relatively predictable climatic cycles may not be so effective in the future.”

6 Illegal high-seas salmon catches continue to some extent, as indicated by occasional U.S. Coast Guard seizures of vessels engaged in high-seas salmon fishing.

7 The Alaska Constitution mandates that “Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses.” How to define or achieve “sustained yield” is far from obvious, given the inherent short-run and long-run variability in salmon returns. The State’s “Policy for the Management of Sustainable Salmon Fisheries” (5 AAC 39.222) states that “Management of salmon fisheries by the state should be based on the following principles and criteria: (1) wild salmon stocks and the salmon’s habitats should be maintained at levels of resource productivity that assure sustained yields . . .; (2) salmon fisheries should be managed to allow escapements within ranges necessary to conserve and sustain potential salmon production and maintain normal ecosystem functioning . . .; (3) effective management systems should be established and applied to regulate human activities that affect salmon . . .; (4) public support and involvement for sustained use and protection of salmon resources should be sought and encouraged . . .; (5) in the face of uncertainty, salmon stocks, fisheries, artificial propagation, and essential habitats should be managed conservatively . . .” Copies of the policy may be found on the web site of the Alaska Department of Fish and Game at www.cf.adfg.state.ak.us/geninfo/pubs/pubshomepage.php.
This Alaska Department of Fish and Game brochure exemplifies the general perception within Alaska that Alaska’s salmon management is “A Story of Success” attributable to conservative management, sound science and habitat protection.

Alaska’s Salmon Management
Story of Success

Management programs and policies promote the sustainability of salmon stocks that are wild, abundant, and healthy. Alaska’s world-famous salmon program is built on the principles of conservative management, sound science, and habitat protection. No salmon stocks of Alaska origin are listed as threatened or endangered.

Alaska’s Conservation Mandate
Successful Salmon Management, In Law and in Practice
Conservation of salmon stocks is required under the Alaska state constitution. Alaska’s constitution, unique among the 50 states, has an article solely devoted to the management and utilization of natural resources. The constitution mandates that renewable resources “shall be utilized, developed and maintained on the sustained yield principle.”

Alaska law states: “The Commissioner shall manage, protect, maintain, improve, and extend the fish, game, and aquatic plant resources of the state in the interest of the economy and general well being of the state, through rehabilitation, enhancement, and development programs, the department must do all things necessary to insure perpetual and increasing production and use of the food resources of state waters and continental shelf areas.”

The Alaska Department of Fish and Game manages salmon fisheries, while the Alaska Board of Fisheries has responsibility for allocating the yield of salmon among users. The clear separation of management authority from allocation authority is one of the strengths of the Alaska management system. The “Sustainable Salmon Fisheries Policy” and other vital conservation management policies define the management program for protecting habitats and sustaining salmon, with priority for wild stocks.

In 1990, Alaska outlawed the farming of salmon to protect strong native stocks from hybridization, disease, pollution, and competition for food.

Alaska’s Environmental Record
Protecting Salmon Habitat
Alaska has always made a strong commitment to conserving and protecting salmon habitats. ADF&G manages salmon in over 15,000 salmon spawning streams and rivers throughout the state.

Alaska’s habitat conservation laws and regulations provide clean, free-flowing waterways vital to abundant, sustainable salmon production. There are very strict laws and regulations governing industry and development activities, such as road building, logging, and mining, to protect vital spawning and rearing salmon streams. The “Anadromous Fish Act” (AS 16.05.870) requires approval for any in-stream construction activities in salmon streams. Under Alaska’s “Forest Practices Act” (AS 41.17.010) buffer zones are required between logging areas and salmon streams to protect spawning and rearing habitats from erosion and other problems. The Commissioner of ADF&G may also acquire water rights to protect fish. Stream flow and volume, necessary for salmon migration and propagation, are protected under the “Water Use Protection Act” (AS 46.15.). In addition, Alaska’s Department of Environmental Conservation (ADEC) monitors and regulates the discharge of pollutants to ensure high water quality in both marine and fresh waters.

Alaska has been willing to forego the economic benefits from activities such as hydropower development in order to sustain salmon resources for future generations. For example, although the option of constructing and operating large-scale, hydropower facilities on both the Susitna River and the Yukon River were closely examined, neither was built. The wild salmon resource from these drainages was a major reason that Alaska chose the no-dam option.
As described in the brochure, managers have a “clear conservation mandate” and the emphasis of commercial salmon fisheries management is “to maintain adequate spawning escapements.”
British Columbia Wild Salmon Resources

After record catches in many commercial salmon fisheries during the mid-1980s, British Columbia wild salmon catches fell dramatically during the 1990s. Some stocks of coho and sockeye salmon also experienced large declines in spawning escapements during the 1990s, leading to a ban on coho fishing along the entire BC coast in 1998 and closures of directed fisheries for some sockeye stocks. Changing ocean conditions, leading to poor ocean survival, may have been key factors in this decline. More favorable ocean conditions since 1999 have led to improved ocean survival, although some specific stocks are still considered to be depressed.8

Table II-5 summarizes the status of British Columbia wild salmon stocks as described in a recent study of the British Columbia seafood industry. In general, most chinook, sockeye and pink salmon stocks are considered “healthy,” while the status of coho and chum salmon stocks is considered “mixed.”

In 2003, the Federal Species at Risk Act (SARA) obliged the Federal Minister of the Environment to take measures to protect ‘endangered’ or ‘threatened’ species. These measures include prohibitions on harming individuals or their residences, and mandatory development of recovery strategies and action plans. Three salmon species—Cultus Lake sockeye, Sakinaw Lake sockeye, and Interior Fraser River coho—were proposed to be listed as ‘endangered’ under SARA. In January 2005, the Government of Canada made a final decision not to list Cultus and Sakinaw sockeye under SARA due mainly to the large socio-economic benefits that would be foregone. As of September 2005 a listing decision on Interior Fraser coho had not been made.

Nevertheless, the threat of listing salmon species has affected and will continue to affect management of salmon fisheries in British Columbia. The result is reduced fishery opportunities in an attempt to increase spawning numbers for populations of concern.

U.S. Pacific Northwest Wild Salmon Resources

The status of U.S. Pacific Northwest salmon resources was summarized in the introduction to the 1996 National Research Council study *Upstream: Salmon and Society in the Pacific Northwest*:

“Wild salmon, which once numbered more than 8-10 million returning adults in the Columbia River basin alone, have declined to less than one-tenth that number up and down the coast of the Pacific Northwest. Most of the fish that now return began their lives in hatcheries . . . The decline in salmon numbers has been observed and lamented for at least a century and a half, as the human population has grown and economic activity has increased. . . More recently, petitions have been filed to list some species or populations as endangered or threatened under the Endangered Species Act; lawsuits have been filed, meetings have been held, federal laws have been passed, and more than $1 billion has been spent over the last 10 years alone to improve salmon runs in the Pacific Northwest. Despite extensive recent efforts and activities to improve conditions for salmon, their overall populations in the region continue to decline. The decline is not universal; some populations or stocks in some streams are not declining, and some in the northern part of the range are even increasing.”

### Table II-5

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook</td>
<td>Healthy</td>
<td>Continued improvement from late 1990s; most stocks at or above escapement goals</td>
</tr>
<tr>
<td>Coho</td>
<td>Mixed</td>
<td>Continued improvement from late 1990s, particularly in Strait of Georgia; interior Fraser River and some North and Central Coast coho remain weak</td>
</tr>
<tr>
<td>Sockeye</td>
<td>Healthy</td>
<td>Increased returns to Nass, Skeena, Barkley Sound and most Fraser River stocks; continued concerns about in-river mortalities in late Fraser River run; Sakinaw Lake, Cultus Lake, Rivers and Smith Inlet stocks depressed</td>
</tr>
<tr>
<td>Pink</td>
<td>Healthy</td>
<td>Record returns to Fraser River in 2001; localized concerns for some Central Coast and Broughton Archipelago stocks</td>
</tr>
<tr>
<td>Chum</td>
<td>Mixed</td>
<td>Generally stocks in south are strong; some North Coast stocks remain depressed</td>
</tr>
</tbody>
</table>


8 The discussion in this section is based on G.S. Gislason & Associates (2004).
The declines are “largely a result of human impacts on the environment caused by activities such as forestry, agriculture, grazing, industrial activities, urbanization, dams, hatcheries and fishing”—and are exacerbated by variations in ocean conditions.

One indicator of the long-term decline is Columbia River commercial salmon catches (Figure II-5). Commercial salmon fishing by European settlers began on the Columbia River in the 1830s, increased rapidly after the 1860s with the development of salmon canning technology, peaked in the 1880s and again in World War I at more than 40 million pounds, and then experienced a long period of decline to annual catches of less than 3 million pounds during the 1990s.

However, this graph overstates the extent of the actual decline in Columbia River salmon returns and catches, because much of the fishery for Columbia River salmon moved offshore, from in-river net fisheries to ocean troll fisheries, during the first half of the 20th century. In addition, Columbia River salmon are also caught in other salmon fisheries off the coasts of Southeast Alaska, British Columbia, Washington and Oregon—illustrating both the complexity of salmon fisheries and the difficulty of describing resource conditions and trends.

The status of individual salmon stocks varies widely across the U.S. Pacific Northwest region. For example, according to a 1992 assessment of 515 Washington salmonid stocks, 201 stocks were considered “healthy,” 124 stocks were considered “depressed,” 18 stocks were considered “critical”—while the condition of 171 stocks was “unknown (Table II-6).

In 2004, the Endangered Species Act status of West Coast salmon and steelhead indicates that 5 of 50 evolutionarily significant units (ESU) are ‘endangered’ (Table II-7) (www.nwr.noaa.gov).

Efforts to rebuild stocks face daunting technical, economic and political challenges. How to rebuild U.S. Pacific Northwest salmon stocks is a complex debate of national importance which has drawn significant attention. From the point of view of commercial wild salmon fisheries, however, U.S. Pacific Northwest salmon catches are much smaller than those of Alaska, and of relatively limited and local economic significance.

Figure II-5 Commercial Catches of Columbia River Salmon, 1866-2000


9 An Evolutionarily Significant Unit, or “ESU,” is a distinctive group of Pacific salmon or steelhead. NOAA Fisheries considers an ESU a “species” under the Endangered Species Act (www.nwr.noaa.gov).
**Table II-6**  Classification of Washington Salmonid Stocks in 1992, by Status and Species

<table>
<thead>
<tr>
<th>Category</th>
<th>Chinook</th>
<th>Chum</th>
<th>Coho</th>
<th>Pink</th>
<th>Sockeye</th>
<th>Steelhead</th>
<th>Bull trout/ D.Varden</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>54</td>
<td>48</td>
<td>37</td>
<td>9</td>
<td>3</td>
<td>36</td>
<td>14</td>
<td>201</td>
</tr>
<tr>
<td>Depressed</td>
<td>35</td>
<td>3</td>
<td>34</td>
<td>2</td>
<td>4</td>
<td>44</td>
<td>2</td>
<td>124</td>
</tr>
<tr>
<td>Critical</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Unknown</td>
<td>14</td>
<td>18</td>
<td>18</td>
<td>2</td>
<td>1</td>
<td>60</td>
<td>58</td>
<td>171</td>
</tr>
<tr>
<td>Extinct</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>108</td>
<td>72</td>
<td>90</td>
<td>15</td>
<td>9</td>
<td>141</td>
<td>80</td>
<td>515</td>
</tr>
</tbody>
</table>


**Table II-7**  Endangered Species Act Status of West Coast Salmon and Steelhead (updated March 25, 2004)

<table>
<thead>
<tr>
<th>Species</th>
<th>Evolutionarily Significant Unit (ESU)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sockeye</td>
<td>Snake River</td>
<td>Endangered</td>
</tr>
<tr>
<td></td>
<td>Ozette Lake</td>
<td>Threatened</td>
</tr>
<tr>
<td>Chinook</td>
<td>Sacramento River</td>
<td>Endangered</td>
</tr>
<tr>
<td></td>
<td>Upper Columbia River Spring run</td>
<td>Endangered</td>
</tr>
<tr>
<td></td>
<td>Snake River Spring/Summer run</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Snake River Fall run</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Puget Sound</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Lower Columbia River</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Upper Willamette River</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Central Valley Spring run</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>California Coastal</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Central Valley Fall and Late Fall run</td>
<td>Candidate</td>
</tr>
<tr>
<td>Coho</td>
<td>Central California Coastal</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Southern Oregon/Northern California</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Oregon Coast</td>
<td>Threatened/Candidate</td>
</tr>
<tr>
<td></td>
<td>Lower Columbia River/Southwest Washington</td>
<td>Candidate</td>
</tr>
<tr>
<td></td>
<td>Puget Sound/Strait of Georgia</td>
<td>Candidate</td>
</tr>
<tr>
<td>Chum</td>
<td>Hood Canal Summer run</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Columbia River</td>
<td>Threatened</td>
</tr>
<tr>
<td>Steelhead</td>
<td>Southern California</td>
<td>Endangered</td>
</tr>
<tr>
<td></td>
<td>Upper Columbia River</td>
<td>Endangered</td>
</tr>
<tr>
<td></td>
<td>Central California Coast</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>South Central California Coast</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Snake River Basin</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Lower Columbia River</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>California Central Valley</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Upper Willamette River</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Middle Columbia River</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td>Northern California</td>
<td>Threatened</td>
</tr>
</tbody>
</table>

Source: www.nwr.noaa.gov/1salmon/salmesa
Northeast Wild Salmon Resources

Historically wild Atlantic salmon were found in eastern North American rivers in New England, Quebec, the Maritime Provinces and Newfoundland. Across much of this area, Atlantic salmon populations are drastically reduced from historic levels.

In the United States, Atlantic salmon were native to nearly every major coastal river north of the Hudson River. Historically, between 300,000 and 500,000 adults returned to U.S. rivers each year. By 2000, adult populations had fallen to less than 1,000. Natural Atlantic salmon runs disappeared from southern New England rivers by the mid-1800s. According to a World Wildlife Fund assessment, Atlantic salmon are extinct in 84 percent of historically salmon-bearing rivers of New England and in critical condition in the remaining 16 percent. Atlantic salmon in Maine were listed as endangered under the federal Endangered Species Act in 2000 (NMFS 2000).

In Canada, wild Atlantic salmon populations have declined by more than 75 percent since the 1970s. In the 1970s, about 1.5 million Atlantic salmon returned to Canadian rivers. Since then returns have fallen to about 350,000 while the proportion of small salmon (grilse) has increased from about 45 percent in the 1970s to about 75 percent. In general, rivers in the north are relatively healthy whereas those in the south (New Brunswick and Nova Scotia) are in serious trouble.

In the United States, commercial harvests of Atlantic salmon were banned by 1948. In Canada, commercial harvests were not banned until 1992.
fishing for salmon in Nova Scotia, New Brunswick and the Gaspé region of Quebec was banned in 1972 and salmon fishing around Newfoundland was closed in 1992.

Numerous factors contributed to the decline of Northeast Atlantic salmon. In southern New England populations were already greatly reduced by the mid-1800s as a result of fishing, water quality degradation and barriers to migration. More recent factors include agricultural water extraction, acidification due to acid rain and increased and unexplained salmon mortality at sea.

Factors Affecting Future Commercial Wild Salmon Catches

We present four factors which may affect future commercial wild salmon catches:

- **Natural environmental variation.** Natural environmental variations, such as ocean conditions among others, cause significant short-run and long-run variation in salmon returns and thus the numbers of salmon available for harvest in commercial fisheries. This natural variation is likely to continue to affect salmon returns and catches in the future, in ways that are difficult to predict.

- **Environmental degradation and restoration.** Historically, stream blockages, pollution, changes in water flows, competition from hatchery releases and other human-caused environmental changes played a major role in the decline of once-healthy wild salmon runs in the Northeast, the U.S. Pacific Northwest, and parts of British Columbia. However, it is unlikely that these factors will result in significant further reductions in commercial catches. Where the pressures on the environment are greatest, in the Northeast and the U.S. Pacific Northwest, commercial catches have already been so reduced that they represent a relatively small part of total wild catches, and it seems unlikely that restoration efforts (as opposed to natural environmental variation) will result in large future increases in commercial catches. In contrast, most of the Alaska fisheries which today account for most North American commercial catches do not face significant environmental threats—in large part because of their remoteness—and managers are committed to conserving those resources.

- **Fishing.** Historically, over-fishing contributed to the decline in North American salmon resources. However, increasingly North American salmon managers are committed to limiting catches to sustainable levels. Over-fishing will likely continue to occur in some fisheries in some years, in part due to the practical difficulties of fishery management, and is thus likely to reduce catches in some areas. However, it seems unlikely that over-fishing will occur on a scale sufficient to cause substantial reductions in total commercial catches.

- **Market Factors.** In the short-term, changes in prices have relatively little effect on commercial catches of wild salmon. Catches cannot increase substantially when prices rise because catch levels are set by managers based on the number of fish returning. If prices are high in a given year, fishermen may fish harder—but managers do not allow them to catch more than the available surplus of fish. In contrast—and less obviously—catches do not decline substantially when prices are low. As discussed in subsequent chapters, this is because there is substantial excess fishing capacity in most commercial salmon fisheries. In most Alaska salmon fisheries, most of the available salmon have continued to be caught and processed, despite a decline in ex-vessel prices.\(^\text{12}\)

Over the longer-term, however, changes in market conditions could have a more significant effect on catches. This will be discussed in Chapters IV, XIII and XIV.

\(^{12}\) The main exception has been in Alaska pink salmon fisheries, where low prices have in some years caused fishermen and processors to forego the opportunity to harvest and process late-season pink salmon returns in years of high abundance.
References

Alaska Department of Fish and Game Wildlife Notebook Series. www.cf.adfg.state.ak.us/geninfo/finfish/salmon/salmhome.htm#species.


Alaska Department of Fish and Game. Policy for the Management of Sustainable Salmon Fisheries (5AAC 39.222) www.cf.adfg.state.ak.us/geninfo/pubs/pubshome.php


CHAPTER III

North American Wild Salmon Fisheries

Key Points

✓ North American wild salmon fisheries are very complex. Salmon are caught along thousands of miles of North Pacific and North Atlantic coastline in fisheries which vary widely with respect to the health of the salmon runs, scale of catches, mix of species caught, types of gear used, products produced, end-markets and economic conditions.

✓ Salmon are caught in commercial, sport and aboriginal fisheries. Although commercial fisheries account for most of the catch, sport and aboriginal fisheries are also of great economic and cultural importance and face significant issues.

✓ Prices paid for all wild salmon species have fallen sharply since the late 1980s, as a result of competition from farmed salmon and many other factors.

✓ The value of commercial wild salmon catches has fallen dramatically since the late 1980s due to falling prices as well as lower sockeye salmon catches.

✓ Through “limited entry” management, North American commercial wild salmon fisheries are strictly regulated with regard to who may fish and how, where and when they may fish. While facilitating some conservation, economic and social goals, these regulations also add to costs and hinder adjustment of the wild salmon industry to changing economic conditions.

Introduction

Wild salmon fisheries differ dramatically with respect to the scale of catches, the mix of species caught, types of gear used, products produced, end-markets and economic conditions. It is generally true that wild salmon prices have declined, that competition from farmed salmon has contributed to the decline in prices and that wild salmon fishermen face economic difficulties. However, the causes of lower prices, the relative importance of farmed salmon as a contributing factor, the economic circumstances of fishermen and the extent to which different strategies might help to address the challenges that they face, all differ widely between fisheries.

Types of North American Wild Salmon Fisheries

North American wild salmon fisheries may be generally divided into three broad types of fisheries: commercial, sport and aboriginal. All three types of fisheries are important, but their relative importance varies widely between different regions.

Commercial Fisheries

Commercial salmon fisheries account for by far the largest share of wild salmon harvests. Salmon are harvested commercially using a wide variety of fishing gear, of which the most common are purse seines, gill nets and troll gear. Tens of thousands of commercial fishermen work seasonally in commercial salmon fishing from California to Alaska and tens of thousands more work in salmon processing and transportation. For well over a century, commercial salmon fishing has been an important part of the economy and culture of the west coast of North America.

Sport Fisheries

Although commercial catches account for by far the largest share of wild salmon catches, large numbers of salmon are also caught by sports fishermen. Sport

1 Exact data on employment in commercial salmon fishing and processing are not available, for a number of reasons. No data are regularly collected on commercial fishing employment in the United States because commercial fishermen are not “covered” by the unemployment insurance system which represents the standard data source for employment in most other industries. Processing employment is not broken out between processing of salmon and processing of other fish done at the same plants. Measuring employment is further complicated by the seasonal nature of commercial salmon fisheries, which for many participants represents only part of their employment and income. We discuss employment and other measures of economic impact further in Chapter XIV.
fishing for salmon is an important recreational activity in the U.S. Pacific Northwest states, British Columbia, Alaska and the maritime provinces of Canada. Providing guiding, lodging and other services to salmon sport fishermen is also a major economic activity that in some areas rivals or exceeds commercial fisheries in value and economic impact.

**Aboriginal Fisheries**

Prior to the settlement of North America by Europeans, Native Americans caught Pacific salmon in large numbers. Salmon was and continues to be a vital food resource and an integral part of their culture. Native Americans continue to catch significant volumes of salmon under a variety of special regulatory frameworks for both subsistence use, and, in some cases, for commercial sale.

In Alaska there are, with certain very limited exceptions, no formally designated “aboriginal” fisheries. However, there are “subsistence” fisheries for customary and traditional uses, which are mainly participated in by rural Alaska Natives. Alaska Natives also participate actively in regular commercial fisheries. In British Columbia and the U.S. Pacific Northwest states (unlike Alaska) there are also specific allocations of commercial catches to Native Americans.

Table III-1 shows estimated total salmon catches in 1999 for Alaska, British Columbia and the U.S. Pacific Northwest states of Washington, Oregon and California. Commercial fisheries accounted for about 98 percent of Alaska catches, 89 percent of British Columbia catches and 96 percent of U.S. Pacific Northwest catches.\(^2\)

However, for two species—chinook salmon and coho salmon, the relative share of commercial fisheries was significantly lower. The commercial share of chinook salmon catches was only 52 percent in Alaska, 40 percent in British Columbia and 68 percent in the U.S. Pacific Northwest states. The commercial share of coho salmon catches was only 85 percent in Alaska, 18 percent in British Columbia and 68 percent in the U.S. Pacific Northwest states. The remainder were caught in either sports fishing or subsistence fishing.

In the remainder of this report, we focus primarily on North American commercial fisheries. However, the economic, cultural and political significance of North American sport and subsistence salmon fisheries should not be underestimated: it is much greater than the shares of these fisheries in total salmon catches might suggest.

### North American Commercial Wild Salmon Catches

North American commercial wild salmon fisheries occur in Alaska, British Columbia and the three U.S. Pacific Northwest states of Washington, Oregon and California. There are important differences between these regions in

<table>
<thead>
<tr>
<th>Region</th>
<th>Fishery</th>
<th>Chinook</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
<th>All Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>Commercial</td>
<td>436</td>
<td>44,571</td>
<td>4,630</td>
<td>145,829</td>
<td>20,945</td>
<td>216,411</td>
</tr>
<tr>
<td></td>
<td>Sport</td>
<td>184</td>
<td>377</td>
<td>633</td>
<td>177</td>
<td>25</td>
<td>1,397</td>
</tr>
<tr>
<td></td>
<td>Subsistence</td>
<td>155</td>
<td>360</td>
<td>90</td>
<td>33</td>
<td>338</td>
<td>976</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>776</td>
<td>45,308</td>
<td>5,353</td>
<td>146,039</td>
<td>21,307</td>
<td>218,783</td>
</tr>
<tr>
<td>British Columbia</td>
<td>Commercial</td>
<td>127</td>
<td>668</td>
<td>8</td>
<td>6,074</td>
<td>939</td>
<td>7,816</td>
</tr>
<tr>
<td></td>
<td>Sport</td>
<td>124</td>
<td>1</td>
<td>13</td>
<td>47</td>
<td>11</td>
<td>195</td>
</tr>
<tr>
<td></td>
<td>Subsistence</td>
<td>65</td>
<td>486</td>
<td>25</td>
<td>104</td>
<td>56</td>
<td>736</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>316</td>
<td>1,154</td>
<td>46</td>
<td>6,224</td>
<td>1,006</td>
<td>8,746</td>
</tr>
<tr>
<td>Pacific Northwest</td>
<td>Commercial</td>
<td>556</td>
<td>21</td>
<td>301</td>
<td>54</td>
<td>256</td>
<td>1,187</td>
</tr>
<tr>
<td></td>
<td>Sport</td>
<td>256</td>
<td>0</td>
<td>144</td>
<td>42</td>
<td>8</td>
<td>450</td>
</tr>
<tr>
<td></td>
<td>Subsistence</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>812</td>
<td>21</td>
<td>444</td>
<td>96</td>
<td>264</td>
<td>1,636</td>
</tr>
</tbody>
</table>

Note: Definitions of commercial, sport and subsistence harvests vary between areas. Sources: Alaska commercial harvests: CFEC Alaska Salmon Summary Data 1980-2005; Allen Howe et al, Participation, Catch, and Harvest in Alaska Sport Fisheries During 1999 (ADFG Sport Fish Division, 2001); Alaska subsistence harvests: ADFG Division of Subsistence, Alaska Subsistence Fisheries 1999 Annual Report; All other data: NPAFC Statistical Yearbook, 1999.

\(^2\) We used data for 1999 because it is the most recent year for which comparable data for commercial, sport and aboriginal fisheries for all three regions (as reported by the North Pacific Anadromous Fish Commission and other sources) were available.

\(^3\) Unless otherwise specified all data on catches in this chapter include hatchery salmon.
the relative scale and status of salmon runs; the environmental conditions for salmon habitat; the mix of species harvested; the mix of commercial, sport and aboriginal uses; the regulatory framework for salmon fishing; and economic, social and political conditions. As shown in Figure III-1, Alaska dominates North American wild salmon catches, and this domination has increased in recent years. For this reason, much of the discussion of wild salmon fisheries in this report focuses on Alaska.

Table III-2 and Figure III-2 provide more detail about salmon catches in metric tons (mt) in these three regions during the five-year period 1996-2000 (we use a recent five-year period because catches vary significantly from year to year). During this period, British Columbia accounted for eight percent of total harvest volume while the U.S. Pacific Northwest accounted for only two percent.

Pink salmon accounted for the largest share of Alaska catch volume (47 percent), followed by sockeye (26 percent).
percent), chum (20 percent), coho (5 percent) and chinook (1 percent). In British Columbia, chum salmon accounted for the largest share (35 percent), followed by pink (33 percent) and sockeye (26 percent). In the U.S. Pacific Northwest, chinook salmon accounted for the largest share (41 percent), followed by chum (31 percent) and coho (17 percent). Thus, while Alaska accounted for 94 percent of pink salmon catches it accounted for only 34 percent of chinook salmon catches.

As shown in Figures III-3, III-4 and III-5, the three regions exhibit quite different trends in wild salmon catches over time. Alaska catches set all-time records in several years during the mid-1990s and remain strong. Alaska sockeye salmon catches fell by more than half between 1995 and 2002, but have since rebounded significantly. The decline in catches of sockeye salmon—which typically command the second highest price per pound and more than half the ex-vessel value of Alaska salmon catches—was a significant factor contributing to the economic difficulties of Alaska salmon fishermen after 1995. It is uncertain what caused the decline in sockeye catches, but ocean conditions, stream conditions and other environmental changes are the most likely causes.

In contrast to Alaska, wild salmon catches fell dramatically in both British Columbia and the U.S. Pacific Northwest during the 1990s—but began to grow again after 1999, particularly in the U.S. Pacific Northwest. As with the decline in Alaska sockeye salmon catches, the dramatic decline in catches of most species in British Columbia and the U.S. Pacific Northwest during the 1990s, while prices were also falling, played an important role in the decline in value of these fisheries.
Figure III-3  Alaska Commercial Salmon Catches, 1980-2005


Figure III-4  British Columbia Commercial Salmon Catches, 1980-2005

Wild Salmon Prices in North America

Figure III-6 shows average ex-vessel prices paid to Alaska salmon fishermen for the period 1980-2005, expressed in nominal dollars per pound (not adjusted for inflation).\(^4\)\(^5\) There are three important things to observe from this figure about prices.

First, different species command dramatically different prices, and the relative ranking of different species tends to stay the same in most (but not all) years. Chinook salmon command the highest prices—well over $1.00 per pound. Prices for sockeye and coho salmon are in a middle range—generally between $0.50 and $1.00 per pound in recent years. Prices for chum and pink salmon are significantly lower, generally less than $0.30 per pound for chum and less than $0.15 per pound for pink salmon in recent years.

Second, prices can vary sharply from year to year—sometimes by 50 percent or more. For example, there were sharp price spikes for all species in 1988, followed by equally dramatic price declines in 1989. Changes in prices are sometimes, but not always, correlated across species, reflecting the fact that they sell into overlapping but not identical markets.

Third, after rising during the 1980s, there was a significant downward trend in prices for all species from 1988 to 2002. Since 2002, price trends have differed between species. Prices for chinook and coho salmon have risen significantly, prices for sockeye salmon have risen slightly and prices for pink salmon have stayed about the same.

This downward trend is more readily apparent when the prices are adjusted for inflation as is shown in Figure III-7. For every species except chinook salmon, average real (inflation adjusted) prices for the period 2000-2005 were less than half of average prices paid during the 1980s. We stress that the adjustment for inflation for these prices was done simply to emphasize the general decline in prices for most salmon since the 1980s.

The causes of this decline in prices are complex, and they vary between species. As we discuss in subsequent chapters, a different mix of products is produced from each species, which sell into different markets.

Numerous factors affect prices. However, for most

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\(^4\) The term “ex-vessel” price is commonly used to refer to the prices paid to fishermen by processors when the fish leaves the vessel. Other common equivalent terms include “grounds price,” “landed price,” “fisherman’s price,” “dockside price,” and simply “fish price.”

\(^5\) Ex-vessel prices for 2005 are preliminary, and will likely increase slightly when post-season bonuses (not yet known at the time this report was written) are included.
Figure III-6  Average Nominal Ex-Vessel Prices for Alaska Salmon, 1980-2005 (not adjusted for inflation)


Figure III-7  Average Real Ex-Vessel Prices for Alaska Salmon, 1980-2005 (adjusted for inflation)

species the single most important factor contributing to the decline in prices has been growing competition from farmed salmon which provides a consistent, fresh product year around to restaurants and supermarkets.

Figure III-8 shows average nominal ex-vessel prices paid to British Columbia salmon fishermen (converted to U.S. dollars). In general, the relative ranking of species is similar to that in Alaska, except that Canadian sockeye prices averaged higher than chinook prices during much of the 1990s. Prices for chinook, sockeye and coho have rebounded since 2001 to levels comparable to the early 1990s.

Figure III-9 compares nominal ex-vessel prices in Alaska, British Columbia and the U.S. Pacific Northwest for sockeye and pink salmon. Similarly, Figure III-10 compares ex-vessel prices in the three regions for chinook and chum salmon. In general, for each species price trends are similar between regions (but not identical). British Columbia and U.S. Pacific Northwest prices average somewhat higher than Alaska prices for sockeye, pink and chum salmon (but not for chinook salmon). Numerous factors contribute to differences between regions, including differences in costs of processing and transportation to end-markets, differences in gear and differences in market perceptions of the quality of salmon from different regions (Knapp 1994).

### Figure III-8

**Average Nominal Ex-Vessel Prices for British Columbia Salmon, 1982-2005 (converted to US $/lb, not adjusted for inflation)**

Figure III-9  Average Nominal Ex-Vessel Prices for Sockeye and Pink Salmon, by Region, 1980-2005 (BC Prices converted to US $/lb)

Sources for Alaska prices are the same as for Figure III-6. Sources for BC prices are the same as for Figure III-8. Sources for PNW prices are the same as for Figure III-5.

Figure III-10  Average Nominal Ex-Vessel Prices for Chinook and Chum Salmon, by Region, 1980-2005 (BC Prices converted to US $/lb)

Sources for Alaska prices are the same as for Figure III-6. Sources for BC prices are the same as for Figure III-8. Sources for PNW prices are the same as for Figure III-5.
Value of Alaska and British Columbia Salmon Catches

Figure III-11 shows the real ex-vessel value (the catch volume multiplied by the inflation-adjusted ex-vessel price) of Alaska salmon catches from 1980 to 2005. There are three important points to be seen in this graph.

First, and most obviously, there has been a dramatic decline in the real value of Alaska salmon catches since the 1980s. Expressed in 2005 dollars, the total value averaged more than $580 million in the first half of the 1980s, $850 million in the second half of the 1980s, $660 million in the first half of the 1990s, $440 million in the second half of the 1990s and $260 million for the years 2000-2005.

Second, for almost this entire period, sockeye salmon accounted for well over half of the value of Alaska salmon—the result of a combination of high catches and high prices, compared with other species. Because they account for a large share of the money they earn, Alaska fishermen sometimes refer to sockeye salmon as “money fish.” From 1988 to 2002, the value of sockeye catches fell even more than for other species as both catches and prices fell. The decline in the value of sockeye catches accounted for 58 percent of the total decline in value of Alaska salmon harvests between 1988 and 2002.

Note that lower sockeye prices do not entirely account for the decline in sockeye value: lower catches were also an important factor. We will discuss the causes of the decline in value in later chapters of this report, but we may note here that the decline in sockeye catch value has almost nothing to do with the U.S. fresh and frozen salmon market—since a very small share of the Alaska sockeye catch went to that market until recently. Until recently, almost all Alaska sockeye were sold either to the Japanese frozen market or were canned, so trends in both of these markets have played a big role in the decline of the value of Alaska sockeye salmon.

Third, the value, in inflation-adjusted terms, of total Alaska salmon catches increased substantially from $180 million in 2002 to $308 million in 2005—driven mostly by an increase in the value of sockeye catches. However, this inflation-adjusted value for 2005 remained far below the inflation-adjusted value of salmon catches during the 1980s and 1990s.

As shown in Figure III-12, British Columbia salmon fishermen have experienced an even more dramatic decline in the real ex-vessel value of their salmon catches than Alaska fishermen. Adjusted for Canadian...
inflation rates, the real ex-vessel value of British Columbia catch between 2000 and 2005 was only 12 percent of the average for the years 1985-89.

This drastic decline in the value of the British Columbia salmon catch is due to the combined effects of a steep drop in the total catch (shown in Figure III-4) and falling prices.

Management of Alaska Commercial Salmon Fisheries

Alaska’s salmon fisheries are managed under Alaska’s “limited entry” program, which was established in the 1970s to limit growth in the number of people fishing in the salmon industry. Alaska has twenty-six different salmon fisheries, defined by fishing area and the type of fishing gear which may be used.

For each of these fisheries, there are a fixed number of “limited entry permits.” Only holders of these limited entry permits (and their crew) are allowed to operate fishing gear. Permit holders are required to be on board their boats when they fish, in order to encourage an owner-operated small-boat fishery.

In each fishery, fishermen may use only the type of gear specified by the permit. There are also numerous other restrictions on boats and gear. For example, in Alaska’s Bristol Bay drift gillnet fishery boats may not exceed 32 feet in length and gillnets may not exceed 150 fathoms (900 feet) in length. Individuals may hold more than one salmon permit, but they may participate in only one salmon fishery per season. A boat may only be used in one salmon fishery per season.

Vessel and Net Restrictions in the Alaska Bristol Bay Drift Gillnet Salmon Fishery

Vessel Restrictions. No vessel registered for salmon net fishing may be more than 32 feet in overall length. An anchor roller may not extend more than eight inches beyond the 32-foot overall length, and any portion that extends beyond the 32-foot overall length may not be more than eight inches in width or height.

Net Restrictions. Gillnet mesh size may not be less than seven and one-half inches during periods established by emergency order for the protection of sockeye salmon. No gillnet may be more than 29 full meshes in depth, including the selvages. No person shall operate or assist in the operation of a drift gillnet exceeding 150 fathoms in length. Any vessel registered for salmon net fishing may not have aboard it or any vessel towed by it, during any open fishing period, more than 150 fathoms of drift gillnet gear in the aggregate.

Sources: Alaska Statutes 5 AAC 06.341 and 5 AAC 06.331.
Limited entry permits were originally distributed for free to individuals with a history of participation in the fishery. New entrants to the fishery must buy (or be given) permits from existing permit holders who choose to leave the fishery. There is an active market for permits, and during the most profitable years of the fishery in the late 1980s, permits for several fisheries sold for more than $200,000. However, as the value of catches declined during the 1990s, permit values declined sharply in many fisheries.

There are seven major fishing areas—Southeast, Prince William Sound, Cook Inlet, Kodiak, Chignik, the Alaska Peninsula and Bristol Bay—as well as several other areas of western and interior Alaska which account for a relatively small share of total catches.

Four major types of gear are used to catch salmon commercially: purse seine, drift gillnet, set gillnet and power troll, as well as several other minor gear types. As shown in Table III-3, there is wide variation between Alaska salmon fisheries in volume harvested, earnings, numbers of permits and average permit prices. The most valuable fisheries are usually the gillnet fisheries in Bristol Bay, Prince William Sound and Southeast Alaska and the purse seine fisheries in Southeast Alaska, Prince William Sound and Kodiak. Note that catches and earnings in individual fisheries may vary widely from year to year.

<table>
<thead>
<tr>
<th>Area</th>
<th>Gear</th>
<th>Total earnings (millions of dollars)</th>
<th>Total catch volume (millions of pounds)</th>
<th>Total permits issued</th>
<th>Alaska resident share of permits</th>
<th>Average earnings per permit fished</th>
<th>Average permit price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southeast</td>
<td>Purse Seine</td>
<td>48.8</td>
<td>251.2</td>
<td>415</td>
<td>45 %</td>
<td>$141,339</td>
<td>$34,700</td>
</tr>
<tr>
<td>Bristol Bay</td>
<td>Drift Gillnet</td>
<td>32.4</td>
<td>80.6</td>
<td>1,885</td>
<td>51 %</td>
<td>$20,699</td>
<td>$34,700</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Drift Gillnet</td>
<td>21.2</td>
<td>26.4</td>
<td>541</td>
<td>73 %</td>
<td>$40,682</td>
<td>$57,500</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Purse Seine</td>
<td>17.1</td>
<td>81.7</td>
<td>384</td>
<td>75 %</td>
<td>$93,727</td>
<td>$17,100</td>
</tr>
<tr>
<td>Statewide</td>
<td>Power Troll</td>
<td>16.2</td>
<td>18.3</td>
<td>965</td>
<td>80 %</td>
<td>$23,073</td>
<td>$13,000</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Purse Seine</td>
<td>12.9</td>
<td>83.8</td>
<td>268</td>
<td>73 %</td>
<td>$87,498</td>
<td>$21,400</td>
</tr>
<tr>
<td>Southeast</td>
<td>Drift Gillnet</td>
<td>12.5</td>
<td>27.4</td>
<td>482</td>
<td>74 %</td>
<td>$28,845</td>
<td>$41,300</td>
</tr>
<tr>
<td>Bristol Bay</td>
<td>Set Gillnet</td>
<td>8.5</td>
<td>20.8</td>
<td>1,010</td>
<td>72 %</td>
<td>$10,181</td>
<td>$25,300</td>
</tr>
<tr>
<td>Chignik</td>
<td>Purse Seine</td>
<td>8.4</td>
<td>17.7</td>
<td>98</td>
<td>85 %</td>
<td>$91,425</td>
<td>$185,800</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Set Gillnet</td>
<td>5.1</td>
<td>12.5</td>
<td>188</td>
<td>72 %</td>
<td>$29,515</td>
<td>$101,800</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Set Gillnet</td>
<td>4.1</td>
<td>6.6</td>
<td>744</td>
<td>84 %</td>
<td>$8,082</td>
<td>$10,600</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Drift Gillnet</td>
<td>3.7</td>
<td>6.3</td>
<td>574</td>
<td>69 %</td>
<td>$7,947</td>
<td>$22,300</td>
</tr>
<tr>
<td>Ak Peninsula</td>
<td>Drift Gillnet</td>
<td>3.6</td>
<td>7.8</td>
<td>160</td>
<td>50 %</td>
<td>$26,623</td>
<td>$123,000</td>
</tr>
<tr>
<td>Ak Pen./Aleut. Is.</td>
<td>Purse Seine</td>
<td>2.9</td>
<td>22.0</td>
<td>121</td>
<td>74 %</td>
<td>$45,983</td>
<td>$48,800</td>
</tr>
<tr>
<td>Ak Peninsula</td>
<td>Set Gillnet</td>
<td>2.0</td>
<td>5.7</td>
<td>113</td>
<td>83 %</td>
<td>$20,027</td>
<td>$73,300</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Set Gillnet</td>
<td>1.3</td>
<td>1.6</td>
<td>30</td>
<td>83 %</td>
<td>$44,732</td>
<td>$60,300</td>
</tr>
<tr>
<td>Yakutat</td>
<td>Set Gillnet</td>
<td>1.1</td>
<td>3.1</td>
<td>169</td>
<td>80 %</td>
<td>$9,954</td>
<td>$27,400</td>
</tr>
<tr>
<td>Statewide</td>
<td>Hand Troll</td>
<td>1.0</td>
<td>1.0</td>
<td>1,295</td>
<td>88 %</td>
<td>$3,318</td>
<td>$4,100</td>
</tr>
<tr>
<td>Kuskokwim</td>
<td>Set Gillnet</td>
<td>0.8</td>
<td>2.6</td>
<td>818</td>
<td>99 %</td>
<td>$1,562</td>
<td>$7,000</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Purse Seine</td>
<td>0.7</td>
<td>1.9</td>
<td>83</td>
<td>90 %</td>
<td>$28,844</td>
<td>$15,800</td>
</tr>
<tr>
<td>Kotzebue</td>
<td>Set Gillnet</td>
<td>0.3</td>
<td>1.8</td>
<td>190</td>
<td>96 %</td>
<td>$4,973</td>
<td>$2,000</td>
</tr>
<tr>
<td>Norton Sound</td>
<td>Set Gillnet</td>
<td>0.1</td>
<td>0.2</td>
<td>190</td>
<td>98 %</td>
<td>$1,233</td>
<td>$4,500</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Beach Seine</td>
<td>0.0</td>
<td>0.0</td>
<td>34</td>
<td>85 %</td>
<td>$0</td>
<td>$16,400</td>
</tr>
<tr>
<td>Upper Yukon</td>
<td>Fish Wheel</td>
<td>0.0</td>
<td>0.0</td>
<td>157</td>
<td>98 %</td>
<td>$0</td>
<td>$7,700</td>
</tr>
<tr>
<td>Lower Yukon</td>
<td>Set Gillnet</td>
<td>0.0</td>
<td>0.0</td>
<td>701</td>
<td>99 %</td>
<td>$0</td>
<td>$11,500</td>
</tr>
<tr>
<td>Upper Yukon</td>
<td>Set Gillnet</td>
<td>0.0</td>
<td>0.0</td>
<td>72</td>
<td>99 %</td>
<td>$0</td>
<td>$7,500</td>
</tr>
<tr>
<td>Total, All Fisheries</td>
<td></td>
<td>204.7</td>
<td>681.1</td>
<td>11,687</td>
<td>76 %</td>
<td>$29,625</td>
<td>$37,492</td>
</tr>
</tbody>
</table>

Source: Commercial Fisheries Entry Commission, Basic Information Tables for Alaska salmon fisheries. Note: Yukon River fisheries were closed to commercial fishing in 2001 due to low salmon returns. As a result, total catches and earnings in Yukon River fisheries were zero.
Descriptions of Alaska salmon harvesting methods from an Alaska Department of Fish and Game brochure about Alaska’s Commercial Salmon Fishery (www.state.ak.us/adfg).

### Salmon Harvesting Methods

Three main gear types catch Alaska salmon: trolling, gillnetting, and purse seining. Recent averages indicate the number of salmon harvested equals 71% by purse seiners, 27% by gillnetters, and 2% by trolls. All commercial salmon fishing boats are relatively small vessels; averaging 30 to 50 feet.

**Trollers** use long trolling poles to pull or troll 2 to 4 deep weighted lines through the water, each with 8 – 12 leaders attached. At the end of each leader there is a lure or baited hook. Boat size varies from small skiffs to vessels of 50 feet or more with most ranging between 25 to 40 feet. Trollers primarily target king, coho, and pink salmon as they enter Alaskan waters on their way to the spawning grounds. Trollers catch a relatively low volume of high-quality fish. The fish they catch are bright and vigorous from fresh ocean waters. They are often sold dressed, or filleted in the fresh or fresh frozen market.

**Gillnetters** set curtain-like nets in the water suspended from a float line at the surface and a weighted lead line along the submerged bottom edge. Nets vary in length from 900 to 1800 feet long. The net’s mesh openings are just large enough to allow an adult fish head to get through and become entangled at the gills. There are two types of gillnets: driftnets that are free floating from boats, and setnets that have one end attached to the shoreline. Boat size is limited to 32 feet or less in Bristol Bay; otherwise, the average range is 30 to 40 feet. Gillnetters primarily harvest sockeye, chum and coho.

**Purse Seiners** use a large floating net, pulled and set in circle by a power skiff, to surround schooling salmon. The weighted “purse line” at bottom of the net is drawn closed to contain the fish. The net full of fish is then gathered to the boat through a high-powered hydraulic block. Purse seiners are not allowed north of the Alaska Peninsula; boat size is limited to 58 feet. Harvests of 250 to 1,500 fish or more are commonly caught in a single set. Purse Seiners harvest mainly pink salmon near the shoreline and close to fresh water spawning grounds where runs are highly concentrated.
Changes in the total value of Alaska salmon fisheries (Figure III-11) are reflected in changes in total earnings for individual salmon fisheries (Table III-4). Relative changes in earnings have not been the same for all fisheries. For example, in the Bristol Bay drift gillnet fishery for 2001-05 were only 31 percent of earnings for 1986-90. In contrast, in the Prince William Sound drift gillnet fishery (which includes the well-known Copper River salmon fishery), earnings for 2001-05 were 86 percent of earnings for 1986-90.

In most fisheries, earnings increased from 2002 to 2005, but remained well below averages for 1986-90. For example, in the Bristol Bay drift gillnet fishery, 2002 earnings were only 16 percent of the 1986-90 average, while 2005 earnings were 50 percent of the 1986-90 average.

These differences in relative changes in value reflect important differences between fisheries in the mix of species caught and the trends in catches over time. Put simply, different Alaska fisheries have experienced different kinds of changes—and have been affected in different ways by competition from salmon farming. We discuss these changes in greater detail in Chapters XIII and XIV.

The limited entry management system has important implications for how the Alaska salmon industry has been affected by competition from farmed salmon and how it may change in the future.

As noted above, the limited entry system was established in the 1970s to restrict further growth in the number of participants in the salmon industry. The number of permits in each fishery was capped at the maximum historic level of participants. In most fisheries this resulted in more fishermen and more fishing boats and gear than was needed to catch the available fish in most years. In economic terms, this resulted in overcapacity and inefficiency: it would have been possible for fewer fishermen and boats to catch the same volume of fish at lower cost.

Over time, as total catch value increased, permit holders invested in bigger and more powerful boats and gear in order to increase their share of the catches. Collectively

### Table III-4

<table>
<thead>
<tr>
<th>Area</th>
<th>Gear</th>
<th>Earnings (millions of nominal dollars)</th>
<th>Earnings as % of 1986-90 average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bristol Bay</td>
<td>Drift Gillnet</td>
<td>154.5</td>
<td>47.8</td>
</tr>
<tr>
<td>Southeast</td>
<td>Purse Seine</td>
<td>53.2</td>
<td>31.4</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Drift Gillnet</td>
<td>39.7</td>
<td>8.6</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Set Gillnet</td>
<td>37.2</td>
<td>8.9</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Purse Seine</td>
<td>34.4</td>
<td>14.9</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Purse Seine</td>
<td>29.4</td>
<td>11.7</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Drift Gillnet</td>
<td>25.3</td>
<td>21.7</td>
</tr>
<tr>
<td>Bristol Bay</td>
<td>Set Gillnet</td>
<td>25.2</td>
<td>10.7</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Purse Seine</td>
<td>23.6</td>
<td>4.2</td>
</tr>
<tr>
<td>Statewide</td>
<td>Power Troll</td>
<td>23.6</td>
<td>18.4</td>
</tr>
<tr>
<td>Chignik</td>
<td>Purse Seine</td>
<td>22.1</td>
<td>6.0</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Drift Gillnet</td>
<td>21.0</td>
<td>6.3</td>
</tr>
<tr>
<td>Southeast</td>
<td>Drift Gillnet</td>
<td>20.6</td>
<td>10.4</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Set Gillnet</td>
<td>13.1</td>
<td>5.4</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Set Gillnet</td>
<td>7.9</td>
<td>3.1</td>
</tr>
<tr>
<td>Lower Yukon</td>
<td>Gillnet</td>
<td>7.7</td>
<td>1.8</td>
</tr>
<tr>
<td>Kuskokwim</td>
<td>Set Gillnet</td>
<td>7.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Yakutat</td>
<td>Set Gillnet</td>
<td>4.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Statewide</td>
<td>Hand Troll</td>
<td>4.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Purse Seine</td>
<td>3.4</td>
<td>0.9</td>
</tr>
<tr>
<td>Kotzebue</td>
<td>Gillnet</td>
<td>1.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Other fisheries*</td>
<td></td>
<td>2.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>562.0</td>
<td>216.9</td>
</tr>
</tbody>
</table>

*Fisheries with average earnings of less than $1 million for 1986-90. Source: CFEC Basic Information Tables. 2005 data are preliminary and will probably increase slightly after final prices including post-season bonuses are calculated.
this resulted in higher total costs without any effect on total catches—further reducing the efficiency of the harvest. Economists refer to this phenomenon of increasing capacity despite limitations on the number of permits and boats as “capital stuffing.”

While prices and catches were high, most Alaska fishermen and fishery managers were not concerned about overcapacity or inefficiency in the salmon fisheries. In 1990, permit prices exceeded $100,000 in 13 of the 26 limited entry salmon fisheries for which Alaska’s Commercial Fisheries Entry Commission reported permit values. Permit prices exceeded $50,000 in 16 fisheries, and permit prices exceeded $25,000 in 20 fisheries. This suggests that most salmon fisheries were profitable: buyers were willing to pay significant prices for the right to participate in most fisheries.

However, as the value of catches began to decline in the 1990s, many fishermen were caught in an economic squeeze as their fishing revenues were sufficient to cover their costs. For many permit holders, the loss in fishing profits was aggravated by a sharp decline in the asset value of their limited entry permits. As shown in Table III-3, in some fisheries a significant share of permits are no longer being fished, as permit holders conclude that they cannot make enough money fishing to cover their costs. However, in many fisheries the number of boats being fished remains well above the levels needed to catch the available fish. The economic inefficiency of the “limited entry” management system derives not only from the fact that more boats and gear are used than are needed to catch the fish. Less obviously, but just as importantly, it derives from the strict restrictions on the type of boats and gear which may be used, and from the “race for fish” as fishermen compete for a share of the total catch.

As noted above, Alaska salmon fisheries are defined in terms of specific types of gear—an essential feature of limited entry management. As a result, despite ever-increasing competition, most Alaska fishermen continue to catch fish in the same way as they have for decades. Because changes in fishing gear or methods typically require action by the Board of Fisheries, it is difficult to innovate: to introduce ways of catching fish which lower costs or result in better quality.

In some Alaska salmon fisheries it might be possible, by using different gear, to catch fish more cheaply and handle them more carefully. In some fisheries, for example, this might be achieved by using purse seines rather than drift gill nets. In others it might be possible by using fish traps, which can catch fish at very low cost and hold them alive. However, salmon traps were banned by the Alaska legislature immediately after statehood, and this ban remains in effect.

For Alaska salmon fishermen to compete successfully in limited entry fisheries, they need to work quickly to catch fish within the limited time periods when fishing is allowed. Slowing down in an effort to handle individual fish more carefully can result in lower catches. This, together with boat size and gear restrictions, results in widely recognized quality problems in some Alaska salmon fisheries, lowering the reputation and value of the fish in end-markets.

As we discuss in Chapters XIII and XIV, as the economic difficulties of the Alaska wild salmon industry increase, there is growing awareness of how the management system adds to costs and lowers quality, thereby adding to the difficulties Alaska salmon faces in competing with farmed salmon. At the same time, however, there is strong resistance to changes in management, because of the economic and social disruption that such changes might mean.

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7 Because of restrictions on overall boat lengths, boats were built wider and higher.
8 According to economic theory, in an efficient fishery, a boat would only fish if it resulted in enough of an increase in the total catch value to cover the costs of operating the boat. But an individual fisherman will fish if his own catch value is enough to cover his costs. However, most of the fish that he catches do not represent an increase in the total catch value, but rather a reduction in the catch value of other boats.
9 Salmon traps have the additional potential conservation benefit of allowing for a precise number of fish of particular species to be caught, while allowing other fish to be released. Note, however, that fish traps are only suitable for fisheries where structures can be located in a manner that does not interfere with navigation and are not susceptible to tidal currents and storm surges, and where high catch volumes offset costs of construction and maintenance.
For example, reducing the numbers of boats fishing to a more economically efficient level—perhaps through a “buyback” of fishing permits—would also reduce employment in the fishery. It could also result in declining fishery participation by residents of small coastal communities, with more of the fish being caught by non-local fleets.

Ultimately, however, the current economic inefficiencies in the Alaska wild salmon industry suggest that the industry can and will continue to compete successfully with farmed salmon in world markets, because of the potential to substantially reduce costs through changes in management. Put differently, competition from salmon farming may force the wild salmon industry to deliver better fish to consumers at lower cost. However, these changes will not come easily.

Management of British Columbia Commercial Salmon Fisheries

In contrast to Alaska, where salmon fisheries are managed by the State of Alaska, in British Columbia the Canadian federal government has sole responsibility for management of salmon fisheries, under the 1867 *Fisheries Act*. The fisheries are managed by the Department of Fisheries and Oceans (DFO), not by provincial governments.

DFO implemented limited entry licensing for BC salmon fisheries in 1969. Currently, licenses are issued for three gear groups: seine, gillnet and troll vessels (Table III-5). License owners pay a fee pegged as a percentage of landed value during a four year base period. Aboriginal (First Nations) owners of salmon licenses can elect to pay a reduced fee, however, doing so restricts the transfer of such license to another Aboriginal person. (Communal “F” licenses held by Aboriginal bands are non-transferable and are subject to the reduced fee as well. For an in-depth discussion of these licenses see James, 2003.)

As shown in Table III-6, most coho and chinook salmon are caught in troll fisheries; most pink salmon are caught in seine fisheries, and significant shares of sockeye and chum salmon are caught in both seine and gillnet fisheries. For each gear group, there are important differences between areas in the relative mix of species caught.

There are several important differences between the limited entry management systems in British Columbia and Alaska:

- Licenses are vessel-based: In Alaska, limited entry permits are owned by individuals, without any designation of the vessels on which they will be fished. In British Columbia, limited entry licenses
### Table III-5  British Commercial Salmon Licenses, 2003

<table>
<thead>
<tr>
<th>Type of license</th>
<th>Total</th>
<th>Non Aboriginal-Held</th>
<th>&quot;F&quot; Communal</th>
<th>Reduced Fee</th>
<th>Full Fee</th>
<th>Sub-Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seine &quot;AS&quot;</td>
<td>276</td>
<td>196</td>
<td>12</td>
<td>18</td>
<td>50</td>
<td>80</td>
</tr>
<tr>
<td>Gillnet &quot;AG&quot; &amp; &quot;N&quot;</td>
<td>1406</td>
<td>870</td>
<td>76</td>
<td>418</td>
<td>42</td>
<td>536</td>
</tr>
<tr>
<td>Troll &quot;AT&quot;</td>
<td>539</td>
<td>489</td>
<td>19</td>
<td>24</td>
<td>7</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2221</td>
<td>1555</td>
<td>107</td>
<td>460</td>
<td>99</td>
<td>666</td>
</tr>
</tbody>
</table>


### Table III-6  British Columbia Salmon Catches, by Gear Group and Area, 2003

<table>
<thead>
<tr>
<th>Gear</th>
<th>Area</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
<th>Chinook</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of fish</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seine</td>
<td>A</td>
<td>170</td>
<td>10</td>
<td>7,003</td>
<td>685</td>
<td>0</td>
<td>7,868</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>696</td>
<td>0</td>
<td>967</td>
<td>1,000</td>
<td>0</td>
<td>2,663</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>867</td>
<td>10</td>
<td>7,971</td>
<td>1,684</td>
<td>0</td>
<td>10,532</td>
</tr>
<tr>
<td>Gillnet</td>
<td>C</td>
<td>683</td>
<td>0</td>
<td>768</td>
<td>780</td>
<td>13</td>
<td>2,244</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>316</td>
<td>6</td>
<td>33</td>
<td>388</td>
<td>10</td>
<td>752</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>249</td>
<td>0</td>
<td>18</td>
<td>239</td>
<td>6</td>
<td>511</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>1,248</td>
<td>7</td>
<td>819</td>
<td>1,406</td>
<td>28</td>
<td>3,508</td>
</tr>
<tr>
<td>Troll</td>
<td>F</td>
<td>4</td>
<td>214</td>
<td>110</td>
<td>0</td>
<td>138</td>
<td>465</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>167</td>
<td>172</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>124</td>
<td>0</td>
<td>105</td>
<td>85</td>
<td>1</td>
<td>315</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>128</td>
<td>214</td>
<td>215</td>
<td>89</td>
<td>306</td>
<td>952</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>2,242</td>
<td>231</td>
<td>9,004</td>
<td>3,180</td>
<td>334</td>
<td>14,991</td>
</tr>
</tbody>
</table>

| **Percentage of fish** |       |         |      |      |      |         |       |
| Seine | A    | 7.6%    | 4.3% | 77.8%| 21.5%| 0.0%    | 52.5% |
|       | B    | 31.1%   | 0.0% | 10.7%| 31.4%| 0.0%    | 17.8% |
|       | **Total** | 38.7%   | 4.3% | 88.5%| 53.0%| 0.0%    | 70.3% |
| Gillnet | C   | 30.4%   | 0.2% | 8.5% | 24.5%| 3.8%    | 15.0% |
|       | D    | 14.1%   | 2.7% | 0.4% | 12.2%| 2.9%    | 5.0%  |
|       | E    | 11.1%   | 0.0% | 0.2% | 7.5% | 1.7%    | 3.4%  |
|       | **Total** | 55.6%   | 2.9% | 9.1% | 44.2%| 8.4%    | 23.4% |
| Troll | F    | 0.2%    | 92.7%| 1.2% | 0.0% | 41.1%   | 3.1%  |
|       | G    | 0.0%    | 0.1% | 0.0% | 0.1% | 50.1%   | 1.1%  |
|       | H    | 5.5%    | 0.0% | 1.2% | 2.7% | 0.3%    | 2.1%  |
|       | **Total** | 5.7%    | 92.8%| 2.4% | 2.8% | 91.6%   | 6.4%  |

are attached to specific vessels with an “overall allowable length” (OAL) of the vessel specified on the license. A license can be transferred only to another vessel that does not exceed the specified OAL.

- No owner-operator clause: Unlike in Alaska, the owner of a salmon license does not have to be on the vessel while it fishes that license. Corporations, including salmon processors, may own fishing licenses.

- Aboriginal licenses: In Alaska commercial salmon fisheries, Native Americans and non-Natives fish under identical regulations: there are no regulations or permits which apply specifically to Natives. In contrast, in British Columbia there are specifically-designated “aboriginal held” licenses. Under the Aboriginal Fisheries Strategy, the government has purchased some commercial fishing licenses and transferred them to First Nations or aboriginal organizations.

In Alaska neither the number of salmon permits nor most salmon fishery regulations have changed significantly since the introduction of the limited entry system in the 1970s. In contrast, in British Columbia there have been several significant changes in the management of the salmon fishery, in response to the decline in salmon stocks, catches, prices and landed value.

In BC, between 1969 and 1977, there was no restriction on the type of gear that could be used on a salmon licensed vessel. In 1977, a moratorium on the number of vessels allowed to fish with seine gear was implemented. Vessels with seine license privileges were permitted to fish for salmon with any gear until 1996, while other vessels were permitted to use either gill net or troll gear or both until 1996.

Two consecutive poor salmon seasons in 1995 and 1996, during which incomes and profits fell to record lows, as well as ongoing concerns for conservation of salmon led the federal government to introduce its Pacific Salmon Revitalization Strategy in 1996. The 1996 “Mifflin Plan” implemented area and gear licensing for the salmon fleet (two areas for seine licenses, three for gillnet and troll licenses), which limited license holders to fishing with a single gear type in a specified area. It also allowed “stacking” of more than one license on a single vessel. The Mifflin Plan and the 1998 Pacific Fisheries Adjustment and Restructuring Program (PFAR) also provided for the purchase or retirement, on a voluntary basis, of commercial salmon licenses. A $280 million buyback program resulted in a decline in the number of commercial salmon licenses from approximately 4,400 to 2,200 between 1995 and 2000 (G.S. Gislason & Associates Ltd).

Traditional mixed stock fisheries have been curtailed, allowing only selective fishing where weak and strong stocks are intermingled. Effectively this significantly reduced the exploitation rates of returning salmon in many fisheries. For example, the Fraser River sockeye fishery, the most important salmon fishery in British Columbia, has had its exploitation rate reduced to 45 percent (McRae and Pearse 2004). Sockeye is the most important species, and specifically, Fraser River sockeye salmon are a very important component of BC commercial and aboriginal fisheries and a growing component of recreational fisheries.

McRae and Pearse (2004) characterize B.C. salmon management as challenging in part because of the commercial, recreational and aboriginal access to the fishery, in addition to access to the stock by American fishermen under the Pacific Salmon Treaty. As with Alaska, the government has to provide an order of priority to demands on the fish, opposite to the order in which the fish are encountered. First priority is to provide adequate spawners in the headwaters and tributaries of rivers; second priority is to provide for aboriginal food, social and ceremonial needs, mainly downstream along the rivers and estuaries but also along the coast; and third is recreational and commercial fishing, mostly at sea.

For example, the United States, under the Pacific Salmon Treaty, must be allocated 16.5 percent of the total allowable catch from the Fraser River. From the 83.6 percent of Canadian catch, the estimated requirements of Canadian First Nations for their food fishery are subtracted, followed by five percent for the recreational fishery (McRae and Pearse 2004). What is left is the commercial fishery total allowable catch. This allocation is then further allocated among the gear types and catch areas. Another difference between Canadian and Alaskan management of allocation is that in Alaska the commercial sector dominates the three fisheries whereas in British Columbia a significant share of catch must go to recreational and aboriginal fisheries.

To further complicate management, in some of the most recent years, there has been significant in-river mortality of Fraser River sockeye (fish dying before they reach the spawning grounds), as a result of water temperatures, endemic parasites and other factors. This has created a significant challenge for managers in deciding what level of commercial catches to allow, in balancing the risks that not enough fish will reach the spawning grounds (if in-river mortality is high) or that significant potential commercial benefits will be foregone (if in-river mortality is low).

There is a vigorous debate within British Columbia over salmon fishery management, including issues such as the management of mixed stock fisheries; allocation between commercial, recreational and aboriginal fisheries; the proper application of the precautionary
approach to fisheries management given lack of data and scientific understanding of resources and risks; and appropriate recovery strategies for endangered salmon stocks. A lengthy public process has been underway to formulate a new Wild Salmon Policy to ensure the long-term viability of salmon populations and the maintenance of habitat.

Management of U.S. Pacific Northwest Commercial Salmon Fisheries

U.S. Pacific Northwest commercial salmon fisheries occur in Washington, Oregon and California and include both in-river and ocean fisheries using troll, gillnet, seine and several other kinds of gear. Management of these fisheries is greatly complicated by numerous factors including: a) the widely varying conditions of wild salmon stocks of the region; b) the fact that many commercial fisheries are mixed stock fisheries (catching fish returning to different river systems) and/or interception fisheries (catching fish closer to or in the rivers to which they are returning); c) the large number of institutions involved in fishery management; d) the diversity of commercial fishing user groups; e) the significant role of sport catches in total salmon catches; and f) the significant role of hatchery fish in commercial catches. 10

A wide variety of federal, state, regional, tribal and international institutions play a role in the management of U.S. Pacific Northwest commercial salmon fisheries. The Pacific Salmon Commission addresses international aspects of salmon management, and plays an important role in the management of Pacific Northwest fisheries. The Commission addresses complex issues relating to mixed-stock fisheries in southeast Alaska, British Columbia and the U.S. Pacific Northwest, which result from the fact that fishermen in all three jurisdictions intercept salmon returning to other jurisdictions. Since the early twentieth century international allocation and management issues for these mixed-stock fisheries have been the subject of debate and negotiation between and within the United States and Canada. The 1985 Pacific Salmon Treaty created the Pacific Salmon Commission and established principles to address these allocation issues.

The 1974 “Boldt decision” reaffirmed the rights of Washington Indian tribes to fish in accustomed places, and allocated 50 percent of the annual catch to treaty tribes. 11 Thus U.S. Pacific Northwest salmon fisheries include both “treaty” and “non-treaty” fisheries. The Northwest Indian Fisheries Commission represents Washington tribes in coordinating the management of treaty fisheries with the Pacific Salmon Commission and federal and state agencies.

In Puget Sound, salmon fisheries are jointly managed under a cooperative arrangement that has evolved since the Boldt decision, under which the Northwest Indian Fisheries Commission and the state of Washington jointly manage catches in accord with international agreements reached within the Pacific Salmon Commission. The Washington Department of Fisheries and Wildlife and the Oregon Department of Fish and Wildlife share responsibilities for management of Columbia River salmon fisheries.

The federal Pacific Fishery Management Council (PFMC) coordinates federal and state management actions with respect to salmon management for California, Idaho, Oregon and Washington. The species managed by the PFMC are chinook, coho and (in some years) pink salmon. There are no directed fisheries for other salmon species such as sockeye, steelhead and chum in Council-managed waters.

In general, non-treaty fisheries in the U.S. Pacific Northwest are managed under limited entry systems. Catches are restricted by restrictions on fishing times, areas and gear types. Permit numbers have been significantly reduced by buyback programs.

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10 Except where otherwise noted, material in this section is from National Research Council (NRC), Committee on Protection and Management of Pacific Northwest Anadromous Salmonids, Upstream: Salmon and Society in the Pacific Northwest (1996).

11 Decision of Judge George Boldt in United States v. Washington, 384 F. Supp. 312, 343 (W.D. Wash. 1974). This decision upheld the right of tribes in the Northwest to fish and to manage fisheries under early treaties; and determined that they are entitled to an opportunity to equally share in the harvest of fish in their traditional fishing areas.
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The Role of Hatcheries in North American Wild Salmon Production

Key Points

✓ A significant share of the salmon caught by North American commercial fishermen are released from hatcheries. In recent years, hatchery fish have accounted for about 38 percent of total Alaska “wild” salmon catches, including about 40 percent of Alaska pink salmon catches and 69 percent of Alaska chum salmon catches. Most Alaska hatchery production is concentrated in Southeast Alaska and Prince William Sound. The importance is highlighted by ADF&G: “The ocean ranching program provides hundreds of Alaskans with seasonal jobs. It is now considered the largest agricultural industry in Alaska” (Farrington 2004 p. 2).

✓ The Alaska hatchery program faces significant economic and political challenges, including:
  • Lower economic net return due to lower prices
  • Declining state financial support for hatcheries
  • Declining direct benefits to fishermen from hatcheries as the share of catches needed to cover costs of hatchery operations increases
  • Opposition from fishermen dependent on natural wild salmon catches who argue that large-scale hatchery catches has depressed ex-vessel prices they receive
  • Lack of markets for “dark” hatchery fish (fish that have physiologically changed as they move back to fresh water) in some years, leading to discarding of fish carcasses after extraction of salmon roe
  • Concerns about potential adverse effects of hatchery releases on Alaska natural wild salmon runs.

✓ There are also significant hatchery programs in British Columbia, the U.S. Pacific Northwest and California, which account for significant shares of the commercial and recreational fisheries.

✓ Hatcheries add another dimension of complexity and ambiguity to the discussion over environmental, economic and social issues related to wild and farmed salmon. Some of the environmental and economic issues associated with salmon farming are also associated with commercial hatchery production.

Introduction

It is common to think of salmon as either “wild” or “farmed.” However, not all “wild” salmon are equally wild. A large share of the salmon returning to North American streams, and a large share of the salmon caught by North American commercial fishermen, are released from hatcheries and are considered ‘ranched’ salmon. However, most discussion is framed in a ‘wild’ salmon context which includes both ‘natural wild’ and ‘ranched.’

In some ways, hatchery salmon are more like farmed salmon than natural wild salmon.\(^2\)

• Like farmed salmon, hatchery salmon spend the first part of their lives in hatchery incubation systems and/or rearing containers, eating similar kinds of feeds.

• Like those farmed salmon which escape into the natural environment, hatchery salmon may potentially affect the genetic diversity of natural wild salmon stocks. This is particularly a concern in Washington, Oregon and California.

• Like farmed salmon, hatchery salmon compete in world markets with natural wild salmon.

• Like farmed salmon, there are significant costs in producing hatchery salmon, and the extent to which hatcheries are economically viable depends upon market conditions.

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1 A good deal of the discussion of this chapter, in particular the portion on Alaska’s hatchery programs, is drawn from Knapp (1999).

2 See footnote 2 in Chapter II.
Unlike farmed salmon, hatchery fish compete with natural wild fish for food. For these reasons, hatcheries add another dimension of complexity and ambiguity to the discussion over environmental, economic and social issues related to wild and farmed salmon.

Once thought of as a way to restore and enhance natural wild salmon runs, hatchery salmon are now recognized as potentially harmful to natural wild salmon runs because of genetic interactions and competition for food and habitat in freshwater and marine environments. There is an active debate among scientists, commercial fishermen and the public as to the appropriate role and scale of salmon hatcheries. This is particularly true in the U.S. Pacific Northwest.

In this chapter we review the role of hatchery salmon in North American commercial wild salmon fisheries, and the economic issues associated with hatchery salmon.

Overview of North American Hatchery Programs

Salmon hatcheries have been established in North America for many purposes including:

- Introducing salmon fisheries where none previously existed.
- Replacing or enhancing natural salmon runs which were extinct or diminished.
- Increasing abundance of salmon for sports fisheries
- Increasing abundance of salmon for commercial fisheries.

Hatcheries were first established in North America in the second half of the nineteenth century, motivated by the recognition that natural stocks of salmonids were in decline and the desire to introduce salmon and trout outside their native ranges (Thorpe 1980). The first hatchery propagation of Pacific salmon (Oncorhynchus spp.) took place in Canada in 1857 (Bardach et al. 1972). Soon after, salmon hatchery techniques were adopted in the United States. The first U.S. hatchery was opened in 1864 in New York State to raise brook trout (Calabi 1990). However, hatchery-based enhancement programs were introduced at a significant scale only after the 1950s. Hatcheries were introduced to Japan in 1877.

More than two billion Pacific salmon were released in 2000 by North American salmon hatcheries (Table IV-1). Alaska accounted for 69 percent of total releases, while Canada and the U.S. Pacific Northwest each accounted for about 16 percent (Table IV-2).

Alaska releases were mostly pink and chum salmon, western Canadian releases (mostly British Columbia) were mostly sockeye, chum and chinook salmon and U.S. Pacific Northwest releases were mostly chinook and coho salmon. Alaska accounted for the largest share of pink and chum salmon releases; Canada accounted for the largest share of sockeye releases, and the U.S. Pacific Northwest accounted for the largest share of chinook and coho releases (Table IV-2).

### Table IV-1 Salmon Fry Releases by Species, Region, and Area, 2000 (millions of fish)

<table>
<thead>
<tr>
<th>Region</th>
<th>Chinook</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>9.2</td>
<td>59.8</td>
<td>19.3</td>
<td>879.7</td>
<td>507.7</td>
<td>1479.7</td>
</tr>
<tr>
<td>Yukon</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Queen Charlotte</td>
<td>0.2</td>
<td>0.0</td>
<td>1.3</td>
<td>0.0</td>
<td>0.0</td>
<td>22.2</td>
</tr>
<tr>
<td>North Coast</td>
<td>4.3</td>
<td>90.5</td>
<td>1.6</td>
<td>0.2</td>
<td>12.7</td>
<td>109.3</td>
</tr>
<tr>
<td>West Coast Vancouver Island</td>
<td>17.5</td>
<td>0.0</td>
<td>2.7</td>
<td>0.0</td>
<td>31.8</td>
<td>51.9</td>
</tr>
<tr>
<td>South Coast</td>
<td>29.2</td>
<td>39.3</td>
<td>14.8</td>
<td>16.9</td>
<td>30.6</td>
<td>130.7</td>
</tr>
<tr>
<td>Interior B.C.</td>
<td>2.2</td>
<td>19.2</td>
<td>0.7</td>
<td>0.0</td>
<td>0.0</td>
<td>22.1</td>
</tr>
<tr>
<td>Canada Total</td>
<td>53.5</td>
<td>148.9</td>
<td>21.1</td>
<td>17.0</td>
<td>97.3</td>
<td>337.9</td>
</tr>
<tr>
<td>Washington</td>
<td>117.4</td>
<td>16.9</td>
<td>43.9</td>
<td>1.6</td>
<td>38.8</td>
<td>229.5</td>
</tr>
<tr>
<td>Oregon</td>
<td>32.3</td>
<td>0.0</td>
<td>8.7</td>
<td>0.0</td>
<td>0.0</td>
<td>46.8</td>
</tr>
<tr>
<td>California</td>
<td>43.8</td>
<td>0.0</td>
<td>0.6</td>
<td>0.0</td>
<td>0.0</td>
<td>46.8</td>
</tr>
<tr>
<td>Idaho</td>
<td>6.8</td>
<td>0.1</td>
<td>0.5</td>
<td>0.0</td>
<td>0.0</td>
<td>15.3</td>
</tr>
<tr>
<td>Pacific Northwest Total</td>
<td>200.3</td>
<td>17.0</td>
<td>53.7</td>
<td>1.6</td>
<td>38.8</td>
<td>338.4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>263.0</td>
<td>225.7</td>
<td>94.2</td>
<td>898.4</td>
<td>643.8</td>
<td>2156.0</td>
</tr>
</tbody>
</table>

Source: North Pacific Anadromous Fish Commission, NPAFC Hatchery Release Data.

Note: Includes all juvenile salmon releases.
Table IV-2  Share of Salmon Fry Releases, by Region and Species, 2000

<table>
<thead>
<tr>
<th></th>
<th>Chinook</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>3%</td>
<td>26%</td>
<td>21%</td>
<td>98%</td>
<td>79%</td>
<td>69%</td>
</tr>
<tr>
<td>Canada</td>
<td>20%</td>
<td>66%</td>
<td>22%</td>
<td>2%</td>
<td>15%</td>
<td>16%</td>
</tr>
<tr>
<td>Pacific Northwest</td>
<td>76%</td>
<td>8%</td>
<td>57%</td>
<td>0%</td>
<td>6%</td>
<td>16%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: NPAFC Hatchery Release Data

Table IV-3  Number of Fry Released per Kilogram of Commercial Catches, 1997-2001

<table>
<thead>
<tr>
<th></th>
<th>Chinook</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>2.3</td>
<td>0.7</td>
<td>1.5</td>
<td>5.5</td>
<td>6.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Canada</td>
<td>53.4</td>
<td>18.3</td>
<td>115.6</td>
<td>2.3</td>
<td>15.3</td>
<td>14.2</td>
</tr>
<tr>
<td>Pacific Northwest</td>
<td>52.1</td>
<td>15.8</td>
<td>42.1</td>
<td>1.8</td>
<td>16.2</td>
<td>34.9</td>
</tr>
</tbody>
</table>

Note: Calculated by dividing average fry releases for the period 1997-2001 (thousands of fish) by average commercial catches for the period 1997-2001 (thousands of kilograms). For the Pacific Northwest, average fry releases for the period 1997-2000 were used because 2001 data were not available.

Table IV-3 provides a general indicator of the relative scale of hatchery releases in comparison to commercial harvests. For chinook, sockeye and coho salmon, hatchery releases per kilogram of commercial catches were much higher in Canada and the U.S. Pacific Northwest than in Alaska—suggesting that commercial fisheries for these species are relatively more dependent on hatcheries in Canada and the U.S. Pacific Northwest than Alaska. For pink and chum salmon, hatchery releases per kilogram of commercial catches were much more comparable among the three regions.

The Hatchery Process

The production of salmon in hatcheries recreates the early portion of the life cycle of the species in a protected environment (Willoughby 1999). Salmon hatcheries consist of both a freshwater and a marine phase. The freshwater phase encompasses the spawning cycle, egg production, hatching and first-feeding stages. As the fry develop, they turn into fingerlings (or parr as the Europeans tend to call them), and finally grow to become smolts. At this point the fish have become physiologically adapted to seawater conditions.

- **Broodstock management**: Broodstock are the fish from which the eggs and milt (sperm) are taken. Selection of the broodstock from adults returning to the hatchery has changed significantly over time. Until recently, little concern was given to such things as managing to maintain the genetic integrity of a river’s native salmon. In recent years, scientists have determined that these needs must be addressed and have prescribed methods to choose broodstock in a more careful manner (National Research Council 1996).
- **Hatchery**: The hatchery phase is probably the most technically demanding, requiring a high degree of organization and planning. The objective of this portion of the cycle is to fertilize and hatch the eggs then raise the fry until release to open water. After hatching, the young fish feed on the contents of their yolk sac for several weeks and are called yolk-sac fry or alevins. A short time after hatching the yolk sac has been almost totally consumed and the alevins are generally developed enough to start feeding. Starter diets formulated with feed ingredients, such as fishmeals and fish oils, give rapid growth.
- **Fry and fingerling development**: When the alevins begin to feed they are known as fry. During this phase, growth is rapid. As they develop, fry become more accustomed to solid feed and increase their activity. When the fry are sufficiently developed, they are transferred into larger tanks. Once the fry reach an average weight of about 5 g, they are known as fingerlings.
- **Smolt production**: Once the larger fingerlings are sufficiently developed, they will undergo major physical and physiological changes to become smolts. These changes mark the transformation from a freshwater fingerling to a seawater fish (Fitzgerald et al. 2002). The smoltification process involves changes in most organ systems, morphological (silvery color), physiological (ATPase activity) and behavioral (swimming with the current), which will allow the fish to survive, grow and develop normally in the marine environment.

Hatcheries managed for stock enhancement of the commercial and sport fisheries, generally release fish to
the open water at either the fry, fingerling or smolt stage depending on species and management objectives. Pink and chum salmon are generally released at the fry stage with a large number of fry released. In British Columbia, the U.S. Pacific Northwest, where the purpose of the hatcheries are generally to ensure the survival of the stock, species such as chinook, coho and sockeye are released as smolts to increase the probability of survival in the wild.

The Alaska Salmon Enhancement Program

Beginning in the 1970s, the State of Alaska supported the development of numerous salmon hatcheries, with the goal of increasing and stabilizing Alaska salmon returns. State support of the Alaska salmon enhancement program was linked to the rapid rise in Alaska oil revenues following the discovery and development of oil on Alaska’s North Slope. The State supported hatchery development by loaning money to private non-profit organizations for hatchery construction and operation, as well as by building and operating State-owned hatcheries which were later transferred to private non-profit regional aquaculture associations.

Beginning in the 1980s catches of both hatchery salmon and natural wild salmon increased rapidly. In 2002, the total catch of hatchery fish was 45 million salmon, about one-third of the total Alaska salmon catch (Figure IV-1). The relative importance of hatcheries varies between different Alaska salmon species. During the period 2000-2002, hatchery fish accounted for 69 percent of Alaska chum salmon catches, 40 percent of pink salmon catches and 12 percent of catches of other species (Table IV-2). Hatchery fish accounted for about

Figure IV-1 Alaska Commercial Salmon Catches Since 1960: Natural Wild Salmon and Hatchery Salmon


3 The Alaska Department of Fish and Game’s annual reports on the Alaska Salmon Enhancement Program, available at www.cf.adfg.state.ak.us/geninfo/enhance/enhance.php, provide detailed information about the program.

4 Hatchery fish are identified in several ways, including coded wire tags, fin clips and otolith marking (a process by which an identifiable microscopic colored ring sequence in fish ear bones is created by exposing fish to a series of planned temperature changes).
28 percent of the total ex-vessel value of Alaska catches. The importance is highlighted by ADF&G: “The ocean ranching program provides hundreds of Alaskans with seasonal jobs. It is now considered the largest agricultural industry in Alaska” (Farrington, C., ADF&G,. 2004 p. 2).

The relative importance of hatcheries also varies between different areas of Alaska. In 2002, Southeast Alaska and Prince William Sound accounted for about 80 percent of hatchery catches (Table IV-4).

Certain Alaska fisheries are overwhelmingly dependent on hatchery salmon, including the Southeast Alaska chum salmon fishery, the Prince William Sound chum salmon fishery and the Prince William Sound pink salmon fishery. In other major fisheries, such as western Alaska sockeye salmon fisheries and the southeast Alaska pink salmon fishery, hatchery fish account for only a small share of total catches. Note that the two highest value species, chinook and sockeye, are less dependent on hatcheries. Part of the explanation is the health of the natural sockeye stocks in Alaska, and the relatively high cost and time it takes to raise chinook smolts.

Although hatcheries have clearly increased Alaska salmon catches, they have not stabilized catches. Salmon catches by region and in the state as a whole still vary greatly from year to year, even with hatchery programs, because hatchery fish are subject to the same ocean conditions as wild salmon. This is illustrated in Figure IV-2. During the period 1990-2005, Alaska hatchery releases of pink salmon were relatively stable, ranging between 800 million and 1 billion fish. During the same period, returns of Alaska hatchery pink salmon ranged from 15 million to 69 million fish. The percentage of fish returning varied from 1.7 percent to 7.2 percent.

Large numbers of hatchery fish are caught by commercial fishermen prior to their return to the hatcheries. Near hatchery sites, boats hired by the hatchery catch additional large numbers of fish in the so-called ‘cost recovery’ fishery. All the proceeds from this fishery go to the hatchery. Any remaining hatchery fish are left to mill around the hatchery and die. They are not ‘programmed’ with a stream in mind to return to. Although some may stray may find a stream and spawn in it, this is neither intended nor desired.

<table>
<thead>
<tr>
<th>Table IV-4</th>
<th>Alaska Salmon Catches by Species and Region, Hatchery &amp; Total, 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
<td><strong>Chinook</strong></td>
</tr>
<tr>
<td>Commercial catches of hatchery fish (000 fish)</td>
<td></td>
</tr>
<tr>
<td>Southeast</td>
<td>87</td>
</tr>
<tr>
<td>Prince William Sound</td>
<td>0</td>
</tr>
<tr>
<td>All other areas</td>
<td>1</td>
</tr>
<tr>
<td><strong>Alaska total</strong></td>
<td><strong>88</strong></td>
</tr>
</tbody>
</table>

| **Share of total hatchery catches, by species** | | | | | | |
| Southeast | 1% | 1% | 16% | 21% | 61% | 100% |
| Prince William Sound | 0% | 4% | 0% | 72% | 23% | 100% |
| All other areas | 0% | 15% | 2% | 81% | 1% | 100% |
| **Alaska total** | 0% | 6% | 4% | 64% | 26% | 100% |

| **Share of total hatchery catches, by area** | | | | | | |
| Southeast | 99% | 4% | 85% | 7% | 48% | 20% |
| Prince William Sound | 0% | 42% | 2% | 66% | 52% | 58% |
| All other areas | 1% | 53% | 13% | 27% | 1% | 21% |
| **Alaska total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

| **Total commercial catches (000 fish)** | | | | | | |
| Southeast | 372 | 787 | 2,986 | 45,612 | 6,294 | 56,051 |
| Prince William Sound | 40 | 2,282 | 650 | 18,950 | 6,373 | 28,275 |
| All other areas | 128 | 19,438 | 1,135 | 23,000 | 2,357 | 46,058 |
| **Alaska total** | **540** | **22,487** | **4,771** | **87,562** | **15,024** | **130,384** |

| **Hatchery share of commercial catches** | | | | | | |
| Southeast | 23% | 15% | 48% | 4% | 89% | 16% |
| Prince William Sound | 0% | 51% | 6% | 99% | 96% | 92% |
| All other areas | 1% | 8% | 19% | 34% | 4% | 21% |
| **Alaska total** | **16%** | **12%** | **35%** | **32%** | **79%** | **34%** |

Source: ADFG Hatchery Data.
Challenges for the Alaska Salmon Enhancement Program

The Alaska Salmon Enhancement Program consists of a variety of public and private sector salmon rehabilitation and enhancement projects. In 2002, these included 29 non-profit corporation hatcheries (by far the most significant component of the program), two state-operated hatcheries, two Federal or Bureau of Indian Affairs hatcheries and several streamside incubation and restoration projects (Farrington 2003).

The Alaska Salmon Enhancement Program has clearly succeeded in increasing total salmon catches, particularly in Southeast Alaska and Prince William Sound. However, the program faces a number of challenges which could affect the future scale of hatchery releases and thus total Alaska salmon catches, particularly of pink and chum salmon. Below, we briefly review these challenges.

Lower Prices

A fundamental problem for the Alaska Salmon Enhancement Program is that real (inflation-adjusted) prices have declined significantly since the start of the program, in particular for chum and pink salmon (Figure IV-3). As a result, investing in raising and releasing young salmon results in less of an increase in future catch value, for any given rate of ocean survival. In theory, we might expect that as prices decline the net economic benefits of hatcheries would decline, and at some point total hatchery releases would begin to decline. However, this has not yet happened to any significant extent. Hatchery releases of pink and chum salmon stopped growing in the mid-1990s, but have not shown any significant decline (Figure IV-4).

In order to understand the relationship between salmon prices and hatchery releases, we must review the structure of hatchery operations and how they are financed. Most salmon hatcheries in Alaska are now operated by private non-profit (PNP) organizations, most of which received initial funding from state grants and capital and operating loans, to be repaid from hatchery revenues. There are two categories of PNP organizations: independent PNPs and regional aquaculture associations.

Hatcheries may earn revenues to cover operating expenses and repay state loans in two ways. First, hatcheries are authorized to catch a percentage of the adult salmon returning to terminal “special harvest
areas” for sale. These are referred to as “cost-recovery” catches. Typically cost-recovery fish are caught by just a few boats, catching very large volumes, working under contract to the hatcheries in the special harvest areas. All other returning hatchery salmon are caught in “common-property fisheries” by commercial, sport and subsistence fishermen.

Second, in management areas with regional aquaculture associations, fishermen may vote to assess an “enhancement tax” on the ex-vessel value of their salmon landings. These enhancement tax funds also support hatchery operations. Enhancement tax rates are presently 3 percent in southeast Alaska and 2 percent in Prince William Sound, Cook Inlet and Kodiak. No enhancement taxes are assessed in other areas.

As ex-vessel prices have declined, enhancement tax collections have declined, so that the hatcheries have had to rely on cost-recovery catches for a greater share of their revenues. In addition, because prices are lower, hatcheries need to catch more fish in the cost-recovery fisheries to meet any given revenue target. As a result, as prices decline an increasing share of the hatchery returns have been caught in cost-recovery fisheries rather than by commercial fishermen in the common property fisheries. This trend is particularly evident for chum salmon, for which the cost-recovery share of catches increased from less than 30 percent in the early 1990s to more than 51 percent in 2003 (Figure IV-5).

As the cost-recovery share of hatchery catches increases, the share of the benefits captured by commercial fishermen (other than those few who participate in the cost-recovery fishing) declines. Put differently, an increasing share of the fish goes to support the hatcheries, rather than the original concept of increasing the total volume of fish available to all fishermen.

Increasing the share of hatchery fish going to cost-recovery harvests has allowed the hatcheries to continue to operate despite lower salmon prices. However, over time, this may create a political problem for the hatcheries, which depend upon enhancement taxes paid by fishermen on all catches—not just catches of hatchery fish—and which also depend upon the political support of commercial fishermen to address other issues which they face (discussed below).

In addition to covering their operating costs, hatcheries also need to make payments on the loans they have received from the State of Alaska’s Fisheries Enhancement Revolving Loan Fund. During the early 1990s, as ex-vessel prices declined, many hatcheries requested and received permission to reschedule loan repayments. As Alaska’s oil revenues have declined, the State is less likely to extend this kind of assistance should hatcheries face financial difficulties in the future.

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**Figure IV-3**  
**Average Real Ex-Vessel Prices for Alaska Chum and Pink Salmon, 1980-2005**

Source: ADFG Catch data. Adjusted for inflation based on Anchorage CPI.
Figure IV-4  Alaska Hatchery Releases of Pink and Chum Salmon Fry, 1980-2005

Source: ADFG Hatchery Data.

Figure IV-5  Hatchery Cost-Recovery Share of Alaska Hatchery Salmon Catches

Source: ADFG Hatchery Data.
Market Effects of Hatchery Production

As we discuss in future chapters, salmon prices are sensitive to total salmon supply. During the 1990s, fishermen in regions of Alaska without hatchery production—in particular areas of interior and western Alaska dependent on chum salmon—argued that increased hatchery catches were responsible for the disastrous decline in prices which they had experienced. More generally, the question began to be raised whether Alaska salmon hatcheries were actually increasing the total value of Alaska salmon catches, or whether the value of the increased harvests was being offset by corresponding negative effects on prices.

How much Alaska hatchery catches may have depressed Alaska salmon prices, or whether or not hatcheries have actually increased the total ex-vessel value of Alaska salmon catches (not to mention net economic value after subtracting costs of hatchery operations) is not an easy question to answer. As we discuss in subsequent chapters, salmon markets are complex and are affected by many factors. In addition, they are subject to structural change, so that the effects of a given volume of hatchery catches on prices may have changed over time.5

In the short-term, higher catches in a given region in any given year tend to lower ex-vessel prices in that year. Over the longer term, prices are driven by world supply and demand rather than supply and demand from any particular region. If, as with hatchery production, other regions have the ability to respond to higher prices by increasing production, then higher or lower production by a particular region will not necessarily affect long-term world prices.

In general, it seems likely that Alaska hatchery production has had some negative effects on ex-vessel prices of chum and pink salmon, but that hatcheries are not the only factor contributing to lower prices. Clearly, hatcheries have benefited fishermen and processors in some areas (primarily Prince William Sound and Southeast Alaska) by greatly increasing catches. At the same time, hatcheries have not benefited, and may well have harmed, fishermen and processors in other areas without hatchery production. Thus, the Alaska salmon hatchery program has at times been an issue between different regions of Alaska.6

Roe “Stripping” or “Salvaging”

A particularly contentious issue associated with the Alaska salmon hatchery program has arisen as a result of declining prices for fresh, frozen and canned salmon while prices for salmon roe have remained strong. In some years the value of fresh, frozen and canned products have fallen below the costs of processing, particularly for lower-quality “dark” salmon caught in hatchery terminal areas after they have begun to undergo physiological changes associated with return to fresh water, and when unexpectedly large returns exceed local processing capacity. For these fish, the most economically profitable utilization is to extract the salmon roe but to dispose of the salmon carcass.

Normally, it is illegal to dispose of salmon harvested in Alaska without utilizing the fish, under a State law which bans the “waste” of commercially harvested fish. However, in some years hatcheries and processors have applied for exemptions from this law and have received permission to grind up and dispose of salmon carcasses at sea, after first removing valuable salmon roe. This practice is commonly referred to as “roe-stripping” or “roe-salvaging” depending on one’s perspective on it.

This “dumping” of salmon has been strongly criticized by some segments of the Alaska salmon industry and the public who have argued that it is immoral to waste fish and that the “stripped” or “salvaged” roe competes unfairly with other roe production. Others have responded that utilizing the valuable salmon roe is better than the alternative of not harvesting the fish at all, in particular since returning hatchery fish provide no ecological benefit and large volumes of dead fish in hatchery terminal areas would pollute these areas.

One example of this issue occurred during the 2003 pink salmon season in Prince William Sound, when 49 million pink salmon were caught after a preseason harvest projection of 27 million fish. More than 4 million pink salmon (about 8 percent of the Prince William Sound pink salmon catch and about 3 percent of the total Alaska pink salmon catch) were ground and “recycled” after the eggs were removed (Tkacz 2003).

When low prices or lack of processing capacity lead to the disposal of hatchery fish after roe extraction, it usually contributes to adverse publicity for the salmon hatchery program and questioning whether the hatchery production is needed—adding to the other political issues faced by hatcheries.7

Effects of Hatcheries on Alaska Natural Wild Salmon

To minimize potential adverse effects of hatchery releases on natural wild runs, the State has established an extensive regional planning process for salmon enhancement and set strict conditions for egg collection, fish transport and release and management

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5 Market effects of the Alaska hatchery program were addressed by Boyce et al. (1993) and Herrmann (1993). These analyses were critiqued by Wilen (1993).

6 A different market-related issue is whether hatchery sales of cost-recovery catches may depress prices paid to local fishermen for both hatchery and natural wild fish caught in common property fisheries.

7 In an Anchorage Daily News article, a Prince William Sound fisherman who is a former chairman of the Alaska Seafood Marketing Institute was quoted as commenting: “It’s just disappointing. . . We’ve got the mother of all runs, and we can’t sell all of the fish. I’m worried. I’m worried that some fishermen and legislators in other areas might think it’s a mistake to be generating these pink salmon, but we’re pretty grateful for them around here for all the opportunity they create. Nobody anticipated this kind of return. We should not do anything knee-jerk about occasionally having overproduction.” (Loy 2003).
of enhanced stocks. Hatcheries may only use eggs collected originally from local wild salmon stocks.\(^8\)

However, as in other areas, some critics still question whether the Alaska salmon hatchery program may adversely affect Alaska’s natural wild salmon runs. One concern relates to the potential for competition for food between hatchery salmon and natural wild salmon, both for juvenile fish in near-shore waters as well as in the open ocean.

Another set of issues relate to the management of commercial fisheries in which fishermen are catching mixed stocks of hatchery and natural wild salmon. If large returns of hatchery fish are mixed with depleted runs of natural wild fish, there is the potential for over-harvests of natural wild fish runs.

Another concern relates to the “straying” of returning hatchery fish into streams with natural runs of wild salmon, with the potential for genetic change in the natural wild salmon populations. For all of these concerns, the scientific complexity of the issues, together with lack of data and research, makes it difficult to determine how serious the potential problems associated with the hatchery program may or may not be.\(^9\)

**“Wild” Image of Alaska Salmon**

An issue which may grow in importance over time is the effect of Alaska’s salmon hatchery program on the “wild” image of Alaska salmon fisheries. The salmon farming industry has been subject to growing criticism over alleged adverse environmental effects as well as market effects on wild salmon fisheries. As we discuss in later chapters, the argument has been made that because of these alleged adverse effects of farmed salmon, consumers should favor wild salmon over farmed salmon. Over time, some salmon farmers may respond to these criticisms by pointing out problems associated with wild salmon. One response is likely to be that not all Alaska salmon are fully “wild,” and that there are environmental and market issues associated with hatchery salmon as well as farmed salmon.\(^10\)

If this caused Alaska’s hatchery program to become a concern for some consumers in the future, it could possibly reduce political support within Alaska for the hatchery program.

It should be noted that Alaska chum salmon, which account for by far the largest share of United States consumption of fresh and frozen Alaska wild salmon, is also the species most dependent on the Alaska hatchery program.

**The Future of the Alaska Salmon Enhancement Program**

The issues discussed above are the subject of an intense and long-running political debate about the Alaska salmon hatchery program, between supporters of the program and those who argue for substantially scaling back hatchery releases. The debate is not widely understood outside of Alaska or the salmon industry.

A series of special studies and task forces and special studies have examined the issues related to hatcheries, and at various times proposals to limit hatchery production have been debated before the Board of Fisheries. In 1991, a committee of the Alaska Senate undertook a special review of fisheries enhancement in Alaska, in order to “assemble and analyze information about the program and the global context in which it operates,” and to “serve as the first step in ensuring that current and future enhancement efforts will be economically and biologically sound, while fulfilling the goals for which the program was established” (Alaska State Senate 1992). In 1996, a “Hatchery Policy Group” was appointed to review and make recommendations on state-wide hatchery production policy and hatchery loan policy (Gardiner 1996). In 2002, the Alaska legislature established a Joint Legislative Salmon Industry Task Force to review issues facing the salmon industry and make recommendations to the legislature. The Task Force formed a number of subcommittees, including a ‘Hatchery Subcommittee’ which was charged with examining Alaska hatchery policy issues.\(^11\)

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\(^8\) See McGee (1995) for a useful review of the planning process and state policies related to the hatchery program and protection of wild salmon.

\(^9\) These concerns were summarized in Environment and Natural Resources Institute (2001): “Alaska’s ocean-ranching salmon hatcheries operate amidst considerable uncertainty. Perhaps the most striking feature uncovered by this review was the many gaps in the scientific data from which one could fairly draw conclusions of the effects hatcheries may or may not have on wild salmon. Alaska has been successful in augmenting salmon harvest with hatchery-produced fish, but whether or not salmon biodiversity has been adequately protected in the process is unanswered. . . . With respect to fish-culture practices, Alaska’s hatcheries are among the best in North America. . . . Given the late date at which Alaska’s ocean-ranching program was established, the state was able to benefit from mistakes made elsewhere. The program started on better footing by having genetic oversight of operations through fish transport permits, hatchery siting, egg takes, broodstock development, etc.” Nevertheless, the report concluded that, as a result of mixed-stock management issues, competition for resources between hatchery and wild salmon stocks, and potential effects on genetic diversity of wild salmon populations, “industrial-scale hatchery salmon production . . . could be jeopardizing Alaska’s wild salmon.”

\(^10\) Dodd (2003) suggested that “the fish which the hatcheries produce for commercial fishermen undoubtedly eat sizeable quantities of prey species as they move up the feed chain towards harvest time, prey that would otherwise be available to truly ‘wild’ fish.” Another example is provided by an article posted on the website of the Washington Fish Growers Association (www.wfga.net): “Salmon farming vs. salmon ranching is another interesting issue that likely doesn’t make its way into the ‘wild is good, farmed is bad’ marketing campaign. In order to help maintain its commercial fishery, and enhance wild fish stocks, Alaska decided to forego the salmon farming route and do salmon ranching instead. Salmon ranching is a lot like salmon farming. Fish are raised in ocean-based pens, fed a steady diet of processed food (purchased in British Columbia, interestingly enough, and consumed at nearly six times the rate used in British Columbia fish-farm operations), fed some dyes important to their health and colour, also antibiotics. When they’re big enough, they get them go, Alaska releases more than 1.5 billion “ranched” fish into the waters every year, and they happily swim away, competing for food with their natural-born cousins, and eventually get caught (along with the ‘wild fish’) in the commercial fishery. . . .”

\(^11\) Information about the activities of the Task Force, including proposed legislation developed by the task force, was posted on the website of the United Fishermen of Alaska, at www.uaft-fish.org/taskforce/.
Earlier task forces and studies have not resulted in major changes to the Alaska’s hatchery program policies or the scale of hatchery releases. However, the underlying political issues remain and the debate over the program continues, even expanding into new fora. With the Marine Stewardship Council’s (MSC) certification of the Alaska salmon fishery as a sustainable fishery (see Chapter XVI for a more thorough discussion), one of the concerns brought up in the certification process in 2000-2001 was the hatchery program. In particular, the assessment team was concerned about the lack of research on the potential effects of salmon hatcheries on the wild stock gene pool and reproductive fitness (Scientific Certification Systems 2000). This concern remained in 2005 as the Alaska salmon fishery entered its new five-year assessment for re-certification under the MSC program.

It is possible that Alaska hatchery salmon releases and catches could decline significantly in the future due to lower economic return of hatcheries and/or changing political circumstances. It is difficult to predict whether such a decline will in fact occur or when it might occur. It could be that hatchery salmon—as opposed to natural wild salmon—would be most affected by changing economic circumstances in wild fisheries.

The British Columbia Salmonid Enhancement Program

In 1977, in response to declining British Columbia salmon runs, the Canadian federal Department of Fisheries and Oceans (DFO) launched a Salmonid Enhancement Program (SEP). The program included both the construction of hatchery facilities as well as a variety of other habitat enhancement projects such as spawning channels, incubation boxes and lake enrichment.

DFO estimates that about 10-20 percent of the British Columbia sport and commercial salmon catch originates from SEP projects, and about a dozen terminal fisheries are dependent on enhanced stocks (DFO 2000a). A terminal fishery is one that occurs at the place where the hatchery salmon were released into fresh water.

In a 2000 review of the Salmonid Enhancement Program, the Pacific Fisheries Resource Conservation Council (PF RCC 2000; DFO 2000b) concluded that:

In hindsight, it is difficult to say whether the Salmonid Enhancement Program and its predecessors, which have accounted for close to a half-billion dollars in public investments over the years, have produced any net return on investment, if measured by a net gain of salmon. There is evidence to suggest a net loss of wild salmon abundance, directly and indirectly because of enhancement initiatives. . .

The Council’s review of the Salmonid Enhancement Program leads inevitably to the conclusion that some facilities created by it have resulted in the displacement of wild salmon by hatchery-produced fish. This has occurred when hatchery salmon have attracted fishing effort that unavoidably produced unsustainably high rates of harvest on co-migrating wild salmon. It has also occurred because juvenile fish from wild populations have been subjected to competition from hatchery fish in rearing areas, and in the ocean phase of the salmon life cycle.

Declines in numerous wild-salmon populations, concurrent with increases in production from a few large hatcheries, tend to create a situation in which salmon abundance is attributable to ever-fewer stocks. This places the salmon resource at an increasingly greater risk of random, catastrophic disruption.

History of Salmon Hatcheries in the U.S. Pacific Northwest

Hatchery techniques for the artificial propagation of Pacific salmon were developed for the first time in Canada around 1857 and soon spread to the United States (Bardach et al. 1972).

The construction and operation of the first hatcheries for Pacific salmon in the United States began on the McCloud River in northern California in 1872 and in 1877 and 1878 on the Clackamas and Rogue Rivers in Oregon (Atkinson 1988). In 1883, the first Canadian hatchery for Pacific salmon was built at Bon Accord (near New Westminster, British Columbia) on the Fraser River (PCSF 2004). The first hatchery in Washington State was built on the Kalamia River in 1895 (WDFW 2004). Four years later, the Washington Department of Fish and Wildlife began the construction of salmon hatcheries in the mid-Columbia River region, on the Wenatchee and Methow Rivers (Wahle and Pearson 1984).

Hatcheries were originally built to reverse the trend of declining populations of wild salmon and to compensate for land use decisions that permanently altered large areas of fish habitat (WDFG 2004). Emphasis was initially placed on chinook and coho salmon despite an incomplete understanding of the complex life history of these species. Hatcheries propagated and stocked salmon for many years without concrete evidence of the success and long-term implications of their efforts.

Large-scale construction of salmon hatcheries began in 1938, when Congress passed the Mitchell Act to provide federal money for construction of hatcheries as a way of replacing the thousands of acres of salmon spawning grounds that were blocked or flooded behind dams. Subsequently, more than 80 hatcheries were built in the Columbia River basin (Novak 1998).

Currently, the State of Washington has one of the largest artificial propagation systems in the world, with
a hatchery program that operates 24 complexes with 91 rearing facilities. Together they raise and release more than 201 million Pacific salmon, 8.5 million steelhead (salmon) trout and 22.6 million trout and warm-water fish (Maynard and Flagg 2001). Hatchery-bred fish help support the State’s $850 million per year sportfishing industry (The Wave News Network 2004).

A group called the Hatchery Review Group unveiled a new blueprint for the State of Washington’s hatchery programs on April 23, 2004 (The Wave News Network 2004). The blueprint cost $28 million to write and has more than 1,000 recommendations for improving the large salmon hatchery system. Examples include closing some hatcheries that are especially detrimental to wild stocks, and limiting the number of hatchery fish released so that they do not over run wild stocks protected under the Endangered Species Act.

In addition, the state has 12 federal hatcheries and 35 tribal rearing facilities which produce another 50 million salmonids for release. In Oregon, the Department of Fish and Wildlife operates 34 hatcheries and 15 other rearing facilities, which release about 43 million Pacific salmon, 5.7 million steelhead (salmon) trout and 8.3 million trout. California has eight salmon and steelhead (salmon trout) hatcheries.

Depending on species and area, the salmon enhancement programs in the U.S. Pacific Northwest produce as much as 70 to 90% of salmon harvested in the commercial and recreational fisheries.

The potential for hatchery salmon to affect wild stocks went unrecognized for many years. Between the mid-1950s and early 1970s, scientists found increasing evidence that hatchery salmon was harming the remaining wild salmon runs. It seems clear now that hatcheries have had demographic, ecological and genetic impacts on wild salmon populations.

These effects include the reduction of genetic diversity within and between salmon populations, creation of mixed-population fisheries, altered behavior of fish, ecological imbalances due to the elimination of the nutritive contribution of carcasses of spawning salmon from streams, and the displacement of the remnants of wild runs (NRC 1996). As Hilborn (1992) notes:

Large-scale hatchery programs for salmonids in the Pacific Northwest have largely failed to provide the anticipated benefits; rather than benefiting the salmon populations, these programs may pose the greatest single threat to the long-term maintenance of salmonids... I argue that hatchery programs that attempt to add additional fish to existing healthy wild stocks are ill advised and highly dangerous.

As a result, academic, environmental and salmon advocate groups have proposed a redesign of the traditional objectives of hatchery management, which needs to shift away from producing more fish for harvest towards providing a means for the recovery and conservation of wild salmon populations (LLTK 2004; NRC 1996).

It is worth noting that there have been a few attempts at private salmon ranching, such as Ore Aqua Foods, a subsidiary of Weyerhaeuser and Anadromous Inc., a subsidiary of British Petroleum, both operating in Oregon during the late 1970s and 1980s. Private salmon ranching is based on the premise that smolts released from the private hatchery will return and will be captured by the “owner” of the fish. These have been unsuccessful primarily because ocean mortality is high and uncertain, and property rights related to salmon released to the ocean are poorly defined. In addition to these problems, salmon enhancement (public or private) may undermine the management of wild stocks through direct and indirect competition.

The 2005 Atlas of Pacific Salmon summarized the breadth and complexity of the issues related to salmon hatcheries in the U.S. Pacific Northwest and elsewhere.

The benefits of hatcheries are compelling: they may offset losses in abundance in naturally spawning stocks and reduce harvest pressure on wild populations; they help stabilize commercial harvest; and they serve as laboratories for the study and preservation of biodiversity. Hatcheries also provide a solid economic base for salmon-dependent communities, including native peoples.

Yet these benefits are counterbalanced with significant scientific uncertainty regarding freshwater and ocean carrying capacity, particularly within a trans-Pacific context... Interbreeding and brood stock transfer among rivers can challenge wild population viability and genetic integrity. Hatchery production can mask ecological problems at the heart of declines in wild populations. Artificial propagation can deprive rivers of marine-derived nutrients... essential to functioning freshwater ecosystems. Unfortunately, isolating impacts of hatchery fish on wild populations is extremely difficult, and so efforts to determine hatchery success or failure remain inconclusive.

Two legislative debates—whether to count hatchery fish under endangered species legislation... and whether to allow surplus hatchery fish to spawn in the wild—have fumigated in recent years, underscoring the fact that hatchery management is among the most controversial issues in fisheries today.
References


Traffic North America 55


http://wdfw.wa.gov/hat/overview.htm


The World Salmon Farming Industry

Key Points

- The origins of salmon farming can be traced back to fertilization trials in Europe in the second half of the eighteenth century. Hatcheries were established one century later in both Europe and North America. Hatchery-based enhancement programs were introduced at a significant scale only after the 1950s in Japan, the USSR, United States and Canada. The modern techniques of salmon culture in floating sea cages were initiated in Norway in the late 1960s.

- By the 1980s and 1990s, commercial salmon farming was well established in many temperate countries around the world (Norway, Scotland, Chile, Canada, etc.). In 1996, salmon aquaculture overcame the salmon fishing industry as the most important supplier of salmon products worldwide. By 2004, global production of farmed salmon exceeded wild harvests by more than one million metric tons (mt).

- There is little potential for further growth in countries such as Scotland and Ireland. Excessive regulatory pressure and conflicts with user groups also limit development in the United States and Canada. Salmon farming appears to have the brightest future in Chile due to ideal environmental conditions and a favorable business climate. Average annual growth rate of the industry between 1984 and 2004 was 42 percent (FAO 2006).

- The United States has developed advanced hatchery and marine growout technologies but ocean-pen production accounts for less than 1 percent of global supply. Alaska placed a permanent moratorium on private, for-profit farmed salmon and salmon trout in 1988, but still allows enhancement programs, which account for a large share of its harvest.

- Increased supplies have generally resulted in falling prices. These low prices appear to have created more problems for the traditional fisheries than for farmed producers since the latter have managed to reduce production costs and improve marketing while the traditional salmon sector has been slow to adjust.

- Transgenic technologies offer new opportunities and new challenges for expansion of the industry.

Introduction

The culture of salmonids (particularly Atlantic salmon, Salmo salar and salmon trout (Oncorhynchus mykiss)) is one of the most important examples of commercially successful intensive aquaculture in the world. It is a demonstration of what can be achieved through conscious investment, innovative research, technological advances and creative marketing strategies. At the same time, it has served to illustrate the dangers of rapid development and depressed prices that result when market capacity to absorb increasing supplies is exceeded.

Of the several salmonid species (including all salmon species and salmon trout) cultured for commercial purposes worldwide, Atlantic salmon is by far the most important. Its native range is the North Atlantic, from New England to Ungava Bay in Canada in the west, Iceland, Greenland and from northern Portugal to the Kara Sea off Russia on the east (Laird, 1996). Its potential for farming is excellent since it is relatively easy to handle, it grows well under culture conditions, it has a relatively high commercial value and it adapts well to farming conditions outside its native range.

Of the five Pacific salmon species that are commercially caught in North America —pink, chum, sockeye, coho and chinook —only coho and chinook are valuable enough for salmon farming. Pink and chum are low value and thus not attractive to salmon farmers. Sockeye salmon is less adaptable for farming because it has lower growth and survival rates, it has a lower fillet yield and it is more susceptible to stress leading to poor product quality. In addition, much less
research has been conducted on sockeye salmon aquaculture as compared to species such as Atlantic salmon. Salmon trout (Oncorhynchus mykiss) is also commercially important, can be farmed in freshwater or seawater installations and is often also referred to as “steelhead trout” or “rainbow trout.”

The preliminary sections of this chapter will provide a brief review of the major steps involved in modern salmon aquaculture (primarily based on Willoughby 1999). For the rest of the report, farmed salmon will be considered as including both salmon and salmon trout.

Subsequently, an historical account of salmon ranching and net-pen culture development in different regions of the world is provided. Production trends will be reviewed for each major producing country and the industry as a whole as potential for further expansion.

The chapter ends with a brief summary of the major factors that have contributed to the remarkable growth of the industry, some of the major issues surrounding the use of commercial salmon feeds and the potential role of biotechnology in the future of salmon farming.

From egg to market size

The production of salmon in intensive aquaculture recreates the life cycle of the species in a protected environment. As such salmon farming consists of both a freshwater and a marine phase. The freshwater phase encompasses the spawning cycle, egg production, hatching and first-feeding stages. As the fry develop, they turn into fingerlings and finally grow to become smolts. At this point the fish have become physiologically adapted to seawater conditions. Hatchery fish are released from the hatcheries at or slightly before this stage, as discussed in Chapter IV.

In the second phase, smolts are transferred to the marine environment, reared to market size and harvested. If the fish develop into sexually mature adults in their first year at sea, they are known as grilse. Grilse are graded out and harvested before maturity because their flesh is of inferior quality. The remaining salmon are allowed to grow to market size, generally 3-5 kg and above.

Adult fish with outstanding features are selected and managed as the broodstock—stock from which eggs and milt are taken. The general goal of the breeding programs is to transmit the desirable traits of the broodstock to the offspring generation.

Broodstock management: In contrast to managing hatcheries for enhancement purposes, broodstock management for fish farms has different objectives. Broodstock are subject to two types of selection, depending on the characteristics of the desirable trait. Individual (or phenotypic) selection is conducted when emphasis is placed on external characteristics (size and skin color) or performance (growth rate). For this type of selection, the number of broodstock should be kept fairly high, with a minimum of 50 or more for each sex (Gjerde 1993). Selection of desirable traits such as disease resistance or harvest quality is done through a more difficult method known as family selection, which requires careful monitoring and marking. To maximize reproductive success, broodstock should always be maintained under carefully controlled conditions and fed a special diet with vitamins and minerals.

The hatchery: The hatchery phase is probably the most technically demanding, requiring a high degree of organization and planning. The objective of this portion of the cycle is to maximize the yield of quality fry for rearing to smolts with a survival rate of more than 90 percent. Survival under natural conditions is considerably lower (around 0.12 percent for Atlantic salmon), because predation by larger animals occurs at much higher rates. After hatching, the young fish feed on the contents of their yolk sac for several weeks and are called yolk-sac fry or alevins. On a dry-weight basis, the yolk makes up about 75 percent of the alevins’ weight. At about four to six weeks after hatching, the yolk-sac has been almost totally consumed and the alevins are generally developed enough to start feeding. Starter diets formulated with feed ingredients, such as freeze-dried fishmeal and fish oils, give rapid growth.

Fry and fingerling development: When the alevins begin to feed they are known as fry. During this phase, growth is rapid and the fish can increase body weight by five to seven percent each day. As they develop, fry become more accustomed to solid feed and increase their activity. When the fry are sufficiently developed, they are transferred into larger tanks. Once fry reach an average weight of about five grams, they are known as fingerlings. Fingerlings display characteristic ovoid stripes along their flanks.

Smolt production: Once the larger fingerlings are sufficiently developed, they will undergo major physical and physiological changes to become smolts. These changes mark the transformation from freshwater fingerlings to seawater fish (Fitzgerald et al. 2002). The smoltification process involves changes in most organ systems, both morphological (silvery color), physiological (ATPase activity) and behavioral (swimming with the current), which will allow the fish to survive, grow and develop normally in the marine environment.

Growout phase: Smolts are transported from the smolt production facility to the growout site in specialized tanker trucks or wellboats. Growout is primarily conducted in the sea in nets, which are supported by some type of floating structure. If cages are placed in
sheltered fjords and bays, designs do not need to be particularly strong. However, expansion of the industry in most countries will involve installation of farms in more exposed sites with stronger currents, which obviously requires cages of a more solid construction. Today, most marine salmon cages have galvanized steel or plastic frames. Cage size has increased over the decades as a result of health and financial considerations. Volumes are now likely to be several thousands of cubic meters, compared with less than 100 in the early days of the industry (Myrseth 1993).

**Use of Antibiotics in Fish Feed**

There has been a significant amount of discussion concerning the use of antibiotics in salmon feed. There are several concerns, including the concerns of antibiotic residues in the salmon flesh that might affect consumers’ health as well as antibiotics that are either passed through the fish into the environment or go directly into the environment through uneaten feed. Figure V-1 shows the antibiotic use in Norwegian salmon and salmon trout aquaculture from 1980 through 2001. The levels of use were highest in the late 1980s, and have dropped precipitously since then. We do not have similar data for Chilean or Canadian aquaculture.

**Historical development of salmon farming**

The general life history of the Atlantic salmon was first described by Hector Boece, the first Principal of the University of Aberdeen (UK) in 1527 (Laird 1996). The first fertilization trials for Atlantic salmon took place in Germany in 1763 (Francis 1865) and were later refined by biologists in Scotland and France.

In the second part of the nineteenth century the techniques of artificial fertilization and incubation of salmon eggs were well developed and soon thereafter hatcheries were established in both Europe and North America. This development was motivated by the recognition that natural stocks of salmon were in decline (Thorpe 1980) and the desire to introduce salmon and trout outside their native ranges.

The history of salmon aquaculture is shown in Table V-1. Beginning in 1976, with the enactment of the 200-mile-limit fishing zones and other constraints to high seas salmon fishing, Japan began promoting hatchery programs and aquaculture development. By the late 1990s the hatchery-based salmon harvest represented approximately 80 percent of Japan’s total salmon production.

![Figure V-1](image-url)

*Source: Norwegian Institute of Public Health; data provided by Sigbjørn Tveten, University of Stavanger, Norway.*
In the United States, private salmon ranching was attempted in California (only one salmon ranch received a permit) and Oregon. Salmon ranching is essentially private stock enhancement where the ranch attempts to make profits from the returning salmon which escape the fishery and natural mortality. Anadromous, Inc. (started in 1974; controlling interest purchased by British Petroleum) and Oregon AquaFoods (started in 1974; purchased by Weyerhauser in 1975) were the most significant operations in Oregon under way by 1980 (R. Mayo and C. Brown, The Mayo Associates, Seattle, Washington, unpublished manuscript). All private salmon ranching in the United States was discontinued by the early 1990s.

While public salmon enhancement programs were growing, private pen-raised salmon began to emerge throughout the world. Salmon aquaculture was originally devised by Danish farmers as a system of earthen ponds for the rearing of the freshwater rainbow trout during the 1890s. The technique was quickly adapted in neighboring Norway but the system failed because of the lower water temperatures that resulted in a shorter growing season (Willoughby 1999).

However, it was soon realized that the seas around Norway, warmed by the influence of the Gulf Stream, would be more suitable than freshwater. This warm oceanic current allows year-round growth of fish as far north as 70º latitude.

Rainbow trout was first reared in seawater in Norway in 1912 but production at a commercial scale did not occur until the 1960s and early 1970s. Production peaked in 1974 at 2,200 mt but quickly declined thereafter due to low prices. Farmers then turned to Atlantic salmon, which was fetching a much higher price at the time (around 27-32 Norwegian kroner (NOK) per pound or US$4-4.5 per pound) (Willoughby 1999).

By 1969, the Grønvedt brothers had already begun growing Atlantic salmon on the Island of Hitra, Norway, in floating net pens (Edwards 1978). Systems

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**Table V-1  Milestones in the salmon aquaculture industry**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1857</td>
<td>First hatchery propagation of Pacific salmon.</td>
</tr>
<tr>
<td>1950s-1960s</td>
<td>USSR, Japan, United States and Canada begin enhancement programs.</td>
</tr>
<tr>
<td>1960s</td>
<td>Norwegian salmon aquaculture emerged.</td>
</tr>
<tr>
<td>1974</td>
<td>Private, for-profit salmon ranching starts in Oregon.</td>
</tr>
<tr>
<td>After 1976</td>
<td>Japan chum hatchery increases rapidly.</td>
</tr>
<tr>
<td>1979</td>
<td>Norway, United States, Canada, Chile, Japan and Scotland have emerging salmon farming industries.</td>
</tr>
<tr>
<td>Late 1970s-1980s</td>
<td>North American and Japanese hatchery programs grow significantly.</td>
</tr>
<tr>
<td>1980</td>
<td>World farmed salmon production accounts for about 1% of world salmon supply.</td>
</tr>
<tr>
<td>1983</td>
<td>World farmed salmon production exceeds world wild chinook salmon harvest.</td>
</tr>
<tr>
<td>1986</td>
<td>World farmed salmon production exceeds combined world wild chinook and coho salmon harvest.</td>
</tr>
<tr>
<td>1990</td>
<td>World farmed salmon production exceeds combined world chinook, coho and sockeye salmon harvest.</td>
</tr>
<tr>
<td>1991</td>
<td>World farmed salmon production exceeds Alaskan salmon harvest (all species).</td>
</tr>
<tr>
<td>1992</td>
<td>World farmed salmon production accounts for ~ 46% of world salmon supply; all U.S. private, for-profit salmon ranching has failed.</td>
</tr>
<tr>
<td>1996</td>
<td>World farmed salmon production exceeds combined harvest of all wild salmon species. Atlantic salmon dominates pen-raised production.</td>
</tr>
<tr>
<td>1996-2004</td>
<td>Increasing market development with farmed salmon as the leader. International prices and production costs continuously decline. Increasing criticism of salmon enhancement programs. Chile and Norway establish record production levels in 2004 with a joint production of nearly 1.2 million mt (round weight). Gap between world aquaculture production and wild combined harvests widens.</td>
</tr>
</tbody>
</table>

Source: Anderson 1997
of sea enclosures and floating sea cages were refined in the early 1970s and the industry soon began to be profitable. By 1972, there were five farms producing a total of 46 mt in Norway and by 1980, there were 173 farms producing a total of 4,300 mt (Heen et al. 1993).

The Norwegian industry began a period of impressive growth but license restrictions on farm size imposed by the government in subsequent years effectively drove investment and expansion overseas. As a consequence, net-pen salmon farming is today also well-established in Scotland, Ireland, Chile, Iceland, Canada, the United States and Australia.

The combination of suitable environmental conditions and pro-business governments in these locations, as well as the expansion of international trade during the 1980s and 1990s, made salmon farming the most important source of salmon products in the world today.

Global farmed salmon production exceeded the world’s total commercial harvest of wild and ranched coho and chinook salmon by the mid-1980s; it exceeded the world’s combined production of coho, chinook and sockeye salmon by 1990; and it exceeded all commercial harvests of wild salmon by 1996 (Table V-1). Global production of farmed salmon and salmon trout exceeded wild harvests of salmon by more than one million mt in 2004 and the gap is expected to widen in forthcoming years (Figure V-2). The development of the pen-reared salmon industry in the major producing countries is further discussed below.

### Development in Europe

#### Norway

The salmon industry developed rapidly in Norway in the last three decades, reaching a total value of over US$1.5 billion in 2004 (FAO 2006). Instrumental to this success was the decisive support of the government in terms of research and development programs, particularly in the early years of the industry’s development. More recently, research and development by the private sector, especially the feed and pharmaceutical firms, has been essential to continued productivity gains.

Figure V-3 shows the contribution of Norway to the global supply of farmed salmon. Leading world production of Atlantic salmon since the late 1960s, Norway became the most important producer of farmed salmon in 1984. Reaching more than 600,000 mt in 2004, production has grown at annual average rate of 17 percent between 1984 and 2004 (FAO 2006).

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**Figure V-2** World Production of Salmon and Trout: Capture Fisheries vs. Aquaculture

Source: FAO (2006)

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1 Figures V-2 and V-3 include all species of salmon and trout reared in marine and freshwater environments.
The sheltered fjords and islands along the Norwegian coast provide excellent hydrographical conditions for the rearing of Atlantic salmon. The industry also benefited from substantial governmental investment in the development of a complex infrastructure of roads and rail links along the coast.

In 1970, production of Atlantic salmon was only 480 mt but it rose to 49,000 mt by 1986. Fearing that a few large companies would dominate the industry, the government set up a licensing program that limited farm size to a maximum of 8,000 m³ of rearing volume. This limit was increased to 12,000 m³ in 1989, with a maximum fish density of 25 kg/m³ (Willoughby 1999).

The industry suffered the consequences of its own success in the early 1990s as overproduction led to a sudden downfall in prices. Many small farmers went bankrupt and the industry had to be reorganized in order to cope with the new market conditions (Hjelt 2000). New laws introduced in 1991 relaxed local ownership and made it possible for a farmer to own several farms.

This was the first indication of consolidation in the industry, marking the beginning of vertically integrated production, i.e., the control and/or ownership over the various production stages: hatchery, smolt production, growout and processing.

The new aquaculture laws and market pressure led to a tremendous decrease in the number of salmon and trout farming companies in the country, from approximately 1,100 in 1990 to 270 in 1998. It is now recognized that this consolidation process has allowed the Norwegian farming industry to retain its highly competitive profile in today’s global market (Forster 2002).

Scotland

Salmon farming began in Scotland in 1966 with the experimental culture of sea-caged rainbow trout by Marine Harvest Ltd. Development was slow during the initial years but it accelerated during the latter half of the 1980s thanks to the financial support programs from the European Community (Integrated Development Program) and the Highlands and Islands Enterprise Council (Willoughby 1999). Development was more rapid in the Western Isles (Shetland) because of the exceptional growing conditions, similar to those found in Norway.

Although there was always a transfer of culture technologies, managerial skills and genetic material...
from Norway to Scotland, the Scottish industry did not evolve in the same way as did its counterpart in Norway. To operate within a certain area, Scottish farmers are required to obtain leases from the Crown Estate Commissioners, the government entity that regulates use of coastal zones in most of the UK.

However, there are not licensing systems restricting farm size or multiple ownership of farms. As a result, for many years the average Scottish farm was larger than the corresponding Norwegian farm. Also, vertical integration occurred much earlier in Scotland and by the early 1990s most of the Scottish farms were owned by multinational corporations (Hjul 1994).

Production has been increasing steadily over time (Figure V-3), reaching nearly 175,000 mt in 2004 (FAO 2006). However, the industry has suffered its share of setbacks, particularly in the early 1990s. Overproduction during these years led to bankruptcy for several farms because of very low salmon prices.

By the time prices recovered and the industry found itself again in the doorsteps of expansion, the oil tanker *Braer* spilled over 85,000 tons of crude oil off the coasts of Shetland. Because of the resulting pollution, the Shetland Salmon Farmers Association and the International Oil Pollution Compensation Fund agreed to destroy the entire smolt generations of 1991 and 1992. Disease problems (sea lice and furunculosis) as well the shortage of suitable sites have constrained further development of the industry in recent years.

The first farm in Scotland, Marine Harvest Ltd., founded by the Anglo Dutch multinational Unilever, was for many years the leading farmed salmon producer in the world. Because of financial difficulties it was sold first to the minerals conglomerate Hanson, then to Booker McConnell’s salmon farming company, to be finally bought by the multinational Dutch feed supplier Nutreco in 1999 (Roberts 2000). In April 2005, MHM-Nutreco merged with Stolt Sea Farm (a Norwegian fish farming group). The resulting company, Marine Harvest, was bid for by Pan Fish, another Norwegian fish farming company, in March 2006. If allowed to go forward by the Norwegian government, Pan Fish-Marine Harvest would be the largest salmon farming conglomerate in the world.

**Ireland**

The salmon farming industry started with experimental culture in sea cages around 1975. As in Scotland, the industry developed in the 1980s due to heavy investment from the European Community and Norwegian entrepreneurs. The local government has also been very supportive, providing funding for a myriad of research and grant-aid programs (Willoughby 1999).

Production increased from 600 mt in 1980 to 25,000 mt in 2002; however, production declines were recorded in 2003 and 2004 (FAO 2006). The industry is mostly concentrated in the west and south-west coastlines; however, sheltered sites are not as numerous as in Norway and Scotland. The only direction for further expansion of the industry appears to be offshore but this will require continued development in cages that can withstand extreme hydrographic conditions.

Decimation of the native sea trout population (*Salmo trutta*) by sea lice perceived to be associated with salmon farms has resulted in strong opposition to further industry development by local fishermen and environmental groups, including sabotage of farm installations.

**Faroe Islands**

The self-governing administrative division of Denmark, the Faroe Islands, are located in the heart of the Gulf Stream in the North Atlantic, northwest of Scotland and halfway between Iceland and Norway. Salmon culture developed in the archipelago around the mid-1980s with the assistance of Norwegian technology and broodfish stocks.

Production reached a record level in 2003 with 65,500 mt (FAO 2006) but potential for further expansion is limited due to a scarcity of sheltered sites. As in Scotland and Ireland, farmers are being pushed offshore but further development will depend on advances in cage construction. The value of farmed salmon in 2003 was approximately US$188 million, exceeding by far the value of traditional marine fisheries.

**Development in North America**

Despite the enormous amount of research conducted on hatchery-based enhancement programs for Pacific salmon, the pen-reared salmon industry did not develop in the United States and Canada at the same pace as it did in Norway for a number of reasons.

In the first place, Pacific salmon does not lend itself to culture conditions as easily as Atlantic salmon. On the other hand, winters can be extremely cold in the Eastern coast of North America and the regulatory pressure exerted by environmental groups has effectively slowed industry growth (Anderson and Bettencourt 1992).

**Canada**

Salmon farming in Canada takes place primarily in British Columbia and New Brunswick. The British Columbia net-pen salmon industry started in 1972 with the production of small coho salmon using surplus eggs from a government hatchery (Folsom et al. 1992). Because coho salmon matures early in the year, it needs to be harvested from the net-pens in the summer, coinciding with the wild salmon harvest. Therefore, low prices always resulted for the farmed coho salmon.
and the industry remained undeveloped for more than one decade (Willoughby 1999).

In 1985-86 Norwegian investors were attracted to British Columbia by its favorable environmental conditions and proximity to the U.S. market. Initially they attempted to culture chinook salmon instead of Atlantic salmon because government regulations prohibited the introduction of non-native fishes. However, chinook salmon is not as easily domesticated as Atlantic salmon because it requires warmer ocean temperatures (>8°C) to achieve optimal growth; however, warm temperatures also foster plankton blooms that may die off, resulting in eutrophication. Chinook salmon is also more susceptible to diseases.

Import restrictions on Atlantic salmon roe (ova), which had been imposed out of concern for the introduction of non-native species, were eventually lifted in 1985 and within a few years production levels of Atlantic salmon exceeded those of farmed Pacific salmon in British Columbia.

Reportedly, there were 75 companies operating by 1989 (Willoughby 1999) but lower prices caused by global oversupply of salmon led to a major restructuring of the industry, and by 1994 only 17 companies were operating.

Growth in recent years has been hampered by conflicts with commercial and recreational salmon fisheries as well as First Nations members and environmental groups. It has been claimed that escaped fish from farm installations may spread diseases and negatively affect the genetic integrity of the native fish populations. The industry is heavily regulated and a moratorium on further expansion was imposed in 1995. The ban on new salmon farms was lifted in 2002.

In New Brunswick, along Canada’s Atlantic coast, experiments conducted in the early 1970s demonstrated that salmon could survive the very low winter temperatures. The first commercially viable operation started in 1978 near Deer Island (Sylvia et al. 2000) and further development took place along the protected coasts of the Bay of Fundy.

The industry has not been nearly as regulated as in British Columbia, and there have been fewer conflicts with First Nations, environmental groups and other special interest groups. A main advantage to firms in this area is the proximity to the large eastern U.S. markets; however, expansion is limited by a shortage of suitable sites for the farms and low ocean temperatures in the winter (Wray 1996a).

Despite constraints to development and the industry shakeout in the early 1990s, farmed salmon production has been steadily increasing on both West and East coasts. Overall production was 700 mt in 1980, exceeded 25,000 mt by 1990, and achieved a record level in 2002, with nearly 130,000 mt (Figure V-3). Government regulation and conflicts with other interest groups remain as the major obstacles to growth.

**United States**

The development of salmon farming in Washington and Maine has paralleled that in the Canadian provinces of British Columbia and New Brunswick. The National Marine Fisheries Service (NMFS) conducted the first experiments with pen-reared salmon at the Manchester Field Station in Puget Sound, Washington, in 1969.


Atlantic salmon arrived in 1986 and since then there has been a move from Pacific to Atlantic salmon production. By 1994, Washington’s salmon production was about 5,000 mt, of which 95 percent was Atlantic salmon (Willoughby 1999). The state industry underwent a period of consolidation in 1996-97, and all former companies are now consolidated into one holding company, The Omega Group, which also has holdings in British Columbia. The Omega Group is a subsidiary of Pan Fish Incorporated (Norway), one of the largest Atlantic salmon rearing companies in the world.

Commercial salmon farming was also attempted in the Northeastern United States in the early 1970s. The first company, Maine Salmon Farms, started producing coho at a pen site in an estuary of the Kennebec River in 1970, but the company failed in the late 1970s.

The first large-scale operation, Fox Island Fisheries, began production in 1973 in Vinelhaven, Maine but it also went out of business in 1979 (Bettencourt and Anderson 1990). Despite these initial failures, the high unemployment rate and the decline of the herring fishery provided additional impetus for aquaculture development in the Eastport-Lubec region in Maine.

Ocean Products, Inc. (OPI) began operations in 1982 in Cobscook Bay with smolts provided by Canadian hatcheries and the U.S. Fish and Wildlife Service. After developing its own hatcheries, OPI became the largest private salmon operation in the United States by 1988.

In 1987, the Norwegian seafood multinational Fjord Seafoods founded Atlantic Salmon of Maine (ASM) by converting a former state hatchery in a modern commercial rearing facility. The company grew continuously over the years through the acquisition of hatcheries and leasing of marine sites.

At the same time, consolidation within Canadian-based firms and the acquisition of OPI led to the creation of Heritage Salmon Company (HSC) in 1991. Both foreign-based companies are the largest salmon producers in Maine.

On both East and West coasts salmon aquaculture has found strong opposition by environmentalists, local property owners and fishermen (Sylvia et al. 2000). For
example, in June 1987, Alaska imposed a temporary moratorium on private, for-profit, farmed salmon and trout, which became permanent in 1988 (Anderson 1997). Although reasons given for this included environmental concerns, spread of disease, pollution issues and genetic degradation of native stocks, other prominent motivating factors for the permanent moratorium were economic, such as market competition and concern about multinational corporations controlling the industry.

Currently, the salmon farming industry in Washington and Maine is facing considerable constraints related to environmental issues and profitability. In a recent report from the Stanford Fisheries Policy Project, the salmon farming industries in British Columbia and Washington are portrayed as posing a clear ecological risk to wild salmon populations in the Pacific Northwest, which led the authors to suggest an international moratorium on the industry (Naylor et al. 2003).

In Maine, there are also concerns related to the potentially negative impact of farmed salmon practices on the recovery of threatened native Atlantic salmon stocks. In May 2003, a lawsuit filed by two Maine residents and the U.S. Public Interest Research Group (an environment and consumer advocate organization) against the two largest salmon farms in the state, Heritage Salmon and Atlantic Salmon of Maine, resulted in the imposition of hefty fines and strict guidelines for the operation of farms in the state.

Under the new regulations, companies must rotate fish to allow some pens to go fallow for up to three years to prevent salmon waste from degrading sensitive seabeds. In addition, companies are forbidden to raise European stocks of Atlantic salmon, which grow faster and resist disease better than native fish. The court ruling forced the sale of Norwegian-owned Atlantic Salmon of Maine to New Brunswick-based Cooke Aquaculture in April 2004 (Portland Press Herald 2004).

As shown in Table V-2, U.S. ocean pen-raised salmon and trout production generally increased until 2000. However, production dropped precipitously from a high of 22,511 mt in 2000 to only 10,249 mt in 2004. At this point, there is little opportunity for growth.

Competitiveness of U.S. farmed salmon producers has been seriously eroded in recent years by the escalating cost of regulatory compliance covering almost all

<table>
<thead>
<tr>
<th>Year</th>
<th>Total: Maine &amp; Washington</th>
<th>MAINE</th>
<th>WASHINGTON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Maine</td>
<td>Atlantic Salmon</td>
<td>Total</td>
</tr>
<tr>
<td>1990</td>
<td>3,438</td>
<td>2,082</td>
<td>N/E</td>
</tr>
<tr>
<td>1991</td>
<td>6,979</td>
<td>4,707</td>
<td>4,552</td>
</tr>
<tr>
<td>1992</td>
<td>10,401</td>
<td>6,120</td>
<td>5,839</td>
</tr>
<tr>
<td>1993</td>
<td>11,074</td>
<td>7,024</td>
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<td>11,224</td>
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<tr>
<td>1995</td>
<td>14,176</td>
<td>10,095</td>
<td>9,982</td>
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<td>13,965</td>
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</tr>
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<td>15,798</td>
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<td>1999</td>
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<td>2000</td>
<td>22,511</td>
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<tr>
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<tr>
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<td>16,314</td>
<td>6,007</td>
<td>6,007</td>
</tr>
<tr>
<td>2004</td>
<td>10,249</td>
<td>8,515</td>
<td>8,515</td>
</tr>
</tbody>
</table>


N/E: Non specified.
aspects of production: disease control, feed additives, effluent discharges, marine mammals, navigation, control of predatory birds and endangered species.

Despite having developed much of the hatchery technology and the most advanced research on health and nutrition, the U.S. salmon farming industry currently accounts for less than 1 percent of world farmed salmon production. This market share is likely to continue to decline.

Protecting wild Atlantic salmon from impacts of salmon aquaculture in the North Atlantic

In 1994, seven member countries of the North Atlantic Salmon Conservation (NASCO) signed an agreement called the “Convention for the Conservation of Salmon in the North Atlantic Ocean to Minimize Impacts from Salmon Aquaculture on the Wild Salmon Stocks.” The agreement recommended specific actions for nations to control impacts of salmon farming, including the development of standards for fish husbandry practices, guidelines for siting of pen structures and the demarcation of exclusion zones.

In 2003, the Atlantic Salmon Federation (ASF) and the World Wildlife Fund (WWF) conducted a country-by-country evaluation of the steps taken by each government to adopt legislation aimed at reducing harmful impacts of aquaculture on the wild salmon populations (Porter 2003).

The evaluation panel found relatively little progress on the adoption of this legislation (no private sector initiatives were evaluated). The greatest progress was made by Norway, followed by Scotland, Canada, Ireland, Iceland, United States and Faroe Islands, in that order. The evaluation panel recommended that significant changes be implemented in the regulatory framework for salmon aquaculture in each of the member countries.

Development in South America

Chile

Farming of salmon is a relatively new industry in Chile and it began with the commercial cage rearing of rainbow trout and coho salmon in 1978. The industry expanded very rapidly beginning in the mid-1980s (Figure V-3).

From a modest production of 500 mt in 1984, Chile moved on to become the second largest producer of salmon in the world in 1992 with 62,200 mt. Chilean production almost equaled that of Norway in 2001 with a little over 500,000 mt. Aquaculture output decreased slightly in 2002 and 2003, but a new record was reached in 2004, with a production of nearly 570,000 mt (FAO 2006). Some industry reports indicate that Chile will likely displace Norway as the world’s largest salmon producer in the near future (The Wave News Network, March 25, 2004). The average growth rate of the industry for the period 1984-2004 was 42 percent per year.

Coho was initially the predominant species, but Atlantic salmon (imported from Norway in 1982) became the leading species in 1992, with about 20,000 mt. The production of salmon trout accelerated in the 1990s and exceeded coho production in 1997 (Bjørndal 2002). In recent years most of the production of coho in Chile is sold frozen to Japan and the bulk of the Atlantic salmon is sold fresh (pin-bone-out fillets) to the United States.

Chile is divided into 13 main regions, of which Regions X, XI and XII, in the southern part of the country, are most suitable for salmon farming. The industry is mostly concentrated around Puerto Montt and the Chiloé Island in Region X, about 1,000 km south of Santiago. The long coastline from Puerto Montt to Cape Horn offers many sheltered sites with ideal water temperatures (10-14ºC) and salinity. Additionally, unpolluted freshwater sources are numerous and most lakes do not freeze in winter, thereby providing favorable conditions for smolt production throughout the year.

There are other factors that explain the success of the Chilean salmon farming industry. Chief among these are easy access to fishmeal for feed, low-cost skilled labor, minimum interference from commercial and recreational fishermen, favorable regulatory climate and little pressure from environmental groups (Hicks 1995).

Moreover, as Chile is located in the Southern Hemisphere, its seasons are opposite to those of the Northern Hemisphere, meaning that Chilean farmers can supply fresh markets during the off-season in the northern hemisphere. However, Bjørndal (2002) argues that the importance of this competitive advantage has been reduced as Atlantic salmon and salmon trout have gained importance in the Chilean salmon industry. Atlantic salmon is harvested throughout the year and is generally marketed fresh primarily in the United States while the Chilean-grown coho and rainbow trout are largely exported frozen to Japan.

The Chilean industry has benefited from investment and joint ventures with Norway, Japan, the U.K. and other countries. Foreigners own the dominant share of many of the large farms but Chilean ownership is increasing (Willoughby 1999). Establishment of a farm is a much more expedited process than in other countries, with project approval taking no more than four months (Wray 1996b). Nevertheless, enforcement of new regulations in the future is expected.

Despite this positive outlook, Chilean aquaculture has also some problems of its own. There is still much room for improvement with respect to health management and disease control. While only small
viral outbreaks have occurred thus far, the risk of a large outbreak in the lakes used for smolt production, where mortality among juvenile fish often ranges from 30 to 50 percent, is not negligible. Currently no health certificates or controls are required when transferring fish into and out of the lakes.

Similarly, antibiotics are used extensively, but the total amount is unknown and there are few government controls (Willoughby 1999). Nevertheless, Chileans have taken significant steps towards ensuring the sustainability of the industry. For example, a large portion of the salmon growing region is covered under a strict program of environmental control, which runs 16 monitoring stations from Puerto Montt to Chiloé.

Because per-capita consumption of fish is low in Chile, the salmon industry has been export-oriented from its beginnings. The main markets are the United States and Japan, representing 36.7 percent and 49 percent, respectively, of Chilean salmon exports in 2000 (Bjørndal 2002).

The Japanese market is mainly supplied with coho and salmon trout while most farmed Atlantic salmon is shipped to the United States. However, their extreme dependency on these two markets makes Chilean exporters vulnerable to the swings of international economic trends, exchange rates and trade policies.

Chileans have tried to develop new markets and products in recent years. In particular, the pin-bone-out (PBO) fillet has been extremely successful in the U.S. market. A long-term goal has been to obtain a third of the European salmon market. Although still accounting for a minor fraction of Chilean exports, those to Brazil have increased considerably since 1993. There is significant potential for expansion in this market, as well as other Latin American countries.

Important Factors Contributing to the Success of Salmon Farming

Forster (2002) provided a comprehensive review of the various factors that have made salmon farming one of the most successful aquaculture enterprises worldwide. A summary of these factors follows:

A. Easily replicated technology: Salmon are raised in cages or net pens. Cages are a relatively simple technology for culturing fish under intensive conditions. If cages are placed in locations with good tidal flow, water exchange rates are many times greater than would be possible in land-based facilities. Although designs and materials can vary widely, all cages adhere to the same basic principles. This simplicity is what allowed Norwegian and Chilean farmers to set up their farms with minimum investment on fixed capital assets and develop their industries in a relatively short period of time.

B. Access to a huge resource: Successful cage culture requires coastlines with the right set of topographic conditions. Candidate sites must provide protection from heavy seas, have at least 15m of depth, an adequate regime of water flow to facilitate water exchange in the cages and optimal seawater temperature and salinity. Of all the countries that provide these conditions for salmon farming, Norway and Chile possess the most extensive coastlines. It is then not a surprise that these two countries are the most important producers in the world. Other countries such as Scotland, Canada, the United States (other than Alaska) and Ireland also provide good topographic conditions but to a lesser extent.

C. Atlantic salmon is a good farm fish: Atlantic salmon is a species with exceptional characteristics for intensive culture. The hatchery rearing is a relatively straightforward process. Eggs are easy to extract and incubate and the young fry are large and capable of feeding directly on dry feed. During growout in cages, they easily tolerate moderate crowding and careful handling. They are also moderately resistant to diseases and quickly grow to market size in less than 18 months after the 50-100 gram juveniles are put in net-pens. The meat quality is excellent and appealing to millions of consumers worldwide. The fillet yield is high, up to 60 percent of edible meat. A high fillet yield is critical for the creation of value-added products. This is an advantage over other mass-market species such as tilapia, which have a much lower yield (30-35 percent).

D. Low cost of production and improvements in productivity: After almost 30 years of uninterrupted progress, salmon farming has achieved a very high

Development in Asia

Japan

The domestic industry started with the culture of sockeye, chinook, chum and pink salmon in the bays of north-east Honshu Island by the Nichiro Fisheries Company. By 1973, Nichiro had focused on pen-raised coho salmon, modeled after Norway’s use of eggs imported from Washington and Oregon (Nasaka 1988). Since then, coho has been the species of choice for Japanese producers.

Domestic production peaked in 1991 with approximately 41,000 mt but has been declining since then. In 2004 only 18,500 mt were produced (FAO 2006). Recently, offshore fish farming installations have been promoted by the government in an attempt to bring the industry to more exposed locations (Willoughby 1999); however, the true potential of offshore farming has not yet been fully assessed.
degree of efficiency. Production costs have been declining continuously in the major-producing nations. Modern, well-run farms can produce salmon today at around $2/kg, and in some cases even lower. Table V-3 presents a typical cost breakdown in a modern salmon farm. The largest cost is feed, making up over half of the total cost. This is so partly because salmon feed is rich in high-quality protein (fishmeal) and fat as compared to many other animal feeds. However, research is continuously aimed at reducing the dependence on fishmeal sources of protein. Advances are expected in the near future as similar breakthroughs have been achieved in other industries.

In addition to technological advances, costs of production have also declined because farms have grown bigger and captured economies of scale. At current production levels (about 15-20 kg per cubic meter of cage volume per year) the cost contribution of capital replacement is very low (Table V-3). Also, labor productivity has boosted in many farms (often exceeding 200 mt per man-year) while management and overhead expenses have been minimized.

E. Corporate ownership: The Norwegian government initially encouraged an industry model of small-scale operators and individual farm ownership. However, like any agricultural commodity sold in the world today, salmon is vulnerable to overproduction. The price crisis of the early 1990s made it clear that the initial policies adopted by the Norwegian government hampered its competitiveness in the global marketplace.

More recently, seafood buyers tend to be large food service operations or retail chains which demand from suppliers an absolute assurance of quality, year round availability and the ability to supply large volumes. In addition, prices must be internationally competitive.

Corporations also find it easier to finance research and development and update equipment and technology because they are able to spread these costs over a larger production volume. Ultimately, corporations are much more resilient and are better equipped to survive through commodity pricing cycles.

It is precisely the cyclical oscillation between profit and losses which contributed to consolidation of the salmon industry (Roberts 2002a; 2002b). The Dutch conglomerate Nutreco became the largest salmon producer in the world, integrated from egg to table, after acquiring the Scottish Marine Harvest and the Norwegian Norsk Hydro farming companies in 2000. Further consolidation occurred in 2005 when Nutreco merged with Stolt Sea Farm from Norway to form the multinational conglomerate Marine Harvest. In March 2006, Pan Fish, another Norwegian fish company, bid to purchase Marine Harvest from Nutreco and Stolt. If the purchase is allowed by the Norwegian government, which is concerned about too much industry consolidation, the combined Pan Fish – Marine Harvest company would become the world’s largest producer of farmed salmon, with an expected production of 346,000 MT in 2006, accounting for over 20 percent of global farmed supplies.

The Norwegian government has also been directly involved in the consolidation of the industry. By the late 1990s, the Norwegian government owned 51 percent of the Norsk-Hydro farming company and had farms and processing plants in Norway, Scotland, Ireland and Chile. With the sale of Norsk-Hydro to Nutreco in 2000, the Norwegian Government was expected to make an exit from state sponsored aquaculture as it only kept Statkorn Holdings, a relatively minor conglomerate compared to Nutreco. However, in a series of maneuvers that took place in 2001 and 2002, Statkorn purchased Sweden-based Ewos, the world’s biggest fish feed manufacturer at the time. Following the acquisition of Ewos, Statkorn engaged in acquisition of assets in all major producing regions in the world. The Statkorn company is now called Cermaq and it is currently

| Table V-3 | Production costs of an efficiently run Atlantic salmon farm in 2000 |
|------------|------------------|----------------|
| Cost item  | $ per kg produced | % of total cost |
| Juveniles  | 0.33              | 16.5           |
| Feed       | 1.10              | 55.0           |
| Labor      | 0.16              | 8.0            |
| Other cost + overhead | 0.29   | 14.5          |
| Depreciation | 0.12          | 6.0            |
| TOTAL      | 2.00              | 100.0          |

Source: Forster (2002)
one of the major salmon feed producers and the second largest farmed salmon producer in the world.

With a successful bid by Pan Fish for Marine Harvest, according to industry estimates (Pan Fish 2006), nearly 40 percent of global farmed salmon production in 2006 would be controlled by only three Norwegian companies (Pan Fish-Marine Harvest, Cermaq, Fjord Seafood) and one Chilean company (AquaChile). Further consolidation is expected to continue in the coming years.

F. Marketing: Salmon farmers have been particularly successful at understanding the market’s need for high-quality seafood product. Over the last two decades there has been a growing public awareness of the health benefits of eating fish as compared to other meats, and an increased demand for fresh products.

Salmon farmers responded by developing the ability to supply a consistent high-quality, fresh product year round, and by supporting these efforts with various generic marketing programs. As a result, Atlantic salmon can be found in almost all supermarkets and restaurants of economically developed countries (Forster 1999).

G. Government support: As with other types of aquaculture, salmon farming has succeeded wherever it receives support and legitimacy from government. That has been the case in Norway, Chile and Scotland, the three major salmon producers in the world.

Although many governments can provide adequate support in research and development, few of them succeed at creating space in public waters and developing a straightforward regulatory framework supportive of the industry. One major problem lies in the public nature of the seawater resource.

For the aquaculture sector to operate efficiently it is important that farmers have secure and reasonably transferable property rights. This is frequently in conflict with the views of existing user groups and other interests.

### Evolution of Prices and Production Costs

Increased supplies of an agricultural commodity generally result in falling prices. Farmed salmon is no exception. Figure V-4 displays the annual inflation-adjusted export price and production cost (in 2004 Norwegian Kroner) of farmed Atlantic salmon from Norway during the period 1985 – 2004 (NDF 2006). Prices of Norwegian salmon consistently declined over this time period, from 86 NOK/kg to 22 NOK/kg. The fall in prices was steeper during 1985-1989. Similar trends have also been experienced in Chile and the United States.

![Graph showing the evolution of prices and production costs of Norwegian Atlantic salmon (1985-2004)](Figure V-4)

Source: Norwegian Directorate of Fisheries 2006 (provided by Frank Asche, University of Stavanger, Norway).
The years 1988 and 1989 were particularly remarkable for the salmon industry. Beginning in 1988, the farmed salmon industry increased production substantially. Falling prices were first observed in Europe late in 1987 and in the United States by mid-1988. In 1989, record supplies of farmed salmon (19 percent higher than 1988 levels), in conjunction with a record wild and ranched salmon harvest, led to an all-time record supply of salmon of more than one million mt (Figure V-2).

By 1989, aquaculture production already contributed 36 percent of the total world supply of salmon. As a consequence, prices declined precipitously. The bankruptcies, divestitures and producer concentration that had been commonplace in the salmon industry, reached a maximum in this period.

In the United States, price declines in 1989 prompted a petition from the Coalition for Fair Atlantic Salmon Trade (FAST), which alleged that Norwegian producers had received countervailing subsidies and were dumping salmon in the United States, materially damaging the domestic industry. This is discussed in more detail in Chapter XV.

Despite falling prices, there was still tremendous growth in the farmed salmon industry in the 1990s due largely to tremendous gains in productivity from innovations in disease control, nutrition, improved brood stocks and more efficient farm systems. The record low U.S. prices in the late 1990s and early 2000s were related to rapid growth in farmed salmon supply, particularly from Chile.

It is now clear that salmon farming operations have been able to remain profitable only by lowering production costs through technological and management innovations as prices have fallen. While average export price/kg in Norway decreased from 86 NOK/kg to 22 NOK/kg, production costs were lowered from 59 NOK/kg to 15 NOK/kg (2004 prices).

A key component of production costs is feed. In the 1980s, feed conversion ratios (FCR) in Norway were around 3 kilograms of feed per kilogram of salmon. In 1999, the average feed conversion ratio was 1.19 kilograms of feed per kilogram of salmon (Guttormsen 2002).

The reduction in production costs and FCR was made possible through consolidation and vertical integration of the industry, better broodstock, technology and improvements in nutrition, disease management and farm production systems (Asche et al. 2003).

Undoubtedly, the many efforts conducted by the industry since 1989 to expand and broaden the market have been instrumental in dealing with the downward pressure on prices.

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Commercial feeds in salmon farming: a controversial topic

Sustainability of Fish Meal and Oil

Salmon is a carnivore and requires a diet with a high protein content to promote and sustain growth rates throughout the entire life cycle. The dependence of salmon farming on the availability of high-quality proteins such as fishmeal and fish oil has raised some concern among environmental groups about potentially negative effects on wild fish stocks (Naylor et al. 2000).

The concern over the sustainability of the stocks of fish from which fishmeal are derived is partly based on a concern that as aquaculture production grows, there is increased pressure on those stocks. However, as Figure V-5 below shows, as worldwide production in aquaculture of fish and shellfish (including all carnivorous fish and shellfish) have increased over the years, the level of fishmeal production has remained roughly the same. One might have expected catches of fish bound for fishmeal production to increase as aquaculture production has increased, however, that has not been the case. Although the share of fishmeal going to aquaculture is increasing (Delgado et al. 2003), the majority of the fishmeal produced worldwide goes to developing nations and is used as feed for livestock, primarily poultry and pigs. In 1986 only 8 percent of fishmeal produced worldwide was going to aquaculture production (Wijkstrom and New 1989). By 1995, 25 percent was going to aquaculture (Tacon 1998) and in 2002 it was up to an estimated 34 percent (Barlow 2002).

Thus, the implication of this is that the cost of fishmeal is generally increasing. As a result, a significant amount of research is currently underway to reduce the dependence of salmon feeds on fishmeal and fish oil (Hardy 1998). Vegetable ingredients such as soybean meal already provide most protein requirements in poultry and swine feeds as well as in catfish diets in the United States. Soybean meal and other low-phosphorus ingredients are currently being examined for their use in commercial salmon feeds (Opstvedt et al. 2003; Bell et al. 2003). This search for alternative feedstuffs is ongoing for 2 reasons: 1) to address concerns related to sustainability of the stock of fish from which fishmeal and fish oil are derived; and, 2) because feed is the largest component of the costs of producing farmed salmon and it is in the industry’s best interest to find ways to reduce those costs.

PCBs in Fish Feed

A recent report published in Science claims that farmed salmon contain higher levels of PCBs than their wild counterparts, that 8 ounces of farmed salmon should not be consumed more than once per month and the source of the PCB contamination is the fish feed (Hites et al. 2004). The study also indicated that farmed salmon from northern Europe had higher...
concentrations of contamination than farmed salmon from South America. The study was based on salmon taken from the water in 2001.

This study was highly controversial. The study has been challenged by the medical community, food scientists and the farmed salmon industry on the health implications of PCBs, which concluded that the benefits of eating fish rich in fatty acids are more clearly proven than the risk of PCB exposure (SOTA 2004; Santerre 2004; Willett 2005). At the heart of one of the controversies is that the study’s authors use the approach of the U.S. Environmental Protection Agency (EPA) to assess comparative health risks of consuming wild and farmed salmon, which bases risks on animal testing. Other scientists feel the approach of the U.S. Food and Drug Administration (FDA) or the World Health Organization (WHO) is the more appropriate approach. Their limits are significantly higher. Referring to the assumed similar affects on humans as on animals of PCBs, Willett (2005) writes in the American Journal of Preventative Medicine about the Hites et al. study, “that report is particularly troublesome, perhaps even irresponsible, because the implied health consequences were based on hypothetical calculations and very small (lifetime risks of $1:10,000$). In contrast, the benefits of eating salmon are based on human data at the doses actually consumed, ..., and are likely to be at least 100-fold greater than the estimates of harm, which may not exist at all.”

The study generated a significant amount of media coverage, with varying levels of responsible reporting. In a study by an affiliate of the Center for Media and Public Affairs, the Statistical Assessment Service investigated the news reporting of this study to determine if the media accurately reported this controversy and provided the key scientific data the public needed to make sense of the study (Butterworth 2004). For our purposes, what is more interesting is to what extent the media distinguished between farmed and wild salmon. Many of the newspaper headlines were quite clear that the study pointed to farmed salmon as being higher in contaminants than others. However, other headlines did not. For example, USA Today, on January 9, 2004 ran a headline that said “Study: Some Salmon are Highly Toxic.” Similarly, that same day the St. Paul Pioneer Press ran the headline “Limit on Eating Salmon is Urged.” While the Washington Post on that date did point out that farmed salmon were ‘toxic,’ its headline would not exactly create confidence in wild salmon either — “Toxins cited in farmed salmon. Cancer risk is lower in wild fish, study reports.”

The study evaluated raw skin-on salmon. Since PCBs reside in the fat, 30-50 percent of the PCBs are carried

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**Figure V-5**

Worldwide Total Aquaculture Production of Fish and Shellfish Relative to Total Fish Meal Production

[Graph showing the comparison of total aquaculture production and total fish meal production from 1976 to 2004.]

Sources: FAO (2006); IFFO (2005).
away in the cooking processed in the dissolved fat. Therefore, if one does not eat the skin or the grey tissue, a lower concentration of PCBs are consumed than what would be implied by the study, independent of whether one uses the FDA/WHO approach or the EPA approach to assessing risk.

There are 2 critical issues in this controversy: a) public health and b) impact on the farmed and wild salmon industries. The above addresses the issue related to public health. The second issue is often assumed to be a positive impact on the wild salmon industry and a negative impact on the farmed salmon industry. However, as headlines above which fail to distinguish between farmed and wild salmon appear, the negative effects can easily be felt by both industries. In addition, as the PCB stories are intermingled and added to the media attention to mercury in tuna and swordfish and other health warnings concerning seafood, there is increasing concern among health professionals that consumers simply get confused about which species to eat and confused or frustrated consumers simply stop eating all seafood.

**MAB-19**

**Plant-based Feeds**

As feed shifts toward plant ingredients, there is the possibility that genetically modified soybeans or other meal-type products will be considered as fish feed, with the addition of fish oils. This will probably create a controversy of another type, one which is shared with industries that extend far beyond fish farming.

**Genetically modified organisms: The next breakthrough or backbreaker in salmon aquaculture?**

Recent advances in biotechnology may hold the key for future expansion of the salmon aquaculture industry. Transgenic technology in particular could provide the means for the development of genetically superior broodstocks exhibiting faster growth rates, improved feed conversion efficiencies, disease resistance, the ability to utilize vegetable protein diets and tolerance to low oxygen levels and water temperatures.

**Transgenic technology**

In order to grow quickly, salmon require nutrition that includes omega-3 fatty acids. The majority of these fatty acids are derived from fish oil. Thus, the growing salmon diet requires the addition of fish oil to farmed fish feed, in order to provide a source of omega-3 fatty acids. However, there is a major shortcoming to this reliance on fish oil. As detailed above, there are many negative impacts that are attributable to the consumption of fish oil. This includes: a) the consumption of potentially contaminated by-products of fish processing, b) mercury contamination, c) the need for fish to be farmed and d) the need for large amounts of fish oil to supply the nutritional needs of salmon. The alternative is to develop a source of omega-3 fatty acids that is not derived from fish oil and is not contaminated with PCBs or mercury. One such source is plant-derived omega-3 fatty acids.

The omega-3 fatty acids in many plants, such as canola, soy, and linseed, are not, however, easily converted to EPA and DHA (omega-3 fatty acids) in human beings. Thus the use of these plants is not an ideal alternative to fish oil. However, biotechnology has freed the omega-3 polynsaturated fatty acid (PUFA) from plants, thus allowing it to be used in salmon feed. This is a major step forward in the development of a practical, safe, and economical source of EPA and DHA for salmon feed.

**Use of Colorants in Salmon Feed**

Some concerns have also been expressed with regard to the addition of synthetic pigments to salmon feeds. The characteristic pink color of salmon flesh is a result of deposition of naturally occurring carotenoid pigments, which are synthesized primarily by phytoplankton and subsequently stored in algae and zooplankton. Higher organisms, including salmon, cannot synthesize carotenoids and therefore rely on a dietary intake. Currently, commercial diets for farmed salmon contain either or both of the synthetic pigments commercially available, astaxanthin and canthaxanthin (Buttle et al. 2001). Current research is directed towards developing natural sources of the color enhancement pigments at a commercial scale. In particular, certain species of microalgae and yeast are being examined as potential sources of astaxanthin in salmon feeds (Muller-Feuga 2001; Harrell et al. 1998).

**Genetically modified organisms**

The next breakthrough or backbreaker in salmon aquaculture? Recent advances in biotechnology may hold the key for future expansion of the salmon aquaculture industry. Transgenic technology in particular could provide the

**Research on transgenic technologies**

Started in the early 1980s in response to problems faced by the aquaculture industry along the east coast of Canada. Most of these coastal waters are characterized by sub-zero temperatures that are lethal to most fishes, including salmon. Therefore, sea cage aquaculture of salmon is almost entirely restricted to a relatively small area in the most southerly part of the region (Hew et al. 1995). The production of faster-growing, freeze resistant salmon would facilitate the expansion of the aquaculture industry in the entire Atlantic coastal region and other areas currently deemed unsuitable for salmon farming.

Successful introduction of genetically modified organisms into the aquaculture industry will involve not only overcoming technological obstacles, but also addressing food safety, environmental safety, animal welfare and consumer acceptance issues.

Environmental organizations and consumer groups have already expressed their concerns on the potential deleterious effect of escaped transgenic salmon on wild salmon populations (Reichhardt 2000). Some members of the salmon farming industry have also expressed an unwillingness to pursue transgenic salmon production. The controversy surrounding genetically modified salmon will likely continue well into the foreseeable future.
References


Traffic North America


Norwegian Directorate of Fisheries (NDF). 2006. Data provided by Frank Asche.


The Great Salmon Run: Competition Between Wild and Farmed Salmon
Overview of World Salmon Markets

Key Points

- Total world salmon and salmon trout supply increased more than four-fold between 1980 and 2001 and the share of North American wild salmon in total world supply fell from more than half to about one-sixth. The increase in farmed salmon consumption and corresponding decrease in the share of North American wild salmon is reflected in all major salmon markets except for canned and salmon roe markets.
- World salmon consumption may be divided among five major markets: the European Union fresh and frozen market, the Japanese fresh and frozen market, the U.S. fresh and frozen market, canned salmon markets and other markets.
- Wholesale prices for wild and farmed salmon declined in all major markets from the late 1980s until about 2002. Wholesale prices for farmed Atlantic salmon and some wild salmon species have increased since 2002. Within these general long-term trends in prices, there have been substantial monthly and annual fluctuations in prices.
- The Japanese and European fresh and frozen salmon markets each consume more than twice as much salmon as the North American fresh and frozen market. It is in these three markets that farmed salmon has had the largest impacts on North American wild salmon. In order to understand the impacts of farmed salmon on North American wild salmon, one must first understand that this is a truly international market, with market forces acting on both the demand and supply side.
- Currency exchange rates—the values of end-market currencies relative to the U.S. dollar—affect the dollar value of foreign wholesale prices and the prices paid to U.S. salmon processors and fishermen. Changes in the value of the Japanese yen relative to the dollar have been a major factor affecting sockeye salmon prices.

Introduction

North American wild salmon are sold in numerous product forms and markets around the world. To understand what is happening to prices for North American wild salmon and how they are affected by farmed salmon, it is important to look at what is happening in all of the important global markets for North American wild salmon.

Press coverage of the issues facing the North American wild salmon industry often focuses on the U.S. market for fresh and frozen salmon, the rapid growth of U.S. imports of farmed salmon and strategies for wild salmon to compete more effectively with farmed salmon within the U.S. domestic market.

However, it is important to understand that the U.S. fresh and frozen market is not the most important market for North American wild salmon. Nor is it the market in which competition from farmed salmon has had the greatest effects on North American wild salmon prices. Other markets—in particular the Japanese market and canned salmon market—until recently accounted for larger shares of North American wild salmon production and have had a greater effect on the value of North American wild salmon harvests.1

In this chapter, we begin by reviewing trends in total world salmon supply and the dramatic decline over the past two decades in the share of North American wild salmon in that supply. Next, we examine the relative scale of salmon consumption in major markets and the relative role of different salmon producing countries in supplying those markets.

We then briefly review trends in the five most important markets for North American wild salmon—the Japanese fresh and frozen salmon market, the U.S.

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1 The volume of U.S. salmon consumed in the U.S. fresh & frozen salmon market is less than the volume which is canned and prior to 2001 was less than the volume exported to Japan.
fresh and frozen salmon market, the European fresh and frozen salmon market, canned salmon markets and the Japanese salmon roe market.

For each of these markets we discuss trends in total supply, trends in the market share of North American wild salmon, trends in wholesale prices, major factors affecting wholesale prices and how these factors have affected prices of North American wild salmon. Our discussion is necessarily brief. All of these markets are complex. Each could be the subject of an entire study.

All major salmon markets have been affected by the dramatic growth in world production of farmed salmon. But they differ in important ways. Their consumers have different traditions, tastes and income levels. They consume salmon in different product forms. They differ widely in the relative shares of wild and farmed salmon in total supply and the relative shares of different producing countries. They have experienced different trends in economic growth and the relative value of their currencies. Understanding these differences is important for beginning to understand the effects of farmed salmon on these markets and the resulting effects on the North American wild salmon industry.

**World Salmon Supply**

Figure VI-1 shows world salmon and salmon trout supply for the years 1980-2004. Major sources of supply include North American wild salmon, Japanese and Russian wild salmon, farmed salmon and farmed salmon trout.

The volume and sources of world salmon supply have changed dramatically over the past two decades. In 1980, total world salmon supply was less than 550,000 metric tons (mt). By 2004 world supply had more than quadrupled to more than 2.4 million mt.

In 1980, North American wild salmon catches of about 300,000 mt accounted for more than half of total world salmon supply. North American wild salmon catches increased to a peak of more than 500,000 mt in 1995 and then declined to about 400,000 mt in 2004—about one sixth of total world supply. The declining share of North American wild salmon in world salmon production is reflected in similarly dramatic declines in the share of North American wild salmon in all major salmon markets except for canned markets and salmon roe markets.

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*Figure VI-1 World Salmon and Trout Supply 1980-2004*

Source: All data are FAO Fishstat+ data except that data (used to calculate North American wild salmon catches) for Alaska are CFEC Alaska Salmon Summary Data 1980-2005 and data for the Pacific Northwest are NMFS catch data. “Farmed trout” includes only farmed rainbow trout raised in salt water.

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2 As was discussed in Chapter V, in this report we use the term “trout” to refer specifically to farmed rainbow trout raised in salt water pens, mostly in Scandinavia and Chile, which is a similar product to farmed salmon and competes directly with farmed salmon in world markets.
Japanese and Russian wild salmon catches more than doubled from less than 250,000 mt to more than 500,000 tons in 1997 and have remained at that level. Since 1996, Japanese and Russian wild salmon catches have exceeded North American wild salmon catches. Note that Japanese catches are generally ranched chum salmon. Hatcheries produce the chum salmon fry that are released to the wild; the returning salmon are intercepted, stripped of roe or milt and then processed as fresh, frozen or salted salmon primarily for the Japanese market.

World production of farmed salmon grew dramatically from less than 10,000 mt in 1980 to more than 1.5 million mt in 2004 (see Chapter V). In 2004, farmed salmon and trout accounted for five-sixths of world supply.

Table VI-1 provides more detail on the contribution of North American wild salmon to total world supply during the period 2000-2004. North American wild production accounted for 17 percent of total world salmon supply. Wild production in other countries—Japan and Russia—accounted for 20 percent of world supply. Farmed salmon accounted for 63 percent of world supply.

World production of sockeye, pink and chum salmon production is entirely wild, including ranched pink and chum. During the period 2000-2004, North America accounted for 80 percent of sockeye supply, 50 percent of pink supply (Russia accounted for most of the rest) and 24 percent of chum production (Japan accounted for almost all of the rest).

There is some wild (including ranched) chinook and coho supply, as well as a significant amount of farmed production. By the 2000-2004 period, farmed production of these species greatly exceeded wild production. North American wild production accounted for about 36 percent of world chinook production and only 14 percent of world coho production.

### Major World Salmon Markets

World salmon consumption may be divided among five major markets: the European Union fresh and frozen market, the Japanese fresh and frozen market, the U.S. fresh and frozen market, canned salmon markets and other markets. There are significant differences between these markets in their sources of supply, species and products consumed and short-run market conditions.

Figure VI-2 shows estimated salmon and trout consumption in each of these major markets for the period 1989-2004, by source of supply.

<table>
<thead>
<tr>
<th>Table VI-1</th>
<th>Average World Wild and Farmed Salmon and Trout Supply, by Species, 2000-2004</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Species</strong></td>
<td><strong>North American wild</strong></td>
</tr>
<tr>
<td>Atlantic</td>
<td></td>
</tr>
<tr>
<td>Chinook</td>
<td>12</td>
</tr>
<tr>
<td>Sockeye</td>
<td>95</td>
</tr>
<tr>
<td>Coho</td>
<td>19</td>
</tr>
<tr>
<td>Pink</td>
<td>167</td>
</tr>
<tr>
<td>Chum</td>
<td>81</td>
</tr>
<tr>
<td>Trout</td>
<td>188</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>374</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Species</strong></th>
<th><strong>North American wild</strong></th>
<th><strong>Japanese &amp; Russian wild</strong></th>
<th><strong>Farmed</strong></th>
<th><strong>Total</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic</td>
<td>36%</td>
<td>2%</td>
<td>62%</td>
<td>100%</td>
</tr>
<tr>
<td>Chinook</td>
<td>80%</td>
<td>20%</td>
<td>100%</td>
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</tr>
<tr>
<td>Sockeye</td>
<td>14%</td>
<td>2%</td>
<td>84%</td>
<td>100%</td>
</tr>
<tr>
<td>Coho</td>
<td>50%</td>
<td>50%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Chum</td>
<td>24%</td>
<td>76%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Trout</td>
<td>17%</td>
<td>20%</td>
<td>63%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17%</td>
<td>20%</td>
<td>63%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: All data are FAO Fishstat+ data except that data (used to calculate North American wild salmon catches) for Alaska are CFEC Alaska Salmon Summary Data 1980-2005 and data for the Pacific Northwest are NMFS catch data. “Farmed trout” includes only farmed rainbow trout raised in salt water.

3 See footnote 2 in Chapter II.
These estimates are based on numerous assumptions of varying reliability and should be considered only approximate. However, they are reasonable indicators of the relative scale of different markets, the relative rates of growth of consumption in different markets and the relative importance of different sources of supply for each market. Appendix B provides technical details of the derivation of these estimates.

There are several important points to be noted from Figure VI-2. First, until recently, the Japanese fresh and frozen salmon market was the world’s largest market. However, the rapidly growing European Union now consumes a slightly larger volume. In 2004, U.S. fresh and frozen salmon consumption was only about half that of Japan or the European Union.

Second, all five markets are important for North American wild salmon. Canned salmon markets account for the largest share of North American salmon production. The Japanese market, which formerly accounted for the largest share, has declined in relative importance due to declining North American production and exports of frozen sockeye salmon.
Third, consumption of farmed salmon grew dramatically between 1989 and 2004 in all markets except for canned salmon. In both relative and absolute terms, the growth in consumption was greatest in the European fresh and frozen market. The European Union accounted for about 50 percent of the increase in world farmed salmon consumption during this period, the United States accounted for 20 percent and Japan accounted for 11 percent.

Fourth—and most importantly for this study—the U.S. fresh and frozen market ranks behind other markets in importance for both wild and farmed salmon. Competition between North American wild salmon and farmed salmon is occurring in multiple markets, which are subject to different trends in both supply and demand. The effects of this competition can only be understood by examining all of these markets, not just the U.S. fresh and frozen salmon market.

Tables VI-2, VI-3 and VI-4 (on the following pages) provide more detailed estimates of supply to each market during the period 2000-2004 from major wild and farmed salmon producers. These estimates are based on numerous different (and sometimes conflicting) data sources and assumptions and should be considered only approximate. However, they serve to provide a general indicator of the relative magnitude of different markets and the relative importance of different sources of supply.

During the period 2000-2004, the U.S. fresh and frozen market consumed about 234,000 mt of salmon annually, or about 14 percent of world salmon consumption. The U.S. fresh and frozen market accounted for about 19 percent of consumption of North American wild salmon and also for about 21 percent of world farmed salmon consumption (Table VI-3). Of U.S. fresh and frozen salmon consumption, North American wild salmon accounted for 16 percent, Chilean farmed salmon accounted for 40 percent and Canadian farmed salmon accounted for 26 percent (Table VI-4).

The European fresh and frozen market consumed about 477,000 mt of salmon annually, or about 30 percent of world consumption. The European market accounted for about 50 percent of farmed salmon consumption, but only about 7 percent of consumption of North American wild salmon consumption. Of European consumption, Norwegian farmed salmon accounted for the largest share (52 percent) followed by United Kingdom farmed salmon (24 percent).

The Japanese fresh and frozen salmon market consumed about 446,000 mt of salmon, or about 28 percent of world consumption. The Japanese market accounted for about 15 percent of North American wild salmon consumption and about 14 percent of farmed salmon consumption. Of Japanese consumption, Japanese wild salmon accounted for the largest share (36 percent), followed by Chilean farmed salmon (17 percent).

Canned salmon markets consumed about 115,000 mt of salmon, or about 7 percent of world consumption. Canned salmon markets accounted for about 39 percent of North American wild salmon consumption but less than 1 percent of farmed salmon consumption.

### Challenges in Estimating World Salmon Consumption

Estimating trends in consumption of salmon from different producing regions in different end-markets is a challenging exercise, for a number of reasons:

- **Inconsistent data.** Different data sources for salmon production and trade are often inconsistent. For example, industry and government sources on farmed salmon production often do not match and export data from one country may not match import data for the countries to which salmon was exported. Some countries’ reported exports exceed their total salmon production.

- **Missing data.** Some kinds of data needed to estimate consumption do not exist. For example, there are no data for how much Alaska wild salmon is consumed in the United States. Consumption can only be inferred by starting with how much salmon was caught and subtracting other uses such as exports and yield losses in processing.

- **Re-exported products.** Some salmon are shipped to one country for processing and then re-exported to other countries. For example, substantial volumes of U.S. salmon are processed in Canada and substantial volumes of Norwegian salmon are processed in Denmark. This makes it difficult to tell where salmon imports actually originated.

- **Varying product yields.** The weight of salmon declines as it is processed. Thus the total volume of consumption is less than the total volume of production. Import and export data reflect varying degrees of processing and thus the same weight does not necessarily reflect the same volume of catches or the same volume of consumption.

For all of these reasons estimates such as those shown in Figure VI-2 require numerous assumptions and analysts’ best judgment and should be considered only approximate.
### Table VI-2: Approximate Annual Average World Salmon Production and Consumption, 2000-04 (thousand metric tons)

<table>
<thead>
<tr>
<th>Type of salmon</th>
<th>Producing country</th>
<th>Total production (round weight basis)</th>
<th>United States fresh &amp; frozen markets</th>
<th>EU Fresh &amp; frozen markets</th>
<th>Japanese fresh &amp; frozen markets</th>
<th>Canned salmon markets</th>
<th>Other markets</th>
<th>Weight loss in processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>North American wild salmon</td>
<td>United States</td>
<td>346</td>
<td>38</td>
<td>18</td>
<td>32</td>
<td>86</td>
<td>49</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>28</td>
<td>9</td>
<td>0</td>
<td>5</td>
<td>11</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>374</td>
<td>47</td>
<td>18</td>
<td>37</td>
<td>97</td>
<td>49</td>
<td>128</td>
<td></td>
</tr>
<tr>
<td>Japanese &amp; Russian wild salmon</td>
<td>Japan</td>
<td>249</td>
<td>0</td>
<td>0</td>
<td>161</td>
<td>5</td>
<td>38</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Russia</td>
<td>205</td>
<td>0</td>
<td>0</td>
<td>27</td>
<td>11</td>
<td>99</td>
<td>68</td>
</tr>
<tr>
<td>Total</td>
<td>454</td>
<td>0</td>
<td>0</td>
<td>188</td>
<td>15</td>
<td>136</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td>Farmed salmon</td>
<td>Norway</td>
<td>483</td>
<td>7</td>
<td>249</td>
<td>34</td>
<td>1</td>
<td>86</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>Chile</td>
<td>370</td>
<td>94</td>
<td>18</td>
<td>75</td>
<td>2</td>
<td>28</td>
<td>152</td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>143</td>
<td>8</td>
<td>105</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>104</td>
<td>61</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>United States</td>
<td>17</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Japan</td>
<td>10</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>86</td>
<td>3</td>
<td>65</td>
<td>4</td>
<td>0</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>1,213</td>
<td>184</td>
<td>437</td>
<td>126</td>
<td>3</td>
<td>133</td>
<td>333</td>
<td></td>
</tr>
<tr>
<td>Farmed trout</td>
<td>Norway</td>
<td>67</td>
<td>0</td>
<td>9</td>
<td>29</td>
<td>0</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Chile</td>
<td>105</td>
<td>3</td>
<td>1</td>
<td>61</td>
<td>0</td>
<td>7</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>16</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>188</td>
<td>3</td>
<td>13</td>
<td>95</td>
<td>0</td>
<td>22</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,229</td>
<td>234</td>
<td>468</td>
<td>446</td>
<td>115</td>
<td>341</td>
<td>631</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Estimates of consumption by end-market are based on numerous assumptions and should considered only approximate indicators of relative volumes. See Appendix B for details of data and assumptions.

### Table VI-3: Approximate Shares of World Salmon Consumption, by Consuming Markets, 2000-2004

<table>
<thead>
<tr>
<th>Type of salmon</th>
<th>Producing country</th>
<th>United States fresh &amp; frozen markets</th>
<th>EU Fresh &amp; frozen markets</th>
<th>Japanese fresh &amp; frozen markets</th>
<th>Canned salmon markets</th>
<th>Other markets</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>North American wild salmon</td>
<td>United States</td>
<td>17%</td>
<td>8%</td>
<td>15%</td>
<td>38%</td>
<td>22%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>36%</td>
<td>0%</td>
<td>19%</td>
<td>45%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>19%</td>
<td>7%</td>
<td>15%</td>
<td>39%</td>
<td>20%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Japanese &amp; Russian wild salmon</td>
<td>Japan</td>
<td>0%</td>
<td>0%</td>
<td>79%</td>
<td>2%</td>
<td>18%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Russia</td>
<td>0%</td>
<td>0%</td>
<td>20%</td>
<td>8%</td>
<td>72%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>0%</td>
<td>0%</td>
<td>55%</td>
<td>5%</td>
<td>40%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Farmed salmon</td>
<td>Norway</td>
<td>2%</td>
<td>66%</td>
<td>9%</td>
<td>0%</td>
<td>23%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Chile</td>
<td>43%</td>
<td>8%</td>
<td>34%</td>
<td>1%</td>
<td>13%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>7%</td>
<td>92%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>100%</td>
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<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>United States</td>
<td>63%</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Japan</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>4%</td>
<td>76%</td>
<td>5%</td>
<td>0%</td>
<td>14%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>21%</td>
<td>49%</td>
<td>14%</td>
<td>0%</td>
<td>15%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Farmed trout</td>
<td>Norway</td>
<td>0%</td>
<td>18%</td>
<td>58%</td>
<td>0%</td>
<td>24%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Chile</td>
<td>4%</td>
<td>1%</td>
<td>86%</td>
<td>0%</td>
<td>9%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>0%</td>
<td>27%</td>
<td>38%</td>
<td>0%</td>
<td>36%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>2%</td>
<td>10%</td>
<td>72%</td>
<td>0%</td>
<td>17%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Estimates of consumption by end-market are based on numerous assumptions and should considered only approximate indicators of relative volumes. See Appendix B for details of data and assumptions.

**Source:** Calculated from consumption estimates in Table VI-2.
Traffic North America 83

Othersalmon markets include fresh and frozen markets in Canada, Russia, Eastern Europe, South America and the Far East. Our estimates of consumption for these markets are less reliable than for the other markets shown in Table VI-2, because they were calculated as residual volumes after subtracting volumes consumed in other markets and assumed yield losses in processing. The combined volume of salmon consumed by these markets is probably larger than that consumed by the U.S. fresh and frozen market but less than that consumed by the European or Japanese fresh and frozen markets. Consumption of farmed salmon has also grown rapidly in these other markets.

Salmon roe markets are not included in the preceding discussion or the figure and tables. The volume of world salmon roe production is relatively small in comparison with that of canned, frozen and fresh salmon. However, salmon roe is also a valuable salmon product. Most salmon roe production is from wild salmon. Japan accounts for the largest share of production, followed by the United States and Russia. Japan is by far the largest consuming market for salmon roe, followed by Russia.

In the following sections, we examine the markets described above in greater detail. For each market we discuss trends in total supply, trends in the market share of North American wild salmon, trends in wholesale prices and major factors affecting wholesale prices.

**The U.S. Fresh & Frozen Salmon Market**

Later chapters of this report provide a detailed discussion of the U.S. market for fresh and frozen salmon. Here, we provide only a brief introductory overview of major trends.

As shown in Figure VI-3, U.S. fresh and frozen salmon consumption grew very rapidly from about 60,000 mt in 1989 to about 250,000 mt in 2004. Almost all of this growth in consumption was from imported farmed Atlantic salmon from Canada and Chile. In contrast, U.S. fresh and frozen market consumption of North American wild salmon has fluctuated with North American wild salmon catches but has not increased substantially over time. Chapter VIII provides a more detailed review of trends in different sources of supply to the U.S. market.

Growth in farmed salmon consumption has transformed U.S. fresh and frozen salmon consumption. Between 1989 and 2004, the share of farmed salmon in total supply increased from 39 percent to 75 percent, while
The Great Salmon Run: Competition Between Wild and Farmed Salmon

Figure VI-3
Estimated United States Fresh & Frozen Salmon Consumption, 1989-2004

Figure VI-4
U.S. Wholesale Prices for Selected Salmon Products: Farmed Atlantic and Wild Chum

Source: See discussion of data sources and assumptions in Appendix B.

Source: Urner Barry Publications, Inc., Seafood Price Current. Prices are low list prices for Chilean 2-3 lb fillets, FOB Miami; 6-8 lb Atlantics, FOB Northeast; 4-6 lb gillnet head-off fresh chum, FOB Seattle; 6-9 lb H&G frozen chum, FOB Seattle.
the share of wild salmon in total supply fell from 61 percent to 24 percent.

Figure VI-4 shows trends in U.S. wholesale prices for four salmon products: fresh farmed Atlantic fillets, fresh farmed Atlantic whole fish, fresh wild chum and frozen wild chum. There are four important points to be noted about U.S. price trends. First, within any given year, there is significant variation in prices from month to month. Within any given year, prices of fresh farmed salmon may vary by as much as $0.50 per pound or more. For example, prices for fresh whole Atlantic salmon typically peak in the spring and decline over the rest of the year. These variations are caused by seasonal variation in demand and supply. Similarly, fresh wild chum salmon prices vary during the season, typically falling as catches increase.

Secondly, different products command different wholesale prices. Not surprisingly, wholesale prices for fresh farmed Atlantic salmon fillets are typically about $1.00 per pound higher than for fresh whole farmed Atlantic salmon because of pin-bone out (PBO) processing. More importantly, fresh whole farmed Atlantic salmon command much higher wholesale prices than frozen wild chum salmon.

Third, prices for all salmon products declined significantly between the early 1990s and 2002. Wholesale prices, not adjusted for inflation, for all four products shown in Figure VI-4 were about $1.00 per pound lower in 2003 than they were in the early 1990s. The decline in prices was not steady or continuous. Prices fell dramatically between 1993 and 1996 and then leveled off for several years. In 2000 and 2001 prices for farmed salmon fell dramatically, declining by 50 percent or more in less than two years.

Fourth, between 2002 and early 2006 prices recovered significantly for all four species, to levels of the mid-1990s. For all four products shown in the figure prices increased by more than $0.50 per pound; for fresh farmed Atlantic fillets prices increased by more than $1.00 per pound.

These longer-term trends in U.S. salmon prices reflect longer-term trends in U.S. demand and supply to the U.S. market. Prices have tended to decline when the growth rate of supply exceeded the growth rate of demand and to stabilize or increase when the growth rate of demand equaled or exceeded the growth rate of supply. Prices trended downwards when supply was growing rapidly prior to 2002; prices recovered when the growth of supply slowed after 2002.

The European Fresh & Frozen Salmon Market

European fresh and frozen salmon consumption grew very rapidly from about 120,000 metric tons in 1989 to about 550,000 mt in 2004. Almost all of this was of

---

4 Note that the figure shows wholesale prices for specific sizes and grades in specific regions of the country. Price trends for other sizes, grades and regions are generally similar but not identical.
Figure VI-6  U.S. Exports of Fresh & Frozen Wild Salmon to the European Union, by Product

Source: NMFS Trade data. “European Union” includes all countries which were members of the European Union as of May 2006.

Figure VI-7  U.S. Exports of Fresh & Frozen Wild Salmon to the European Union, by Country

Source: NMFS Trade data. “European Union” includes all countries which were members of the European Union as of May 2006.
**Figure VI-8**  Wholesale Prices of Fresh Atlantic Salmon at the Paris Rungis Market ($/lb)

<table>
<thead>
<tr>
<th>Year</th>
<th>Scottish 2-3 kilos</th>
<th>Norwegian 2-3 kilos</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
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<tr>
<td>1996</td>
<td></td>
<td></td>
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<td>1997</td>
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<td>1998</td>
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<td>2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Beginning July 2004 data are for 3-4 kilo salmon.

Source: FAO Globefish Salmon Commodity Update, May 2006 (page 17), and earlier issues. Prices converted from French Francs and Euros to U.S. dollars using Federal Reserve Bank of St. Louis Exchange Rate data.

**Figure VI-9**  Average Export Prices of Selected U.S. Salmon Exports to the European Union

- Frozen coho
- Frozen chum
- Frozen pink

Source: NMFS Trade data. “European Union” includes all countries which were members of the European Union as of May 2006.
farmed Atlantic salmon. Norway has accounted for about half of total European consumption, while the United Kingdom has accounted for about one-quarter. North American wild salmon accounts for only about 4 percent of total EU consumption.

Between 1989 and 2005 U.S. total annual exports to the European Union ranged between 13 and 27 thousand mt. Most exports were frozen chum, frozen pink and frozen coho salmon (Figure VI-6). Recall from Chapter III that pink and chum salmon are generally not of the same high quality as wild chinook, coho and sockeye and are generally poorer quality than farmed salmon. The most important export markets were France, Germany and Spain (Figure VI-7).

As European salmon consumption increased, prices for both farmed and wild salmon trended downwards from the late 1980s until 2002 (Figures VI-8 and VI-9). Farmed salmon prices increased rapidly after 2002 and reached near-record levels in early 2006 (Figure VI-8). Average prices also increased after 2002 for U.S. wild coho salmon exported to Europe, but not for wild pink salmon (Figure VI-9).

The Japanese Fresh & Frozen Salmon Market

Japan was by far the largest salmon market in the world until the late 1990s when the European salmon market grew to about the same size. Japan consumes significant volumes of all wild and farmed salmon species from almost every major salmon producing country.

As in the United States and Europe, since the late 1980s there has been dramatic growth in consumption of farmed salmon and trout in Japan (Figure VI-10). However, Japan has experienced a very different trend in total salmon consumption than the U.S. and European markets. The growth in Japanese consumption of farmed salmon and trout has been mostly offset by declining consumption of wild salmon—resulting in much smaller growth in total consumption.

Japan consumes very large volumes of wild salmon, including both Japanese ranched salmon as well as wild salmon imported from North America and Russia. Since the late 1980s, Japanese imports of North American wild salmon have declined dramatically, reflecting lower North American sockeye salmon catches and changing markets. In contrast, Japanese imports of Russian salmon increased, as an increasing share of Russian production was exported following the collapse of the USSR.

Japanese salmon consumption grew rapidly from less than 300,000 mt in the mid-1980s to almost 500,000 mt in 1996 due to growth in consumption of both wild and farmed salmon. Between 1996 and 2000, however, wild salmon consumption declined sharply due to

Figure VI-10  Estimated Japanese Fresh & Frozen Salmon Consumption, 1989-2004

Source: See discussion of data sources and assumptions in Appendix B.
lower imports of North American wild salmon and lower Japanese catches of ranched salmon. Total Japanese consumption has increased since 2000, but has fluctuated and has not recovered to the 1996 level.

The Japanese consume a wider variety of salmon products than Americans or Europeans. Sliced salmon fillets, known as kirimi, are one of the most common salmon product forms. These may be salted, marinated or unsalted. Grilled sliced salmon, served with a bowl of steamed rice, may be part of lunch, dinner, or traditional Japanese breakfast. Salmon is a common element in a range of prepared meals, sold either “ready-to-eat,” “ready-to-heat,” or “ready-to-cook.” It is a common filling for rice balls, a popular lunch item. Numerous other traditional and modern preparations of salmon are sold in supermarkets and fish stores. As with other fish and food products in Japan, quality standards for salmon products are very high.

Japanese salmon consumption patterns and preferences vary by geographical area and by age group. Usage and preparation of salmon differs by species depending on the texture of the meat, the oil content and the color. In markets where wild salmon was traditionally preferred, farmed salmon has gained increasing acceptance in the Japanese market as wild salmon supply has declined and farmed supply has expanded dramatically.

Japanese salmon consumption patterns are also highly seasonal, reflecting the timing of wild salmon runs in Japan and other countries (Wessells et al. 1994). However, seasonal consumption patterns have weakened over time as freezing technology has allowed wild salmon to be consumed year round and because of the year-round availability of farmed salmon.

The largest component of Japanese supply is wild chum salmon, almost all of which is fish released from hatcheries in northern Japan which are caught in coastal fisheries during the fall. (Figure VI-11). Catches of these ranched “fall chum” salmon have varied significantly from year to year, reflecting changes in fish releases and ocean survival rates. Fall chum salmon catches peaked in 1996 at 222,000 mt, fell by almost half to 125,000 mt in 2000 and were about 200,000 mt in 2004.

Until 1997, wild sockeye salmon—most of it imported frozen from North America—accounted for the second largest share of Japanese salmon supply. However, the share of wild sockeye in total supply declined dramatically from 33 percent in 1993 to just 11 percent in 2004 as sockeye supply declined and the supply of farmed salmon increased rapidly.

Most of the growth in Japanese salmon supply during the 1990s resulted from rapid growth in the supply of farmed coho salmon (mostly from Chile), farmed Atlantic salmon (mostly from Norway) and farmed trout (from Chile and Norway).

The North American wild salmon industry has been most affected by changes in the Japanese market for “red-fleshed” salmon. “Red-fleshed” salmon species which compete directly in the Japanese marketplace include sockeye salmon, coho salmon, chinook salmon and trout. During the 1990s, the total supply of red-fleshed salmon expanded dramatically as a result of rapid growth in Japanese imports of farmed coho and farmed trout. During the same time period, the supply of wild sockeye declined dramatically as North American catches declined and a smaller share of North American catches was frozen. As a result, the wild share of the Japanese red-fleshed salmon market declined from 73 percent in 1993 to just 25 percent in 2004 (Figure VI-12).

The increase in red-fleshed salmon supply, along with other factors, resulted in a dramatic decline in average prices. Figure VI-13 shows Japanese monthly average wholesale prices for frozen wild sockeye salmon and frozen farmed coho salmon for the twenty-five year period 1981-2006, measured in yen per kilogram. Figure VI-14 shows the same prices measured in $ per pound, after adjusting for dramatic changes in the yen-dollar exchange rate which occurred over this period.

*Photographs by Gunnar Knapp*
Figure VI-11  Japanese Salmon and Trout Supply, by Species

Source: Data are from various editions of the Seafood News Power Data Book, page 3. 1991 data are from the 2001 edition; 1992-2001 data are from the 2002 edition; 2002-2004 data are from the 2005 edition. Total supply estimates in this figure are higher than the estimates used in calculating Figure VI-10 for the years 1999-2004. This is because the estimates of Japanese consumption shown in Figure VI-10 for these years subtract Japanese salmon exports, which increased from 2,547 metric tons in 1999 to 60,062 metric tons in 2004.

Figure VI-12  Japanese "Red-Fleshed" Salmon Supply, by Species

Source: Sources are the same as for Figure VI-11.
There are three important points to be noted about Japanese wholesale prices. First, measured in yen, Japanese wholesale prices for frozen salmon have declined dramatically. During the 1980s prices for frozen sockeye salmon were generally more than 1200 yen per kilogram. Since 2000, prices have been below 600 yen per kilogram—only half the level of the 1980s. The decline in prices was driven partly by the increase in total salmon supply and partly by other factors including a slowdown in the Japanese economy and changes in the Japanese food distribution system. The food distribution system has changed due to increasing consolidation in the retail sector (larger supermarkets and chains). This leads to increased purchases in bulk and creates market power on the part of the buyer.

Second, as in the U.S. and European markets, against the longer-term trend of declining wholesale salmon prices have been up-and-down price cycles lasting 2-3 years. These price cycles have been driven primarily by periods of lower or higher total salmon supply caused by changes in wild salmon catches and farmed salmon production.

In the Japanese trade press, changes in prices are attributed to numerous factors, including wild salmon harvests and the extent to which they correspond to preseason projections, farmed salmon production and imports and increases or decreases in frozen salmon inventories. Market psychology and speculation also play a role in wide price swings. When the market is perceived to be “falling,” buyers are reluctant to buy, contributing to downward pressure on price. When the market is perceived to be rising, buyers rush to buy, contributing to upward pressure on price.

Third, price trends for wild sockeye salmon and farmed coho salmon have been correlated but not identical. During the early 1990s wild sockeye salmon and farmed coho salmon sold for similar prices. Since the late 1990s farmed coho prices have been lower than wild sockeye prices much of the time, reflecting increasing supply of farmed coho and decreasing supply of wild sockeye. The fact that at times wild sockeye have commanded higher prices than farmed coho indicates that part of Japanese demand is specifically for sockeye salmon. The fact that this price differential declines when wild sockeye supply increases suggests that sockeye-specific demand is limited and that as sockeye supply increases it competes more directly with farmed salmon and trout.

(We discuss the effect of farmed salmon supply on sockeye prices in more detail in Chapter XIII.)

Fourth, long-term price trends in Japan are different when expressed in yen (Figure VI-13) than when expressed in dollars (Figure VI-14). This is because the value of the yen relative to the dollar changed substantially over the past two decades. During the mid-1980s the value of the yen relative to the dollar

![Figure VI-13](image_url)


Source: “All wild sockeye” prices are Tokyo Central Wholesale Market data. “Farmed Chilean Coho” and “Wild Bristol Bay Sockeye” prices are from the Seafood News Power Data Book 2002 edition for months prior to May 2002. Beginning May 2002, prices are from FIS Japan Frozen Wholesale Prices data.
was rising very rapidly. This is the main reason why Japanese wholesale prices expressed in dollars rose dramatically between 1984 and 1988 (and one of the main reasons why ex-vessel prices paid to fishermen for wild salmon rose dramatically during this period). After 1989 the value of the yen continued to rise, but not as rapidly. As a result wholesale prices expressed in dollars trended downwards, but the relative decline was not as great as for prices expressed in yen.

In contrast to the United States and most countries in Europe, Japan may be considered a mature market for salmon. Per capita consumption is high, salmon is widely available and consumers are very familiar with salmon. Thus it seems unlikely that total Japanese salmon demand will grow significantly in the future.

Canned Salmon Markets

For most of the history of the North American salmon industry, canned salmon was by far the most important product. It was only in the 1970s, with the development of freezing technology and the rapid growth in Japanese demand for imported frozen salmon from America, that other products—in particular frozen salmon—became important. Canned salmon remains an important and valuable product form for U.S., Canadian and Russian wild salmon fisheries.

Until very recently, almost all canned salmon production was from wild salmon. The United States is the largest producer of canned salmon, followed by Russia or Canada, depending on the year (Figure VI-15). Total world canned salmon production varies widely from year to year. This reflects high annual variation in catches of wild Pacific salmon, particularly for pink salmon.

Pink salmon typically accounts for about three-quarters of North American canned salmon production, while sockeye salmon accounts for most of the rest. High wild salmon catches led to high canned pink salmon production in the 1980s and 1990s, including several years of record or near-record production (Figure VI-16). Canned sockeye salmon production remained relatively high as well, despite falling catches, as the canned share of sockeye salmon production increased.

Europe (particularly the United Kingdom) is the most important market for canned sockeye, while the United States is the most important market for North American canned pink salmon. Between 2000 and 2004, about 92 percent of U.S. canned sockeye salmon production was exported, while only about 29 percent of U.S. canned pink salmon production was exported.

Source: Prices are the same prices shown in Figure VI-13 converted to $/lb using Federal Reserve Bank of St. Louis Exchange Rate data.

Figure VI-14


5 Estimates of Russian wild canned salmon production are of uncertain reliability. Increasing volumes of Russian salmon are being frozen and shipped to other countries such as Korea and Thailand for canning. It is difficult to trace the scale of this canned production or to quantify its role in world markets.
Figure VI-15  Estimated World Canned Salmon Consumption, 1989-2004

Source: See discussion of data sources and assumptions in Appendix B.

Figure VI-16  North American Canned Salmon Pack

Source: Canned pack is from NFPA Canned Pack Data and BC Canned Salmon Pack Bulletin Data.
The United Kingdom is the largest export market for canned salmon, followed by Australia, the Netherlands and Belgium.

U.S. retail canned pink salmon prices typically range between $1.50 and $2.00 for a 14.75 ounce “tall” can, while prices for “tall” cans of sockeye are almost twice that. Canned pink consumption varies widely by region, with the highest consumption in the southeast. Canned pink salmon consumption is highly seasonal, peaking in March.

Average wholesale prices for both canned pink and canned sockeye salmon fell sharply in the early 1990s and have generally remained low, particularly for pink salmon. In contrast to fresh and frozen salmon wholesale prices, canned salmon wholesale prices did not recover strongly after 2002 (Figure VI-17).

In general, short-run changes in canned salmon markets tend to be driven by supply conditions, while longer-run changes also reflect the influence of longer-term trends in demand. Prices typically fall after seasons of high canned salmon production and rise after seasons of low production. Inventories serve to dampen these effects of large or small production in any given year. Canned salmon is processed during the summer harvest season but sold over the course of the entire year. As a result, large inventories of canned salmon are built up during the late summer and early fall, which are then drawn down over the winter and spring. The level of “carryover” inventories at the start of a new harvest season—an indicator of the tightness of supply conditions for canned salmon—is considered a key market indicator by the industry. Two years of high catches and canned salmon packs can flood the market.

There is concern within the salmon industry about whether canned salmon is becoming “old-fashioned” and whether demand will decline as the population declines of consumers who grew up eating canned salmon as a staple food. There is interest within the industry in developing more new product forms which are more attractive and convenient.

Historically, cans of salmon included the skin and bones (which are soft and edible). In recent years, production of “skinless-boneless” canned salmon has increased,
Figure VI-17  Average Wholesale Prices for Alaska Canned Salmon (per 48-can case)

Source: ADOR Salmon Price Reports. Data prior to August 2000 are statewide average prices; later data are average prices for Bristol Bay sockeye and Southeast Alaska pinks.

Figure VI-18  Estimated United States Per Capita Consumption of Canned Fish

Source: USDA ERS Food Supply Data. Worksheet mtfish.xls; spreadsheet “Pcc.”
which offers consumers a more attractive product. Another recent new product form has been plastic pouches, which are thermally processed similarly to canned salmon. At present however these products, which cost more to produce, represent only a small share of “thermally processed” salmon products, while traditional cans continue to account for most production.

Figure VI-18 shows U.S. per capita consumption of canned fish products, which is dominated by canned tuna. Per capita canned salmon consumption varies widely from year, reflecting differences in the canned pack and available supply and related changes in retail prices and promotions—but is typically less than one-third that of canned tuna.

Canned farmed salmon production increased after 2000 but remains only a small share of world supply. U.S. imports of Chilean canned farmed salmon increased from 60 mt in 2001 to 2,961 mt in 2003 but fell to 2,607 mt by 2005. Although the volume of canned farmed salmon imports remains relatively small compared to total U.S. production, it may be beginning to affect markets for Alaska canned salmon processors. Anecdotal evidence from press reports attributed the closure of a major salmon cannery in Cordova, Alaska following the 2003 season to the loss of a market for boneless-skinless canned pink salmon at Costco and Sam’s Club stores, which chose instead to buy canned Atlantic salmon from Chile (Welch 2004).

Salmon Roe Markets

Salmon roe is an important and valuable salmon product, especially in the Japanese and Russian markets. Although most of the world’s salmon roe production is from wild salmon, production of roe from farmed salmon and trout is growing in importance and offers considerable economic opportunity for the future.

Almost all U.S. salmon roe production is exported, mostly to Japan—the world’s largest market—and increasingly to Russia. Japanese domestic production is
the largest source of supply to the Japanese market, primarily chum salmon ikura from large Japanese catches of hatchery chum salmon. Imports of U.S. ikura (primarily from chum salmon) and sujiko (primarily from other species) represent the next largest source of supply, followed by imports from Russia (Figure VI-19).

To date, relatively little roe is produced from farmed salmon, because most farmed salmon are harvested well before they start to mature sexually. However, production of roe from Scandinavian farmed trout, considered to be of high quality, is increasing and could have significant effects on future roe markets.

Salmon roe prices vary from year to year, reflecting year-to-year changes in Japanese domestic supply and import supply (Figure VI-20), as well as longer-term changes in demand for salmon roe products. A sharp peak in ikura prices in 2000 resulted from very low Japanese chum salmon harvests, which reduced Japanese domestic production.

In general, salmon roe markets are affected by different factors than those affecting markets for fresh, frozen and canned salmon and exhibit different trends over time. Salmon roe is and will likely remain an important contributor to the value of wild salmon catches.
References

Products and Markets for North American Wild Salmon

Key Points

✓ The major products produced from wild salmon are canned salmon, frozen salmon, fresh salmon and roe (eggs). For each species of wild salmon, the relative importance of different products varies, and the relative importance of different end-markets varies.

✓ Between 2000 and 2004, less than one fifth of U.S. wild salmon was sold fresh or frozen in the U.S. domestic market, where it was subject to direct competition from U.S. imports of farmed salmon.

✓ More than twice as much U.S. fresh and frozen wild salmon was sold in export markets as in the U.S. domestic market. Thus, most competition between U.S. wild salmon and farmed salmon was occurring in Japan and the EU rather than the U.S. market. About two-fifths of U.S. wild salmon was sold in canned salmon markets where it faced relatively little competition from farmed salmon.

✓ Salmon roe is a very valuable wild salmon product. Between 2000 and 2004, salmon roe accounted for about one-quarter of the total wholesale value of Alaska salmon products.

<table>
<thead>
<tr>
<th>Species</th>
<th>Most important products</th>
<th>Most important markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook</td>
<td>Frozen</td>
<td>United States</td>
</tr>
<tr>
<td></td>
<td>Fresh</td>
<td>United States</td>
</tr>
<tr>
<td>Sockeye</td>
<td>Frozen</td>
<td>Japan</td>
</tr>
<tr>
<td></td>
<td>Canned</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Coho</td>
<td>Frozen</td>
<td>Japan</td>
</tr>
<tr>
<td></td>
<td>Canned</td>
<td>United States</td>
</tr>
<tr>
<td>Pink</td>
<td>Canned</td>
<td>United States</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>United States</td>
</tr>
<tr>
<td></td>
<td>Fresh</td>
<td>United States</td>
</tr>
<tr>
<td>Chum</td>
<td>Roe</td>
<td>Japan</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>United States</td>
</tr>
<tr>
<td></td>
<td>Fresh</td>
<td>United States</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nature of competition with farmed salmon</th>
<th>Canned markets</th>
<th>Export fresh &amp; frozen markets</th>
<th>US fresh &amp; frozen markets</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relatively little competition from farmed salmon</td>
<td>1%</td>
<td>13%</td>
<td>87%</td>
<td>100%</td>
</tr>
<tr>
<td>Competition with farmed salmon in foreign markets</td>
<td>35%</td>
<td>53%</td>
<td>12%</td>
<td>100%</td>
</tr>
<tr>
<td>Competition with farmed salmon in U.S. domestic market</td>
<td>9%</td>
<td>50%</td>
<td>41%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>70%</td>
<td>26%</td>
<td>4%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>7%</td>
<td>52%</td>
<td>41%</td>
<td>100%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>40%</td>
<td>42%</td>
<td>17%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: Shares for individual species may be biased to the extent that exports were reported as “unspecified.” Source: Table VII-8.
Introduction

In this chapter we review the products made from North American wild salmon and the markets these products are sold into. We begin by reviewing the variety of products made from wild salmon. Next, we review the products made from Alaska wild salmon, how production varies between species and how production has changed over time.

We then look at end-markets for U.S. salmon products—the volumes of different products and species consumed in the United States and exported to other countries.

We then examine wholesale price trends for different Alaska wild salmon products, and how wholesale prices have compared with ex-vessel prices paid to fishermen over time.

Next we examine production, end-markets and prices for Alaska salmon roe, a valuable product which has increased in relative importance to the industry as prices for canned, frozen and fresh salmon has declined.

Finally, we briefly discuss products and markets for British Columbia wild salmon, which are generally similar to those for Alaska wild salmon.

<table>
<thead>
<tr>
<th>Table VII-1</th>
<th>Wild Salmon Processing Stages and Product Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fishing and Processing Stage</strong></td>
<td><strong>Primary Processing</strong></td>
</tr>
<tr>
<td>Unprocessed “whole” or “round” fish delivered by fishermen</td>
<td>First stage of processing to preserve fish after they are caught; generally bulk processing of large volumes</td>
</tr>
<tr>
<td>Fishermen direct sales to consumers</td>
<td>Fresh</td>
</tr>
<tr>
<td>Fishermen sales to processors</td>
<td>Frozen (various sizes) (various grades); Frozen round</td>
</tr>
<tr>
<td>Canned</td>
<td>Tails; Halves; Quarters; Four-pound; Skinless-boneless; Salmon pouches</td>
</tr>
<tr>
<td>Roe</td>
<td>Ikura (caviar); Sujiko (whole skeins)</td>
</tr>
</tbody>
</table>
few weeks) primary processors often need to process large volumes of fish in relatively short periods of time. This is an important practical constraint for wild salmon processing and marketing. Even though value-added products might be more attractive to consumers and command higher prices, the only practical means of preserving large volumes of fish caught in a short period of time may be canning or freezing the fish in headed and gutted form.

After primary processing, frozen (and some fresh) products usually undergo further “secondary processing” into the product forms sold to retailers, restaurants and consumers. These include frozen fillets and steaks as well as a wide variety of other products including smoked salmon, marinated portions, salmon nuggets and popular Japanese consumer products such as kirimi (sliced fillets) and teien (fillets salted by soaking in brine solutions)

Canned salmon—the major salmon product form until the 1970s—remains a very important product for the wild salmon industry. Salmon is canned in several different standard sizes, of which the most important are “talls” and “halves.” Historically, a “tall” was a 1-pound can and a “half” was a half-pound can. Over time, the actual fish weight in the cans has declined slightly.

Salmon roe (eggs extracted from female salmon) is also a valuable product of the North American salmon industry. We discuss salmon roe products and markets at the end of this chapter.

Figures VII-1 and VII-2 show the total volume and wholesale value of these salmon products produced in Alaska between 1984 and 2004. Both production volume and value show significant variation from year to year, reflecting variation in catches. Variation in value is also a function of changes in prices, which is a function of changes in catches as well as other market forces. Frozen and canned salmon account for most of the volume and value of production.

The total wholesale value of Alaska salmon production (in nominal dollars, unadjusted for inflation) peaked in 1988 at more than $1.15 billion, and then fell by more than half to $516 million in 2002. By 2004 total wholesale value stood at $825 million.

Source: Alaska Department of Fish and Game, Commercial Operator Annual Reports.

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1 Wholesale value is the first wholesale value paid to Alaska primary processors, as reported in processors’ annual Commercial Operator Annual Reports submitted to the Alaska Department of Fish and Game.
Figure VII-2  Alaska Salmon Wholesale Value, 1984-2004

Source: Alaska Department of Fish and Game, Commercial Operator Annual Reports.

Canned salmon products: quarter, halves and tails

Frozen headed and gutted wild sockeye salmon

Photograph by Gunnar Knapp

Photograph by Norman Van Vactor
Alaska Salmon Production

Table VII-2 and Figure VII-3 summarize average annual Alaska salmon production (excluding roe) by product and species over the years 2000-2004. The most important products are canned and frozen salmon. Frozen salmon accounted for 49 percent of Alaska salmon production and canned salmon accounted for 41 percent. Fresh salmon accounted for only 8 percent.

The mix of products generated from Alaska salmon catches varies widely between species. For two species—pink salmon and sockeye salmon—canned salmon accounts for a significant share of production.
### Average Alaska Salmon Production, by Product and Species, 2000-2004

<table>
<thead>
<tr>
<th>Product</th>
<th>Chinook</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metric tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canned</td>
<td>37</td>
<td>20,544</td>
<td>1,142</td>
<td>58,168</td>
<td>3,101</td>
<td>82,992</td>
</tr>
<tr>
<td>Fresh</td>
<td>1,071</td>
<td>5,003</td>
<td>1,743</td>
<td>2,449</td>
<td>6,207</td>
<td>16,473</td>
</tr>
<tr>
<td>Frozen</td>
<td>2,220</td>
<td>35,132</td>
<td>8,806</td>
<td>22,645</td>
<td>29,943</td>
<td>98,747</td>
</tr>
<tr>
<td>Other</td>
<td>30</td>
<td>628</td>
<td>92</td>
<td>1,587</td>
<td>704</td>
<td>3,040</td>
</tr>
<tr>
<td>Total</td>
<td>3,358</td>
<td>61,308</td>
<td>11,783</td>
<td>84,214</td>
<td>39,814</td>
<td>200,477</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Share of production, by product</th>
<th>Canned</th>
<th>Fresh</th>
<th>Frozen</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canned</td>
<td>1%</td>
<td>32%</td>
<td>66%</td>
<td>1%</td>
<td>100%</td>
</tr>
<tr>
<td>Fresh</td>
<td>34%</td>
<td>8%</td>
<td>57%</td>
<td>1%</td>
<td>100%</td>
</tr>
<tr>
<td>Frozen</td>
<td>10%</td>
<td>15%</td>
<td>75%</td>
<td>1%</td>
<td>100%</td>
</tr>
<tr>
<td>Other</td>
<td>69%</td>
<td>3%</td>
<td>27%</td>
<td>2%</td>
<td>41%</td>
</tr>
<tr>
<td>Total</td>
<td>8%</td>
<td>16%</td>
<td>75%</td>
<td>2%</td>
<td>41%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Share of production, by species</th>
<th>Canned</th>
<th>Fresh</th>
<th>Frozen</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canned</td>
<td>0%</td>
<td>6%</td>
<td>2%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Fresh</td>
<td>25%</td>
<td>30%</td>
<td>36%</td>
<td>21%</td>
<td>31%</td>
</tr>
<tr>
<td>Frozen</td>
<td>1%</td>
<td>11%</td>
<td>9%</td>
<td>3%</td>
<td>11%</td>
</tr>
<tr>
<td>Other</td>
<td>70%</td>
<td>15%</td>
<td>23%</td>
<td>52%</td>
<td>42%</td>
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<tr>
<td>Total</td>
<td>4%</td>
<td>38%</td>
<td>30%</td>
<td>23%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: Alaska Department of Fish and Game, Commercial Operator Annual Reports.
Note: Does not include salmon roe.

### Average Annual Alaska Salmon Production, 2000-2004

Source: Alaska Department of Fish and Game, Commercial Operator Annual Reports.
For the years 2000-2004, canned salmon accounted for 69 percent of pink salmon production and 34 percent of sockeye salmon production.

Frozen salmon is the most important product for all species except for pink salmon. For the years 2000-2004, frozen salmon accounted for 75 percent of chum and coho salmon production, 57 percent of sockeye salmon production, and 27 percent of pink salmon production.

Fresh salmon accounted for 32 percent of chinook salmon production, 16 percent of chum production and 15 percent of coho production for the years 2000-2004.

Figures VII-4, VII-5 and VII-6 show trends in production for the years 1984-2004 for the three most important Alaska species: sockeye salmon, pink salmon and chum salmon. For all three species, total production fluctuated from year to year according to the salmon catches. The relative mix of different products in production also fluctuated from year to year.

For sockeye salmon, the large increase in catches during the early 1990s resulted in larger and larger production of frozen salmon. However, as catches declined after the mid-1990s, frozen sockeye production fell dramatically before increasing in 2003 and 2004. Average canned sockeye production did not exhibit a similar decline as catches declined, in other words, as sockeye catch declined after the mid-1990s a greater share of catches were processed into the relatively lower valued canned products. Fresh sockeye production—a relatively small share of total sockeye production for most of this period—increased sharply in 2004.

For pink salmon, large variations in catches from year to year resulted in corresponding variations in production, but the relative mix of products produced stayed about the same for most of the period. The frozen share of pink salmon production increased in 2003 and 2004.

For chum salmon, frozen and fresh salmon production grew rapidly as catches increased during the 1990s, but fell after 2000 as catches fell. Between 2000 and 2004, the relative share of fresh production increased while that of frozen production declined.

**Figure VII-4** Alaska Sockeye Salmon Production, 1984-2004

<table>
<thead>
<tr>
<th>Year</th>
<th>Canned</th>
<th>Frozen</th>
<th>Fresh</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td></td>
<td></td>
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<tr>
<td>1986</td>
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<td>1992</td>
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<td>2002</td>
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<td>2004</td>
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</tbody>
</table>

Source: Alaska Department of Fish and Game, Commercial Operator Annual Reports.
Figure VII-5  Alaska Pink Salmon Production, 1984-2004

Source: Alaska Department of Fish and Game, Commercial Operator Annual Reports.

Figure VII-6  Alaska Chum Salmon Production, 1984-2004

Source: Alaska Department of Fish and Game, Commercial Operator Annual Reports.
Having discussed the products made from wild Alaska salmon, we next discuss the end markets that United States wild salmon products are sold into. Analyzing markets for wild salmon is complicated by several factors:

- Although data are available to track United States exports of wild salmon to other countries, there are no data to track how much Alaska wild salmon or U.S. Pacific Northwest wild salmon is sold in the United States. We can only estimate sales to the United States indirectly, by subtracting exports from production.
- Production data are only available for Alaska wild salmon (but not for U.S. Pacific Northwest wild salmon) whereas export data are only available for all United States production (including both Alaska and U.S. Pacific Northwest wild salmon).
- U.S. salmon export data include some exports for which the species is not specified. This makes it impossible to know actual total export volumes for each species, which in turn makes it impossible to estimate precisely volumes “not exported” (consumed domestically) for each species.

For these reasons, estimating the volumes of U.S. wild salmon sold domestically requires making a number of assumptions. The numbers which we present for U.S. consumption in this and the following chapter should be considered approximate estimates rather than precise data. Appendix C describes our methodology for estimating U.S. consumption.

The volumes of salmon sold to different markets vary from year to year because of year-to-year variations in the catch volume. Rather than discuss end market volumes in any particular year, we instead present estimates of average exports and domestic consumption for the five-year period 2000-2004. For this reason also, the numbers presented in this section should be considered general indicators of the relative importance of different end markets for different species. The actual volumes going to these different markets vary from year to year.

The most important end markets for U.S. canned salmon production are the United States and the United Kingdom. Most canned pink salmon is sold to the U.S. domestic market, while most canned sockeye salmon is sold to the United Kingdom and other export markets.

### Table VII-3 Estimated End-Markets for U.S. Canned Salmon Production, 2000-2004

<table>
<thead>
<tr>
<th>Average annual volumes, thousand metric tons</th>
<th>Approx. U.S. Production*</th>
<th>Approx. volume consumed in USA**</th>
<th>Exports by Country</th>
<th>United Kingdom</th>
<th>Canada</th>
<th>Australia</th>
<th>Netherlands</th>
<th>Other countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook</td>
<td>0.04</td>
<td>0.04</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Sockeye</td>
<td>22.0</td>
<td>1.2</td>
<td>20.1</td>
<td>11.4</td>
<td>6.1</td>
<td>1.2</td>
<td>0.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Coho</td>
<td>1.2</td>
<td>1.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Pink</td>
<td>59.2</td>
<td>42.3</td>
<td>16.9</td>
<td>5.6</td>
<td>4.7</td>
<td>3.2</td>
<td>1.4</td>
<td>2.0</td>
</tr>
<tr>
<td>Chum</td>
<td>3.2</td>
<td>2.3</td>
<td>0.9</td>
<td>0.1</td>
<td>0.3</td>
<td>0.0</td>
<td>0.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Unspecified***</td>
<td>-5.2</td>
<td>5.2</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td>0.1</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>85.6</td>
<td>42.5</td>
<td>43.1</td>
<td>17.5</td>
<td>13.5</td>
<td>4.9</td>
<td>2.5</td>
<td>4.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Share of total</th>
<th>Approx. U.S. Production*</th>
<th>Approx. volume consumed in USA**</th>
<th>Exports by Country</th>
<th>United Kingdom</th>
<th>Canada</th>
<th>Australia</th>
<th>Netherlands</th>
<th>Other countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook</td>
<td>100%</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Sockeye</td>
<td>100%</td>
<td>9%</td>
<td>91%</td>
<td>52%</td>
<td>28%</td>
<td>6%</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Coho</td>
<td>100%</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Pink</td>
<td>100%</td>
<td>71%</td>
<td>29%</td>
<td>9%</td>
<td>8%</td>
<td>5%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Chum</td>
<td>100%</td>
<td>73%</td>
<td>27%</td>
<td>2%</td>
<td>8%</td>
<td>0%</td>
<td>3%</td>
<td>13%</td>
</tr>
<tr>
<td>Unspecified***</td>
<td>100%</td>
<td>50%</td>
<td>50%</td>
<td>20%</td>
<td>16%</td>
<td>6%</td>
<td>3%</td>
<td>6%</td>
</tr>
</tbody>
</table>

*Sum of Alaska production and Pacific Northwest production. Alaska production estimated as the maximum of Alaska canned production reported in ADFG COAR data and estimated volume calculated from NFPA Alaska canned pack data.

**Volume consumed in United States estimated by subtracting export volume from approximate U.S. production. May overstate actual consumption in United States to the extent that exports of the species are included in “unspecified” exports.

***Negative “unspecified” consumption is export volume for which the species was not known.
**Figure VII-7**

Estimated End Markets for US Canned Salmon Production, 2000-2004 (average annual volumes, thousand metric tons)

Source: Alaska Department of Fish and Game, Commercial Operator Annual Reports.

**Table VII-4**

Estimated End-Markets for U.S. Frozen Salmon Production, 2000-2004

<table>
<thead>
<tr>
<th>Average annual volumes, thousand metric tons</th>
<th>Approx. U.S. Production*</th>
<th>Approx. volume consumed in USA**</th>
<th>Exports</th>
<th>Japan</th>
<th>Canada</th>
<th>France</th>
<th>China</th>
<th>Other countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook</td>
<td>2.2</td>
<td>1.5</td>
<td>0.7</td>
<td>0.4</td>
<td>0.1</td>
<td>0.0</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Sockeye</td>
<td>35.1</td>
<td>6.8</td>
<td>28.4</td>
<td>24.5</td>
<td>1.2</td>
<td>0.1</td>
<td>0.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Coho</td>
<td>8.8</td>
<td>3.1</td>
<td>5.7</td>
<td>2.0</td>
<td>0.9</td>
<td>0.7</td>
<td>0.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Pink</td>
<td>22.6</td>
<td>5.1</td>
<td>17.5</td>
<td>0.6</td>
<td>0.7</td>
<td>1.9</td>
<td>2.9</td>
<td>11.3</td>
</tr>
<tr>
<td>Chum</td>
<td>29.9</td>
<td>12.1</td>
<td>17.9</td>
<td>1.2</td>
<td>1.2</td>
<td>2.4</td>
<td>3.8</td>
<td>9.2</td>
</tr>
<tr>
<td>Unspecified***</td>
<td>-3.0</td>
<td>3.0</td>
<td>1.2</td>
<td>0.3</td>
<td>0.1</td>
<td>0.2</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>98.7</td>
<td>25.6</td>
<td>73.2</td>
<td>30.0</td>
<td>4.2</td>
<td>5.3</td>
<td>8.0</td>
<td>25.6</td>
</tr>
</tbody>
</table>

Share of total

| Chinook                                     | 100%                     | 69%                             | 31%     | 19%   | 3%     | 1%     | 3%    | 6%             |
| Sockeye                                     | 100%                     | 19%                             | 81%     | 70%   | 3%     | 0%     | 2%    | 5%             |
| Coho                                        | 100%                     | 35%                             | 65%     | 23%   | 10%    | 8%     | 2%    | 22%            |
| Pink                                        | 100%                     | 23%                             | 77%     | 3%    | 3%     | 8%     | 13%   | 50%            |
| Chum                                        | 100%                     | 40%                             | 60%     | 4%    | 4%     | 8%     | 13%   | 31%            |
| Unspecified***                              |                          |                                 |         |       |        |        |       |                |
| TOTAL                                       | 100%                     | 26%                             | 74%     | 30%   | 4%     | 5%     | 8%    | 26%            |

*Sum of Alaska production and Pacific Northwest production. Alaska production estimated as the maximum of Alaska canned production reported in ADFG COAR data and estimated volume calculated from NFPA Alaska canned pack data.

**Volume consumed in United States estimated by subtracting export volume from approximate U.S. production. May overstate actual consumption in United States to the extent that exports of the species are included in “unspecified” exports.

***Negative “unspecified” consumption is export volume for which the species was not known.
The most important end markets for U.S. frozen salmon production are Japan, the United States, China, France and Canada. During the period 2000-2004, exports to Japan accounted for about 70 percent of frozen sockeye production, 23 percent of frozen coho production and 19 percent of frozen chinook production. Relatively little frozen chum or pink salmon was sold to Japan. The United States was the largest market for frozen products of all species except sockeye.

China was the largest export market for frozen pink and chum salmon. Exports of frozen chum and pink salmon to China, which have grown rapidly in recent years, are not necessarily destined for consumption in China. A large part of these exports are salmon frozen in the round for subsequent re-processing in China and export to other countries in a variety of product forms.

As noted above, U.S. production of fresh salmon is relatively small in comparison with canned and frozen salmon. Most fresh chinook, chum and coho salmon are consumed in the United States. In contrast, Canada is the largest market for fresh sockeye and pink salmon. Generally, most of these exports of “fresh” salmon consist of unprocessed salmon shipped to plants in British Columbia for processing into canned product, which are then often re-exported as Canadian product.

**Figure VII-8**

*Estimated End Markets for US Frozen Salmon Production, 2000-2004 (average annual volumes, thousand metric tons)*

Source: Alaska Department of Fish and Game, Commercial Operator Annual Reports.
Table VII-6 summarizes our estimates of end markets for U.S. wild salmon for each species. The seven markets which accounted for more than 10,000 metric tons (mt) are shown in bold. As shown in Table VII-7, these seven markets accounted for 73 percent of total U.S. wild salmon production. The top three markets—the U.S. canned market for pink salmon and the export frozen and canned markets for sockeye salmon—together accounted for 43 percent of total production.
As shown in Table VII-9, the most important end markets are different for each species of Alaska salmon. The most important markets for chinook salmon are the U.S. fresh and frozen markets. The most important markets for sockeye salmon are the export frozen market and canned markets. The most important markets for coho salmon are the export frozen market and the U.S. frozen and fresh markets. The most important markets for pink salmon are the U.S. canned market and the export frozen and canned markets. The most important markets for chum salmon are the U.S. frozen market and the export frozen market.

Table VII-9 shows the same information for end-market shares for U.S. wild salmon, summarized by the nature of competition from farmed salmon. As we discuss in later chapters, U.S. wild salmon has faced relatively little direct competition to date from farmed salmon in canned salmon markets (although some farmed salmon is now beginning to be canned). In contrast, U.S. wild salmon has faced stiff competition from farmed salmon in export fresh and frozen markets as well as in U.S. fresh and frozen markets.

Perhaps the most important point to be drawn from Table VII-9—and from this entire chapter—is that during the years 2000-2004 less than one fifth of U.S. wild salmon was sold fresh or frozen in the U.S. domestic market, where it was subject to direct competition from U.S. imports of farmed salmon.

The effects of imported farmed salmon on markets for U.S. wild salmon are the subject of much interest and a major focus of this report. But during the years 2000-2004, more than twice as much U.S. wild salmon was sold in export fresh and frozen markets as in the U.S. domestic market. Competition from farmed salmon is equally intense in foreign fresh and frozen salmon markets. But many of the strategies which have been suggested for competing against farmed salmon, such as tariffs on farmed salmon or expanded domestic marketing of U.S. wild salmon would have little or no effect on foreign markets. Put simply, competition between U.S. wild salmon and farmed salmon is occurring in a global market, not only or even primarily in the domestic market.

### Table VII-7

<table>
<thead>
<tr>
<th>Species</th>
<th>End market</th>
<th>Average volume (000 mt)</th>
<th>% of total volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pink</td>
<td>US canned market</td>
<td>42.3</td>
<td>20%</td>
</tr>
<tr>
<td>Sockeye</td>
<td>Export frozen market</td>
<td>28.4</td>
<td>13%</td>
</tr>
<tr>
<td>Sockeye</td>
<td>Export canned market</td>
<td>20.1</td>
<td>10%</td>
</tr>
<tr>
<td>Chum</td>
<td>Export frozen market</td>
<td>17.9</td>
<td>8%</td>
</tr>
<tr>
<td>Pink</td>
<td>Export frozen market</td>
<td>17.5</td>
<td>8%</td>
</tr>
<tr>
<td>Pink</td>
<td>Export canned market</td>
<td>16.9</td>
<td>8%</td>
</tr>
<tr>
<td>Chum</td>
<td>US frozen market</td>
<td>12.1</td>
<td>6%</td>
</tr>
<tr>
<td>All other markets</td>
<td></td>
<td>56.3</td>
<td>27%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>211.4</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: Table VII-6.

### Table VII-8

<table>
<thead>
<tr>
<th></th>
<th>U.S. canned</th>
<th>Export canned</th>
<th>U.S. frozen</th>
<th>Export frozen</th>
<th>U.S. fresh</th>
<th>Export fresh</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook</td>
<td>1%</td>
<td>0%</td>
<td>19%</td>
<td>9%</td>
<td>67%</td>
<td>4%</td>
<td>100%</td>
</tr>
<tr>
<td>Sockeye</td>
<td>3%</td>
<td>32%</td>
<td>11%</td>
<td>45%</td>
<td>1%</td>
<td>8%</td>
<td>100%</td>
</tr>
<tr>
<td>Coho</td>
<td>9%</td>
<td>0%</td>
<td>23%</td>
<td>42%</td>
<td>19%</td>
<td>8%</td>
<td>100%</td>
</tr>
<tr>
<td>Pink</td>
<td>50%</td>
<td>20%</td>
<td>6%</td>
<td>21%</td>
<td>-2%</td>
<td>5%</td>
<td>100%</td>
</tr>
<tr>
<td>Chum</td>
<td>5%</td>
<td>2%</td>
<td>28%</td>
<td>42%</td>
<td>13%</td>
<td>10%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>20%</td>
<td>20%</td>
<td>12%</td>
<td>35%</td>
<td>5%</td>
<td>8%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: End-markets which accounted for more than 10% of production are shown in **bold**. Shares for individual species may be biased to the extent that exports were reported as “unspecified.”

Source: Table VII-6
Also important to note is that during the years 2000-2004, about two-fifths of U.S. wild salmon was sold in canned salmon markets. As we discuss below, canned salmon prices have fallen sharply in recent years, and this has been a major factor in the decline in ex-vessel prices paid to wild salmon fishermen for pink and sockeye salmon. Relatively little of this decline can be attributed to direct competition from farmed canned salmon. Nevertheless, canned markets may have been indirectly affected by farmed salmon. By depressing markets for fresh and frozen salmon, farmed salmon may have caused wild salmon producers to can a relatively larger share of wild catches, leading to greater supply of canned salmon and lower canned salmon prices than would otherwise have occurred.

Only one wild salmon species—chinook salmon—was primarily dependent on the U.S. fresh and frozen market during the 2000-2004 period. Eighty-seven percent of U.S. chinook production remained in the U.S. market—the rest was exported. The comparable shares were 41 percent for coho and chum salmon, 12 percent for sockeye salmon and only 4 percent for pink salmon.

### Wholesale Price Trends for Alaska Salmon Products

Figures VII-9, VII-10 and VII-11 show trends in average wholesale prices for the major products produced from Alaska sockeye, pink and chum salmon, as well as ex-vessel prices paid to fishermen for these species. “Wholesale prices” are the average wholesale prices received by Alaska primary processors, calculated by dividing sales value by total sales volume.

Note that the wholesale prices are expressed in dollars per processed pound. For purposes of comparison with wholesale prices, we divided the ex-vessel price by standard processing yields for the most important wholesale product for each species. This gives processors’ cost of fish purchases per pound of processed product.

There are four important points to note about wholesale price trends. First, for all of the major products produced from these three species, wholesale prices rose rapidly in the late 1980s, peaked in 1988 and trended downwards over the 15-year period from 1988 to 2002. The decline in prices over this period would appear more dramatic if the graphs showed “real” (inflation-adjusted) prices. The decline in prices was not continuous—there were years when prices rose—but the long-term trend was downwards.

Second, between 2002 and 2004 wholesale prices increased for the major fresh and frozen salmon products made from these species (frozen sockeye, frozen pink and fresh and frozen chum). However, 2004 nominal prices were below levels of the early 1990s (except for frozen pink salmon).

Third, there was no corresponding price rise between 2002 and 2004 for canned sockeye and pink salmon. Canned salmon prices did not rebound during this period as they did for fresh and frozen salmon.

Fourth, in general, trends in wholesale prices were reflected in ex-vessel prices paid to fishermen. In general, when processors received higher wholesale prices for the products made from salmon, they paid fishermen higher prices; when processors received lower prices, they paid fishermen lower prices.

---

**Table VII-9**

<table>
<thead>
<tr>
<th>Nature of competition with farmed salmon</th>
<th>Relatively little competition from farmed salmon</th>
<th>Competition with farmed salmon in foreign markets</th>
<th>Competition with farmed salmon in U.S. domestic market</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Canned markets</td>
<td>Export fresh &amp; frozen markets</td>
<td>US fresh &amp; frozen markets</td>
<td></td>
</tr>
<tr>
<td>Chinook</td>
<td>1%</td>
<td>13%</td>
<td>87%</td>
<td>100%</td>
</tr>
<tr>
<td>Sockeye</td>
<td>35%</td>
<td>53%</td>
<td>12%</td>
<td>100%</td>
</tr>
<tr>
<td>Coho</td>
<td>9%</td>
<td>50%</td>
<td>41%</td>
<td>100%</td>
</tr>
<tr>
<td>Pink</td>
<td>70%</td>
<td>26%</td>
<td>4%</td>
<td>100%</td>
</tr>
<tr>
<td>Chum</td>
<td>7%</td>
<td>52%</td>
<td>41%</td>
<td>100%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>40%</td>
<td>42%</td>
<td>17%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: Shares for individual species may be biased to the extent that exports were reported as “unspecified.”

Source: Table VII-8.

2 From Chapter III, chinook landings are only 2 percent of total wild landings and are caught from California to Alaska.

The Great Salmon Run: Competition Between Wild and Farmed Salmon
Figure VII-9  Average Annual Wholesale and Ex-Vessel Prices for Alaska Sockeye Salmon

Source: Ex-vessel prices are from CFEC Alaska Salmon Summary Data 1980-2005; Wholesale prices are from ADFG COAR data. Processor’s fish cost based on assumed yield of 74%.

Note: During the years 1984-2004, the frozen share of sockeye production ranged between 53% and 90%. The canned share ranged between 8% and 38%.

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Figure VII-10  Average Annual Wholesale and Ex-Vessel Prices for Alaska Pink Salmon

Source: Ex-vessel prices are from CFEC Alaska Salmon Summary Data 1980-2005; Wholesale prices are from ADFG COAR data. Processor’s fish cost based on assumed yield of 74%.

Note: During the years 1984-2004, the canned share of pink production ranged between 56% and 83%. The frozen share ranged between 13% and 42%.
Wholesale and ex-vessel prices did not change in exactly the same way: the margin between average wholesale prices and processors’ average fish costs was not exactly the same each year. There are a number of reasons for this. Average costs of processing vary from year to year depending upon the mix of products produced, the size of the catch and the relative distribution of catches between different regions. Roe prices also vary from year to year. This is particularly important for chum salmon, for which roe accounts for a substantial share of total wholesale value.

**Alaska Salmon Roe Production and Markets**

Salmon roe is a valuable product of the wild salmon industry. Between 2000 and 2004, salmon roe accounted for about 17 percent of the total wholesale value of Alaska salmon products.

Salmon roe is processed at primary processing plants into two major product forms: *ikura* (individual eggs or salmon caviar) and *sujiko* (eggs in whole skeins). Salmon roe processing, which requires specialized...
grading and handling skills, is often carried out or supervised by Japanese “roe technicians” who travel to Alaska for the salmon season. *Ikura* is a relatively higher value product, but is also more difficult to process. In general, most chum salmon roe is processed into *ikura*, while most roe of other species is processed into *sujiko* (although roe of all species may be processed into both products).

Table VII-10 provides an overview of Alaska salmon roe production for the years 2000-2004. The volume of roe production as a percentage of the total catch volume, sometimes referred to as “roe yield,” varied from 1.7 percent for chinook salmon to 4.2 percent for chum salmon.

Average wholesale prices paid for salmon roe between 2000 and 2004 ranged from $4.13/lb for pink salmon roe to $8.82/lb for chum salmon roe. The total wholesale value of roe production averaged $115 million, of which chum salmon accounted for $54 million, or almost half. Chum salmon roe accounts for a much higher share of Alaska salmon roe value than of the catch volume because both roe yields (amount of roe extracted per fish) and average prices are higher for chum salmon than for other species.

Prices for North American chum roe are dependent to a large extent on the volume of chum roe produced in Japan, the world’s largest producer of chum salmon (almost entirely hatchery-produced) and the main market for salmon roe.

Salmon roe accounted for 47 percent of the total wholesale value of chum roe products produced in Alaska—almost equal to the combined wholesale value of fresh, frozen and canned chum salmon. Roe accounted for 20 percent of the wholesale value of pink salmon. Roe is a relatively higher share of total value for these species partly because their flesh value is lower than for other species.

Almost all salmon roe is exported. As recently as 1997, more than 90 percent of roe exports were to Japan. Since then, exports to other countries have increased, particularly Russia, China, Germany, Netherlands, South Korea and Israel. By 2004, the share of Japan in U.S. roe exports had fallen to 72 percent, while the combined share of these other countries was 22 percent.

Markets for salmon roe are completely distinct from farmed salmon markets. They are driven by different factors than markets for farmed salmon. One reason is that production of salmon roe from farmed salmon has been relatively low, because salmon farmers usually sell salmon before the eggs are mature.

As a result, salmon roe has not experienced a general downward trend in prices like other North American salmon products. As shown in Figure VII-12, prices for chum and pink salmon roe have been relatively strong since 2000. However, sockeye roe prices declined by more than one-third between 1991 and 2004.

The total value of roe production varies from year to year, reflecting variation in salmon catches, roe yields and roe prices (Figure VII-13). The total wholesale value of roe production peaked in 2000 at $155 million, driven by a combination of high chum salmon catches and chum roe prices. Between 2002 and 2004, the wholesale value of roe production averaged $102 million.

**Table VII-10: Overview of Alaska Salmon Roe Production (annual averages, 2000-2004)**

<table>
<thead>
<tr>
<th></th>
<th>Chinook</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of roe production</td>
<td>69</td>
<td>1,805</td>
<td>318</td>
<td>4,450</td>
<td>2,771</td>
<td>9,413</td>
</tr>
<tr>
<td>(metric tons)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Alaska salmon catch</td>
<td>3,991</td>
<td>86,966</td>
<td>15,880</td>
<td>156,940</td>
<td>66,674</td>
<td>330,451</td>
</tr>
<tr>
<td>(metric tons)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roe production as % of catch</td>
<td>1.7%</td>
<td>2.1%</td>
<td>2.0%</td>
<td>2.8%</td>
<td>4.2%</td>
<td>2.8%</td>
</tr>
<tr>
<td>volume</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average wholesale price of</td>
<td>$4.91</td>
<td>$4.35</td>
<td>$4.38</td>
<td>$4.13</td>
<td>$8.82</td>
<td>$5.57</td>
</tr>
<tr>
<td>roe ($/lb)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wholesale value of roe</td>
<td>0.7</td>
<td>17.3</td>
<td>3.1</td>
<td>40.5</td>
<td>53.9</td>
<td>115.5</td>
</tr>
<tr>
<td>($ millions)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wholesale value of salmon</td>
<td>21.2</td>
<td>274.8</td>
<td>39.2</td>
<td>161.0</td>
<td>61.8</td>
<td>558.1</td>
</tr>
<tr>
<td>flesh ($ millions)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roe value as share of total</td>
<td>3%</td>
<td>6%</td>
<td>7%</td>
<td>20%</td>
<td>47%</td>
<td>17%</td>
</tr>
<tr>
<td>wholesale value (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: ADFG COAR data; CFEC Alaska Salmon Summary Data 1980-2005.
Figure VII-12  
Average Wholesale Prices Paid to Processors for Alaska Salmon Roe

Source: ADFG COAR data

Figure VII-13  
Wholesale Value of Alaska Salmon Roe Production

Source: ADFG COAR data
As the total wholesale value of Alaska salmon flesh products (canned, frozen and fresh salmon) fell between 1988 and 2002 (recall Figure VII-2 at the beginning of this chapter) the relative share of salmon roe in the wholesale value of Alaska salmon increased. Between 2000 and 2002, salmon roe accounted for approximately 20 percent of total salmon wholesale value and more than half of the wholesale value of chum salmon. As the value of salmon flesh products increased after 2002, the relative share of roe in wholesale value declined.

**British Columbia Salmon Production**

The preceding sections of this chapter have discussed Alaska salmon products and markets in detail. We conclude with a brief discussion of products and markets for British Columbia wild salmon.  

In general, the products produced from British Columbia wild salmon are similar to those produced from Alaska, they sell into similar end markets and wholesale prices have followed similar trends.

Table VII-11 shows the volume and value of products produced from British Columbia wild salmon in 1996, the most recent year for which detailed production data have been published. Frozen salmon accounted for 49 percent of total production, followed by canned salmon (30 percent) and fresh salmon (13 percent). One important difference from Alaska was that a larger share of sockeye salmon production was canned (52 percent) than was frozen (33 percent).

Table VII-12 summarizes Canadian salmon exports for 1999. The most important export markets for Canadian wild salmon were the United States, the United Kingdom and Japan. Exports to the United Kingdom were primarily canned salmon; the United Kingdom accounted for about half of all Canadian canned salmon exports.

As in Alaska, most Canadian frozen sockeye salmon was exported to Japan. Japan was also the most important export market for Canadian frozen chinook. As in Alaska, the United States is the most important market for Canadian frozen pink and chum salmon. The United States is by far the most important market for Canadian fresh salmon of all species.

A complicating factor in analysis of Canadian wild salmon production and markets is that a significant share of the salmon which are processed and exported are salmon caught in Alaska or Russia and brought to

---

3 We are not aware of any production data for U.S. Pacific Northwest salmon similar to that available for Alaska and British Columbia.
British Columbia for processing (B.C. Ministry of Finance and Corporate Relations 2001). In 2004, for example, 62 percent of British Columbia canned salmon production was of imported salmon, mostly from Alaska (Table VII-13).

As shown in Table VII-14, the United States is a net exporter of wild salmon products to Canada. In 2003 the United States exported more than 6,000 mt of fresh wild salmon to Canada. Probably most of this fresh salmon was delivered directly by U.S. fishermen to Canadian processors. Similarly the United States exported more than 18,000 mt of canned salmon to Canada. Table VII-12 indicates that it is likely much of this canned salmon was subsequently re-exported to markets in other countries.

The fact that trade of both unprocessed and processed salmon occurs in both directions between the United States makes it difficult to determine the relative significance of Canadian wild salmon in the U.S. market and the relative significance of the United States as a market for Canadian wild salmon. In general, however, Canadian wild salmon catches are relatively small compared to those of Alaska and Canadian imports represent a relatively small share of U.S. wild salmon consumption.

<table>
<thead>
<tr>
<th>Table VII-11</th>
<th>British Columbia Salmon Production, by Species and Product, 1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chinook</td>
</tr>
<tr>
<td>Production volume (metric tons)</td>
<td></td>
</tr>
<tr>
<td>Canned</td>
<td>44</td>
</tr>
<tr>
<td>Fresh</td>
<td>171</td>
</tr>
<tr>
<td>Frozen</td>
<td>284</td>
</tr>
<tr>
<td>Other*</td>
<td>107</td>
</tr>
<tr>
<td>Roe</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>619</td>
</tr>
<tr>
<td>Share of production volume</td>
<td></td>
</tr>
<tr>
<td>Canned</td>
<td>7%</td>
</tr>
<tr>
<td>Fresh</td>
<td>28%</td>
</tr>
<tr>
<td>Frozen</td>
<td>46%</td>
</tr>
<tr>
<td>Other*</td>
<td>17%</td>
</tr>
<tr>
<td>Roe</td>
<td>2%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

## Table VII-12

### Canadian Wild Salmon Exports by Product, Species and End Market, 1999

<table>
<thead>
<tr>
<th>Product</th>
<th>Species</th>
<th>United States</th>
<th>United Kingdom</th>
<th>Japan</th>
<th>Other countries</th>
<th>Total</th>
<th>United States</th>
<th>United Kingdom</th>
<th>Japan</th>
<th>Other countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canned</td>
<td>Sockeye</td>
<td>56</td>
<td>1,443</td>
<td>16</td>
<td>394</td>
<td>1,909</td>
<td>3%</td>
<td>76%</td>
<td>1%</td>
<td>21%</td>
</tr>
<tr>
<td></td>
<td>Coho</td>
<td>102</td>
<td>0</td>
<td>103</td>
<td>205</td>
<td>2,059</td>
<td>0%</td>
<td>50%</td>
<td>0%</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Pink</td>
<td>61</td>
<td>2,531</td>
<td>15</td>
<td>3,267</td>
<td>5,874</td>
<td>1%</td>
<td>43%</td>
<td>0%</td>
<td>56%</td>
</tr>
<tr>
<td></td>
<td>Chum</td>
<td>16</td>
<td>0</td>
<td>394</td>
<td>209</td>
<td>399</td>
<td>8%</td>
<td>0%</td>
<td>0%</td>
<td>92%</td>
</tr>
<tr>
<td></td>
<td>Unspecified</td>
<td>89</td>
<td>0</td>
<td>19</td>
<td>109</td>
<td>218</td>
<td>82%</td>
<td>0%</td>
<td>1%</td>
<td>17%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>222</td>
<td>4,076</td>
<td>32</td>
<td>3,976</td>
<td>8,306</td>
<td>3%</td>
<td>49%</td>
<td>0%</td>
<td>48%</td>
</tr>
<tr>
<td>Frozen</td>
<td>Chinook</td>
<td>262</td>
<td>0</td>
<td>446</td>
<td>712</td>
<td>809</td>
<td>37%</td>
<td>0%</td>
<td>63%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Sockeye</td>
<td>49</td>
<td>0</td>
<td>992</td>
<td>1,218</td>
<td>1,267</td>
<td>4%</td>
<td>0%</td>
<td>81%</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Coho</td>
<td>47</td>
<td>0</td>
<td>23</td>
<td>85</td>
<td>135</td>
<td>55%</td>
<td>0%</td>
<td>27%</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td>Pink</td>
<td>293</td>
<td>0</td>
<td>64</td>
<td>487</td>
<td>551</td>
<td>60%</td>
<td>0%</td>
<td>13%</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>Chum</td>
<td>2,241</td>
<td>8</td>
<td>701</td>
<td>4,961</td>
<td>5,663</td>
<td>45%</td>
<td>0%</td>
<td>14%</td>
<td>41%</td>
</tr>
<tr>
<td></td>
<td>Unspecified</td>
<td>54</td>
<td>0</td>
<td>127</td>
<td>0</td>
<td>127</td>
<td>30%</td>
<td>0%</td>
<td>70%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2,946</td>
<td>8</td>
<td>2,353</td>
<td>2,337</td>
<td>7,644</td>
<td>39%</td>
<td>0%</td>
<td>31%</td>
<td>31%</td>
</tr>
<tr>
<td>Fresh</td>
<td>Chinook**</td>
<td>3,235</td>
<td>0</td>
<td>317</td>
<td>0</td>
<td>3,552</td>
<td>91%</td>
<td>0%</td>
<td>9%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Sockeye</td>
<td>96</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>102</td>
<td>94%</td>
<td>0%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Coho</td>
<td>610</td>
<td>0</td>
<td>137</td>
<td>0</td>
<td>653</td>
<td>93%</td>
<td>0%</td>
<td>7%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Pink</td>
<td>200</td>
<td>0</td>
<td>200</td>
<td>200</td>
<td>400</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Chum</td>
<td>2,324</td>
<td>1</td>
<td>0</td>
<td>22</td>
<td>2,346</td>
<td>99%</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Unspecified</td>
<td>1,489</td>
<td>0</td>
<td>1</td>
<td>1,490</td>
<td>1,491</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>7,954</td>
<td>1</td>
<td>366</td>
<td>23</td>
<td>8,344</td>
<td>95%</td>
<td>0%</td>
<td>0%</td>
<td>4%</td>
</tr>
<tr>
<td>Fish Livers &amp; Roes</td>
<td>40</td>
<td>0</td>
<td>127</td>
<td>32</td>
<td>199</td>
<td>290</td>
<td>20%</td>
<td>0%</td>
<td>64%</td>
<td>16%</td>
</tr>
<tr>
<td>Pickled/Cured</td>
<td>291</td>
<td>0</td>
<td>2</td>
<td>73</td>
<td>366</td>
<td>439</td>
<td>80%</td>
<td>0%</td>
<td>1%</td>
<td>20%</td>
</tr>
<tr>
<td>Salted/Dried</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>15%</td>
<td>0%</td>
<td>80%</td>
<td>6%</td>
</tr>
<tr>
<td>Smoked</td>
<td>118</td>
<td>127</td>
<td>42</td>
<td>287</td>
<td>434</td>
<td>434</td>
<td>41%</td>
<td>0%</td>
<td>44%</td>
<td>15%</td>
</tr>
<tr>
<td><strong>ALL PRODUCTS</strong></td>
<td>11,579</td>
<td>4,085</td>
<td>3,050</td>
<td>6,486</td>
<td>25,200</td>
<td>95%</td>
<td>0%</td>
<td>4%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

*Bold shading indicates markets accounting for more than 20% of exports.
**May include exports of farmed chinook salmon.

## Table VII-13

### British Columbia Canned Salmon Pack (48 lb cases, all species)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production from domestic salmon</th>
<th>Production from imported salmon</th>
<th>Total</th>
<th>Domestic share</th>
<th>Imported share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>514,505</td>
<td>475,412</td>
<td>989,917</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>1997</td>
<td>681,344</td>
<td>55,035</td>
<td>736,379</td>
<td>93%</td>
<td>7%</td>
</tr>
<tr>
<td>1998</td>
<td>241,394</td>
<td>493,965</td>
<td>735,359</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>1999</td>
<td>255,806</td>
<td>706,479</td>
<td>962,285</td>
<td>27%</td>
<td>73%</td>
</tr>
<tr>
<td>2000</td>
<td>398,946</td>
<td>247,320</td>
<td>646,266</td>
<td>62%</td>
<td>38%</td>
</tr>
<tr>
<td>2001</td>
<td>414,295</td>
<td>244,017</td>
<td>658,312</td>
<td>63%</td>
<td>37%</td>
</tr>
<tr>
<td>2002</td>
<td>345,122</td>
<td>128,310</td>
<td>473,432</td>
<td>73%</td>
<td>27%</td>
</tr>
<tr>
<td>2003</td>
<td>415,676</td>
<td>134,926</td>
<td>550,602</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>2004</td>
<td>147,697</td>
<td>243,692</td>
<td>391,389</td>
<td>38%</td>
<td>62%</td>
</tr>
<tr>
<td>2005*</td>
<td>246,179</td>
<td>233,518</td>
<td>479,715</td>
<td>51%</td>
<td>49%</td>
</tr>
</tbody>
</table>

### Table VII-14 United States Wild Salmon Trade with Canada, 2005 (metric tons)

<table>
<thead>
<tr>
<th>Species</th>
<th>Product</th>
<th>US exports to Canada</th>
<th>US imports from Canada</th>
<th>Net exports (+) or imports (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook</td>
<td>Fresh</td>
<td>155</td>
<td>872</td>
<td>-717</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td></td>
<td>569</td>
<td>-569</td>
</tr>
<tr>
<td>Sockeye</td>
<td>Canned</td>
<td>8,962</td>
<td>133</td>
<td>8,829</td>
</tr>
<tr>
<td></td>
<td>Fresh</td>
<td>3,349</td>
<td>77</td>
<td>3,272</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>1,795</td>
<td>11</td>
<td>1,785</td>
</tr>
<tr>
<td>Coho</td>
<td>Fresh</td>
<td>339</td>
<td>246</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>1,482</td>
<td>187</td>
<td>1,295</td>
</tr>
<tr>
<td>Pink</td>
<td>Canned</td>
<td>9,015</td>
<td>57</td>
<td>8,958</td>
</tr>
<tr>
<td></td>
<td>Fresh</td>
<td>626</td>
<td>26</td>
<td>601</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>1,403</td>
<td>219</td>
<td>1,184</td>
</tr>
<tr>
<td>Chum</td>
<td>Canned</td>
<td>265</td>
<td></td>
<td>265</td>
</tr>
<tr>
<td></td>
<td>Fresh</td>
<td>1,303</td>
<td>386</td>
<td>918</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>611</td>
<td>1,891</td>
<td>-1,280</td>
</tr>
<tr>
<td>Unspecified</td>
<td>Canned</td>
<td>190</td>
<td>57</td>
<td>133</td>
</tr>
<tr>
<td></td>
<td>Fresh</td>
<td>571</td>
<td>1,544</td>
<td>-974</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>83</td>
<td>942</td>
<td>-859</td>
</tr>
<tr>
<td>TOTAL</td>
<td>Canned</td>
<td>18,432</td>
<td>247</td>
<td>18,185</td>
</tr>
<tr>
<td></td>
<td>Fresh</td>
<td>6,344</td>
<td>3,151</td>
<td>3,193</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>5,375</td>
<td>3,819</td>
<td>1,556</td>
</tr>
</tbody>
</table>

Note: Includes only wild Pacific salmon. Includes only canned, fresh and frozen salmon. Excludes re-exports. Source: NMFS Fisheries Trade data.
References


Overview of U.S. Salmon Consumption

Key Points

- During the years 2000-2004, Americans consumed an average of about 284,000 metric tons of salmon annually, of which approximately:
  - one-third was Pacific salmon and two-thirds was Atlantic salmon
  - one-third was wild and two-thirds was farmed
  - one-third was domestic production and two-thirds was imported
  - three-fifths was fresh salmon, one-fifth was frozen salmon and one-fifth was canned salmon
- 21 percent of Pacific salmon was fresh while 87 percent of Atlantic salmon was fresh
- Total U.S. salmon consumption increased dramatically from about 130,000 metric tons in 1989 to more than 300,000 metric tons in 2004, mostly due to rapid growth in consumption of imported farmed salmon. Between 2000 and 2004, about 78 percent of fresh and frozen salmon consumption in the United States was imported farmed salmon.
- Between 2000 and 2004, about 16 percent of total salmon consumption in the United States was canned salmon.
- Since 2001, salmon (including canned salmon) has ranked third among fish species consumed in the United States, after shrimp and canned tuna and accounted for about 14 percent of U.S. fish consumption. Fish represented less than 8 percent of total U.S. consumption of meat, poultry and fish in 2001, while salmon represented just 1 percent.

Introduction

Our goal in this chapter is to provide an overview of U.S. salmon consumption. This overview is needed to understand the salmon trade and marketing issues discussed later in this report.

We begin by describing U.S. salmon consumption: how much salmon Americans consume, what species they consume, what products they consume, where it comes from and how much is wild and farmed. Next we describe recent trends in salmon consumption over time. We then discuss the relative scale of U.S. salmon consumption compared with consumption of other kinds of seafood and compared with meat.

The data presented in this chapter are estimates derived from a number of sources. In general, estimated consumption is equal to U.S. production plus imports minus exports. Appendix C describes how the estimates were derived and the data sources they are based on. In reading the chapter, it is important to keep the following in mind:

- Our estimates of consumption from imports are more reliable than our estimates of consumption from domestic production—because more comprehensive and detailed data are available for imports than for domestic production.
- Our estimates of longer-term trends in consumption

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1 This method of estimating consumption is known as a “disappearance model.” Consumption is assumed to be the total of all potential sources of supply minus the volume that “disappears” from potential supply.
are more reliable than our estimates for any given year, or for year-to-year changes.\textsuperscript{2}

Our estimates should not be considered precise measures of U.S. salmon consumption—but they do provide a useful overview of U.S. salmon consumption and how it has been changing.

**Overview of U.S. Salmon Consumption**

Not all salmon is the same. Salmon consumed in the United States varies by species, product, origin (domestic and imported) and type (wild and farmed). There are important differences in U.S. consumption and trends over time for different combinations of these characteristics.

Tables VIII-1 and VIII-2 provide an overview of average annual U.S. salmon consumption for the period 2000-2004.\textsuperscript{3} In those years, Americans consumed an average of about 284,000 metric tons of salmon annually. Of this total, 105,000 metric tons (37 percent) was Pacific salmon (chinook, sockeye, coho, pink and chum), while 180,000 metric tons (63 percent) was Atlantic salmon.

Fresh salmon accounted for about three-fifths of total U.S. consumption (63 percent) while canned salmon accounted for about 16 percent and frozen salmon accounted for about 21 percent. About two-thirds (68 percent) of U.S. salmon consumed was imported and about two-thirds (65 percent) of salmon consumed was farmed.

There are significant differences between Pacific and Atlantic salmon consumption in products, origin and

### Four Important Characteristics for Describing Salmon Consumption

| Species: | Americans consume five species of Pacific salmon (chinook, sockeye, coho, pink and chum) as well as Atlantic salmon.\textsuperscript{4} These species vary considerably in size, taste and suitability for different kinds of products. |
| Product: | Americans consume salmon which is initially processed or imported in three major product forms: canned, frozen and fresh. Increasingly, fresh and frozen salmon are being imported as value-added fillets.\textsuperscript{4} |
| Origin: | Americans consume both domestic and imported salmon. |
| Type: | Americans consume both farmed and wild salmon. |

### Table VIII-1

<table>
<thead>
<tr>
<th></th>
<th>Pacific</th>
<th>Atlantic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>105</td>
<td>180</td>
<td>284</td>
</tr>
<tr>
<td>Canned</td>
<td>47</td>
<td>0</td>
<td>47</td>
</tr>
<tr>
<td>Frozen</td>
<td>36</td>
<td>24</td>
<td>60</td>
</tr>
<tr>
<td>Fresh</td>
<td>22</td>
<td>156</td>
<td>178</td>
</tr>
<tr>
<td>Domestic</td>
<td>81</td>
<td>10</td>
<td>91</td>
</tr>
<tr>
<td>Imported</td>
<td>24</td>
<td>170</td>
<td>193</td>
</tr>
<tr>
<td>Wild</td>
<td>97</td>
<td>2</td>
<td>99</td>
</tr>
<tr>
<td>Farmed</td>
<td>7</td>
<td>178</td>
<td>185</td>
</tr>
</tbody>
</table>

Note: Estimates include only canned, frozen and fresh products. Products for which species were “unspecified” are included in “Pacific salmon” category. Estimated using the United States Salmon Market Database described in Appendix C. See Appendix C for detailed discussion of methodology and sources used to develop estimates.

\textsuperscript{2} This is partly because domestic production data are incomplete, particularly for products produced from U.S. Pacific Northwest wild salmon. In addition, the estimates do not account for changes in inventories of frozen and canned salmon from year to year. They may overstate consumption in years when inventories are built up, or understate consumption in years when inventories are drawn down.

\textsuperscript{3} A related species of growing importance is salmon trout. Our consumption estimates in this chapter do not include salmon trout.

\textsuperscript{4} Smoked salmon is also an important salmon consumer product, but accounts for a relatively small share of imports or primary processing.

\textsuperscript{5} See Appendix C for a detailed discussion of how the estimates for all tables and graphs in this chapter were derived.
type. Close to half (45 percent) of the Pacific salmon was canned, 34 percent was frozen and only 21 percent was fresh. In contrast, none of the Atlantic salmon was canned, 13 percent was frozen and 87 percent was fresh. Most (93 percent) of the Pacific salmon was wild, while almost all (99 percent) of the Atlantic salmon was farmed. Most (77 percent) of the Pacific salmon was domestic salmon produced in the United States, while most (94 percent) of the Atlantic salmon was imported. (However, 23 percent of the Pacific salmon was imported and six percent of the Atlantic salmon was domestic.)

Pacific salmon accounted for almost 100 percent of canned consumption, 60 percent of frozen consumption and only 12 percent of fresh consumption.

Table VIII-3 provides more detailed estimates of U.S. salmon consumption for the years 2000-2004 by species and product. There were considerable differences between the five species of Pacific salmon in total volume consumed and the mix of products consumed. Canned salmon accounted for the largest share of consumption for pink salmon (91 percent). Frozen salmon accounted for the largest share of consumption of sockeye salmon (69 percent), coho salmon (43 percent) and chum salmon (59 percent). Fresh salmon accounted for the largest share of consumption (80 percent).6

As shown in Table VIII-4, pink salmon dominated estimated U.S. canned salmon consumption (96 percent) followed by sockeye and chum salmon. Atlantic salmon accounted for the largest share of frozen salmon consumption (40 percent) followed by chum salmon (23 percent), sockeye salmon (12 percent) and pink (9 percent). Atlantic salmon dominated fresh salmon consumption (88 percent) followed by chinook and chum salmon.

These differences between consumption patterns for different species are important. They show that not all wild salmon is the same: different species of wild (mostly Pacific) salmon are sold in different product forms and compete in different ways with farmed (mostly Atlantic) salmon in the U.S. market. Put differently, as we discuss later in this report, different species of wild salmon vary in the ways and the extent to which they have been affected by competition from farmed salmon.
Trends in U.S. Salmon Consumption

Estimated total U.S. salmon consumption increased dramatically from about 130,000 metric tons in 1989 to more than 300,000 metric tons in 2004, as shown in Figure VIII-1. Most of the growth in total consumption was due to rapid and sustained growth in consumption of fresh salmon, which more than tripled from 54,000 metric tons in 1989 to 183,000 metric tons in 2004.\(^7\) Note that estimated consumption of canned and frozen salmon fluctuates significantly from year to year. This is because most canned and frozen salmon is wild salmon, for which catches and production—which determine the volumes available for consumption—vary greatly from year to year.

\(^7\) Our consumption estimates cover the period 1989-2004 because these are, respectively, the first year for which detailed data for U.S. salmon trade are available and the most recent year for which detailed data for Alaska salmon production were available when this report was written. Our estimates show zero consumption of frozen salmon for 1989 and 1990 because exports exceeded reported imports plus estimated domestic consumption for these years. Our estimates may overstate consumption of fresh salmon and understate consumption of frozen salmon, especially for the earlier part of this period, because we assumed that all U.S. Pacific Northwest wild salmon production which was not canned was sold fresh (data on actual U.S. Pacific Northwest fresh and frozen production are not available). See Appendix C for further discussion.
Trends in Canned Salmon Consumption

Canned salmon is an important part of U.S. salmon consumption, although its share of total consumption is declining. Canned salmon accounted for 59 percent of estimated U.S. salmon consumption in 1989 and 15 percent in 2001. Canned salmon is an important product form for U.S. wild salmon, particularly pink and sockeye, in both domestic and export markets.

As noted above, almost all U.S. canned salmon consumption is of domestic wild salmon—primarily pink salmon. In recent years, estimated canned salmon consumption has fluctuated between 30 and 60 thousand metric tons—reflecting fluctuations in Alaska pink salmon harvests, pack and inventories—but showed no clear long-run trend.

Canned salmon sells into a very different market than fresh and frozen salmon and is bought by different consumers at different prices for different uses. 8 Until very recently, relatively little farmed salmon has been canned and farmed salmon has had relatively little effect on canned salmon prices. In the remainder of this section, we limit our discussion to trends in U.S. consumption of fresh and frozen salmon.

Trends in Fresh and Frozen Salmon Consumption

United States consumption of fresh and frozen salmon increased rapidly after 1989. As shown in Figure VIII-2, this growth was driven primarily by growth in imports: of fresh salmon until 2002 and of frozen salmon after 2002. The share of imports in U.S. fresh and frozen salmon consumption increased from 54 percent for the period 1991-1995 to 80 percent for the period 2000-2004.

As shown in Figure VIII-3, until 2002 most of the growth in U.S. consumption of fresh and frozen salmon was driven by rapidly rising imports of farmed salmon. The share of farmed salmon in U.S. fresh and frozen salmon consumption increased from 49 percent for the period 1991-1995 to 78 percent for the period 2000-2004. Between 1989 and 2002, estimated U.S. annual

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8 Historically, canned salmon consumption has been highest in the south among lower-income consumers.
average consumption of farmed salmon increased eight-fold, from less than 25,000 metric tons to more than 200,000 metric tons.

During this period U.S. wild salmon consumption also increased. Thus the growth in farmed salmon consumption was not driven by substitution by consumers of farmed salmon for wild salmon. Rather, it was driven by expansion in the fresh and frozen salmon market, in particular by introducing fresh farmed salmon to markets in which wild salmon had not been available, such as the U.S. Midwest.

As shown in Figure VIII-4, most U.S. farmed salmon consumption is imported fresh. Until 2002, most of the growth in U.S. farmed salmon consumption was in imported fresh fillets. However, imports of fresh salmon declined in 2003 and 2004, while imports of frozen farmed salmon (primarily fillets) continued to grow. Total U.S. farmed salmon imports (and consumption) declined in 2004. However this decline was temporary and farmed salmon imports grew to a new record of almost 200,000 metric tons in 2005. As shown in Figure VIII-5, the United States and Canada produce most of the wild fresh and frozen salmon consumed in the United States. Since 1989, imports from Canada have declined, due to declining Canadian wild salmon catches. Since 2003, there has been rapid growth in imports of frozen fillets from China (much of which are reprocessed from frozen pink and chum salmon exported from the United States to China). Recall, as noted in the introduction to this chapter, that the estimates of consumption from imports are more reliable than the estimates of consumption from U.S. domestic production, because better data are available for imports than for domestic production.

As shown in Figure VIII-6, all five Pacific salmon species contribute to U.S. consumption of wild fresh and frozen salmon. Chum salmon accounts for the largest share. Estimated consumption for each species varies significantly from year to year, reflecting variation in wild harvests and production.

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9 Figure VIII-4 shows estimated consumption through the year 2005, while earlier figures in this chapter show estimates only through the year 2004. The reason is that Figure VIII-4 is based primarily on import data, which were available through 2005. Data for domestic production were available only through 2004.
**Figure VIII-4** Estimated United States Farmed Salmon Consumption, by Product

*Estimates for consumption from 2005 domestic production were not available.

Source: Estimated using the United States Salmon Market Database described in Appendix C.

**Figure VIII-5** Estimated United States Fresh and Frozen Wild Salmon Consumption, by Country of Origin


**Imports from other countries since 2002 are mostly frozen fillets imported from China.

Source: Estimated using the United States Salmon Market Database described in Appendix C.
Having reviewed important recent trends, it is useful to put U.S. salmon consumption in context by comparing it with consumption of other seafood products and other forms of protein.

Figure VIII-7 shows estimates of per capita fish consumption for the top seven species consumed in the United States. Since 2001, salmon (including canned salmon) has ranked third among fish species consumed in the United States, after shrimp (which has been increasing) and canned tuna (which has been decreasing). Since the early 1990s, consumption of salmon has passed that of cod, catfish and Alaska pollock. In 2004, salmon accounted for about 13 percent of U.S. fish consumption, compared with just five percent in 1989. Shrimp accounted for 25 percent of U.S. fish consumption and canned tuna accounted for 20 percent.

As shown in Figure VIII-8, U.S. per capita seafood consumption is low in comparison with meat and poultry. Per capita consumption of fish was only 16 pounds per person in 2004, in comparison with 73 pounds for poultry, 63 pounds for beef and 49 pounds for pork, lamb and veal. Per capita consumption of salmon was only 2 pounds.

Put differently, all fish together represented less than 8 percent of total U.S. consumption of meat, poultry and fish in 2004, while salmon represented just 1 percent. Although U.S. salmon consumption is growing and the salmon industry is very important to those who make their living from it, salmon remains only a very small fraction of U.S. protein consumption.

It is instructive to contrast trends in salmon consumption with trends in poultry consumption. Annual consumption of poultry has been increasing steadily in the United States for the past half-century, as it has in other industrialized countries. The growth in poultry consumption is due to a combination of factors including lower prices, an increasing variety of convenient product forms and a trend among U.S. consumers towards a healthier diet. During the period 1988-2004, when U.S. per capita salmon consumption increased by 1.7 pounds, U.S. per capita poultry consumption grew by 20.7 pounds.
Figure VIII-7  Estimated Shares of United States Fish Consumption: Top Seven Species (share of edible weight)

Sources: NMFS Fisheries of the United States 2004; NFI Per Capita Fish Consumption Estimates.

Figure VIII-8  U.S. Per Capita Consumption of Meat, Poultry and Fish (edible weight)

Source: USDA ERS Food Supply Data.
As shown in Figure VIII-9, U.S. per capita seafood consumption is far below that of traditional seafood consuming nations such as Japan, Norway and France, and is roughly comparable to levels in Canada and the United Kingdom. From one perspective, this might suggest that Americans are meat eaters rather than fish eaters, implying that substantial growth in consumption of salmon and other fish is unlikely. From another perspective, it might suggest that consumption of salmon and other fish has ample room to grow.

**Figure VIII-9** Per Capita Seafood Consumption in Selected Countries

Source: FAO FAOSTAT Food Supply Database.
References


North American Salmon Trade

Key Points

✓ There have been major shifts in U.S. salmon trade patterns since the late 1980s: the United States changed from being a net exporter to a net importer. In 1995 the United States had a salmon trade surplus of $500 million. Two years later the United States had a $14 million trade deficit. The deficit in 2005 reached $494 million. The salmon trade deficit is due to increases in farmed salmon imports and a decline in U.S. exports, consisting primarily of wild Pacific salmon harvested in Alaska.

✓ U.S. import patterns of farmed salmon have changed significantly. Prior to the 1990s, Norway dominated the U.S. market until anti-dumping and countervailing duties were imposed on Norwegian producers in 1991. Canada and Chile now hold dominant positions in the U.S. market.

✓ Farmed salmon producers and processors consistently bring innovations that have changed the market over the past fifteen years. Imports of Atlantic salmon increased greatly in the second half of the 1990s after Chilean salmon producers introduced the pin bone out fillet in 1994/1995. The aquaculture industry continues to introduce value-added products in convenient forms, which increases consumer demand.

Introduction

U.S. trade in salmon products changed dramatically over the past 25 years. During this period, the United States changed from a net exporter of salmon products to a net importer. In addition, overall salmon supply increased and prices fell.

Foreign salmon farmers, the U.S. salmon industry (traditional and farmed) and U.S. consumers all continue to adjust to these changes. In general, foreign salmon producers initiated these changes through the creation of inexpensive, consistent, high-quality farmed salmon products, year-round availability and increased availability of convenient, consumer-friendly products, while U.S. consumers and restaurant patrons benefited from lower prices.

The traditional salmon industry in the United States has been slow to adapt and has found itself relegated from having a dominant market share to a secondary position.

Trade Status

Between the late 1980s and 2005, the United States transitioned from being a net exporter of salmon products to a net importer of salmon products¹ (Figure IX-1). In 1989, the United States had a salmon trade surplus of just over $650 million. This surplus disappeared in a two-year period; between 1995 and 1997 the net trade balance in salmon products changed from a $500 million surplus to a $14 million trade deficit. The deficit grew nearly 40 times larger between 1997 and 2003 to a value of $530 million. Because of declining salmon prices, the deficit decreased in 2004 to nearly $440 million but it grew again in 2005 to reach $494 million.

The changing trade balance is attributable to long-term trends in both U.S. exports and imports of salmon products. Between 1989 and 2005, U.S. exports declined in value from $912 million to $694 million - a decline of almost 24 percent. This period of decline for U.S. exports was, conversely, a period of rapid growth for U.S. imports of salmon products. Imports value more than quadrupled during the period, from $257 million to $1.2 billion (Figure IX-2).

Figure IX-2 also hints at another underlying factor influencing both exports and imports. The salmon import data reflect smooth steady increases each and every year since 1992. The value of exports, while showing a long-term downward trend, also shows yearly variability. The U.S. dependence on wild and hatchery-based fisheries is a factor affecting the year-to-year variability of trade. The United States primarily

¹ The trade balance is the value of a country’s exports minus the value of the country’s imports for the same product plus the value of the country’s re-exports. Re-exports of foreign products are commodities which have entered the U.S. as imports, are not sold and then are exported from the U.S. in substantially the same condition as when imported.
imports farmed salmon products and exports wild salmon products from the Pacific. Wild-caught production of salmon shows greater variation from year-to-year than production from aquaculture sources. Figure IX-3 compares yearly U.S. production of salmon from Alaska with world farmed production of salmon (Atlantic, chinook and coho salmon) between 1976 and 2004 (ADF&G 2006; FAO 2006). Farmed salmon production slightly exceeded Alaska wild salmon production for the first time in 1991. By 1994 farmed salmon production was clearly higher than Alaska’s wild harvest. Alaska’s production has stayed in a range of 200,000 to 400,000 metric tons (mt) during much of the period.

Figure IX-1 U.S. Salmon Trade Balance 1989-2005

Species included are Atlantic, Chinook, Chum, Coho, Pink, and Sockeye. Products forms include Fresh, Frozen, Canned, Salted, Smoked, Preserved, and Roe.
Species included are Atlantic, Chinook, Chum, Coho, Pink, and Sockeye. Products forms include Fresh, Frozen, Canned, Salted, Smoked, Preserved, and Roe.

Farmed species are Atlantic, chinook, and coho salmon. Farmed production of other salmon species is negligible.
Sources: Alaska Department of Fish & Game (2006); FAO (2006).
Supply of Salmon Products

With imports steadily increasing and U.S. landings generally varying around a relatively stable mean, the total U.S. supply of salmon products has been increasing. Figure IX-4 shows how U.S. total salmon supply (round or whole weight)² rose 170 percent over the last 15 years to roughly 460,000 mt in 2004. Figure IX-4 also illustrates the inherent variability in U.S. domestic supply because of the U.S. reliance on wild caught product. Imports account for an increasing share of total U.S. supply of salmon products. Over the past several years, imports by round weight have accounted for roughly 70 percent of total U.S. salmon supply.

Figure IX-4 includes imports of smoked salmon. Although smoked salmon imports have grown rapidly from about 1,000 tons (approximately $11 million) in 1998 to 3,270 mt ($35.5 million) in 2005 (primarily from Norway), they still represent a minimal component of the market (approximately 1.4 percent of imports quantity and 3 percent of import value). Because global increases in farmed salmon production have resulted in falling prices in the major world markets, salmon farmers could potentially increase production of smoked salmon and other high-value products as a way to strengthen prices.

Imports of smoked salmon have been occasionally involved in cases of contamination by Listeria monocytogenes and other Listeria species. These are foodborne pathogenic bacteria that may develop in a wide variety of dairy, bakery, meat and fish products. Listeria monocytogenes has been isolated from fishery products on a regular basis since the late 1980s, and is more prevalent in cold-smoked fish (Jørgensen and Huss 1998). The U.S. Food and Drug Administration (FDA) has taken strong action against many processors and importers due to the presence of L. monocytogenes. Between 1987 and August 1998 there were 45 recalls of domestic and imported ready-to-eat finfish products in the United States with most of the recalls concerning imported smoked salmon from Canada (Jinneman et al. 1999). Although there is no international agreement on ‘acceptable levels’ of L. monocytogenes in foods, the World Health Organization (WHO) recognizes that a concentration of 100 Colony Forming Units (CFU) per gram poses low risk to the consumer (FAO 1999). The FDA policy is much stricter, requiring complete absence of Listeria in ready-to-cook foods.

![Figure IX-4 U.S. Salmon Supply (Round Weight)](image)

Source: See Appendix D.

² Round (whole) weight calculations are made by dividing the appropriate product weight by the product conversion ratio found in Crapo et al. (1993)—see Table X-1. These by-species ratios allow the conversion of individual products such as fillets into whole fish or headed and gutted equivalents.
U.S. Imports of Salmon and Trout

U.S. imports of salmon and salmon trout products have followed the growth trend of world production. Quantity and value of U.S. imports continue to increase virtually every year. In quantity terms, imports grew at an impressive pace (over 15 percent per year) during the mid- and late 1990s through 2002. Imports have grown at a reduced pace since 2003. In fact, the quantity of imports declined by 1.6 percent in 2004 relative to 2003, but imports rebounded again in 2005, with quantities exceeding the 2004 volumes by 6 percent. In value terms, 2005 imports exceeded 2004 imports by 14.6 percent (USDC/NMFS 2006).

The distribution of U.S. imports among supplying countries has changed since the advent of large-scale farmed salmon production in the early-to-mid-1980s (Figure IX-5). Prior to the 1990s, Norwegian producers dominated the U.S. market until the United States imposed anti-dumping and countervailing duties on Norwegian producers (discussed further in Chapter XV). Now, Norway supplies less than 4 percent, by value, of U.S. salmon imports.

Canada and Chile hold dominant positions in overall quantity and value. In value terms, these countries accounted for 34 and 51 percent of imports, respectively, in 2005. However, each country specializes in exporting a different product to the United States. Canada dominates the U.S. import market for whole salmon while Chile dominates the U.S. market for salmon fillets (86 percent and 76 percent market share by value, respectively). The U.K. supplies 3 percent of overall imports by value. Nearly all salmon imports coming from the U.K. are whole, dressed Atlantic salmon (USDC/NMFS 2006).

Imports from China have increased dramatically in recent years, from only 3,600 mt in 2002 to nearly 19,000 mt in 2005. In fact, China became the third largest exporter to the U.S. market in 2004 (after Chile and Canada). Most of Chinese imports consist of Pacific salmon originally captured in Alaska but sent to China for processing into fillets. The processed product is then shipped back to the United States. This trend is likely to continue in the future.

On average, fresh salmon and salmon trout products account for 80 percent of total imports in terms of both quantity and value (Figure IX-6). Fresh products comprised most of the increase in salmon imports over the last 10 years, but imports of frozen salmon as well other product forms such as smoked and canned salmon have also increased. In 2003 and 2004, declines in imported quantities of fresh products were compensated with increases in imports of frozen products.

Growth in U.S. imports of salmon has been primarily driven by the surge in imported quantities of fresh and frozen fillets (Figure IX-7). In 1994/1995, Chilean farmers introduced to the market salmon fillets with the pin bones removed, a technological innovation that set the stage for the explosive growth in salmon imports seen in recent years. Comparatively, imports of whole fish have grown at a much lower rate, remaining relatively flat (at around 75,000 mt) since 1997.
**Figure IX-6** U.S. Imports of Salmon and Salmon Trout Fresh vs. Frozen Products


**Figure IX-7** U.S. Imports of Salmon and Salmon Trout Whole vs. Fillets

Canned salmon represents a very small portion of U.S. imports as compared to fresh and frozen products (2.8 percent and 2.3 percent market shares by quantity and value in 2005). Historically, Canada has supplied the majority of canned imports but recently Thailand and Chile have passed Canada as the dominant supplier. Canned salmon from Canada and Thailand is predominately wild Pacific. Thailand does not have a salmon industry of its own but it processes salmon caught in the North Pacific region. In 2005, the United States imported 3,647 mt of canned salmon from Thailand. Canned imports from Chile (mostly farmed salmon) have also increased significantly in recent years, from 60.5 mt in 2001 to 2,607 mt in 2005 (USDC/NMFS 2006).

The increasing flow of salmon and salmon trout imports into the U.S. market can be attributed entirely to worldwide growth in the aquaculture industry. Up until 1990, U.S. imports consisted primarily of wild Pacific salmon species (Figure IX-8). However, beginning in 1991, imports have consisted mostly of farmed Atlantic salmon. Farmed production of Pacific salmon species (chinook and coho) has also been imported, but on a much smaller scale.

**Evolution of U.S. Salmon and Salmon Trout Import Prices**

Figures IX-9 through IX-11 illustrate the evolution of import prices in the U.S market for the period 1989-2005. Despite the substantial price declines observed in 2001 and 2002, nominal prices have in general remained flat through the period (Figure IX-9). If adjusted for inflation, a much clearer downward trend in prices would be evident (not shown on graphs). Figure IX-10 contrasts average prices of fresh and frozen products. Prior to 2000, fresh salmon and salmon trout commanded an average price premium of approximately $0.46 per lb. This premium decreased to around $0.20 since 2000, which has probably been caused by the large increases in imports of fresh fillets.

Average prices of whole fish and fillets are shown in Figure IX-11. Fillets were priced lower than whole fish before the introduction of the pinbone-out technology in 1994/1995. In contrast, boneless fillets command a price premium over whole fish. Import prices of fillets increased to around $2.75 per lb. by the year 2000, but declined in 2001 and 2002 to less than $2.00. There has been a significant rebound in prices since 2003. Prices per pound of whole salmon and salmon trout have been less variable but also declined substantially in 2001 and 2002. Same as with fillets, prices started recovering in the most recent period (2003-2005).

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**Figure IX-8**

**U.S. Imports of Farmed Salmon and Salmon Trout vs. Imports of Wild-Caught Pacific Salmon**

The Farmed Salmon category includes farmed Chinook and Coho in addition to farmed Atlantic salmon and salmon trout.

Figure IX-9  U.S. Imports of Salmon and Trout: Average Annual Price - All Products

Figure IX-10  U.S. Imports of Salmon and Trout: Average Price of Fresh and Frozen Products

Salmon Farming and Innovations in the U.S. Market

Before the pinbone-out (PBO) technology was introduced in 1994/1995, most salmon available in the United States was a headed and gutted product that required a level of skill and attention to successfully fillet and remove the pinbones for the consumer. Chilean producers introduced PBO fillets in response to the market demand for a more convenient product form.

In 2004, the PBO fillet accounted for 74 percent of U.S. farmed Atlantic salmon imports by round weight, and total Atlantic salmon imports were roughly 600 percent higher than they were prior to the introduction of the PBO fillet (USDC/NMFS 2006).

The market for farmed salmon products continues to change on a yearly basis. Recent growth continues to focus on fresh and frozen PBO fillets and more recently on the creation of value-added products. The International Boston Seafood Show (IBSS), held from March 10-12, 2006 in Boston, MA, highlighted some of the more recent additions to the value-added products provided by overseas producers. Several new value-added products designed for both the retail and wholesale markets are being introduced. They include: six-ounce salmon fillets in pouches for individual sale (with nutritional information); vacuum-sealed, pre-made salmon kabobs for restaurants; and pre-sliced, portioned fillet cuts for the sushi market in ten-ounce vacuum sealed packages, among others. These are typical industry innovations designed to continue to push U.S. salmon sales even higher by making the product as convenient as possible.

Potential Impact of *Science* Article

In Chapter V we discussed a recent *Science* article (published on January 9th, 2004) exploring the presence of organic contaminants in farmed and wild salmon (Hites et al. 2004). These results have been highly publicized, and may have had a temporary influence on U.S. imports of farmed salmon since most U.S. supply of farmed salmon is imported. In fact, U.S. imports of farmed salmon in the first quarter of 2004 were 20 percent lower than in 2003, as indicated by Figure IX-12.

The figure shows that relative to imports the year before, imports in January, February and March of 2004 were below levels during the same period in the prior year—the article was released January 9. This may be attributable to the *Science* article, although it may also be attributable to other factors—what we present here is a simple graphical analysis, not a rigorous statistical analysis. The drop was largest in
February, the month after the release of the article when the media coverage of the research’s results was the most widespread. However, the pattern quickly shows that deviations in monthly imports from their historic norm disappear. Thus, it is possible that the effect, if attributable to the *Science* article, was short-lived. However, to fully determine the effect of the article on consumers’ perceptions of farmed and wild salmon, a more thorough statistical analysis should be conducted as there may be longer term and less clearly observable effects.

**Figure IX-12** Monthly U.S. Imports of Farmed Salmon and Salmon Trout: Percent Change in Quantity Relative to Previous Year

References


The U.S. Salmon Distribution System

Key Points

✓ The U.S. salmon distribution system is complex and varied. Participants include fishermen, fish farmers, processors, importers, secondary processors, broadline distributors, specialty seafood distributors, brokers, traders and many different kinds of retail and food service companies. Salmon flows through this system in many different ways.

✓ The salmon distribution system is evolving in several important ways. Salmon distribution channels are changing, with fewer and larger distributors handling an increasing share of total volume, and an increasing share of salmon being sold directly by large fish-farming companies and large wild salmon processors to large retail and food service chains. The retail and food service industries are becoming more concentrated. The farmed salmon industry is becoming increasingly concentrated, with fewer and larger producers accounting for a larger share of total farmed salmon production. Wild salmon primary processors are also becoming increasingly concentrated.

✓ The price of salmon increases as it moves through the distribution system from the fisherman or fish farmer to the consumer. Processing margins—the increase from the prices processors pay to fisherman to wholesale prices received by processors—tend to be higher than prices paid to fisherman. Significant costs of salmon processing include tendering, labor, plant overhead and “yield” (lower processed weight resulting in higher fish cost per processed pound). Processors’ profits vary significantly from year to year.

Overview of the U.S. Salmon Distribution System

The U.S. salmon distribution system is complex and varied. There are many ways in which salmon may get from a fisherman or fish farmer to a consumer. They may be as simple as a fisherman selling to a consumer at the dock or they may involve multiple stages of processing, transportation and distribution in which the fish and the products made from it change ownership several times. For every general rule about how things work, there are exceptions (Knapp et al. 2001).

Figure X-1 provides a simplified depiction of the U.S. salmon distribution system. There are many different participants. The most important of these include fishermen, primary processors, importers, secondary processors, broadline distributors, specialty seafood distributors, brokers, traders and many different kinds of retail and food service companies.

Salmon flows through this system in many different ways, as depicted by the arrows in the figure. Many companies may perform multiple functions of the system, such as: fishing and primary processing; primary processing and secondary processing; importing and manufacturing; or importing and distributing. Some companies handle both wild and farmed salmon; others handle only wild salmon or only farmed salmon. Below, we briefly review the function performed by each major participant.¹

Fishermen and fish farmers catch or grow the fish. As discussed in other chapters of this report, in most North American wild salmon fisheries only holders of limited entry permits can catch fish commercially, and there are numerous restrictions on where, when and how they can fish.

Primary processors head and gut the fish and then usually can it, freeze it, or ship it to fresh markets. The basic function of primary processing is to transform the fish into product forms which can either be shipped directly to fresh markets or stored for later processing and distribution. How much processing a primary processor does can vary greatly, depending on the product and the market.

¹ Much of the remaining text for this section, discussing the functions performed by major participants in the salmon distribution system, was originally written by Peter Redmayne for Knapp et al., A Village Fish Processing Plant: Yes or No? (2001).
Secondary processors buy products from primary processors and do additional processing into more convenient product forms. A secondary processor in Seattle, for example, may buy headed and gutted (H&G) salmon from a fish plant in Alaska and have it processed into skinless, boneless salmon portions (e.g. fillets). Traditionally, secondary processors did their processing in the United States. However, more and more secondary processing is being done in developing countries like China and Thailand, due to lower labor costs and a large, skilled work force.
Many primary Alaska seafood processors also perform secondary processing functions. In this case, primary processors reprocess their own product, as well as raw material they buy from other primary processors. Primary processors will also buy raw material from traders, since processors will not always sell directly to competing processors.

Brokers act as the sales agents for the actual owners of the product (foreign or domestic processors in many cases, or importers) and receive a commission on any sales they transact. Brokers, who do not normally take title to goods, often work a specific region of a country where they have developed relationships with buyers. Brokers normally sell to wholesale distributors or to higher-volume end users such as restaurant chains or supermarket chains.

Traders purchase salmon and sell to other traders, exporters, importers, distributors, foodservice operators or retail supermarket chains. Traders usually specialize in a few specific seafood commodities and minimize market risk by doing “back-to-back” deals where they do not buy products until they have identified a customer. While brokers earn commissions from sales, traders earn a profit on the margin between their purchase price and their sales price. Volume is important for traders because of the small margins realized on each sale.

Distributors purchase products from processors, traders, importers or wholesalers and provide physical delivery of products to foodservice operations (restaurants, hotels, schools, hospitals) or retail markets (supermarkets, fish markets). In general, distributors do not spend a great deal of time “selling” new items and species or developing new markets. Two types of distributors handle seafood: broadline distributors and specialty seafood distributors.

Broadline distributors, who usually specialize in either the foodservice or supermarket markets, sell a very large range of food and non-food items. Foodservice broadliners sell thousands of food, table and kitchen items to restaurants, hotels and food operations at hospitals, schools, cruise lines and other outlets where food is prepared and sold or served. Retail broadliners, on the other hand, will supply supermarkets with a comprehensive, although less extensive variety of items. In a number of cases, retail broadliners are a cooperative owned by a regional group of independent supermarkets.

While seafood is but one of many food items offered by broadline distributors, it is an important commodity. The largest national broadline distributor in the U.S., Sysco Corp., sells approximately $1 billion worth of seafood annually to its foodservice accounts. Generally, broadline distributors do not purchase seafood directly from foreign suppliers but deal with importers, processors and brokers. Most of the seafood carried by broadline distributors is frozen. However, a growing number of broadline distributors carry some fresh seafood items that are available on a regular basis.

Specialty seafood distributors, as the name indicates, specialize in seafood or seafood-related products, with an emphasis on fresh products. Specialty seafood distributors sell to both foodservice and retail accounts. Most major U.S. cities have one or two specialty seafood distributors that dominate the market and a number of smaller seafood distributors. Seafood distributors normally make deliveries directly to individual restaurants or retail stores as often as five days a week. In the case of larger supermarket chains, though, a seafood distributor may deliver to a central warehouse and the chain will make deliveries to its individual units. Specialty seafood distributors purchase seafood from importers, processors, brokers, traders and other distributors.

Foodservice buyers include restaurants and institutions (including hospitals, schools, factories and large offices). The restaurant segment of food service includes large seafood chains, such as Red Lobster, Long John Silver’s and Captain-D’s; family restaurants such as Chili’s, Perkins and Denny’s; and casual dining and independent restaurants. While most foodservice operations buy from distributors, the purchase decision is often made after a sales presentation of a new product by an importer, processor or broker. Each foodservice operation has individual requirements as to price, product form, packaging, frequency of delivery and other factors.

Retail buyers consist primarily of large regional supermarket chains. However, in recent years mergers have created some powerful chains with national reach. For example, Kroger Stores, based in Ohio, has purchased major supermarket chains in California, Washington and Oregon, while Safeway and Albertson’s have increased their holdings across much of the U.S. In most cases, seafood purchasing decisions, particularly for fresh products, are made at the national or regional division level. Rarely are purchasing decisions made at the level of the individual supermarket.

Of the 31,000 supermarkets in the U.S. with annual sales in excess of $2 million, approximately 10,000 have full-service seafood counters. As a rule, a supermarket will not operate a full-service seafood counter unless it can sell at least $5,000 worth of seafood a week, since the labor costs associated with running a full-service counter are high. A full-service seafood counter in a busy store in an affluent neighborhood can sell $20,000 to $40,000 worth of seafood a week.

Large volumes of fresh and frozen seafood are also sold through warehouse/club stores such as Costco and Sam’s Club. Most seafood purchasing decisions for
club stores are also made at the national and regional levels. For some fresh seafood items that are readily available—like farmed salmon—club stores will sign a contract for guaranteed pricing for a three- or six-month period. Depending on the product, club stores will buy direct from processors, importers, or seafood distributors. As a general rule, club stores buy fresh seafood from seafood distributors and frozen seafood directly from processors and importers.

Independent fish markets are still important retail outlets on the East Coast of the U.S., but less so in the West. A retail fish market will generally move considerably more seafood than a seafood counter at an individual supermarket.

**Seafood importers** purchase products from foreign suppliers that export seafood, including fish farmers. Importers normally purchase products outright and pay for them either on shipment or on receipt of the products in their own countries. In many cases, though, payment will be subject to clearance by local health authorities, such as the FDA in the U.S. In some cases, large seafood distributors, restaurant chains, or supermarkets do their own importing and buy direct from foreign suppliers.

**Seafood exporters** purchase a product and sell it to a buyer (an importer) in another country. The seafood an exporter buys can be purchased from a seafood processor, or a trading company that has purchased the product from a processor. Many large seafood processors in Alaska do their own exporting and sell their salmon directly to buyers in other countries.

As a rule, exporters will not purchase a product until they know they have a buyer for it. Exporters are usually paid for their products by a Letter of Credit (LC) or by a direct bank wire transfer (TT). Depending on the terms of the sale, an exporter may be paid either when the product is shipped or when it is received by the importer.

**Major Salmon Distribution Channels**

Figure X-2 shows major distribution channels for wild and farmed salmon within the salmon distribution system. In general, the distribution system for both wild and farmed salmon is evolving in five important ways:

- The retail and food service industries are becoming more concentrated, with large retail and food service chains accounting for a larger share of total sales to consumers. These large buyers are able to reduce costs through economies of scale, including buying in large volumes. They prefer to buy from suppliers who can reliably provide large volumes of consistent quality over long periods of time.
- The salmon distribution system is becoming shorter and more concentrated, with fewer and larger distributors handling an increasing share of total volume, and an increasing share of salmon being sold directly to large retail and food service chains by large fish-farming companies and large wild salmon processors (Anderson 1997; Naylor et al. 2003).
- The farmed salmon industry is becoming increasingly concentrated, with fewer and larger producers, with facilities in multiple countries, and vertically integrated into feed production and primary and secondary processing, accounting for a larger share of total farmed salmon production (Anon 2002, Anon 2004a, Anon 2004b, Anon 2004c).
- Wild salmon primary processors are becoming increasingly concentrated. Many medium-sized processors and some larger processing plants have been closed or sold to larger processors operating multiple plants in different locations, whose operations are typically diversified to include processing of other wild species.
- New “niche” markets and distribution channels are developing for fresh and value-added products in which higher quality wild salmon products are being sold at higher prices from smaller producers to smaller buyers.

**Price Markups in the Salmon Distribution System**

As salmon moves through the distribution system from the fisherman or fish farmer to the consumer, its price increases. A consumer may pay $5.99/lb—or $15.99/lb—for a salmon product for which the fisherman was paid $0.59/lb. Many fishermen and many consumers cannot understand why the price should not be higher for the fisherman, or lower for the consumer—or both. They question what accounts for the markups and whether they can be justified by costs. In the remainder of this chapter we examine how and why salmon prices increase as salmon moves through the distribution system.

Throughout this discussion it is important to understand that salmon pricing and price markups are complex topics. As discussed repeatedly throughout this report, there are numerous different salmon species, products and end-markets, which reach consumers in numerous different ways. For all of these species, products, end-markets and distribution channels, prices at different levels can and do change from year to year, from season to season and even from day to day. The factors affecting prices are very complex. Prices at every level are affected by prices at every other level, as well as costs, the structure of the industry, the relative supply of different products to different markets and the myriad factors affecting consumer demand.
1. Traditional wild salmon distribution channels:

(A) Some fishermen near population centers sell fish directly to consumers.

(B) Most fish are sold to primary processors who then sell to secondary processors who sell to distributors who sell to retailers or restaurants.

2. Evolving wild salmon distribution channels:

(C) Large primary processors are producing value-added products (secondary processing) and selling directly to large retail and restaurant chains.

(D) Some fishermen are "self-marketing"—doing their own primary processing and value-adding (or having their fish custom-processed) and selling directly to small retail stores or restaurants.

3. Distribution channels for imported farmed fish:

(E) Foreign fish farmers pay for their own custom processing and sell directly to U.S. based importers (or sometimes distributors), which sell to retail stores and restaurants.

(F) Larger multinational fish farming corporations deal directly with large retail and restaurant chains.
Confusing this issue are differences between popular perceptions that prices should be “fair” and the reality of how markets work. One popular perception is that fishermen should be paid a “fair” price that allows them to earn a decent living for their hard (and often dangerous) work, and that allows them to maintain the standard of living they have attained in the past and compensates them for their investments in boats and permits. Another popular perception is that consumers should be charged a “fair” price for the fish they buy, which reflects actual costs of catching, processing and distributing the fish—rather than excessive profits for middlemen or large and/or foreign-owned corporations.

The reality is that competition drives salmon markets and prices. Put simply, most participants in the salmon distribution system, from fishermen to consumers, try to sell for the highest price they can get and to buy for the lowest price they can get. Not many consumers, retailers, distributors or processors will choose the higher of two price offers for fish of equal quality from sellers who are the same in other respects. Not many fishermen, processors, distributors or retailers will choose the lower of two price offers from buyers who are the same in other respects.2

Salmon markets are complicated by the fact that not all buyers and sellers are “the same in other respects.” Competition occurs not only with respect to price, but also with respect to other factors. Some buyers and sellers are more reliable, or more convenient to deal with, or offer more favorable opportunities to do other kinds of business. At some stages of the distribution system this may allow sellers to mark prices up more than they would be able to if buyers were making decisions based solely on the price of salmon. For example, consumers do not necessarily buy salmon where the price is lowest. They may be willing to pay higher prices at stores in more convenient locations, or which have other products on sale.

Risk is another important and complicating factor in salmon pricing. A profit on one transaction may offset a loss on another transaction. The fact that a seller appears to have earned a substantial profit on a particular fish sale does not necessarily mean that the seller is earning high profits on average.

Effects of Changes in Fish Weight on Prices

An important—and often overlooked—factor in how prices increase through the distribution system is that for any given weight of fish caught by a fisherman or produced by a fish farmer, a smaller weight of fish products is actually purchased by consumers. For example, 100 pounds of salmon caught by a fisherman may only result in 33 pounds of salmon fillets purchased by a consumer.

The most important reason for this decline in weight is that not all of the weight of the live or “round” salmon is edible product. Typically, 25-28 percent of the weight of wild salmon is lost in heading and gutting during processing, resulting in a 72-75 percent “yield” of dressed/head-off weight from “round weight.” As headed and gutted salmon are further processed into fillets or steaks during secondary processing, more weight is lost. The weight of skinless/boneless fillets is only about 33-38 percent of the round weight of the fish.

The top half of Table X-1 shows typical processing yields for selected wild salmon products from round weight and from dressed/head-off weight. The bottom half of the table shows the implications of the change in weight for the price of the fish.

To understand how changes in weight affect price, consider the example in Table X-2, based on average yields for wild chinook salmon. Suppose a fisherman sells 1000 pounds of chinook salmon to a primary processor who processes them into dressed/head-off fish weighing 720 pounds. Suppose next that the primary processor sells the fish to a secondary processor who processes them further into skinless/boneless fillets weighing 360 pounds.

Suppose further that the fisherman, the primary processor and the secondary processor all sell the fish for a total of $1000—in other words, without any increase in the total value to pay for costs of processing. After each stage of processing, the fish will have to be sold for a higher price per pound to make up for the lower weight. The price will have to increase from $1.00/lb to $2.78/lb—or by 278 percent—just to make up for the lower weight.

In addition to weight losses in processing, other factors also contribute to the difference between the weight of fish caught by fishermen and that purchased by consumers. Some fish may spoil or be damaged in other ways during transportation and storage. In addition, not all products offered for sale are bought. Especially for fresh salmon, fish not sold after one or two days may go unsold, or may have to be sold at a deep discount—meaning that other fish must be sold for a higher price to get the same average price per pound for sales from any given shipment.

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2 In the salmon industry, as in any industry, there is always a possibility that some participants may engage in illegal price-fixing activity. There is no evidence that illegal activities are a significant factor in overall pricing at any level in the U.S. market for wild or farmed salmon. This does not mean, of course, that no one ever tries to fix prices, or that no one ever succeeds. But given the huge number of participants in the industry, and the ease of entry and exit into every level of the distribution system, in most markets and in most parts of the distribution system it would be difficult to successfully fix prices for any sustained period of time. In 2003, after a widely publicized four-month trial of Bristol Bay salmon processors and importers for alleged price-fixing, an Alaska jury found no evidence of a conspiracy to fix prices after just five hours of deliberation (Loy 2003).
Multiple Prices for Products from the Same Fish

A different important—and also often overlooked—factor in how prices increase through the distribution system is that not all of the fish purchased by a buyer are sold for the same price. A processor may process fish purchased from a given fisherman into different products and sell them for different prices. A distributor may sell fish purchased from a given processor into different markets for different prices. A retailer may sell some fish at a “regular” price and other fish for a “sale” price. In all of these cases, if we look only at the fish sold for the highest price, we will get an unrealistic picture of profits made by the seller as well as what the seller might be able to afford to pay a supplier.

Table X-3 provides an illustration of this point. Suppose a processor buys 1000 pounds of fish from a

<table>
<thead>
<tr>
<th>Table X-1</th>
<th>Estimated Wild Salmon Average Processing Yields and Implied Price Increases due to Changes in Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>Yield</td>
<td>Dressed/Head-On</td>
</tr>
<tr>
<td></td>
<td>88% Chinook 92% Sockeye 92% Coho 91% Pink 89%</td>
</tr>
<tr>
<td>Dressed/Head-Off</td>
<td>72% Chinook 74% Sockeye 75% Coho 73% Pink 74%</td>
</tr>
<tr>
<td>Canned</td>
<td>67% Chinook 67% Sockeye 67% Coho 65% Pink 67%</td>
</tr>
<tr>
<td>Skin-On Fillet</td>
<td>55% Chinook 53% Sockeye 57% Coho 52% Pink 60%</td>
</tr>
<tr>
<td>Skinless Fillet</td>
<td>46% Chinook 46% Sockeye 51% Coho 42% Pink 50%</td>
</tr>
<tr>
<td>Skinless/Boneless Fillet</td>
<td>36% Chinook 35% Sockeye 38% Coho 33% Pink 38%</td>
</tr>
<tr>
<td>Steaks</td>
<td>58% Chinook 57% Sockeye 62% Coho 58% Pink 58%</td>
</tr>
<tr>
<td>Dressed/Head-Off</td>
<td>Skin-On Fillet 76% Sockeye 72% Coho 76% Pink 72%</td>
</tr>
<tr>
<td></td>
<td>64% Sockeye 62% Coho 68% Pink 67%</td>
</tr>
<tr>
<td></td>
<td>50% Sockeye 47% Coho 51% Pink 51%</td>
</tr>
<tr>
<td></td>
<td>81% Sockeye 77% Coho 81% Pink 78%</td>
</tr>
<tr>
<td>Price increase due to yield (= 1/Yield)</td>
<td>Round</td>
</tr>
<tr>
<td>Dressed/Head-Off</td>
<td>Dressed/Head-On 114% Sockeye 109% Coho 109% Pink 110%</td>
</tr>
<tr>
<td></td>
<td>139% Sockeye 135% Coho 133% Pink 137%</td>
</tr>
<tr>
<td></td>
<td>149% Sockeye 149% Coho 149% Pink 149%</td>
</tr>
<tr>
<td></td>
<td>182% Sockeye 189% Coho 175% Pink 192%</td>
</tr>
<tr>
<td></td>
<td>217% Sockeye 217% Coho 196% Pink 238%</td>
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<td>278% Sockeye 286% Coho 263% Pink 303%</td>
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<tr>
<td></td>
<td>172% Sockeye 175% Coho 161% Pink 172%</td>
</tr>
<tr>
<td>Dressed/Head-Off</td>
<td>Skin-On Fillet 132% Sockeye 139% Coho 132% Pink 139%</td>
</tr>
<tr>
<td></td>
<td>156% Sockeye 161% Coho 147% Pink 172%</td>
</tr>
<tr>
<td></td>
<td>200% Sockeye 213% Coho 196% Pink 222%</td>
</tr>
<tr>
<td></td>
<td>123% Sockeye 130% Coho 123% Pink 128%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table X-2</th>
<th>An Example of How Changes in Weight Affect Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Round fish</td>
</tr>
<tr>
<td>Total price (assumed to be constant)</td>
<td>$1000</td>
</tr>
<tr>
<td>Yield from round fish</td>
<td>100%</td>
</tr>
<tr>
<td>Weight</td>
<td>1000</td>
</tr>
<tr>
<td>Price per pound</td>
<td>$1.00</td>
</tr>
</tbody>
</table>

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fisherman, and finds (as is often the case) that the quality of the fish varies. Suppose he is able to sell one-third of the fish for $5.00/lb, one-third for $3.00/lb and one-third for only $1.00/lb, for a total sales value of $3000. If his processing cost is $1.00/lb for all the fish, so that his total costs are $1000, he can afford to pay a maximum of $2000 to the fisherman—or $2.00/lb. If he does this, he will just break even (make zero profit).

If we look only at the third of the fish that the processor sells for the highest price of $5.00, it will appear that the processor is getting a markup of $3.00/lb and earning a profit of $2.00/lb. This is in fact the case—for those fish. However, he is also losing $2.00/lb for the fish that he is forced to sell for just $1.00/lb. It would be impossible for the processor to pay the fisherman more for the fish that he sold for $5.00/lb unless he paid him less for the rest of his fish.

The same point applies more generally to markups at any level in the distribution system. Focusing on the markups and apparent prices for the highest-priced fish may give a misleading picture of average markups for all fish.

Markups Between Ex-Vessel and Wholesale Prices for Wild Salmon

The first markup in the price of wild salmon occurs between the price paid to fishermen and the wholesale price received by processors. Figure X-3 shows average prices paid to Alaska chum salmon fishermen and average wholesale prices received by Alaska chum salmon processors for fresh and frozen chum salmon. For example, in 2002 fishermen were paid an average of $0.16/lb for chum salmon. Processors sold fresh salmon for an average of $0.45/lb and frozen salmon for an average of $0.41/lb. Thus the average “processor margin” (defined here simply as the difference between the wholesale price and the ex-vessel price, without any adjustment for yield) was $0.29/lb for fresh salmon and $0.25/lb for frozen salmon. The wholesale price was more than double the ex-vessel price.

“Processor margin” defined in this way can be misleading for two reasons. The first reason is that the fisherman’s price is expressed in dollars per round pound, while the wholesale price is in dollars per processed pound. To compare the two prices and see how much the processor is really “marking up” the price, we would need to compare the prices on the same weight basis. Adjusting for an assumed processing yield of 74 percent, the processor paid fishermen $0.21/lb when expressed in terms of the pounds of fresh or frozen salmon produced from the fish. Thus the processor’s markup over the cost of the fish was lower: $0.24/lb for fresh salmon and $0.20/lb for frozen salmon.

Another reason for which this comparison can be misleading—particularly for chum salmon—is that the price comparison does not include the value of the roe produced from the salmon. The value derived by the processor from the fish is substantially higher because salmon roe was also produced from the fish.

As may be seen from Figure X-3, the processor margins for frozen and fresh chum salmon (the markups between the ex-vessel price and wholesale prices) declined substantially during the 1990s. As salmon

| Table X-3 | An Example of How Multiple Products or Multiple Prices affect Markups |
|-----------|------------|-----------|-----------|
| Product   | Total      | #1 fish (highest quality) | #2 fish (lower quality) | #3 fish (lowest quality) |
|-----------|------------|
| Pounds delivered by fisherman | 1000 | 33% | 33% | 33% |
| Quality distribution of production (%) | 1000 | 33% | 33% | 33% |
| Production (pounds) | 1000 | $5.00 | $3.00 | $1.00 |
| Processor's selling price ($/lb) | 1000 | $3000 | $1667 | $1000 |
| Processing cost ($/lb) | 1000 | $1.00 | $1.00 | $1.00 |
| Total value of sales ($) | 1000 | $3333 | $3333 | $3333 |
| Total processing cost ($) | 1000 | $333 | $333 | $333 |
| Total payment to fisherman ($) | 1000 | $2000 | $1667 | $1000 |
| Processor profit ($) | 1000 | $0 | $0 | $0 |
| Price per pound paid to fisherman ($/lb) | 1000 | $2.00 | $3.00 | $1.00 |
| Apparent markup by processor ($/lb) | 1000 | $3.00 | $1.00 | -$1.00 |
| Apparent processor “profit” ($/lb) | 1000 | $2.00 | $0.00 | -$2.00 |

3 This figure was also included in Chapter VII as Figure VII-11. Figures VII-9 and VII-10 are similar graphs of ex-vessel and wholesale prices for sockeye salmon and pink salmon.
prices declined, fishermen and processors earned less money. This was generally the case for other wild salmon species as well. The processor margin for frozen chum salmon increased in 2003 and 2004.

Table X-4 shows average “processing margins,” calculated in the same way, for all five Alaska wild salmon species for the years 2000-2004. Margins differ from year to year and from species to species. In recent years processing margins have generally been higher than ex-vessel prices. Put differently, the markup between the fisherman’s price and the wholesale price is higher than the price paid to fishermen (which also implies that the wholesale price is more than double the ex-vessel price).

Processors’ costs and profits are the subject of considerable speculation and debate among fishermen. Processors are reluctant to share information about their costs and are often suspicious of efforts to examine whether their profits are “justified”—pointing out that fishermen tend to focus their interest on years, species and products for which processors make money, rather than those for which they lose money. They also point out the difficulty of calculating per-pound costs when a large share of costs are fixed costs of capital used to process not only salmon but also other species.

However, various studies have attempted to examine costs and profitability of processing salmon. A typical example is the University of Alaska analysis of Bristol Bay salmon processing costs shown in Table X-5 (refer also to the discussion of the analysis on the following page).

In general, these studies have suggested that the most significant costs of salmon processing include tendering, labor, plant overhead and “yield” (lower processed weight resulting in higher fish cost per processed pound). These studies also suggest that processors’ profits vary significantly from year to year.

4 The relative decline in processor margins was greater for chum salmon than for other species because of the higher relative price of chum salmon roe and the higher roe yield of chum salmon. Processors could continue to process and sell fresh and frozen chum salmon even with low margins because of the value of the roe.
<table>
<thead>
<tr>
<th>Species</th>
<th>Year</th>
<th>Chinook</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
</tr>
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<tbody>
<tr>
<td>Ex-vessel price</td>
<td>2000</td>
<td>$1.92</td>
<td>$0.78</td>
<td>$0.57</td>
<td>$0.15</td>
<td>$0.29</td>
</tr>
<tr>
<td></td>
<td>2001</td>
<td>$1.68</td>
<td>$0.58</td>
<td>$0.48</td>
<td>$0.13</td>
<td>$0.36</td>
</tr>
<tr>
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<td>2002</td>
<td>$1.38</td>
<td>$0.60</td>
<td>$0.36</td>
<td>$0.10</td>
<td>$0.20</td>
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<tr>
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<td>2003</td>
<td>$1.41</td>
<td>$0.62</td>
<td>$0.49</td>
<td>$0.11</td>
<td>$0.19</td>
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<td>Wholesale price</td>
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<tr>
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<td>$2.05</td>
<td>$0.74</td>
<td>$0.87</td>
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<tr>
<td>Processing Margin (not adjusted for yield)</td>
<td>Canned</td>
<td>2000</td>
<td>$0.58</td>
<td>$1.92</td>
<td>$1.28</td>
<td>$0.95</td>
</tr>
<tr>
<td></td>
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<td>$1.69</td>
<td>$1.20</td>
<td>$0.82</td>
<td>$0.43</td>
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<td>$1.16</td>
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<td>$0.56</td>
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<tr>
<td></td>
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<td>$0.99</td>
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<td>$0.74</td>
<td>$0.76</td>
<td>$0.45</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>$0.52</td>
<td>$1.80</td>
<td>$1.08</td>
<td>$0.81</td>
<td>$0.45</td>
</tr>
<tr>
<td></td>
<td>Fresh</td>
<td>2000</td>
<td>$2.03</td>
<td>$1.61</td>
<td>$0.81</td>
<td>$0.30</td>
</tr>
<tr>
<td></td>
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<td>$2.32</td>
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<td>$0.60</td>
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<td>$2.49</td>
<td>$1.32</td>
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<td>Average</td>
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<td>2000</td>
<td>$1.02</td>
<td>$0.99</td>
<td>$1.04</td>
<td>$0.47</td>
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<td></td>
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<td>$0.78</td>
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<td>$0.64</td>
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<td>$0.79</td>
<td>$1.11</td>
<td>$0.97</td>
<td>$0.51</td>
<td>$0.40</td>
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</table>

Note: Based on Alaska Department of Fish and Game ex-vessel price estimates and wholesale value and volumes from Commercial Operator Annual Reports. Data are statewide annual averages. Differences in processing margin from year to year are partly due to differences in the geographic distribution of catch between different regions with different costs.

The Great Salmon Run: Competition Between Wild and Farmed Salmon
A Guide to Typical Bristol Bay Processing Costs

While they vary considerably form processor to processor, it’s still useful to begin to understand the typical costs a processor incurs processing your fish. Keep in mind that processing costs can vary widely from year to year. One factor is the run size—the more fish a processor processes, the cheaper the per pound charges for overhead. But if the run size is too big, the cost of long-hauls and flying fish to other plants can add up in a hurry. Another factor that varies from year to year is what’s happening in other fisheries. If crab or herring catches are down, a processor has to charge more of his plant and overhead costs to salmon.

TAXES & ASSESSMENTS. Shore based processors pay a 3 percent Alaska business tax on the ex-vessel value of the fish they freeze. Canneries pay a 4.5 percent tax and floating processors pay 5 percent. Processors also pay an assessment of 0.3 percent of ex-vessel value to the Alaska Seafood Marketing Institute (ASMI).

TENDER COSTS. Tender costs in Bristol Bay can range from nothing (in the case of smaller cash buyers) to between $.15 and $.20/lb for traditional processors. Tender costs for long hauls to Kodiak or other areas can be as much as $.25/lb. Tender costs depend on contracts that processors negotiate before the season. Often they can be tied to a herring contract, which can reduce costs. Costs also reflect market conditions: when prices are down, tenders—like fishermen—usually get paid less. In recent years, tender costs have gone up in Bristol Bay as processors have increased tender capacity to improve quality by cutting down on delivery times.

SERVICES TO FISHERMEN. Some processors—especially cash buyers—don’t provide any services and, hence, don’t have any costs. But most large, established processors provide services to foster loyalty among their fishermen. Providing services such as boat storage, net lockers, delivery of emergency spare parts and other miscellaneous services can end up costing processors as much as $.05/lb. or more.

ROE VALUE. Roe value per round pound is revenue that offsets a processors’ costs. The roe value is the roe yield time the price of roe. Typically, Bristol Bay processors sell their roe “green” (or unprocessed) to Japanese companies, whose technicians grade and process the roe at the plant. Depending on where the fish are harvested and their quality, the roe yield may be between 2 percent and 3 percent of the round weight of the fish. Processors usually receive between $3 and $5/lb. for roe. The price is a function of quality (which deteriorates the longer the time between harvest and processing) and market conditions. For fish that get long-hauled to plants in Kodiak or elsewhere, roe yield drops to zero. Usually the roe ends up adding between $.06 and $.15 per round pound to the value that your processor gets from your salmon—in effect reducing the cost of the fish to the processor by that amount. Because of long-hauls, average roe value per round pound is somewhat lower for canned salmon. For fish frozen in the round, processors don’t get paid separately for the roe, which gets extracted and processed in Japan.

PROCESSING YIELD: When you remove the head, guts and roe, the weight of your salmon goes down, which increases the cost of fish per processed pound. To calculate the fish cost per processed pound, divide the cost per round pound by the processing yield. Processing yields for H&G sockeye are typically between 74 percent and 76 percent, though yields may be as low as 72 percent for small fish. Processing yields for canned sockeye are about 59 percent, which is equivalent to 75 round pounds for a case of 48 14.75 oz. cans. Even for frozen round sockeye, the final weight ends up 2-3 percent less than the weight purchased from fishermen, for a yield of about 97-98 percent.

PROCESSING COSTS. Processing costs include all the direct costs that a processor incurs from the time fish are delivered to the plant until the fish are shipped from the plant—including labor, packaging, utilities and plant overhead. Processing costs for frozen H&G salmon in Bristol Bay usually range between $.55-.65/lb. on an H&G finished weight basis. Processing costs for frozen round sockeye usually range between $.40-.45/lb. Processors use $30-$35/case (for 14.75 oz. tall) as a rule of thumb for the cost of canning sockeye salmon, which works out to $.68-.79/lb. Custom processing rates are a good indicator of processing costs—although sometimes processors will charge less than their total processing costs for custom processing in order to spread plant overhead out over more volume.

TRANSPORTATION & STORAGE COSTS. Depending on when and where they sell their fish, processors may or may not pay transportation and storage costs. Processors used to sell most of their frozen sockeye production to Japanese importers FOB Bristol Bay, so that they didn’t incur any shipping or storage costs. That’s changing. This year, most Bristol Bay fish went to Japan unsold, adding transportation, import and storage costs. In our mid-range estimates for this article, we compare FOB Alaska costs with FOB Alaska prices, so we don’t include any transportation or storage costs. Fish sold in Japan get a higher price—but costs are higher, too. In contrast, most canned salmon is shipped to Seattle, stored in warehouses and sold over the course of the year—at a cost of about $.08-.12 per canned pound.

OTHER COSTS. “Other costs” include all the costs that we haven’t listed yet that would normally be subtracted from the selling price in order to calculate profit. They include the cost of a processor’s general overhead—office rental and salaries of management and sales personnel. They also include insurance, interest expense on pack loans and debt service for loans on plant and equipment. These costs can vary widely between different processors depending on their debt load and the volume of other species that they process. A very rough estimate is between $.05 and $.15/lb.

It is much more difficult to describe and explain how salmon prices increase between the wholesale and retail level than between the fisherman and the wholesale level. There are two fundamental reasons for this. First, there are far more retail salmon products than there are wholesale salmon products. The same headed and gutted fresh or frozen salmon purchased at wholesale may be made into numerous different retail products of different sizes, different yields, different additives and different packaging.

Secondly, unlike wholesale prices—which tend to be similar at any given time for similar salmon products—retail prices for the same products vary significantly between different stores, even in the same geographic area. What stores charge and what consumers are willing to pay depends not only on the product they are selling but also convenience (store location, parking, availability of other products, etc.), information (knowledge of the consumer and the store staff about the product), reliability (consistency of availability of the product, assurance of product quality) and many other factors. Different stores have different pricing strategies for salmon. At some stores, salmon is frequently “on sale”—discounted by widely varying amounts.

For these reasons, it is meaningless to talk about “the retail price of wild salmon” or the “retail price of farmed salmon.” It is difficult even to describe the retail price of a particular kind of salmon product in a particular location. This can be seen in the newspaper advertisements for salmon on the following two pages, for salmon sold by stores in the Maryland suburbs of Washington, DC.5

In April 2001 stores were selling fresh boneless Atlantic salmon fillets for prices ranging between $3.99 lb and $6.99/lb. The same store (Giant) advertised prices of $5.99/lb, $6.99/lb and $3.99/lb on three separate weeks. Clearly, there was no single “retail price of fresh boneless Atlantic salmon fillets” in the Washington, D.C. area in April 2001, nor any standard markup for this product. Rather, there were widely varying prices and widely varying markets.

Similarly, during the summer of 2003 stores were selling fresh chum salmon for prices as low as $9.99/lb (for whole salmon) to $2.99/lb (for steaks)—making it difficult to describe the retail price or markups for fresh chum salmon.

Table X-5  

<table>
<thead>
<tr>
<th></th>
<th>Frozen Dressed</th>
<th>Frozen Round</th>
<th>Canned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price paid to fishermen</td>
<td>$0.97</td>
<td>$0.75</td>
<td>$0.97</td>
</tr>
<tr>
<td>+ Taxes and assessments</td>
<td>$0.03</td>
<td>$0.02</td>
<td>$0.03</td>
</tr>
<tr>
<td>+ Tender cost</td>
<td>$0.17</td>
<td>$0.17</td>
<td>$0.17</td>
</tr>
<tr>
<td>+ Costs of services to fishermen</td>
<td>$0.03</td>
<td>$0.03</td>
<td>$0.03</td>
</tr>
<tr>
<td>= Fish cost per round lb.</td>
<td>$1.20</td>
<td>$0.97</td>
<td>$1.20</td>
</tr>
<tr>
<td>- Roe value per round lb. (= roe yield x roe price)</td>
<td>$0.09</td>
<td>$0.09</td>
<td>$0.00</td>
</tr>
<tr>
<td>= Fish cost per round lb., net of roe value</td>
<td>$1.11</td>
<td>$0.88</td>
<td>$1.20</td>
</tr>
<tr>
<td>+ Processing yield</td>
<td>74%</td>
<td>74%</td>
<td>97%</td>
</tr>
<tr>
<td>= Fish cost per processed lb., net of roe value</td>
<td>$1.51</td>
<td>$1.20</td>
<td>$1.24</td>
</tr>
<tr>
<td>+ Processing costs per processed lb.</td>
<td>$0.60</td>
<td>$0.60</td>
<td>$0.40</td>
</tr>
<tr>
<td>+ Transportation and storage costs before sale</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>+ Other costs</td>
<td>$0.10</td>
<td>$0.10</td>
<td>$0.10</td>
</tr>
<tr>
<td>= Processor's total cost</td>
<td>$2.21</td>
<td>$1.90</td>
<td>$1.74</td>
</tr>
<tr>
<td>Average price received by processor</td>
<td>$2.45</td>
<td>$1.80</td>
<td>$2.20</td>
</tr>
<tr>
<td>Profit or loss (= average price - total cost) per processed lb.</td>
<td>-0.24</td>
<td>-0.10</td>
<td>-0.46</td>
</tr>
<tr>
<td>per round lb.</td>
<td>-0.18</td>
<td>-0.07</td>
<td>-0.45</td>
</tr>
</tbody>
</table>

Note: Costs and prices can vary widely between processors. Any given processor’s profits or losses could be higher or lower than shown in this table.

Markups between Wholesale and Retail Prices

5 We are grateful for the assistance of Barbara Knapp of Germantown, Maryland, who has collected retail salmon advertisements in local newspapers for more than ten years.
We are unaware of any reliable source of data on “average” U.S. retail prices for fresh and frozen salmon. Although it is easy to go into a store and see what a particular salmon product is selling for in that particular store in that particular week, it is very difficult to determine “average” or even “typical” prices of salmon sold in a particular area—much less the entire country. This is especially the case because quantities sold vary dramatically between different stores and at different times. A store with a high price may be selling far less salmon than a store with a low price.

In April, 2001 stores in the Maryland suburbs of Washington, DC were selling fresh boneless Atlantic salmon fillets for prices ranging between $3.99 lb and $6.99/lb. The same store (Giant) advertised prices of $5.99/lb, $6.99/lb and $3.99/lb in three succeeding weeks. Photos: Gunnar Knapp
Newspaper Advertisements of Selected Maryland Stores for Fresh and Frozen Wild Chum Salmon, Summer 2003

Magruder's, July 14, 2003

Whole Fresh Pacific Silver Brite Salmon 99¢

Giant, August 10, 2003

Fresh Pacific Salmon Fillet 3.99 lb.

Shoppers Food Warehouse, August 24, 2004

West Coast Silverbrite Fresh Salmon Halves 1.98 lb.

Giant, July 27, 2003

2.99 lb.

Shoppers Food Warehouse, September 7, 2003

Previously Frozen West Coast, Sold in Packs 2 lbs. or More Arctic Salmon Fillets 1.98 lb.

During the summer of 2003 stores in the Maryland suburbs of Washington, DC were selling fresh chum salmon (referred to variously as “Pacific salmon,” “west coast silverbrite” and “fresh Pacific silverbrite” for prices from as low as $.99/lb (for whole salmon) to $2.99/lb (for steaks). Photos: Gunnar Knapp
Figures X-4 and X-5 compare wholesale prices with advertised retail prices in Maryland stores for fresh farmed Atlantic salmon fillets and various fresh wild chum salmon products. Advertised retail prices vary widely at any given time. Nevertheless, it is clear that for both farmed and wild salmon, prices are higher at the retail level than the wholesale level—typically at least twice as high.

In considering the reasons for this price increase, keep in mind that the product weight sold at retail may be considerably lower than the product weight purchased at wholesale, as discussed earlier. This is one important factor in price markups between wholesale and retail.

Below we briefly discuss other components of salmon price markups above the wholesale level. Keep in mind that these should be considered only general rules of thumb: actual markups vary widely in different markets and at different times (Knapp et al. 2001). 6

Traders will make whatever margin they can on any given transaction. Because most traders have very little overhead and often work independently in small offices, they can work on a very small margin if the volume of the transaction is large enough. On smaller volume transactions, though, a margin of 5 cents a pound is typical. For example, a trader selling a truckload of fresh Alaska chum salmon to a supermarket buyer in Boston will make $2,000 on a 40,000-pound truckload if he marks it up 5 cents a pound.

Traders can also make a higher margin, if they see a special opportunity that can arise when either the companies they are buying from, or those they are selling to, are not fully aware of the market conditions. In cases like this, it is possible for a trader to make 10 cents or more a pound.

If a trader has to invest a lot of time and effort into a sale, or find a market for a new product, he will normally require a higher margin. A trader trying to develop a new market for, say, a skinless, boneless chum salmon fillet, may not be interested in committing the necessary time and effort unless he thinks he can make a margin of at least 25 or 50 cents a pound on the initial orders. As the business is developed and the volume increases, however, a trader is normally willing to work on a lower margin.

Brokers may earn a commission of between two and seven percent of the sales price, depending on the product and the volume.

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6 Much of the remaining text for this section, discussing other components of price markups, was originally written by Peter Redmayne for Knapp et al., A Village Processing Plant: Yes or No? (2001).
Broadline distributors’ markups vary considerably. A broadline distributor like Associated Grocers that delivers to supermarkets will typically mark up frozen seafood items 5 to 10 percent. Fresh seafood items, on the other hand, may be marked up 15 to 20 percent, since they require more handling. In addition, the “shrink”—seafood that must be thrown away because it has gone bad—is much higher with fresh seafood. Broadline distributors that sell to supermarkets can mark product up less, because they deliver a very large volume of orders per stop.

Broadline distributors with foodservice accounts have an average mark up between 10 and 20 percent. If they have to compete with seafood distributors on a certain product, broadline distributors may take a very small mark up to get the business on that item. After broadline distributors have the business, though, they will normally try to increase the mark up. How high the distributor can mark the product up is largely a function of the knowledge of the buyer. Since sales people for most broadline distributors are paid largely on a commission basis, they will charge their customers as much as they can.

Specialty seafood distributors have a higher delivery cost than broadline distributors, because the total dollar value of their order is usually lower because their deliveries are limited to seafood. However, the higher delivery cost is offset by the fact that seafood distributors have lower overall operating costs. As a result, specialty seafood distributors will normally mark up seafood products about the same amount as broadline distributors, usually in a range between 10 to 15 percent, depending on the value of the product.

There is a growing trend for seafood distributors to supply large customers such as supermarket chains on a cost plus basis. Under this arrangement, a distributor will mark product up a negotiated amount above the distributor’s actual cost. Typically, this markup can be anywhere from six to 10 percent above cost, depending on the sales volume of the customer and the level of merchandising support the distributor has to supply.

Supermarkets with full-service seafood departments typically mark up the price of seafood between 10 and 25 percent, although supermarkets may sell the salmon at a low price as a ‘loss-leader.’ A loss-leader is a product put on sale in an effort to get the customer into the store. As such, some products are sold slightly above, at or below cost as an enticement to draw traffic into stores.

A supermarket’s mark up is necessary to cover its high overhead costs, including the labor required to staff a full-service seafood counter. In addition, supermarkets,
like other buyers, have to account for the “shrink” associated with seafood. When a supermarket does a product demonstration and hands out cooked samples, for example, this product is considered shrink. Product that cannot be sold and has to be discarded is also considered shrink. Furthermore, seafood—which is over 70 percent water—will dehydrate over time and lose moisture, which is, of course, weight. In a refrigerated case, this dehydration can be as much as one percent a day.

Because of their higher sales volume and lower overhead, club stores will take a much smaller markup on items. This markup is typically 10 to 15 percent. Restaurants generally try to operate with a food cost that runs between 30 and 35 percent. That means for a $12 entree, the cost of the food will typically be around $4. A restaurant that pays $8 for a pound of a chinook salmon fillet, will typically price that salmon portion of that entree (seafood portions are typically six to eight ounces) at about $12. By the time the vegetables and starch are added, a chinook salmon entree may run $16 to $20, depending on the restaurant. Restaurants need a high mark up on their food to cover their high operating costs, which include labor and real estate.

Examples of Markups from Fisherman to Consumer

Various studies have attempted to describe how and why salmon prices increase from the fisherman to the consumer. Tables X-6 and X-7 are two examples from University of Alaska Anchorage studies from the mid-1990s. Neither should necessarily be considered typical or representative. However, they help to illustrate the numerous ways in which costs and profits are added at different levels, resulting in a much higher final price to the consumer than that paid to the fisherman.

<table>
<thead>
<tr>
<th>Table X-6</th>
<th>Example of Markups for Fresh Wild Salmon Sold at Retail on the East Coast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grounds price paid to fishermen</td>
<td>$0.80/lb.</td>
</tr>
<tr>
<td>Add taxes and assessments</td>
<td>$0.03/lb.</td>
</tr>
<tr>
<td>Add tendering costs</td>
<td>$0.15/lb.</td>
</tr>
<tr>
<td>Subtract roe value</td>
<td>-$0.12/lb.</td>
</tr>
<tr>
<td>Cost of fish to processor (per round pound)</td>
<td>$0.86/lb.</td>
</tr>
<tr>
<td>Cost of fish to processor, after adjusting for 74 percent H&amp;G yield</td>
<td>$1.16/lb.</td>
</tr>
<tr>
<td>Add processing and packaging costs (includes plant overhead costs)</td>
<td>$0.46/lb.</td>
</tr>
<tr>
<td>Add processor’s general overhead and profit</td>
<td>$0.20/lb.</td>
</tr>
<tr>
<td>Add air freight to Seattle and trucking to East Coast</td>
<td>$0.40/lb.</td>
</tr>
<tr>
<td>Cost of fish to distributor</td>
<td>$2.22/lb.</td>
</tr>
<tr>
<td>Add distributor’s mark up (to cover reboxing, reicing, trucking and profit)</td>
<td>$0.25/lb.</td>
</tr>
<tr>
<td>Cost to supermarket</td>
<td>$2.47/lb.</td>
</tr>
<tr>
<td>Add supermarket markup</td>
<td>$0.52/lb.</td>
</tr>
<tr>
<td>Price to consumer for H&amp;G salmon</td>
<td>$2.99/lb.</td>
</tr>
</tbody>
</table>

Source: UAA 1996.
Table X-7  Estimate of Markups for Wild Salmon Sold at a Seattle Restaurant

<table>
<thead>
<tr>
<th>The $17 Copper River King Dinner: Where the Money Goes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grounds Price for Copper River King</strong></td>
</tr>
<tr>
<td>Fishermen’s Taxes and Assessments</td>
</tr>
<tr>
<td>Processor’s Taxes and Assessments</td>
</tr>
<tr>
<td>Tendering Costs</td>
</tr>
<tr>
<td>Subtract Roe Value</td>
</tr>
</tbody>
</table>

**Cost of Round Fish Delivered to Processor** | $1.68/lb. |
| Adjust for H&G Yield (74%) | $2.27/lb. |
| Add Processing, Packaging & Overhead Costs | $0.46/lb. |
| Add Air Freight to Seattle | $0.30/lb. |
| Adjustment for Loss on #2’s | $0.13/lb. |
| Add Processor’s Average Profit Margin | $0.20/lb. |

**Cost of Copper River King to Distributor** | $3.36/lb |
| Adjust for Skinless Boneless Portions (58%) | $5.79/lb |
| Add Distributor’s Labor Cost of Producing Portions | $0.75/lb |
| Add Packaging Costs | $.10/lb. |
| Add Delivery Costs | $.20/lb. |
| Add Distributor’s Profit Margin | $.20/lb. |

**Cost of H&G Copper River King Portion to Restaurant** | $7.04/lb |

**Add Restaurant Costs**

- Combined Product & Labor Costs | 65% of sales price is industry standard |
- Cost of 8-oz. Dinner Portion | $3.52 |
- Other Food Costs | $0.86 |
- Labor Costs | $6.67 |
- General and Administrative Expenses (Rent, equipment, depreciation, utilities, etc.) | $5.10 |
- Gross Profit Margin | $0.85 |

**Price of Copper River King Dinner** | $17.00 |

*Notes*

- Assumes 3% yield @ $4.00/lb.
- Estimate from Craig Wiese, Alaska Sea Grant Marine Advisory Program
- Assumes 20% of fish are #2’s which sell for 20% less.

---

Note: Prices and costs are typical. Actual costs and prices for specific processors, restaurants and distributors may differ.

References


Overview of U.S. Salmon Consumers

Key Points

✓ As price and availability change, different kinds of people are eating salmon and their familiarity with salmon is changing. Tomorrow’s salmon consumers will not necessarily be like today’s or yesterday’s salmon consumers. Available data suggest that Americans are eating salmon more frequently as salmon becomes cheaper and more widely available.

✓ For thinking about what might influence decisions of current consumers about whether to buy farmed or wild salmon, what frequent consumers learn and think is most important. For thinking about how to expand future salmon consumption, what less frequent consumers learn and think may be more important.

✓ Two recent surveys suggest that just under one-fifth of American salmon consumers had heard of farmed salmon, were aware that farmed and wild salmon are different and considered wild salmon preferable. But about three-quarters of salmon consumers either had not heard of farmed salmon or did not have an opinion about differences between farmed and wild salmon. An earlier, 1994 survey of mid-Atlantic and New England seafood consumers showed that farmed salmon was slightly preferred and 40 percent had heard of salmon farming.

✓ A relatively small share of salmon consumers know or care about differences between wild and farmed salmon. Labeling salmon as “wild” or “farmed” may not influence most salmon consumers’ purchase decisions.

✓ Negative information about farmed salmon will not necessarily strengthen overall wild salmon sales. Negative messages about farmed salmon may cause some consumers to switch from farmed to wild salmon—but may cause others to eat less of both farmed and wild salmon.

✓ There has also been negative information distributed about wild salmon, in particular that some salmon are endangered, which may discourage consumers from buying salmon out of concern for the environment.

Introduction

In this chapter we summarize available information about U.S. fresh and frozen salmon consumers: who buys salmon, how often they buy salmon, where they buy salmon, what kinds of products they buy, what influences their buying decisions and what they know about wild and farmed salmon. Our goal is to provide basic information about consumers to set the stage for our discussion in subsequent chapters of this report relating to marketing, certification and labeling. Our analysis is based on a number of consumer and industry surveys completed back to 1989, many of which are unpublished or not readily available.

We begin by reviewing challenges in describing U.S. salmon consumers: why it is difficult to answer the kinds of questions we are asking in this chapter. Next, we describe the surveys which we reviewed. We then summarize and compare the information about U.S. salmon consumers available from these surveys.

Inherent Challenges in Describing U.S. Salmon Consumers

There are a number of inherent challenges in describing U.S. “salmon consumers” and where and why they buy salmon. These challenges make it
difficult to design surveys of salmon consumers. They also make it difficult to interpret some of the surveys that have been done in the past.

First, the U.S. population is very diverse, as are U.S. salmon consumers. How much salmon and other kinds of food people buy and why they buy it varies greatly by region, by income level, by type of household, by age and by ethnic group.

Second, “salmon” is not one product but rather a variety of different products—including fresh and frozen salmon, canned salmon and smoked salmon. These products are consumed in very different ways, by different kinds of consumers.

Third, American consumers eat salmon at home and at restaurants (as well as cafeterias and other food service establishments). Put differently, they buy salmon from both retail and from food-service sellers. There are important differences between retail and food-service in what people buy and what influences their buying decisions.

Fourth, what people buy and eat depends upon price. This fundamental point is all-too-often ignored in discussions of consumer preferences. Asking people about preferences without asking about prices may provide irrelevant or misleading information. If we ask a consumer “would you rather drive a Porsche or a Chevrolet?” or “would you rather eat steak or hamburger?” we will tend to get one kind of answer. But what consumers actually buy will reflect not only what they would like to buy, but what they can afford. For this reason, asking a consumer “would you rather eat wild salmon or farmed salmon?” may be misleading unless we specify the relative prices of both products.

Fifth, what people buy and eat also depends upon availability and convenience. What kinds of salmon people buy is influenced by what kinds of salmon are available in the stores where they shop and the restaurants where they eat. Just because a consumer “prefers” wild salmon to farmed salmon doesn’t necessarily mean that she is willing to make a special trip to a different store to buy it, or that she won’t buy farmed salmon at times of year when wild salmon is not available.

Sixth, current salmon consumers are not necessarily the same as potential salmon consumers. At any given time, the people who eat salmon are influenced by price, availability and their past experience with and knowledge of salmon. As prices and availability of salmon change, as consumers’ familiarity with salmon changes, the characteristics of salmon consumers may also change. In general, as the price of a product declines and it becomes more widely available, it will be purchased by a broader group of consumers who tend to know less about the product and have less defined taste preferences. What matters for the newer consumers may be different than what matters for seasoned consumers.

Seventh, how much salmon consumers buy also depends on consumers’ attitudes towards other kinds of foods and the prices and availability of other foods. Wild salmon competes not only with farmed salmon but with many other kinds of fish as well as other kinds of proteins. The choice faced by consumers in both stores and restaurants is not just “wild salmon or farmed salmon?” but also “salmon or halibut?” and “salmon or beef or pork or chicken?”

The implication of the challenges listed above is that it is a complex task to describe salmon consumers and why they buy salmon, because there are many different kinds of consumers buying many different kinds of salmon at many different kinds of places for many different reasons—all of which can change as prices and availability of salmon and other foods change over time.

Overview of Consumer Surveys

Table XI-1 provides an overview of eight consumer surveys which we reviewed. In this chapter, we refer to different surveys by the names of the organizations which conducted them and the years in which they were conducted.

The surveys were conducted by different organizations, for different purposes, in different parts of the United States, using different methodologies. The surveys differed in how they screened for respondents, so the responses reflect consumption, preferences and opinions of different kinds of consumers. They asked different kinds of questions, making it difficult to compare the response between surveys. Not all the reports which we reviewed included detailed information about the survey methodology, making it difficult to judge the reliability of the information or how to interpret it. It is important to keep these limitations in mind in interpreting and comparing the results of different surveys.

Note that the surveys were conducted during a period of time (1989-2002) when U.S. farmed salmon imports and farmed salmon consumption were rising rapidly. It is likely that salmon consumers and their preferences were changing as well during this period and have probably continued to evolve since then. Thus the surveys may be considered historical snapshots from different angles of a changing scene.

DPA Group 1989 Survey

In 1989, the DPA Group surveyed U.S. salmon consumers for the Canadian Department of Fisheries and Oceans (Egan and Gislason 1989). The objectives of the study were to identify U.S. market opportunities for Canadian fresh and frozen salmon.

Surveys were mailed to 5,400 consumers in five major cities in the United States in January 1989. The sample
of consumers was selected from a consumer mail panel of 220,000 households maintained by Market Facts Inc., a market research company. The sample included 1,080 households in each of five metropolitan areas: Los Angeles, San Francisco, Chicago, New York and Dallas. The combined population of these areas was 21 percent of the total number of American households in 1988. A total of 4041 surveys were returned, for an overall survey response rate of 75 percent.

The survey was to be filled out by the adult member of the household who had the most recent birthday. Thus the responses reflect individual rather than household frequency of consumption.

<table>
<thead>
<tr>
<th>Table XI-1</th>
<th>Overview of Consumer Surveys</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization</strong></td>
<td><strong>Survey year</strong></td>
</tr>
<tr>
<td>DPA Group – prepared for Canada’s Department of Fisheries and Oceans</td>
<td>1989</td>
</tr>
<tr>
<td>University of Rhode Island – funded by the U.S. Department of Agriculture</td>
<td>1994</td>
</tr>
<tr>
<td>NPD Group – prepared for the Alaska Seafood Marketing Institute</td>
<td>1994</td>
</tr>
<tr>
<td>The Research Department, Inc. – prepared for the Alaska Seafood Marketing Institute</td>
<td>1996</td>
</tr>
<tr>
<td>University of Rhode Island Sea Grant</td>
<td>1998</td>
</tr>
<tr>
<td>Compendium Group – prepared for the Alaska Seafood Marketing Institute</td>
<td>1999-2000</td>
</tr>
<tr>
<td>Seafood Choices Alliance</td>
<td>2001</td>
</tr>
<tr>
<td>TRD Frameworks – prepared for the Alaska Seafood Marketing Institute</td>
<td>2001 &amp; 2002</td>
</tr>
</tbody>
</table>
University of Rhode Island 1994 Survey

In 1994, a group of researchers from the Universities of Rhode Island, New Hampshire and Delaware surveyed Northeastern and Mid-Atlantic consumers as part of a study of consumer preferences for Northeastern aquaculture products (Wessells et al. 1994). The survey was a mail survey of 5,000 randomly selected households in Northeastern and Mid-Atlantic states, which asked questions about frequency of finfish consumption and perceptions of different kinds of finfish. The survey was to be filled out by the individual in the household who was chiefly responsible for the retail purchase of seafood for home consumption. A total of 1529 surveys were returned. The difficulty with a survey of this type is that there are not any mailing lists specifically for seafood consumers. Thus some of those households who received this survey were not seafood consumers and as such did not respond. Therefore a response rate of 30 percent may be deceptive. For example, if households which consumed seafood were more likely to respond, the responses may represent a larger (but unknown) share of those households.

The questions about salmon consumption asked “How often do you or another member of your household buy each of the following fresh items . . . to prepare and consume at home?” Thus the survey asked only about at-home consumption, questions related to frequency of household purchases and perceptions of wild versus farmed fish.

NPD Group 1994 Consumer Panels

In 1994, the NPD Group’s NET and CREST Services prepared a study of U.S. fish and seafood consumption (NDP 1996). The report was based on detailed data on food consumption, as recorded in 14-day diaries, from the NPD Group’s NET® and CREST consumer panels. The National Eating Trends Panel (NET®) was composed of 2,000 households who kept a 14-day diary on all foods eaten in-home. The CREST panel was composed of 12,800 households who kept a 14-day diary on all restaurants visited.

The results of the study were reported in terms of “eatings per 1,000 capita during a two-week period.” Technically, what this means is how many times a product would be eaten by a group of 1,000 people during a two-week period. For example, the eatings score of pizza was about 800 in 1994, meaning that a group of 1,000 people would have had 800 pizza meals during a two-week period. But it is not possible to tell from the information reported in the study how the consumption was distributed—for example whether 800 people had one pizza meal, or 400 people had two pizza meals, or 100 people had eight pizza meals.

The Research Department 1996 Survey

In 1996, The Research Department, Inc. conducted a national telephone survey of 1,005 randomly selected households (The Research Department 1996b). The purpose of the study was to collect information about frequency of consumption of fresh or frozen salmon, awareness of whether salmon was wild and farmed and factors affecting consumption decisions. Respondents were asked whether they had consumed fresh or frozen salmon either at home or away from home in the past year and whether they intended to purchase it during the coming year. If they had purchased salmon they were asked whether it was wild or farmed, or if they didn’t know. The survey also asked open-ended questions about respondents’ reasons for not buying wild salmon, as well as concerns respondents might have about buying wild salmon. The survey did not ask any questions about frequency of salmon consumption, so it was not possible to separate the responses of frequent consumers from those of infrequent consumers.

University of Rhode Island 1998 Survey

In 1998, researchers from the University of Rhode Island interviewed 1,640 randomly selected seafood consumers in a national telephone survey as part of a study of US consumers’ hypothetical preferences for eco-labeled seafood—in an effort to find out if consumers were at all interested in eco-labeled seafood (Wessells et al. 1999). Respondents were screened by the question “do you or other members of your household eat fresh or frozen fish and seafood?” Only those who answered “yes” were interviewed. The survey asked only about fresh and frozen seafood consumed at home; thus it excluded canned seafood and seafood eaten at restaurants. The survey asked one question about the frequency of fresh and frozen salmon consumption at home and showed how the answers to this question differed by geographic location and respondents’ beliefs about the status of Pacific salmon. It also elicited their preferences for eco-labeled salmon versus non-labeled where the label certified no overfishing of that product’s source fishery.

Compendium Group 1999-2000 Survey

In 1999 and 2000, the Compendium Group conducted a lengthy “nationally projectable telephone survey” of 1994 seafood consuming households for the Alaska Seafood Marketing Institute (ASMI) (Compendium Group 2000). Interviews were conducted with the person “who does most of the major grocery shopping” for the household. Respondents were screened by the question “When you buy groceries, do you buy fresh, frozen or canned fish”? Only those who responded “always,” “sometimes” or “seldom” were interviewed; those who answered “never” were excluded from the survey.

The survey asked questions about how frequently respondents purchased salmon of various product forms, including canned salmon, fresh salmon fillets, fresh salmon steaks, frozen salmon steaks and smoked salmon; where the salmon was purchased; and factors
influencing purchases. The survey also asked about perceptions of wild and farmed salmon and how different kinds of information might influence buying decisions. In general, the Compendium Group survey is the most detailed survey of U.S. salmon consumers of which we are aware.

**Seafood Choices Alliance 2003 Survey**

In 2003 Seafood Choices Alliance—an advocacy group for “building interest in and awareness of sustainable seafood issues by working collaboratively with conservation organizations and the seafood sector to ensure the widest possible dissemination of information about sustainable seafood”—issued a report on *The Marketplace for Sustainable Seafood: Growing Appetites and Shrinking Seas* in 2003. The report included a section on consumer attitudes related to sustainability, which relied in part on a nationwide telephone survey of 1,000 U.S. frequent seafood consumers conducted in March 2001 by the independent market research firm, The Mellman Group. Respondents were screened by the question “About how often would you say you eat fish or other seafood at home or in restaurants?” Only those who responded “once a month” or more frequently were interviewed.

The survey asked a wide variety of questions about awareness of environmental issues related to seafood and how different kinds of information might influence buying decisions. The survey did not ask specifically about frequency of salmon consumption.

**TRD Frameworks 2001 and 2002 Surveys**

TRD Frameworks conducted consumer surveys for ASMI in 2001 and 2002 (TRD Frameworks 2002). They purchased a list of randomly selected men and women, ages 18-64 with incomes over $25,000, living in six metropolitan areas: Los Angeles, San Francisco, Chicago, Boston, Baltimore/Washington D.C. and Atlanta. They used Computer Assisted Telephone Interviews (CATI) to conduct surveys with people in this sample. Respondents were screened by questions about their income and salmon purchases. Only those who purchased salmon more than twice per year and with incomes of more than $25,000 (if one earner) or $50,000 (if two or more earners) were interviewed.

The surveys asked about frequency of salmon consumption, factors influencing salmon consumption and awareness of and importance of different kinds of information which might affect salmon purchases. The surveys were intended to provide a method of monitoring changes over time in awareness of and attitudes towards Alaska salmon and farm-raised salmon and to determine the impact of various potential messages about Alaska salmon on the likelihood of purchase.

**Frequency of Fresh and Frozen Salmon Consumption**

Tables XI-2 through XI-7 provide estimates from six different consumer surveys about the frequency of fresh and frozen salmon consumption by Americans. Note that different surveys asked different questions of different kinds of people in different ways over a fourteen-year period. For example, some surveys asked only about fresh and frozen salmon consumption at home; some also asked about consumption in restaurants and some asked about both. Some surveys were conducted by mail while others were conducted by telephone. The surveys varied in how they asked consumers about their frequency of consumption. For all of these reasons, the results of the surveys are not directly comparable. But to the extent that different surveys show similar results, they tend to reinforce the validity of those results.

### Table XI-2

<table>
<thead>
<tr>
<th>DPA Group 1989 Survey: Frequency of Fresh or Frozen Salmon Consumption by Household</th>
<th>At home</th>
<th>In restaurants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once per week</td>
<td>14%</td>
<td>10%</td>
</tr>
<tr>
<td>Twice per month</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Once per month</td>
<td>11%</td>
<td>10%</td>
</tr>
<tr>
<td>Once every three months</td>
<td>3%</td>
<td>8%</td>
</tr>
<tr>
<td>Rarely</td>
<td>5%</td>
<td>7%</td>
</tr>
<tr>
<td>Never</td>
<td>58%</td>
<td>57%</td>
</tr>
</tbody>
</table>

Note: Based on 4041 responses to a mail survey of consumers in five major US cities. The survey had an overall response rate of 75%. Data in the table were calculated by multiplying the percentage of households which consumed salmon (43%) by the percentage of salmon-consuming households which consumed at each level. Data are from page 2-1 and Appendix C, Table 2-15.
### Table XI-3

University of Rhode Island 1994 Survey: “How often do you or another member of your household buy fresh salmon to prepare or consume at home?”

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly</td>
<td>5%</td>
</tr>
<tr>
<td>Once every 2 weeks</td>
<td>8%</td>
</tr>
<tr>
<td>Once per month</td>
<td>17%</td>
</tr>
<tr>
<td>Once every 3 months</td>
<td>13%</td>
</tr>
<tr>
<td>Once every 6 months</td>
<td>10%</td>
</tr>
<tr>
<td>Once a year</td>
<td>5%</td>
</tr>
<tr>
<td>Rarely</td>
<td>14%</td>
</tr>
<tr>
<td>Never</td>
<td>28%</td>
</tr>
</tbody>
</table>

Note: Based on 1529 responses of households in the Northeastern and Mid-Atlantic regions to a mail survey. The survey had a 30% response rate.

### Table XI-4

The Research Department 1996 Survey: “Have you consumed fresh or frozen salmon either at home or away from home in the past year?”

<table>
<thead>
<tr>
<th>Answer</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>40%</td>
</tr>
<tr>
<td>No</td>
<td>60%</td>
</tr>
</tbody>
</table>

Note: Based on 1005 responses to a national telephone survey.

### Table XI-5

University of Rhode Island 1998 Survey: "How often did you purchase salmon during the past year to eat at home?"

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased salmon during the past year</td>
<td>53%</td>
</tr>
<tr>
<td>About once a week or more</td>
<td>4%</td>
</tr>
<tr>
<td>About once every two weeks</td>
<td>8%</td>
</tr>
<tr>
<td>Once a month</td>
<td>15%</td>
</tr>
<tr>
<td>Once every two or three months</td>
<td>14%</td>
</tr>
<tr>
<td>Once every six months</td>
<td>8%</td>
</tr>
<tr>
<td>Less than once every six months</td>
<td>4%</td>
</tr>
<tr>
<td>Did not purchase salmon during the past year</td>
<td>47%</td>
</tr>
</tbody>
</table>

Note: Based on 1640 responses to a national telephone survey of households which consumed fresh or frozen fish or seafood.

### Table XI-6

Compendium Group 1999-2000 Survey: Responses About Frequency of Salmon Purchases

<table>
<thead>
<tr>
<th>Question</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>“How frequently do you purchase salmon to prepare at home?”</td>
<td>Very frequently-more than once a month</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>Somewhat frequently-several times a year</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td>Not very frequently</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>31%</td>
</tr>
<tr>
<td>“How often do you typically order salmon in a restaurant?”</td>
<td>Once a week or more</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>One to three times per month</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Several times per year</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>Once a year or less</td>
<td>22%</td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>42%</td>
</tr>
<tr>
<td></td>
<td>Don't know</td>
<td>1%</td>
</tr>
</tbody>
</table>

Note: Based on 1994 responses to a national telephone survey of households which bought fresh, frozen or canned fish.
Table XI-7

<table>
<thead>
<tr>
<th>Response</th>
<th>2001 survey</th>
<th>2002 survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very frequently—more than once a month</td>
<td>41%</td>
<td>38%</td>
</tr>
<tr>
<td>Somewhat frequently—at least every 1-2 months</td>
<td>31%</td>
<td>34%</td>
</tr>
<tr>
<td>Not very frequently—less than 6 times a year</td>
<td>28%</td>
<td>28%</td>
</tr>
</tbody>
</table>

Note: Based on computer assisted telephone interviews in six metropolitan areas (900 in 2001 and 601 in 2002) with respondents who purchased salmon “more often than twice a year.”

Table XI-8

<table>
<thead>
<tr>
<th>Survey</th>
<th>Type of consumption</th>
<th>Frequently</th>
<th>Somewhat frequently</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPA Group 1989</td>
<td>At home</td>
<td>23%</td>
<td>14%</td>
<td>8%</td>
<td>58%</td>
</tr>
<tr>
<td>DPA Group 1989</td>
<td>Away from home</td>
<td>19%</td>
<td>18%</td>
<td>15%</td>
<td>57%</td>
</tr>
<tr>
<td>University of Rhode Island 1994</td>
<td>At home</td>
<td>13%</td>
<td>40%</td>
<td>19%</td>
<td>28%</td>
</tr>
<tr>
<td>The Research Department 1996</td>
<td>At home or away from home</td>
<td></td>
<td></td>
<td></td>
<td>60%</td>
</tr>
<tr>
<td>University of Rhode Island 1998</td>
<td>At home</td>
<td>12%</td>
<td>29%</td>
<td>12%</td>
<td>47%</td>
</tr>
<tr>
<td>Compendium 1999-2000</td>
<td>At home</td>
<td>16%</td>
<td>26%</td>
<td>27%</td>
<td>31%</td>
</tr>
<tr>
<td>Compendium 1999-2000</td>
<td>Away from home</td>
<td>12%</td>
<td>23%</td>
<td>23%</td>
<td>42%</td>
</tr>
</tbody>
</table>

*Definitions varied between surveys, and were based on the best fit of response categories to the following definitions: “frequently”–more than once per month; “somewhat frequently”–once every six months to once every month; “rarely”–less than once every six months. Precise comparisons between surveys are not possible. All responses are for fresh or frozen salmon only, and exclude canned salmon consumption.

Table XI-8 compares estimates of frequency of salmon consumption by Americans from five of the consumer surveys. For this table, we grouped frequency of consumption estimates into four categories: “frequently,” “somewhat frequently,” “rarely,” and “never.” The grouping should be considered only very approximate, because the actual frequency of consumption categories varied between the different surveys. The most directly comparable categories are “never” (which was used in each survey) and “frequently.”

We may draw several general conclusions from comparing these different surveys. First, all of the surveys show that American consumers vary widely in their frequency of salmon consumption. Some consumers—probably less than 20 percent of all Americans—eat salmon frequently (more than once a month). Other consumers—at least 30 percent of all Americans—never eat salmon. The remainder are somewhat evenly divided between those who eat salmon somewhat frequently (twice per year or more) and rarely (less than twice per year).

Second, a comparison of the surveys suggests that more Americans are eating salmon as salmon has become cheaper and more widely available. The surveys suggest that the percentage of survey respondents who “never” eat salmon declined during the 1990s, from about 50-60 percent to about 30-40 percent.²

At-Home Consumption vs. Restaurant Consumption

American consumers eat salmon both at home and in restaurants. The most recent survey to ask about consumption both at home and in restaurants was the Compendium Group 1999-2000 survey (Table XI-6). The frequency categories were different for at-home and restaurant consumption, making a direct comparison difficult. However, the percentage of Americans who “never” consumed salmon in restaurants was 42 percent, while the percentage who “never” consumed salmon at home was 35 percent. The percentage who consumed salmon at least once per

² For one survey—the University of Rhode Island 1994 survey of Northeastern and Mid-Atlantic consumers—the percentage of respondents who “never” ate salmon at home was much lower (28 percent). However, that survey specifically targeted seafood consumers. People who didn’t eat salmon were less likely to return the survey, which could explain why a lower percentage responded “never.”
month in restaurants was 12 percent, while the percentage who consumed salmon “more than once a month” at home was 16 percent.

The 1989 DPA Survey (Table XI-2) found similar percentages of Americans who “never” consumed salmon at-home (58 percent) and in restaurants (57 percent). Comparing the two surveys suggests that the frequency of salmon consumption increased during the 1990s both at home and in restaurants, but that at-home consumption may have increased relatively more rapidly.

In any case, the surveys show that both the retail market and the food-service market are important for understanding American salmon markets and salmon consumers.

**Frequency of Consumption vs. Volume of Consumption**

In thinking about salmon markets and salmon marketing, it is important to distinguish between consumers and consumption. Table XI-9 gives a simple example of why this is important. Suppose, as shown in the table, that 16 percent of all consumers eat salmon “frequently,” 26 percent “somewhat frequently,” 27 percent “rarely,” and 31 percent “never.” (These are the percentages for at-home consumption estimated by the Compendium 1999-2000 survey shown in Table XI-6.)

Now suppose that consumers who buy salmon “frequently” buy salmon 24 times per year, those who buy “somewhat frequently” buy salmon six times per year and those who buy salmon “rarely” buy salmon one time per year. These assumptions are for purposes of illustration only: we do not have enough information from the survey to know how frequently they actually buy salmon.

Under these assumptions, as shown in Table XI-9, the 16 percent of consumers who buy salmon “frequently” would account for 68 percent of consumption, while the 27 percent who buy salmon “rarely” would account for only five percent of consumption. The important point is not the numbers in this particular hypothetical example, but simply the mathematical fact that those who consume salmon relatively more frequently account for a relatively greater percentage of consumption than they do of consumers.\(^3\)

This is important when considering how different kinds of information or marketing might affect consumption of farmed and wild salmon. For information or marketing which might influence decisions of current consumers about whether to buy farmed or wild salmon, what frequent consumers learn and think is most important. In contrast, for information or marketing which might affect how much salmon consumers eat, what less-frequent consumers learn and think may be more important—because these groups represent a much larger share of the total population.

---

<table>
<thead>
<tr>
<th>Table XI-9</th>
<th>Percent of Consumers vs. Percent of Consumption: A Hypothetical Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>“How often do you consume salmon?”</strong></td>
<td>Frequently</td>
</tr>
<tr>
<td>Percent of all consumers</td>
<td>16%</td>
</tr>
<tr>
<td>Number of consumers</td>
<td>160</td>
</tr>
<tr>
<td>Percent of salmon consumers</td>
<td>23%</td>
</tr>
<tr>
<td>Purchases per year (assumed)</td>
<td>24</td>
</tr>
<tr>
<td>Total purchases</td>
<td>3840</td>
</tr>
<tr>
<td>Percent of total consumption</td>
<td>68%</td>
</tr>
</tbody>
</table>

\(^3\) In Table XI-9, even if those who purchased salmon “frequently” bought salmon only 12 times per year, they would still account for more than half of total consumption.
Characteristics of Fresh and Frozen Salmon Consumers

Several of the surveys provide economic and demographic data about the characteristics of American salmon consumers. There are several clear characteristics which are consistent across all of the surveys.

First, as shown in Tables XI-10 and XI-11, the frequency of salmon consumption increases with income. These results are consistent with what we would expect for a higher-priced protein.

Second, as shown in Tables XI-12 through XI-14, rates of fresh and frozen salmon consumption tend to be higher in the west. In particular, rates of consumption are slightly higher in Pacific Coast states than they are in other parts of the country, although the Northeast is a close second.

<table>
<thead>
<tr>
<th>Table XI-10</th>
<th>University of Rhode Island 1994 Survey: “How often do you or another member of your household buy fresh salmon to prepare or consume at home?”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response groups</strong></td>
<td><strong>All households</strong></td>
</tr>
<tr>
<td>Frequent</td>
<td>30%</td>
</tr>
<tr>
<td>Infrequent</td>
<td>42%</td>
</tr>
<tr>
<td>Never</td>
<td>28%</td>
</tr>
</tbody>
</table>

Note: Based on 1529 responses of households in the Northeastern and Mid-Atlantic regions to a mail survey. The survey had a 30% response rate.

<table>
<thead>
<tr>
<th>Table XI-11</th>
<th>The Research Department 1996 Survey: “Have you consumed fresh or frozen salmon either at home or away from home in the past year?”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
<td><strong>All respondents</strong></td>
</tr>
<tr>
<td>Yes</td>
<td>40%</td>
</tr>
<tr>
<td>No</td>
<td>60%</td>
</tr>
</tbody>
</table>

Note: Based on responses to a national telephone survey.

<table>
<thead>
<tr>
<th>Table XI-12</th>
<th>The Research Department 1996 Survey: “Have you consumed fresh or frozen salmon either at home or away from home in the past year?”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Groups</strong></td>
<td><strong>All respondents</strong></td>
</tr>
<tr>
<td>Yes</td>
<td>40%</td>
</tr>
<tr>
<td>No</td>
<td>60%</td>
</tr>
</tbody>
</table>

Note: Based on responses to a national telephone survey. In the “West” 2% of respondents answered “don’t know.”
The one exception to this pattern is that the 1999-2000 Compendium Group survey showed a higher percentage of consumers who consumed salmon “very frequently” and a lower percentage who “never” consumed salmon in the South Atlantic region than in the West. Growth in farmed salmon consumption has been relatively greater in the South Atlantic region than in other regions, perhaps because this region is closer to Miami, where much of the farmed salmon imported from Chile enters the United States. Farmed salmon has created a market for salmon where it had previously not existed to any large extent.

Salmon consumption varies with other characteristics such as urban or rural residence, age and education (Table XI-15). The factors tend to be correlated with income. The survey reports do not present sufficient information to tell whether these factors have an independent effect on the frequency of salmon consumption.

### Table XI-13

**University of Rhode Island 1998 Survey:** “How often did you purchase salmon during the past year to eat at home?”

<table>
<thead>
<tr>
<th></th>
<th>National average</th>
<th>New England</th>
<th>Middle Atlantic</th>
<th>East North Central</th>
<th>West North Central</th>
<th>South Atlantic</th>
<th>East South Central</th>
<th>West South Central</th>
<th>Mountain</th>
<th>Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased salmon during the past year</td>
<td>53%</td>
<td>60%</td>
<td>55%</td>
<td>55%</td>
<td>47%</td>
<td>52%</td>
<td>45%</td>
<td>42%</td>
<td>46%</td>
<td>71%</td>
</tr>
<tr>
<td>About once a week or more</td>
<td>4%</td>
<td>3%</td>
<td>5%</td>
<td>3%</td>
<td>4%</td>
<td>3%</td>
<td>1%</td>
<td>2%</td>
<td>3%</td>
<td>10%</td>
</tr>
<tr>
<td>About once every two weeks</td>
<td>8%</td>
<td>13%</td>
<td>12%</td>
<td>10%</td>
<td>4%</td>
<td>10%</td>
<td>1%</td>
<td>2%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Once a month</td>
<td>15%</td>
<td>15%</td>
<td>12%</td>
<td>12%</td>
<td>10%</td>
<td>16%</td>
<td>18%</td>
<td>14%</td>
<td>13%</td>
<td>25%</td>
</tr>
<tr>
<td>Once every two or three months</td>
<td>14%</td>
<td>13%</td>
<td>15%</td>
<td>17%</td>
<td>17%</td>
<td>10%</td>
<td>14%</td>
<td>14%</td>
<td>8%</td>
<td>16%</td>
</tr>
<tr>
<td>Once every six months</td>
<td>8%</td>
<td>11%</td>
<td>4%</td>
<td>9%</td>
<td>8%</td>
<td>9%</td>
<td>9%</td>
<td>7%</td>
<td>9%</td>
<td>6%</td>
</tr>
<tr>
<td>Less than once every six months</td>
<td>4%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>4%</td>
<td>2%</td>
<td>2%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Did not purchase salmon during the past year</td>
<td>47%</td>
<td>40%</td>
<td>45%</td>
<td>45%</td>
<td>53%</td>
<td>48%</td>
<td>55%</td>
<td>58%</td>
<td>54%</td>
<td>29%</td>
</tr>
</tbody>
</table>

**Note:** Based on 1640 responses to a national telephone survey of households which consumed fresh or frozen fish or seafood.

**Source:** URI 1998 Survey, page 19.

### Table XI-14

**Compendium Group 1999-2000 Survey:** “How frequently do you purchase salmon to prepare at home?”

| Group                      | All respondents | Region
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>North East</td>
</tr>
<tr>
<td>Very frequently-more than once a month</td>
<td>16%</td>
<td>15%</td>
</tr>
<tr>
<td>Somewhat frequently-several times a year</td>
<td>26%</td>
<td>25%</td>
</tr>
<tr>
<td>Not very frequently</td>
<td>27%</td>
<td>24%</td>
</tr>
<tr>
<td>Never</td>
<td>31%</td>
<td>36%</td>
</tr>
</tbody>
</table>

**Note:** Based on 1994 responses to a national telephone survey of households which bought fresh, frozen or canned fish.
Types of Stores Where Consumers Buy Fresh and Frozen Salmon

Responses to the Compendium Group 1999-2000 survey, shown in Table XI-16, suggest that most consumers purchase salmon for home consumption at grocery stores, rather than seafood markets. Note, however, that the report does not provide any information on whether where people buy salmon varies depending on how frequently they purchase it. Put differently, the percentage of sales at different kinds of stores is not necessarily the same as the percentage of salmon consumers who shop at different kinds of stores. Other surveys find the same results: consumers tend to buy their seafood at supermarkets.

### Table XI-15

**The Research Department 1996 Survey: “Have you consumed fresh or frozen salmon either at home or away from home in the past year?”**

<table>
<thead>
<tr>
<th>Group</th>
<th>Yes</th>
<th>No</th>
<th>Don't know</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Area</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metropolitan Area</td>
<td>42%</td>
<td>58%</td>
<td></td>
<td>781</td>
</tr>
<tr>
<td>Non-Metropolitan Area</td>
<td>33%</td>
<td>67%</td>
<td></td>
<td>218</td>
</tr>
<tr>
<td><strong>Age Group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24</td>
<td>35%</td>
<td>65%</td>
<td></td>
<td>145</td>
</tr>
<tr>
<td>25-34</td>
<td>36%</td>
<td>62%</td>
<td>1%</td>
<td>233</td>
</tr>
<tr>
<td>35-44</td>
<td>41%</td>
<td>58%</td>
<td></td>
<td>183</td>
</tr>
<tr>
<td>45-54</td>
<td>45%</td>
<td>55%</td>
<td></td>
<td>136</td>
</tr>
<tr>
<td>55-64</td>
<td>43%</td>
<td>57%</td>
<td></td>
<td>114</td>
</tr>
<tr>
<td>65+</td>
<td>43%</td>
<td>57%</td>
<td></td>
<td>169</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less Than High School</td>
<td>30%</td>
<td>70%</td>
<td></td>
<td>97</td>
</tr>
<tr>
<td>High School Graduate</td>
<td>26%</td>
<td>74%</td>
<td>1%</td>
<td>331</td>
</tr>
<tr>
<td>Some College</td>
<td>43%</td>
<td>57%</td>
<td></td>
<td>247</td>
</tr>
<tr>
<td>College Graduate</td>
<td>57%</td>
<td>42%</td>
<td>1%</td>
<td>289</td>
</tr>
</tbody>
</table>

Note: Based on 1005 responses to a national telephone survey.

### Table XI-16

**Compendium Group 1999-2000 Survey: “Have you ever purchased [salmon product]?” “Did you buy it at a grocery store, seafood market, club store, or someplace else?”**

<table>
<thead>
<tr>
<th></th>
<th>Fresh salmon fillets</th>
<th>Fresh salmon steaks</th>
<th>Frozen salmon steaks</th>
<th>Smoked salmon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ever purchased?</td>
<td>56%</td>
<td>56%</td>
<td>20%</td>
<td>45%</td>
</tr>
<tr>
<td>Grocery store</td>
<td>75%</td>
<td>75%</td>
<td>77%</td>
<td>57%</td>
</tr>
<tr>
<td>Seafood market</td>
<td>22%</td>
<td>23%</td>
<td>12%</td>
<td>22%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
<td>2%</td>
<td>8%</td>
<td>21%</td>
</tr>
<tr>
<td>Don't know/refused</td>
<td>3%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Based on 1370 responses to a national telephone survey of households which bought fresh, frozen or canned fish. Did not include consumers who “never” purchased salmon to prepare at home.
Consumer Awareness of and Opinions about Wild and Farm-Raised Salmon

The Compendium 1999-2000 survey and the TRD Frameworks 2001 & 2002 surveys asked similar series of questions about U.S. salmon consumers’ awareness of and opinions about wild and farmed salmon. Tables XI-17 and XI-18 show responses to these questions.

To understand what the responses reported in the surveys mean—and do not mean—it is critical to track the flow of questions in the survey: how responses to a given question affected who was asked the next set of questions. In both surveys salmon consumers were first asked if they had ever heard of farm-raised salmon. Only those who had heard of farm-raised salmon were then asked if they thought there were any differences between wild and farm raised salmon. Only those who thought there were differences were then asked which was better—wild or farmed salmon?

In both surveys, of those who were asked the final question about which was better, a majority responded “wild salmon.” But it would be very misleading to infer from this that a majority of salmon consumers think that wild salmon is better than farmed salmon—because only a relatively small percentage of the respondents to each survey were asked this question.

<table>
<thead>
<tr>
<th>Table XI-17</th>
<th>Questions and Responses in the Compendium 1999-2000 Survey About Salmon Consumption and Knowledge and Opinions About Wild and Farmed Salmon</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3. How frequently do you purchase salmon to prepare at home?</strong></td>
<td><strong>Percentage of responses</strong></td>
</tr>
<tr>
<td><strong>33. How often do you typically order salmon in a restaurant?</strong></td>
<td></td>
</tr>
<tr>
<td>Answered “Never” to both questions [STOP]</td>
<td>25%</td>
</tr>
<tr>
<td>All other answers [ANSWER Q 39a]</td>
<td>75%</td>
</tr>
<tr>
<td><strong>39a. “As you may know, there are several different species of salmon. How familiar would you say you are with the different species of salmon?”</strong></td>
<td></td>
</tr>
<tr>
<td>“Not familiar at all” [SKIP TO Q 55]</td>
<td>50%</td>
</tr>
<tr>
<td>All other answers [ANSWER Q 53]</td>
<td>50%</td>
</tr>
<tr>
<td><strong>53. “Have you ever heard of farm-raised salmon?”</strong></td>
<td></td>
</tr>
<tr>
<td>“No” or “Not sure” [STOP]</td>
<td>58%</td>
</tr>
<tr>
<td>“Yes” [ANSWER Q 55]</td>
<td>42%</td>
</tr>
<tr>
<td><strong>55. “In your opinion, are there any differences between naturally caught salmon and farm-raised salmon?”</strong></td>
<td></td>
</tr>
<tr>
<td>“No” or “Not sure” [STOP]</td>
<td>58%</td>
</tr>
<tr>
<td>“Yes” [ANSWER Q 56]</td>
<td>42%</td>
</tr>
<tr>
<td><strong>56. “Overall, which do you feel is better?”</strong></td>
<td></td>
</tr>
<tr>
<td>“Not sure”</td>
<td>14%</td>
</tr>
<tr>
<td>“Farm-raised salmon”</td>
<td>29%</td>
</tr>
<tr>
<td>“Naturally-caught salmon”</td>
<td>57%</td>
</tr>
</tbody>
</table>

Note: Based on answers of 1487 national telephone survey respondents who purchased salmon for consumption at home or in restaurants.
Tables XI-19 and XI-20 show a different way of looking at the survey results, in which we group consumers into exclusive categories based on their knowledge of and opinions about wild and farmed salmon.

The first thing to note is that according to the Compendium 1999-2000 survey, 25 percent of Americans never eat salmon, either at home or in restaurants (Table XI-19). This does not mean that they never will or would eat salmon. They represent potential future consumers and potential future consumption. However, it seems likely that if or as they begin to consume salmon, most of these non-salmon eaters would not, at least at first, know or care much about whether the salmon is wild or farmed salmon.

If we consider current salmon consumers, both surveys suggest that just under one-fifth of American salmon consumers have heard of farmed salmon, are aware that farmed and wild salmon are different and consider wild salmon preferable. Of the remaining four-fifths of consumers, a small share specifically consider farmed salmon preferable to wild. But about three-quarters of salmon consumers either have not heard of farmed salmon or do not have an opinion about differences between farmed and wild salmon.

Of the consumers interviewed in the Seafood Choices Alliance 2001 survey, 52 percent were unable to say whether the seafood they purchased was wild-caught or farmed.

In January 1996, The Research Department, Inc. conducted eight focus group discussions for ASMI to explore consumers’ attitudes toward and purchase habits for Alaska seafood (The Research Department 1996a). They summarized the focus group comments about wild and farmed salmon as follows:

- There was very little awareness that salmon is farmed.
- Stores did not label salmon as farmed or wild.
- The Dallas and Atlanta groups were more positive about farm-raised fish – because they were familiar/comfortable with farmed catfish and trout.
- The Los Angeles and Chicago panelists raised more questions about farmed product.
- Overall, the panelists split on the question of farm-raised salmon. Those who felt positively believed farm-raised conditions would be more controlled and safe; perceived ocean-caught seafood to be a safety risk; equated farm-raised salmon with catfish or trout; or said because farms are closer, the salmon would be fresher and cheaper. Those who felt negatively focused on feeding processes; possibilities of disease; the non-natural environment and not enough room for the fish to move; and less flavor; or they said that they preferred ocean-caught fish in general.

In 1999, the Compendium Group conducted focus groups for ASMI in six cities (Compendium Group

<table>
<thead>
<tr>
<th>Table XI-18</th>
<th>Questions and Responses in the TRD 2000 &amp; 2001 Surveys About Knowledge and Opinions About Wild and Farmed Salmon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 9a. “Have you ever heard of farm-raised salmon?”</td>
<td>2000</td>
</tr>
<tr>
<td>“No” [STOP]</td>
<td>37%</td>
</tr>
<tr>
<td>“Yes” [ANSWER Q 9b]</td>
<td>63%</td>
</tr>
<tr>
<td>Q 9b. “In your opinion, are there any differences between naturally-caught salmon and farm-raised salmon?”</td>
<td>2000</td>
</tr>
<tr>
<td>“No” [STOP]</td>
<td>60%</td>
</tr>
<tr>
<td>“Yes” [ANSWER Q 9c]</td>
<td>40%</td>
</tr>
<tr>
<td>Q 9c. “Overall, which do you feel is better?”</td>
<td>2000</td>
</tr>
<tr>
<td>“Not sure”</td>
<td>12%</td>
</tr>
<tr>
<td>“Farm-raised salmon”</td>
<td>15%</td>
</tr>
<tr>
<td>“Naturally-caught salmon”</td>
<td>72%</td>
</tr>
</tbody>
</table>

Note: Based on computer assisted telephone interviews in six metropolitan areas (900 in 2001 and 601 in 2002) with respondents who purchased salmon “more often than twice a year.”

4 The calculations in these two tables are our own. Neither survey report considered the overall implications of the responses for what they tell us about what Americans know and believe about wild and farmed salmon. Differences in response percentages are not necessarily statistically significant except where specifically identified as being statistically significant.

5 This survey was limited to consumers who ate fish or seafood once a month or more; the question referred to all fish—not just salmon.
They summarized the focus groups comments about wild and farmed salmon as follows:

- When purchasing salmon, participants usually did not know the origin of the salmon, were not concerned about the origin and did not ask about the origin.
- Although there was some awareness of the names of different salmon species, consumers did not know their characteristics. They rarely knew what species they were consuming.
- A minority of consumers believed they knew something about differences between farm-raised and wild salmon—but the discussions revealed much misinformation. Consumers were not sure if stores carried farm-raised or wild salmon. Most assumed it was farmed. The majority did not care if salmon was farm-raised or wild.
- Consumers had differing opinions about the differences between farm-raised and wild salmon. Some believed farmed salmon was cleaner and healthier due to a controlled environment. Participants who had tried wild salmon tended to believe it was better due to its natural qualities such as freshness and ocean diet.

The 1994 survey conducted by the University of Rhode Island found that 38 percent of respondents, or 538 respondents, had heard of farmed salmon. These respondents were from the mid-Atlantic and New England states.

Wessells and Holland (1998) used the data gathered from the 1994 University of Rhode Island survey to study the relative importance to salmon consumers of price, information about whether salmon are wild or farmed and information about seafood safety inspection (FDA vs. USDA). A portion of the survey requested that respondents rank their preferred products among nine products in which three product attributes—price, inspection agency and whether salmon were wild or farmed—varied. By ranking the products that had the attributes they preferred, respondents showed their willingness to trade off attributes against one another. Statistical analysis of the responses showed that—for these eastern U.S. consumers surveyed in 1994—seafood safety, certified by a government agency, was more important than the information on whether salmon were wild or farmed. Table XI-21 shows the estimated relative market shares of different hypothetical product pairings. Even with varying prices, seafood safety inspection information had a much bigger effect on estimated market share than whether the product was wild or farmed.

6 The focus on seafood safety inspection was during a period of much public debate about the adequacy of seafood inspections and a struggle within the Federal government regarding which Federal agency should be responsible.
If both products were inspected by the same agency and sold at the same price, farmed salmon was preferred to wild salmon (Pairing A). Even if wild salmon sold at a cheaper price, it was only slightly preferred over farmed salmon (Pairing D). The preference for farmed salmon over wild salmon is probably unique to the eastern United States and would likely not have been the result had the study been done in the western United States. Moreover, preferences may have changed since the survey was completed more than a decade ago.

In interpreting survey and focus groups results, it is important to keep in mind the possibility that different consumers may have very different products in mind when they talk about “wild” salmon (frequently referred to as ‘naturally caught’ by the surveys) or “farmed” salmon. Farmed salmon is a relatively homogeneous product: most of the farmed salmon sold in the United States is fresh Atlantic salmon of relatively consistent quality. In contrast, “wild” salmon may be any of five species which vary significantly in size, appearance and taste. Some is fresh and some is previously frozen. Prices of these products vary widely.

Some wild salmon is typically much more expensive than farmed salmon; some is typically much cheaper. These differences are illustrated by the three salmon advertisements shown on the next page—all from stores in Maryland suburbs of Washington, D.C. in September 2003. The top advertisement is for fresh wild chinook salmon at $11.99/lb; the bottom advertisement is for fresh wild chum salmon at $1.98/lb. The middle advertisement is for fresh farmed Atlantic salmon at $4.99/lb.

Clearly, these two “wild salmon” products are very different. Asking consumers whether they prefer “wild” salmon to farmed salmon may be misleading or meaningless without specifying which wild salmon product we are referring to. It is possible, for example, that people who say they specifically prefer wild salmon to farmed salmon have in mind products like the fresh wild chinook salmon, or other high-quality wild salmon products. However, wild chinook salmon represents only a small percentage of wild salmon catches. Wild chum salmon accounts for a much larger share of the wild salmon actually available to the U.S. consumer market.

Table XI-21
Estimated Market Shares for Hypothetical Salmon Product Pairings for Eastern U.S. Consumers, 1994

<table>
<thead>
<tr>
<th>Product pairing</th>
<th>Information provided to consumers</th>
<th>Estimated market shares*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$4.49/lb USDA Inspected Farmed</td>
<td>81%</td>
</tr>
<tr>
<td></td>
<td>$4.49/lb USDA Inspected Wild</td>
<td>19%</td>
</tr>
<tr>
<td>B</td>
<td>$5.49/lb FDA Inspected No information Farmed</td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td>$4.49/lb No information Farmed</td>
<td>37%</td>
</tr>
<tr>
<td>C</td>
<td>$4.99/lb FDA Inspected No information Farmed</td>
<td>97%</td>
</tr>
<tr>
<td></td>
<td>$4.99/lb No information Farmed</td>
<td>3%</td>
</tr>
<tr>
<td>D</td>
<td>$4.49/lb FDA Inspected Wild</td>
<td>56%</td>
</tr>
<tr>
<td></td>
<td>$5.49/lb FDA Inspected Farmed</td>
<td>44%</td>
</tr>
<tr>
<td>E</td>
<td>$4.49/lb No information Wild</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>$5.49/lb FDA Inspected Farmed</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Estimated based on 1994 URI survey respondent rankings of nine products.

7 This is suggested by the results of a subsequent survey reported on by Wessells, Donath and Johnston (1999).
Newspaper Advertisements of Selected Maryland Stores for Wild and Farmed Salmon, September 2003

Fresh Wild Chinook Salmon:
Sutton Gourmet, September 24, 2003

Fresh Farmed Atlantic Salmon:
Giant, September 23, 2003

Frozen Wild Chum Salmon:
Shoppers Food Warehouse, September 7, 2003

Photos: Gunnar Knapp
Factors Influencing Salmon Purchase Decisions

Several surveys have asked about factors that are important to salmon consumers. Tables XI-22 and XI-23 shows results from two of the surveys. Consistently, surveys suggest that taste, freshness and health are very important to a majority of consumers. A smaller percentage respond that “price” is very important.\(^8\)

In 2000, the Compendium Group conducted interviews with “typical shoppers” at eight grocery stores.\(^9\) Key findings from these surveys included the following:

- Consumers, to a large extent, come to a grocery store with a list in mind. While “fish” or “seafood” is often on the list, “salmon” rarely is. Salmon competes with other finfish species available to consumers.
- When it comes to selecting a specific fish or seafood, taste, meal variety and price are what matters to shoppers. Gaining a large core of “heavy” consumers of salmon would be difficult due to the sheer variety of seafood options and consumers’ desire to experiment.
- When asked how much “price” mattered in decisions about whether to purchase fresh salmon, 45 percent responded “very much,” 34 percent responded “not very much,” and 19 percent responded “not at all.”

<table>
<thead>
<tr>
<th>Table XI-22</th>
<th>Compendium Group 1999-2000 Survey: “How important are each of the following in your decision to serve salmon at home?”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very important</td>
</tr>
<tr>
<td>Taste</td>
<td>84%</td>
</tr>
<tr>
<td>Freshness</td>
<td>74%</td>
</tr>
<tr>
<td>Health Benefits</td>
<td>52%</td>
</tr>
<tr>
<td>Price</td>
<td>38%</td>
</tr>
<tr>
<td>Availability</td>
<td>36%</td>
</tr>
</tbody>
</table>

Note: Based on 1370 responses to a national telephone survey of households which bought fresh, frozen or canned fish. Did not include consumers who “never” purchased salmon to prepare at home.

<table>
<thead>
<tr>
<th>Table XI-23</th>
<th>Seafood Choices Alliance 2001 Survey: Importance of Factors in Deciding What Kind of Fish or Other Seafood to Buy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One of most important or very important</td>
</tr>
<tr>
<td>Freshness and smell</td>
<td>92%</td>
</tr>
<tr>
<td>Taste and texture</td>
<td>87%</td>
</tr>
<tr>
<td>Possibility of contamination with bacteria or harmful chemicals</td>
<td>78%</td>
</tr>
<tr>
<td>Health and nutritional benefits</td>
<td>70%</td>
</tr>
<tr>
<td>Price</td>
<td>53%</td>
</tr>
<tr>
<td>Whether the species is overfished</td>
<td>44%</td>
</tr>
</tbody>
</table>

Note: Based on a national telephone interviews of 1000 consumers who purchased seafood or fish at least once per month.

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\(^8\) Most surveys have not defined what is meant by “price.” It is likely that the larger the relative price difference between two products, the more price matters to consumers.

\(^9\) The stores were selected to include a mix of upscale stores and “every day low price” stores and to represent a wide geographic mix. Each store sold “a wide line of fresh, frozen, smoked and canned salmon products.”
Effects of Potential Messages on Likelihood of Salmon Purchases

Various studies have explored the effects of potential “messages” in marketing salmon to consumers. In general, these surveys found that consumers varied in how they would respond to messages. For most messages, less than half of consumers said that the information would affect their salmon purchases.

In general, messages about health benefits had the greatest effects on the likelihood of consumer purchase. Of fresh salmon buyers responding to the Compendium Group supermarket surveys, 55 percent said they would be “more likely to buy fresh salmon in the future” if they knew that “salmon has the highest level of Omega-3 fatty acids of all seafood”; 47 percent if they knew that it was naturally caught in the ocean and not raised in a fish farm,” and 47 percent if they knew that “salmon was originally from Alaska.” Similarly, for respondents to the TRD 2001 and 2002 surveys, messages about health benefits of Alaska salmon had the greatest effect on the likelihood of purchase (Table XI-24).

The Seafood Choices Alliance 2001 survey suggested that an “environmentally friendly” label would affect the likelihood of purchase for well over half of seafood consumers (Table X-25). Note, however, that this survey asked about all seafood purchases—not just salmon—and was limited to consumers who purchased seafood more than once per month.  

### Table XI-24

<table>
<thead>
<tr>
<th>Message</th>
<th>Percent responding “much more likely to buy”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2001 survey</td>
</tr>
<tr>
<td>Alaska salmon is one of the best sources of omega-3 and vitamin E. One salmon meal per week can reduce the risk of primary cardiac arrest.</td>
<td>41%</td>
</tr>
<tr>
<td>Alaska wild salmon is not threatened or endangered</td>
<td>32%</td>
</tr>
<tr>
<td>Alaska wild salmon is certified by the Marine Stewardship Council for sustainability and management</td>
<td>27%</td>
</tr>
<tr>
<td>Farm raised salmon is imported from other countries.</td>
<td>27%</td>
</tr>
<tr>
<td>Farmed salmon is threatening Alaska family fishing businesses.</td>
<td>36%</td>
</tr>
</tbody>
</table>

Note: Based on computer assisted telephone interviews in six metropolitan areas (900 in 2001 and 601 in 2002) with respondents who purchased salmon “more often than twice a year.” Consumers were read statements about salmon and then asked “Does this information make you more or less likely to buy Alaska-fished salmon, or does it not make any difference”?

### Table XI-25

<table>
<thead>
<tr>
<th>“Suppose some kinds of seafood were labeled as ‘environmentally responsible.’ Would you be more or less likely to buy seafood that had an ‘environmentally responsible’ label or wouldn’t it make any difference?”</th>
<th>Much more likely</th>
<th>Somewhat more likely</th>
<th>Somewhat less likely</th>
<th>Much less likely</th>
<th>No difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>41%</td>
<td>31%</td>
<td>6%</td>
<td>5%</td>
<td>18%</td>
</tr>
<tr>
<td>“Suppose some seafood items on menus in restaurants were labeled as ‘environmentally responsible.’ Would you be more or less likely to order seafood that was labeled as ‘environmentally responsible’ or wouldn’t it make any difference?”</td>
<td>39%</td>
<td>28%</td>
<td>8%</td>
<td>6%</td>
<td>19%</td>
</tr>
</tbody>
</table>

Note: Based on a national telephone interviews of 1000 consumers who purchased seafood or fish at least once per month.

---

10 Earlier questions in the survey asked respondents about how much they had heard about “the harm from eating certain kinds of contaminated or unsafe fish,” “the harm done to the ocean environment by certain kinds of commercial fishing,” and “the harm done to the environment by certain kinds of fish farming.”
The 1998 University of Rhode Island survey investigated whether or not consumers would be willing to buy—and perhaps pay more for—salmon which was eco-labeled. In a paper published in a peer-reviewed journal, statistical analysis was done which assessed consumer preferences for eco-labeled salmon and the influence of species, certifier and household attitudes on those preferences (Wessells et al. 1999).

Among the questions asked, respondents were asked their view of the status of Pacific salmon stocks. Of all respondents (n = 1640), 14 percent considered Pacific salmon to be severely over-fished, 21 percent moderately over-fished, 3 percent not at all over-fished and 62 percent unsure. The largest percentage of those who thought Pacific salmon was over-fished had a graduate or undergraduate college degree.

Respondents were presented with a comparison of two hypothetical salmon products, where the attributes were certification, price and certification agency. Certification was simply the presence of or lack of information on the product that it had come from a fishery which was not over-fished. Certification agencies varied between the National Marine Fisheries Service (NMFS), the World Wildlife Fund (WWF) and the Marine Stewardship Council. Prices varied to capture willingness to pay estimates.

Results indicate that respondents favored eco-labeled salmon over salmon that was not eco-labeled, although the extent to which they favored eco-labeled salmon was sensitive to the price premium. In other words, as the price of eco-labeled salmon increased relative to non-labeled salmon, consumers would choose non-labeled. The certification agency elicited no real response—respondents were more or less indifferent to this choice. Respondents who were members of an environmental organization, or who practiced environmentally conscious purchasing behavior, were more likely to choose eco-labeled salmon than those who were not. Generally speaking, the larger the weekly budget for seafood purchases, the more likely the household was to choose eco-labeled salmon.

**Potential Recent Influences on Salmon Consumer Preferences**

All of the surveys discussed in this chapter were conducted prior to 2004. Since then, several things may have had an impact on salmon consumers’ preferences. Studies of potential health risks associated with farmed and wild salmon (particularly Hites et al. 2004) have received a great deal of attention in the U.S. press (see Chapter V). Non-governmental organizations have conducted public relations campaigns against salmon farming (see Chapter XII). As of April 2005, Federal law requires country-of-origin labeling of fresh seafood at retail outlets, and also requires differentiating farmed from wild fish (see Chapter XVII). Thus consumers can now actively demand products from one production process versus the other. An important question is the extent to which these changes may have affected markets for farmed and wild salmon.

We are not aware of any publicly available surveys of U.S. salmon consumers conducted since 2004 which are comparable with the earlier surveys discussed in this chapter. As a result, it is very difficult to quantify how economically significant recent changes in U.S. salmon consumer preferences may be. We are unable to quantify the extent to which preferences may have changed for those consumers who actually purchase salmon, or the extent to which changes in preferences have actually affected these consumers’ purchase decisions, given differences in relative availability and price of farmed and wild salmon.

In 2005 the Alaska Seafood Marketing Institute hired The Hale Group to conduct an online national survey to investigate restaurant consumers’ attitudes and behaviors relative to Alaska Seafood and preferences versus other sources and brands (The Hale Group 2005). A summary of the survey results concluded that “the knowledge base regarding the seafood category, of the consumers interviewed, was varied. . . This knowledge ‘confusion’ often manifests itself when consumers are focused on comparing wild to farm-raised products . . coupled with the fact that consumers often leave this selection to the operator (many menus do not state more than the species offered).”

Asked how important different factors were in ordering fish at chain restaurants, 65 percent of respondents thought it was important “whether the fish/seafood is wild or farm-raised.” However, a number of other factors were considered important by a higher percentage of respondents, including “is high quality” (92 percent); “is fresh (never frozen)” (72 percent); “is caught using responsible fishing methods” (70 percent); “great taste” (90 percent); and “there is a plentiful supply (is not in danger of being over-fished)” (69 percent). This more recent evidence is consistent with earlier surveys: even relatively frequent seafood consumers do not necessarily know or care whether fish are wild or farmed—or do restaurants necessarily provide them a choice.

Other chapters of this report review market evidence related to the extent of potential recent changes in U.S. salmon demand—as reflected in U.S. salmon imports and prices. As discussed in Chapter IX, U.S. farmed salmon imports declined briefly in early 2004—perhaps in response to the Hites et al (2004) study—but subsequently recovered to earlier levels. As discussed in Chapter VII, prices for wild chinook and coho salmon have risen sharply. This market evidence
suggests that recent publicity has strengthened consumer demand for some wild salmon species and product forms—which represent a relatively small share of total wild salmon production—but does not appear to have resulted in any significant large-scale change in the market for farmed salmon.

Implications

What are the implications of what is known about American salmon consumers for future salmon consumption and for the marketing of wild and farmed salmon? In thinking about this question, it is important to be aware of the limitations of past consumer surveys. Perhaps more importantly, as price and availability change, different kinds of people are eating salmon and their familiarity with salmon is changing. Tomorrow’s salmon consumers will not necessarily be like today’s or yesterday’s salmon consumers.

Frequent salmon consumers account for a relatively greater percentage of consumption than they do of consumers. For thinking about what might influence current salmon sales, these consumers are most important. However, for thinking about how to expand future salmon consumption, less frequent consumers may be more important—because there are many more of them.

Clearly, there is no “typical” American salmon consumer. Consumers vary widely in how much salmon they buy, what they buy, where they buy it and why they buy it. Information about wild and farmed salmon is likely to affect different consumers’ purchase decisions in different ways. This suggests that there is no single best marketing strategy for wild or farmed salmon. There are many different markets and many different opportunities. Different strategies will have different effects on different consumers in different markets.

Most consumers have either not heard of farmed salmon or do not have an opinion about differences between farmed and wild salmon. Relatively few specifically prefer wild salmon to farmed salmon. One implication of the fact that a relatively small share of salmon consumers know or care about differences between wild and farmed salmon is that labeling salmon as “wild” or “farmed” may not influence most salmon consumers’ purchase decisions.

Another implication is that negative information about farmed salmon will not necessarily strengthen overall wild salmon sales. Negative messages about farmed salmon may cause some consumers to switch from farmed to wild salmon—but may cause others to eat less of both farmed and wild salmon.

Similarly, if some consumers believe wild Pacific salmon to be over-fished or endangered, this may cause them to switch from wild to farmed salmon, or—if they are not aware of the difference—to eat less salmon. We do not have sufficient information in either of these cases to judge which of these potential effects of consumer perceptions may be more important.
References


Overview of North American Salmon Marketing

Key Points

- Marketing wild salmon successfully requires that the wild salmon industry—fishing, processing and distribution—create products that buyers and consumers want, at the times and places they want them, and for prices they are willing to pay.

- Naturally wild salmon has certain inherent marketing advantages, including the fact that it is wild, natural, produced in North America and managed sustainably. However, wild salmon also faces certain inherent marketing challenges, including variability and uncertainty of quantity of catches, short seasons, highly variable fish quality and variable fish size.

- Good and consistent quality is an integral part of successful marketing. There are significant quality problems in many North American wild salmon fisheries which result from how fish are caught and handled. Quality problems affect the reputation of Alaska wild salmon in the market and hamper marketing of Alaska wild salmon. There is lack of agreement about what should be done to address quality programs in the Alaska salmon industry.

- The wild salmon industry is not an integrated enterprise with a common goal. It is a highly competitive industry. Competition occurs between fishermen, processors, species, regions, and countries. The wild salmon industry is also divided by conflicts between fishermen over allocation and conflicts between fishermen and processors over prices. Competition and internal conflicts hamper efforts to achieve cooperation within the industry in marketing. There is tension between cooperation in generic marketing of “wild salmon” and more focused marketing of salmon of particular regions or producers.

- There has been little systematic evaluation of past wild salmon marketing efforts. More generally, it is difficult to distinguish between the effects of marketing and changes in prices and supply.

- The implications of negative publicity about farmed salmon for the marketing of farmed and wild salmon are unclear. It appears likely to help wild salmon in certain markets but may be detrimental to longer-term growth in demand.

- Marketing is an integral part of the farmed salmon industry. Control over production enables salmon farmers to integrate marketing with every stage of production, processing and distribution.

- Cooperation between wild and farmed salmon producers in generic marketing of “salmon” could expand the total market. However, most wild salmon producers have not been receptive to the idea of cooperating with salmon farmers, partly because wild producers have no assurance that expanded farmed salmon production would not dissipate the potential benefits from expanding demand.

Introduction

In this chapter we provide an overview of North American salmon marketing. The general goal of the chapter is to describe, as best possible using available data and previous studies, how both wild and farmed salmon are marketed in North America and issues associated with salmon marketing. This chapter will set the stage for more detailed analysis in later chapters of specific marketing issues, including “Analysis of MSC Certification of Alaska Salmon” (Chapter XVI) and “Analysis of Potential Effects of Salmon Labeling Requirements” (Chapter XVII).

This report was written during a period of significant change in North American salmon marketing. In 2004, the Alaska legislature and the salmon industry made major changes to the structure and funding of the Alaska Seafood Marketing Institute (ASMI), which for many years has played a leading role in wild salmon.
marketing efforts. New federal and state grant programs provided significant funding for a variety of regional and private marketing efforts. Non-governmental organizations opposed to salmon farming increased efforts to persuade consumers and retailers not to buy farmed salmon. The farmed salmon industry expanded efforts to respond to these attacks and to highly publicized research on potential health risks associated with farmed salmon. The combined effects of these changes will remain to be seen.

**Defining “Marketing”**

The term “marketing” means different things to different people. Broadly defined, “marketing” includes a wide spectrum of integrated activities by individual firms or an industry to understand, communicate with and meet the needs of customers.

Marketing professionals emphasize that a common business mistake is to conceive of marketing too narrowly—as involving only promotion. Effective marketing also requires careful consideration of the other three “Ps” of marketing: Product, Price and Place (Figure XII-1).

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**Some Definitions of “Marketing”**

Marketing experts encourage firms and industries to think about marketing broadly, as suggested by the following definitions offered by various consultants, associations and textbooks:

- “Creating a customer”
- “Finding out what your customers want and giving it to them.”
- “Marketing is the management process for identifying, anticipating and satisfying customer requirements profitably.”
- “Marketing is everything you do to promote your business, from the moment you conceive of it to the point at which customers buy your products or services and begin to patronize your business on a regular basis.”
- “Marketing is so basic that it cannot be considered a separate function. It is the whole business seen from the point of view of its final result, that is, from the customer’s point of view….Business success is not determined by the producer but by the customer.”

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*Elements of marketing which represent special challenges for wild salmon

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1 Peter Drucker quotation posted on website of Quentin Fong, University of Alaska Seafood Marketing Specialist, www.dced.state.ak.us/cbd/seafood/seafoodmarketing/quentinscorner/quentinscorner.htm
Marketing wild salmon successfully requires that the wild salmon industry—fishing, processing and distribution—create products that buyers want, get the products to buyers at the times and places they want them, and sell them at prices buyers are willing to pay. Similarly, retailers and food-service operators need to provide consumers with products they want, at the times and places they want them, and at prices consumers are willing to pay. As we discuss below, certain elements of marketing represent special challenges for wild salmon, because of the nature of the product and relative lack of control over production (compared with most other food products).

The Relationship between Wild Salmon Marketing and Quality

Good and consistent quality is an integral part of successful marketing. Good quality helps to increase demand; poor quality reduces demand. Inconsistent quality also increases business risk and therefore reduces demand. If buyers and consumers are not confident about quality, they are not willing to pay as much—or they may not be willing to buy at all.

There are significant quality problems in many North American wild salmon fisheries. These problems include net-marks, external and internal bruising, blood seepage, gapping and softness or mushiness. They result from lack of careful handling and waiting too long or not keeping fish sufficiently chilled between the time they are caught and the time they are processed.

Practices that contribute to market quality concerns for Alaska salmon were summarized bluntly in a 2002 report prepared for the Alaska legislature (Surefish Seafood Quality Specialists 2002). They included:

- “Rough handling at every stage is commonplace”
- “Well over half of Alaska salmon is not chilled by harvesters and chilling at tender and plant levels is often inadequate”
- “Many areas routinely hold fish for six hours or more, thinking that such a “short time” without ice is not a problem”
- “Fish age is often extensive, resulting in significant quality problems and poor shelf life”
- “Even if the fish looks okay on the outside, internal damage from the above such as gaping and internal bruising, which cannot be seen from the outside, is the result”
- “Drastic variations even within the same grade or box”

As a result, the report concluded, although buyers understand the difference between wild and farmed salmon they consider wild salmon more risky. Buyers are concerned that quality standards are not consistent and that quality is not as represented, resulting in yield losses and shorter shelf life.

The report noted that “some previous marketing efforts have contributed to the problem.” Samples shipped as part of marketing efforts were “often inconsistent, poor quality, or mixed species.” If samples were of high quality, producers were “unable to follow-up at that same level. As a result most buyers now do not believe producer claims of high quality and must now have it proven to them.”

At present, for almost all wild salmon fisheries, there are no uniform mandated quality standards. Under existing regulations, wild salmon have to be safe to eat—but they do not have to look good or taste good. While many or most individual fishermen and processors may strive to produce high quality fish, some do not.

The lack of uniform quality standards hampers any effort to market “wild” salmon or “Alaska” salmon. The fact that a salmon is “wild” or that it is “Alaskan” does not guarantee that it is a good product. To some buyers, it signals that it may not be a good product.

Quality problem: internal bruises in a wild chum salmon fillet

Photograph by Gunnar Knapp

This problem is widely recognized within the wild salmon industry. One of the greatest potential marketing advantages of wild salmon—the quality image associated with natural wild fish—is undermined by how some fishermen and processors handle those fish.

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2 We use the term “buyer” to refer to companies which buy salmon, such as retailers and food-service companies. We use the term “consumer” to refer to individuals who buy salmon for their own or family consumption.
Policy Goals of Improving Wild Salmon Quality and Marketing

Since wild salmon prices began to decline in the early 1990s, fishermen, processors, policy makers and consultants have debated how to address the problems facing the wild salmon industry. A series of task forces, industry forums and reports have examined the issues and made recommendations about strategies for the industry.³

A consistent theme running throughout this discussion has been the need for improving the quality and marketing of wild salmon. The argument has been that the wild salmon industry has been a production-driven commodity industry, overly dependent on the canned salmon market and the Japanese frozen market, which has devoted insufficient attention to quality, development of new products and marketing. Therefore, to compete effectively with farmed salmon in a changing market, the industry needs to improve quality, to develop new products to respond to new market demand and opportunities, to devote significantly more resources to marketing (particularly in the U.S. fresh and frozen market) and to market in more effective ways.

While there has been general agreement about the goal of improving quality, there has not been agreement about how to achieve this goal. Some have argued for mandating handling or quality standards, such as requiring icing or chilling by fishermen or requiring that fish be processed within a certain period of time after harvesting. Others have strongly opposed mandated standards, arguing that they may be uneconomic, unfair, or impossible to achieve, and have argued instead for education efforts and financial assistance for investments in quality improvement, such as ice-making facilities or chilling equipment. More recently, as discussed later in this chapter, some producers have established their own quality standards, which are monitored and certified by external certifying organizations.

Similarly, the goal of more and better marketing has been expressed repeatedly since the early 1990s:

“We will collectively move the salmon industry from a production-driven fish industry to a market-driven food industry that knows its customers... We must build in predictability and consistency for the buyers of Alaska salmon.” (Strategic Solutions Consulting Group 1997)

However, as with improving quality, there has not been agreement about how to improve the marketing of Alaska wild salmon or how to fund such efforts. As discussed below, the industry continues to debate this issue, and to experiment with new approaches to marketing. The fact that the issues of how to improve quality and marketing remain central to the policy debate within the wild salmon industry reflects the complexity and difficulty of these issues.

Challenges in Marketing Wild Salmon

Wild salmon has certain inherent marketing advantages, including the fact that it is wild, generally sustainably managed, produced in North America and tastes delicious. This has led to a strong belief within the wild salmon industry that these advantages can and should be the basis for successful marketing.

However, the North American wild salmon industry also faces a number of challenges to effective marketing in the face of ever-increasing competition from farmed salmon. Before reviewing North American wild salmon marketing, it is useful to review these challenges, as they are reflected in the marketing organizations and activities which exist—and which do not exist.

The biology of salmon results in several significant inherent challenges to wild salmon marketing (see Chapter II). These include:

• High annual variation in catches.
• Uncertainty of catches.
• Catches occur during specific relatively short seasons.
• Variable fish sizes and quality.

As summarized in Table XII-1, all of these inherent challenges represent disadvantages for wild salmon in competing with farmed salmon.

Competition among Wild Salmon Producers

The wild salmon industry is not an integrated enterprise with a common goal. In contrast, it is a highly competitive industry. Within the wild salmon industry, salmon sellers compete for customers, and

³ Reports of most of these efforts are posted at the web site of the Alaska Department of Community and Economic Development’s Office of Fisheries Development, at http://www.dced.state.ak.us/cbd/seafood/seafoodreports.htm.
salmon buyers compete for suppliers. On a broader scale, competition occurs between species, regions, and countries.

Different Alaska regions compete to create reputations and brands for their products. Copper River salmon competes with salmon from other Alaska areas such as Cook Inlet and Kodiak. Canadian wild salmon competes with Alaska wild salmon in United States and abroad. Salmon from Washington, Oregon and California compete against each other and against salmon from British Columbia and Alaska.

Natural wild salmon competes with hatchery wild salmon. As was discussed in Chapter IV, some fishermen in regions without hatcheries, such as interior and western Alaska, have argued that Alaska salmon hatcheries have depressed prices for Alaska pink and chum salmon by producing too many fish. Some fishermen argue their markets would be better if hatcheries produced less fish.

More generally, any wild salmon fishery’s markets would be better if other wild fisheries produced less fish. High Alaska wild salmon catches—usually viewed as evidence of successful management of Alaska’s wild salmon fisheries—increase the difficulty of marketing the catch. In recent years, this has particularly been the case for pink salmon. Large canned pink salmon packs have depressed prices. In an effort to strengthen prices, the federal government has purchased substantial volumes of canned pink salmon in recent years, under a U.S. Department of Agriculture commodity purchase program. Between 1997 and 2005, the federal government spent $84 million on purchases of canned pink salmon—an average of $9.3 million per year (USDA 2006).

If considered from this perspective, in any economic enterprise, a marketing strategy should include consideration of the appropriate scale of production for market conditions in both the short-run and the long-run. However, for wild salmon fisheries, there has been almost no discussion of the appropriate scale of aggregate production from a marketing perspective. In general, in every fishery the goal of fishery managers and the industry has been to produce as much salmon as possible (on a sustainable basis). Any discussion of controlling aggregate production would immediately raise the complex question of whose production should be reduced. Unlike in agriculture, where production controls have been attempted with varying success, it would be very difficult to devise a practical way for different regions to share “fairly” in controlling salmon production.

A fundamental challenge in marketing wild salmon is the tension between cooperating with other wild salmon producers to promote “wild salmon” and more narrowly focused efforts to market the salmon of a region or an individual company. In any common marketing strategy, conflicts arise over whether the benefits of the strategy are being shared fairly in proportion to costs.

Other Conflicts within the Wild Salmon Industry

Beyond competition in the marketplace, there are many other conflicts within the wild salmon industry which make it more difficult to achieve cooperation in marketing. One set of conflicts is between fishermen and processors over prices paid to fishermen. In many wild salmon fisheries, fishermen believe that they are not paid fairly by processors. A long-standing history of mistrust has included bitter fisherman’s strikes and lawsuits alleging price-fixing by salmon processors. This conflict hampers cooperation among fishermen and processors over how to market wild salmon effectively. In particular, there is tension between

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4 In a generic marketing campaign launched by Brand Oregon, the planned advertisement was for “Oregon wild” salmon. This title was quickly contested by fish activists because of hatchery salmon, so that the advertisement was changed to “Oregon wild caught” salmon. www.katu.com/outdoor/story.asp?ID=65875.

5 A class-action suit filed in 1996 alleging price-fixing by Bristol Bay salmon processors and Japanese importers ended in May 2003 when an Anchorage jury unanimously cleared the defendants of the charges after a four-month trial. Combined legal costs for both sides totalled about $50 million—about the same as the entire budget of the Alaska Seafood Marketing Institute between 1998 and 2003, and about 50 percent more than the total funds raised by the salmon marketing tax paid by Alaska salmon fishermen between 1994 and 2003.
fishermen and processors over whether the benefits of marketing are reflected fairly in the prices paid to fishermen.

Many wild salmon runs are fished by more than one group of commercial salmon fishermen. This leads to numerous conflicts between different groups over allocation, or the share of the fish that each group is allowed to catch (or the extent to which fishery regulations tend to favor one group over another). One type of allocation conflict arises when fishermen using different kinds of gear fish for salmon in the same area. Examples include conflicts between drift gillnet fishermen and set gillnet fishermen in Bristol Bay, and conflicts between gillnet fishermen and seine fishermen in British Columbia.

Another type of allocation conflict arises when returning salmon swim through one fishing area en route to other fishing areas, again leading to disputes about how much fishermen in each area should be allowed to catch. The most prominent example is the long-running dispute between Alaska, British Columbia and U.S. Pacific Northwest fishermen related to the Pacific Salmon Treaty. Another example is the dispute over interception by fishermen in Alaska’s False Pass fishery of chum salmon returning to western Alaska river systems.

These conflicts within the wild salmon industry are important. It is harder for an industry which is deeply divided over many internal issues to work together effectively towards common marketing goals.

Lack of Marketing Experience

Most wild salmon fishermen—and many other people in the salmon industry—have relatively little experience in marketing. Knowing how to catch and process fish is not the same as knowing what buyers or consumers want, or how to market fish.

Paradoxically, it may be more difficult for wild salmon fishermen to be objective in thinking about marketing wild salmon than for people without a salmon fishing background. Fishermen who are used to eating wild salmon and being around people who also eat wild salmon may not understand how wild and farmed salmon may taste to first-time or occasional salmon consumers, or what they may know or care about salmon or where it comes from or how it is produced. They are unlikely to have a detailed understanding of the salmon distribution chain, the factors that influence buyers for retail and food service organizations, or what marketing strategies have been cost-effective and successful in other food industries. To the extent that this is true for the U.S. domestic market, it is even more true for foreign markets such as Europe and Japan. Fishermen’s instincts about what marketing approaches may be most cost-effective and successful for wild salmon are not necessarily right.

Not surprisingly, however, many of the wild salmon marketing activities discussed in this rest of this chapter are directed or controlled by wild salmon fishermen or others with relatively little experience in marketing, including politicians and government bureaucrats. Regardless of the sincerity, dedication and hard work of these individuals, lack of experience is a constraint to the effectiveness of these activities.

Costs of Marketing

Marketing costs money. Effective marketing requires sustained funding over multiple years. The dramatic decline in the value of wild salmon catches and production has made it harder for the wild salmon industry to fund marketing efforts. In Alaska, a decline in state oil revenues further contributed to a decline in state funding for salmon marketing.6

Private Sector Wild Salmon Marketing

The most important component of wild salmon marketing is that undertaken by private companies—processors and fishermen—in marketing their own products. Marketing by private companies affects the entire wild salmon industry through its effects on buyer and consumer awareness of wild salmon and its qualities.

Marketing by Processors

Salmon processors engage in a wide variety of marketing efforts for their own products. These include, for example, efforts to improve product quality, new product development, branding, certification (such as Marine Stewardship Council chain-of-custody certification), advertising (primarily

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6 The dramatic rise in oil prices in 2005 and 2006 greatly increased Alaska oil revenues, and could potentially reverse this trend.
Fishermen and others outside the processing industry have often criticized processors for insufficient attention to marketing. As competition has increased and marketing has become increasingly important, this criticism is probably less valid today than it was formerly. Fishermen and the general public may not be aware of processors’ marketing efforts, because most of these efforts are not targeted towards the general public.

Marketing by individual companies builds on and adds to messages reaching buyers and consumers about wild salmon. New product development efforts also help to test consumer acceptance of new products and create buyer and consumer awareness, making it easier for other processors to introduce their own new products.

**Fishermen’s Direct Marketing**

Since the early 1990s, dissatisfaction with prices paid by traditional processors has created interest among many salmon fishermen in “direct marketing,” or marketing their own fish. In some cases the fishermen process their own fish into products such as fresh fillets or smoked fish, sometimes with the help of family members or paid employees. In other cases, fishermen pay traditional processors to “custom process” their fish, but retain ownership of the fish to market it themselves.

Direct marketing operations vary widely in scale and sophistication. Typically, fishermen engaged in direct marketing begin by selling their fish to small “niche” markets, such as friends and family members, acquaintances in their home town, or a few restaurants or stores. They may spend significant periods of time outside the salmon season selling fish, meeting with customers and planning operations and markets for the coming season.

Over time, some direct marketing efforts grow into large-scale operations, with fishermen buying fish from other fishermen, hiring more workers and investing in processing facilities and equipment. Eventually, in this way, some fishermen become processors.

The following page provides two examples of wild salmon direct marketing efforts, reproduced from other publications. Many more examples may be found from across Alaska, British Columbia and the U.S. Pacific Northwest.

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**Selected Marketing Themes from Web Sites of Major Alaska Salmon Processors**

**TRIDENT SEAFOODS**
(www.tridentseafoods.com)

**Wild salmon promotion.** “Trident only sells wild salmon. Wild salmon are caught by fishermen as they return to their spawning streams after spending years in the cold Pacific Ocean developing their fatty layer rich with omega-3s. Wild-caught salmon have a significantly more flavorful quality and more brilliant color than farm raised salmon.” “(Alaska salmon) are processed within hours to ensure the highest quality. Roughly half of the Alaska salmon catch is canned with the remainder being quick-frozen, capturing the fresh-caught flavor unique to Alaskan wild salmon.”

**Quality assurance.** Trident’s “carefully conceived mix of mobile and fixed production assets gives us the ability to control our seafood products From the Source to the Plate®. From the fishermen, to the processors, to the plant managers, all Trident employees assume personal responsibility for Trident quality. We are constantly aware that the products we handle are not simply raw materials but a valuable food source for people around the world.”

**NORQUEST SEAFOODS:**
(www.norquestseafood.com)

**Value-added products.** “Our proximity to salmon resources gives us the ability to select the finest quality salmon for smoking and offer it to our valued customers... NorQuest produces a full spectrum of smoked products for food service, retail, ingredient processing, the seafood case, specialty gift shops, and mail order... Our smoked products are all natural and contain no artificial preservatives or colorings.”

**Quality assurance.** “From the moment the seafood is harvested, we take great care to ensure that its inherent wholesome qualities are quickly preserved. Whether it is frozen on board one of our processing vessels or in one of our shore plants, the same urgency is put into freezing, grading, packing, and shipping your seafood.” “...NorQuest is 100 percent accountable for the quality of every product... “

**ICICLE SEAFOODS**
(www.icicleseafoods.com)

**Value-added products.** “The combination of an abundance of Alaska salmon and consumer demand for easy to prepare meals has provided the opportunity for Icicle to develop a line of both Foodservice and Retail value-added salmon products under the SALMON CHEF brand.”

**New product development.** “Icicle Seafoods was one of the first to produce skinless/boneless canned salmon.”
Bruce Gore, Triad Fisheries, Sitka Alaska (1997)

Gore started marketing his own fish in 1978. In addition to his own fish, he now markets frozen-at-sea salmon for approximately 20 trollers. All participants must meet the strict handling and quality standards set by Gore’s company, Triad Fisheries. Fish are identified with a numbered tag attached to the gill that remains on the fish until purchased by the consumer. The tag is used not only to distinguish Gore’s product in the marketplace, but as a quality control measure that permits problem fish to be traced back to the boat, time and location of capture.

All Gore-tagged fish are stunned, bled (including back flushing of the blood line), dressed and frozen to 40 degrees F on board the vessel. To ensure the salmon are frozen pre-rigor, all fish are frozen within 90 minutes of capture.

Gore markets his fish domestically and in Asia. He says it took him three to five years to establish a market niche for his premium quality salmon. “I felt the best way to maintain high quality of the fish I caught was to freeze it at sea,” he says. “The market needed a product it could defrost in six months and was still a beautiful fish. This was to be my marketing advantage. It took at least three years to convince people that my fish really were a premier product and that this was not a marketing ploy.”

Gore operates out of Sitka, using a local processor to custom pack his product. The fish are held in the public cold storage facility there until enough product accumulates to fill a refrigerated container for shipment to cold storage in Seattle. At the Seattle facility, Gore repackages his product to meet the order specifications of his customers.


Fisherman Kenny Wilson’s fish smoking business in Dillingham, Alaska, is in its second successful year. Wilson is selling his smoked sockeye salmon in vacuum sealed pouches in Alaska markets. Before Wilson started his family business, he, like most other local Bristol Bay fishermen, fished for as many salmon as possible for an ex-vessel price of 40 cents a pound. Now he fishes only until he has the quantity of salmon he can handle in the smokery, and his family business gets 30 dollars per pound of product. Wilson started the business after he attended a University of Alaska Marine Advisory Program seafood technology workshop. The class covered seafood smoking, quality assurance, HACCP regulations, and other topics. Wilson got some funding to help his business from the Community Development Quota (CDQ) Program through the Bristol Bay Economic Development Corporation.

Clearly, direct marketing has worked for some fishermen, and direct marketing efforts are developing new market niches for wild salmon. It is likely that the volume of salmon sold through direct marketing will increase over time. However, it is unlikely that direct marketing will absorb more than a relatively small share of the total volume of wild salmon, for several reasons. In particular, as seen in Chapters VI and VII, a relatively small share of all wild salmon production is sold fresh or frozen in the North American market (for the period 2000-2004, this share was less than one-fifth). Other constraints include:

- Direct marketing operations are, by definition, small in scale: a fisherman marketing his own catch and perhaps that of a few other fishermen. It would be very difficult for small-scale operations to process a significant share of the larger Alaska wild salmon runs which account for the bulk of wild salmon catches.
- Direct marketing is not easy. It requires hard work and a variety of skills. As pointed out in the Alaska Fisherman’s Direct Marketing Manual, “a good fisherman does not necessarily make a good fisheries business person, and a business person is what you are if you do direct marketing.”
- Total niche market demand is limited. As more fishermen engage in direct marketing, they will find themselves in competition with other direct marketers, which will tend to lower prices and profits.

From an economic perspective, fishermen engaged in direct marketing who increase their earnings are not getting more money from fishing. Rather, they are earning more money by doing more things—by engaging not just in fishing but also in processing, distribution and marketing. They are working harder—sometimes much harder. Whether or not a direct marketing effort is a success cannot be determined from how much higher a price per pound a fisherman receives, but only from whether the increase in price covers the additional cost, time and risk of the additional processing, distribution and marketing activities he is taking on.

The organization and mission of ASMI is summarized in the Alaska statutes shown on the following page. ASMI is a public corporation which operates independently but is ultimately subject to the authority of the State of Alaska. ASMI is governed by a board appointed by the Alaska Governor consisting of two commercial fishermen and five seafood processors.8

ASMI summarizes its mission as follows:

The Alaska Seafood Marketing Institute is a marketing organization with the mission of increasing the economic value of the Alaska seafood resource through:

- Increasing positive awareness of the Alaska Seafood brand,
- Collaborative marketing programs that align ASMI and industry marketing efforts for maximum impact within the food industry,
- Long-term proactive marketing planning,
- Quality assurance, technical industry analysis, education, advocacy and research,
- Prudent, efficient fiscal management.

ASMI’s mission is very broad. It is to promote all species of seafood and their by-products that are harvested in Alaska. Thus, ASMI is charged not just with promoting Alaskan salmon, but also Alaskan crab, halibut, pollock, and many other species—which collectively greatly exceed Alaska salmon in total volume and value, which sell into very different markets, and which face different market opportunities and challenges.

The Alaska Seafood Marketing Institute (ASMI)

The oldest and best-known organization involved in marketing Alaskan wild salmon is the Alaska Seafood Marketing Institute, or ASMI, which was established by the Alaska Legislature in 1981 (ASMI 2006).7

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7 Except where otherwise indicated, material for this section is from the ASMI web site: www.alaskaseafood.org.

8 Until 2004, ASMI was governed by a 25-member board appointed by the Alaska Governor, of whom twelve were required to be commercial fishermen (with mandatory representation of different regions) and twelve were required to be seafood processors. The legislation requiring this large and cumbersome board, which passed in the early 1990s, reflected the historical tension (discussed above) among regions and between processors and fishermen. Recognizing problems arising from the former board structure, in 2004 the legislature adopted the current board structure, along with other significant changes to ASMI.
Recognition of the quality problems in the Alaska seafood industry led to the charge to ASMI of developing “market-oriented quality specifications for Alaska seafood to be used in developing a high-quality image for Alaska seafood,” and to develop marketing programs based on inspection and premium quality seals. This is a difficult challenge. The difficulty and cost of achieving any given quality standard varies widely between species being promoted—including salmon—and among different seafood producing regions and gear types.

**ASMI Funding**

ASMI has received funding from several different sources which have changed over time. As shown in Figure XII-2, between 1982 and 1993, ASMI received direct appropriations from the State of Alaska averaging more than $2 million annually. After 1993 the State began to reduce appropriations. Between FY 1999 and FY 2006 ASMI did not receive any direct appropriations from the State.

The decline in State appropriations to ASMI—despite repeated recommendations for State support of ASMI salmon marketing from industry groups, State task forces and several governors—was due to a combination of factors. These included dissatisfaction with ASMI among some parts of the Alaska seafood industry; a philosophical belief that private industry, including the seafood industry, should “pay its own way”; declining political influence of the seafood industry in the legislature; and a tighter fiscal situation for the State of Alaska. In a turnaround, in the spring of 2006, the legislature appropriated $1 million to ASMI—the first direct state funding in more than a decade. This likely reflected not only growing political support for ASMI and the seafood industry, but also the dramatic increase in state oil revenues resulting from higher oil prices.

ASMI’s most consistent source of funding has been a tax on Alaska seafood processors. Prior to 2004, the tax was calculated as 0.3 percent of the ex-vessel value of all seafood landings (not just salmon), and raised about $3 million annually. Unlike other revenue sources, these funds are not subject to restrictions on how they may be spent.

Beginning in 1994, the legislature passed a “salmon marketing tax” of one percent of the ex-vessel value of salmon landings, to be paid by salmon fishermen. The specific purpose of the tax was to fund marketing of salmon in the U.S. domestic market, and initially these funds could not be used for marketing in other countries. Due to the decline in the ex-vessel value of Alaska salmon, ASMI’s funding from the tax declined significantly from a peak of $4.8 million in 1996 to $1.4 million in 2003.

In the fall of 2004, the legislature eliminated the one percent salmon marketing tax paid by fishermen and enacted provisions under which processors voted to increase the seafood marketing assessment paid by processors on all seafood from 0.3 to 0.5 percent. These changes were part of a broad reorganization of ASMI which changed the composition of the ASMI Board (giving processors more control, and increasing the relative share of funding for marketing other Alaska species such as pollock).

Federal grants have provided a final important source of funding for ASMI. Federal grants peaked in 1992 at
$8.8 million, declined to $2.9 million in 2003, and increased sharply in 2004 and 2005 with large grants from several new funding sources. Until 2000, almost all federal funds received by ASMI were grants under the U.S. Department of Agriculture’s Market Access Program, which assists U.S. commodity groups in export marketing. In 2000, ASMI received a multi-year grant from the federal Economic Development Administration for domestic salmon marketing.

ASMI’s total funding for marketing all Alaska seafood fell from a peak of $14.7 million in 1995 to $7.2 million in 2003. Excluding federal grants restricted to export promotions, funding potentially available for domestic marketing fell from $9.1 million in 1996 to $5.1 million in 2003. In 2005, ASMI received major grants from two federally-funded marketing efforts (discussed below), the Alaska Fisheries Marketing Board and the State’s “Alaska Fisheries Revitalization” program.

ASMI Marketing Activities

ASMI’s activities have been divided into three distinct marketing programs: foodservice, retail, and export. The retail and foodservice programs focus on the U.S. domestic market, while the export program has undertaken marketing efforts in numerous foreign markets including the European Union, Australia, China, Japan and Taiwan.

In general, ASMI has focused on promoting a positive image for Alaska salmon and other seafood, and on retail and food service promotions, for which ASMI provides promotional materials while buyers contract separately with Alaska salmon suppliers.

Beyond these marketing activities, ASMI plays an ongoing role as an advocate for the salmon industry in both normal and emergency situations. As noted in ASMI’s FY 2001 Annual Report:

“Twice in its history, ASMI has pulled the industry through cataclysmic events—the canned salmon scare in 1982 and the Exxon Valdez Oil Spill in 1989. In both cases, ASMI launched massive public relations campaigns to avert market disasters. Hardly a week goes by that ASMI isn’t correcting a misperception, educating a reporter, or setting the record straight on a seafood story somewhere in the world.”

How effective has ASMI been in marketing Alaska wild salmon in the United States? This is not an easy question to answer. It is difficult to separate the effects of ASMI from those of all the other factors affecting the U.S. market, including the dramatic growth in farmed salmon imports. It is particularly difficult to evaluate the long-term benefits of sustained, multi-year efforts to promote a favorable image for “Alaska wild salmon.”

ASMI points to a variety of measures of how it has been reaching buyers and consumers with messages about Alaska salmon, as shown below. But it is difficult to know what these messages are achieving—how they are actually affecting buyers’ and consumers’ decisions, or how those decisions may be affecting prices for Alaska salmon.
Constraints for ASMI in Marketing Alaska Salmon

Alaska has a long history in promoting Alaska salmon and other seafood nationally and internationally, and enjoys wide recognition among buyers. However, ASMI faces significant constraints to the role which it can play in marketing Alaska salmon.

The most important among these may be that ASMI has no control over the production and sale of Alaska salmon. This means that of the four “P’s” of effective marketing—product, price, place and promotion—ASMI can only directly engage in promotion, primarily advertising and public relations. In particular ASMI

Measures of ASMI Effectiveness
(from ASMI’s FY 2001 Annual Report)

“Expenditure of $900,000 generated media coverage valued at $19.7 million in equivalent ad cost (the cost of buying advertising space/time to reach that many people)”

“Achieved 14.5 million ‘impressions’ (each instance of the Alaska salmon message reaching a consumer is referred to as an ‘impression’).”

“More than 13 million pounds of fresh and frozen Alaska seafood sold through retail promotions.”

“58 grocery chains with 7,103 stores involved in ASMI promotions.”

“More than 11.5 million pounds of Alaska seafood sold through foodservice promotions.”

“35,000 chefs exposed to ASMI and Alaska seafood through promotions and educational seminars.”

Examples of ASMI Alaska Wild Salmon Marketing Activities
(as described in ASMI’s FY 2001 Annual Report)

“The Federal Economic Development Administration (EDA) . . . awarded ASMI a $5 million grant to help the Alaska salmon industry cope with the negative impact of farmed salmon imports. . . . The majority of the grant supports a national public relations campaign for Alaska salmon. The first year of the campaign succeeded in carrying key messages about Alaska salmon to U.S. consumers through newspaper, radio and TV:

- Press kits sent to newspaper food editors across the country generated stories about Alaska salmon across America . . .

- Radio news releases for Earth Day featured interviews [which] highlighted the advantages of choosing sustainable Alaska salmon, and aired on 803 stations across the country reaching 6.2 million listeners.

- Over 20 million television viewers watched Alaska salmon grilled outdoors by nationally known chef Graham Kerr in a segment ASMI produced for morning talk shows.

- Local chefs making appearances on TV and radio programs are educating the audience about the superiority of Alaska salmon versus farmed salmon.”

“A collaboration between Whole Foods, the Marine Stewardship Council (MSC) and ASMI led to a month-long promotion at Whole Foods stores nationwide. Whole Foods, the world’s largest natural and organic supermarket, used the promotion to educate customers about sustainable fishing practices and the importance of buying fish from MSC-certified sources. . . . Alaska salmon was aggressively promoted at all 125 Whole Foods stores. The promotion included national public relations, celebrity chef endorsements, eye-catching materials in the stores (posters, recipe cards, informational brochures, etc.) and a chain-wide Alaska salmon sampling day. . . .”

“ASMI conducted its first promotion with the 500-unit club store Sam’s Club during the Summer 2001 ‘Wild about Flavor’ promotion.”

“A retail field marketing representative for the West Coast was hired to set up promotions with grocery store chains.”

“Consumer interest in the health benefits of omega-3 fatty acids prompted ASMI to create the Healthy Meal Planner. The booklet communicates the health benefits of omega-3 fatty acids in simple terms. . . . The Healthy Meal Planner explains that omega-3s may be easily added to the diet by eating two meals of Alaska canned salmon each week. . . . The Healthy Meal planner has been offered to consumers through retail promotions, and has also been distributed to 12,500 dieticians and nutritionists.”

“Distinctive promotions for canned salmon were conducted in the fall and the spring, building on the theme of canned salmon as an ideal ‘meal solution.’”

“ASMI provides retailers with tools to increase Alaska seafood sales. Creative new promotions for all species of Alaska seafood were developed for use by retailers during peak consumption periods in fall, spring and summer.”
cannot affect product variety, quality and design, nor can it affect price.

As discussed above, there is an intense debate within the Alaska salmon industry about how to address quality problems. ASMI is stuck in the middle of this debate, recognizing that quality is essential for effective marketing, but without any authority to mandate a resolution of the issue.

ASMI faces further political constraints which derive from its role as a “public corporation of the state” and its dependence on state and federal spending. In marketing Alaska salmon during the 1990s, at a time of greatly expanding competition from farmed salmon, ASMI faced the challenge of addressing the needs of numerous constituencies—fishermen, processors, and regions—with limited resources, with the inevitable result that some parts of the Alaska salmon industry felt that ASMI wasn’t doing enough for them.

Concerns with ASMI expressed by fishermen—a key constituency—reflected and derived from the following:

- ASMI had not stopped or reversed the decline in prices for wild Alaska salmon or the erosion of Alaska’s market share in the U.S. fresh and frozen market or other markets.
- Most fishermen could not see any tangible results of ASMI’s activities. Alaska and the U.S. Pacific Northwest, where most fishermen live and work, are far from most of the cities where ASMI promotions occur. Even if they lived in those cities, they would not necessarily be aware of ASMI’s extensive work with the seafood trade—buyers of seafood for major retailers and food service companies. Relatively few fishermen ever saw the ASMI advertisement in Seafood Business magazine pictured on an earlier page in this chapter, or ASMI’s booths at trade shows such as the International Boston Seafood Show.
- Most wild salmon fishermen had relatively little experience in food marketing, and they had relatively little ability to evaluate objectively what marketing strategies may be effective or not. For example, some fishermen criticized ASMI for not aggressively attacking farmed salmon, while ASMI cautioned that negative messages about farmed salmon might confuse consumers and be counterproductive for wild salmon.
- As discussed earlier, many fishermen distrusted processors—who played a major role on the ASMI Board. Fishermen argued variously that they were not paid fairly by processors, that processors were not sufficiently committed to developing new products and markets for Alaska salmon, and that some processors were involved in selling farmed salmon.

These concerns led to the expansion of the ASMI board in the early 1990s to twenty-five members, with equal representation of fishermen and processors. However, the expanded board was too large to operate effectively or efficiently in giving direction to ASMI. Given the political process for ASMI board appointments and the mandate for representation of fishermen and different regions, inevitably some of the Board members had limited experience in and understanding of marketing. These problems in turn led to declining processor engagement with ASMI, aggravating the challenges inherent in a marketing function separate from production and sales.9

In recognition of these problems, after extensive discussion within the industry, in 2004 the Alaska legislature enacted major changes to the ASMI statutes establishing the current smaller board, which is effectively controlled by processors, and which better facilitates “collaborative marketing programs that align ASMI and industry marketing efforts for maximum impact within the food industry.”

A continuing politically imposed constraint is that under statute, ASMI may not promote seafood from specific geographic regions or for specific brand names. Thus to the extent that specific regions or brand names represent potential marketing tools, ASMI may not take advantage of them. This has contributed to a push for separate funding of regional marketing activities, discussed below.

State of Alaska “Salmon Revitalization Strategy”

For a number of years the Alaska state government has been involved in salmon marketing-related activities independent of ASMI. These have included efforts of the State’s Office of International Trade to gather information and assist exporters in the Japanese and Korean markets, research and fisheries development efforts of the Alaska Department of Community and Economic Development and the work of the Alaska Department of Fish and Game in support of certification of Alaska salmon fisheries by the Marine Stewardship Council as “sustainable.”

In 2003 the State of Alaska undertook a new “State of Alaska Fisheries Revitalization Strategy,” supported by $50 million in federal fisheries disaster funds and economic development funds.10 Approximately $10 million of this funding was to be used for a “Salmon

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9 Perhaps inevitably, given the political environment in which it operates, ASMI was subject to more parochial criticisms. For example, ASMI was criticized by some Alaska legislators for maintaining an office in Bellevue, Washington, rather than having all of its staff in Alaska—despite the fact that Alaska is not a cost-effective location for most domestic or international marketing efforts.

10 Details of the Fisheries Revitalization Strategy are at www.dced.state.ak.us/cbd/seafood/revitalization/.
Marketing Grant Program” to be administered by the Alaska Department of Community and Economic Development. According to the program announcement:

“This Program is intended to assist Alaska salmon marketers to fund industry’s ‘best thinking’ on how to most effectively market wild Alaska salmon. Applications may seek funding for activities directly associated with marketing Alaska salmon products that have already undergone product design and development work. . . . Products eligible under this program should have already demonstrated market acceptance and be ready for a dedicated marketing plan. Funded expenses may include promotional activities, familiarization tours, trade shows, related marketing travel, packaging and label design, test product giveaways, tasks related to product marketing, and personnel costs. . . .”

According to a 2005 report on the program, approximately $10.6 million was awarded to three tiers of applicants, with varying grant award maximums and match requirements.11 Of $10.6 million in awards, $3.7 million was spent for advertisements, $1.6 million for in-store demonstrations, $1.1 for discount promotions, $948 thousand for customer visiting, $645 thousand for slotting, and $620,000 for trade shows—with the remaining $2.0 million going to a wide variety of categories such as familiarization tours, market research, display equipment, and product samples. More than 90 percent of the funding went to marketing efforts targeting the U.S. market. Almost 60 percent went to pink salmon marketing efforts, primarily for pouches, cans and burgers.

Clearly the Alaska Salmon Marketing Grant program represented a significant infusion of state-administered federal funding for marketing by the Alaska salmon industry. However, it is unclear what effects the program may have had or whether the marketing efforts it supported will be sustainable.

Alaska Fisheries Marketing Board

In the spring of 2003, the U.S. Congress adopted legislation establishing and appropriating $10 million to an “Alaska Fisheries Marketing Board” (AFMB). According to the legislation, the purpose of the Board was:

“to award grants to market, develop, and promote Alaska seafood and improve related technology and transportation with emphasis on wild salmon, of which 20 percent shall be transferred to the Alaska Seafood Marketing Institute. The Board shall be appointed by the Secretary of Commerce and shall be administered by an Executive Director to be appointed by the Secretary. The Board shall submit an annual report to the Secretary detailing the expenditures of the board.”12

An eleven-member Board was appointed in October 2003. The Board included an Alaska state senator, the Executive Director of ASMI, five representatives of fishermen’s associations, representatives of an Alaska retail chain and a transportation company, and two representatives of smaller Alaska seafood processors. Notably absent were any representatives of the largest Alaska salmon processors based in Seattle.

Although its marketing goals are similar to that of ASMI, AFMB operates under fewer constraints than ASMI, and can expand its efforts into unusual realms of marketing. For example, unlike ASMI, AFMB can promote a specific region of the state or a specific company. The Executive Director, Bill Hines of the National Marine Fisheries Service, believes that AFMB can occupy a unique niche where the organization can address those areas other organizations cannot (Welch 2003).

AFMB allocated $6.9 million for marketing programs in 2004. Of this, $5.9 million was allocated for salmon marketing, while the remaining $1 million was allocated for Alaska pollack marketing. Salmon funds were allocated to 64 Alaska salmon processors based on the volume of salmon they had purchased in 2003. The five largest processors each received more than $500,000 in marketing funds, while the twenty-one smallest processors received less than $1,000 each. Processors could use the funds for a wide variety of salmon marketing activities, with relatively few restrictions.

In 2005, The Alaska Fisheries Marketing Board received considerable attention when it granted $500,000 to Alaska Airlines to paint a picture of a wild Alaska king salmon along nearly the full length of a Boeing 737 passenger jet.13 However, the attention also raised questions about federal funding for the program, how the $29 million allocated to the program since 2003 had been spent, and the fact that the Alaska Fisheries Marketing Board had no official web site and hadn’t released an annual report for public review (Ruskin 2005).


12 Section 209 of the 2003 Consolidated Appropriations Resolution.

13 Pictures of the jet are posted on the Alaska Airlines website at http://www.alaskaair.com/as/www2/Promo/fishplane.asp. According to the website, the “Salmon-Thirty-Salmon” aircraft symbolizes the critical role Alaska Airlines plays in transporting fresh Alaska seafood to the continental United States and beyond.
Alaska Regional Marketing Efforts

A number of organizations have been formed in Alaska to promote wild salmon from particular fisheries or regions, such as the Copper River, Cook Inlet and Northwest Alaska.

Alaska’s best-known regional “brand” of wild salmon is Copper River salmon. Copper River sockeye and chinook salmon, caught in the Prince William Sound drift gillnet fishery, enjoy several key marketing advantages. First, Copper River was until recently the first North American wild salmon fishery to open each year, in early May. Second, the fish have an unusually high oil content and are considered among the best-tasting of Alaska salmon (although many other regions also claim this distinction). Third, the fishery is located near the town of Cordova, which has an airport with a runway where jets can land—making it easier to ship fresh fish to Lower 48 markets.

Building on these advantages, Cordova-based fishermen and processors, working together with Seattle-area retail stores and restaurants, have created extensive “brand” awareness for Copper River salmon as a premium Alaska wild salmon.¹⁴ Most Copper River sockeye and king salmon are bled and iced or chilled. The start of each season features media publicity and advertising for Copper River fish. This has resulted in a significant price premium for early-season Copper River salmon. As shown in Figure XII-3, in most years since the late 1980s, sockeye salmon ex-vessel prices have averaged significantly higher in the Prince William Sound area (which includes the Copper River fishery) than the Alaska average. For the years 2001-2005, prices averaged about $0.64/lb higher in Prince William Sound—twice as high as the statewide average price.

This price difference suggests that quality and regional branding can indeed help to boost prices, although in this case price differences are not solely attributable to regional branding. Part of the price differences likely derive from lower processing and distribution costs in the Prince William Sound fishery than in other more remote areas of Alaska such as Bristol Bay. Copper River salmon prices also benefit from the limited supply of fresh wild salmon early in the season; prices tend to come down later once salmon from other Alaska fisheries come on the market. Note also that the premium market position of Copper River sockeye did not insulate it from a significant downward price trend during the early 1990s.

In recent years fishermen and processors in other areas of Alaska have tried to create regional “brand” recognition similar to that enjoyed by Copper River salmon. Usually these efforts have required participating fishermen to meet specific quality standards.

One example is the Aleutians East Regional Marketing Project, initiated in 2002 and organized by the Alaska Fisheries Development Foundation (AFDF), the Aleutians East Borough, and local area fishermen and fish processing companies, with partial funding from the National Marine Fisheries Service.¹⁵ The project is working to develop a high-value domestic market niche for late-run coho and sockeye salmon, sold under the “Aleutia” brand name. The Alaska Fisheries

¹⁴ According to the Alaska Department of Community and Economic Development, “the success of Copper River salmon in the marketplace is a testament to the potential for regional niche marketing in Alaska. The Copper River Fishermen’s Coop, currently inactive, established a brand name for the region’s fish in the 1980’s and began to focus on quality fish handling. . . . More recently, the Copper River Salmon Producers Association applied for a Copper River certification mark from the U.S. Patent and Trade Office to officially brand their product. They continue to lead the promotion of quality standards for fishermen, tenders and processors in Alaska. Cordova District Fishermen United (CDFU), a Cordova fishing organization representing processors and harvesters, facilitates the general marketing efforts for regional participants. (http://www.dced.state.ak.us/cbd/seafood/seafoodmarketing/regionalmarketing.htm.)

¹⁵ This description of the Aleutians East marketing program is based on information posted at the AFDF website (www.afdf.org).
Development Foundation will purchase fish for the project from local fishers at a price sufficient to provide clear incentive to participate in the program. Further, AFDF contracts with local processors to do the requisite primary processing of the fish and arranges for subsequent sale and distribution of the fish. AFDF contracts with third party quality assurance inspectors for the purpose of maintaining defined quality standards for the program.

Another Alaska regional branding effort is the “Kenai Wild” branding program for Cook Inlet salmon, in which the Cook Inlet Salmon Branding board provides inspections of fish caught in the inlet and if the fish meet quality standards they are then marketed with the “Kenai Wild” brand. Strom (2003) suggested that some fishermen were skeptical of this branding project:

“While other areas of the state showed upward movement in sockeye prices, Cook Inlet remained between $.50 and $.60 with a nickel bonus for ice. The much ballyhooed Kenai Wild brand was bringing $.55 a lb. to the fishermen while processors grabbed all the profit on the 200,000 lbs. of deliveries, claiming that added production costs absorbed the higher prices the salmon returned at the wholesale end from an increasingly eager market. Fishermen were disgusted; and, many vowed not to return to such [an] unprofitable situation.”

This article suggests that regional marketing efforts, like many other attempts to improve quality and marketing of Alaska wild salmon, are vulnerable to the problem that fishermen do not necessarily receive—or perceive—any immediate benefits in higher prices to compensate for the additional costs such programs impose. This leaves many fishermen skeptical of proposals for significant changes from business as usual in Alaska salmon fisheries.

In general, while there are clearly opportunities in regional marketing, there are also costs, difficulties and risks. The Alaska Department of Community and Economic Development provided a useful summary of these in its “potential pitfalls from regional marketing,” shown in the box on the following page.

Responding to growing interest in regional marketing, in 2004 the Alaska legislature enacted legislation allowing fishermen to vote to form “regionalseafood development associations” (RSDAs), supported by taxes on fish landings within the region, which may engage in regional marketing activities. In May 2006, Bristol Bay drift gill net permit holders voted to implement a one percent marketing tax on salmon landings, which is projected to generate about $700,000 annually (The Wave 2006). In effect, money which these fishermen had formerly paid to support ASMI through the former salmon marketing tax will now go to a regional marketing organization controlled by Bristol Bay fishermen.

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Figure XII-3: Average Ex-Vessel Prices for Alaska Sockeye Salmon

Source: Copper River ex-vessel prices are from Alaska Department of Fish and Game, “Salmon Exvessel Price Time Series by Species” (a one-page summary distributed at public events). Statewide average prices are from CFEC Alaska Salmon Summary Data 1980-2005.
Potential Pitfalls from Regional Marketing
*(From the web site of the Alaska Department of Commerce, Community and Economic Development)*

A number of potential pitfalls exist that may prove detrimental to the Alaska salmon industry in general with numerous regional marketing efforts in existence. This page is provided to encourage producers who utilize regional marketing programs to be informed of concerns and actively engaged in efforts that will reduce or eliminate these problems.

**Diminishing other Alaska salmon.** Alaska salmon producers are concerned that one regional marketing program will seek to differentiate its products by unfavorably comparing them against other Alaska salmon products. It is agreed that this might lead to a diminished value for some salmon and possible consumer confusion in general. To eliminate this possibility, regional marketers are asked to:
- remain positive in their promotions,
- avoid comparative statements regarding other Alaska salmon, and
- focus comparative examples, if used at all, to salmon and other livestock options produced outside of Alaska.

**Poor coordination among all efforts.** It can be expected that some form of communication will be necessary if there are several independent regional marketing programs. Funding for all regional marketing programs will be scarce. This will create competition between the programs for limited funds. Regional marketers may pursue the same markets, which may be unable to support the volumes each region is capable of producing. It may be helpful for regions to coordinate with each other about where they intend to market their products. Other adverse effects from poor coordination may necessitate the establishment of a formal means of communication.

**Competition with a similar region.** The Alaska salmon industry is known for being tremendously competitive. Not only do processors compete heavily with each other, but fishermen are at odds with processors, fishing gear types often compete within a region, and even similar gear types fight over fish within their regions. There is a belief within regional marketing that participants must maintain an air of neutrality and teamwork when operating within a successful regional marketing program. Quality is a huge component of successful branding and if one sector of the industry fails to meet their responsibilities, it is damaging for all. It may also be ill advised for two distinct marketing efforts to exist within the same region. This could cause consumer confusion leading to diminished sales for all parties.

**Slow market development.** Any branding effort takes time, particularly if money is limited to fund the efforts. This will be the case with Alaska salmon. Anyone interested in establishing a regional marketing program should have adequate funding and be patient in realizing the benefits of a branded product.

Source: [http://www.dced.state.ak.us/oed/seafood/seafoodmarketing/regionalmarketing.htm](http://www.dced.state.ak.us/oed/seafood/seafoodmarketing/regionalmarketing.htm)

Other Alaska Wild Salmon Marketing Activities

*The Alaska Symphony of Seafood*

The “Alaska Symphony of Seafood” is a nationwide contest for new seafood products organized by the Alaska Fisheries Development Foundation. The purpose of the contest is “to provide incentive for seafood processors to develop new, innovative, value-added products made from Alaska-caught marine resources.” Contest winners are picked by a panel of judges made up of nationally known food experts. The prize is an opportunity to display the winning entries at the International Boston Seafood Show.

For a number of years the Symphony of Seafood (formerly the Symphony of Salmon) has served to highlight new Alaska salmon products, and to generate publicity about Alaska salmon within the seafood trade. However, the experience of one year’s winner may serve to illustrate one of the challenges in marketing wild salmon. In 2001, the Grand Prize was won by a small, Native-owned processor located on the Yukon River in Marshall, Alaska, for their Yukon King Traditional Smoked Salmon Strips. However, the following season the processor did not operate because of very low Yukon River salmon runs.

*Logo of the 2003 Alaska Symphony of Seafood*

Used with permission of Symphony of Seafood

*Alaska Quality Seafood*

Alaska Quality Seafood (AQS) is a new program which provides an opportunity for wild salmon processors to obtain third-party certification that their products meet the quality standards represented by four different quality seals. Participating processing plants agree to
adopt new grading standards that are consistent statewide. All fish is inspected when it arrives at the plant and during the final product grading. Inspections are conducted or audited by third-party inspectors to ensure compliance. Once inspection is complete, an official seal to indicate the grade is applied to the box.

Website of the Alaska Quality Seafood Program (www.alaskaqualityseafood.com)

The end goal of the program is to provide seafood buyers throughout the distribution chain assurance that they will receive the exact grade of salmon they specify, each and every time they order. According to AQS, the program has been shown to increase the confidence of seafood buyers in Alaska salmon and to increase product shelf life and decrease waste, and has resulted in higher prices for product from participating plants.

AQS is a project of the Alaska Manufacturers’ Association (AKMA), a non-profit organization which is part of the National Institute of Standards and Technology Manufacturing Extension Partnership (MEP). AKMA and AQS have been funded in part by the national MEP, as well as by the State’s Alaska Science and Technology Foundation, other federal grants, and affiliation and client fees.

AQS provides a private, voluntary mechanism by which participating processors could address market concerns about the quality of Alaska wild salmon. A critical issue for the future success of AQS will be whether processors are able and willing to pay for a larger share of the cost of the program in the future.

British Columbia Salmon Marketing Council

The British Columbia Salmon Marketing Council (BCSMC) is an organization similar in concept to ASMI, but much smaller, which is charged with generic marketing of British Columbia wild salmon. The Council is supported by a levy on wild salmon catches of 0.5 percent of landed value. The Council “undertakes research and educational programs for the development and promotion of commercially harvested wild B.C. salmon, and communicates to national and international markets the quality, availability and value of wild BC salmon.” The general manager summarized the activities of the BSCMC as follows in Snell (2003):

“Every single working day the staff of the BSCMC (now only two) are working to spread the story that wild BC salmon are abundant again, that they are being responsibly and sustainably harvested, and that they are the superior choice for the discriminating consumer looking for healthy food. There are a lot less wild salmon than there are industrially produced farm salmon—so only the very fortunate will have the opportunity to purchase and enjoy them. We tell this story to magazine, newspaper or radio reporters who call; to schools that are doing salmon or environment projects; to food distributors and retailers; to chefs in domestic restaurants; to government officials in every country that have heard of us—and to some that haven’t; to tourists at summer events and dockside sales in B.C.; to thousands of people at trade shows. We simply tell it everywhere that we can because we believe that until wild BC salmon is fully differentiated from the flood of international farm salmon, fishermen will not get the fair price for their salmon that they deserve and need.”

Marketing North American Farmed Salmon

North American farmed salmon marketing, like wild salmon marketing, includes both marketing activities of individual companies as well as those of associations of producers. Marketing is an integral part of the activities of the large corporations which produce most of the farmed salmon consumed in North America, and is facilitated by vertical integration within the industry. Much more than for wild salmon, marketing of farmed salmon fits the classic definition of “marketing” as an orientation of the entire industry to meet the evolving demands and opportunities of the market.
Between September 30, 1996 and June 1, 1997, Salmon Marketers International (SMI) conducted a targeted generic salmon promotion in Atlanta, Boston, Miami, San Francisco, Seattle and Washington, D.C. The campaign included radio spots, point-of-sale recipe cards and a variety of public relations efforts (Anderson, Lombardi and Wessells, 1997).

Although the promotional effort was funded by the farmed salmon industry, it did not differentiate between farmed and traditional ocean-caught salmon. It targeted the final retail consumer with the objective to “create top-of-mind awareness of salmon as a meal option and to stimulate the impulse sale of fresh salmon.” Analysis of the results before and after each city campaign indicated sales increased approximately nine percent relative to the control market.

The program, primarily funded by the farmed salmon industry in Chile, was discontinued when the U.S. Coalition for Fair Atlantic Salmon Trade (FAST) filed an anti-dumping and countervailing petition against the Chilean salmon exporters on June 12, 1997. Since that time, virtually all farmed salmon marketing in the United States has been conducted by individual salmon companies, and it typically targets wholesale buyers for food service and retail outlets. Most final consumer marketing is done by retail outlets or restaurants through flyers, newspaper ads, specials and direct contact with consumers by in-store staff or waiters.

Amenability of Farmed Salmon to Marketing

As discussed earlier in this chapter, farmed salmon has numerous inherent marketing advantages relative to wild salmon, which derive from the vastly greater control that farmers have over production. It is this control which enables salmon farmers to integrate marketing with every stage of production, processing and distribution.

A useful example is the ability of salmon farmers to control the color of farmed fish through the use of feed additives, as symbolized by the much-publicized Roche SalmoFan™ color chart. The color chart is a classic example of marketing—of learning what matters to consumers, and producing to meet those needs.

Until recently, most marketing activities of the salmon farming industry have been oriented towards the buyers in the retail and food service industries. In competing for long-term contracts as well as shorter-term spot market sales, farmed salmon producers have sought to understand and meet the needs of these buyers. Except for trade shows and advertisements in the trade press, most of these activities occur outside of the public view.

Until recently, cooperation among salmon farmers occurred primarily within regional and national organizations of salmon farmers. The most important of these, with respect to the North American market, are SalmonChile (formerly the Association of Chilean Salmon and Trout Farmers), the British Columbia Salmon Farmers Association, and the New Brunswick Salmon Growers Association. In addition to marketing, these organizations represent their members on a variety of other issues including salmon farming regulation and trade disputes.

The marketing activities of regional salmon farmers’ organizations have evolved over time with the industry. Rodrigo Infante, General Manager of SalmonChile, described this evolution in an interview with the Intrafish news service published December 19, 2003:

“Times are changing and so are the challenges. Ten years ago, the challenge was to make ourselves known in the world as salmon producers, and to get customers to think of Chile when buying salmon, not only as a source for product but also as a source for information. The mediums used were publicity campaigns, newspaper advertisements, and other advertising. The basic message was that Chile is a producer of salmon. Chile has a quality assurance system. If you need a salmon product, think of Chile.

Therefore, the first objective was to make ourselves known. Our goal was to get producers to become familiar with the markets and understand how they worked. That’s why many market studies were done, to see how sales could be increased for Chilean salmon, or salmon in general, and to look for ways to get into the markets.

Those were the challenges at the beginning of the 90s decade. By the mid-90s, the industry was already much more consolidated. The industry was more developed, had international recognition, and production was more intelligent. Salmon consumption grew and so did the industry on a global scale. With all that came a stage of generating alliances, of co-operation, especially in the American market. A generic campaign was done in the United

Farm salmon color chart

Photo by Gunnar Knapp

17 Discussed further in Chapter XV.
States. Thus the running theme was to look for possibilities of working together.

The growth in supply and cost decreases for greater production efficiency, things that go together, made prices drop. And the [salmon] world became somewhat crazed and producers were at war with each other. That’s when accusations of dumping came about. I would define this period as a setback. It was each one for himself, to defend his own, to continue operating in his own space, without looking beyond himself.

Now I think that we are in a much more mature stage, where it is understood that there is great potential demand still untapped in the market. That it is a market where salmon has [wide] acceptance, that we have common enemies, and that it is much more worth it to work together to improve the image of salmon product among consumers. Every country can find its own way to set itself apart. But this is done in the market, where companies must try to produce efficiently and find a place for their product in the market, rather than making it a fight between each other....

What is important is [that we] produce a high-quality product that is well received by consumers. It’s important that consumers become more educated about salmon products. There are obviously still many people who have yet to learn what salmon is all about. That it is beneficial to your health. That it reduces your cholesterol. They need to learn more about how it is produced. That it is safe. That it is produced under the highest quality standards. Therefore, all the products consumers receive are optimal, having passed through a series of registries and controls. And that companies are ISO certified and have the proper procedures to produce.

They also need to know that it is a sustainable product. That its production is not harming the environment, but rather is helping along the development of very remote local communities, a clear and evident benefit for salmon farming countries and regions. I think these are positive messages [we can give to consumers]. . . . We can observe the market and focus our efforts into adequately informing consumers of all these [positive] messages having to do with our industry, our product and the development of our activity. I think these are our challenges.”

The latest stage in the evolution is Salmon of the Americas (SOTA)—a new association formed in June 2003 by members of the Chilean, Canadian and U.S. salmon farming industries. SOTA’s mission, as described on its website, is “to improve health, awareness and dining enjoyment of consumers in North America by providing timely, complete, accurate and insightful information about salmon on behalf of the member companies.”

SOTA is a private nonprofit-making corporation based in Miami, governed by a board consisting of four representatives from the Canadian industry, four from the Chilean industry and two from the US industry. SOTA is funded by a per-kilo assessment on members’ salmon exports to the United States. SOTA’s operating budget for 2003 was approximately $3 million.

SOTA highlights several themes that are likely to be central to marketing efforts by salmon farmers over the next few years. These include:

- Addressing health concerns associated with farmed salmon raised by recent studies
- Addressing other potential concerns which have been raised by groups critical of salmon farming, such as the environmental sustainability of aquaculture
- Emphasizing positive economic contributions of aquaculture
- Pointing out that a significant share of “wild salmon” are hatchery fish

The last of these themes has only recently been emphasized by salmon farmers, but it may receive increased attention as a response to claims that wild salmon are more “natural.”

SOTA is becoming increasingly sophisticated in its responses to critiques of farmed salmon and in proactive farmed salmon marketing efforts. For example, in an April 2006 interview with the trade journal Intrafish, SOTA chair Rafael Puga noted that (Cherry 2006):

“In late 2005, we placed an insert into most of the newspapers in the United States, with information about the industry. We did this a few days after one of the characters of a television show made a statement against farmed salmon compared with wild salmon. Although the episode was only fiction, we thought it was a good idea to inform the public about the truths of the industry. We did this without responding directly to the program. We also bought six pages in the Sunday magazine of the New York Times, and this year we are preparing a series of

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18 The discussion in this section is based on information from the Salmon of the Americas website (www.salmonoftheamericas.com) and an article published by Intrafish news services (www.intrafish.com) on June 23, 2003 (Cherry 2003).

19 Under the heading “How Farming Techniques Help Wild Salmon” the website points out that “Many people are surprised to learn that fully one in three of the salmon caught in the waters off Alaska, the principal salmon fishery, started their life in a hatchery. Over 1.5 billion of these salmon are released into the ocean each year where they join their naturally wild cousins, grow and are caught with them. In Alaska, this represents about 30 percent of the catch. In the lower 48 states, hatcheries account for over half the salmon caught.”
advertorials, which are kinds of editorials with salmon information, with data about the latest studies released on the benefits of eating salmon."

The emergence of SOTA is a reminder that any marketing effort, positive or negative, is likely to bring about responses from competitors once it begins to have an effect. As negative messages about farmed salmon have increased, the salmon farming industry has begun to respond in a coordinated way. These efforts are likely to increase in proportion to the economic threat represented by the efforts of groups critical of salmon farming.

Potential Collaboration in Wild and Farmed Salmon Marketing

An idea which has been discussed within the salmon industry for many years, by both salmon farmers and (to a lesser extent) wild producers, is to cooperate in generic promotion of salmon as a healthy and tasty alternative to other proteins. The potential advantages of this approach would be to focus the combined efforts of the industry on expanding the total market, rather than competing for shares of a smaller market.

Potential themes of a cooperative approach are illustrated in a “Wild or Farmed” comparison posted on the Salmon of the Americas website, which is reproduced on the following page. The messages are that both wild and farmed salmon are healthy and tasty, and the availability of both wild and farmed salmon serves to increase the range of choices for consumers.

While salmon farmers have expressed, in various informal ways, an interest in cooperation, most wild salmon fishermen have not been receptive to this idea. Although larger wild salmon marketing organizations, in particular ASMI, have generally refrained from attacking farmed salmon, neither have they defended farmed salmon or explored opportunities for cooperation. As discussed earlier, some wild salmon producers have welcomed and sought to benefit from criticism of farmed salmon.

These differences in opinion with regard to collaboration are not surprising. Wild salmon producers, whose production is limited by nature, have no assurance that the potential benefits from cooperating with farmed producers would not be dissipated by expanded farmed salmon production. This same issue has hampered international cooperation between salmon farmers.

In response it might be argued that all salmon producers benefit from positive promotions of salmon (and more generally, seafood), and that as the size of the total market grows niche markets specifically for wild salmon will also grow.
“Wild or Farmed?” Comparison Posted on the Salmon of the America’s Website

Which is Better for You? Which Tastes Better?
In these days of complex decisions about food, the answer to this one is refreshingly simple. Both!

Which is Better for You?
Knowing which foods are good for you is important because you want to eat foods that help you live better and not just fill you up. Salmon, farmed or wild, fits the bill.

Which Tastes Better?
Take your pick. Salmon isn’t the only food that gives you choices. Which tastes better? A Bordeaux or a Merlot? A Granny Smith or a McIntosh apple? (or a Red Delicious or a Gala?) You get the picture—lots of choices. Salmon is the same. It’s all good, but there are differences. Many people can tell differences among the five major species of wild salmon as they can between some wild and farm-raised salmon. Try them all and see for yourself.

Low in Saturated Fat
There are differences among wild species and among wild and farmed salmon. But, no matter which one you choose, compare and see just how low in saturated fat a serving of salmon is:

<table>
<thead>
<tr>
<th>FOOD</th>
<th>SATURATED FAT</th>
<th>OMEGA-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmed Atlantic Salmon</td>
<td>2.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Wild Chinook Salmon</td>
<td>3.1</td>
<td>2.0</td>
</tr>
<tr>
<td>Wild Chum Salmon</td>
<td>0.8</td>
<td>0.6</td>
</tr>
<tr>
<td>Farmed Coho Salmon</td>
<td>1.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Wild Coho Salmon</td>
<td>1.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Wild Pink Salmon</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Wild Sockeye Salmon</td>
<td>1.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Chicken (breast)</td>
<td>2.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Chicken (thigh)</td>
<td>4.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Ground Beef</td>
<td>5.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Pork Loin</td>
<td>8.4</td>
<td>0.0</td>
</tr>
</tbody>
</table>

1 All content in grams per 100 grams, raw
2 Because Atlantic salmon comprise over 95 percent of the farmed salmon raised, the figures regarding nutrient content are given for this farmed species. Wild Atlantic salmon is an endangered species and not fished commercially in North America.
3 Average of white and dark meat with skin, raw
4 Ground beef, 85% lean, 15% fat, raw
5 Fresh loin blade, bone in, raw

High in Omega-3 Fatty Acids

<table>
<thead>
<tr>
<th>FOOD</th>
<th>PROTEIN</th>
</tr>
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<tbody>
<tr>
<td>Farmed Atlantic Salmon</td>
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</tr>
<tr>
<td>Wild Chinook Salmon</td>
<td>19.9</td>
</tr>
<tr>
<td>Wild Chum Salmon</td>
<td>20.1</td>
</tr>
<tr>
<td>Farmed Coho Salmon</td>
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</tr>
<tr>
<td>Wild Coho Salmon</td>
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<tr>
<td>Wild Pink Salmon</td>
<td>19.9</td>
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<tr>
<td>Wild Sockeye Salmon</td>
<td>21.3</td>
</tr>
<tr>
<td>Chicken (breast)</td>
<td>20.9</td>
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<tr>
<td>Chicken (thigh)</td>
<td>17.3</td>
</tr>
<tr>
<td>Ground Beef</td>
<td>15.0</td>
</tr>
<tr>
<td>Pork Loin</td>
<td>15.8</td>
</tr>
</tbody>
</table>

1 All content in grams per 100 grams, raw
2 Because Atlantic salmon comprise over 95 percent of the farmed salmon raised, the figures regarding nutrient content are given for this farmed species. Wild Atlantic salmon is an endangered species and not fished commercially in North America.
3 Average of white and dark meat with skin, raw
4 Ground beef, 85% lean, 15% fat, raw
5 Fresh loin blade, bone in, raw
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CHAPTER XIII

Effects of Farmed Salmon on Wild Salmon Prices

Key Points

✓ The most important factor driving change in world salmon prices has been rapid and sustained growth in world farmed salmon and salmon trout production. This has fundamentally transformed world salmon markets—not only because of the dramatic growth in total supply, but also because of the changes that it has represented in the kinds of salmon products which are available, the timing of production, market quality standards and organization of the industry.

✓ Different wild salmon species and markets have been affected in different ways by farmed salmon. Generalizations about effects of farmed salmon on “wild” salmon prices risk being overly simplistic and misleading.

✓ During the 1990s the rapid growth of farmed salmon supply depressed prices not only for farmed salmon but also in most traditional wild salmon markets.

✓ More recently, prices for farmed and wild salmon have stabilized or increased. Wholesale price trends for farmed and wild salmon appear less closely correlated, suggesting that differentiation is occurring in markets for wild and farmed salmon. Some wild salmon products sell for lower prices than farmed salmon, while others command price premiums.

✓ Many other factors besides farmed salmon have also affected wild salmon prices. These include:
  • Increasing concentration in the retail and food service industries
  • Increased world pink and chum salmon harvests
  • Following the collapse of the Soviet Union, the emergence of Russian wild salmon as a significant competitor to North American wild salmon in the Japanese frozen market and world canned salmon and salmon roe markets
  • Declining consumer demand for canned salmon
  • The end of the Japanese “bubble” economy of the 1980s and a stubborn economic recession in Japan, historically the most valuable market for North American fresh and frozen wild salmon

Introduction

Since 1988, when prices hit historic highs, there have been dramatic changes in markets for wild salmon. Between 1988 and 2002, these changes were reflected in declining prices for most wild salmon products and declining prices paid to wild salmon fishermen. Figure XIII-1 shows prices paid to Alaska salmon fishermen expressed as a percentage of average real (inflation-adjusted) prices paid over the period 1980-2005. In 2002, prices were less than half of the average for this period for all species except chinook (which accounts for less than two percent of the Alaska catch volume).

Between 2002 and 2005 real prices recovered, to varying extents, for all species except pink salmon. Prices increased significantly for chinook salmon and coho salmon (which together account for less than seven percent of the Alaska salmon catch volume). Prices increased much more modestly for sockeye and chum salmon.

In this chapter we examine the causes of these changes in wild salmon prices, and in particular the effects of farmed salmon on wild salmon prices. We begin with a brief overview of economic theory of how farmed salmon affects wild salmon markets. We next discuss challenges in quantifying the specific impacts of farmed salmon on wild salmon prices. We then briefly review available evidence about the effects of salmon farming and other factors on prices of wild salmon.

Throughout this discussion, it is important to keep in mind that the causes of changes in wild salmon prices,
and the effects of farmed salmon, vary for different wild salmon species. It is difficult to quantify the specific effects of farmed salmon on wild salmon prices, as many other factors have also affected prices.

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**Figure XIII-1**

Real Alaska Ex-Vessel Prices as a Percentage of Average for 1980-2005


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**Overview—Economic Theory of Effects of Farmed Salmon on Wild Salmon Prices**

Salmon markets are complex. To introduce this complex topic we begin by discussing price formation in a market with only wild salmon—before the introduction of farmed salmon.

Figure XIII-2 is a simplified representation of price formation in a market with only wild salmon. Numerous different factors together simultaneously determine prices at different market levels—ex-vessel, wholesale, and retail. Ultimately, prices at all levels of the market chain are driven by factors affecting both supply (shown in *italics* on the left side of the diagram) and demand (shown in *italics* at the top of the diagram).

Raw product supply is driven by fishing costs, environmental factors such as decadal ocean changes and effects of drought on spawning streams, hatchery production, natural wild salmon stocks, fisheries management programs and fishermen’s preseason expectations about ex-vessel prices.

Final product demand is driven by consumer tastes, consumer incomes, prices of salmon and prices of substitute species of fish and meat. Media and advertising, such as positive media reporting on the healthful benefits of eating salmon or negative media on endangered salmon, influence consumer tastes and preferences.

Costs and the relative market power of different players in the market determine the relationships between prices at the ex-vessel, wholesale and retail level.

At any given time, many different factors are affecting prices and there are many different potential reasons why prices may change. For example, all of the following could contribute to a decrease in wild salmon prices:

- An increase in catches due to favorable environmental factors, such as favorable ocean conditions (by increasing supply)
- An increase in hatchery production (by increasing supply)
- A decrease in the price of beef (by lowering demand for salmon)
- An increase in retail labor costs (by increasing the margin between retail prices and wholesale prices)
Wild salmon ex-vessel prices (the prices paid to fishermen) are driven mainly by wild salmon wholesale prices. The difference or “margin” between wholesale prices and ex-vessel prices depends upon the costs of processing and transporting fish, as well as the extent of competition for fish among the processors fishermen sell to and more generally the relative market power of fishermen and processors. This margin is relatively more stable than wholesale or ex-vessel prices. This means that when wholesale prices rise or fall, ex-vessel prices tend to rise or fall by a similar absolute (dollar) amount.\(^1\)

If margins are relatively stable in absolute (dollar) terms, then changes in the factors which affect prices—such as fish catches or consumer demand—tend to have a greater relative or percentage effect on ex-vessel prices than on wholesale prices. To see why this is so, consider a simple example in which the wholesale price falls from $3.00 to $2.00, or by 33 percent (Table XIII-1). If the margin between the wholesale price and the ex-vessel price stays at $1.00, the ex-vessel price falls from $2.00 to $1.00, or by 50 percent.\(^2\)

This example shows why ex-vessel prices are likely to be relatively more sensitive to changes in market conditions than wholesale or retail prices (and helps to explain why prices paid to wild salmon fishermen have been so significantly affected by salmon farming). Ex-

\(^1\) This may be seen in the graphs of wholesale and ex-vessel prices for Alaska salmon shown in Chapter VII (Figures VII-9, VII-10, and VII-11).

\(^2\) For purposes of this simple illustration, Table XIII-1 assumes a constant margin. Actual margins are not constant, and tend to increase when wholesale prices increase. However, as long as margins change by a smaller percentage than wholesale prices—as is typically the case—ex-vessel prices will change by a greater percentage than wholesale prices.
vessel prices received by wild salmon fishermen are much lower than retail or wholesale prices, after deducting the significant costs of processing, distribution and retailing. As a result, when retail or wholesale prices decline, fishermen experience a much greater proportional decline in the prices they are paid.

Salmon farming has significantly increased the complexity of salmon markets. Figure XIII-3 is a simplified representation of price formation in a market with both farmed and wild salmon. This figure keeps all the factors which affect prices in Figure XIII-2, while adding new factors related to salmon farming.

There are several important points to be drawn from this figure. First, prices of farmed and wild salmon affect each other at both the wholesale and retail levels. To varying degrees, farmed and wild salmon are substitutes; meaning that buyers will switch between wild and farmed salmon depending upon the relative prices of each. Thus, to some extent, prices of wild and farmed salmon will track one another. If farmed salmon prices rise, buyers are willing to pay more for wild salmon. If farmed salmon prices fall, buyers are not willing to pay as much for wild salmon.

**Figure XIII-3  Price Formation in a Market with Farmed and Wild Salmon**

- Prices of other fish and meat
- Consumer incomes
- Consumer tastes
  - Media & Advertising
- Salmon feed costs
- Salmon farming technology
- Other salmon farming costs
- Salmon farming regulation
- Environmental factors
  - Hatchery production
  - Natural wild salmon runs
  - Wild fisheries management
  - Fishing costs

Demand for salmon products

Farmed salmon production

Supply of wild salmon products

Wild salmon catches

Wild salmon catches

Value of wild salmon catches

FARMEED SALMON
RETAIL PRICES

WILD SALMON
RETAIL PRICES

FARMEED SALMON
WHOLESALE PRICES

WILD SALMON
WHOLESALE PRICES

FARMEED SALMON
EX-VEssel PRICES

WILD SALMON
EX-VEssel PRICES

Retailing & distribution costs

Exchange rates

Processing & transportation costs

Yields
How closely prices of wild and farmed salmon are linked depends upon the extent to which buyers view them as substitutes, which in turn depends on the physical characteristics of the fish, the product form and the extent to which buyers care about the origin of the fish or whether they are farmed or wild. This will likely vary depending on the species of wild salmon. In addition, the extent to which particular wild salmon species and farmed salmon are substitutes may change over time if buyers’ knowledge of and relative preferences for wild and farmed salmon change over time.

How buyers perceive the relative quality of farmed and wild salmon affects the relative price levels that they command in the market. If buyers perceive that a particular wild salmon product is superior to farmed salmon, then that wild product may command a price premium over farmed salmon. If buyers perceive that a wild salmon product is inferior to farmed salmon, that product’s prices may be discounted relative to farmed salmon prices.

What matters are not only perceptions of consumers. Perceptions also matter of wholesale buyers—retail and food service operators—who consider not just taste but also reliability of supply, consistency of sized, shelf-life and other factors which affect their costs.

The introduction of farmed salmon also changes the dynamics of salmon markets—how supply and prices change over time. In a market with only wild salmon, short-term changes in prices are driven primarily by natural fluctuations in wild catches, while longer-term trends in prices are driven primarily by changes in demand. If wild catches are low in a particular year, prices rise and if wild catches are high, prices fall, all else held constant. Thus the financial effect on fishermen of a low catch is partially offset by higher prices.

In a market with only one type of salmon (e.g. wild), year to year there tends to be an inverse relationship between wild salmon catches and wild salmon prices. Longer-term (multi-year) trends in average prices are driven primarily by longer-term trends in catches, as well as changes in consumer demand.

With the introduction of salmon farming, these market dynamics change in several important ways. First, as farmed production becomes an ever-larger share of total supply, wild salmon prices are driven more and more by farmed salmon supply rather than by wild salmon supply as wild salmon becomes a smaller player in the market. This results in a weaker inverse relationship between wild salmon catches and prices—which means that wild salmon fishermen can no longer count on a low catch being offset in part or in full by higher prices. The inverse relationship between wild catch and prices still exists—but it is muted by the larger market.

Another way in which the introduction of farming changes the dynamics of salmon markets results from the ability of salmon farmers to adjust production in response to changes in expected profits. If farmers expect to make profits, they have an incentive to expand production. If farmers expect to lose money in the future, they have an incentive to reduce production. Either decision involves risks, because it takes many months for a fish to reach market size, by which time conditions in the market may have changed. If farmers expect prices to rise and expand production they risk losing money if prices do not rise. If farmers expect lower prices and reduce production they risk being left short of product to sell if prices rise.

If farming is at first highly profitable, this tends to result in rapid expansion of farmed production—resulting in declining prices—until profits fall to a “normal” level. If demand were constant and costs were constant, production would eventually stabilize when prices fell to the level at which farmers no longer had any financial incentive to expand production. However, if costs of production decline, prices can continue to decline by a similar amount, allowing production to continue to expand (but more gradually) over time, while prices continue to fall (but more gradually).

If farmers are overly optimistic about future prices, they may produce so much salmon that prices are driven below costs of production—causing salmon farmers to lose money. Subsequently, in reaction to losing money, farmers may cut back on production so much that prices rise well above costs of production.

These periods of over-production followed by cutbacks in production may lead to price cycles for farmed salmon, with periods of very low prices followed by periods of higher prices—similar to the price cycles which occur for beef and pork. These price cycles—driven by the farmed salmon industry—will in turn affect wild salmon prices.

Other Effects of Farmed Salmon on Wild Salmon Markets

The effects of farmed salmon on wild salmon markets go far beyond those resulting from an increase in total supply. Farmed salmon has profoundly changed almost every part of the salmon business. Almost every part of the fresh and frozen salmon industry—including distribution, retail and food-service—has shifted its orientation from wild salmon to farmed salmon. Before farmed salmon, the industry was oriented towards distributing and selling a limited range of salmon products, of widely varying quality, which were available only seasonally in limited, varying and...
uncertain quantities from relatively small producers. Now the salmon industry is oriented towards distributing a much wider range of salmon products, of much more consistent quality, in much larger volumes, from much larger producers. Wild salmon has become a smaller, specialized part of a much larger salmon business, involving special challenges but also special opportunities.

Farmed salmon has increased quality standards for salmon in world markets. Most farmed salmon is a visually appealing product of consistent quality. Given a choice, buyers and consumers are less willing to purchase wild salmon unless it is equally attractive and of equally consistent quality.

Farmed salmon has changed the timing of market demand for salmon. Formerly salmon was a seasonal product: fresh salmon was available only during (primarily) summer salmon runs. Now fresh farmed salmon is available year-round, and suppliers of wild fresh salmon face a marketing disadvantage because they cannot meet the needs of those retail and foodservice buyers who wish to offer consumers the same products year-round.

The farmed salmon industry has developed new salmon products and raised buyer and consumer expectations for product convenience. One important example is the development of pinbone-out fillets, which now represent a major, and increasing, share of the U.S. salmon market. With pinbone-out fresh farmed salmon fillets now widely available, consumers are less likely to choose less convenient wild salmon product forms with bones.

Farmed salmon changes consumers’ perceptions of what “salmon” tastes like. As more and more consumers eat farmed salmon, the more likely they are to consider the taste of farmed salmon to be what salmon “should” taste like. They may come to consider that wild salmon tastes less like “salmon” than farmed salmon.

Farmed salmon has greatly expanded the availability of salmon, especially in the mid-West and East. As total supply and the reliability of supply has increased, farmed salmon is now commonly available year-round in U.S. restaurants and retail stores which formerly carried salmon only seasonally, if at all.

Over time, as the supply and availability of farmed salmon has increased, demand has also increased. As consumers who may have never eaten salmon or eaten it only rarely try it—perhaps because it is on sale or a new option on a restaurant menu or a friend serves it to them—they are more likely to purchase it in the future. Increasing demand has allowed the farmed salmon industry to continue to grow. World markets now absorb far more salmon than they could have a decade ago. This growth in demand represents an opportunity for wild salmon. In a much bigger market, there are new opportunities for those wild salmon producers who can take advantage of the potential competitive advantages of wild salmon—ranging from costs of production to taste, appearance and other characteristics of wild salmon.

Over the past few years, concerns of some consumers about health and environmental issues associated with farmed salmon have emerged as another potential competitive advantage of wild salmon, and contributed to a steep rise in prices paid for some kinds of high-quality wild salmon (such as troll-caught chinook salmon) in some markets.

Other Factors Affecting Wild Salmon Prices

As discussed earlier, salmon markets are complex, and many different factors affect salmon prices. It is clear that many other factors in addition to farmed salmon have affected wild salmon prices in recent years—although it is difficult to quantify their effects.

After farmed salmon, one of the most important factors affecting salmon prices has likely been globalization of world food markets. Loosely defined, “globalization” includes a wide variety of changes in the world economy, including technological revolutions in communications and transportation; increasing reliance on markets (as opposed to government controls); reductions in trade barriers; greater world economic integration in markets for resources, goods, services, labor and capital; shifts in production from higher-cost to lower-cost producers; consolidation and integration resulting in larger, more powerful firms operating in many countries; growing consumer incomes in developed and developing countries; and increasing consumer expectations for quality, convenience, variety and lower prices.

Globalization is transforming seafood processing, distribution and retailing. Changes in the seafood industry associated with globalization include rapid expansion of seafood trade; increasing consolidation and market power in the retail and food service industry; restructuring of seafood distribution networks; increasing pressure on seafood suppliers to lower costs, internationalization of standards for food handling and safety and a shift in labor-intensive seafood processing to countries with low labor costs.

One important effect of globalization is that relatively few large retail and foodservice buyers are dominating more and more of the seafood market—including the salmon market—in the United States, Europe and Japan. These buyers want consistent and reliable supply of large volumes of seafood at low, stable and competitive prices. In general, farmed salmon meets
the needs of these buyers better than wild salmon. As a result, the trend towards concentration in the retail and food service industries tends both to stimulate growth in the farmed salmon industry, and also to exacerbate the effects of farmed salmon on wild salmon markets.

More generally, salmon, like other food and non-food products, is increasingly being sold in a global market, in which all sources of supply directly or indirectly affect all markets. This represents both an opportunity for North American wild salmon producers (who have historically benefited from selling to export markets) but also a threat (from growing competition from other salmon suppliers in both domestic and foreign markets).

Changing wild salmon supply conditions have affected wild salmon prices, and are likely to continue to do so in the future. Important changes in wild salmon supply conditions that have occurred over roughly the same time period as the dramatic expansion of farmed salmon supply include:

- Increased world pink salmon harvests (partly from North American and Russian hatcheries) and canned pink salmon production
- Increased world chum salmon harvests, primarily due to North American and Japanese hatchery production
- Following the collapse of the Soviet Union, the emergence of Russian wild salmon as a significant competitor to North American wild salmon in the Japanese frozen market (Russian sockeye) and world canned salmon and salmon roe markets (Russian pink and chum salmon)

Changes in consumer demand have also affected wild salmon prices. Some of these have resulted from the rapid expansion of farmed salmon supply and the development of new salmon product forms. Others include:

- Declining consumer demand for canned salmon with the development of other more convenient and attractive product forms, including frozen, fresh and MRE (meals ready to eat), and the aging of traditional canned salmon consumers. Recall that “declining demand” does not necessarily mean declining sales. Rather, it means a decline in the volume that consumers are willing to purchase at any given price. In other words, it means that any given volume can only be sold for a lower price. As was discussed in Chapter VIII, the fact that given volumes of canned pink and canned sockeye salmon command lower wholesale prices than formerly strongly suggests that canned salmon demand is declining (or, more technically, the demand curve for canned salmon is shifting inward).

- Declining Japanese consumer demand for certain traditional salmon roe products, in particular sujiko.
- The end of the Japanese “bubble” economy of the 1980s and a stubborn economic recession in Japan, historically the most valuable market for North American fresh and frozen wild salmon.

All of these factors suggest that the market challenges faced by North American wild salmon producers go well beyond competition from farmed salmon. Thus, even if salmon had never been farmed, the wild salmon industry would likely have experienced challenges and change in recent years.

### Challenges in Quantifying the Effects of Farmed Salmon on Wild Salmon Prices

Above, we have briefly reviewed economic theory of how we would expect farmed salmon to affect wild salmon prices. However, for a number of reasons, it is very difficult to quantify the specific effects of farmed salmon on specific wild salmon prices over time. Put differently, it is difficult to say how much of a change over time in the price of a particular wild salmon product, or the price paid to a fisherman for a given wild salmon species, was caused by farmed salmon.

The challenges in quantifying the effects of farmed salmon on wild salmon prices result from the variety and complexity of salmon markets, as well as the rapidity of changes that have occurred in these markets. There is not a single “salmon market,” but rather many different markets for many different products and many different species in many different countries which are all linked, to varying degrees, in the international salmon market system. At any given time, many different factors are affecting these different markets in many different ways. And all of these markets are experiencing rapid changes not only as a result of salmon farming but also because of rapid changes in the world economy and the global food industry.

To quantify how market factors affect each other, economists usually use statistical techniques known as “econometrics,” which examine how variations in different variables (such as wild salmon catches, farmed salmon production, exchange rates and prices) have been related to each other over time. However, there are several significant challenges in using econometrics to study salmon markets.

First, the more complex a market is, and the more factors that affect it, the more data are required for an econometric analysis of the relationship between different variables. But many of the kinds of data needed for econometric analyses of salmon markets simply do not exist. For example, no data are available for the volume of

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4 Recall that the estimates presented earlier in this report were derived by subtracting reported U.S. exports from the sum of reported domestic production and imports, and can only be considered approximations of actual supply.
wild salmon entering the U.S. fresh and frozen market.\textsuperscript{4} Similarly, no consistent data series are available for U.S. retail prices for wild salmon of different species and product forms. This makes it very difficult to estimate empirically the effects of wild salmon supply on wild salmon retail prices in the U.S. market.

Second, salmon markets have been changing rapidly. The mix of fresh and frozen products available today varies from those of a decade ago. Distribution channels and market structure have changed, as have costs of transportation and distribution. The kinds of stores and restaurants where salmon is sold have changed. As total supply has expanded, new kinds of consumers are eating salmon. What consumers know about wild and farmed salmon has changed. Because of these and other changes, farmed salmon does not necessarily affect wild salmon markets in the same way today as it did a decade ago. With these continuing changes, historical data may not provide reliable information about current salmon market relationships.

Some changes that may have affected salmon markets have occurred only recently—such as extensive publicity about health and environmental issues associated with farmed and wild salmon. Not enough time has passed to measure how long-lasting the effects of this publicity may be and whether any permanent changes in market relationships may have occurred.

Third, many of the factors affecting salmon markets have been changing over time in a similar way—continually increasing or decreasing from year to year rather than varying from year to year in different ways. For example, farmed salmon supply has been increasing during the same period of time that retail and food service industries have been becoming more concentrated. Theoretically, we would expect both of these changes to put downward pressure on salmon prices. But because they have both been changing in similar ways over time, it is difficult to distinguish statistically between the relative effects each is having on prices.

For all of these reasons, econometric modeling of salmon markets is difficult. Although various economists have attempted econometric analyses of certain salmon markets, there has been insufficient research to quantify how much of the changes in wild salmon prices in recent years can be attributed specifically to farmed salmon.

**Comparison of Price Trends for Farmed and Wild Salmon**

One way to gain insights into the effects of farmed salmon on wild salmon markets is by comparing price trends for farmed and wild salmon. As discussed above, the relative prices commanded by farmed and wild salmon provide an indicator of how buyers perceive the relative quality of farmed and wild salmon, while the extent to which farmed and wild prices tend to move together provides an indicator of the extent to which they are perceived as substitutes and how directly they compete with each other in different markets.\textsuperscript{5} In this section we briefly compare wholesale prices of farmed salmon with wholesale prices of wild chum and chinook salmon in the U.S. market, and with wholesale prices of wild sockeye salmon in the Japanese market.

Wild chum salmon is generally considered a relatively lower quality fish than chinook, coho and sockeye salmon, and generally commands lower ex-vessel, wholesale and retail prices than these other wild species. Most chum salmon is sold in retail stores as whole, fillet, steak and value-added products, rather than in restaurants.

Since the 1990s, wild chum salmon has accounted for between one-third and one-half of the fresh and frozen wild salmon sold in the U.S. market (Figure XIII-4). As U.S. farmed salmon consumption has grown, the share of wild chum salmon in U.S. fresh and frozen salmon consumption has declined over time. During the period 2000-2004, wild chum salmon accounted for only about nine percent of U.S. fresh and frozen consumption, and Americans consumed about nine times as much farmed salmon as wild chum salmon.

Figure XIII-5 compares trends in wholesale prices for farmed Atlantic and wild chum salmon in the U.S. market.\textsuperscript{6} Over the entire period from 1991 to 2006, fresh and frozen chum salmon sold at significantly lower wholesale prices than fresh farmed whole Atlantic salmon and Atlantic salmon fillets. Clearly, U.S. wholesale buyers view fresh and frozen wild chum salmon as a lower quality product than fresh farmed Atlantic salmon.

Farmed Atlantic and wild chum prices exhibit similar long-run (multi-year) trends over time—suggesting that they are substitutes to some extent and compete in some market segments. Prices for both Atlantic and chum salmon trended downward between 1991 and 1996 and upwards between 1996 and 1999.

In general, it appears that U.S. farmed salmon wholesale prices limit the prices buyers are willing to pay for wild chum salmon. However, other factors, such as the supply of chum salmon, also affect chum prices and the extent to which buyers “discount” chum salmon prices compared with farmed Atlantic salmon.

In contrast to chum salmon, chinook salmon—particularly troll-caught chinook—are considered a

\textsuperscript{5} Other factors besides substitutability can contribute to similar price movements over time. For example, imposing the same tax on two products may make their prices change in the same way, even if they are not substitutes. However, if prices move closely together over time, both up and down, this strongly suggests that they are substitutes.

\textsuperscript{6} This figure was presented earlier in Chapter VI.
Figure XIII-4  Estimated United States Fresh and Frozen Salmon Consumption: Wild Chum, Wild Chinook, Other Wild, and Farmed

Source: Estimated using the United States Salmon Market Database described in Appendix C.

Figure XIII-5  U.S. Wholesale Prices for Selected Salmon Products: Farmed Atlantic and Wild Chum

Source: Urner Barry Wholesale Price Data reported in Urner Barry Publications, Inc., Seafood Price Current. Prices are low list prices for the first issue of the month for Chilean 2-3 lb fillets, premium scale-on, pinbone-out, FOB Miami Chilean C-trim Atlantic fresh fillets; 6-8 lb whole Atlantic, FOB Northeast; 4-6 lb gillnet head-off fresh chum, FOB Seattle; 6-9 lb H&G semi-brite frozen chum, FOB Seattle.
very high quality wild salmon, and a large share are sold to restaurants. However, chinook salmon represent only a small share of U.S. salmon supply. During the period 2000-2004, wild chinook salmon accounted for only about three percent of U.S. fresh and frozen consumption, and Americans consumed more than twenty times as much farmed salmon as wild chinook salmon.

Figure XIII-6 compares wholesale prices of farmed Atlantic and wild troll-caught chinook salmon. During the 1990s wild chinook salmon commanded similar prices to fresh whole Atlantic salmon, and exhibited similar long-term and short-term changes in prices—suggesting that U.S. wholesale buyers considered them relatively close substitutes and that they competed in similar markets.

However, since 2003, prices of wild troll-caught chinook have risen steeply to more than double the prices paid for fresh whole Atlantic salmon. This suggests that several factors which have occurred since 2003, including wild salmon marketing efforts, negative publicity about farmed salmon, and growth in total market demand all may have played a role in allowing wild troll caught salmon to command this price premium.

As discussed in Chapter VI, frozen sockeye salmon competes in the Japanese market with other frozen “red-fleshed” salmon, particularly farmed Chilean coho and farmed Chilean and Norwegian salmon trout. During the 1990s, as farmed imports grew rapidly and sockeye production declined, the sockeye share of the Japanese red-fleshed salmon market declined dramatically. Increasingly, sockeye salmon is being sold to specialized regional and product markets which specifically prefer sockeye salmon, rather than competing directly with farmed coho and trout in high-volume retail markets.

As shown in Figure XIII-7, Japanese wholesale prices of frozen wild Bristol Bay sockeye salmon and frozen farmed Chilean coho salmon tended to move together relatively closely prior to 1998. Since 1998, however, prices of farmed coho have several times fallen significantly below prices of wild sockeye during periods of low sockeye production or high coho production.

In general, prior to the introduction of farmed salmon, wild salmon was sold in a limited number of traditional markets—defined as a particular product sold to a particular kind of consumer in a particular kind of store or restaurant in a particular region. As farmed salmon was introduced, it competed initially

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7 The scales are different for Figures VIII-4 and VIII-5, because troll-caught fresh chinook salmon commands much higher prices than gillnet-caught fresh and frozen chum salmon.
with wild salmon in some traditional markets—depressing wild salmon prices in those markets—and also developed new markets.

As farmed salmon supply has continued to expand, the total market has continued to grow and diversify. Salmon is now being sold in more product forms, to more kinds of consumers, in more kinds of stores and restaurants and in more regions in more countries. The limited supply of wild salmon, representing a smaller share of the market, is being sold increasingly in particular market segments where it can compete most effectively with farmed salmon. Some of these are higher-end niche markets, such as the high-quality restaurants and fish stores where most troll-caught fresh chinook salmon are sold, and command high prices from buyers willing to pay a premium for high-quality wild salmon. Others are lower-end markets, such as supermarket fish counters where fresh and frozen chum salmon provide an economical salmon choice. As premium (highly differentiated) wild salmon competes less directly with farmed salmon, wholesale buyers of wild salmon for niche markets are less directly influenced by the wholesale prices being paid for farmed salmon.

Relative Magnitude of Effects of Farmed Salmon on Different Markets

The relative growth in farmed, wild and total salmon supply has differed widely between different major world markets. As shown in Table XIII-2, comparing average annual supply for the periods 1990-94 and 2000-04, total supply to the U.S. fresh and frozen market increased by 170 percent. In contrast, total supply to the Japanese fresh and frozen market increased by only 11 percent.8

The relative contribution of farmed salmon and trout to total supply also varies widely between markets. During the period 2000-04, farmed salmon and trout accounted for 96 percent of estimated consumption for the EU fresh and frozen market, 80 percent of the U.S. fresh and frozen market and 49 percent of the Japanese fresh and frozen market.

Given the rapid growth of farmed salmon supply to the U.S., European Union and Japanese fresh and frozen markets, and the high share of farmed salmon in total supply to each of these markets by the end of this period, it seems reasonable to expect that growth in farmed salmon supply would have had a negative effect on wild salmon prices in all three of these markets.

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8 Note also that the 184 percent increase in farmed salmon and trout supply to the canned market is deceptive since the absolute numbers are very small.
In contrast, given the very small contribution of farmed salmon to world canned salmon supply, farmed salmon probably had very small direct effects on canned salmon prices prior to 2000-04. Nevertheless, canned markets may have been indirectly affected by farmed salmon. By depressing markets for fresh and frozen salmon, farmed salmon may have caused wild salmon producers to can a relatively larger share of wild catches, leading to greater supply of canned salmon and lower canned salmon prices than would otherwise have occurred.9

Changes in Salmon Market Dynamics

As discussed earlier, as wild salmon becomes a smaller share of world salmon supply, we would expect to see a less direct inverse relationship between wild salmon supply and wild salmon prices. For example, in the 1980s and early 1990s, when wild Alaska sockeye harvests dominated total supply of “red-fleshed” salmon to the Japanese market, prices paid to Alaska sockeye fishermen tended to be lower when catches were high, and higher when catches were low (Figure XIII-8).10 After the late 1990s, when sockeye was a much smaller share of Japanese supply, the inverse relationship between catches and prices was weaker. However, there continued to be an inverse relationship between the total Japanese supply of “red-fleshed” frozen salmon and average annual Japanese wholesale prices for wild sockeye salmon (Figure XIII-9).11 As total imports increased during the 1990s, sockeye prices fell; as total imports leveled off after 2000-01, sockeye prices stabilized.

The fall in sockeye prices during the 1990s, which seems inconsistent with the decline in sockeye catches and Japanese wild sockeye imports, is consistent with the dramatic increase in total Japanese supply which occurred during the same time period. It is what we would expect if sockeye prices were being driven not only by sockeye supply but also by total supply—both farmed and wild.

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9 In 2003 Chile began to produce significant volumes of canned salmon. Thus, farmed production may be gaining importance as a factor in canned salmon markets.

10 Note that we would not expect to see a perfect inverse relationship. Numerous factors other than catches also influence prices, such as inventories and exchange rates.

11 “Red-fleshed” frozen salmon imports include frozen sockeye, coho and trout. In Figure XIII-9, both average prices and annual imports are measured for the “salmon year” of May-April.
Figure XIII-8  Alaska Sockeye Salmon Catch and Real Ex-Vessel Price, 1982-2005

After the late 1990s, when sockeye was a much smaller share of Japanese supply, there was no apparent inverse relationship between catches and prices.

In the 1980s and early 1990s, when wild sockeye dominated Japanese salmon supply, there was a clearer inverse relationship between sockeye catches and prices.


Figure XIII-9  Japanese “Red-Fleshed” Frozen Salmon Imports & Wild Sockeye Wholesale Price

Source: All data are reported on a "salmon-year" basis (May-April). Wild sockeye imports and farmed salmon imports were calculated from monthly BANR Japanese Salmon Import Data. Total imports for years prior to 1992-93 (when sockeye salmon import data were not reported) were calculated from Japan Tariff Association Salmon Trade Data. Sockeye wholesale price is annual (May-April) unweighted average of monthly sockeye prices from the following sources: 6/91-1/97: data reported in Bill Atkinson's News Report; beginning 2/97: FIS Japan Frozen Wholesale Prices Data, low end of price range for 4-6 lb sockeye.
Effects of Catch Volume on Wild Salmon Catch Value

What matters to wild salmon fishermen is not just the price they receive, but also the volume of fish they catch, both of which together affect the value of what they catch.

The economic difficulties of the wild salmon industry are commonly blamed on lower prices, and by implication on farmed salmon. For all species, lower prices have been the most important cause of the loss in value. However, this is not the whole story. To varying degrees for each species, changes in catches—which were not caused by farmed salmon—have magnified or reduced the effects of changes in prices on the value of wild salmon catches.

The top half of Table XIII-3 shows average price, catch and value for each Alaska salmon species for the period 1986-90 and for the years 2002 and 2005. The bottom half of the table shows percentage changes in price, catch and value between these three periods.

Between 1986-90 and 2002, prices declined sharply for all species. For chinook and sockeye salmon, catches also declined (by 22 percent and 42 percent, respectively)—magnifying the decline in value. In contrast, for coho, pink and chum salmon, catches increased—offsetting the decline in value to varying extents.

Between 2002 and 2005, prices increased for all species except pink salmon. For chinook, sockeye and pink salmon, catches also increased—magnifying the rebound in value for chinook and sockeye salmon. For pink salmon, the percentage increase in catches exceeded the percentage decrease in price, causing the catch value to rise. In contrast, catches declined for coho and chum salmon. For chum salmon, the percentage decrease in catch exceeded the percentage increase in price, causing the catch value to fall.

| Table XIII-3 Percentage Changes in Price, Catch and Value of Alaska Wild Salmon: 1986-90 to 2002 and 2002 to 2005 |
|--------------------------------------------------|--|---|---|---|---|---|---|---|---|
| 1986-90 avg. | Chinook | Sockeye | Coho | Pink | Chum | Total |
| Price (2005 $/lb) | $3.09 | $2.50 | $1.75 | $0.69 | $0.79 |
| Catch (millions of lbs) | 12 | 235 | 36 | 240 | 85 |
| Value (millions of 2005 $) | $362.20 | $566.83 | $62.11 | $156.60 | $71.84 |
| 2002 | | | | | |
| Price (2005 $/lb) | $1.49 | $0.65 | $0.39 | $0.11 | $0.22 |
| Catch (millions of lbs) | 9 | 135 | 39 | 301 | 139 |
| Value (millions of 2005 $) | $13.71 | $88.27 | $15.30 | $31.89 | $30.42 |
| 2005 | | | | | |
| Price (2005 $/lb) | $2.05 | $0.71 | $0.69 | $0.10 | $0.24 |
| Catch (millions of lbs) | 10 | 264 | 32 | 543 | 95 |
| Value (millions of 2005 $) | $21.28 | $188.50 | $21.86 | $52.80 | $23.15 |
| Change, 1986-90 avg. to 2002 | -52% | -74% | -77% | -85% | -72% |
| % change in price | -22% | -42% | 8% | 25% | 64% |
| % change in catch | -62% | -84% | -75% | -80% | -58% |
| % change in value | 37% | 9% | 76% | -8% | 12% |
| Change, 2002 to 2005 | 33% | 95% | -19% | 81% | 32% |
| % change in price | 55% | 114% | 43% | 66% | 24% |
| % change in volume | -34% | -71% | -60% | -86% | -69% |
| % change in value | -11% | 12% | -13% | 127% | 12% |
| Change, 1986-90 avg. to 2005 | -34% | -71% | -60% | -86% | -69% |
| % change in price | -41% | -67% | -65% | -66% | -68% |
| % change in volume | -11% | 12% | -13% | 127% | 12% |
| % change in value | 55% | 114% | 43% | 66% | 24% |

CHAPTER XIV

Economic and Social Effects of Changes in Wild Salmon Markets

Key Points

- Commercial salmon fishing, tendering and processing contribute to the economic livelihoods of tens of thousands of people and dozens of coastal communities from California to Alaska. Just as importantly, salmon fishing is a way of life, defined in part by independence, tradition and the beauty and wildness of the environment in which people work and live.

- The decline in value of wild salmon catches and production has had wide-ranging economic and social effects on wild salmon fishermen and fishing communities. Among the most important effects are:
  - A dramatic decline in permit and boat values, with a corresponding loss in the value of fishermen’s assets
  - Inability of fishermen to meet loan payments, resulting in losses of permits and boats
  - Decline in fisheries participation, with many limited entry permits not being fished
  - “Multiplier” economic effects on fishing communities as fishermen, processors, hatcheries and local governments earn and spend less money
  - Economic and political pressure to “restructure” salmon fisheries to make them more efficient, through permit buybacks and other changes, resulting in loss of employment and other economic and social changes

Introduction

Commercial salmon fishing, tendering and processing contribute to the economic livelihoods of tens of thousands of people and dozens of coastal communities from California to Alaska. Just as importantly, salmon fishing is a way of life, defined in part by independence, tradition, access to a public resource and the beauty and wildness of the environment in which people work and live.

The commercial salmon industry, and the way of life of commercial salmon fishermen and their communities, has been in a period of rapid and continuous change for several decades. During the 1980s, high prices led to good times throughout much of the industry—in particular in Alaska. Economic prosperity was reflected in speculatively high limited entry permit values, new boat purchases and a general sense of optimism.

As was discussed in Chapter III, during the 1990s, almost all North American wild salmon fisheries suffered a dramatic decline in the value of catches and production. As was discussed in Chapter XIII, there were many causes of this decline in value, and the causes varied from fishery to fishery. Most—but not all—of the decline in value resulted from lower prices, although lower salmon returns played an important role in some areas and for some species. Much—but not all—of the decline in prices was caused by competition from farmed salmon, although many other factors also played a role.

Between 2002 and 2005, there was a substantial rebound in the value of catches and production for some Alaska salmon fisheries—caused partly by higher prices for some species, and partly by higher sockeye catches. However the 2005 value remained far below the real value of salmon catches during the 1980s and 1990s.

The decline in value of wild salmon catches and production has had wide-ranging economic and social effects on wild salmon fishermen and fishing communities. The effects vary widely between fisheries. To varying extents, they include:

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1 It should also be noted that the farmed salmon industry in British Columbia, New Brunswick and Maine has had positive economic and social impacts on coastal communities outside major urban centers. In British Columbia, over 90% of farmed salmon jobs at the farm site and in processing plants occur outside the major urban centers of Vancouver and Victoria. We thank Gordon Gislason for this information.
• A dramatic decline in permit and boat values, with a corresponding loss in the value of fishermen’s assets
• Inability of fishermen to meet loan payments, resulting in losses of permits and boats
• Closure of processing plants and loss of markets for fishermen
• Decline in fisheries participation, with many limited entry permits not being fished
• Increased difficulty in finding experienced crew willing to work for the same share of a smaller catch value.
• Loss of local tax revenues due to lower fisheries business taxes
• Declining funding for hatcheries due to smaller revenues from aquaculture assessments
• “Multiplier” economic effects on fishing communities as fishermen, processors, hatcheries and local governments earn and spend less money
• Declining interest on the part of children in fishing as an occupation
• Migration of young people and fishing families out of fishing communities in search of other work
• Economic and political pressure to “restructure” salmon fisheries to make them more efficient, through permit buybacks and other changes, resulting in loss of employment and other economic and social changes
• Political reallocation of fishery resources from commercial to sport fisheries as the perceived relative values of commercial and sport values shift
• Pressure to embrace other economic opportunities (tourism, mining, etc.), leading to further changes in the character of communities
• Social stress, reflected in problems such as alcohol abuse and family violence

As noted frequently throughout this report, wild salmon fisheries are very diverse. They differ greatly in the kinds of fishermen who participate, the economic investments required of participants, and the economic dependence of participants and their communities on the fisheries. They also differ in the kinds of economic changes which have occurred in recent years, the causes of those changes, and their broader economic and social effects.

Similarly, wild salmon fishermen are very diverse. Within the same fishery, salmon fishing may be the sole source of income for some participants, while for others it is only incidental income. For some fishermen, salmon fishing has been a family tradition for generations, while others come from other traditions. Some salmon fishermen are highly educated; some are illiterate. Some have worked in the salmon fishery for decades; some are teenagers. Some have many alternative options for employment and income; some have none.

Put simply, the economic and social effects of changes in wild salmon markets vary widely between fisheries and between fishermen. Our goal in this chapter is to illustrate the kinds of economic and social effects that some fisheries, fishermen and communities are experiencing as salmon markets change. But the effects that we describe do not necessarily apply to all fisheries, all fishermen, or all communities. In some fisheries and communities, improving market conditions are reversing some of the negative economic and social effects observed while prices and value were declining.

Throughout the chapter, we use quotes from fishermen and other industry participants and observers as examples of how people experiencing social and economic effects describe these changes. Keep in mind that these quotes reflect the experiences and opinions of particular individuals in particular circumstances. Other individuals—even in the same fishery—may have had very different experiences and may hold very different opinions.

Other Factors Contributing to Economic and Social Change

Changes in Salmon Allocations

As we discussed in Chapter XIII, the effects of changes in markets have been aggravated by a significant decline in salmon catches in some fisheries. Not all changes in catches are due to lower salmon returns. Some result from changes in allocations, or the share of wild salmon runs which participants in a fishery are allowed to catch.

There are numerous conflicts over the allocation of commercial salmon resources between different regions or within regions between gear groups. Examples include conflicts over allocation of migratory salmon stocks between Alaska, British Columbia and Pacific Northwest fishermen; conflicts over allocation of chum salmon between Alaska’s False Pass fishery and other western Alaska fisheries; conflicts over allocation between drift gillnet fishermen and set gillnet fishermen in Alaska’s Bristol Bay fishery; and conflicts over allocation between gillnet fishermen and seine fishermen in British Columbia.

In some areas, commercial salmon fishermen face allocation conflicts with sport fisheries. Examples include conflicts over allocation of chinook and coho

2 Quotes cited as “ISER 2003” are from interviews with permit holders in Alaska’s Cook Inlet salmon fishery conducted in 2003 by researchers based at the University of Alaska Anchorage Institute of Social and Economic Research. Keep in mind that this fishery has not only experienced lower prices but also allocation conflicts with sport fisheries, which many commercial fishermen believe has resulted in unfair reductions in commercial fishing opportunities.
salmon in southeast Alaska, British Columbia and the Pacific Northwest; and conflicts over allocation of sockeye and chinook salmon in Alaska’s Cook Inlet.

For the commercial fishermen affected by these allocation conflicts, the economic stakes are high. They invest significant resources, time and emotion in the political process attempting to influence allocation decisions. They may perceive “unfair” allocation decisions as having major economic and social impacts, and they may be as concerned about allocation as about prices, as is reflected in these comments of fishermen affected by allocation disputes:

“What we’re talking about with this proposal is letting [Area M fishermen] get more economic benefit, is letting them make more money down here so the people in Western Alaska starve.”

“In terms of a fleet that’s looking for stability now and in the future, it’s a tremendous blow. It seems that we have done nothing but gone backwards ever since this treaty was signed and even before.”

“Politics, that is our biggest problem. When I started fishing there was so much more time for fishing. In the past five years, I figure I’ve lost between 10-35% of my catch due to the Board of Fish.”

Changes in Other Fisheries

Salmon are not the only species—or necessarily the most important species—for many fishermen and fishing communities. There are dozens of other valuable fisheries in Alaska, British Columbia and the U.S. Pacific Northwest, such as halibut, sablefish, herring, cod, Dungeness crab, Tanner crab, King crab, shrimp, rockfish and pollock—to name just a few. For all of these fisheries, there are different resource issues, market issues, and political issues. For many fishermen, processors and fishing communities, the economic and social effects associated with changes in other fisheries are as important as or more important than those associated with salmon.

For example, Pacific herring prices have declined sharply in recent years due to declining Japanese demand for salted herring roe. Mainly because of lower prices, the average value of Alaska herring catches fell from $54 million in 1986-90 to $10 million in 2000-02. Most of this loss in value may be considered a loss to salmon fishermen—because most herring fishermen also fish for salmon.

As another example, the introduction of Individual Fishing Quota (IFQ) management in the Alaska and British Columbia halibut and sablefish fisheries had important economic and social effects on many fishermen and communities. Since about two-thirds of the boats which fished for halibut in Alaska in the early 1990s also fished for salmon, these changes—both positive and negative—were experienced by large numbers of salmon fishermen. Survey responses show that some fishermen felt that IFQ management of halibut hurt them by cutting into their opportunity to supplement income from salmon fishing with income from halibut fishing:

“It took away 1/3 of my total income. Now I have to rely on salmon to pay for my livelihood and salmon just doesn’t do it alone.”

“No available alternative fishery to harvest in light of a bad salmon season.”

“Our quota was so small it’s not worth fishing for now so we don’t halibut fish at all, when before we could go out for a small catch when we needed some extra money.”

The important point to recognize is that the commercial fishing industry is not just about salmon. It is far more complex. There are many other fisheries facing many other kinds of changes, which affect salmon fishermen and fishing communities in many important ways.

The Exxon Valdez Oil Spill

The Exxon Valdez oil spill of March 24, 1989 had profound economic, social and emotional effects on fishing communities of Alaska’s Prince William Sound and areas to the west where the oil drifted in the weeks after the spill.

The spill came at a time when salmon prices were beginning to decline from the record prices reached in 1988. In the years that followed, prices and catch

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3 Alaska Board of Fisheries member Russell Nelson, quoted in Moore (2004).
5 ISER (2003).
6 National Marine Fisheries Service ex-vessel value data, converted to real 2002 dollars based on the Anchorage Consumer Price Index.
7 Under IFQ management, boats were limited to catching individual quotas, which were allocated based on the past catches. The introduction of IFQ management system was very controversial. Supporters argued that the new management system made the fishery safer, reduced costs, and increased value because of the opportunity to market fresh halibut over a nine-month period. Opponents argued that the distribution of quotas was unfair, that the new system divided fishing communities between those with and without quota, and hurt communities where halibut landings declined. (Knapp, 1997).
8 Berman and Leask (1994).
9 Halibut fishermen’s comments on effects of the IFQ program, from Knapp and Hull (1996). Note that other halibut fishermen likely felt that the economic gains from IFQ management of the halibut fishery helped offset the effects of a declining salmon fishery.
values fell, and many Prince William Sound salmon fishermen lost their permits and boats. Many fishermen blamed the fall in prices on the spill. This is unlikely, given that prices fell throughout Alaska, British Columbia and the U.S. Pacific Northwest. However, it is certain that the oil spill exacerbated the stresses experienced by Prince William Sound fishermen and communities in recent years.

**Overview of Economic Changes in Alaska Salmon Fisheries**

The Alaska Commercial Fisheries Entry Commission (CFEC) publishes “Basic Information Tables” for Alaska salmon fisheries. These data provide a useful starting point for reviewing economic changes in Alaska salmon fisheries in recent years.

Table XIV-1 provides summary data for twenty-one salmon fisheries for the period 1986-90, arranged in order of value of total earnings. For most fisheries, this was the period when earnings were at their highest. Tables XIV-2, 3 and 4 show changes in these fisheries between the 1986-90 period and 2002 (when earnings were at their lowest in many fisheries) and between 2002 and 2005 (as earnings recovered to some extent).

As was discussed earlier in Chapter III, there are significant differences between fisheries in gear type, earnings, catch volume, number of permits and permit prices. There are also significant differences between fisheries in the extent to which earnings declined.

<table>
<thead>
<tr>
<th>Area</th>
<th>Gear</th>
<th>Total earnings (millions of dollars)</th>
<th>Total catch volume (millions of pounds)</th>
<th>Total permits issued</th>
<th>Share of permits fished</th>
<th>Alaska resident share of permits</th>
<th>Average earnings per permit fished (millions of dollars)</th>
<th>Average permit price (dollars)</th>
<th>Permit wealth (millions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bristol Bay</td>
<td>Drift Gillnet</td>
<td>154.5</td>
<td>119.8</td>
<td>1,854</td>
<td>99%</td>
<td>56%</td>
<td>$83,738</td>
<td>$178,597</td>
<td>315.0</td>
</tr>
<tr>
<td>Southeast</td>
<td>Purse Seine</td>
<td>53.2</td>
<td>112.9</td>
<td>420</td>
<td>89%</td>
<td>44%</td>
<td>$143,186</td>
<td>$66,511</td>
<td>27.7</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Drift Gillnet</td>
<td>39.7</td>
<td>25.4</td>
<td>586</td>
<td>80%</td>
<td>71%</td>
<td>$68,557</td>
<td>$133,907</td>
<td>75.1</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Set Gillnet</td>
<td>37.2</td>
<td>23.4</td>
<td>743</td>
<td>88%</td>
<td>88%</td>
<td>$56,909</td>
<td>$49,764</td>
<td>37.0</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Purse Seine</td>
<td>34.4</td>
<td>39.1</td>
<td>387</td>
<td>65%</td>
<td>76%</td>
<td>$110,467</td>
<td>$87,001</td>
<td>33.2</td>
</tr>
<tr>
<td>Prince William Sd.</td>
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<td>29.4</td>
<td>67.2</td>
<td>270</td>
<td>94%</td>
<td>72%</td>
<td>$115,090</td>
<td>$169,596</td>
<td>44.6</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Drift Gillnet</td>
<td>25.3</td>
<td>18.2</td>
<td>542</td>
<td>95%</td>
<td>73%</td>
<td>$49,081</td>
<td>$100,153</td>
<td>53.7</td>
</tr>
<tr>
<td>Bristol Bay</td>
<td>Set Gillnet</td>
<td>25.2</td>
<td>19.6</td>
<td>988</td>
<td>94%</td>
<td>76%</td>
<td>$27,065</td>
<td>$48,224</td>
<td>47.1</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Purse Seine</td>
<td>23.6</td>
<td>33.0</td>
<td>125</td>
<td>94%</td>
<td>81%</td>
<td>$201,602</td>
<td>$207,383</td>
<td>24.7</td>
</tr>
<tr>
<td>Statewide</td>
<td>Power Troll</td>
<td>23.6</td>
<td>14.2</td>
<td>956</td>
<td>87%</td>
<td>79%</td>
<td>$28,424</td>
<td>$29,498</td>
<td>27.8</td>
</tr>
<tr>
<td>Chignik</td>
<td>Purse Seine</td>
<td>22.1</td>
<td>16.3</td>
<td>101</td>
<td>100%</td>
<td>85%</td>
<td>$219,366</td>
<td>$366,000</td>
<td>32.9</td>
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<tr>
<td>Alaska Peninsula</td>
<td>Drift Gillnet</td>
<td>21.0</td>
<td>15.3</td>
<td>164</td>
<td>99%</td>
<td>58%</td>
<td>$129,215</td>
<td>$269,478</td>
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</tr>
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<td>Southeast</td>
<td>Drift Gillnet</td>
<td>20.6</td>
<td>21.0</td>
<td>486</td>
<td>96%</td>
<td>69%</td>
<td>$44,277</td>
<td>$82,654</td>
<td>38.7</td>
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<tr>
<td>Kodiak</td>
<td>Set Gillnet</td>
<td>13.1</td>
<td>11.2</td>
<td>188</td>
<td>85%</td>
<td>78%</td>
<td>$89,121</td>
<td>$79,284</td>
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</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Set Gillnet</td>
<td>7.9</td>
<td>6.3</td>
<td>114</td>
<td>94%</td>
<td>83%</td>
<td>$73,821</td>
<td>$80,957</td>
<td>9.1</td>
</tr>
<tr>
<td>Lower Yukon</td>
<td>Gillnet</td>
<td>7.7</td>
<td>7.6</td>
<td>707</td>
<td>95%</td>
<td>99%</td>
<td>$11,441</td>
<td>$23,514</td>
<td>16.5</td>
</tr>
<tr>
<td>Kuskokwim</td>
<td>Set Gillnet</td>
<td>7.4</td>
<td>11.1</td>
<td>832</td>
<td>97%</td>
<td>100%</td>
<td>$9,096</td>
<td>$10,843</td>
<td>9.0</td>
</tr>
<tr>
<td>Yakutat</td>
<td>Set Gillnet</td>
<td>4.8</td>
<td>3.3</td>
<td>165</td>
<td>95%</td>
<td>84%</td>
<td>$30,607</td>
<td>$31,289</td>
<td>5.1</td>
</tr>
<tr>
<td>Statewide</td>
<td>Hand Troll</td>
<td>4.0</td>
<td>2.6</td>
<td>1,878</td>
<td>40%</td>
<td>91%</td>
<td>$5,315</td>
<td>$6,505</td>
<td>12.1</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Purse Seine</td>
<td>3.4</td>
<td>4.6</td>
<td>83</td>
<td>81%</td>
<td>99%</td>
<td>$50,383</td>
<td>$92,642</td>
<td>7.6</td>
</tr>
<tr>
<td>Kotzebue</td>
<td>Gillnet</td>
<td>1.1</td>
<td>2.0</td>
<td>220</td>
<td>77%</td>
<td>97%</td>
<td>$6,128</td>
<td>$8,878</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Total, All Fisheries | 559.3 | 592.5 | 11,810 | 83% | 78% | 869.8

Notes: Excludes fisheries with average earnings of less than $1 million for 1986-90. Permit wealth estimated as the number of permanent permits issued (not including interim permits) multiplied by average permit price. Average permit prices and permit wealth estimates exclude 1986 for Chignik Purse Seine fishery because no permit price estimate was available. Source: CFEC Basic Information Tables.

10 Table III-3 provided similar data for 2001.

Table XIV-2 shows changes in average annual total earnings and average annual earnings per permit fished between 1986-90 and 2002 and between 2002 and 2005. Between 1986-90 and 2002, total earnings for all fisheries combined fell by $417 million, or 74%. However, the relative decline varied between fisheries. In ten fisheries, total earnings fell by more than 80%. In a few fisheries, earnings declined much less dramatically. For example, total earnings in the Prince William Sound drift gillnet fishery fell by only 17%.

Between 2002 and 2005, total earnings for all fisheries combined increased by $146 million. Thus between 2002 and 2005, total earnings for all fisheries recovered about one-third of the decline in value of the earlier period.

As discussed below, as earnings declined, some permit holders stopped fishing, so that the number of permits fished declined. As a result, the percentage decline in earnings per permit fished was not as great as the percentage decline in total earnings. Those permit holders who continued to fish experienced less of a decline in earnings than if all permit holders had continued to fish. In some fisheries, such as the Prince William Sound Purse Seine fishery, so many permit holders stopped fishing that those who remained had higher average earnings in 2005 than they had had in the 1986-90 period.

To appreciate the implications of the decline in earnings shown in Table XIV-2, it is important to remember that the data show total earnings rather than net earnings. After taking costs into account, the drop in net earnings—the income fishermen actually take home

Table XIV-2

<table>
<thead>
<tr>
<th>Area</th>
<th>Gear</th>
<th>Change in total earnings</th>
<th>Change in average earnings per permit fished</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bristol Bay</td>
<td>Drift Gillnet</td>
<td>-129.0</td>
<td>51.8</td>
</tr>
<tr>
<td>Southeast</td>
<td>Purse Seine</td>
<td>-33.0</td>
<td>9.5</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Drift Gillnet</td>
<td>-34.0</td>
<td>9.7</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Set Gillnet</td>
<td>-31.7</td>
<td>10.0</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Purse Seine</td>
<td>-23.7</td>
<td>6.5</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Purse Seine</td>
<td>-24.2</td>
<td>12.8</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Drift Gillnet</td>
<td>-4.3</td>
<td>2.3</td>
</tr>
<tr>
<td>Bristol Bay</td>
<td>Set Gillnet</td>
<td>-18.6</td>
<td>9.7</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Purse Seine</td>
<td>-21.2</td>
<td>4.4</td>
</tr>
<tr>
<td>Statewide</td>
<td>Power Troll</td>
<td>-11.1</td>
<td>9.4</td>
</tr>
<tr>
<td>Chignik</td>
<td>Purse Seine</td>
<td>-16.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Drift Gillnet</td>
<td>-16.9</td>
<td>6.8</td>
</tr>
<tr>
<td>Southeast</td>
<td>Drift Gillnet</td>
<td>-12.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Set Gillnet</td>
<td>-10.2</td>
<td>3.6</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Set Gillnet</td>
<td>-5.9</td>
<td>2.9</td>
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<tr>
<td>Lower Yukon</td>
<td>Gillnet</td>
<td>-5.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Kuskokwim</td>
<td>Set Gillnet</td>
<td>-7.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Yakutat</td>
<td>Set Gillnet</td>
<td>-4.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Statewide</td>
<td>Hand Troll</td>
<td>-3.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Purse Seine</td>
<td>-2.6</td>
<td>-0.1</td>
</tr>
<tr>
<td>Kotzebue</td>
<td>Gillnet</td>
<td>-1.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Note: Excludes fisheries with average earnings of less than $1 million for 1986-90. 2005 earnings data are preliminary and will probably increase slightly after post-season bonuses are included.
Source: CFEF Basic Information Tables.
after paying for costs of fishing—has been even greater. As a simple example, suppose a fisherman’s total earnings fall from $30,000 to $10,000. This is a decline of 66%. But if his costs are $10,000, so that his net income falls from $20,000 to zero, it is a drop of 100%.

This basic point—that what matters is income after costs—is reflected in this Bristol Bay fisherman’s sardonic comments about his 2001 fishing season:

“Aboard Bobby’s boat we were stunned and disgusted. At $.40/lb the bills ate up our meager earnings and then some. . . Next June I think I’ll charter a plane and fly over to Bristol. To save costs maybe I can entice some other Bay fishermen to share the charter. . . We’ll open the window and each of us in turn can throw his wallet into the murky water. Then we’ll fly home, with a head start on everyone else to make up our losses.”

Limited entry permits for Alaska salmon fisheries are transferable: they may be bought and sold. Permit prices vary widely between fisheries, reflecting differences in potential earnings and profits. As shown in Table XIV-3, as earnings in salmon fisheries fell between the 1986-90 period and 2002, permit prices also fell in every fishery. The percentage decline in permit prices varied between fisheries. In 14 of 21 fisheries, permit prices fell by more than 50%. In nine fisheries, permit prices fell by more than 75%.

The decline in permit prices resulted in a corresponding decline in permit wealth, or the “paper value” of all permits, calculated as average permit price multiplied by the number of permanent permits in the fishery. As shown in Table XIV-3, between the 1986-90

<table>
<thead>
<tr>
<th>Area</th>
<th>Gear</th>
<th>Change in average permit prices</th>
<th>Change in permit wealth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>millions of dollars as % of 1986-90 avg.</td>
<td>millions of dollars as % of 1986-90 avg.</td>
</tr>
<tr>
<td>Bristol Bay</td>
<td>Drift Gillnet</td>
<td>-158.9</td>
<td>31.5</td>
</tr>
<tr>
<td>Southeast</td>
<td>Purse Seine</td>
<td>-43.7</td>
<td>19.0</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Drift Gillnet</td>
<td>-122.2</td>
<td>27.6</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Set Gillnet</td>
<td>-41.8</td>
<td>2.0</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Purse Seine</td>
<td>-77.1</td>
<td>4.4</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Purse Seine</td>
<td>-149.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Drift Gillnet</td>
<td>-59.2</td>
<td>6.7</td>
</tr>
<tr>
<td>Bristol Bay</td>
<td>Set Gillnet</td>
<td>-36.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Purse Seine</td>
<td>-167.8</td>
<td>15.6</td>
</tr>
<tr>
<td>Statewide</td>
<td>Power Troll</td>
<td>-15.5</td>
<td>13.9</td>
</tr>
<tr>
<td>Chignik</td>
<td>Purse Seine</td>
<td>-179.4</td>
<td>27.0</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Drift Gillnet</td>
<td>-244.7</td>
<td>22.6</td>
</tr>
<tr>
<td>Southeast</td>
<td>Drift Gillnet</td>
<td>-54.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Set Gillnet</td>
<td>-22.5</td>
<td>19.0</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Set Gillnet</td>
<td>-18.4</td>
<td>12.1</td>
</tr>
<tr>
<td>Lower Yúkon</td>
<td>Gillnet</td>
<td>-10.8</td>
<td>4.3</td>
</tr>
<tr>
<td>Kuskokwim</td>
<td>Set Gillnet</td>
<td>-3.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Yakutat</td>
<td>Set Gillnet</td>
<td>-7.7</td>
<td>10.8</td>
</tr>
<tr>
<td>Statewide</td>
<td>Hand Troll</td>
<td>-2.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Purse Seine</td>
<td>-81.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Kotzebue</td>
<td>Gillnet</td>
<td>-6.9</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>-680.3</strong></td>
<td><strong>97.4</strong></td>
</tr>
</tbody>
</table>

Note: Excludes fisheries with average earnings of less than $1 million for 1986-90.

Source: CFEC Basic Information Tables.

period and 2002, total nominal permit wealth fell by $680 million. During the same period, average annual total earnings declined by $417 million (Table XIV-2). The decline in permit wealth was 163% of the decline in average annual total earnings.

The effect of the decline in permit wealth was a major financial loss to many Alaska salmon fishermen, over and above the loss in their earnings from salmon fishing. For example, between the 1986-90 period and 2002, the average annual earnings of a permit holder in the Bristol Bay drift net salmon fishery fell by $62,000. Over the same period, the value of the fisherman’s permit fell by $159,000—more than double the decline in annual earnings.

Between 2002 and 2005, as earnings increased in most fisheries, average permit prices and permit wealth also increased in most fisheries. However, the recovery in permit wealth during this period was less than 15% of the decline in permit wealth during the earlier period.

The decline in Alaska salmon permit holders’ wealth was not limited to the decline in value of their permits. As discussed below, as prices declined, large numbers of permit holders quit fishing. As a result, more boats—often constructed specially to meet fishing conditions and boat size regulations for particular fisheries—were offered for sale. This led to a fall in boat prices, aggravating the loss in the value of fishermen’s investments.

Many salmon fishermen borrowed money from the State of Alaska, commercial banks, or processors to finance their purchases of permits and boats. As permit and boat values have fallen, they found it increasingly difficult to make loan payments. For many, their debt exceeded the value of their permits and boats—making it impossible to sell out and pay off their debts.

<table>
<thead>
<tr>
<th>Table XIV-4</th>
<th>Changes in Alaska Salmon Fisheries, 1986-90, 2002, and 2005: Number of Permits Issued and Fished</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
<td><strong>Gear</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Bristol Bay</td>
<td>Drift Gillnet</td>
</tr>
<tr>
<td>Southeast</td>
<td>Purse Seine</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Drift Gillnet</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Set Gillnet</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Purse Seine</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Purse Seine</td>
</tr>
<tr>
<td>Prince William Sd.</td>
<td>Drift Gillnet</td>
</tr>
<tr>
<td>Bristol Bay</td>
<td>Set Gillnet</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Purse Seine</td>
</tr>
<tr>
<td>Statewide</td>
<td>Power Troll</td>
</tr>
<tr>
<td>Chignik</td>
<td>Purse Seine</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Drift Gillnet</td>
</tr>
<tr>
<td>Southeast</td>
<td>Drift Gillnet</td>
</tr>
<tr>
<td>Kodiak</td>
<td>Set Gillnet</td>
</tr>
<tr>
<td>Alaska Peninsula</td>
<td>Set Gillnet</td>
</tr>
<tr>
<td>Lower Yukon</td>
<td>Gillnet</td>
</tr>
<tr>
<td>Kuskokwim</td>
<td>Set Gillnet</td>
</tr>
<tr>
<td>Yakutat</td>
<td>Set Gillnet</td>
</tr>
<tr>
<td>Statewide</td>
<td>Hand Troll</td>
</tr>
<tr>
<td>Cook Inlet</td>
<td>Purse Seine</td>
</tr>
<tr>
<td>Kotzebue</td>
<td>Gillnet</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11810</strong></td>
</tr>
</tbody>
</table>

Note: Excludes fisheries with average earnings of less than $1 million for 1986-90. The low share of permits fished in the Chignik Purse Seine fishery in 2002 was due to the Chignik Salmon Cooperative. Source: CFEC Basic Information Tables.

12 The permit holder did not personally experience the full loss in earnings, as part of the decline was absorbed by crew members who are paid on a share basis.
As shown in Table XIV-4, between the 1986-90 period and 2002, the share of limited entry permits which were fished in all Alaska fisheries combined fell from 83% to 59%. The total number of limited entry salmon permits fished in Alaska fell by 3,275, or by 33%.

In some cases fishermen chose to quit fishing because they could no longer make money at it. In other cases, they quit fishing because processors stopped operating, or limited the number of fishermen they would buy from.

Between 2002 and 2005, as earnings increased, the number of permits fished in most fisheries increased. However, in several major fisheries, including the Southeast, Kodiak and Prince William Sound purse seine fisheries, the number and share of permits fished continued to decline.

Economic and Social Effects of Changes in Salmon Fisheries

Above, we have described basic economic changes in salmon fisheries which can be measured and for which there are data: changes in fishermen’s earnings, permit values and fisheries participation. These basic economic changes have numerous and far-reaching economic and social effects, which are difficult to quantify but no less real or important. In the remainder of this chapter, we review some of the most important of these effects.

For those fishermen who have stayed in the salmon fishery, the decline in earnings has often brought important changes in how they fish, their standard of living and their lifestyle. They cannot maintain their boats and their gear the way they used to. They cannot afford to live the way they used to. Many have had to take on additional work.

Some older fishermen view these changes philosophically as a return to the way salmon fisheries were before the boom years of the 1980s.

“There used to be no big money in fishing when I started. We had big years and it is back to the way it used to be. . . Everyone used to have other jobs. Anyone who fished in Cook Inlet had to have another job. There were only a few years where people made enough that they didn’t have to work the rest of the year. Those years were the exception.”13

Changes in salmon fishing affect families. Traditionally, many fishing boats or sites were family operations. Now many fishermen see their children turning to other, more promising opportunities.

“Fishing used to be more of a family operation. Then people started dropping out because they had to feed their families by working full time on other jobs. People started skipping fishing so they could support their families.”14

The decline in salmon fishing income affects fishermen’s pride and self esteem:

“People used to be proud to be a gill netter. People now ask you what you do, and you don’t want to tell them. They ask you why you are an idiot.”15

As permits change hands and the economics of the fishery change, the nature of salmon fishing is also changing. New entrants into the salmon fishery may have different motivations for fishing. In some cases, increasing economic pressures lead to more intense and less friendly fisheries. In other cases, the lower economic stakes lead to a more relaxed and laid-back attitude for those who continue to fish.

The decline in fishing income has numerous “multiplier” economic effects. As fishermen earn less, they hire fewer crew. They pay less for taxes. They spend less on boats, gear, nets, fuel and maintenance. They cut back on their household expenditures. All of these cutbacks ripple through the businesses that support the fishing industry and through local economies.

“...Fishing has been what I would call our ‘safety net economy’ in the smaller villages. With every boat which is dropped, it means six to eight people that are left without employment, not to mention the processing jobs.”16

“Fewer jobs, less raw fish tax for communities and a further drop in the value of Alaska’s salmon permits. Those are the grim prospects for Alaska following the December announcement that Wards Cove Packing will shut down their Alaska salmon operations and put their facilities up for sale. . . Wards Cove ranked as the eighth largest seafood processor in the state, employing about 509 Alaskans and more than 1,200 non-residents during 2001. . . Wages aren’t the only lost revenue. Impacts ripple through local and state economies in the form of reduced fuel and grocery sales, raw fish tax, sales tax, fuel tax, utility expenditures and so on.”17

Beyond these economic effects, changes in the salmon industry have far-reaching social effects on fishing communities.

13 ISER 2003.
14 ISER 2003.
15 ISER 2003.
16 Gordon Jackson, spokesman for the Southeast Inter-Tribal Fish and Wildlife Commission, quoted in Miller (2002).
17 Miller (2003).
“Closing Wards Cove [Kenai cannery] didn’t change the social scene between fishermen: it stopped it dead in its heels. There is hardly any socializing that goes on between fishermen anymore. I don’t like that. Everyone at Wards Cove hung out with each other and we were a close group. You can’t help but just see people less now than you used to when we were all on the grounds together.”

“The economy in this area is tipping away from fishing to tourism, which is depressing. And as a result, a lot of the character of the place is being lost. There are a lot more outsiders coming in seasonally, and they are the ones with the money. Less and less people are living here full time who care about the community.”

As the economic difficulties of the salmon industry intensify, pressure builds for “restructuring” how fisheries are managed, in order to make them more economically viable. These changes usually involve reducing the number of boats fishing in some way. One way to do this is through government-financed permit “buybacks.” Another way to do so is through fishermen’s cooperatives, in which only some permit holders fish, with those who agree not to fish receiving a share of the value of the catch.

Fisheries restructuring has economic and social impacts. As the number of boats fishing declines, so does fishing employment, as well as other fisheries expenditures and the economic activity they support. Opportunities for young people to get into fishing are reduced. The benefits of fishing flow to a smaller and sometimes different group of people, who may not live in the same communities. Those who continue to fish do not necessarily end up better off.

For these reasons and many others, fisheries restructuring is controversial. For any proposed medicine for the salmon industry, some consider the cure worse than the disease. Debate over whether or how to restructure fisheries can divide fishermen and communities. The resulting tensions may be considered yet another social impact of the market changes which were the impetus for restructuring.

A significant restructuring of British Columbia salmon fisheries, attributable in part to changing markets and farmed salmon, included the two permit buyback programs of the late 1990s. In 1996 Canada implemented the ‘Mifflin Plan’ to reduce the size of the commercial salmon fleet in British Columbia. The plan redefined limited entry salmon licenses with respect to fishing area and gear, and spent C$80 million to purchase and retire about 800 licenses. A second permit buyback took place in 1998 at a cost of C$200 million to retire a further 1,400 licenses. The two buyback programs costs C$240 million and halved the salmon fleet from about 4,400 licenses to 2,200 licenses. Job losses were a major concern in the debate over these buybacks, as well as the economic effects on smaller rural communities.

In Alaska’s Chignik salmon fishery, beginning in 2002, the Board of Fisheries in effect divided the fishery into two separate allocations, one reserved for those permit holders who chose to join a fisherman’s cooperative, and one for those who preferred to continue to fish independently. Of the 100 permit holders in the fishery, 77 chose to join the cooperative, which was allocated 69% of the catch. The cooperative “hired” about 20 of its members to catch its allocation, and shared the profits with the remaining fishermen who sat out the fishery—thus achieving significant cost savings, and also allowing for more careful handling of the fish because the cooperative boats worked together.

However, in early 2006 the Alaska Supreme Court ruled that the Chignik cooperative violated the provision of the Alaska Limited Entry Law which requires that permit holders fish their own permits—effectively ending the cooperative unless the legislature changes the law.

The four-year experiment with the Chignik salmon cooperative was very controversial. Many of the independent fishermen who chose not to join the cooperative felt that the equal sharing of profits by the cooperative was unfair to those fishermen who had historically had higher-than-average catches, and that their fishing opportunities were unfairly reduced in the “independent” fishery. The debate over the cooperative bitterly divided the community, as illustrated by the following comments of permit holders surveyed by the University of Alaska Anchorage:

I have only positive feelings for the changes in management and harvesting brought on by the co-op. I did miss fishing this past summer, but I realize that it was better for me and my community and family to sacrifice fishing to try to enact positive change in our fishery.

The co-op caused a lot of hard feelings in Chignik. The fishery turned family members against each other—friends against friends. . . This didn’t help the villages make more money; it didn’t help crew that had no jobs or cannery jobs. It made some over-extended fishermen a few dollars that isn’t going to help them from going broke anyway.

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18 ISE R 2003.
19 ISE R 2003.
20 Muse (1999).
21 Alaska Supreme Court (2006).
We’re poor spokesmen. We don’t talk a lot. We just work hard and don’t say a lot and all those decisions get made in favor of the people who do all the talking. I never believed in the welfare program. I came from a poor family, but we worked for what we got. This co-op is something of a welfare program for the people who have a permit but who haven’t fished.

Although Chignik is the only Alaska fishery that has seen significant restructuring to date, debate is occurring in fisheries across the state about proposals for change. Much of this debate is over which is the lesser evil: the economic and social pain of continuing with the current management system, or the economic and social pain associated with change.

“Take your fish and try to convince the folks in Japan or Europe or the housewives down in the Lower 48 to pay a buck more a pound to protect your lifestyle. It doesn’t play outside of Alaska.”

“Change is in the wind, and it’s no time to be wintered up in the cabin expecting tomorrow to be just like yesterday. After years of declining harvest values, individual bankruptcies, requests for relief by coastal communities and disaster declarations by the governor, the salmon industry has made a convincing case that it can’t go on like this. However unanimous we may be in our pain, though, it’s unlikely we’ll all survive the remedy. So if you’re a salmon fisherman, it’s time to find out what’s in the syringe.”

As we hope this chapter has illustrated, the economic and social effects of changes in the wild salmon industry are far-reaching. Although there are many common themes, each wild salmon fisherman has his or her own story. Many are eloquent in how they talk about fishing and the changes they have experienced.

“Before there was always hope. You may get a bad season but you knew next year would be better.”

“There are a lot of hard feelings in the salmon industry about what has happened to our livelihood.”

“I like the challenge of fishing. I’ll fish until I die.”

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References


Overview of Salmon Trade Policy Issues

Key Points

✓ There are virtually no tariff barriers on imports of salmon into the United States, based on the U.S. Harmonized Schedule of Tariffs (USITC 2004).

✓ The only other trade restrictions the United States has imposed on imports are countervailing and anti-dumping duties on imports of Norwegian and Chilean salmon.

✓ To date, these protective measures have had little effect on prices of salmon in the United States and have been very costly to pursue. However, it is expected that the salmon industry is likely to continue to explore these options for relief from import competition.

Introduction

Trade policy has not been a tool that has been extensively used to prevent the importation of farmed salmon into the U.S. market, with the exception of two legal actions brought against Chile and Norway, each by U.S. farmed salmon producers. The primary exporters to the United States (Canada, Chile, Scotland and Norway) are all signatories to the General Agreement on Tariffs and Trade (GATT), and members of the World Trade Organization (WTO) (WTO 2005). Canada is part of the North American Free Trade Agreement (NAFTA), and the United States has recently signed a free trade agreement with Chile (the United States-Chile Free Trade Agreement). There has been relative trade harmony amongst these nations with respect to salmon.

There are basically three constraints on importation of salmon into the United States, and those are tariffs, countervailing duties and anti-dumping duties. This chapter first presents the tariff structure on U.S. imports of salmon. Next we describe the countervailing duty and anti-dumping cases which were taken to the U.S. International Trade Commission (USITC) by U.S. farmed salmon producers against Norway in 1989, then against Chile in 1997. Lastly, we discuss the outcomes of those cases for U.S. salmon producers (both farmed and wild).

U.S. Harmonized Tariff Schedule

The U.S. International Trade Commission (Office of Tariff Affairs and Trade Agreements) is responsible for publishing the Harmonized Tariff Schedule for the United States (HTSA). The HTSA provides the applicable tariff rates and statistical categories for all merchandise imported into the United States; it is based on the international Harmonized System, the global classification system that is used to describe most world trade in goods (www.usitc.gov/tata/hts/index.htm).

Tables XV-1 and XV-2 provide a summary of the tariff position of the United States with respect to salmon and trout of all product forms (USITC 2004). These tables show the rates of duties (tariffs) for various salmon products; fresh and frozen in Table XV-1 and fillets and processed salmon in Table XV-2. From this it is easy to see that most salmon products come into the United States free of any duties. In fact, the only product that does not come in free, canned salmon in oil, has a tariff rate of 6 percent, except for Canada which is free and for Chile which is 4.5 percent in 2004. The U.S.-Chile Free Trade Agreement stipulates that even the Chilean tariff, reduced to 3 percent in 2005, will be reduced to 1.5 percent in 2006 and become zero in 2007 (USITC 2003).

In contrast to the other salmon products which carry no tariff, the United States does import some canned salmon in oil from Chile, although it is not a significant amount. In addition, amounts of imported Chilean canned salmon in water are greatly increasing and are not subject to any tariffs. Table XV-3 shows the import amounts and values beginning in 2002. Prior to 2002 there were negligible amounts imported.
## Table XV-1

**Harmonized Tariff Schedule for Fresh and Frozen Salmon**


<table>
<thead>
<tr>
<th>Heading/Subheading</th>
<th>Stat. Suffix</th>
<th>Article Description</th>
<th>Unit of Quantity</th>
<th>Rates of Duty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>General</td>
</tr>
<tr>
<td>0302</td>
<td></td>
<td>Fish, fresh or chilled, excluding fish fillets and other fish meat of heading 0304</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Salmonids, excluding livers and roes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trout (Salmo trutta, Oncorhynchus mykiss, Oncorhynchus clarki, Oncorhynchus aguabonita, Oncorhynchus gilae, Oncorhynchus apache, and Oncorhynchus chrysogaster)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0302.11.00</td>
<td>Rainbow trout (Salmo gairdneri), farmed</td>
<td>kg</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0302.12.00</td>
<td>Pacific salmon (Oncorhynchus nerka, Oncorhynchus gorbuscha, Oncorhynchus keta, Oncorhynchus tschawytscha, Oncorhynchus kisutch, Oncorhynchus masou and Oncorhynchus rhodurus), Atlantic salmon (Salmo salar) and Danube salmon (Hucho hucho)</td>
<td></td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0302.19.00</td>
<td>Fish, frozen, excluding fish fillets and other fish meat of heading 0304</td>
<td></td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pacific salmon (Oncorhynchus nerka, Oncorhynchus gorbuscha, Oncorhynchus keta, Oncorhynchus tschawytscha, Oncorhynchus kisutch, Oncorhynchus masou and Oncorhynchus rhodurus)</td>
<td></td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0303.11.00</td>
<td>Sockeye salmon (red salmon) (Oncorhynchus nerka)</td>
<td>kg</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0303.12.00</td>
<td>Chinook (king)</td>
<td>kg</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0303.12.00</td>
<td>Chum (dog)</td>
<td>kg</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0303.12.00</td>
<td>Pink (humpie)</td>
<td>kg</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0303.12.00</td>
<td>Coho (silver)</td>
<td>kg</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0303.12.00</td>
<td>Other</td>
<td>kg</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0303.19.00</td>
<td>Other salmonidae, excluding livers and roes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trout (Salmo trutta, Oncorhynchus mykiss, Oncorhynchus clarki, Oncorhynchus aguabonita, Oncorhynchus gilae, Oncorhynchus apache, and Oncorhynchus chrysogaster)</td>
<td>kg</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0303.22.00</td>
<td>Atlantic salmon (Salmo salar) and Danube salmon (Hucho hucho)</td>
<td>kg</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>0303.29.00</td>
<td>Other</td>
<td>kg</td>
<td>Free</td>
</tr>
</tbody>
</table>
### Table XV-2: Harmonized Tariff Schedule for Fillets and Processed Salmon

**Harmonized Tariff Schedule of the United States (2004)**

<table>
<thead>
<tr>
<th>Heading/Subheading</th>
<th>Stat. Suffix</th>
<th>Article Description</th>
<th>Unit of Quantity</th>
<th>Rates of Duty</th>
</tr>
</thead>
<tbody>
<tr>
<td>0304</td>
<td></td>
<td>Fish fillets and other fish meat (whether or not minced), fresh, chilled or frozen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0304.10</td>
<td></td>
<td>Salmon.................................................................</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>0304.10.40</td>
<td></td>
<td>Atlantic (Salmo salar); Farmed..................................</td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not farmed.......................................................</td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td>0304.20</td>
<td></td>
<td>Frozen fillets: Salmonidae........................................</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>0304.20.60</td>
<td></td>
<td>Trout...............................................................</td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other........................................................................</td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td>0305</td>
<td></td>
<td>Fish, dried, salted or in brine; smoked fish, whether or not cooked before or during the smoking process; flours, meals and pellets of fish, fish for human consumption:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Smoked fish, including fillets: Pacific salmon (Oncorhynchus nerka, Oncorhynchus gorbuscha, Oncorhynchus keta, Oncorhynchus tschawytscha, Oncorhynchus kisutch, Oncorhynchus masou and Oncorhynchus rhodurus), Atlantic salmon (Salmo salar) and Danube salmon (Hucho hucho).</td>
<td>kg...............</td>
<td>5%</td>
</tr>
<tr>
<td>0305.41.00</td>
<td>00</td>
<td>Prepared or preserved fish; caviar and caviar substitutes prepared from fish eggs: Fish, whole or in pieces, but not minced: Salmon:</td>
<td>Free (Canada, Chile, Mexico)</td>
<td></td>
</tr>
<tr>
<td>1604</td>
<td></td>
<td>In oil, in airtight containers..................................</td>
<td>Free (Canada, Mexico) 4.5% (Chile)</td>
<td></td>
</tr>
<tr>
<td>1604.11</td>
<td></td>
<td>Pink (Humpie)......................................................</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sockeye....................................................................</td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other........................................................................</td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td>1604.11.20</td>
<td>20</td>
<td>Canned: Chum (dog)..................................................</td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>Pink (humpie).......................................................</td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>Sockeye....................................................................</td>
<td>kg</td>
<td></td>
</tr>
<tr>
<td>1604.11.40</td>
<td>10</td>
<td>Other........................................................................</td>
<td>Free</td>
<td></td>
</tr>
</tbody>
</table>

### Table XV-3: U.S. Imports of Chilean Canned Salmon, 2002-2005

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Canned salmon in oil</td>
<td>20,592</td>
<td>181,000</td>
<td>30,888</td>
<td>273,479</td>
<td>11,970</td>
<td>78,750</td>
<td>10,296</td>
<td>90,253</td>
</tr>
<tr>
<td>Canned salmon not in oil</td>
<td>334,475</td>
<td>1,134,472</td>
<td>2,930,355</td>
<td>14,654,318</td>
<td>2,798,274</td>
<td>14,084,488</td>
<td>2,596,436</td>
<td>13,550,803</td>
</tr>
</tbody>
</table>

U.S. Salmon Farmers and Anti-dumping and Countervailing Cases

Anti-dumping and countervailing duties on imports of products into the United States have been the only concerted efforts on the part of the U.S. salmon industry to protect the U.S. market from less expensive imported salmon.

Over the past two decades, the U.S. farmed salmon industry has petitioned the U.S. International Trade Commission, under the U.S. Department of Commerce, to impose trade restrictions in the form of anti-dumping and countervailing duties. The results of these duties are to increase the price of salmon imports in the United States and limit 'unfair' competition from imports. These measures have also been considered by the traditional ocean harvest salmon industry from time to time as an appropriate measure to increase ex-vessel prices. However, the salmon fishing industry has not initiated the petitions.

Currently, there are both countervailing and anti-dumping duties in place for some farmed salmon products from Norway and Chile.

Prior to considering the two examples involving salmon from Norway and Chile, it is necessary to define the essential features of the regulations. 1

The three provisions available for relief from import competition under the U.S. law are:

1. Countervailing Duties — These duties are imposed when imports into the United States are determined to be receiving an 'unfair subsidy' from a foreign government. The underlining principle is that the subsidy gives the foreign producers selling in the United States an unfair advantage by artificially reducing costs or enhancing revenue. In order for a countervailing duty to be implemented, it must be demonstrated that the subsidized foreign product has damaged the U.S. industry through actions, such as reduced prices, in the U.S. marketplace. When countervailing duties are imposed, they apply to all producers receiving the subsidy.

2. Anti-dumping Duties — These duties are used when imports are being sold, or are likely to be sold, in the United States at a less than 'fair value' (i.e. 'dumping'). The official definition of dumping is, 'a price which is lower than the price for which it is sold in the home market, after adjustments for difference in the merchandise, quantities purchased, and the circumstance of the sale' (USITC 2001). In an anti-dumping case, all producers of a given import from the same country may not be selling their product at less than fair market value.

3. Safeguard Remedies — Used when rapidly increasing imports of a good injure or threaten to injure a U.S. industry or the creation of a U.S. industry. Sections 201-204 of the Trade Act of 1974 authorize safeguard remedies (USITC 1998). To date, this action has not been used in the case of imports of farmed salmon.

Salmon and Countervailing/Anti-dumping Duties

Over the past few decades, there have been several countervailing duty and anti-dumping cases involving the seafood industry. Two farmed salmon cases, below, illustrate how countervailing and anti-dumping duties have been implemented.

Norwegian salmon case

This case against imported fresh, farmed, whole Atlantic salmon from Norway in the early 1990s illustrates the potential countervailing and anti-dumping duties possess to influence trade and prices. In 1989, falling prices of salmon in the U.S. market were the catalyst for a petition from the Coalition for Fair Atlantic Salmon Trade, a U.S. farmed salmon industry group, alleging that Norwegian producers had received countervailable subsidies and were also dumping salmon in the U.S. market. The petition alleged that the subsidies and the dumping were damaging the domestic salmon industry by driving down prices in the United States.

In response to the petition, the U.S. International Trade Commission (USITC) opened an investigation into the practices of the Norwegian salmon producers. The Commission issued its preliminary ruling on September 26, 1990, and ruled that Norwegian salmon farmers were dumping salmon and receiving a countervailable subsidy (Anderson 1997).

In arguments before the ITC regarding the level of damage to the U.S. farmed salmon industry as a result of Norwegian salmon imports, the Norwegians claimed that all U.S. salmon (farmed and wild) and all salmon imports directly competed in the U.S. market. The argument was that all salmon are substitutes for each other because, at harvest, all salmon are whole and fresh, including low-value pink and chum salmon (which were largely canned) and sockeye salmon (which is almost entirely exported to Japan). In essence, the Norwegians argued that their product was a small slice of a much larger market and, therefore, was not likely to have enough market power to result in material damage to the U.S. farmed salmon industry.

The U.S. Coalition for Fair Atlantic Salmon Trade used empirical market research and examples from Norwegian salmon marketing campaigns to argue that

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1 This section is largely taken from King and Anderson (2003).
the fresh, whole, farmed Atlantic salmon was not a direct competitor with all salmon. In particular, it was pointed out how much of the wild salmon (notably sockeye, chum and pink) is either canned or exported and never enters the U.S. market and is, thus, not in direct competition with fresh, premium-grade Norwegian Atlantic salmon.

Furthermore, they argued that the Norwegian Atlantic salmon promotional campaigns had emphasized the superior quality of Norwegian Atlantic salmon, year-round availability, uniformity and freshness. These are attributes that most wild salmon cannot attain, especially pink and chum salmon from Alaska. In addition, at the time Norway targeted high-end restaurants mostly outside the Pacific Northwest in direct competition with U.S. farmed salmon, not wild salmon. The petitioners concluded that Norway made every effort to differentiate itself from most wild salmon and that the Norwegian Atlantic salmon most directly competed with other whole, fresh, farmed salmon. Therefore, the Norwegians controlled a considerable share of the relevant segment of the salmon market.

In conclusion, the U.S. Department of Commerce (USDC) generally agreed with the Coalition for Fair Atlantic Salmon Trade and imposed an anti-dumping duty that ranged from 15.65 percent to 31.81 percent, depending on the company, indicating that they were selling 15.65 percent to 31.81 percent below ‘fair market value.’ In addition, a countervailing duty of 2.27 percent was imposed. This duty indicated a very minor subsidy rate.

These relatively high duties caused Norwegian salmon products to become uncompetitive in the U.S. market. As can be seen in Figure XV-1, Norway’s share of salmon imports sank from over 40 percent of the U.S. fresh salmon (chinook, coho & Atlantic) imports in 1989 to less than 2 percent of the market in 1991.

Farmed salmon from Chilean and Canadian producers rapidly took Norway’s place. Another consequence was an increase in Norwegian shipments to Japan, reducing the market share that traditionally corresponded to U.S. exporters. With the rapid entry of Canada and Chile, prices did not change appreciably, which resulted in virtually no relief for the U.S. farmed salmon industry. The entire process was time consuming, costly and did little to enhance prices in the United States.

In the first five-year reviews of the antidumping and countervailing duty orders, the ITC determined that revocation of the orders would be likely to lead to continuation of material injury to the domestic industry within a reasonably foreseeable time. The second five-year reviews, instituted on February 2, 2005, led to the same basic conclusion (USITC 2006 – final results published on September 8, 2005). As a result, the antidumping and countervailing orders against fresh salmon from Norway will remain active for the foreseeable future.

Figure XV-1
U.S. Imports of Fresh Salmon (Atlantic, Chinook, Coho)
Norwegian Countervailing Duty and Antidumping Case

[Graph showing U.S. imports of fresh salmon from 1989 to 1992, with data points for Norway, Canada, Chile, Others, and average price over time.]

Chilean salmon case

On June 12, 1997, the U.S. Coalition for Fair Atlantic Salmon Trade filed a petition with the USDC and the ITC alleging that Chilean exports of Atlantic salmon products to the United States were injuring the U.S. farmed salmon industry since they were subsidized and being sold at less than fair value. Following the Tariff Act of 1930, the ITC opened an investigation into those Chilean exports. On July 31, 1997, the ITC announced that it had finished its preliminary investigation and determined that there was evidence of both countervailable subsidies and salmon product dumping (Federal Register 1997a).

The Chilean salmon case illustrates how much the market had changed in just a few years. The focus of the Norwegian salmon case in the early 1990s was on whole, fresh Atlantic salmon, but the Chilean case was broadened to include all salmon products from Chile, particularly the market for pinbone-out (PBO) fillets, which were experiencing explosive growth in production. The U.S. Coalition for Fair Atlantic Salmon Trade argued that all fresh, farmed salmon products (whole or fillet) were substitutes for each other. A whole salmon can be transformed into fillet. They also claimed that the Chileans were dumping product onto the market by selling below the price they received in other international markets and, in cases, selling below cost.

The Chileans argued that by introducing PBO fillets, they were expanding into markets that were not buying whole, fresh, salmon. For example, the Chileans claimed they provided PBO fillets to chain restaurants and supermarkets (especially in the South and Midwest) that had not previously handled salmon. They argued that these outlets would not purchase whole salmon because they did not have the skilled labor necessary to fillet it.

They also indicated that they targeted consumers who would rarely purchase whole salmon and stores that would be unlikely to carry it. Furthermore, they argued that they had lower costs and that U.S. producers could not produce enough to satisfy this new and growing market.

The Chilean salmon case ended somewhat differently than the Norwegian case. In the November 19, 1997, Federal Register, the ITC announced that it had determined that Chilean Atlantic salmon exporters and producers were not receiving significant countervailable subsidies from the Chilean government (Federal Register 1997b).

However, in the January 16, 1998, Federal Register, the ITC announced that it had determined that three of the five largest Chilean producers and exporters of salmon were selling their product in the United States at less than fair market value (Federal Register 1998). The margins were determined to be quite small. These companies received duties ranging between 2.24 percent and 10.91 percent. Smaller companies, not among the top five producers, were hit with a duty of 5.19 percent (Salmon Trade Alliance 1998).

These duties were much smaller than those enacted against the Norwegians six years earlier, and they had little effect on the growth of U.S. imports of Chilean salmon, especially fresh fillets. As can be seen in Figure XV-2, the growth of Chilean sales in the United States was largely unaffected. Prices did not improve. In particular, the price of whole fresh salmon continued to trend downward. In one respect, the Chilean and Norwegian cases were quite similar, in that they were both time consuming, costly and did little to enhance price.

On June 2, 2003, the U.S. Department of Commerce initiated a sunset review of the anti-dumping duty order on fresh Atlantic salmon from Chile to determine whether revocation of the order would be likely to lead to continuation of dumping and material injury to the domestic industry. On July 25, 2003 the USDC published the final results from the review on which it decided to revoke the antidumping order because “domestic interested parties expressed no interest in the continuation of this order” (Federal Register 2003). On August 13, 2003 USDC published notice that it was rescinding its sunset review, formalizing the removal of all anti-dumping duties on fresh Atlantic salmon from Chile.

Non-Tariff Trade Barriers: The Case of Microbial Hazards

Although at a much lower scale, trade of salmon products in the United States has also been restricted by non-tariff barriers such as rejections and detentions of imported shipments on accounts of health concerns related to the presence of foodborne pathogenic bacteria (e.g., *Listeria monocytogenes*). With respect to food safety matters, the Uruguay Round of Multilateral Trade Negotiations developed the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) and the Agreement on Technical Barriers to Trade (TBT Agreement) to allow countries to take legitimate measures to protect the life and health of their consumers while prohibiting them from using measures in a way that unjustifiably restricts trade (FAO 1999).

As with many other foodborne pathogenic bacteria, no internationally specific standards or recommendations have been developed for *L. monocytogenes*. Even though no large outbreaks of listeriosis have occurred due to the consumption of contaminated fishery products, several countries (including the United States) currently enforce a zero-tolerance policy for *L.
*monocytogenes* in fishery products. Between 1987 and August 1998 there were 45 recalls of domestic and imported ready-to-eat finfish products in the United States, with most of the recalls concerning imported smoked salmon from Canada (Jinneman et al. 1999). A recent panel of experts convened by the FAO (FAO 1999) concluded that, given the current knowledge of *Listeria* and listeriosis, a zero-tolerance policy for all ready-to-eat fishery products may be overly conservative relative to providing an adequate level of public health protection, in addition to imposing a heavy economic burden on producers. The panel recommended that risk assessment studies be conducted to establish maximum limits rather than zero-tolerance.

In recent years, other countries have introduced regulations allowing maximum limits on the content of *L. monocytogenes* in foods. In the specific case of smoked salmon, it is recommended that products have a “use-by-date” label such that at the end of product shelf-life, *L. monocytogenes* numbers will be less than 100 CFU/g (Colonies Forming Units per gram). Health authorities should also ensure that the stated shelf-life for ready-to-eat products are within safe limits and that highly susceptible individuals are informed and provided with guidelines about safe handling of food.
References


Analysis of Marine Stewardship Council Certification of Alaska Salmon

Key Points

✔ Ecolabels have emerged in recent years to convey production process information otherwise unavailable to consumers, and may affect their buying choice as much as price or observable qualities of a product. The extent to which consumers will make choices based on this information depends on several factors, including: consumer knowledge of relevant issues, understanding of connection between issues and purchase decisions, clarity of information presented and perceived trustworthiness of the certifying agency.

✔ The Alaska salmon fishery was certified to the Marine Stewardship Council (MSC) standard for a sustainable fishery in October 2000, making salmon products from the fishery eligible to be marketed with the MSC ecolabel.

✔ Estimates are that less than 10 percent of Alaska salmon is marketed with the MSC logo.

✔ The largest volume of MSC-labeled Alaskan salmon is sold in European markets, less in the United States. Even though the top six U.S. seafood firms all have chain-of-custody certification, none are supplying MSC-labeled canned salmon to the U.S. market. Processors cite a lack of interest by U.S. consumers in MSC-labeled product as reasons why there is so little labeled product sold in the U.S. market. Whole Foods, the nation’s largest natural food chain, sells fresh/frozen MSC-labeled Alaskan salmon on a seasonal basis, as well as some processed products. The January 2006 announcement of Wal-Mart to carry only MSC-certified fresh/frozen seafood within the next three to five years may have the largest potential impact on the visibility of MSC-labeled Alaska salmon yet.

✔ Evaluation of the environmental outcomes point toward improvements made in management as required by the MSC to maintain certification. Alaska has elected to proceed with re-assessment for another 5 years of certification.

Introduction

Ecolabeling programs evaluate the production process of a fishery with regard to established environmental standards set by an independent third party. If the process meets these standards, the producer or marketer may buy a license to use a specific ecolabel in marketing efforts. In effect, the label conveys to the consumer otherwise unobservable information concerning a product’s environmental impact. The consumer is then able to choose among product alternatives, ecolabeled and not. In theory, if the consumer perceives benefits from seafood from sustainable fisheries, then the consumer will pay a premium for that product, creating a market-based incentive for the fishery to become and remain certified.

The most famous example of seafood ecolabeling is the ‘dolphin-safe’ label on canned tuna. This label came about in the early 1990s as a result of public pressure to capture tuna in a process where dolphins were not encircled or harmed in any way. The U.S. Dolphin Consumer Information Protection Act of 1990 specifies that the dolphin-safe label may only be used for tuna coming from fisheries which do not encircle dolphins. All canned tuna, even cat food, available in the United States is labeled as dolphin safe. In the United States, there is no available choice consumers can make for non-dolphin safe tuna.

A better example of an ecolabeling program in seafood, in which consumers can choose to buy ecolabeled products or non-labeled products, is the Marine Stewardship Council (MSC). The MSC was created in 1997 through a cooperative effort of the environmental organization the World Wildlife Fund (WWF) and Unilever, a multi-national corporation. The goal of this partnership was to provide a standardized mechanism for certifying and labeling sustainable seafood products from wild fisheries worldwide, thereby providing a
Third-party consumer ecolabeling can serve three functions in the marketplace: 1) it can provide independent evaluation and endorsement of a product; 2) it can act as a consumer protection tool; and 3) it can be a means of achieving specific environmental policy goals.

An ecolabeling organization owns its environmental endorsement symbol or trademark. It licenses the use of its mark for a specified period of time and a specific fee. An ecolabeling organization has usually three tasks: standard setting, accreditation and marketing. Standard setting determines the environmental standards a product must meet to qualify for the ecolabel. Accreditation is given by the ecolabeling organization to trained certification companies. Independent assessment determines whether a given product meets those standards. If certified, then the logo can be licensed to be put on the certified products.

The effectiveness of ecolabels depends on consumer awareness of the label, and consumer acceptance of the label (trust and understanding). Awareness is generally the result of a successful promotion. Acceptance depends on: 1) public understanding of the relevant issues; 2) public understanding of the connection between relevant issues and product choices; 3) an accurate and clearly understood presentation of the product attributes; and 4) an understanding of what specific actions (e.g. purchase decisions) individuals can take in response to the information provided by the labeling program.

For ecolabeling initiatives to be broadly accepted, the issues surrounding labeling must become prominent so consumers will actively look for the labels. Thus, ecolabeling programs perform a public education role as well. A labeling program is also more likely to be accepted if it is offered by a credible source.

Seafood Ecolabeling of Wild Fisheries

There are several controversial issues related to ecolabeling, particularly related to fisheries, which has led to concern by nations around the world, both developed and developing. Partly in response to these concerns, the United Nations Food and Agriculture Organization (FAO) developed in 2005 its own guidelines for fisheries ecolabeling which outline the principles that should govern ecolabeling programs. These guidelines include the need for reliable, independent auditing, transparency of standard-setting and accountability and the need for standards to be based on good science. They also lay down minimum requirements and criteria for assessing whether a fishery should be certified and ecolabel awarded, drawing from FAO’s Code of Conduct of Responsible Fisheries to do so.
The Marine Stewardship Council

The MSC’s mission statement is to safeguard the world’s seafood supply by promoting the best environmental choice. It describes itself as a non-profit organization that works to enhance responsible management of seafood resources, to ensure the sustainability of global fish stocks and the health of the marine ecosystem. The MSC defines its obligations as:

- Conservation of marine fish populations and the ocean environment on which they depend;
- Conservation of the world’s seafood supply for the future;
- Provision of consumers with accurate information about the best environmental choice in seafood;
- Engaging in partnership with our stakeholders;
- Ensuring their program and its benefits are available to all regardless of size or region;
- Engaging in activities responsibly and openly.

The MSC states its beliefs that:

- the right to fish carries an obligation to do so responsibly and sustainably;
- well-informed consumer choice is a positive force for conservation;
- well-informed markets help environmentally responsible businesses to be more competitive;
- independent certification provides credible information that everyone can trust.

The three Principles of the MSC are:

**Principle 1:** A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.

**Principle 2:** Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

**Principle 3:** The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

Based on the mission statement and three principles noted above, the MSC has created a standard that fisheries must meet before they can become certified: the Principles and Criteria for Sustainable Fishing. Having set the standard, the MSC has accredited a number of certification bodies (the third-party independent entities) who then judge the fishery against the standard. Certification is voluntary and accessible to all wild capture fisheries.

Certification lasts five years and is subject to annual audits to confirm improved required improvements are being made. No product from the fishery can bear the MSC ecolabel identifying it as being from a well-managed source until chain-of-custody/traceability requirements have been met ensuring that fish from the certified fishery are not mixed with uncertified fish in the supply chain. Once the fishery is certified, and chain-of-custody/traceability requirements are met all the way up the supply chain, the MSC’s trading company, MSCI, licenses the use of the MSC logo.

There are costs to the certification process. Those fisheries being assessed contract with the independent third-party certification firm – the MSC receives no funds other than funds from the license of its logo. Costs of certification vary depending on the size and complexity of the fishery. These costs are normally confidential between the client and the certification firm. The client also varies from fishery to fishery. In some cases it is the industry that pays for the certification, as in the pollock fishery. In others, as in the case of the Alaska salmon fishery, the State government through the Alaska Department of Fish and Game, funded the certification.

Subsequent to the certification, anyone handling product from the fishery must pay for a chain of custody certification — for example, processors. Anyone using the MSC logo must pay the license fee to the MSCI. There are costs of the audits that occur post-certification, and costs of re-certification every five years. The major cost of certification remains, however, the cost of running a well-managed, sustainable fishery.

The MSC welcomed FAO’s guidelines, saying that the development of the guidelines showed an endorsement of ecolabeling as a tool to achieve sustainable management of fisheries (MSC 2005). Rupert Howes, the MSC Chief Executive Director, stated that the MSC standard is consistent with the core FAO requirements, and is strengthened by the setting of the FAO’s credible international minimum standard.

Customer Licence Code MSC0285 (www.msc.org)
Evaluations of the MSC

In January 2004, two evaluation studies of the MSC were released, one by Wildhavens Consultancy contracted by the Homeland and Oak Foundations and the Pew Charitable Trusts, and another by The Bridgespan Group contracted by the Packard, Oak and Esmée Fairbairn Foundations (Wildhavens Consultancy 2004; The Bridgespan Group 2004). The major criticism of the MSC was that it lacked credibility with U.S. environmental groups. Both reports indicated that the MSC needed to improve the quality and consistency of assessments and annual audits. The MSC since then has taken several steps to address these concerns, and has made considerable progress on many fronts in the last two years.

It is worth noting, however, that neither report was critical of the certification of Alaska salmon, beyond those concerns that were raised by the stakeholders at the time of assessment and the expert panel of scientists reviewing the application for certification.

MSC certification of the Alaska Salmon Fishery

The Alaskan salmon fishery assessment began as a test case for the MSC. Having constructed draft principles and criteria as the basis for a standard, the MSC wished to apply these to two to three volunteer fisheries. Representatives from Alaska volunteered that the MSC consider the salmon fishery as one of the test cases. The MSC began discussions in 1998 with a working group formed by the Alaska Department of Fish and Game (ADF&G) comprising of fishermen, processors, government managers and conservation groups concerning Alaska’s potential participation as a test case to which the MSC could apply the MSC Principles and Criteria for Sustainable Fishing.

There was not unanimity within the working group that the salmon fishery should be considered as a test case.

Members of the working group, mainly processors and fishermen, did not want the MSC assessment to provide an opportunity for using one fishery against another or one gear type against another in the allocation process. In the end, the working group agreed that the salmon fishery could be used as a test case, under certain conditions. Those conditions were:

- The project would include all species, all gear types
- The project report, when written, would not identify individual fisheries’ problems, but would talk about species groupings to avoid issues that may affect arguments about allocation
- The MSC would pay for the testcase
- The testcase could be converted to an official certification evaluation if requested by ADF&G

In this MSC and ADF&G partnership of a test fishery, ADF&G contributed time of its staff needed to prepare the data and other information for the certification body, and would in return get a report for this fishery as to whether or not it comply with the MSC standard. The report from the certification body would aggregate all the fisheries, and not report on individual fisheries in order to satisfy the conditions bulleted above.

Certification of the Alaska salmon fishery proceeded as a test case for the MSC. Scientific Certification Systems (SCS) was chosen as the accredited certification body for the project. SCS selected three experts into the assessment team—Dr. Lee Alverson of Natural Resource Consultants in Seattle, Washington; Dr. Louis Boisford a the University of California, Davis; and M. Paul Krasnowski, a retired ADF&G biologist. Dr. Chet Chaffee of the SCS managed the assessment team’s activities to ensure compliance with MSC requirements (Phillips, Ward and Chaffee 2003).

Certification by the Marine Stewardship Council

Fisheries certified: US Alaska salmon; UK Thames herring driftnet, South West (England) mackerel handline fishery and Burry Inlet cockle fishery (South Wales); Western Australia rock lobster; Loch Torridon Nephrops (Scotland); South Georgia Patagonian toothfish, New Zealand hoki; Mexico’s Baja California spiny lobster; South African hake; Gulf of Alaska (U.S.) pollock; and Eastern Bering Sea/Aleutian Islands (U.S.) pollock; BSAI Pacific Cod (U.S.); Hastings Fleet Dover Sole (UK); Hastings Fleet Pelagic (U.K.).

Fisheries undergoing full assessment as part of the MSC certification process: Canada’s British Columbia salmon; Chilean hake; North Sea herring; Pacific halibut (Alaska, Washington and Oregon); Pacific halibut (British Columbia, Canada); US Alaska sablefish; California Chinook salmon; and Australian Mackerel Icefish; Lake Hjälmaren Pikeperch Lakes (Sweden); Lakes and Coorong fisheries (South Australia); US Oregon Dungeness Crab; Maryland Stiped Bass (U.S.); Oregon Pink Shrimp (U.S.); Norwegian North Sea Saithe and North East Arctic Saithe; Patagonian scallop.

Additional fisheries are in the pre-certification process, which is confidential and at the end of which the fisheries choose whether or not to pursue full assessment.

Source: MSC 2006

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Environmental Issues and Stakeholder Concerns from MSC Certification of Alaska Salmon

There were several environmental issues of concern for the assessment team.

Sustainability

Under Principle 1, the assessment team raised the question of how well the management system, which has done well in years of large populations of salmon, would fare if there was a downturn in ocean conditions which had recently been favorable for salmon.

Under Principle 2, the team identified a weakness that should be corrected: the implementation of a program to identify by catch in net fisheries.

Under Principle 3, the assessment team was concerned about the lack of research on the potential effects of salmon hatcheries on the wild stock gene pool and reproductive fitness.

Stakeholders’ Concerns

One of the most important facets of the assessment process for MSC certification is the involvement of stakeholder groups. Stakeholder groups include fishermen, environmental groups, other levels of the marketing chain, recreational fishermen, other governmental agencies. Native Americans and any other person or group that in some way is impacted by the fishery under assessment. Consulting all stakeholder groups ensures that any and all issues concerning the management of the fishery are included in the deliberations of the assessment team. The issues brought to the attention of the assessment team are evaluated to determine their relevance to the assessment and the MSC process, as well as to determine their veracity.

In the case of Alaska salmon, during the test assessment, there were few concerns brought up by industry. For the most part, industry seemed happy with the management system as it existed.

According to Chaffee, the conservation sector was also quiet. Local, regional and national groups known to be concerned with salmon issues were contacted, and any thoughts they had on the assessment and the fishery were generally positive. The Audubon Society, the Sierra Club of British Columbia and the Canadian fishing industry raised a few concerns:

- The influence of salmon hatcheries on the genetic integrity of wild salmon stocks
- The ecological effect from adding thousands of additional salmon fry into specific areas and their effect through competition for the plankton food source
- The adequacy of marking hatchery salmon to understand their influence in Prince William Sound and other areas
- Interception of Pacific salmon destined for Canada and other coastal areas
- Concern that the state budget for salmon management has been cut to the point that there is little to no room for research and development into new management strategies and techniques

Outcomes of the certification assessment

The test case results for the Alaska salmon fishery were sufficiently positive to persuade Alaska that its chances of receiving full certification were good. The state agreed to proceed with the full certification assessment in 1998, using the same assessment team. Greater consultations with stakeholders in Canada took place with the full assessment, as well as increased evaluation of hatchery-related issues and transboundary stock management.

In their report to ADF&G in September 2000, the SCS recommended that the salmon fisheries in Alaska be certified by the MSC in October 2000. Some examples of specific strengths in Alaska salmon management included:

- Statutes and regulations codify the authority and decisions of the management system
- The Board of Fisheries (BOF) has adopted numerous management plans that control harvests and assure escapement in many important fisheries throughout Alaska; management philosophy, articulated as BOF policy, has generally been codified as well
- Clearly codified state regulations establish the primacy of management for sustained yield and identify subsistence as the priority use for the harvestable surplus
- The limited entry system has helped to control effort in salmon fisheries throughout the state and has thus facilitated management for sustained yield
- The Emergency Order system allows rapid, on-site response to changed or unexpected fishery conditions
- The management system has a very high success rate in achieving target escapements, and conducting orderly harvest of surplus stocks
- Policies are in place (including a mixed stock policy) generally aimed at protecting dominant and weak stocks
- The management system has demonstrated the ability and willingness to close fishing areas and seasons to protect depleted stocks
- There are adopted Escapement Goal, Sustainable Fisheries and genetics policies
- There is a mandate for sustainable salmon fisheries in the state constitution
There were requirements for continued certification included conditions with which ADF&G would have to comply to remain certified over time. These issues were the focus of continued monitoring each year after the initial certification, to ensure sustainability of salmon. They were (SCS 2000):

- Within three years of certification the ADF&G must:
  - Determine the number of salmon spawning stocks or spawning stock aggregates in the state that are managed on the basis of a) escapement goals determined by stock-recruitment analysis; b) escapement goals determined by average escapements; and c) no established escapement goals.
  - Categorize each spawning stock or spawning stock aggregate according to relevant characteristics such as: whether it is a mixed stock fishery, the number of individual stocks exploited, methods used to estimate escapement, whether escapement goals were based on data before or after the mid-1970s and whether the monitored stocks exploited in the mixed stock fisheries are representative of unmonitored stocks exploited.
  - Present the distributions in terms of the number of spawning populations, the number of fish and the economic value of the fishery.
- Within three years of certification the ADF&G must provide an explanation to the certification body about how Alaska salmon fisheries will continue to be sustainably managed even if there is an event that changes ocean survivals back to rates equivalent to those seen in the 1950s, 1960s and 1970s.
- Within one year after certification, ADF&G must provide evidence to the certification body that the joint stock status report for northern coho required by the Pacific Salmon Treaty (PST) is being undertaken in a timely and cooperative manner.
- Within two years after certification, ADF&G must present to the certification body an explanation of why ADF&G believes the stocks being co-managed under the PST are considered sustainable based on the current management paradigm.
- Within three years after certification the state must implement a sampling program to identify major non-salmon fish species, birds and marine mammals taken in the salmon net fisheries of the State. The program should be designed to provide a reasonable understanding of fish, shellfish, birds and marine mammals taken incidentally in the fisheries.
- Before five years pass after certification, ADF&G must provide evidence and a summary regarding its findings on by-catch of non-salmon species taken in the Alaskan salmon fisheries to an accredited certification body.
- Within two years of certification, ADF&G must present information to the certification body reporting on progress made by the Commercial Fisheries Entry Commission on reducing the number of permits to the numbers determined to be consistent with the limited entry law on an annual basis.
- The Department must identify long-range research needed to assess the magnitude of the interaction of hatchery programs on the wild stock gene pool and the effect on the reproductive fitness of those stocks. The department must document the programs, policies and regulations and statutes as well as specific actions taken to assure the consistency of the hatchery program with the Genetics Policy.

The primary issues raised in the latest surveillance audit (2003-2004) include: status of stocks statewide; focal stocks for the annual surveillance; escapement goals; unmonitored, lesser stocks; the June fishery in Area M, South Unimak and Shumagin Islands; changes in management; changes in ADF&G staffing levels; and hatchery production in Alaska. Given that the system in Alaska is one in which the catch levels are set by management based on escapement goals, the status of the stocks, annual surveillance and whether or not management is successful in meeting escapement goals are all of real concern. These have been of continual concern since the original assessment. The same can be said of hatchery production. In particular, the surveillance audit recommends that “a re-assessment should examine what recent genetic and population research is being conducted to ascertain the ongoing effects of hatchery releases” (SCS 2004).

It was announced in February 2005 that ADF&G will fund a re-assessment for recertification of the Alaska salmon fishery. The timeline for completing the re-assessment was extended to 25 December 2006, due to the complexity of the fishery. The MSC certificate for the fishery will remain active for the same period (SCS 2006a).

In July 2005 the 2004-2005 Annual Surveillance Report was issued, the final surveillance report under the first five-year certification. In it, SCS found that the salmon fisheries in Alaska continued to meet the standards of the MSC and to comply with the requirements for continued certification, including having met all of the conditions in the bullets above (SCS 2005).

The MSC’s Carrots and Sticks

The Wildhavens report criticizes the MSC, stating that ‘the MSC places too much emphasis on the punitive threat of losing certification and not enough on the
positive inducement granting certification provides.’ The recommendation is that it is better to use the positive incentive of establishing pre-conditions to pull indicators up to the best practices level prior to certification. It is not clear if Wildhavens applies this criticism to the Alaska salmon fishery certification. In any case, the MSC has not accepted the suggestion that applying pre-certification conditions with only the possibility of realizing market benefits some years hence provides enough of an incentive to draw fisheries into the program. Some outside observers state that the Wildhavens criticism points to a lack of understanding of market incentives. Without the market, there is no ecolabel and thus no incentive for environmental improvement. The MSC asserts that its program is based upon a continuous improvement model: having passed a minimum standard which stretches environmental performance beyond that required by existing regulation, fisheries must continue to improve, not only by meeting its certification conditions but also overall as collective understanding of sustainability evolves.

Chain-of-custody certification
Certification of the fishery as sustainable is only the first step in getting the product to consumers, and in building that market-based incentive for the actors in the salmon fishery. Without those incentives, there would be no logic in maintaining the certification.

The next step in the process of getting MSC-labeled Alaska salmon to the consumer is chain-of-custody certification. Chain-of-custody certification provides proof that any product sold under the MSC logo or ecolabel can be shown to originate from a certified fishery. It applies to all entities involved in the supply chain from the fisherman, through primary and secondary processors, wholesalers, distributors, importer, retailers, food service, restaurants or any other business that handles MSC product.

The MSC web page lists the firms that have undergone chain-of-custody certification for Alaska salmon—in the United States that list includes 42 firms. It also includes nine British Columbia firms who handle both Alaskan and British Columbia salmon. In the United States, many large firms have gained chain-of-custody certification, including what are likely the six largest seafood firms in the U.S. handling Alaska salmon—Icicle Seafoods, Ocean Beauty Seafoods, Peter Pan Seafoods, NorQuest Seafoods, North Pacific Processors and Trident Seafoods.

Assessment of the British Columbia Salmon Fishery
The British Columbia salmon fishery is undergoing the full assessment process for potential certification by the MSC. The British Columbia Salmon Marketing Council is the client, which is entirely an industry group for wild salmon. They entered into the assessment in early 2001, however the assessment has been beset by a variety of delays.

The BC salmon assessment is proceeding along much different lines from the Alaska assessment. In this case the client requested that SCS, the certification body, conduct an assessment based on individual fisheries. This has led to 40 different fisheries, based on the different gear types, river systems and species. In addition, aboriginal and recreational fishing is also being taken into account. The assessment has not arrived at a point in which there is any more information.

Assessment of the California King Salmon Fishery
In December 2002, the California Department of Food and Agriculture awarded the California Salmon Council a $125,000 grant for a pilot project seeking to certify California king salmon fishery under the MSC program. A full assessment began in April 2004 for the troll-caught chinook salmon fishery. California is the leading producer of troll-caught chinook salmon along the Pacific coast. Fishing is by barbless hook and line using artificial lures and bait highly selective to chinook salmon. In 2003, the industry produced 6.4 million pounds and its primary markets are major cities in California, with some exports to Japan, Germany and the U.K. (MSC 2003).

Analysis of MSC Ecolabeling of the Alaska Salmon Fishery
There are, broadly speaking, two impacts of the MSC certification: 1) the impact on the environment and the salmon fisheries; and 2) economic impacts for the entire industry. In this case the definition of industry includes the seafood market, including the fishermen, processors, wholesalers, importers/exporters and the retail, foodservice and restaurant sectors.

The surveillance reports discussed above speak to the first impact. The 2004-2005 surveillance report of the SCS indicates that the Alaska salmon fishery has met all the conditions imposed during the initial certification of the fishery, thus one can conclude that the environmental conditions have improved. The re-assessment of the salmon fishery is proceeding differently than the initial assessment. Rather than assessing the Alaska salmon fishery as a single fishery for all rivers, all gear types and all species, the fishery is being assessed with 16 units of certification, generally defined by geographical area, each containing various species and generally more than one gear type (SCS 2006). One of the issues being raised within the assessment process is the use of hatcheries as a management tool. Thus, while previous conditions regarding hatcheries were addressed, met and discussed in surveillance reports, concerns remain and are being brought up again in the re-assessment process.
The evaluation of the economic impacts is more difficult. How does one measure positive economic impact? If the theory of ecolabels holds, then one could expect that the price of Alaska salmon would increase after certification as consumers would now pay a premium for the ecolabeled product relative to non-ecolabeled products. This might then be reflected in the ex-vessel prices.

Chapter XIII showed that there are a very large number of factors that influence salmon prices. For a variety of reasons, many related to lack of data, there have been no studies done to determine the impact of farmed salmon on wild salmon prices. Similarly, there are no existing studies of the price impacts of MSC labeling on product prices. It is quite simply very difficult to tease out the specific effect of the MSC certification exclusive of the effect of all the other demand and supply forces that move wild salmon prices at the ex-vessel level. Thus, at best, there is anecdotal evidence of market impacts of MSC labeling.

In addition, the discussion that follows will show that in spite of the MSC certification of the Alaska salmon fishery, a very small proportion of the product that flows from that fishery is actually marketing with the MSC ecolabel, or logo. As a result, any premium that the consumer may be paying (which is undetermined as yet) is going to have a minimal, if not zero, impact on the ex-vessel price.

The following section describes what is known of the current state of the markets for MSC-labeled salmon from Alaska. Portions of the discussion are taken from Roheim (2003).

Evaluation of Outcomes of MSC Certification for Alaska Salmon Markets

Consumer access to the product, consumer awareness of the label and consumer acceptance of the label (trust and understanding) are key to the effectiveness of the ecolabel. Awareness is generally the result of successful promotions. Acceptance depends on: 1) public understanding of the relevant issues; 2) public understanding of the connection between relevant issues and product choices; 3) an accurate and clearly understood presentation of the product attributes; and 4) an understanding of what specific actions (e.g., purchase decisions) individuals can take in response to the information provided by the labeling program.

MSC chief executive Rupert Howes reports that there has been over $70 million in retail sales of MSC-labeled Alaska salmon in 10 countries (DiPietro 2005). Consumers’ access to MSC product is growing, particularly in the UK and Western Europe. The UK has a diverse set of MSC-labeled Alaska salmon products. Figure XVI-1 shows the variety of goods available to the consumer at retail outlets. According to The Bridgespan report, retail chains representing 85 percent of U.K. food sales carry MSC-labeled product.

Two leading supermarket chains in the UK, Tesco and Sainsbury’s, competed to become the first to have newly certified product on their shelves. Sainsbury’s, the UK’s largest fish retailer, was an early supporter of the MSC and the first UK supermarket to stock MSC-labeled seafood products. Sainsbury’s has stocked Alaskan salmon since the summer of 2002.

One producer, Young’s Bluecrest — which has recently changed its name to Young’s Seafood Limited — the largest seafood producer in the UK, having recognized the potential value of the MSC label, created an entirely new brand based around the MSC label. The ‘Fish for Life’ brand is designed to promote the health benefits of fish to the consumer and assure them that by buying these products they have not contributed to the global problem of overfishing. A value-added Alaskan salmon product was launched in September 2002. Unfortunately, the product was pulled from the market in May 2004 due to lack of consumer demand. It continues to carry MSC Alaska salmon, such as that shown in the accompanying graphic. In the case of the Fish for Life product, Young’s displayed the words ‘wild Alaska chum’ salmon on the package of its product with the MSC logo appearing on the front of the package. In the accompanying graphic here, we see ‘wild pink’ salmon, with no mention of ‘Alaska’ on the package, and the MSC logo in the lower left hand corner, also on the front of the package.

Other European countries with significant Alaska certified salmon available for consumers are Switzerland, Germany, Austria and Belgium. Major international retail support comes from Migros.

3 There remains, however, a ‘Fish for Life’ hoki product on the market.
Cooperative and Coop Schweitz in Switzerland; Delhaize based in Belgium. Gottfried Friedrichs in Germany began to market MSC products in October 2002. Metro in Germany has recently become a strong supporter of the MSC, carrying MSC-certified products. Migros was the first supermarket chain in continental Europe to sell MSC products. Migros has conducted several aggressive product promotions of the MSC product to their consumers, building consumers’ recognition of the logo and the logo’s meaning.

Delhaize, which has 117 supermarkets in Belgium, with 183 affiliated supermarkets and 148 smaller neighborhood grocery stores is enthusiastic about including MSC products in their product line. Delhaize has the third largest number of supermarkets in New England (Hannaford Brothers) with 86 stores and nine percent of the market (WorldCatch Wave 2002). Products marketed include Alaska salmon fillets and smoked Pacific salmon.

However, a German frozen seafood manufacturer, Frosta AG, reported a 7.6 percent decline in sales and an operating loss of US$9.1 million in 2003, which it blames largely on consumer disinterest in or lack of awareness of its MSC-certified line of New Zealand hoki and wild Alaska salmon (The Wave News Network 2004; Cherry 2005). The company is one of the largest frozen seafood manufacturers in Germany.

### Figure XVI-1 Availability of MSC-certified Alaskan salmon in the U.K. as listed on the MSC website as of September 2006. (MSC 2006b)

<table>
<thead>
<tr>
<th>United Kingdom</th>
</tr>
</thead>
</table>
| Store/Brand | Canned Alaska salmon: Pink salmon 105g, 212g, 418g  
Canned Alaska salmon: Red salmon 212g, 418g  
Sainsbury’s fresh Alaska salmon fillets (June to August - fish counter)  
Sainsbury’s smoked Alaska salmon: Coho 140g  
Sainsbury’s smoked Alaska salmon: Sockeye 160g  
Sainsbury’s salmon with a mozzarella and tomato crust 360g  
Sainsbury’s 2 Wild Alaskan salmon fishcakes 180g  
Sainsbury’s ‘Taste the Difference’ Wild Alaskan salmon fillets 240g  
Sainsbury’s Salmon goujons 200g  
Sainsbury’s Be Good to Yourself Wild Alaskan Salmon with Mediterranean sauce in herb breadcrumb 300g  
Pesto crusted wild Alaska salmon 300g |
|              | Wild Alaskan smoked silver salmon slices 100g  
Wild Alaskan smoked salmon 260g  
Wild Alaskan salmon fillets |
|              | Alaska salmon fillets in a lime and coriander marinade  
‘Go Cook’ 2 Alaska salmon fillets in a tomato and mascarpone cheese sauce 360g |
| Tesco         | Wild Alaskan Coho smoked salmon 140g  
Wild Alaska Sockeye smoked salmon 140g  
Fresh Alaska salmon fillets (seasonal) (fish counter)  
Wild Alaskan salmon paté 113g |
|              | Canned Alaska salmon: Pink salmon 213g  
Canned Alaska salmon: Red salmon 418g |
| Asda          | Pink salmon in watercress |
|               | 2 Alaska salmon en croute 370g |
| Iceland       | Frozen wild Alaskan salmon fillets  
Garlic & Herb Salmon Goujons 500g  
Salmon & Pasta |
| Young’s Bluecrest | ‘Simply Salmon’ Alaska salmon fillets in a garlic and herb crumb 240g  
‘Simply Salmon’ Alaska salmon fillets in a malted wholegrain crumb 240g |
| Birds Eye     | Breaded salmon nuggets 2kg  
10 Pacific salmon suprèmes 1.4kg  
20 Pacific salmon steaks 2.8kg  
12 Pacific salmon steaks 2.04kg  
Wholemeal breaded Alaska salmon portions |
| Brakes        | Smoked Alaska salmon 140g |
| Duchy Selections | Smoked Alaska salmon 140g |
Figure XVI-2 shows availability in the United States, which is not as deep or broad, although it has grown substantially between 2002 and 2005. All MSC salmon products sold in the United States are chinook, coho and sockeye products. Most MSC-labeled products are being sold outside the major national supermarket chains network and not reaching the average consumers, with the exception of a couple of recently introduced products appearing in Safeway. Wegmans, a regional chain in the mid-Atlantic, has introduced some MSC-labeled products as well.

In the United States, natural foods chains Wild Oats and Whole Foods Market have been strong supporters of MSC products, particularly Whole Foods Market. Whole Foods is the nation’s leading natural foods grocer currently selling many MSC-labeled products in more than 130 stores nationwide. Whole Foods’ vice president Ms. Margaret Wittenberg is quoted in the MSC annual report 2003/2004 as stating, “Our partnership with the Marine Stewardship Council allows us to actively demonstrate our commitment to improving the health of the world’s fisheries” (MSC 2004).

Whole Foods first carried MSC-labeled fresh salmon in June 2001. The following year, Whole Foods Markets kicked off sales of labeled Alaskan salmon in its stores with a big promotion in June and July 2002 called “Fish for Our Future.” The Fish for Our Future educational awareness campaign highlighted wild Alaska salmon, the first North American seafood species to earn an ecolabel from the MSC. They have reported strong interest and strong sales during the promotions. The 2004 promotion ran from June 15 through July 30, which included ‘Wild Alaska Salmon Week’ from June 30 to July 4. The primary species marketed was sockeye.

Whole Foods reports that wild salmon is becoming a larger part of sales in their chain. One of the key features of Whole Foods marketing of their seafood is that they do a marketing splash for seafood as it comes in season. For example, there is a large promotional effort in May to highlight fresh California king salmon. At the end of May Whole Foods highlights fresh Copper River salmon, followed by fresh sockeye and coho in June, July and August and so on. Finally, the supermarket chain is beginning to source high-quality frozen salmon for the off-season, to carry in addition to fresh farmed salmon. It is, however, hard to identify which product attribute—ecolabeled or fresh wild—is generating any premium price that Whole Food’s consumers might be paying.

Colorado-based Xanterra Parks and Resorts has become the first hospitality operation in the United States to undergo chain-of-custody certification for MSC-certified Alaska salmon. They promoted certified Alaska salmon in nine national parks during the summers of 2003 and 2004, including Yellowstone, North and South Rim at Grand Canyon, Crater Lake, Bryce Canyon and Zion National Parks.

In the summer of 2002, Washington-based SeaBear was the first U.S. firm to apply the MSC’s ecolabel to nationally distributed smoked salmon products. The logo is featured on their top-selling Copper River smoked salmon. SeaBear ships wild salmon direct to customers across the country as far away as the United Arab Emirates and also sells its products through high-quality retailers including Thriftway, Hannaford Brothers, QFC and Larry’s.

In November 2001, Norm Thompson Outfitters of Portland, Oregon, became the first catalog company in the world to offer smoked salmon products bearing the MSC label.

Is There Room in the Market for MSC-labeled Alaska Salmon to Grow?

Absolutely. The entire fishery is certified. At the moment, pending re-certification all Alaska salmon products are eligible to bear the MSC logo. The more appropriate question is “can MSC-labeled Alaska salmon take market share away from farmed salmon?” Figure VI-2, which shows world salmon consumption, shows that the EU is a very large market for fresh and frozen salmon, but the source is primarily farmed salmon. There is a perception that European consumers are more inclined to purchase environmentally-friendly product, therefore, it may well be that at some point in the future MSC-labeled Alaska salmon will begin to increase its market share in that market.

At the current point in time, little MSC-labeled product is being sold in the Japanese market, however, the current Integrated Strategic Plan of the MSC contains milestones that target development of the Japanese market for MSC products. There may become a point in time when the MSC label will be beneficial to Alaska salmon exports to Japan.

The U.S. market is a bit more perplexing. The Bridgespan Group reported that approximately five percent of Alaskan salmon is sold in the United States with an MSC logo, and certainly much of that is reaching the consumer through Whole Foods. As mentioned above, some of the largest firms processing, distributing and marketing salmon in the United States have MSC chain-of-custody certification, including

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4 It is worth highlighting that Whole Foods, Inc. is a 25-year-old company and the first and only retailer in the U.S. to have its retail operations designated as “Certified Organic” by Quality Insurance International, a federally recognized independent third-party certification organization (www.wholefoodsmarket.com). In addition, Whole Foods granted $225,000 over three years to create a fisheries manager position for the MSC. The role of the fisheries manager was to expand MSC’s outreach to sustainable and well-managed fisheries with a goal of introducing those fisheries to the MSC program, ultimately increasing the number of certified seafood products available to consumers, Kate Troll, formerly a policy analyst for the State of Alaska’s Department of Fish and Game, held this position while it was funded.
## Figure XVI-2
Availability of MSC-certified Alaskan salmon in the United States as listed on the MSC website as of September 2006. (MSC 2006b)

<table>
<thead>
<tr>
<th>United States</th>
<th>Store/Brand</th>
</tr>
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</table>
| **Whole Foods Market** | Whole Catch Wild Alaskan salmon burgers 363.5g  
Whole Catch Wild Alaskan cold smoked salmon 113g  
Whole Catch Wild Alaskan cold smoked salmon 227g  
Whole Catch Wild Alaskan smoked salmon eastern spice 226g  
Whole Catch Wild Alaskan smoked salmon traditional 226g  
Whole Catch Wild Alaskan smoked salmon asian 226g  
Whole Catch Wild Alaskan sockeye salmon fillets 340g  
Fresh Alaska salmon fillets (in season) |
| **Wal-Mart** | Aquacuisine: 'Seafood Tonight' brand Alaska salmon patty cakes 199g  
Wild Alaska salmon fillets 454g  
SmartyKat BenefitBitz Natural salmon treat 56g |
| **Wildcatch** | Frozen Coho Alaska salmon fillets (sold in Wild Oats stores)  
Frozen Sockeye Alaska salmon fillets (sold in Wild Oats stores)  
Smoked Alaska salmon (sliced) 114g (sold in Wild Oats and Whole Foods Market stores)  
Peppered smoked King salmon 170g (sold in Wegman’s and Whole Foods Market stores)  
Smoked King salmon 170g (sold in Wegman’s and Whole Foods Market stores)  
Canned Alaska salmon 106g, 213g (sold in Whole Foods Market stores)  
Natural Salmon Jerky 114g (sold in Whole Foods Market stores)  
Wildcatch: Alaska sockeye salmon burger patty 114g (sold in Whole Foods Market stores) |
| **www.seabear.com** | Copper River Sockeye smoked salmon 170g, 450g  
Smoked Alaska Sockeye salmon pouch 227g |
| **www.vitalchoice.com** | ‘Wild Red’ canned Alaska salmon 106g, 212g  
Wild Alaskan sockeye salmon oil capsules (90 and 180 capsules)  
Alaska sockeye salmon pouch 170g |
| **Norm Thompson** | Copper River Sockeye smoked salmon 170g (Christmas season) |
| **Xanterra Parks and Resorts (selected outlets)** | Alaska salmon: fillets, fishcakes, burgers and smoked |
| **Ducktrap River** | Sliced Alaska coho cold smoked salmon 113g  
Sliced Alaska coho bagged smoked salmon 113g |
| **www.takustore.com** | Hot Smoked Alaska Sockeye Salmon Fillets 1.3-1.8 lb  
Hot Smoked Alaska Sockeye Salmon Pieces 0.15lbs-0.75lbs  
Cold Smoked Alaska Sockeye Salmon Fillet 1.5lbs  
Cold Smoked Alaska Sockeye Salmon Trays 6oz  
Cold Smoked White Alaska King Salmon Trays 6oz  
Alaska Salmon Jerky plain or peppered 3oz or 6oz  
Taku Smoked Alaska Salmon Spread 8oz  
Taku Wings (Smoked Alaska Salmon Belly Fins) 6oz  
Smoked Alaska Salmon Snack (Hot smoke sockeye, king or coho salmon) 2oz  
Fresh Frozen Alaska King Salmon Steak - 0.5-1lb |
| **Safeway** | Wild Alaska Sockeye cold smoked salmon 113g  
Wild Alaska Sockeye hot smoked salmon 113g |
| **Trident** | Trident brand Premium wild Alaskan salmon burgers 1.367 kg |
| **Ocean Beauty** | Sea Choice brand Alaska sockeye salmon fillets 340g  
Sea Choice 4 Wild Alaskan Salmon Burgers 363g  
Sea Choice 4 herb crusted Wild Alaskan Salmon Burgers 363g |
| **Gold Seal** | Wild salmon oil capsules 1,000mg (120 capsules) |
| **www.nmwtlandtrust.org** | Bristol Bay canned Alaska red sockeye salmon 418g |
| **Odyssey** | Wild Alaska sockeye salmon 908g (sold in Sam’s Club stores) |
| **Seafood Producers Cooperative** | Alaska salmon fillets (for export) |
| **Portlock** | ‘Pure Catch’ Wild Alaskan sockeye salmon fillets |
some of the largest canning firms. Therefore, it is somewhat puzzling that we do not see more MSC-labeled salmon in fresh/frozen and canned product forms in the major supermarket retail chains in the United States, other than Whole Foods. The puzzle continues with the Alaska Seafood Marketing Institute (ASMI). As recently as June 2005, ASMI ran a full page advertisement of grilled Alaskan salmon in *Bon Appetit, Cooking Light and Sunset* magazines and the advertisement did not contain the MSC logo or any mention of the MSC certification of the Alaskan salmon fishery on it (Alaska Seafood Marketing Institute 2006) The audience reached by those magazines is possibly the most likely audience to purchase ecolabeled salmon, and yet they are not being informed of the ecolabeled product. No explanation for this has been given that the authors of this report are aware of. The MSC label cannot assist Alaskan salmon in competing with farmed salmon imports if it is not referred to in marketing materials.

With respect to a lack of logos on canned salmon sold in the United States, many companies label their canned salmon with ‘Pacific’ in order to be able to freely switch between Alaska and British Columbia salmon into the product as supply and prices dictate. This removes the costs of maintaining separate labels for each product. Until British Columbia salmon is certified, they may not wish to use the MSC logo.

While the Alaska industry may not be creating a supply push for MSC-labeled salmon, Alaska salmon may benefit from an increase in demand-pull for MSC certified products on both sides of the Atlantic in the future. With the recent announcement of Wal-Mart to carry only seafood from MSC-certified fisheries within the next three to five years, wild salmon sold by Wal-Mart will be certain to carry the MSC logo (McGovern 2006). Given that Wal-Mart also sells farmed salmon, this will set up an interesting competition between the two products.

The MSC is focusing significant attention on Europe to expand the market for MSC-labeled goods. As one can see on the MSC website (www.msc.org), there is a greater diversity and increased market penetration of ecolabeled Alaskan salmon into the European market, particularly Switzerland. The future looks bright for an expansion of the market for ecolabeled salmon in the European market for a couple of reasons: a) Consumers in Europe appear more inclined toward environmentally-friendly products, and so demand, with sufficient brand advertisement, may increase; and b) industry in Europe is encouraged to engage in environmentally-friendly activities for many reasons, including reporting their activities in sustainability to shareholders in their annual reports. Furthermore, there is increasing activity on the part of retailers in Europe to procure seafood from sustainable sources which may create further demand pull for MSC-certified seafood, including Alaskan salmon.

The net impact of the increasing demand for MSC-certified seafood on Alaskan salmon is uncertain, but with an overall positive effect. It is likely to have disproportionate impacts across the various species with more positive impacts on the higher valued species – chinook, coho and sockeye. Most sockeye salmon continues to go to the Japanese market, which will remain largely unaffected in the near term at least. However, as competition within the Japanese salmon market grows, a growing market for MSC-labeled sockeye salmon in the United States and Europe would prove beneficial to the Alaska industry. The sheer size of the chum and pink salmon catch implies that the current size of the market represented by Wal-Mart and other corporations who may follow their lead in the United States and the retailers in Europe may be insufficient to significantly impact prices. In addition, they are focusing on fresh/frozen products, not the processed products into which chum and pink are typically produced. However, the European market sells pink and chum salmon with the MSC logo, and while this market is only a small fraction of the total landings of pink and chum, it is a positive market development.
References


Seafood Labeling Programs and Their Potential Implications for North American Salmon

Key Points

- New mandatory labels identifying country-of-origin and whether the salmon was farmed or wild are in use as of April 2005 by most retail establishments. These labels provide no obvious incentives to improve either the environment or sustainability of salmon resources. They may provide incentives for the farmed salmon industry to make changes within their production systems.

- Costs to producers of supplying country-of-origin labeling are non-trivial. The major cost comes from maintaining traceability of the product from production to the retail outlet and costs of adjusting information on labels.

- It is not clear how consumers will react to country-of-origin labeling, or whether they will be willing to pay a premium for salmon products that cover the additional costs imposed on the distribution chain.

- Organic standards for aquacultured products have been drafted by the National Organic Program Aquaculture Working Group, but no standards have yet been drafted for wild products. The latter standards will be created within an environment of significant controversy as organic agricultural producers and the National Organic Standards Board are strongly opposed to certification of wild fish as organic.

Introduction

Ecolabels are not the only labeling that consumers are being introduced to. In all cases, the logic is that consumers have the right to know as much about the products they purchase as possible.

With respect to seafood, consumers already receive mandatory information on nutritional content of the top 20 most-consumed seafood products, through labeling at the fresh seafood counters of their supermarkets. Many consumers have seen warnings in restaurants and in the newspapers concerning the safety of consuming certain types of seafood, due to several factors including taint from pollution.

While country-of-origin information is often voluntarily given with fresh, frozen and otherwise processed seafood in the United States, as of April 2005 this information is mandatory, in addition to information on country-of-processing. Furthermore, beginning April 2005, the product must also be accompanied by labels indicating whether it was produced by farming or captured wild.

Moreover, there are plans to create standards for organic wild seafood products within the United States that have been vehemently opposed by the organic agricultural community. Also controversial, but from different perspectives, are the drafted standards for organic farmed fish products.

This chapter will discuss these labeling programs, and assess the potential implications for Alaska salmon.

Food and Fish Labels: What do they mean?

Country-of-Origin Labeling

As industries find themselves competing in increasingly competitive global markets, they often look toward new ways to differentiate themselves from the competition. The U.S. agricultural producers led the way lobbying for country-of-origin labeling on food products within the United States. It was intended to create a marketing advantage for U.S. products. The assumption is that the consumer will see the ‘Product of the United States’ label and prefer that product above other nations’ produce.

There is similar mandatory labeling regulation already in place in the EU, instituted in 2002. According to EC

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1 Recall from Chapter II that ‘wild’ salmon from Alaska includes ranched (or hatchery-bred and raised) fish, which are released to the wild and become part of the ‘wild’ catch.
Regulation No. 2065/2001, the label must state country of origin, farmed versus wild, and if wild, the catch area at sea.

In the United States, legislation in the 2002 Farm Security and Rural Investment Act (generally known as the ‘Farm Bill’) allowed for two years of voluntary compliance with the country-of-origin labeling, with mandatory compliance following in September 2004. The USDA produced guidelines in 2002 that apply to fresh and frozen meat (beef, pork and lamb), fish and shellfish, peanuts and perishable produce (fruits and vegetables). After 2004, firms supplying covered seafood commodities to retailers were required to maintain a verifiable record-keeping audit trail that identifies the country of origin and country of processing. Mandatory compliance for all products except seafood was postponed, but country-of-origin labeling is now mandatory for all fish and seafood as of April 2005.

Under the interim final rule, fish and shellfish covered commodities must be labeled at retail, unless they are an ingredient in a processed food item (USDA/AMS 2004). Foodservice establishments such as restaurants, bars, lounges, food stands, and cafeterias are exempt. COOL requires that suppliers and centrally located retail records are maintained for one year. This interim final rule became effective in April 2005.

The law also requires seafood to be labeled as either wild or farmed. To obtain a “US Product” label, farmed seafood must be hatched, raised, harvested and processed in the United States; wild-caught seafood must be either caught in the waters of the United States or by a U.S.-flagged vessel, and also must be processed in the United States or aboard a U.S.-flagged vessel. Under that definition, hatchery salmon would be considered wild.

The American Frozen Food Institute (2003) has called it the ‘Bill of Unintended Consequences,’ with unintended confusion regarding what exactly constitutes “Made in the USA.” The USDA estimates cost of country-of-origin labeling and record-keeping for all products affected—fresh and frozen meat (beef, pork and lamb), fish and shellfish, peanuts and perishable produce (fruits and vegetables)— will be $628 million to retailers, $340 million for food handlers, and $1 billion for producers. It is unclear what the costs to the seafood industry alone will be.

Retailers are uncertain about the costs of compliance and enforcement. In a General Accounting Office report (GAO 1999) there are several sources of costs to retailers that apply particularly well to the seafood industry. In the case of the fresh seafood counter, retailers would have to display the same seafood item from different countries separately — for example, salmon from Chile would sit next to salmon from Canada next to salmon from Scotland. Retailers may not have sufficient fresh seafood counter space to accommodate this, although it is generally rare that retailers sell fresh salmon from several sources concurrently. In addition, seafood shipments generally vary from week to week, such that retailers incur costs of changing store signs and labels to reflect the origins of different shipments. As a result of these costs and potentially others, retailers might take one of several possible strategic approaches. The retailers might pass some or all of the costs down to their suppliers, or on to the consumers. They may also decide to stock more prepackaged seafood, which would already be labeled.

The costs of changing labels to reflect changing country-of-origin and country-of-processing are amplified when dealing with processed product, such as frozen products. These costs primarily affect those who are packaging the product, typically processors. There is worry that the contents of the label will only cause consumers confusion, rather than being very informative. The Food Marketing Institute in the United States has stated that the labeling program is expensive, complicated and that it is not in the best interest of the consumer (Fiorillo 2002). The only major impact on consumers seen by this group is an increase in prices.

In Europe, the country-of-origin regulation is in its growing stages. The United Kingdom recently passed the legislation it needed for the labeling program, but not everyone is happy with how it turned out. For example, if retailers in the United Kingdom source their farmed salmon from several different countries, then the retailers can label their salmon as ‘farmed in Scotland, Norway or Chile’ (Cameron 2003).

An added element to the country-of-origin labeling is that the label must also state whether the product is farm raised or wild caught. This applies in both the European Union and United States.

As of June 2005, the Food Marketing Institute found in a survey of shoppers that only 2 to 3 percent looked for country of origin when buying meat, produce or seafood (Primedia Business Magazines & Media 2005). These consumers visited the grocery store on average 2.2 times per week and spent an average of $92.50 per week per household.

Color-Added Salmon

The U.S. Food and Drug Administration (FDA) requires retailers to label food containing color additives, and as such, retailers nationwide are being told to label farmed salmon as having color additives. This requirement has been in place for since 1995, but is only now being enforced as a result of a lawsuit against three large retailers, Kroger, Safeway and
Albertsons. The lawsuits seek millions of dollars in damages for plaintiffs who believe they were tricked into paying too much for farmed salmon that did not indicate that it contained the colorants ‘canthaxanthin’ or ‘astaxanthin’ (discussed in more detail in Chapter V). The FDA has ruled that both of these are safe for human consumption.

The justification for the label is that food safety may be compromised if there are artificial colors added. In this case of an additive to feed, not significantly different to what is done in the poultry industry, what information is conveyed to the consumer? In one example, very naïve consumers might believe that ‘color-added’ simply means someone behind the seafood counter puts red dye on the fillet before setting it in the seafood counter. With no accompanying education, consumers are confused and potentially misinformed. In a particularly egregious example, in an editorial in the *Pittsburgh Post-Gazette*, readers are told that salmon are ‘…“sprayed with a coloring that can damage human eyes and cause allergic reaction” and that the spray is a “spray paint,” none of which are true’ (*Pittsburgh Post-Gazette* 2004).

To ensure that consumers are provided information on exactly how farmed salmon are provided the canthaxanthin or astaxanthin, as additives in their feed, the international salmon farming organization Salmon of the Americas has created a web site (www.salmonoftheamericas.com) from which retailers can download labels to display at their seafood counters.

**Organic**

Organic food is produced by farmers who emphasize the use of renewable resources and the conservation of soil and water to enhance environmental quality of future generations (www.usda.gov). Organic meat, poultry, eggs and dairy products come from animals that are given no antibiotics or growth hormones. A certifier inspects the farm where the food is grown to make sure the farmer is following all the rules necessary to meet organic standards. The term ‘organic’ on a food product describes a complete system of production that begins on a farm, according to the Organic Trade Association in the United States.

From a marketing perspective, growth in retail sales of organic products in the United States has equaled 20 percent or more annually since 1990. Organic products are now available in nearly 20,000 natural foods stores, and are sold in 73 percent of all conventional grocery stores (Dimitri and Greene 2002). The organic industry in the United States is forecast to grow at a steady pace over the next 20 years, but slower than the 20 percent pace of the previous 16 years, according to the Organic Trade Association (IntraFish Media 2005). The market in the United Kingdom is also a growing market, with organic meat and poultry sales growing at 150 percent between 2000 and 2005 (Cherry 2005).

Current organic standards in the United States apply only to agricultural products, but in the European Union organic standards apply to agricultural products and farmed fish. The U.S. Organic Foods Production Act of 1990 (OFPA) leaves the door open to allow for organic standards for fish and shellfish because it includes ‘fish used for food’ within the definition of livestock. This language provides the authority for the USDA to establish national standards for the production, handling and labeling of these products when they are to be sold, labeled, or represented as organic. The USDA interprets the OFPA language to include both finfish and shellfish.

Due to public interest among some groups in the development of organic standards for both wild and aquacultured fish and shellfish, during April-May 2000 the National Organics Program (NOP) conducted public meetings in Mobile, Alabama; Anchorage, Alaska; and Providence, Rhode Island. These meetings showed little consensus on organic certification of products derived from aquatic animals. Commentators both favored and opposed developing production and handling standards for aquatic animals.

In order to more fully examine the issues raised by the commentators, the National Organics Standards Board (NOSB) formed an aquatic animal task force at its June 2000 meeting. In October 2001, this task force issued a general recommendation calling for the development of standards for the certification of aquaculture production and a prohibition on the development of standards for the certification of wild-harvested aquatic animals.

However, since 2001, the interest in the certification of aquatic animals has grown significantly. Some USDA-accredited organic certification agents have developed private standards to address the market demand for these products. Most recently Senators Ted Stevens and Lisa Murkowski from Alaska were able to add an amendment to a defense spending bill to mandate the USDA to generate standards for organic wild fish. A rider to the Supplemental Appropriations Bill, passed by Congress in April 2003, resolved any previous uncertainty about whether organic standards for wild-harvested aquatic animals could be developed under the authority of the OFPA. The Organic Trade Association in the United States is against this, because in their view ‘organic’ is being misconstrued to mean ‘natural.’

Why is there controversy over organic wild seafood? In the simplest terms, organic requires that the producer be in control of the product from the start, to control its environment and its nutrition sources. Wild fish swim through uncontrolled water and eat uncontrolled food. There is no control whether a fish

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swims through clean water or polluted water, similarly no control over what the fish consumes. In contrast, uncontrolled water and food are less of an issue with aquaculture. The aquaculturist controls the water quality by deciding where to place the pens. The amount and type of food is monitored. Recently, the USDA also determined that as fishmeal is non-synthetic and fishmeal is preserved with natural substances it may be allowed as a feed additive or feed supplement (USDA 2005).

In June 2005 the USDA National Organic Program’s Aquatic Animals Task Force—Aquaculture Working Group was appointed to determine standards for organic aquaculture production. Another has yet to be formed, as of April 2006, for wild-caught fish and seafood. The Aquaculture Working Group released draft organic standards for the production, handling and labeling of food and animal feed products derived from aquatic animals in January 2006 for consideration by the full task force, which were released for public comment (USDA 2006). After the public comment period, the NOSB will decide whether to recommend the standards be put into rule by the USDA.

Internationally, several countries and international organizations have created standards for organic aquaculture. Tacon and Brister (2002) indicate that there are approximately 20-25 private and non-private certifying bodies with a diverse set of aquaculture standards that sometimes vary considerably from country to country, certifier to certifier, and species to species. The International Federation of Organic Agriculture Movements (IFOAM) is another international body that is attempting to create guidelines that will normalize organic production and certification worldwide.

**Implications for the Alaska Salmon Market**

Consumers in two of the largest seafood markets in the world, the United States and European Union, are faced with mixed messages regarding the quality of seafood available to them. On the one hand, they have been told often that seafood promotes good health. On the other hand, they are being told that fish contains mercury and PCBs, that there are artificial colorants being added to their fish, and that by purchasing certain types of fish they are encouraging misuse of the resource or environment. They are caught up in a controversy in which the terms ‘natural’ and ‘organic’ are being used interchangeably, and the consumer may or may not know the distinction between the two.

Country-of-origin labeling and production method labeling further complicate the messages.

What are the implications of these new labeling initiatives and issues for the Alaskan salmon industry? Participating in voluntary labeling programs may be costly. The industry needs to weigh the costs of participating against the expected benefits. If consumers are willing to pay more for products that have particular attributes discussed in this chapter and in Chapter XVI, then the industry’s costs of providing that information may be covered. Economic theory tells us that industry should provide the information the consumer demands up to the point where marginal costs of providing the information is equal to the marginal revenue received for the product’s attribute, in other words, to the point where the expenditure of an additional penny in providing the information is equal to the additional penny received in the price of the product.

There are many sources of costs for the labeling discussed in this chapter. There are the costs of changing labeling on product packaging. In the case of country-of-origin and in farmed/wild labeling there are costs of changing packaging as frequently as sources change. However, most significant of all post-harvest costs for any labeling program may be traceability and maintenance of chain-of-custody.

Traceability is an identity preservation system. It involves being able to identify the origin of a particular unit and/or lot of products within the supply chain, and the capacity to track the path of a particular unit (USDA/ERS 2002; Carvajal 2003; Derrick and Dillon 2004). Generically, traceability is the ability to trace, follow and uniquely identify a product unit or batch through all stages of production, processing and distribution. It shows the path of that unit or batch through all the intermediate steps of the product flow and the supply chain. This information does not necessarily need to be entirely contained on the product label; some may be contained in company records. However, it must be verifiable. In the regulatory framework for providing consumers with information regarding seafood products, it requires that the information concerning the commercial designation, the production method, scientific species name, and the catch area shall be available at each stage of marketing of the species concerned.

How is this accomplished? For example, for a wild fish, a processor would need to know the country of origin, and segregate and label product accordingly. Records which help ensure traceability might be transportation records, receiving records, processor plant identification system, sales receipts, shipping manifests, inspection records, segregation plan, production records, inventory records, UPC codes, location of harvest, etc. For a processor of farmed fish, the list might look very similar. An owner of a hatchery would have to identify and segregate fingerlings as to the origin of destination, properly label and identify all marketable size fish sold, maintain the integrity of the identification and maintain ownership transfer records. Clearly, this is not costless. ‘The supplier that can clearly trace the journey of his seafood from sea to
plate will be a valued friend of buyers who are now facing lawsuits (such as U.S. supermarket chains) and new regulations pertaining to the labeling of the seafood they sell consumers,’ states John Fiorillo, the editor of The Wave News Network (Fiorillo 2003).

What Information do U.S. Consumers Want?

The industry is likely to have a good understanding of how much traceability, preserving the identities of a product with emphasis on the types of attributes discussed above, will cost. What is less well known is how much consumers are willing to pay. In the case of labeling, conveying information on a negative attribute of fish (for example, added color) not only might the industry incur more costs from the labeling requirements, but the consumer might also want a price discount on that product.

Consumers hold the answer whether labeling programs will be successful or not. Consumers signal to the industry their willingness to pay for these attributes and labels regarding these attributes. If, for example, there is no willingness to pay more for knowing that the seafood product is organic, then that sends a strong signal to industry to drop plans to pursue production of organic seafood.

There has been little research done on the actual value of various types of information on consumer demand for labeled seafood products. To do a rigorous scientific study, generally the researcher needs to know retail prices and quantities sold, prices and quantities sold of competing products (perhaps same species but non-labeled), and characteristics of the consumers. Such data is difficult to collect.

Data can be obtained at a cost at the retail level from Universal Product Codes on prices and quantities, by brand, but this data is only available for processed seafood products, and does not include with it information on the country-of-origin of the product nor any other information contained on the packaging. Data from fresh full-service seafood counters can only be obtained in collaboration with the retail outlet, which is usually not a relationship retailers cultivate with researchers.

Implications

It is not easy to predict exactly how U.S. consumers will react to increased labeling of salmon—country of origin, farmed versus wild, organic, ecolabeled and color-added. In theory, the country-of-origin of salmon should not have much of an impact, especially if consumers believe that U.S. authorities are doing their job ensuring that imported salmon, regardless of country of origin, meet or exceed U.S. safety standards. In addition, the foreign sources of salmon (Norway, Chile, Scotland, Canada and Ireland) are not viewed as nations with poor hygienic standards. On the contrary, there are many very favorable views of these countries. ‘Buy American’ continues to pull in many consumers, however.

Similarly, it is difficult to predict whether or not organic salmon will be in demand by the consumer. Organic agricultural products have been on the market for many years, yet have only achieved approximately two percent of U.S. grocery sales—although they have generally trended upward.

Regardless of consumer demand for salmon with specified country-of-origin, farmed versus wild, organic versus not organic, etc., will any of these labels have an effect on the sustainability of Alaskan wild-caught salmon? The answer is ‘probably not.’ None of these labels are likely to change the methods by which salmon are caught or harvested in the United States or any of the other source nations. None are likely to improve management policies for wild salmon, or provide incentives to discontinue hatchery enhancement of the fisheries. None are likely to make wild salmon more sustainable. Nor do they necessarily need to do any of these things.

In fact, the primary positive impacts of such labeling programs may occur in supplies of farmed salmon. As the European Union continues to certify organic farmed salmon, fewer antibiotics and other chemicals will be used in the farmed salmon industry. As the United States pushes ‘color-added’ labeling, the world farmed salmon industry will expedite its research into finding lower cost, plant protein-based fish feed that does not contain the color additives of concern to some. As more focus is put on the country-of-origin of farmed salmon, there may be more effort on the part of farmed salmon exporting nations to ensure the environment around culture areas are pristine, and perform better in ratings of environmental groups. In other words, labeling is more likely to provide incentives for aquaculturists, who can control the production process for their products better than fishermen, to supply what the consumer demands and capture the gains from the market.

However, there is a bright spot for Alaskan salmon. Namely, the label ‘wild’ salmon appears to be very important in the market at the moment. As mentioned in the previous chapter, while ASMI is generally not utilizing the MSC logo in their marketing materials, they are certainly highlighting the fact that their product is wild and ‘natural’. Restaurants and supermarkets, chains and independents across the country are also emphasizing that Alaska salmon is a wild product. This, in combination with some other factors as discussed in other chapters, may have had some positive impact on prices for the higher valued species (chinook and coho) during 2004-2005.
References


The Great Salmon Run: Competition Between Wild and Farmed Salmon
The Future of Salmon Aquaculture in North America

Key Points

✓ There is little doubt that most of the future growth in world salmon supplies will occur because of aquaculture, rather than increased harvests of wild salmon stocks. Salmon aquaculture will continue to develop in Northern Europe and to a lesser degree in North America (particularly Canada) but currently Chile has the greatest potential for growth.

✓ Aquaculture offers great advantages over capture fisheries, such as consistency of supply, year-round availability, greater quality control, and the possibility of longer-term contracts. In addition, the aquaculture sector is more attentive and has a greater capacity to respond to market demands. For example, large restaurant chains and supermarkets will increasingly source their supplies of fresh salmon from aquaculture. Wild salmon appears to be moving more toward the market extremes (Knapp 2001). On one hand, wild salmon are being sold into niche, high-end markets (e.g. Copper River salmon), and on the other hand, the bulk of the wild salmon is moving into certain low-end markets, such as frozen and canned fish (esp. pinks and chums). Because aquaculture contributes to low salmon prices, the economic incentive to enter into traditional salmon fisheries is reduced (Anderson 1985).

✓ Over the last two decades the global industry has been affected by cyclical movements of prices but consolidation processes and diversification into other species could bring some stabilization in the next years. Provided certain environmental concerns related to the integrity of wild stock populations and fishmeal content in salmon diets largely can be addressed, the future of the global salmon industry appears to be continued growth.

✓ However, the same cannot be said of the aquaculture industries in North America given the competition with overseas producers, heavy regulatory pressure, and confrontation with environmental groups. The U.S. ocean-pen salmon aquaculture industry may see some growth, but it will more likely contract in the near future. The Canadian ocean-pen aquaculture industry may see some growth in the future, but farmers will continue to struggle with stringent government regulations and opposition from environmental groups, particularly in British Columbia.

Farmed Salmon Production Trends

There is little doubt that most of the future growth in world salmon supplies will occur because of aquaculture (Anderson 2002). This is a fact recognized even by opponents of aquaculture development. According to FAO statistics, salmon aquaculture exceeded landings from capture fisheries for the first time in 1996. By the year 2001, aquaculture already accounted for more than two-thirds of world salmon supplies (FAO 2003). While world salmon fisheries have hovered around 0.8 million metric tons during the last 10 years, farm production has grown at an annual average rate of 11% in the same period. All indications are that this trend will continue in the future.

Commercial salmon aquaculture started in Norway more than 25 years ago and for many years Norway was the dominant farm-raised salmon producer. However, the combination of ideal environmental conditions, widespread availability of suitable sites, and a favorable business climate fostered by a supportive government make Chile the country with the highest potential for future growth. FAO world statistics for 1999 indicate that Norway’s production exceeded Chile’s by around 150,000 pounds. However, two years later Chile had closed the gap and matched Norway’s production at slightly over 500,000 pounds. Chile has the potential to become the largest salmon producer in the world.
Bjørndal (2002) estimates that the average annual growth rate for the Chilean industry in the near future will be in the range of 20-30%, considerably lower than the historical average (annual growth was 55% between 1984 and 2001) but still rapid for an industry that is maturing. Expansion will hinge on infrastructure development (roads, shipping ports, processing plants) in the southernmost regions of the country, where environmental conditions for salmon aquaculture are ideal. Japan and the United States have traditionally been the most important markets for Chilean producers and they will continue to be in the foreseeable future. The United States will likely be the target of increased salmon production from Chile as a relatively strong U.S. dollar will continue to favor seafood imports. Chilean exports to Latin American countries such as Brazil have increased in recent years, but these alternative outlets will remain small in comparison to the predominant U.S. market. Attempts to gain a sizable share of the European market have been difficult to date given the stiff competition with Norway. This situation is unlikely to change in the forthcoming years.

Trends in Product Development

The future salmon industry will require the development of innovative products to satisfy the existing needs of the market. A major breakthrough already occurred with the introduction of chef-ready pinbone-out (PBO) fillets in the mid-1990s by Chilean producers, which paved the way to increasing production of salmon fillets as compared to whole fish. In the United States, for instance, fillets have been the predominant product form since the year 2000. New product development will imply a greater degree of processing in the producing countries. In this regard Chile will have a competitive advantage over other countries (Norway, Canada, Scotland) because of its lower labor costs. To date, U.S. processors have had difficulty in competing with the PBO fillet.

Future marketing strategies for farmed salmon will most likely exploit convenience and the health-related attributes of salmon as compared to competing protein sources such as beef and chicken. These strategies will focus not only on the individual consumer but also on the needs of large-scale purchasers such as chain restaurants and supermarkets. Aquaculture has been favored by major seafood purchasers because of its consistency of supply, year-round product availability, and high-quality assurance. This segment of the market, particularly chain restaurants, is increasingly demanding a wider availability of convenient, ready-to-serve, portion-controlled products. Aquaculture will most likely satisfy these market demands through continued innovation in product development. In contrast, the marketing efforts of the wild suppliers have focused on negative environmental and health-related attributes of farmed salmon (such as the risk of the presence of contaminants) and the positive image of ‘wild’ salmon.

Technological Improvements in Aquacultural Production

Technological improvements in salmon aquaculture have resulted in a consistent decline in production costs over the last two decades. Farm operation has improved to the point that labor and energy costs represent now a very low share of total costs. Improvements in feeding systems and feed management have also considerably reduced feed costs, but to a lesser extent than other operating costs. As a result, feed is expected to become a greater share of total cost in the near future, even though overall costs of production will continue its downward trend. Almost every imaginable aspect of salmon farming (breeding, feeding systems, disease management) will see improvements through continued investment in technology.

There has been some recent controversy on the use of fishmeal in commercial salmon feeds. Critics argue that feeding carnivorous fish such as salmon leads to a net loss of fish supplies because salmon farms consume more fish (as feed) than they produce (Naylor et al. 2000). Industry advocates maintain that salmon are very efficient converters of feed into edible flesh, consuming only 1.1-1.5 pounds of feed for every pound of meat produced (Forster and Hardy 2001). In comparison, chickens require about two pounds of feed for every pound of meat that is produced. Other authors (Asche and Tveterás 2004) refute the existence of a ‘fish meal trap’ limiting growth since increased demand for feed cannot affect reasonably well-managed fish stocks in reduction fisheries, and even if stocks are mismanaged, fish feed demand will not have an effect as long as the fishmeal and oil markets are integrated with the similar but much larger vegetable meal and oil markets.

Although the fishmeal dispute may remain unsettled in the near future, feed companies are continuously looking for alternate ways to reduce the proportion of fishmeal in salmon feeds. In fact, fishmeal content has been reduced from 70% in 1972 to 35% today (Loder 2003). Salmon feeds will continue to shift away from fishmeal towards plant ingredients (soy, rapeseed oil, and corn gluten) as protein sources while reducing the amounts of key fish oils to the extent possible. New feed technologies will also reduce the amount of nutrients that is leached from feed pellets.

Disease management is another aspect of environmental concern that will see substantial improvements in the future. The development of vaccines has brought about large reductions in the use of antibiotics and other chemicals. In Norway, the use
of antibiotics in salmon farming has been cut by 98.8% since the mid 1980s as a result of vaccination, making Norwegian salmon rank lowest in the world in use of antibiotics per kg of meat (IntraFish 2003). Disease outbreaks in salmon farms will be better managed in the future, and this will contribute to reduced risk of exposure to wild populations.

Salmon farmers have diversified into other species such as cod. Wild cod stocks have virtually been depleted in much of the North Atlantic region and as such there appears to be a clear opportunity for aquaculturists in this nascent industry. Considerable investments in R&D have already been undertaken in France, Norway, and Scotland. Diversification into production of other species may contribute to reduce supply growth of salmon, and strengthen prices for salmon (Roberts 2003).

The North American Salmon Farming Industry

Although farmed salmon is likely to extend its dominance over global supply, ocean-pen salmon aquaculture in North America will continue to face numerous obstacles. Low-cost producers (e.g., Chile) will present formidable competition for domestic salmon farmers. The industry will also be subject to increased regulatory oversight (e.g., Endangered Species Act on the East Coast) and confrontation from environmental organizations on issues such as fish escapes and transfer of diseases to wild populations. Conflicts with other coastal resource users will continue to arise. Given continued strong opposition to salmon farming, Alaska’s moratorium on ocean-pen aquaculture will not be lifted in the foreseeable future. This will limit aquaculture in Alaska to the hatcheries which are used to release salmon to enhance the harvest of the commercial salmon fisheries. Despite this restriction, the salmon-ranching industry in Alaska is now considered its “largest agricultural industry” (Farrington 2004, p2.). While the U.S. ocean-pen salmon aquaculture industry could see some growth (possibly offshore or land based), it will more likely contract in the near future.

The Canadian ocean-pen aquaculture industry may see some growth in the future, but farmers will continue to struggle with stringent government regulations and opposition from environmental groups, particularly in British Columbia (PricewaterhouseCoopers 2003). Salmon pricing cycles will cause further consolidation of the industry, putting some companies out of business and forcing reorganization in the surviving firms. Currently, most Canadian salmon is exported as whole fish but more value-added processing such as PBO fillets is likely to occur in the future.
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Effects of Salmon Farming on North American Wild Salmon Resources

Key Points

✓ The potential direct effects of salmon farming on wild resources differ for different wild salmon producing regions of North America. How salmon farming might affect wild salmon resources depends in part on whether farmed species are native to the region. In the Northeast, both wild salmon and farmed salmon are Atlantic salmon, while in the other regions wild salmon are Pacific salmon while most farmed salmon are Atlantic salmon. In the Northeast, because wild and farmed salmon are the same species, there is relatively greater risk of genetic interaction between farmed and wild salmon and for transmission of diseases. In other regions, there is a risk of establishment of non-native Atlantic salmon.

✓ Potential direct effects salmon farming might have on wild salmon resources also depend on the proximity of salmon farms to wild salmon migration routes. North American salmon farming operations are concentrated in relatively small areas compared to the range of North American wild salmon resources. The largest wild salmon runs, in Alaska, are located great distances from any salmon farms.

✓ In theory, salmon farming could benefit wild salmon resources if salmon farming caused lower market prices which in turn led to lower commercial catches for over-fished wild salmon runs (Anderson 1985). But lower prices will not necessarily lead to lower catches, because in most wild salmon fisheries it would be possible to catch the available fish at lower cost by using fewer boats or more efficient gear. And lower catches would not necessarily benefit wild salmon resources, because the largest commercial salmon fisheries are not over-fished.

✓ Lower prices caused by farmed salmon could reduce the profitability of hatchery operations and erode political support for hatcheries, leading to a decline in hatchery releases. Potentially this could benefit natural wild salmon resources, to the extent that hatchery releases represent a risk to wild salmon stocks, as some critics allege.

Introduction

In earlier chapters, we have examined the economic and social effects of salmon farming on the wild salmon industry, and marketing and trade issues to which they have given rise. In this chapter, we look briefly at the effects of salmon farming on North American wild salmon resources.

Salmon farming may potentially affect wild salmon resources in many different ways, both directly and indirectly. Potential direct effects of salmon farming on wild salmon resources would occur as a result of interactions in the environment between farmed salmon operations and wild salmon. These include possible transmission of diseases, genetic interactions between wild fish and escaped farmed fish, or the introduction of non-native species which might compete with native wild salmon species. The extent to which these effects have occurred or might occur is controversial, and has been the subject of considerable debate. As economists, we have no independent expertise to add to this debate. We do not attempt to say what direct effects have occurred or might occur. Instead, we point out the differences in the relative potential significance of these effects for different salmon producing regions.

Potential indirect effects of salmon farming on wild salmon resources include changes in wild salmon catches, commercial hatchery releases and commitment to managing wild salmon resources for commercial fishing. In theory, some indirect effects might be positive while others might be negative.

Both the potential direct and indirect effects of salmon farming on wild salmon resources are uncertain. Clearly they vary widely between different salmon producing regions and for different species of salmon.
We cannot give any definitive answers about how significant these effects have been or might be in the future. Our goal is to provide a framework for thinking systematically about these potential effects.

Potential Direct Effects of Salmon Farming on Wild Salmon Resources

Table XIX-1 summarizes several potential direct effects of salmon farming on wild salmon resources. The potential significance of these effects varies for different wild salmon producing regions, for several reasons.

How salmon farming might affect wild salmon resources depends in part on whether the species are native to the region. If farmed species are native to the region—the same species as local wild salmon—then there is greater potential for escaped farm fish to interbreed with or out-compete wild fish, thus affecting the genetic diversity of wild salmon stocks. \(^1\)

Presumably there is also greater potential for transmission of disease\(^2\), although this may not be the case for all diseases. In contrast, if farmed species are not native to the region, then there is a risk that escaped farmed fish could become established in the region, with unknown ecological effects.

\(^1\) Potential effects on genetic diversity also depend on whether farmed fish are from local runs or from other areas—as with salmon hatcheries.

\(^2\) Transmission of disease can go both ways—farmed salmon can transmit disease to wild salmon, but there have also been cases where wild salmon have transferred disease to the farmed stock.
The relative potential significance of these two effects varies between the Northeast and Canadian Maritimes and other wild salmon producing regions, because in the Northeast both wild salmon and farmed salmon are Atlantic salmon, while in the other regions wild salmon are Pacific salmon while most farmed salmon are Atlantic salmon. Put differently, salmon farms in the Northeast presumably pose relatively greater likelihood of change in the genetic diversity of local wild salmon stocks and for transmission of disease to local wild salmon stocks, while salmon farms in the Northwest pose a risk of introduction of non-native Atlantic salmon.

How salmon farming might affect wild salmon resources also clearly depends on the proximity of salmon farms to wild salmon migration routes. Although there is some risk of disease transmission from farmed fish to wild stocks and from wild stocks to farmed salmon, clearly the risk of disease transmission is greater closer to salmon farms.

North American salmon farming operations are concentrated in relatively small areas compared to the range of North American wild salmon resources. While some wild salmon migration routes are close to salmon farms—in parts of Maine, New Brunswick, Nova Scotia, Puget Sound and British Columbia—most wild salmon never come near salmon farms, including almost all of the Alaska wild salmon which account for most North American commercial wild salmon catches, as well as the wild salmon returning to Newfoundland, Labrador, the Columbia River basin and California.3

Potential Indirect Effects of Salmon Farming on Wild Salmon Resources

Potential indirect effects of salmon farming on wild salmon resources are those which might occur as a result of economic, social and political effects of salmon farming on the wild salmon industry, wild salmon commercial hatcheries and wild salmon management. Table XIX-2 summarizes some of these potential effects.

As with direct effects, these indirect effects are complex, uncertain and difficult to quantify. However, their potential significance clearly varies for different wild-salmon producing regions.

Wild Salmon Catches

In theory, salmon farming could have a positive effect on wild salmon resources if salmon farming caused a reduction in wild salmon catches for salmon runs which would otherwise have been over-fished (Anderson, 1985). For this to happen, the following three effects would have to occur:

- Salmon farming causes prices to fall for wild salmon
- Lower prices result in lower wild salmon catches
- Lower wild salmon catches benefit wild salmon resources

The first of these effects has occurred. Salmon farming has caused wild salmon prices to fall (although it has not been the sole factor causing prices to fall). However, the second effect has not occurred to any significant extent, nor is it necessarily likely to occur in the future. Fewer permits are being fished, but not to an extent where wild salmon catches are decreasing.

Ordinarily, we would expect lower prices to result in lower catches in a wild fishery. However, this will not necessarily be the case in overcapitalized limited entry salmon fisheries, such as some Alaska salmon fisheries. To understand why, recall that these fisheries are regulated by managers to achieve goals for “escapement,” or the number of returning salmon which enter rivers to spawn. Any returning salmon above the escapement goal are considered surplus and available for harvest. Managers adjust the fishing opportunities in-season to allow boats to catch these “surplus” fish. Therefore, even if fewer boats fish or they fish less intensively, catches do not necessarily decline, because managers can increase fishing opportunities to adjust for the lower effort.

In this kind of fishery, as prices first begin to decline, lower prices result in lower profits, but all boats continue to fish. As prices further decline, some boats may leave the fishery, but the remaining boats are able to catch all of the available fish and lower prices are partially offset by higher average catches. As prices further decline and more boats leave the fishery, managers expand fishing opportunities for the remaining boats so that they can catch all of the available fish. Finally, if prices decline still further, political pressure is likely to lead to changes in fishery management to allow for the use of more efficient gear, such as salmon traps, which can catch fish at lower cost.

Thus, lower prices may—but not necessarily—lead to lower wild salmon catches. In Alaska, British Columbia and the U.S. Pacific Northwest, there has been little systematic empirical analysis of the extent to which the decline in salmon prices has affected salmon catches or escapement. It is likely that the effects of the decline in prices on catches vary by fishery and species, and that the effects have been greatest for lower-valued species (such as some Alaska pink-salmon fisheries) as well as for remote, low-volume higher-cost fisheries (such as those of interior and northwestern Alaska).

Even if prices fall far enough to cause wild salmon catches to fall, this will not necessarily benefit wild

3 Potential direct effects of salmon farming on wild resources in different regions are reviewed, from varying perspectives, in BC Environmental Assessment Office (2003); Gaudet (2001); Noakes et al. (2000); Volpe (2001); Waknitz et al. (2002); and Watershed Watch (2001). These are only a few examples from a large and growing literature debating the effects of salmon farming.
As we discussed in Chapter II, the explicit goal of managers in most commercial wild salmon fisheries is to manage fish sustainably, so that catches do not adversely affect the harvest from wild salmon resources or the potential for future wild salmon catches.

Note also that a decline in the number of boats fishing is most likely to cause a decline in catches in years of large salmon runs, when a smaller fleet may not be able to catch all of the available fish during peak periods of the run. However, reducing catches during years of large runs is less likely to benefit wild salmon resources. Lower catches would be more likely to benefit wild salmon resources during years of low runs, when escapement might otherwise be insufficient to meet spawning needs.

In mixed stock salmon fisheries, where fish returning to different streams are swimming together, lower catches may benefit salmon runs other than those for which managers are setting escapement goals. In theory, any significant commercial catches have the potential to adversely affect small runs in mixed stock fisheries (Anderson 1985). Thus, in theory no commercial fishing is without some risk to some wild salmon.
resources, and any reduction in wild salmon catches attributable to competition from farmed salmon would reduce these risks and thus tend to benefit these wild salmon resources.

In general, although it is clear that salmon farming has contributed to lower prices for wild salmon, there is little empirical evidence to suggest that lower prices have significantly contributed to healthier wild salmon resources by reducing catches. The extent to which such effects may have occurred likely varies widely by fishery. Clearly, the potential significance of any “reduction in over-fishing” effect varies by region. In the Northeast, because there are no commercial wild salmon fisheries, there cannot be any benefit from any reduction in commercial catches. In Table XIX-2, we speculate that a farmed salmon-driven decline in prices might benefit some U.S. Pacific Northwest, British Columbia and Alaska salmon resources.

**Hatchery Releases**

As we discussed in Chapter IV, hatcheries account for a significant share of North American commercial wild salmon catches. There is an ongoing debate about potential adverse effects of hatchery releases on natural wild salmon runs. In theory, salmon farming could cause a reduction in hatchery releases by reducing the profitability of hatchery operations and eroding political support for hatcheries. In turn, a reduction in commercial hatchery releases could benefit natural wild salmon resources. Arguably, salmon farming may be partly responsible for the levelling off of Alaska hatchery releases during the 1990s after rapid growth in releases during the 1980s.
References


The Great Salmon Run: Competition Between Wild and Farmed Salmon
Outlook for the Future and Recommendations

Before summarizing, discussing the future outlook, and providing recommendations for future actions, it is useful to return to the objective of this report: increase the understanding of the economic interactions between North American wild salmon and domestic and imported farmed salmon.

The most important factor driving change in world salmon markets and prices has been rapid and sustained growth in world farmed salmon and salmon trout production. This has fundamentally transformed world salmon markets—fostered not only through the dramatic growth in total supply, but also by the changes in the kinds of salmon products which are available, the timing of production, market quality standards and organization of the industry.

The focus of the report has been on the changes which are occurring in wild salmon fisheries in North America. While farmed salmon is responsible to some extent for the long term trend of lower prices for wild salmon, it is definitely not the only reason for the lower prices or for the economic difficulties currently faced by many of the wild salmon fisheries. However, from the overall decline in prices comes a series of ripple effects that have spread through the entire market chain—retail to ex-vessel. Individuals from consumers to wholesalers, processors and fishermen are all in some way impacted by the structural changes that have come about in the last 15 years, partly because of the growth of farmed salmon production. To describe and explain these changes, the report examines the economics of the industry and the economic impacts of changes in the marketplace.

In considering how salmon farming may affect North American wild salmon resources, it is important to keep in mind that natural environmental variation and hatchery management are probably the most important factors affecting wild salmon catches in both the short-run and the long-run.

Key Points

- Historically, most North American wild salmon has been canned or exported frozen. A relatively small share has been sold fresh or frozen in the U.S. market, although this share is growing. Thus the market challenges and opportunities facing North American wild salmon cannot be understood or addressed by only thinking about the U.S. fresh and frozen market.

There are significant differences in the physical characteristics of Pacific salmon which result in differences in the products made from them, the markets they sell into and the prices paid for them.

Currently, less than one fifth of U.S. wild salmon is sold fresh or frozen in the U.S. domestic market, where it is subject to direct competition from U.S. imports of farmed salmon. More than twice as much U.S. wild salmon is sold in export fresh and frozen markets as in the U.S. domestic market. Thus, most competition between U.S. wild salmon and farmed salmon is occurring in Japan and the EU rather than the U.S. market. More than two-fifths of U.S. wild salmon is sold in canned salmon markets where it has faced relatively little competition from farmed salmon.

- High-quality fresh farmed salmon—mostly Atlantic, with smaller volumes of chinook and coho—was introduced in the 1980s into a U.S. market that primarily sold high-valued wild chinook and coho salmon in the West and low-valued wild chum and pink salmon throughout the rest of the country. Fresh farmed salmon imports year around drove the expansion of the market for fresh salmon and the resulting rapid growth in farmed salmon imports.

During the years 2000-2004, Americans consumed about 284,000 mt of salmon annually of which approximately one-third was Pacific salmon and two-thirds was Atlantic salmon; one-third was wild and two-thirds was farmed; one-third was domestic production and two-thirds was imported; three-fifths was fresh salmon, one-fifth was frozen salmon and one-fifth was canned salmon.

There were significant differences in U.S. consumption of Pacific salmon (which is mostly
wild) and Atlantic salmon (which is nearly exclusively farmed): 45 percent of Pacific salmon was canned while almost no Atlantic salmon is canned; 34 percent of Pacific salmon was frozen while only 13 percent of Atlantic salmon was frozen; 21 percent of Pacific salmon was fresh while 87 percent of Atlantic salmon was fresh.

Total U.S. salmon consumption increased dramatically from less than 130,000 mt in 1989 to more than 300,000 mt in 2004, mostly due to rapid and sustained growth in consumption of imported farmed fresh salmon.

- **Inherent characteristics of wild salmon fisheries**—short seasons, variable and uncertain catches, and remote locations—create challenges for wild salmon in meeting demands of the new world market created by fresh farmed salmon. The laws and regulations governing how salmon are harvested add to these challenges.

Salmon are caught along thousands of miles of North Pacific coastline in fisheries which vary widely with respect to the health of the salmon runs, timing and duration of the harvest, scale of catches, mix of species caught, type of gears used, products produced, end-markets and economic conditions.

Through “limited entry” management, commercial wild salmon fisheries are strictly regulated with regard to who may fish and how, where and when they may fish. While facilitating some conservation, economic and social goals, these regulations also add to costs and hinder adjustment of the wild salmon industry to changing economic conditions. Catches of Alaska salmon are regulated by managers to achieve “escapement” goals for the number of fish reaching the spawning grounds. Catches are driven primarily by the number of fish returning, rather than by economic conditions. Wild salmon returns and catches vary widely from year to year and over longer periods of time due to natural factors such as ocean conditions. Fishing seasons for wild salmon are short. All of these factors make it difficult for the wild salmon fishery to be managed such that the harvest meets market demands of consistent, year-round supply and uniform, high quality.

- **The market challenges faced by North American wild salmon producers** go beyond competition from farmed salmon and include other factors such as declining demand for canned salmon and the slowdown in the Japanese economy.

Many other factors besides farmed salmon have also affected wild salmon prices and markets. These include: increased concentration in the retail and foodservice industries; increased world pink and chum salmon harvests (primarily related to hatchery programs); the emergence of Russian wild salmon as a significant competitor in the Japanese frozen market and world canned salmon and salmon roe markets; declining consumer demand for canned salmon; the end of the Japanese “bubble” economy of the 1980s and a stubborn economic recession in Japan, historically the most valuable market for North American fresh and frozen wild salmon.

In addition, although the economic difficulties of the wild salmon industry are commonly blamed on lower prices, lower catches have also been important factors in the loss in value (price times quantity) of the chinook and sockeye salmon fisheries.

- **U.S. trade policies are not likely to be effective tools for addressing the challenges wild salmon producers face.**

Trade policy has not been an instrument used by the wild salmon producers as a means to limit competition with farmed salmon within the U.S. market. The only two instances of trade policy interventions have been brought by the farmed salmon industry in the United States against Norway and Chile. While the Norwegian case was successful in displacing Norwegian salmon from the U.S. market, there was no substantial price effect as Canada and Chile filled the supply void left by Norway. Similarly, the Chilean case had little impact on prices for farmed salmon in the United States.

In summary, among the means by which North American wild salmon can regain value, trade policy does not appear to be a very effective option. Even if the wild salmon producers were to file similar cases against Chilean salmon imports, there is little indication that dumping and/or countervailable subsidies currently exist. Farmed salmon production costs are low and it does not seem likely that such a suit against Chileans by North American wild salmon producers would be considered.

- **The benefits of MSC labelling to the Alaska salmon industry have not yet been clearly demonstrated.** Although use of the MSC label is significant in marketing relatively small volumes of Alaska salmon in the EU, the industry has made relatively little use of the MSC label in marketing much larger volumes of Alaska salmon in the United States.

The Alaskan salmon fishery was originally assessed as a test case and became certified in 2000, evaluating the entire fishery, with all species and gear types in all of Alaska as one fishery. Among stakeholders’ concerns were the environmental and genetic impacts of the use of extensive hatchery programs in Alaska to enhance salmon populations.

Evaluations of market outcomes indicate that
MSC-certified Alaskan salmon is being sold in the EU, but very little is sold in the United States. Even though the top six seafood firms all have chain-of-custody certification, little MSC-certified canned salmon is supplied into the major retail supermarket chains in the United States. The Alaska Seafood Marketing Institute, in magazine advertising of salmon targeted for barbeque grills is not using the MSC logo in its marketing. Generally, there is relatively little utilization of MSC certification of the Alaska salmon resource as ‘sustainable’ in marketing either in the United States or abroad.

• Although farmed-versus-wild labeling appears to have benefited some Alaska salmon, the benefits to wild salmon of other labeling programs such as country-of-origin labeling, and organic labeling are less certain. Country-of-origin labeling may benefit farmed salmon as well as wild salmon. Organic labeling is more likely to benefit farmed salmon as there is minimal likelihood of the creation of U.S. organic standards for wild fish. While organic labeling may provide incentives for the farmed salmon industry to address environmental concerns related to farmed salmon production, labeling programs are unlikely to create new incentives for better management of wild salmon.

Neither country of origin nor organic labels are necessarily going to change the methods by which wild salmon are caught or harvested in the United States or any of the other source nations. Neither labels are necessarily going to improve management policies for wild salmon, or provide incentives to discontinue hatchery enhancement of the fisheries. Neither are necessarily going to make wild salmon more sustainable.

Some positive impacts of such labeling programs are likely to occur in supplies of farmed salmon. As the EU continues with certified organic farmed salmon and as the United States moves toward organic farmed salmon, fewer antibiotics and other chemicals are likely to be used in the farmed salmon industry. Greater changes may occur in the uses and sourcing of fishmeal and mitigation of environmental impacts of farmed salmon production. As the United States pushes ‘color-added’ labeling, the world farmed salmon industry will expedite its research into finding alternatives.

Wild labeling may be having a positive impact on the market for high-quality wild salmon (chinook, coho and sockeye) in the United States. ASMI, restaurants and supermarkets are all marketing wild Alaska salmon.

• Negative publicity regarding farmed salmon may have a short-run negative impact on farmed salmon, but will not necessarily benefit wild salmon. Negative publicity may paint both wild and farmed salmon with the same brush, especially among the majority of potential consumers who eat relatively little salmon and know little if anything about differences between farmed and wild salmon. The farmed salmon industry is working actively to address environmental and health issues raised by critics and over the longer term comparisons may not be in the interest of wild salmon.

Negative information about farmed salmon will not necessarily strengthen overall wild salmon sales in the longer run. Negative messages about farmed salmon may cause some consumers to switch from farmed to wild salmon—but may cause others to eat less salmon regardless of production method, either through confusion or because there is an implication that both salmon are equally complicit.

There are also consumers who believe that wild salmon are endangered (due to what they hear about salmon runs on the west coast of the United States). These individuals may consume farmed salmon for fear of exacerbating the threat to the stock of wild salmon. Again, the media often play a role in disseminating poor information.

• To date salmon farming appears to have had little effect on commercial wild salmon resources, either negative or positive. Most significant commercial salmon fisheries are located great distances from salmon farms. Lower prices caused by competition have not necessarily reduced wild salmon catches because the main limiting factors are regulatory rather than economic.

Lower prices do not necessarily result in lower catches in overcapitalized limited entry fisheries. As we discussed in Chapter II, the explicit goal of managers in most commercial wild salmon fisheries is to manage fish sustainably, so that catches do not adversely affect the potential for future wild salmon catches.

Outlook for the Future

Most future growth in world salmon supplies will occur because of aquaculture. Chile has the greatest potential for growth, although salmon aquaculture will continue to develop somewhat in northern Europe. Large restaurant chains and supermarkets—dependent on a large, consistent, year-round supply of product—are likely to increasingly source their salmon from aquaculture. Wild salmon is likely to be sold increasingly in a wide range of other markets. These include higher-end niche markets (to consumers who
specifically prefer wild salmon), traditional canned salmon markets and lower-end markets where wild salmon (pink and chum) can compete on price.

Improvements in farmed salmon feeding systems and feed management have also considerably reduced feed costs, but to a lower extent than other operating costs. As a result, feed is expected to become a greater share of total cost in the near future, even though overall costs of production will continue their downward trend. Almost every imaginable aspect of salmon farming (breeding, feeding systems, disease management) will see improvements through continued investment in technology.

Although farmed salmon is likely to extend its dominance over global supply, ocean-pen salmon aquaculture in North America will continue to face numerous obstacles. Low-cost producers (e.g., Chile) will present formidable competition for domestic salmon farmers. The industry will also be subject to increased regulatory oversight (e.g., Endangered Species Act on the East Coast) and confrontation from environmental organizations on issues such as fish escapes and transfer of diseases to wild populations. Conflicts with other coastal resource users will continue to arise. The moratorium on ocean-pen aquaculture in Alaska will not be lifted in the foreseeable future, limiting aquaculture in this state to the hatchery level. The U.S. ocean-pen salmon aquaculture industry may see some growth, but it will more likely contract in the near future.

The positioning of salmon aquaculture as the driving force in global seafood markets has reduced the importance of the once-dominant wild salmon supplies. Current trends indicate that wild salmon will increase its presence in niche, regional and low-end (e.g., canned) markets. In the United States, niche markets for chinook, coho and sockeye will primarily consist of high-end restaurants in major cities. An important regional market will continue to develop in the U.S., Pacific Northwest states, where marine aquaculture has traditionally received little public support. Nevertheless, these niche and regional markets will remain relatively small and will absorb a minor portion of the total wild salmon supply.

In the future, the highest sales volume North American outlets for wild salmon, particularly chum and pink salmon, may be valued-added processed salmon products (e.g. salmon burger and microwavable convenience meals), and restaurants such as fast-food and mid-price range chains. In terms of the international market, U.S. exports of frozen salmon will continue to be a major commodity. U.S. canned salmon exports have been increasing in recent years relative to other product forms. However, more salmon is being exported to Asia for further processing then returning to the United States as valued-added product imports.

The Japanese market will continue to be an important export market for wild salmon, and the European market may become an expanding market for Alaskan salmon. In Japan, Alaskan salmon will face increasing competition from farmed salmon, and will have to meet that challenge with outstanding quality. It is possible that Alaska may be able to expand its market in Europe if it further develops its wild and sustainable attributes. High-quality canned product, no bones or scales, will also be a plus in that market.

**Recommendations**

The report offers nine recommendations to policymakers, the environmental community and the fishing and fish farming industries. These recommendations are based on the assumption that multiple goals are important in the consideration of salmon issues and policies. These goals include protection and sustainability of wild salmon resources and the marine environment; providing consumers with a wide variety of healthy, appealing and economic opportunities to consume salmon; maximization of economic, social and cultural benefits derived from North American wild salmon resources, particularly for individuals and communities traditionally dependent on wild salmon; and realizing the potential for responsible salmon farming to promote economic development both in the North America and other countries.

- **Provide accurate and balanced information about salmon.** Government, scientists, the wild and farmed salmon industries, non-governmental organizations and the press have a responsibility to provide the public with accurate and balanced information about salmon issues. Misinformation—including overly simplifying complex issues, or overstating the degree of certainty of scientific knowledge—is ultimately counter-productive, serving to confuse consumers and undermine confidence in all parties to policy debates.

- **Harmonize regulatory food safety standards.** Governments have a responsibility to provide consumers with clear information about food safety on which they can make informed choices. There are significant discrepancies between the U.S. Food and Drug Administration (FDA) and the U.S. Environmental Protection Agency (EPA) with regard to acceptable levels of contaminants in fish. These contribute to consumer confusion over the healthfulness of salmon and work against the long-term interest of both the wild and farmed salmon industries.

- **Collect better data about seafood markets and consumers.** Existing data are insufficient to
measure or analyze how and why American fish consumption is changing, or how factors such as price, labeling, certification and origin affect fish consumption, including wild and farmed salmon. Given the importance of fish in North American diets—from not only an economic but a health perspective—the U.S. government and the seafood industry should commit to improved data collection and analysis related to fish consumption and markets. In particular, better data should be collected on wholesale and retail prices in the United States for seafood, much as the U.S. Department of Agriculture routinely collects for agricultural products. In addition, routine USDA household surveys on food consumption should focus more on households’ seafood consumption, including the species, product forms and quantities of seafood that households are consuming. Only a Federal agency, such as the USDA, has the capability to collect this information consistently over time, across different regions of the United States and with appropriate representation of different segments of the U.S. population.

- **Recognize and mitigate environmental impacts of fish production.** Recognizing and addressing environmental impacts (known as “externalities” by economists) is essential for of sustainable resource management. Possible negative environmental impacts of salmon farms may include disease transmission from hatcheries and farms to wild stocks, pollution (for example from waste feed), competition with wild stocks and the consumption of chemical residues potentially found in salmon by humans or other organisms. Hatchery release programs may have similar effects. Wild fisheries can also have negative environmental effects, such as the discharge of waste fish, disease transmission from wild fish to fish farms, overfishing and human consumption of residue pollutants. All of these potential effects should be recognized and addressed. To reduce potential negative effects of biological interactions between wild salmon and farmed salmon, including disease, pollution, and inter-/intra species competition, policies and regulations should be employed that reduce the likelihood of direct interaction between wild and farmed salmon, such as appropriate farm siting and cage construction standards. There should be strict compliance with chemical and antibiotic use protocols.

- **Recognize the role of hatcheries.** Salmon hatcheries account for a significant share of North American “wild” salmon catches, particularly of pink and chum salmon. There are important issues related to the effects of hatcheries on salmon ecosystems, as well as to the economic role of hatcheries in commercial salmon fisheries and markets. These issues should be explicitly recognized in analysis and policy discussions about North American “wild” fisheries.

- **Expand marketing efforts.** Marketing wild salmon as ‘wild’ has been successful in the U.S. market in 2005, particularly for the higher quality species—chinook, coho and sockeye—and has contributed to increases in ex-vessel prices paid to fisherman for these species. However, it has had no clear impact on ex-vessel prices for pink and chum salmon – which comprise 66 percent of Alaskan salmon landings. Achieving sustained increases in ex-vessel prices for pink and chum salmon will require expanding demand for the products made from these species (or, alternatively a reduction in supply through changes in management).

- **Recognize that the choices are not between wild and farmed salmon.** It is essential to move away from the simplistic perspective that policy makers and consumers face a choice between wild salmon and farmed salmon. Salmon farming is a major world industry which is here to stay. Wild salmon is incapable of supplying the much larger domestic and world salmon market which has been created by farmed salmon. Natural wild salmon, hatchery salmon, and salmon farming all offer potential economic opportunities and benefits to consumers. All also have inherent risks. The real issues are how to take responsible advantage of the potential economic opportunities and benefits to consumers from both wild and farmed salmon.

- **Work to ensure wild salmon is a competitive product.** A competitive strength of farmed salmon is consistent high quality that can be delivered to the market when the buyer demands it. To improve market conditions for wild fresh or frozen salmon the wild salmon industry must provide buyers with product which meets the higher quality standards established by farmed salmon. For wild salmon to compete effectively with farmed salmon, it is not enough for it to be ‘wild.’ The fish must also be handled very carefully when caught and processed and delivered where and when the buyer demands it.

- **Take advantage of potential benefits of MSC certification for Alaska wild salmon.** Sustainability, and the traceability proving sustainability provided by a certification program such as the MSC, are becoming increasingly important to many in the seafood market chain in the United States and Europe. Wild salmon enjoys potential market advantages as a “sustainable” product. To fully recognize these potential advantages the Alaska salmon industry should seek to make more use of the MSC label, and to develop and promote its importance to buyers and consumers as a measure of sustainability and traceability.
The Great Salmon Run: Competition Between Wild and Farmed Salmon
Major Data Sources

This appendix provides an overview of major data sources used for this study. We list these data sources alphabetically. The bold headings for each data source are short names we use in the report in referring to these data sources. We developed these names to standardize and simplify citations to these data sources in the report, tables and figures.

Another purpose of this appendix is to serve as a reference source for readers who may be interested in further research about salmon markets and the salmon industry. By providing a comprehensive listing of data sources here, with brief descriptions of the data and their limitations, we hope to make it easier for others to research this complex topic.

**ADFG Alaska Catch and Production Reports Salmon Data**

Until 1985 the Alaska Department of Fish and Game published annual “Catch and Production” reports with detailed data on Alaska catches and production by species and area. These reports were discontinued after 1985.

**ADFG Catch Data**

The Alaska Department of Fish and Game (ADFG) reports data for Alaska salmon catches based on “fish tickets” filled out for all deliveries by commercial salmon fishermen to fish processors, as well as direct sales by fishermen to other buyers. These data are available from several different sources. A problem with the ADFG catch data is that there is no single “official” website or publication where “final” data are reported. Data reported on different websites or in different ADFG publications frequently vary slightly. One reason for this is that the ADFG “fish ticket” database is continuously being updated for reasons such as the discovery of misplaced fish tickets or the correction of coding errors in previously entered fish ticket data. Another reason is inconsistencies in whether or not the data include catches from test fisheries, hatchery cost-recovery catches and other nontypical fisheries. ADFG catch data reported in this study were downloaded from the Alaska Department of Fish and Game website:

[www.cf.adfg.state.ak.us/geninfo/finfish/salmon/salmhome.htm](http://www.cf.adfg.state.ak.us/geninfo/finfish/salmon/salmhome.htm)

**ADFG Catch Data 1878-1981**

For historical Alaska salmon catch data for this report, we used data from an Alaska Department of Fish and Game report, “Alaska Commercial Salmon Catches, 1878-1981,” which was published in January 1982. A more recent and more detailed report, “Alaska Commercial Salmon Catches, 1878-1997,” Alaska Department of Fish and Game Regional Information Report No. 5J99-05 (March 1999), is available on the website of the Alaska Department of Fish and Game at:


**ADFG COAR Data**

In April of every year, all Alaska fish processors are required to submit “Commercial Operator Annual Reports” to the Alaska Department of Fish and Game. In these reports they are required to report the total volume of fish purchased, by species and area; the total amount paid for fish purchased, by species and area; the total volume (weight) of production, by product, species and area; and the total first wholesale value of production. We refer to the production data reported by processors as “Alaska production data” and we refer to the average prices calculated by dividing first wholesale value by production volume as “Alaska production prices.”

Production, wholesale value and production price data for 1980-1983 are from the annual “Catch and Production” reports formerly published by the Alaska Department of Fish and Game. This series was discontinued in the mid-1980s and the COAR production data are no longer published on a regular basis. However, data are available upon request from the Alaska Department of Fish and Game. For the years 1984-2004 we used production data provided by the Alaska Department of Fish and Game over a number of years.
ADFG Hatchery Data

The Alaska Department of Fish and Game prepares annual reports on the Alaska Salmon Enhancement Program, which are available at:

www.cf.adfg.state.ak.us/geninfo/enhance/enhance.htm.

These reports include detailed data on egg takes, fry releases, total returns and catches of hatchery fish in the “common property harvest” and the “cost recovery harvest.” The data on catches of hatchery fish are based on in-season sampling of catches. Hatchery fish are identified in several ways, including coded wire tags, fin clips and otolith marking (a process by which an identifiable microscopic colored ring sequence in fish ear bones is created by exposing fish to a series of planned temperature changes).

ADOR Salmon Price Reports

Since 2000, the Alaska Department of Revenue (ADOR) has prepared “Salmon Price Reports” which report total monthly sales volume (pounds) and sales value (dollars) reported by Alaska processors, by species, product and region. In theory, these reports provide more detailed data on Alaska wholesale price trends than the COAR reports, because they are monthly data and give a more detailed product breakdown (for example, data are reported separately for different can sizes). In practice however, much of the reports are left blank because of confidentiality restrictions. Still, the data provide a very useful source for tracking monthly sales volumes and wholesale price trends for major products such as southeast Alaska canned pink salmon and Bristol Bay frozen sockeye salmon, for which sufficient processors report monthly sales that are not confidential. The ADOR Salmon Price reports are available at:

http://www.tax.state.ak.us/reports.asp

Anchorage CPI

The only measure of Alaska inflation rates is that provided by the U.S. Department of Labor, Bureau of Labor Statistics’ “Annual Average Consumer Price Index, All Items - All Urban Consumers” (CPI-U) for the Municipality of Anchorage. The price index data are posted at the website of the Alaska Department of Commerce and Workforce Development’s Research and Analysis Division:

http://almis.labor.state.ak.us/

BANR

BANR is an abbreviation for Bill Atkinson’s News Report, a weekly eight-page summary of articles and data from the Japanese seafood trade press, translated into English by Bill Atkinson. Published from the early 1980s until March 2006 (shortly before Bill Atkinson’s death in April 2006), BANR was a very useful source of information on Japanese markets for salmon and other species.

BANR Japanese Salmon Import Data

*Bill Atkinson’s News Report* reported monthly data for the volume of Japanese salmon imports by country. Beginning with 1996, the data also included imports of trout fillets. This data source did not report value or prices separately by country; import value was aggregated for all countries.

BC Canned Salmon Pack Bulletin

The “BC Canned Salmon Pack Bulletin” published by the British Columbia Ministry of Agriculture and Lands reports data on the British Columbia canned salmon pack, by species, on a 48-lb case basis. This bulletin is updated regularly over the summer salmon season. The report also distinguishes between production from Canadian salmon and production from imported salmon (most of which is likely from Alaska). The Bulletin is available at:


BC Salmon Data 2000-2005

Data for British Columbia salmon harvest volume and value, by species, for the years 2000-2005 was provided April 2, 2006 by Vancouver-based economic consultant Gordon Gislason, who has studied BC fisheries for many years. Gislason noted that BC catch data are usually subject to revision for three or four years, and that the data for 2000-2002 should be “final” but the 2003-2005 data could be revised in the future.

BCSMC Database

The British Columbia Salmon Marketing Council has a very useful online database at:

http://www.bcsalmon.ca/

The database includes information for the following:

- Farmed salmon harvest by species
- Wild salmon catch weight, value and number of fish by species, area and gear type
- Average fish prices by species and area
- Production in round weight and processed weight, by species and product (canned, fresh and frozen)
- Weight and value of exports by species, product type, and consuming nation
CFEC Alaska Salmon Summary Data 1975-1996
This is a database of Alaska salmon harvests for the years 1975-1996, which was provided to Gunnar Knapp by the Commercial Fisheries Entry Commission in June 1998. The database includes price, volume, value, number of fish and average fish weight, by year, area, species and gear type.

CFEC Alaska Salmon Summary Data 1980-2005
Data for Alaska statewide salmon landings by species for the years 1980-2005. Prepared by the Commercial Fisheries Entry Commission on March 31, 2005 in response to a request by Gunnar Knapp. Includes data on pounds landed, number of fish landed, average statewide price and earnings.

Notes provided with the data include the following: (1) 2005 price and value data is preliminary, and will change. Post-season bonuses and adjustments are not included in this year; (2) Gears / harvests include: set and drift gill net, beach and purse seine, hand and power troll, fish wheel, hatchery cost recovery, test fish, derby and confiscated. Excluded are: hatchery and roe-stripped carcasses; personal use, donated and discarded harvests; and other salmon harvested but not sold

CFEC BIT Data
The Alaska Commercial Fisheries Entry Commission (CFEC) posts “Basic Information Tables” (BIT) for each Alaska salmon fishery that report annual data for number of permits issued (by residency of permit holders), total catch weight and value (all species combined), and average annual permit prices. These data are posted at the CFEC website under “Fishing Statistics and Activities” at:
http://www.cfec.state.ak.us/Mnu_Summary_Info.htm

DFO Aquaculture Statistics:
Canadian aquaculture production statistics (volume and value) by species and province are available at the Canada Fisheries and Oceans Statistical Services aquaculture statistics website: http://www.pac.dfo-mpo.gc.ca/species/salmon/salmon_fisheries/catchstats_e.htm
The data do not distinguish between production of different species of salmon.

DFO Canada Salmon Export Data 1989-1999
Data for Canadian salmon exports by species, product and country for the years 1989-1999. Provided to Gunnar Knapp by Department of Fisheries and Oceans, September 13, 2000.

DFO Catch Data
The Canada Department of Fisheries and Oceans reports annual data for commercially harvested salmon retained catch by gear type and area at the following website:
http://www.pac.dfo-mpo.gc.ca/species/salmon/salmon_fisheries/catchstats_e.htm
This source provides data for number of fish (“pieces”) only. Information is not provided on fish weight, value or price.

DFO Salmon Catch Volume Data 1996-2005
Data for British Columbia salmon catch volume (round pounds) by species for the years 1996-2005. The data were provided to Gunnar Knapp by Christina Burridge of the British Columbia Seafood Alliance, March 2006. The original source was the Canada Department of Fisheries and Oceans.

DFO Trade Data
Canadian fisheries trade statistics (volume and value of exports and imports, by species and product and/or by country—but not by species and product and country) are available at the Canada Fisheries and Oceans Statistical Services trade statistics website:
http://www.dfo-mpo.gc.ca/communic/statistics/trade/canadian_trade/index_e.htm

FAO FAOSTAT Food Supply Database
The Food and Agriculture Organization of the United Nations (FAO) maintains a series of online statistical databases known collectively as “FAOSTAT” at the following website: http://faostat.fao.org/. Among a series of “Nutritional” databases, the “Food Supply” database includes annual estimates, beginning in 1961, of per capita consumption (live weight equivalent) of “fish, seafood” by country.

FAO Fishstat+ Data
FAO Fishstat+ is a set of software and databases developed and maintained by the Food and Agriculture Organization of the United Nations (FAO) Fisheries Division to provide access to various FAO fisheries statistics. FAO Fishstat+ includes data for both wild salmon catches and aquaculture production, by country and species. Note that the FAO Fishstat+ data appear to substantially understate U.S. wild pink and chum
salmon harvests. The software and databases may be downloaded from the FAO website at:

FAO Globefish Salmon Commodity Update
The FAO Globefish program tracks world fisheries markets and publishes a variety of reports on markets for different species. Among these are annual “Commodity Update” publications for different species, including salmon. The Salmon Commodity Updates include a wide variety of international market data for salmon, including monthly wholesale price series for a number of different markets. Information about the FAO Globefish Program and the Commodity Update publications is available at the FAO Globefish website: www.globefish.org.

FIS Japan Frozen Wholesale Prices Data
The proprietary website www.fis.com posts prices from numerous fish markets around the world. The “Market Prices” section of this website includes prices which are updated weekly for the “Japanese Frozen” market. These include weekly minimum and maximum Japanese wholesale prices for frozen Atlantic salmon, Alaska (presumably Bristol Bay) sockeye salmon, Chilean farmed coho salmon and Chilean and Norwegian rainbow trout, by size. The data are generally consistent with wholesale price data reported in the Seafood News Power Data Book. Japanese monthly market prices for frozen salmon used in this report are “minimum” prices for 4-6 pound sockeye salmon, 4-6 pound Chilean coho, and 4-6 pound Chilean trout, as reported for the first week of the month.

Federal Reserve Bank of St. Louis Exchange Rate Data
The Federal Reserve Bank of St. Louis posts monthly exchange rate data between the dollar and other major currencies at:
http://research.stlouisfed.org/fred2/
For this report, to convert annual prices or values into US dollars, except where otherwise specified, we calculate annual average exchange rates as simple averages of monthly exchange rates.

Japan Tariff Association Salmon Trade Data
The Japan Tariff Association publishes detailed data on Japanese fisheries imports and exports, by species and country. Information about the Japan Tariff Association and how to obtain trade data is available at:
www.kanzei.or.jp/english/.

Maine DMR Farmed Salmon Data
The Maine Department of Marine Resources reports data on annual farmed salmon production in Maine at:
www.maine.gov/dmr/aquaculture/leaseinventory2005/fishharvestchart.htm

NFI Per Capita Fish Consumption Estimates
The National Fisheries Institute (NFI) posts estimates of annual U.S. per capita consumption of the “top ten” fish species (edible weight) on its website at:
www.aboutseafood.com/media/top_10.cfm.
The estimates are calculated by Howard Johnson of H.M. Johnson & Associates.

NFPA Canned Pack Data
The National Food Processors Association (NFPA), which tests all canned salmon lots produced in the United States, prepares annual “Canned Salmon Pack” reports which summarize total United States canned salmon production in number of cases by species, can-size and region (three Alaska districts—Southeast, Central and Western—and Washington).

NFPA Canned Stocks Data
Until 1997 the National Food Processors Association reported estimated canned salmon stocks for the months October through June. After 1997 NFPA stopped reporting canned salmon stocks.

NMFS Catch Data
Data for fish catches by state and species are posted on the National Marine Fisheries Service (NMFS) commercial landings website:

NMFS Cold Storage Holdings Data
Until December 2002 the National Marine Fisheries Service published monthly data on U.S. cold storage holdings of frozen fish. These reports have since been discontinued. The last report may be found at:
http://www.nwr.noaa.gov/1gdfsh/stats01.htm
NMFS Fisheries of the United States

The National Marine Fisheries Service, Office of Science and Technology, publishes an annual report on “Fisheries of the United States,” which includes a wide variety of useful data on United States fisheries. The report is available at the Office of Science and Technology website at:


NMFS Japanese Fisheries Imports Data

The National Marine Fisheries Service Southwest Regional Office reports monthly Japanese fisheries imports (volume and value), by species. Beginning with November 1996, the data are available at:

http://swr.ucsd.edu/fmd/sunee/imports/jimp.htm

The same data were reported in Bill Atkinson’s News Report (see BANR Japanese Fisheries Imports Data). Note that these data are for total imports, by species, from all countries. Salmon imports by country were reported in BANR Japanese Salmon Imports Data.

NMFS Japanese Fisheries Exports Data

The National Marine Fisheries Service Southwest Regional Office reports monthly Japanese fisheries exports (volume and value), by species. Beginning with November 1996, the data are available at:


NMFS Trade Data

The National Marine Fisheries Service reports data on U.S. imports, exports and re-exports of salmon (and other fish species) at its “Foreign Trade Information” website:


NPAFC Catch Data and NPAFC Hatchery Release Data

The annual reports and statistical yearbooks of the North Pacific Anadromous Fish Commission (NPAFC), available at: http://www.npafc.org/, provide data on commercial catches, sport catches, and subsistence catches of Pacific salmon for the Pacific Northwest, Canada, Alaska, Russia and Japan. They also provide data on hatchery releases of salmon fry.

PACFIN Salmon Data

PacFIN is a joint Federal and State data collection and information management project funded in part by a grant from the National Marine Fisheries Service and in part by the states of Alaska, California, Oregon, and Washington. PACFIN maintains the “Pacific Fisheries Information Network” of fisheries data. The annual “Washington, Oregon and California (W-O-C) Report 307” includes data on landings into the states of Washington, Oregon and California for all marine species including salmon, including metric tons, revenues and price-per-pound. The reports are available at:

http://www.psmfc.org/pacfin/data/index-woc.html

SalmonChile Data

The Chilean salmon industry association SalmonChile (www.salmontchile.cl) produces a detailed monthly report of data and analysis of market information for the Chilean salmon industry (Análisis Estadístico y de Mercado), including detailed data for Chilean exports, as well as other information related to production, prices and world market conditions.

Seafood News Power Data Book

The Japanese Company Suisan Tsushin (Seafood News) publishes an annual collection of seafood market data in Japanese which is named the “Marine Products Power Data Book.” This publication includes extensive data about Japanese salmon harvests, salmon imports, wholesale prices and other Japanese data as well as international data—much of which are Japanese press estimates not published elsewhere.

Statistics Canada Aquaculture Statistics

Statistics Canada produces an annual report entitled Aquaculture Statistics which provides a wide range of data on Canadian aquaculture, including production and value by province and species, as well as exports by species and country. The report is available at:

http://www.statcan.ca/english/IPS/Data/23-222-XIE.htm

Statistics Norway Fish Farming Report

A wide variety of data about the Norwegian salmon industry may be found in the annual “Fish Farming” report published by Statistics Norway, which is available at:

http://www.ssb.no/english/subjects/10/05/nos_fiskeoppdrett_en/.

Tokyo Central Wholesale Market Data

The Tokyo Central Wholesale Market, which is operated by the Metropolitan Government of Tokyo,
publishes monthly and annual data for total sales of frozen salmon, by species, including the volume of sales and the average price. These official monthly and annual publications are in Japanese and are expensive as well as difficult to obtain except by visiting Japan. These data are reprinted from time to time in other sources such as Bill Atkinson’s News Report and the Seafood News Marine Products Power Data Book.

Several limitations should be kept in mind in using the Tokyo Central Wholesale Market data. First, the data aggregate all sales of frozen salmon for each species, regardless of country of origin, size and grade, and whether the salmon are farmed or wild. Second, the data include only actual sales at the Tokyo Central Wholesale Market. In contrast, other Japanese “Tokyo wholesale price data” reported in the Japanese trade press typically present prices for a particular size and grade of salmon (such as Bristol Bay #1 grade 4-6 pounds). However, an advantage of the Tokyo Central Wholesale Market data is that they provide continuous price data series going back at least to the 1970s.

**Urner Barry Wholesale Price Data**

Urner Barry Publications, Inc. is a New Jersey-based company which tracks market conditions for a wide variety of food products, including seafood. Twice each week Urner Barry publishes Urner Barry’s Seafood Price Current, an eight-page newsletter which reports United States wholesale prices for a wide variety of seafood products. One page of this report provides wholesale prices for a wide variety of salmon products. Most of the products for which prices are regularly reported are farmed salmon. For most wild salmon products, price data are reported only occasionally or rarely. Fresh salmon prices, for example, are only reported during wild salmon seasons. Urner Barry price data are the best available data for tracking long-term wholesale price trends for farmed salmon in the United States. They also provide the most detailed U.S. wholesale price data available for certain wild salmon products, particularly frozen wild chum salmon.

Multi-year weekly data series for selected salmon product forms are available in print and CD format from Urner Barry. Information about ordering these data are available at the Urner Barry website at:


**USDA ERS Food Supply Data**

The United States Department of Agriculture (USDA) Economic Research Service (ERS) annually calculates the amounts of several hundred foods available for human consumption in the United States; these estimates are also called “food supply” or “food disappearance” data. These data are available in spreadsheet format at the ERS website:


The “Red Meat, Poultry and Fish” spreadsheet (mtpcc.xls) provides annual estimates of per capita consumption of beef, pork, lamb, veal, chicken, turkey and fish beginning in 1909.

**Washington DFW Farmed Salmon Data**

The Washington Department of Fish and Wildlife reports annual data on commercial production of Atlantic salmon in Washington State for the years 1990-2003 at:

wdfw.wa.gov/fish/atlantic/comcatch.htm.
Methodology for Estimating World Salmon Production and Consumption

In Chapter VI we present estimates of consumption in major world salmon markets, by source of supply. Table VI-2, which is reproduced below as Table B-1, provides annual averages of these estimates for the years 2000-2004. Figures VI-2, VI-3, VI-5, VI-10 and VI-15 show annual estimates of consumption for different major markets (aggregated for North American wild salmon, Japanese and Russian wild salmon, farmed salmon, and farmed trout).

In this appendix, we describe the methodology used to develop these estimates. As noted in the chapter, the estimates are based on numerous data sources and assumptions of varying reliability and should be considered only approximate. Our purpose was to provide general indicators of the relative scale of different markets, the relative rates of growth of consumption in different markets, and the relative importance of different sources of supply for each market.

### Table B-1

<table>
<thead>
<tr>
<th>Type of salmon</th>
<th>Producing country</th>
<th>Total production (round weight basis)</th>
<th>United States fresh &amp; frozen markets</th>
<th>EU Fresh &amp; frozen markets</th>
<th>Japanese fresh &amp; frozen markets</th>
<th>Canned salmon markets</th>
<th>Other markets</th>
<th>Weight loss in processing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North American wild salmon</strong></td>
<td>United States</td>
<td>346</td>
<td>38</td>
<td>18</td>
<td>32</td>
<td>86</td>
<td>49</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>28</td>
<td>9</td>
<td>0</td>
<td>5</td>
<td>11</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>374</td>
<td>47</td>
<td>18</td>
<td>37</td>
<td>97</td>
<td>49</td>
<td>128</td>
</tr>
<tr>
<td><strong>Japanese &amp; Russian wild salmon</strong></td>
<td>Japan</td>
<td>249</td>
<td>0</td>
<td>0</td>
<td>161</td>
<td>5</td>
<td>38</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Russia</td>
<td>205</td>
<td>0</td>
<td>0</td>
<td>27</td>
<td>11</td>
<td>99</td>
<td>68</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>454</td>
<td>0</td>
<td>0</td>
<td>188</td>
<td>15</td>
<td>136</td>
<td>114</td>
</tr>
<tr>
<td><strong>Farmed salmon</strong></td>
<td>Norway</td>
<td>483</td>
<td>7</td>
<td>249</td>
<td>34</td>
<td>1</td>
<td>86</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>Chile</td>
<td>370</td>
<td>94</td>
<td>18</td>
<td>75</td>
<td>2</td>
<td>28</td>
<td>152</td>
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<tr>
<td></td>
<td>UK</td>
<td>143</td>
<td>8</td>
<td>105</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>104</td>
<td>61</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>United States</td>
<td>17</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Japan</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>86</td>
<td>3</td>
<td>65</td>
<td>4</td>
<td>0</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>1,213</td>
<td>184</td>
<td>437</td>
<td>126</td>
<td>3</td>
<td>133</td>
<td>333</td>
</tr>
</tbody>
</table>

**Note:** Estimates of consumption by end-market are based on numerous assumptions and should be considered only approximate indicators of relative volumes. See Appendix B for details of data and assumptions.
We divided world salmon consumption into five major markets: Japanese fresh and frozen salmon markets, European Union fresh and frozen salmon markets, United States fresh and frozen salmon markets, canned markets, and “other markets.” The “European Union” includes all countries which were European Union members in May 2005 (and excludes European countries that are not EU members, such as Norway). “Canned markets” includes all canned salmon markets worldwide. “Other markets” includes all countries not included in the other four markets (for example, all consumption in countries such as Canada, Russia, Norway, China, Australia and Brazil).

We divided sources of supply into “North American wild salmon,” “Japanese and Russian wild salmon,” “farmed salmon,” and “farmed trout.” The choice of these five markets and these four sources of supply was based primarily on our goal of contrasting major differences between the Japanese, European Union and United States fresh and frozen markets and partly on the limits of available data—which would have made it difficult to develop more detailed estimates.

Production was estimated on a round-weight basis. Consumption was estimated on a processed weight basis. Since most of the consumption estimates are based on export or import data, the weight basis is the weight of products exported or imported.

In discussing our methodology, we use the reference codes shown below for different combinations of producing countries and consuming end markets.

Table C3 summarizes the data sources and assumptions used to derive production or consumption estimates for each reference code. It also serves to illustrate the complexity of the world salmon market and the challenges in deriving the estimates presented in Chapter VI of changes in world salmon consumption and production.

### Table B-2 Reference Codes for Discussion of Estimates

<table>
<thead>
<tr>
<th>Type of salmon</th>
<th>Producing country</th>
<th>Total production (round weight basis)</th>
<th>United States &amp; EU fresh &amp; frozen markets</th>
<th>Japanese fresh &amp; frozen markets</th>
<th>Canned salmon markets</th>
<th>Other markets</th>
<th>Weight loss in processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>North American wild salmon</td>
<td>United States</td>
<td>A1</td>
<td>B1</td>
<td>C1</td>
<td>D1</td>
<td>E1</td>
<td>F1</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>A2</td>
<td>B2</td>
<td>C2</td>
<td>D2</td>
<td>E2</td>
<td>F2</td>
</tr>
<tr>
<td>Japanese &amp; Russian wild salmon</td>
<td>Japan</td>
<td>A3</td>
<td>B3</td>
<td>C3</td>
<td>D3</td>
<td>E3</td>
<td>F3</td>
</tr>
<tr>
<td></td>
<td>Russia</td>
<td>A4</td>
<td>B4</td>
<td>C4</td>
<td>D4</td>
<td>E4</td>
<td>F4</td>
</tr>
<tr>
<td>Farmed salmon</td>
<td>Norway</td>
<td>A5</td>
<td>B5</td>
<td>C5</td>
<td>D5</td>
<td>E5</td>
<td>F5</td>
</tr>
<tr>
<td></td>
<td>Chile</td>
<td>A6</td>
<td>B6</td>
<td>C6</td>
<td>D6</td>
<td>E6</td>
<td>F6</td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>A7</td>
<td>B7</td>
<td>C7</td>
<td>D7</td>
<td>E7</td>
<td>F7</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>A8</td>
<td>B8</td>
<td>C8</td>
<td>D8</td>
<td>E8</td>
<td>F8</td>
</tr>
<tr>
<td></td>
<td>United States</td>
<td>A9</td>
<td>B9</td>
<td>C9</td>
<td>D9</td>
<td>E9</td>
<td>F9</td>
</tr>
<tr>
<td></td>
<td>Japan</td>
<td>A10</td>
<td>B10</td>
<td>C10</td>
<td>D10</td>
<td>E10</td>
<td>F10</td>
</tr>
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<td></td>
<td>Others</td>
<td>A11</td>
<td>B11</td>
<td>C11</td>
<td>D11</td>
<td>E11</td>
<td>F11</td>
</tr>
<tr>
<td>Farmed trout</td>
<td>Norway</td>
<td>A12</td>
<td>B12</td>
<td>C12</td>
<td>D12</td>
<td>E12</td>
<td>F12</td>
</tr>
<tr>
<td></td>
<td>Chile</td>
<td>A13</td>
<td>B13</td>
<td>C13</td>
<td>D13</td>
<td>E13</td>
<td>F13</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>A14</td>
<td>B14</td>
<td>C14</td>
<td>D14</td>
<td>E14</td>
<td>F14</td>
</tr>
</tbody>
</table>
### Table B-3  Methodology for Derivation of Production and Consumption Estimates

<table>
<thead>
<tr>
<th>Codes</th>
<th>Type of Estimate</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1-A14</td>
<td>Total Production</td>
<td>All data are FAO Fishstat+ data except that data for U.S. wild salmon production are the sum of Alaska data from CFEC Alaska Salmon Summary Data 1980-2005 and Pacific Northwest data from NMFS catch data. Data for “Farmed trout” includes only farmed rainbow trout raised in salt water.</td>
</tr>
<tr>
<td>G1-G14</td>
<td>Weight Loss in Processing</td>
<td>Weight loss in processing was calculated by subtracting estimated consumption in all five end-markets from total production. Note that weight loss in processing will be under-estimated if consumption is over-estimated or if production is under-estimated (and vice versa). For most type-of-salmon/producing-country combinations, estimated weight loss in processing represented between 25% and 35% of total production for the 2000-2004 period. For a few type-of-salmon/producing-country combinations (U.S. farmed salmon, Japan farmed salmon, and Other farmed salmon), estimated weight loss in processing was less than 10% of total production for the 2000-2004 period—an unrealistically low estimate, suggesting that total consumption was over-estimated or total production was under-estimated. For a small number of year/type-of-salmon/producing-country combinations, estimated total consumption exceeded estimated total production. For these combinations, weight loss in processing was set equal to zero.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Codes</th>
<th>Salmon Type</th>
<th>Producing Country</th>
<th>Market</th>
<th>Methodology</th>
</tr>
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<tbody>
<tr>
<td>B1</td>
<td>Wild</td>
<td>USA</td>
<td>USA</td>
<td>Estimated using the United States Salmon Market Database described in Appendix C. Based primarily on NMFS Trade data, ADFG COAR data, NFPA Canned Pack Data, NMFS Catch Data, and PACFIN Salmon Data. Note that estimates omit U.S. consumption of fresh and frozen wild salmon imported from countries other than Canada, Japan and Russia—including imports from China—which have increased significantly in recent years. As a result estimates of U.S. consumption of wild salmon shown in Chapter VI are slightly less than estimates shown in Chapter VIII. Although most of the wild salmon imported from other countries such as China was probably originally harvested in the United States, Canada, Japan or Russia, we have no way of determining its original country of origin.</td>
</tr>
<tr>
<td>B2</td>
<td>Wild</td>
<td>Canada</td>
<td>USA</td>
<td>Based on U.S. imports reported in NMFS Trade data. See Appendix C for discussion of how salmon imports were coded as wild or farmed.</td>
</tr>
<tr>
<td>B3</td>
<td>Wild</td>
<td>Japan</td>
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<td>USA</td>
<td></td>
</tr>
<tr>
<td>B5</td>
<td>Farmed</td>
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<td>USA</td>
<td></td>
</tr>
<tr>
<td>B6</td>
<td>Farmed</td>
<td>Chile</td>
<td>USA</td>
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<td>USA</td>
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<td>B8</td>
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<td>USA</td>
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<td>B10</td>
<td>Farmed</td>
<td>Japan</td>
<td>USA</td>
<td></td>
</tr>
<tr>
<td>B11</td>
<td>Farmed</td>
<td>Others</td>
<td>USA</td>
<td></td>
</tr>
<tr>
<td>B9</td>
<td>Farmed</td>
<td>USA</td>
<td>USA</td>
<td>Estimated using the United States Salmon Market Database described in Appendix C. Based primarily on NMFS Trade Data, Maine DMR Farmed Salmon Data, and Washington DFW Farmed Salmon Data.</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
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<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>B12</td>
<td>Trout</td>
<td>Norway</td>
<td>USA</td>
<td>Assumed to be zero. U.S. fisheries trade data do not distinguish between imports of “salmon trout” and other trout. In addition, Chilean exports of trout to the U.S. are roughly similar to total U.S. “trout” imports.</td>
</tr>
<tr>
<td>B14</td>
<td>Trout</td>
<td>Others</td>
<td>USA</td>
<td>Assumed to be zero. Although some Canadian salmon were exported to the EU, available data (DFO Canada Salmon Export Data 1989-1999) suggest that these exports were relatively small volumes, and that most Canadian fresh and frozen salmon exports were to the United States and Japan. FAO Glofisal Commodity Update data report annual EU imports of Canadian salmon of between 2300 and 6300 metric tons for the period 1989-2004. However, these data do not distinguish between farmed and wild Canadian salmon.</td>
</tr>
<tr>
<td>B13</td>
<td>Trout</td>
<td>Chile</td>
<td>USA</td>
<td>Assumed to be zero. No data were available to estimate exports of fresh or frozen salmon from Japan or Russia to the EU or EU imports of fresh or frozen salmon from Japan or Russia.</td>
</tr>
<tr>
<td>C1</td>
<td>Wild</td>
<td>USA</td>
<td>EU</td>
<td>Assumed to be zero. U.S. fisheries trade data do not distinguish between imports of “salmon trout” and other trout. In addition, Chilean exports of trout to the U.S. are roughly similar to total U.S. “trout” imports.</td>
</tr>
<tr>
<td>C2</td>
<td>Wild</td>
<td>Canada</td>
<td>EU</td>
<td>Estimated as total of EU imports from Ireland, the Faeroe Islands, Iceland and “other” farmed salmon producers (excluding major producers reported in the table).</td>
</tr>
<tr>
<td>C3</td>
<td>Wild</td>
<td>Canada</td>
<td>EU</td>
<td>EU imports from Norway reported in Glofisal Commodity Update 2006, page 26.</td>
</tr>
<tr>
<td>C4</td>
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<td>Russia</td>
<td>EU</td>
<td>EU imports from Norway reported in Glofisal Commodity Update 2006, page 26.</td>
</tr>
<tr>
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<td>EU</td>
<td>EU imports from Norway reported in Glofisal Commodity Update 2006, page 26.</td>
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<td>EU</td>
<td>EU imports from Norway reported in Glofisal Commodity Update 2006, page 26.</td>
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<td>UK</td>
<td>EU</td>
<td>EU imports from Norway reported in Glofisal Commodity Update 2006, page 26.</td>
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<td>EU imports from Norway reported in Glofisal Commodity Update 2006, page 26.</td>
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<tr>
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<td>Category</td>
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<td>Destination</td>
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<td>--------</td>
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<td>Trout</td>
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<td>EU</td>
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</tr>
<tr>
<td>C13</td>
<td>Trout</td>
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<td>EU</td>
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</tr>
<tr>
<td>C14</td>
<td>Trout</td>
<td>Others</td>
<td>EU</td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>Wild</td>
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<td>Japan</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>Wild</td>
<td>Canada</td>
<td>Japan</td>
<td></td>
</tr>
<tr>
<td>D3</td>
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<td>D4</td>
<td>Wild</td>
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<td>D5</td>
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<td>Chile</td>
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<tr>
<td>D7</td>
<td>Farmed</td>
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<tr>
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<td>Farmed</td>
<td>Others</td>
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<tr>
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<td>Farmed</td>
<td>USA</td>
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</tr>
<tr>
<td>D10</td>
<td>Farmed</td>
<td>Japan</td>
<td>Japan</td>
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</tr>
</tbody>
</table>

Estimated from Norwegian trout exports reported in Statistics Norway “Fish Farming 2003” report, Table 5.5, as the sum of exports to those EU countries for which exports were reported. May understate total Norwegian trout exports to the EU. Export data for 2004 were not available and were estimated based on the assumption that the ratio of Norwegian exports to Norwegian production (as reported in FAO Fishstat+ data) stayed the same as in 2003.

Calculated based on two assumptions: (1) Production weight share of total round weight was equal to share of Norwegian trout export weight share of Norwegian trout production round weight; (2) That portion of production not exported to Japan was consumed in either the EU fresh or frozen market or “Other markets” in the same proportion as the relative volumes of these two markets in Norwegian exports.

Based on U.S. exports reported in NMFS Trade data.


Based on U.S. exports reported in NMFS Trade data.

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
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<td>Trout</td>
<td>Norway</td>
<td>Japan</td>
</tr>
<tr>
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<td>Trout</td>
<td>Chile</td>
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</tr>
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<td>Trout</td>
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</tr>
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<td>Wild</td>
<td>USA</td>
<td>Canned</td>
</tr>
<tr>
<td>E2</td>
<td>Wild</td>
<td>Canada</td>
<td>Canned</td>
</tr>
<tr>
<td>E5</td>
<td>Farmed</td>
<td>Norway</td>
<td>Canned</td>
</tr>
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<td>E6</td>
<td>Farmed</td>
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<td>Trout</td>
<td>Others</td>
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</tr>
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</tr>
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<td>Farmed</td>
<td>Chile</td>
<td>Other</td>
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<td>F7</td>
<td>Farmed</td>
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<td>Other</td>
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<td>F8</td>
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</tr>
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<td>Japan</td>
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</tr>
<tr>
<td>F11</td>
<td>Farmed</td>
<td>Others</td>
<td>Other</td>
</tr>
<tr>
<td>F12</td>
<td>Trout</td>
<td>Norway</td>
<td>Other</td>
</tr>
<tr>
<td>F13</td>
<td>Trout</td>
<td>Chile</td>
<td>Other</td>
</tr>
</tbody>
</table>
In Chapter VIII we presented estimates of U.S. salmon consumption by species. In this appendix, we describe how we developed those estimates.

Overview of Methodology

We began by developing assumptions about U.S. imports, exports and domestic production of salmon by species (Atlantic, chinook, coho, sockeye, pink, chum and “unspecified”), product (fresh, frozen, canned, roe, other), and “origin” (wild and farmed). For each species/product/origin combination, we then estimated U.S. consumption using the following formula:

\[
\text{U.S. consumption} = \text{imports} + \text{domestic production} - \text{exports}
\]

Weight Basis for Analysis

As any given delivery of fish is caught, processed, distributed and finally sold, the weight of the fish declines as parts of the fish are discarded during primary processing (typically the head and guts) and secondary processing (bones, skin, fins, etc.). The headed and gutted weight after primary processing may for example be about 75% of the “round weight” of the fish as it comes out of the water, and the weight of the fillets sold to consumers may be only about 50% or less of the round weight.

To be meaningful, comparisons of salmon volumes (production, exports, consumption, etc.) should ideally be on a common “weight basis.” Potential common weight bases for describing U.S. salmon consumption include a “round-weight basis,” a primary processed-weight basis,” or an “edible-weight basis” (final product weight basis).

We reported U.S. consumption of imported salmon on an “import-weight basis”—which is simply the weight of the product as reported in the import statistics. A potential problem with this is that imports are in different product forms for which a given import weight does not necessarily correspond to a given edible weight. Fillets account for a growing share of U.S. imports; thus the edible weight represented by a given volume of salmon imports has been growing over time.

We estimated and reported U.S. consumption of domestically produced salmon on a “production-weight” basis, or the weight of the fish after primary processing, which is the weight reported in Alaska production data from the ADFG “Commercial Operator Annual Report” database. We assumed that exports (which we subtracted from U.S. production to estimate consumption from domestic production) were also on a production-weight basis.

Data Sources and Coding for Imports and Exports

We used annual data for U.S. salmon imports and exports for the years 1989-2004, by product and country, as reported on the National Marine Fisheries Service (NMFS) “Foreign Trade Information” website at: www.st.nmfs.gov/st1/trade/index.html. We began with 1989 because data for earlier years were only available for a much less detailed range of salmon products.

During these years NMFS reported imports and exports of 55 different salmon products. Table C-1 shows our coding of these products by species (Atlantic, chinook, coho, pink, sockeye, chum, and “unspecified”), product (fresh, frozen, canned, roe, other), and “origin” (wild, farmed and “uncertain”).

We coded the origin of all export products as either farmed or wild. In contrast, we initially coded the origin of some import products as “uncertain” because it was not possible to tell from the product name alone whether the imported product was wild or farmed. These products included coho salmon and chinook salmon for which the product name did not indicate whether the product was wild or farmed, as well as “NSPF” (nonspecified) salmon.
We based our final “origin” coding for imported products for which the origin was “uncertain” on the country from which the product was imported. We assumed that “uncertain” products imported from Canada, Japan, Russia, Thailand and China were “wild,” while “uncertain” products imported from all other countries were “farmed.” We included Thailand and China as likely exporters of “wild” salmon because these countries reprocess significant volumes of wild salmon caught in the United States, Russia and Japan.

NMFS reported some imports of the products “Salmon Atlantic Fillet Fresh Wild” and “Salmon Atlantic Fresh Wild.” Some of these reported imports appear to be miscoded. For example, it seems highly unlikely that the United States would have imported “wild Atlantic salmon” from Chile, Australia, India, Japan or Mexico—as we are unaware of any wild Atlantic salmon runs in those countries. Other countries, such as Iceland, have at least have some wild Atlantic salmon runs, although it seems likely that some reported “wild” Atlantic salmon imported into the United States from these countries was actually “farmed.” However, as we had no reliable basis for adjusting for possible errors in the data, we coded all “wild Atlantic salmon” as “wild.” In any case, reported imports of “wild Atlantic salmon” were small.

<table>
<thead>
<tr>
<th>NMFS Trade Product</th>
<th>Species</th>
<th>Product</th>
<th>Origin (Import Code)</th>
<th>Origin (Export Code)</th>
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<td>Chinook</td>
<td>Fresh</td>
<td>Uncertain</td>
<td>Wild</td>
</tr>
<tr>
<td>SALMON CHINOOK FROZEN</td>
<td>Chinook</td>
<td>Frozen</td>
<td>Uncertain</td>
<td>Wild</td>
</tr>
<tr>
<td>SALMON CHINOOK STEAKS FRESH</td>
<td>Chinook</td>
<td>Fresh</td>
<td>Uncertain</td>
<td>Wild</td>
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<tr>
<td>SALMON CHINOOK STEAKS FROZEN</td>
<td>Chinook</td>
<td>Frozen</td>
<td>Uncertain</td>
<td>Wild</td>
</tr>
<tr>
<td>SALMON COHO FRESH</td>
<td>Coho</td>
<td>Fresh</td>
<td>Uncertain</td>
<td>Wild</td>
</tr>
<tr>
<td>SALMON COHO FROZEN</td>
<td>Coho</td>
<td>Frozen</td>
<td>Uncertain</td>
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<td>SALMON COHO STEAKS FRESH</td>
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<td>Uncertain</td>
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<td>Fresh</td>
<td>Wild</td>
<td>Wild</td>
</tr>
<tr>
<td>SALMON ATLANTIC FRESH WILD</td>
<td>Atlantic</td>
<td>Fresh</td>
<td>Wild</td>
<td>Wild</td>
</tr>
<tr>
<td>SALMON CHINOOK FRESH WILD</td>
<td>Chinook</td>
<td>Fresh</td>
<td>Wild</td>
<td>Wild</td>
</tr>
<tr>
<td>SALMON CHUM CANNED NOT IN OIL</td>
<td>Chum</td>
<td>Canned</td>
<td>Wild</td>
<td>Wild</td>
</tr>
</tbody>
</table>
For this report, we only estimated U.S. consumption of fresh, frozen and canned salmon. We did not estimate consumption of roe or “other” product forms.

**Data Sources and Coding for U.S. Domestic Production**

**Alaska Fresh and Frozen Wild Salmon Production**

For Alaska fresh and frozen wild salmon production, we used ADFG COAR data. All Alaska production is wild, and products in the COAR database are coded by species and the same product codes which we used for our analysis (fresh, frozen, canned, roe and other).

**Alaska Canned Wild Salmon Production**

For Alaska canned wild salmon production, we began by converting NFPA Canned Pack data for Alaska from cases to metric tons, based on an assumed weight of 44.25 pounds per case of “48-tall” cans. We then compared these estimated volumes with the canned salmon production volumes reported in the ADFG COAR data. For each year/species combination, we used whichever figure was higher as our assumption for Alaska canned salmon production.

**U.S. Pacific Northwest Canned Wild Salmon Production**

For U.S. Pacific Northwest canned wild salmon production, we used NFPA Canned Pack data for Washington, converted to metric tons based on an assumed weight of 44.25 pounds per case of “48-tall” cans.

We next estimated the corresponding “round weight” of Pacific Northwest canned production, by dividing estimated canned weight by the assumed canned yields shown in Table C-2.

### Table C-2

**Assumed Wild Salmon Primary Product Yields from Round Weight**

<table>
<thead>
<tr>
<th>Species</th>
<th>Fresh</th>
<th>Frozen</th>
<th>Canned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook</td>
<td>.72</td>
<td>.72</td>
<td>.67</td>
</tr>
<tr>
<td>Sockeye</td>
<td>.74</td>
<td>.74</td>
<td>.67</td>
</tr>
<tr>
<td>Coho</td>
<td>.75</td>
<td>.75</td>
<td>.67</td>
</tr>
<tr>
<td>Pink</td>
<td>.73</td>
<td>.73</td>
<td>.65</td>
</tr>
<tr>
<td>Chum</td>
<td>.74</td>
<td>.74</td>
<td>.67</td>
</tr>
</tbody>
</table>

U.S. Pacific Northwest Fresh and Frozen Wild Salmon Production

We had canned production data for Washington, but no other production data for U.S. Pacific Northwest wild salmon. In the absence of better data, we assumed that all U.S. Pacific Northwest salmon was either canned or sold fresh (in other words, that none was frozen). We recognize that this likely underestimates frozen production and overstates fresh production, but because of the small production volumes any error introduced by this assumption would be small compared with total U.S. salmon consumption.

We then estimated U.S. Pacific Northwest fresh wild salmon production in three steps:

1. We began with NMFS Catch Data for the round weight of Pacific Northwest wild salmon harvests.
2. We subtracted the estimated round weight of salmon that was canned (calculated as described above) to estimate the round weight of salmon sold fresh.
3. We converted this round weight to production weight basis by multiplying by the assumed yields for fresh salmon shown in Table C-2.

Farmed Salmon Production

For U.S. farmed salmon production (round weight) we used the sum of Maine farmed salmon production (from DMR Farmed Salmon Data) and data for Washington farmed salmon production from Washington Agricultural Statistics Service (various years) for 1989-1999 and Stanley (2005) for 2000-2004. We assumed that all of this salmon was sold fresh. We converted round weight to production weight based on assumed yields from round weight to dressed head/on weight of .916 for Atlantic salmon1 and .880 for “nonspecified” farmed salmon.2 Almost all U.S. farmed salmon production was Atlantic salmon during this period. However, between 1989 and 1999 Washington farmed salmon production included small and declining volumes of “nonspecified” farmed salmon (probably chinook).

Estimation of U.S. Consumption

For each species/product/origin combination, we estimated U.S. consumption using the following formula:

\[
\text{U.S. consumption = imports + domestic production - exports}
\]

This method of estimating domestic consumption assumes that whatever was produced domestically but not exported was consumed domestically. However, it is possible that canned or frozen salmon produced in a given year was neither consumed nor exported, but rather added to salmon inventories. To the extent that this occurred in any given calendar year, our estimates would tend to overstate consumption in years in which inventories were built up. Conversely, our estimates would tend to underestimate consumption in years in which inventories were drawn down.

In earlier efforts to estimate U.S. consumption, we have adjusted our consumption estimates for net changes in inventories. However, it is no longer possible to do this, as canned and frozen salmon inventory data are no longer available.

Note that not adjusting for changes in canned or frozen salmon inventories may result in wider annual variation in estimated consumption than actually occurred, with consumption underestimated in some years and overestimated in others. However, as most inventories are eventually consumed, average consumption over periods of several years should be relatively more accurate, with underestimates in some years balancing out overestimates in other years.

Another potential problem with our estimates—as with any empirical analysis—may be incomplete or inaccurate data. For example, if some Alaska processors fail to report production to the Alaska Department of Fish and Game, resulting in an underestimate of production in the ADFG COAR data, there will be a corresponding shortfall in our estimates of U.S. consumption.

One indicator that this may have occurred to some extent is that for some species and products (particularly frozen sockeye), in some years reported U.S. exports exceeded reported U.S. production—which would have implied negative consumption. Where this occurred (primarily in data for 1989 and 1990) we assumed that U.S. consumption was zero. This is why, for example, Figure VIII-1 shows estimated U.S. frozen salmon consumption of zero in 1989 and 1990. We recognize that frozen salmon consumption was not in fact zero in those years, but we have no reliable method of estimating what actual consumption would have been—except that it was likely relatively small.

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1 Based on farmed Atlantic salmon yield assumption (BC Ministry of Agriculture, Fisheries and Forestry 1993).
2 Chinook yield from round to dressed head/on salmon reported in Crapo, Paust and Babbitt (1993).
References


Crapo, Chuck, Brian Paust and Jerry Babbitt, 1993. *Recoveries and Yields from Pacific Fish and Shellfish*, University of Alaska Sea Grant College Program, Revised MAB-37.

