The Wild Salmon Industry:  
Five Predictions for the Future

by

Gunnar Knapp  
Professor of Economics  
Institute of Social and Economic Research  
University of Alaska Anchorage  
3211 Providence Drive  
Anchorage, Alaska 99508  
(907) 786-7717 (telephone)  
(907) 786-7739 (fax)  
afgpk@uaa.alaska.edu (e-mail)

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Abstract

Given the rapid growth in world farmed salmon production, what is the future of wild salmon harvesting? This paper offers five predictions for the future of the wild-caught salmon industry:

1. Wild salmon harvests will continue to fluctuate from year to year due to natural causes.

2. Average wild salmon harvests will decline somewhat from levels of the 1990's, due to a combination of natural environmental factors, human-related environmental factors, political factors, and economic factors.

3. Wild salmon will be sold increasingly in markets in which it can best compete with farmed salmon. These include higher-priced markets in which wild salmon competes based on "wild" attributes, lower-priced markets in which wild salmon competes based on price, and canned markets.

4. Wild salmon prices will be driven by farmed salmon prices and wild supply. The more directly wild salmon competes with farmed salmon, the more trends in wild salmon prices will reflect trends in farmed salmon prices.

5. Wild salmon will be harvested and processed more efficiently and the quality of wild salmon products will improve.

These predictions are based on several stipulated assumptions concerning the farmed salmon industry.
**Introduction**

The rapid growth of the farmed salmon industry over the past two decades has dramatically changed world salmon production and markets. Wild salmon now accounts for less than half of total world salmon supply (see graph below). Given the rapid growth in global farmed salmon production, what is the future of the wild salmon industry?

In this paper, I offer five predictions for the future of the wild salmon industry. My predictions are based on past trends as well as reasoning about how environmental, economic, and political factors may affect the wild salmon industry in the future.

I ask the reader to keep in mind that these are not predictions for the next year, but rather for changes that may occur gradually over the next decade and beyond.
Overview of the Wild Salmon Industry

Commercially-harvested wild salmon consist almost entirely of five species of Pacific salmon (Oncorhyncus). Commercial harvests of wild Atlantic salmon (Salmo) are very small. The United States, Japan, Russia and Canada account for almost all wild salmon harvests. The mix of species harvested differs by country. The most important species are pink and sockeye salmon for the United States, chum salmon for Japan, and pink salmon for Russia. Harvests of each species by each country vary widely from year to year.

Table 1: Average Annual World Wild Salmon Harvests During the 1990s (thousand mt)

<table>
<thead>
<tr>
<th>Species</th>
<th>USA</th>
<th>Japan</th>
<th>Russia</th>
<th>Canada</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pink Salmon (O. gorbuscha)</td>
<td>153</td>
<td>23</td>
<td>144</td>
<td>15</td>
<td>334</td>
</tr>
<tr>
<td>Chum salmon (O. keta)</td>
<td>58</td>
<td>209</td>
<td>24</td>
<td>14</td>
<td>305</td>
</tr>
<tr>
<td>Sockeye salmon (O. nerka)</td>
<td>130</td>
<td>5</td>
<td>14</td>
<td>21</td>
<td>171</td>
</tr>
<tr>
<td>Coho salmon (O. kisutch)</td>
<td>21</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Chinook salmon (O. tshawytscha)</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>TOTAL</td>
<td>371</td>
<td>237</td>
<td>185</td>
<td>58</td>
<td>851</td>
</tr>
</tbody>
</table>

Sources: Fisheries agencies in the respective countries with responsibility for wild salmon management.

I use the term “wild” to include “ranched” salmon raised in hatcheries and released to augment wild adult stocks. Ranched fish account for almost all Japanese chum salmon harvested, about 40% of U.S. pink salmon harvests, about 70% of U.S. chum salmon harvests, and some Russian pink and chum salmon harvests (exact data on Russian hatchery harvests are not available). Overall, ranched fish from hatcheries account for about 40% of world wild salmon harvests, although this share varies substantially from year to year.

Wild salmon are processed into four major product forms--canned, frozen, fresh, and salmon roe. Markets differ widely for different species and their country of origin. Most US and Canadian pink salmon, and about one-third of US and Canadian sockeye salmon is canned for sale to US and European markets. About two-thirds of North American sockeye salmon is frozen and sold to the Japanese market. Most North American chum, coho and Chinook salmon are sold fresh or frozen in the United States or Europe. Most Japanese chum salmon are sold fresh in the Japanese market. Most Russian salmon are sold on the Russian market but exports to Japan and other countries are increasing. Most salmon roe, from all species, is sold to the markets of Japan or Russia.

As farmed salmon production has grown, wild salmon's share of the total world salmon market has declined in proportion to its declining share of total supply. However, wild salmon still accounts for almost all of the world's canned salmon production and production of salmon roe, because there is relatively little farmed production devoted to
these products. By contrast, the decline in wild salmon's share of fresh and frozen markets worldwide has been even greater than its declining share of total salmon supply.

In general, prices trended downwards for wild salmon products during the 1990s. Certainly, competition from farmed salmon, and growing total world supply, were major contributing factors in the decline in prices. However, record harvests of wild salmon, and changing consumer demand for canned salmon also played a role.

The diversity of wild salmon species, management systems, products, and markets makes generalization about “the wild salmon industry” difficult. In the following discussion of predictions for the future, the reader is asked to consider that there is not necessarily a single future for wild salmon. The wild salmon industry may evolve in different ways for different countries and for different species.

Assumptions about Farmed Salmon

The future of the wild salmon industry will be driven in large part by developments in the salmon farming industry. Given this, I make several assumptions about the future of farmed salmon:

- **Farmed salmon production costs will continue to decline.**

The farmed salmon industry is still very young in comparison to the thousands of years over which experience has accumulated in meat and poultry farming. As more experience in salmon farming is gained, further cost reductions are likely. Factors contributing to lower production costs will include increased feed conversion efficiency (partly by the breeding of faster-growing fish) and increased efficiency in fish processing and distribution.

As aquaculture production of salmon and other species expands, increasing demand for fish-meal and fish oil, major ingredients in salmon feed, may lead to higher prices for these commodities. However, there is potential to divert fish-meal from other agricultural uses to salmon farming, as well as for substitution of vegetable-based alternatives for salmon feed fish-meal; this will tend to offset the effects of higher fish-meal prices.

- **World farmed salmon production will continue to grow.**

As costs of production continue to decline, farmers will continue to expand production. Although various factors such as disease, storms, declining prices and political opposition will lead to reduced production in some years and/or in some countries, over time global farmed salmon production will continue to increase.

- **Average prices for farmed salmon will decline gradually.**

Farmed salmon prices have trended downwards over the past decade, in response to increasing world supply of both farmed and wild salmon. It is this decline in prices which has encouraged world markets to absorb vastly expanded production. Further
farmed salmon price decreases will occur as farmed production increases and costs decline. However, the growth in demand that will cause world markets to absorb future increases in farmed salmon supply will result in only relatively small price reductions; the major factor driving long-run average prices of farmed salmon will be costs of production. As long as prices exceed farmed salmon production costs, farmers will expand production; this in turn will drive prices down until they approach costs of production.

- Periodic over-supply and under-supply will cause price cycles for farmed salmon - similar to price cycles for cattle or pigs.

Because of the long time-period required to grow farmed salmon, farmers base their production on prices they expect to receive two or more years in the future. In any given year, it is thus unlikely that actual production will be at levels causing prices to hold constant. In years of over-supply, prices will fall; in years of under-supply, prices will rise.

- Aggressive marketing by the farmed salmon industry will play an important role in expanding worldwide demand that will absorb increased production.

Farmed producers are actively involved in the development of new markets. Aggressive marketing and the development of new value-added products have the potential to greatly expand world salmon demand.

Prediction #1: Wild salmon harvests will continue to fluctuate from year to year.

Wild salmon harvests have always fluctuated from year to year for no obvious reasons. Significant and unpredictable year-to-year fluctuations in wild harvests add to the cost and economic risk of wild salmon harvesting and processing, and represent a permanent source of market instability.

Prediction #2: Average wild salmon harvests will decline somewhat from the levels of the 1990s, due to a combination of natural environmental factors, human-related environmental factors, political factors, and economic factors.

Whilst all these factors will have a bearing on future wild salmon harvests, the relative importance of each will vary between countries and species - and the magnitude of the potential decline in each case, and in harvests overall, is very difficult to predict. Even as total harvests decline, harvests may increase for some species and/or areas.

Natural environmental factors completely beyond human control will probably be the most important influences on future wild salmon harvests - but they are the most difficult to predict.
Historically, long-term "regime shifts" in North Pacific ocean climate conditions, occurring every few decades, have been correlated with harvests of Pacific salmon. The causes of regime shifts are not well understood, nor the mechanisms by which they affect ocean survival of wild salmon. But the mechanisms are known to include the effects of ocean temperatures and currents on salmon and also their predators and their prey. Changes in ocean conditions affect different species in different ways, and may tend to increase runs of a given species to some areas, while reducing runs of the same species to other areas. The 1980s and 1990s were a period of historically high wild salmon returns. It is likely that at some point less favorable ocean conditions will lead to lower wild salmon harvests.

**Human-related environmental factors** - such as the rate at which salmon runs are harvested, and human effects on the environment - will also affect future salmon harvests. Over-harvesting, construction of dams, and pollution of rivers are all environmentally-impacting human activities that have contributed to the decline of once-healthy wild salmon runs in many places. It is unlikely that these factors will lead to large further declines in wild salmon harvests in the near future. The largest wild salmon runs do not face immediate human-caused environmental threats because they are in remote areas of Alaska and Russia. Management agencies seek to allow adequate escapement of salmon to spawning streams to allow commercial harvests to be sustained, however, inadequate enforcement could lead to over-harvesting of some Russian salmon stocks. Certainly, in the long term the future of the wild salmon industry will pivot on conservative harvest rates and protection of salmon streams and spawning habitat.

**Political factors** are restrictions on commercial wild salmon harvests for reasons other than protection of salmon resources. One political factor which may reduce future wild commercial salmon harvests is increased competition from sport fishermen seeking a larger share of salmon resources. This competition is likely to intensify with growing world population and income. Another political factor is increasingly negative public attitudes towards commercial fishing in general, with perceptions of over-fishing, bycatch waste, and ecological damage, as well as "fish rights" activism.

**Economic factors** include changes in prices and costs. If wild salmon prices decline this would reduce the profitability of "ocean-ranching" (hatchery) operations in Japan, Alaska, and Russia, which would in turn likely lead to some reductions in hatchery releases and, consequently, harvests of hatchery fish. In addition, harvests would not be economically viable for some wild runs for which the costs of processing and transporting salmon to market exceed market prices; these would tend to be smaller or more remote runs with higher harvesting and processing costs, and runs of lower-priced species (pink and chum).

However, the fact that harvesting permits still command high prices in many Alaska limited-entry salmon fisheries indicates that the value of the harvests exceeds the costs of catching the fish. This suggests that the fish would continue to be harvested even if prices fall (despite the value of the permits declining consequently). Also, in many salmon fisheries it would be possible to reduce harvesting costs through changes in management. Thus, for these reasons the largest wild salmon runs would continue to be harvested even if prices declined substantially.
Prediction #3: Wild salmon will be sold increasingly in markets in which it can best compete with farmed salmon. These include higher-priced markets in which wild salmon competes based on "wild" attributes, lower-priced markets in which wild salmon competes on price, and canned markets.

Table 1 summarizes relative economic advantages and disadvantages of salmon supplied from the wild compared with farmed salmon. Wild salmon will tend to be sold in those markets where it is most helped by its economic advantages, and/or least harmed by its economic disadvantages.

Wild salmon will be able to command higher prices in markets serving those consumers seeking specific attributes of wild salmon - such as taste, color, nutritional value, "wildness," or "romance" - or consumers who prefer to purchase wild salmon because they believe that doing so is more environmentally responsible than eating farmed salmon. These markets include both larger markets in which consumers have traditional taste preferences for wild salmon, such as traditional Japanese sockeye salmon consumers, as well as smaller "niche" markets. Alaska Copper River salmon are an example of a niche market in which wild salmon command high prices because of their reputation (enhanced by marketing) for superior taste as well as being the first wild salmon of the season in North America.

As world salmon consumption expands, there will be more salmon consumers. Some of the new consumers will be attracted by special characteristics of wild salmon and will seek out wild salmon specifically for these qualities.

Wild salmon is at a disadvantage compared with farmed salmon in supplying the majority of the world's potential salmon consumers who do not have traditional or even recently acquired preferences for wild salmon. Most of these consumers will buy most of their salmon from the large retail and food service companies that increasingly dominate food sales in higher income countries. Increasingly, these companies are seeking to reduce costs by purchasing large volumes from large-scale suppliers to meet particular volume, quality, and delivery specifications. Because of their far greater control over production, farmed salmon producers are better able to meet the requirements of the large-scale buyers. Partly for this reason, farmed salmon will increasingly become the "regular" kind of fresh, frozen, and value-added salmon sold by supermarkets and large food-service operations. In turn, most consumers will come to perceive farmed salmon as the "regular" kind of salmon - and may prefer it over wild salmon because of familiarity with the taste and consistency in quality and appearance.
Table 1: Economic Advantages and Disadvantages of Wild Salmon Compared with Farmed Salmon

<table>
<thead>
<tr>
<th>Advantages/Disadvantages</th>
<th>Wild Salmon</th>
<th>Farmed Salmon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages</td>
<td>Fish production costs: Only costs are fisheries management and harvesting. Ocean-ranching also includes costs of hatchery operations. Costs of harvesting could potentially be greatly reduced (although this is politically difficult).</td>
<td>Farmers incur all costs of raising fish.</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>Production volume: Production volume is inconsistent from year to year and difficult to predict.</td>
<td>Farmers can accurately forecast production and guarantee supply commitments.</td>
</tr>
<tr>
<td></td>
<td>Production timing: Wild harvests must occur during a short summer run.</td>
<td>Farmed production can occur over many months or year-round.</td>
</tr>
<tr>
<td></td>
<td>Product consistency: There is wide variation in the size and quality of individual wild fish.</td>
<td>Farmed fish can be produced of consistent sizes and quality.</td>
</tr>
<tr>
<td>Potentially</td>
<td>Processing and distribution costs: Variation in harvest volume and fish size and quality adds to costs; but there may be economies of scale for large concentrated harvests.</td>
<td>Predictability of production volume and timing and consistency of product reduces costs.</td>
</tr>
<tr>
<td>Advantages or Disadvantages</td>
<td>Consumer taste perceptions: Some consumers specifically prefer the taste and appearance of wild salmon.</td>
<td>Many consumers are unfamiliar with wild salmon; farmers can affect taste and appearance characteristics.</td>
</tr>
<tr>
<td></td>
<td>Other consumer perceptions: Wild salmon may be perceived as more &quot;natural&quot;-but may be perceived as endangered.</td>
<td>Farmed salmon are not &quot;endangered&quot;, but consumers may regard them as less &quot;natural&quot; (i.e. perceive negative environmental impacts of farming).</td>
</tr>
</tbody>
</table>

In selling to large buyers and to consumers without specific preferences for wild salmon, the wild salmon industry can make up for these competitive disadvantages by selling at lower prices. Because of the potential for wild salmon to be produced at lower cost than farmed salmon, wild salmon not able to capitalize on specific advantages associated with "wildness" will tend to become a lower-priced alternative to farmed salmon, compensating via lower prices for its disadvantages in production timing, production...
volume, product consistency, and consumer perceptions. The United States market for fresh and frozen chum salmon represents an example of a market in which wild salmon competes on price, selling at a significant price discount compared to farmed Atlantic salmon.

Wild salmon probably has an advantage in canned markets, as suggested by the fact that only a small share of farmed salmon is canned. Short, concentrated seasons are less of a disadvantage for wild salmon when committed for canning, partly because canned salmon can have prolonged storage at low cost, and partly because large volumes allow for economies of scale in canning operations. Consistency of fish size and appearance is also less important than for other salmon products, and traditional canned salmon consumers are used to the taste of wild salmon.

**Prediction #4: Wild salmon prices will be driven by farmed salmon prices and wild supply. The more directly wild salmon competes with farmed salmon, the more trends in wild salmon prices will reflect trends in farmed salmon prices.**

Farmed salmon will represent an increasing share of world salmon supply and will play an increasingly important role in setting price levels for wild salmon. Wild salmon products which are perceived to be of higher quality than farmed salmon will command higher prices than farmed salmon. Others will be sold as lower-priced alternatives to farmed salmon, as discussed above.

Fluctuations in wild salmon harvests will have less of an effect on wild salmon prices than formerly, because wild salmon will be a smaller share of total salmon supply in the markets in which they are sold. The more directly wild salmon products compete with farmed salmon, the more their prices will reflect trends in farmed salmon prices, and the less they will be affected by fluctuations in wild harvests. For this reason, prices for most fresh, frozen, and value-added wild salmon products are likely to trend downwards as farmed salmon prices decline, even if wild salmon harvests decline.

Prices of wild salmon products which compete less directly with farmed salmon - such as canned salmon or niche market products - will be relatively less affected by farmed salmon price levels, and relatively more affected by wild salmon harvests. Depending also on trends in demand, prices for these wild salmon products could rise over time if wild salmon harvests decline.

Prices of different wild salmon species will reflect these factors in different ways. Gradually declining farmed salmon prices will put downward pressure on prices of wild-caught species sold in fresh and frozen markets, including sockeye, chinook, coho and chum salmon. Farmed salmon prices will have less of an effect on pink salmon prices, more affected by this species’ harvest volumes, and changing demand for canned salmon. (As a point of interest, concerning pink or chum salmon, prices of neither are likely to fall much further, because they are already near a "floor" imposed by the costs of hatchery production and fish harvesting. For these two species prices cannot fall much
further without reducing hatchery production and/or harvests, which would in turn reduce supply and help maintain prices at or above this “floor.”)

**Prediction #5: Wild salmon will be harvested and processed more efficiently, and the quality of wild salmon products will improve.**

There is substantial potential to reduce costs of wild salmon harvesting and processing, and improve quality, through changes in fishery management. In many fisheries there is excess harvesting capacity and the number of fishing boats could be reduced without reducing catches. For example, salmon traps - currently banned in Alaska - could catch fish more cheaply and also allow for better handling and thus give higher product quality. These kinds of changes are politically very difficult, because they would reduce the number of fishermen and substantially change the nature of wild salmon fisheries. However, over time market pressures will drive the salmon harvesting and processing sectors to seek ways to cut costs and increase value.

**Key Areas of Uncertainty for Wild Salmon**

Any prediction of the future is of course subject to uncertainty. Several factors stand out as particularly uncertain - yet important - in predicting the future of the wild salmon industry.

First among these is the extent to which wild salmon harvests may be affected by natural environmental factors. It is possible that little change will occur in ocean conditions for salmon, causing little change in current harvest levels. Alternatively, as has occurred in the past, changes in ocean conditions could lead to dramatic reductions in wild salmon harvests, which could in turn significantly reduce the importance of wild salmon. In part because of the difficulty of predicting how climate may change, scientists are unable to predict with confidence how or when wild salmon returns may change.

A second area of uncertainty is the extent to which the characteristics of wild salmon will be valued by consumers in the future. It is possible to envision (as many wild salmon fishermen would like) a large increase in the number of consumers who prefer wild salmon because it is "natural." However, it is also possible to envision an erosion of traditional preferences for wild salmon, as may be currently occurring in Japan where the share of wild sockeye salmon in the Japanese market is declining.

A third area of uncertainty is to what extent and how rapidly change will occur in how wild salmon is harvested. As noted above, there is substantial potential to reduce costs and improve quality through changes in fishery management - but these changes are politically very difficult. How and when these changes occur will affect the future role of wild salmon in world markets.
Conclusion

Competition from farmed salmon will continue to pose significant challenges for wild salmon, but expanding world demand will also create new opportunities. Although farmed salmon will capture an increasing share of world markets, wild salmon will remain an important part of world supply. Fundamental reasons why wild salmon can continue to compete with farmed salmon include natural quality characteristics of wild salmon and the potential for low costs of its production.
About the Author

Gunnar Knapp is a Professor of Economics at the University of Alaska Anchorage. For the past decade he has studied markets for Alaska wild salmon and how they are changing with the rapid growth of the farmed salmon industry. He has written numerous reports on Alaska salmon markets, and has given dozens of presentations for industry, academic and government groups. From 1994 to 1998 he directed the Salmon Market Information Service, an industry-funded program to provide market information to Alaska salmon fishermen. Selected recent publications are available at his web site at www.iser.ualaska.edu/iser/people/knapp.