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Jennifer I. Schmidt^{ab} & F. Stuart Chapin III^c

^a Scenarios Network for Alaska and Arctic Planning (SNAP), University of Alaska Fairbanks (UAF), Fairbanks, Alaska, USA

^b Institute of Arctic and Marine Biology, University of Tromsø/The Arctic University of Norway, Tromsø, Norway

^c The Institute of Arctic Biology and Department of Biology and Wildlife, University of Alaska Fairbanks (UAF), Fairbanks, Alaska, USA

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Relationship of Community Characteristics to Harvest Reporting: Comparative Study of Household Surveys and Harvest Tickets in Alaska

JENNIFER I. SCHMIDT^{1,2} AND F. STUART CHAPIN III³

¹Scenarios Network for Alaska and Arctic Planning (SNAP), University of Alaska Fairbanks (UAF), Fairbanks, Alaska, USA

²Institute of Arctic and Marine Biology, University of Tromsø/The Arctic University of Norway, Tromsø, Norway

³The Institute of Arctic Biology and Department of Biology and Wildlife, University of Alaska Fairbanks (UAF), Fairbanks, Alaska, USA

Accurate harvest reporting is critical for wildlife management. Rural Alaskan communities reported a median of 42% of moose harvested via traditional harvest tickets compared to those reported in household surveys. This harvest-report ratio did not change over time. Twice as many moose were reported harvested during subsistence household surveys (n = 8,039) than on hunter harvest tickets (n = 3,557). Percentage of the community that was indigenous, used and shared moose, and absence of a wildlife biologist or road access were associated with low harvest-report ratios. Analysis revealed that household surveys provide important information about moose harvest rates and their use should be expanded. Reporting rates might be improved by building trust through respectful dialogue between hunters and managers and by placing more emphasis on the benefits of reporting harvests and less emphasis on enforcement.

Keywords Alaska, harvest reporting, hunting, moose, subsistence, wildlife management

Introduction

Information provided by hunters is often used by wildlife managers to assess trends in the number of animals harvested, hunter success, and as an index of wildlife population size (Crichton, 1993; Usher, DeLancy, Wenzel, Smith, & White, 1985). Accurate harvest information is useful in developing harvest regulations (Kilpatrick, LaBonte, & Barclay, 2005) and in understanding factors that influence hunter success (Albert, Bowyer, & Miller, 2001). Potential sources of inaccurate reporting include poor survey design (MacDonald & Dillman, 1968), inability of an angler or hunter to recall (Filion, 1980), cultural conflicts (Andersen & Alexander, 1992; McCorquodale, 1997), and non-response or non-compliance by hunters (Filion, 1980; Strickland et al., 1994; Unsworth, Johnson, Nelson, & Miyasaki, 2002).

Address correspondence to Jennifer I. Schmidt, Institute of Arctic and Marine Biology, University of Tromsø/The Arctic University of Norway, Naturfagbygget Naturf 2418, 9037 Tromsø, Norway. E-mail: jischmidt0@gmail.com

In addition to legal human harvest, declines in localized moose populations are thought to be compounded by illegal, unreported, and ceremonial harvest of moose (Bentzen, 2010; Stout, 2010; Tobey, 2010). Although managers state that poor reporting and illegal harvest is an important issue, its magnitude varies and is difficult to estimate (Bentzen, 2010; Gorn, 2010; Westing, 2010). Illegal harvests are a worldwide problem and have threatened both wildlife species and the sustainability of some cultures (Gibbons et al., 2000; Poulsen, Clark, & Mavah, 2007; Zhou & Jiang, 2004). More accurate harvest information would both improve understanding of the factors regulating game populations and better document harvest and use by communities (Hunt, 2013; Kilpatrick et al., 2005).

In Alaska, moose (*Alces alces gigas*) hunting is widespread for both sport and food (Ballew, Tzilkowski, Hamirick, & Nobmann, 2006; Hundertmark, Thelen, & Schwartz, 1993). Moose have long been a staple in the diets of many Alaskans, and wild foods have been an integral component of Alaskan indigenous culture for thousands of years (Ballew et al., 2006; Nelson, 1973). Wildlife harvest is also an important component of food security because of the small number of wage-paying jobs, high cost of living, and limited availability of commercial foods in rural communities (Mitchell, 1986; Wolfe, 2000).

In Alaska, hunter harvest tickets are the most common form of reporting moose harvests. After a hunting license is purchased, an individual can obtain a free harvest permit, allowing a hunter to harvest one moose. Alaskan hunters are required to return the report portion of the harvest ticket regardless of success. In the mid-1980s, 80–85% of hunters in the largely rural northwest portion of Alaska did not purchase hunting licenses (Schaeffer, Barr, & Moore, 1986) and therefore had no tickets with which to report their moose harvest. Most (77%) wildlife managers in western Alaska believed that over- or under-reporting of caribou harvest limited the quality and usefulness of harvest data (Klein, Moorehead, Kruse, & Braund, 1999).

Some managers in Alaska suggest the use of household surveys to get a more complete harvest estimate (Dau, 2009; Gorn, 2010; Westing, 2010). The Alaska Department of Fish and Game (ADF&G) Division of Subsistence and the U.S. Fish and Wildlife Service (USFWS) conducts household surveys to collect information that is independent from harvest tickets about fish and game harvest (Fall, 1990; Wentworth, 2007a, 2007b; Wolfe, 2000). Surveys often report more harvest of waterfowl, fish, marine mammals, and moose than do harvest tickets (Butler, 2010; Davis, 2005; Williams, Coiley-Kenner, & Koster, 2010; Wolfe & Paige, 2002). For example, harvest estimates from fish permits were 14–40% lower than household survey estimates, due to low participation in the permit process, but was increased to 69% by education and outreach (Williams et al., 2010). In rural communities, the interviewer is typically a trusted community resident, and results are recorded anonymously and aggregated to the community level, making self-incrimination difficult (Davis, 2005; Trent, 1995). Harvest-survey researchers generally obtain permission from tribal governments, which improves relationships and information-sharing in these largely indigenous communities.

The only previous comparison of reporting discrepancies between harvest tickets and household surveys for moose in Alaska found considerable variation among communities (Andersen & Alexander, 1992). Based on quantitative comparison of 10 communities over two years and interviews in three communities, the authors suggested three potential explanations for variation among villages in returning harvest tickets: (a) high compliance in communities with a resident ADF&G biologist, reflecting either greater access to information or greater risk of enforcement; (b) low compliance in smaller rural communities, reflecting less access to hunting licenses and harvest tickets; (c) low compliance in

communities with a high proportion of indigenous residents reflecting cultural traditions or attitudes about wildlife management.

The objective of our study was to more rigorously evaluate drivers of harvest reporting by expanding the scope of the Andersen and Alexander (1992) study to all of rural Alaska over a longer time period (26 years). Our goal was to compare harvest estimates from two different survey methods, community characteristics associated with reporting divergences, and explore the utility of household surveys to capture a more complete picture of harvest than harvest-ticket approaches. Based on Anderson and Alexander (1992) we hypothesized (a) that under-reporting of moose harvest was widespread in Alaska, (b) that this reflected both cultural characteristics (percentage indigenous residents and other cultural attributes) and fear of enforcement (presence of an area biologist), and (c) that the magnitude of under-reporting had decreased through time. To test these hypotheses and explore other potential explanations of under-reporting, we compared: (a) the reported harvest in the subsistence household surveys and harvest tickets; (b) characteristics of communities that under-report (cultural characteristics, link to the road system, and presence of an area biologist); and (c) correlations among community characteristics. Based on these observations, we suggest ways to improve reporting rates.

Methods

Data

We used 108 communities in Alaska (Figure 1) for which the ADF&G, Division of Subsistence conducted household surveys and moose hunting activity was reported in at least one year between 1984 and 2009. We excluded communities from areas where there are no or few moose, requiring travel outside the region to harvest a moose.

For each community, we estimated the annual number of moose harvested using two independent data sources. We calculated the total number of moose harvested per community based on harvest tickets returned by moose hunters from each community to ADF&G Division of Wildlife Conservation and compared this estimate with the harvest number estimated in household surveys conducted by ADF&G Division of Subsistence in the same community and year, as described by Wolfe and Utermole (2000). The year for the subsistence household surveys (calendar year: January through December) was defined differently than the regulatory year (July 1–June 30) so we used the date of kill reported on the harvest tickets to adjust the harvest tickets so that both databases were based on calendar year. The Division of Subsistence attempts a complete census (100% of households) in small communities (<100 households) and uses a random or stratified sample of households in larger communities.

Database Comparisons

To compare the two databases we calculated a harvest-report ratio for each community following an approach used to document Alaskan whale harvest (Burn, 1989). Harvest-report ratio compares the number of harvested moose reported by harvest tickets to the number of harvested moose reported by subsistence surveys. We define the harvest-report ratio as:

$$\text{Harvest-report ratio} = \frac{\text{Number of harvested moose reported on harvest tickets}}{\text{Number of harvested moose estimated from household surveys}}$$

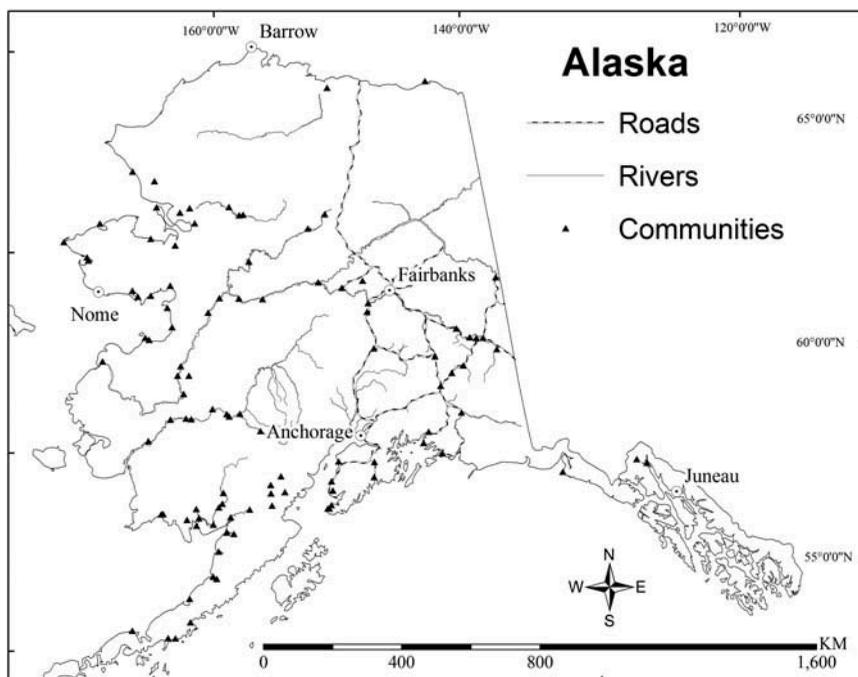


Figure 1. Communities represented by triangles were used to explore community harvest-report ratios by moose hunters in Alaska from 1984 through 2009 ($n = 108$).

If no moose were reported harvested by a community in the subsistence surveys ($n = 27$) or via harvest tickets ($n = 79$) they were removed from analysis because use would result in a misleading ratio. Since most of the communities involved reported harvesting moose in other years only three communities were removed from this analysis. We examined whether removing communities reporting no moose harvested influenced t -test results and basic statistics; it did not. We also calculated the difference between the two databases in the number of harvested moose reported during the study period. Since this method would not be affected by zero values we included all communities. Data used for our research will be archived on the LTER site under the name of the lead author (http://www.lter.uaf.edu/data_b.cfm).

Community Comparisons and Correlations

To assess community and subsistence characteristics that might influence harvest-report ratio, we documented for each community (a) characteristics that had previously been tested as potential correlates of harvest-report ratio (i.e., household income, presence of an area ADF&G biologist, population size, and percent of the community that is Alaska Native; Andersen & Alexander, 1992), (b) community characteristics from the subsistence household surveys (percent of the community that hunts, harvests, uses, gives, or receives moose), and (c) other potential explanatory variables (the straight-line distance of each community from a resident ADF&G biologist and percent of general harvest tickets). We considered the percent of general tickets because non-general tickets have more stringent reporting requirements. Geographic information system (GIS) was used to calculate the straight-line distance of each community to a resident ADF&G biologist (a rough approximation of the

travel distance between communities). In cases where community population and economic data (population size, percent Alaska Native residents, and median household income) were unavailable from the household surveys (Alaska Department of Fish and Game, 2010), we used the census (e.g., 1990, 2000, or 2010) that most closely approximated the year of harvest (U.S. Census Bureau, 2010). In communities where data from both databases were reported for multiple years (1–7 years, 69 of 108 communities), we used the average value of all years reported to calculate the average harvest-report ratio and other community characteristics to reduce the influence of communities that were sampled more often and to reduce temporal autocorrelation.

A community was defined as under-reporting when it reported fewer harvested moose in the harvest ticket database than the lower bounds of the confidence limit of the subsistence harvest survey estimate. Other communities were classified as not-under-reporting. We used a Wilcoxin t -test to compare communities that under-reported and did not-under-report. In cases where a community changed from under-reporting in some years to not-under-reporting in other years, one average of each potential correlate of harvest-report ratio was calculated during the years they under-reported and another average during the years when the community was not-under-reported (17 of 108 communities). We also used a Wilcoxin t -test to compare potential correlates of harvest-report ratio between communities on and off the road system (Figure 1) and between communities with and without a resident ADF&G biologist. If variance of the variable was unequal in the t -test, we performed a Welch-Satterthwaite t -test; if the variances were equal, we performed a pooled t -test. Pearson correlation coefficients were used to examine correlations among sharing variables. We used linear regression to test whether the percent of the households sampled in a community influenced harvest-report ratio.

Results

Database Comparisons

Subsistence household surveys were conducted in 108 communities between 1984 and 2009 with some communities surveyed multiple years (1–7 years; $N = 267$ single-year comparisons). The percent of the households sampled within a community did not influence harvest-report ratio (linear regression). Single-year comparisons indicate that most communities (80%) reported more moose harvested on household surveys than with harvest tickets. Overall, less than half as many moose were reported harvested in the ticket database as with subsistence household surveys (Median = 42%). During the entire study period, more than twice as many moose were reported harvested during subsistence household surveys ($N = 8,039$) than on hunter harvest tickets ($N = 3,557$). When we incorporated the confidence limits (CL) associated with the household surveys, 70% of the reported harvests from tickets were below the lower 95% lower bounds of the CL . Linear regression indicated there was no change in harvest-report ratios over the 26-year study period.

Community Comparisons

Communities that tended to under-report had a significantly ($p < .05$; t -test) greater percent of households that harvest ($t(122) = 3.41$), use ($t(122) = 2.04$), and gave away moose ($t(51) = 4.84$) and had a high proportion of Alaska indigenous residents ($t(122) = 2.62$; Table 1). Also these communities had a slight tendency toward greater distance to an area biologist, median household income, and percent of households that received

Table 1
Comparison of community means based on reporting rates system
in Alaska from 1984 through 2009^a

	Not under-reporting <i>n</i> = 23	Under-reporting <i>n</i> = 102	<i>p</i> -value
Reporting-rate ratio	1.5 ± 0.19	0.35 ± 0.03	<.001 ^c
Hunter harvest tickets	18.8 ± 6.9	10.9 ± 2.2	.32 ^c
Subsistence household survey	13.6 ± 5.5	29.5 ± 3.4	.03
Difference between 2 databases ^b	5.3 ± 2.2	-18.4 ± 2.1	<.001 ^c
Percent who hunt moose	42.3 ± 4.8	43.7 ± 2.0	.55
Percent who harvest moose	12.9 ± 2.6	25.6 ± 1.6	<.001
Percent who use moose	56.5 ± 4.2	67.0 ± 2.2	.02
Percent who give away moose	15.2 ± 1.9	26.9 ± 1.5	<.001 ^c
Percent who receive moose	47.4 ± 4.2	51.9 ± 1.9	.18
Percent Alaska indigenous residents	54.8 ± 7.5	73.9 ± 23.0	.02
Population size	551 ± 293	480 ± 92	.87 ^c
Median household income	30,188 ± 3,150	35,360 ± 1,470	.15
Percent general hunt	56.2 ± 8.6	64.2 ± 3.7	.49
Distance to nearest resident ADF&G biologist	102 ± 15	129 ± 10	.21

^a“Under-reporting” indicates that the reporting rate from harvest tickets was less than the lower confidence limit from household surveys. “Not-under-reporting” indicates that the reporting rate from harvest tickets was not less than or equal to the lower CL of reports from household surveys.

^bDifference is the subsistence household survey database minus the hunter harvest-ticket database. Positive numbers indicate more moose reported in harvest-ticket database.

^cUnequal variances.

moose. The two most pronounced differences ($p < .001$; t -tests) between communities that under-reported and those that did not were in harvesting and giving away moose. Within under-reporting communities, 10% ($n = 10$) reported more than 50% of the households giving away moose with a maximum value of 100%; meanwhile, the largest percentage of households that gave away moose among communities that did not under-report was slightly less than a third (32%). The 17 communities that shifted among years in whether they reported more or fewer moose on harvest tickets than on subsistence surveys had a greater proportion of households that harvested ($t(58) = 4.52$; $p < .001$), used ($t(64) = 3.30$; $p < .01$), and gave away ($t(73) = 4.18$; $p < .001$) moose during the years in which they under-reported.

Communities off the road system had a lower harvest-report ratio ($t(89) = -3.74$), a higher proportion of Alaska indigenous residents ($t(26) = 6.82$), and a greater percent of households that used ($t(105) = 2.16$) and shared moose (give ($t(105) = 3.09$); received ($t(105) = 2.95$); [Table 2](#)). Only 40% of the moose harvested were reported on harvest tickets in communities off the road system, versus 83% for communities on the road system. Communities off the road system were smaller in population size ($t(22) = -1.88$) and further from an area biologist ($t(66) = 4.71$; t -test).

Table 2
Comparison of communities on and off the road system in Alaska from 1984 through 2009. Communities on the road system are “roaded”^a

	Roaded <i>n</i> = 22	Non-roaded <i>n</i> = 86	<i>p</i> -value
Reporting-rate ratio	0.83 ± 0.16	0.4 ± 0.04	<.001 ^c
Hunter harvest estimate	24.9 ± 7.2	7.6 ± 1.6	<.001 ^c
Subsistence household survey	40.6 ± 8.3	24.4 ± 3.3	.87
Difference between 2 databases ^b	-15.6 ± 4.5	-16.6 ± 2.3	.87
Percent who hunt moose	49.9 ± 4.1	42.3 ± 2.2	.10
Percent who harvest moose	21.9 ± 3.0	25.3 ± 1.8	.39
Percent who use moose	57.6 ± 3.9	68.7 ± 2.4	.04
Percent who give away moose	17.9 ± 2.2	28.3 ± 1.6	.003
Percent who receive moose	41.3 ± 3.9	54.2 ± 2.0	.01
Percent Alaska indigenous residents	30.7 ± 7.0	81.2 ± 2.3	<.001 ^c
Population size	1,017 ± 369	320 ± 47	.001 ^c
Median household income	36,021 ± 315	34,852 ± 1,606	.77
Percent general hunt	67.5 ± 7.1	61.5 ± 4.1	.50
Distance to nearest resident ADF&G biologist	70 ± 11	143 ± 11	<.001 ^c

^a“Roaded” means communities on the road system and “non-roaded” is off the road system.

^bDifference is the subsistence household survey database minus the hunter harvest-ticket database. Positive numbers indicate more moose reported in harvest-ticket database.

^cUnequal variances.

Communities with a resident biologist had almost three times the harvest-report ratio of communities without a biologist (Table 3). Communities with a resident area biologist reported more moose harvested in both databases, received less moose ($t(106) = 2.38$), had a lower percentage of Alaska indigenous households ($t(106) = 2.09$), were larger in population size ($t(106) = -3.24$), and a higher median household income ($t(106) = -2.06$; Table 3). Unlike the other two comparisons, there was no significant difference between the percent of the households that used moose.

Correlations Among Community Characteristics

The strongest correlations ($r(106) > .7$) occurred among hunting and harvesting and also sharing variables (e.g., use, give, and receive; Figure 2). Communities that harvest tended to use ($r(106) = .69$) and give away moose ($r(106) = .73$). If a household was given moose, they used it ($r(106) = .77$). This sharing network is illustrated by the fact that moose were commonly received (52%) and used by households (66%) even though only a quarter of households harvested moose (25%). Slightly more households harvested moose than gave moose away (26%). Thus these households gave moose to several households since the percentage that received and used was much greater than the percent of households that gave away moose. There was a broad range in the amount of sharing that occurred regardless of ethnic composition, indicating sharing networks are not limited to indigenous culture (Figure 2).

Table 3
Comparison of communities with and without a resident area biologist
in Alaska from 1984 through 2009^a

	Resident biologist <i>n</i> = 6	No resident biologist <i>n</i> = 102	<i>p</i> -value
Reporting-rate ratio	1.2 ± 0.3	0.46 ± 0.04	<.001 ^c
Hunter harvest estimate	60.0 ± 14.1	8.3 ± 1.7	<.001 ^c
Subsistence household survey	83.1 ± 20.2	24.3 ± 2.8	<.001 ^c
Percent who hunt moose	36.3 ± 8.7	44.1 ± 2.0	.36
Difference between 2 databases ^b	-20.6 ± 11.0	-16.1 ± 2.1	.63
Percent who harvest moose	27.0 ± 6.3	24.4 ± 1.6	.71
Percent who use moose	51.7 ± 8.8	66.9 ± 2.2	.10
Percent who give away moose	21.9 ± 4.3	26.3 ± 1.5	.48
Percent who receive moose	34.2 ± 7.2	52.4 ± 1.9	.02
Percent Alaska indigenous residents	45.3 ± 11.5	72.3 ± 3.1	.04
Population size	1,570 ± 409	397 ± 86	.002
Median household income	47,596 ± 4,578	34,453 ± 1,446	.03
Percent general hunt	64.0 ± 13.2	62.7 ± 3.7	.93
Distance to nearest resident ADF&G biologist	0 ± 0	135 ± 9	<.001 ^c

^aResident biologist lives in the community and is employed by the Alaska Department of Fish and Game.

^bDifference is the subsistence household survey database minus the hunter harvest ticket database. Positive numbers indicate more moose reported in harvest-ticket database.

^cUnequal variances.

Discussion

Our results generally support the findings of Andersen and Alexander (1992), showing that rural Alaskan communities report fewer harvested moose (Median 42%) via harvest tickets than in household surveys. There is general agreement that the household surveys provide a more accurate estimate of the “true” harvest (T. Paragi and C. Brown, personal communication, 2008), although there are potential errors in both methods of estimating the number of moose harvested. Given that 80% of communities reported more moose on subsistence surveys than on harvest tickets, it is likely that harvest tickets are an underestimate of actual harvest. The problem of low reporting rates is widespread and extends beyond rural Alaska with its high proportion of indigenous hunters. For example, Pennsylvania deer hunters reported less than 40% of their harvest in 2009 (Pennsylvania Game Commission, 2010), similar to the harvest-report ratio in Alaska. Other approaches to estimating non-reporting include mark-recapture methods to estimate mortality (including harvest numbers) (Rosenberry, Diefenbach, & Wallingford, 2004), but this is not feasible in large, remote areas like Alaska. Subsistence household surveys could provide an appropriate method of data collection in remote, less developed areas of the world, including rural Alaska.

Communities that under-reported had a larger proportion of indigenous residents and showed more pronounced sharing of moose (harvest, use, and sharing). The sharing of

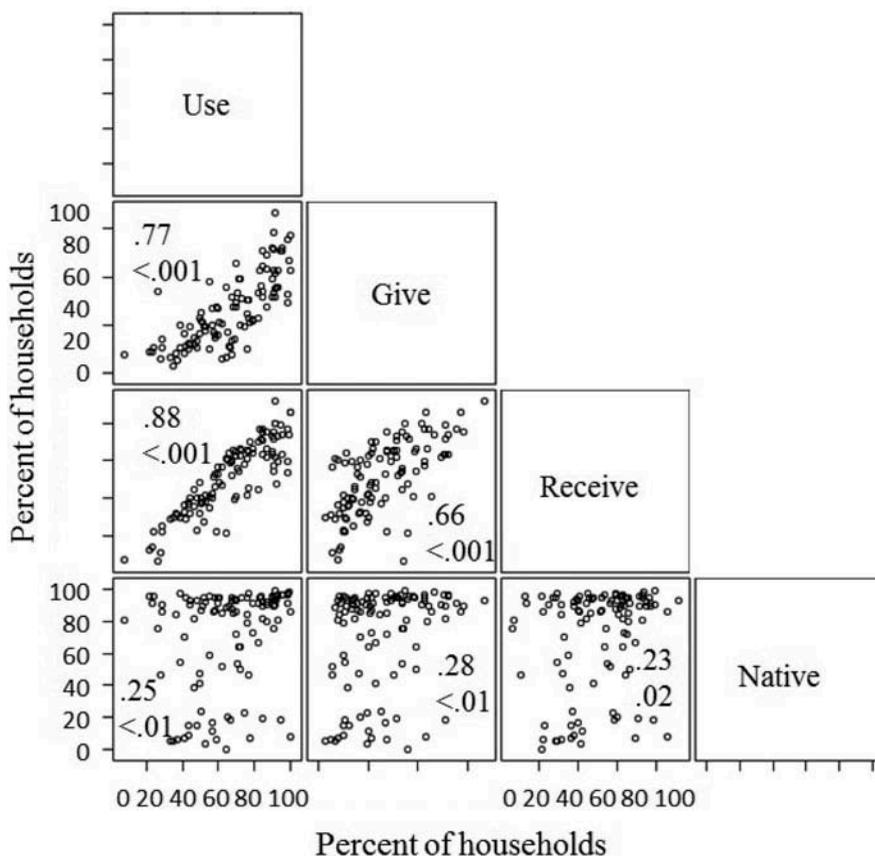


Figure 2. Scatter plot of community characteristics (in units of percentage of the households in the community) used to examine harvest-report ratios by moose hunters in Alaska from 1984 through 2009. Pearson correlation coefficients and *p*-values are within the matrix boxes $n = 108$.

harvested food with both relatives and non-relatives is a well-documented cultural practice in Alaskan indigenous communities (Endter-Wada & Levine, 1996; Wolfe & Walker, 1987), with 30% of households (i.e., “super-households”) often accounting for 70% of the harvest by weight and then sharing this food with elders and kinship networks (Magdanz et al., 2005). The proportions of households that shared (26%) and received (52%) moose in the communities in our study are roughly consistent with this “30–70 rule,” indicating that food sharing by “super-households” is currently widespread in rural Alaskan communities (Wolfe, 1987). Regardless of ethnicity, this sharing tradition and the simple necessity of acquiring food in communities with limited access to, and high cost of, commercial food places hunters in conflict with hunting regulations that restrict hunter harvest to one moose per year, inevitably leading to incomplete reporting of moose harvest (Andersen & Alexander, 1992). Alaska allows proxy hunting, in which a person who cannot hunt (e.g., disabled, blind, or >65 years old) transfers their ticket to another hunter, but it is unknown how commonly or effectively this practice is used.

Results from both *t*-tests (*p*-values) and correlations ($r > .70$) indicate a strong presence of group hunting and sharing during moose hunting, regardless of ethnicity. Previous North American research has documented sharing networks among indigenous cultures

(Andersen & Alexander, 1992; Magdanz et al., 2005; Ratt, 2001) but this is one of the few studies to document sharing patterns among non-indigenous hunters in North America. Given that group hunting for moose is common in Scandinavia (Lavsund, Nygrén, & Solberg, 2003; Solberg & Sæther, 1999) and that Alaskan moose are large, a group effort is not surprising. Akin to Scandinavia hunter data collection methods, harvest tickets could collect information on group size, hunting license numbers, and total harvest in group hunts so as to avoid double counting.

The risk of getting “caught” by enforcement agents may strongly influence whether hunters report their harvest. Communities on the road system, where resident biologists had greater mobility and were closer to most communities, had double the harvest-report ratio of those located off the road system. Similarly, communities with a resident game biologist had three times the harvest-report ratio of communities without a resident biologist. Furthermore, the community off the road system with the highest harvest-report ratio also had a resident area biologist. Hunter interviews in previous studies suggest that both fear of enforcement (Andersen & Alexander, 1992) and trust developed through information exchange with resident ADF&G biologists are important (Kruse, Klein, Braund, Moorehead, & Simeone, 1998). Some hunters feel that harvest reporting is intrusive or should not be used for enforcement or believe that human harvest is negligible compared to other factors influencing population dynamics (Kruse et al., 1998; Schaeffer et al., 1986; Trent, 1995). Similarly, in Pennsylvania, where hunters indicated that they knew it is important to report their harvest, they did not understand why it was important or how the data would be used (Pennsylvania Game Commission, 2010). Together these observations and studies suggest that harvest reporting might increase if ADF&G biologists interacted more regularly with hunters and focused on trust-building and the benefits of accurate reporting rather than enforcement. A mentor program that engaged young people in the system might improve this relationship and help young hunters understand why reporting is important and what is done with the data. In areas where harvest-report ratios are low we suggest wildlife biologists engage with the school system. Given the potential importance of trust and of the risk of being caught, we suspect that community engagement by area biologists is critical.

Only two of Alaska’s largest 20 communities have had subsistent household surveys so our results apply largely to small rural communities. Urban hunters account for about 65% of total moose hunters (unpublished data, 2002–2006) and return their tickets at rates similar to rural communities (82% and 77%, respectively) (Kellie unpublished ADF&G data). If even a small percent of urban hunters fail to report their harvest, this could result in a large number of unreported harvests. Household surveys in larger Alaskan communities could provide valuable information on the cultural dimensions of use and sharing of wild foods by urban residents and a check on the accuracy of harvest-ticket reports by urban hunters. Harvest of other wild foods (e.g., salmon, migratory birds) is routinely estimated by managers through community surveys even in large Alaskan communities (Wentworth, 2007a; 2007b), indicating that harvest surveys are feasible in large communities.

We found that harvest-report ratio did not increase over the 26 years for which data are available, despite efforts to improve access to information, hunting licenses, and harvest tickets and to enforce hunting regulations. Despite their apparent inaccuracy as a measure of harvest, harvest tickets have the advantages of lower cost per community and of providing statewide harvest data in all years. Although access to hunting information has improved, the regulations have become more complex as a result of more widespread antler restrictions and increased number of non-general hunts. This, together with multiple land ownership around communities (state, federal, Native corporations), can result

in hunters reporting their harvest to the incorrect agency or not reporting their harvest because they are unsure if their moose is legal (Tobey, 2010). As the human population continues to grow and land ownership becomes more complicated, especially in underdeveloped countries, regulations and restrictions are likely to be established and become more complex. Thus, outreach to hunters, especially by indigenous or local employees, simplification and increased consistency between state and federal hunting regulations, and use of a unified state-federal database could all contribute to more complete and accurate harvest reporting.

The suggestions we have presented in this article relative to harvest reporting may also apply to other human-dimension issues facing wildlife managers, such as gaining support for the use of hunting in urban areas to control game populations, poaching, illegal guiding activity, and improving hunting participation rates, especially among youth. Engagement, transparency, and open communication allow stakeholders to understand the direct and indirect benefits and costs to them, thus increasing compliance and participation in the system.

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