

Regional Patterns of Fish and Wildlife Harvests in Contemporary Alaska

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ABSTRACT. Subsistence harvests of fish and wildlife play a vital role in the economies and ways of life of rural Alaska communities. State and federal laws establish a priority for subsistence over other fishing and hunting. These laws recognize that the economic, cultural, and social role of subsistence fishing and hunting is not uniform across Alaska: federal law limits eligibility to rural residents, and state law, while allowing all state residents to participate, requires the identification of nonsubsistence areas where subsistence fishing and hunting are not permitted. But defining “rural Alaska” and “nonsubsistence areas” sparked decades of political debate and litigation. A review of nonsubsistence areas by the Alaska Joint Board of Fisheries and Game in 2013 resulted in updated estimates of noncommercial fish and wildlife harvests. Comprehensive data from systematic household surveys in 198 rural communities provided a basis for estimating harvest levels and trends at census-area and statewide levels and crucial input to board deliberations. In 2012, rural Alaska harvests averaged 134 kg/person, while urban Alaska harvests averaged 10 kg/person. The statewide rural harvest was 26% below an estimate for the 1980s, but changes varied by region. Throughout the Arctic and Subarctic, factors shaping subsistence harvests include development, the rising costs of living, shifting resource populations, regulations, climate change, and cultural change. Understanding the vulnerability and adaptability of northern communities requires monitoring of subsistence harvests through annual programs and periodic comprehensive community studies.

Key words: Alaska; subsistence fishing; subsistence hunting; harvest monitoring; food security

RÉSUMÉ. La récolte du poisson et du gibier à des fins de subsistance joue un rôle essentiel dans les économies et les modes de vie des collectivités rurales de l'Alaska. La législation de l'État et la législation fédérale accordent la priorité à la récolte de subsistance par opposition à toute autre forme de chasse ou de pêche. Ces lois reconnaissent que le rôle économique, culturel et social de la pêche et de la chasse de subsistance n'est pas uniforme à l'échelle de l'Alaska : la législation fédérale restreint l'admissibilité aux résidents des milieux ruraux, tandis que la législation de l'État, bien qu'elle permette à tous les résidents de l'État de participer à ces activités, exige l'identification des zones de non-subsistance où la chasse et la pêche de subsistance sont interdites. Cependant, la définition de ce qui constitue l'« Alaska rural » et les « zones de non-subsistance » a fait l'objet d'un débat politique et d'un litige pendant des dizaines d'années. L'examen des zones de non-subsistance réalisé par l'Alaska Joint Board of Fisheries and Game (le conseil) en 2013 a donné lieu à l'estimation actualisée des récoltes non commerciales du poisson et du gibier. Des données exhaustives prélevées grâce à des sondages systématiques effectués auprès des ménages de 198 collectivités rurales ont servi de fondement à l'estimation des récoltes et à la détermination des tendances dans la zone de recensement de même que des niveaux à l'échelle de l'État, en plus de présenter des données cruciales ayant servi dans le cadre des délibérations du conseil. En 2012, les récoltes des régions rurales de l'Alaska ont atteint 134 kg/personne en moyenne, tandis que les récoltes des régions urbaines de l'Alaska ont atteint 10 kg/personne en moyenne. À l'échelle de l'État, la récolte rurale a été inférieure à l'estimation faite pour les années 1980 dans une mesure de 26 %, mais les changements variaient d'une région à l'autre. Dans l'Arctique et dans la zone subarctique, les facteurs exerçant une influence sur les récoltes de subsistance comprennent le développement, le coût de la vie à la hausse, l'évolution des populations de ressources, la réglementation, le changement climatique et le changement culturel. Pour comprendre la vulnérabilité et l'adaptabilité des collectivités du Nord, il y a lieu de surveiller les récoltes de subsistance par le biais de programmes annuels et d'études communautaires périodiques et exhaustives.

Mots clés : Alaska; pêche de subsistance; chasse de subsistance; surveillance des récoltes; insécurité alimentaire

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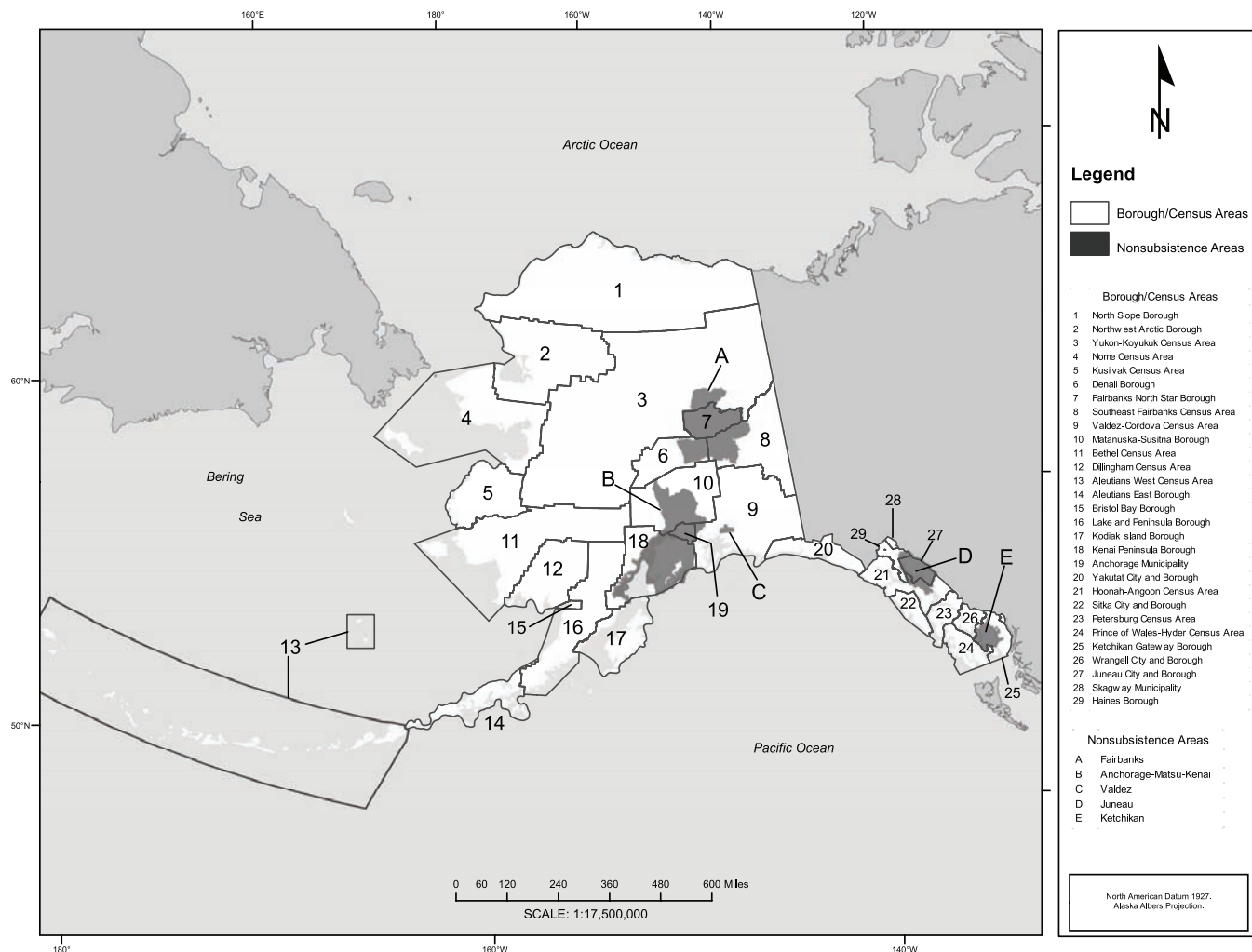


FIG. 1. Alaska boroughs, census areas, and nonsubsistence areas, 2012.

INTRODUCTION

In the early 21st century, subsistence harvests of wild renewable resources remain vital to the economy, culture, and way of life of hundreds of rural communities in Arctic and Subarctic North America (Priest and Usher, 2004; Wolfe, 2004; Aslaksen et al., 2009; Natcher, 2009; GNWT, 2011; Fall, 2014). Environmental, economic, and socio-cultural changes challenge the sustainability of these harvests (Ford and Smit, 2004; Wenzel, 2009; Moerlein and Carothers, 2012). Assessing the performance of management regimes intended to support subsistence opportunities requires reliable and comprehensive harvest data. In Alaska, quantification of subsistence harvests is complex because of data gaps, multiple responsibilities for collecting data, and decades of debate over definitions.

This paper traces the development of the concepts of “mixed economy,” “rural Alaska,” and “nonsubsistence areas” as tools for implementing Alaska’s subsistence laws, then updates estimates of subsistence and other non-commercial harvests of fish and wildlife by the residents

of Alaska’s rural and urban areas (Fig. 1). The update was prepared for a reconsideration of the boundaries of Alaska’s nonsubsistence areas—areas where subsistence does not play a principal economic and sociocultural role. A key objective is to demonstrate that understanding factors shaping subsistence harvests requires effective programs for monitoring and reporting these harvests.

ALASKA SUBSISTENCE HARVEST MANAGEMENT

Management of subsistence fishing and hunting in Alaska is divided among the state and several federal agencies (Table 1). The Federal Subsistence Board (FSB) regulates most federal subsistence fisheries and hunts on federal lands and federally reserved waters (about 60% of the state). The State of Alaska regulates state subsistence fisheries and hunts on most lands and waters through the Board of Fisheries and the Board of Game.

State and federal laws establish a priority for subsistence uses of most fish and wildlife in Alaska. These laws define

TABLE 1. Regulatory responsibilities for subsistence hunting and fishing in Alaska.

Resource	Regulatory body ¹	Management agency
Most fish and wildlife on most federal, state, and privately owned lands and waters	State of Alaska Board of Fisheries and State of Alaska Board of Game	Alaska Department of Fish and Game
Most fish and wildlife on federally owned lands and federally reserved waters, for qualified rural Alaska residents	Federal Subsistence Board	U.S. Fish and Wildlife Service; National Park Service; Bureau of Land Management; U.S. Forest Service
Pacific halibut	North Pacific Fishery Management Council	National Marine Fisheries Service
Migratory birds	Alaska Migratory Bird Co-Management Council	U.S. Fish and Wildlife Service
Seals, sea lions, whales		National Marine Fisheries Service
Sea otters, polar bears, walrus		U.S. Fish and Wildlife Service

¹ The International Whaling Commission and the Alaska Eskimo Whaling Commission set harvest quotas for bowhead whales. NMFS monitors the annual fur seal harvests in the Pribilof Islands. There are no regulatory seasons or harvest limits for other marine mammals. Several Alaska Native co-management bodies work with federal agencies in managing these populations.

subsistence as customary and traditional noncommercial uses of fish and wildlife for food, raw materials, handicraft production, and exchange. Under current state law (State of Alaska, 2014: AS 16.05.258), any Alaska resident may participate in subsistence fisheries and hunts, which may take place only outside nonsubsistence areas. The federal Alaska National Interest Lands Conservation Act (ANILCA; Public Law 96-487, Title VIII) limits participation in federally regulated subsistence fisheries and hunts to qualified rural residents.

Other federal laws also address subsistence harvesting of certain resources in Alaska. Under the Marine Mammal Protection Act, only coastal Alaska Natives may participate in subsistence harvests of marine mammals. The amended Migratory Bird Treaty Act allows subsistence harvests of migratory birds and their eggs by Alaska Native and non-Native residents of designated rural areas. Federal regulations limit participation in the Alaska subsistence halibut fishery to residents of designated rural areas and members of Alaska tribes with customary and traditional uses of halibut.

DEFINING SUBSISTENCE USES OF FISH AND WILDLIFE IN ALASKA

Alaska's Native people have relied on subsistence fishing, hunting, and gathering for sustenance for millennia (Helm, 1981; Damas, 1984; Berger, 1985; Suttles, 1990; Langdon, 2002). In the 1960s, as background for settlement of Alaska Native land claims, the Federal Field Committee for Development Planning in Alaska noted the continuing dependence of Alaska Native villages on wild foods (FFC, 1968:39, 50–54). Nevertheless, in 1971, the U.S. Congress extinguished “any aboriginal hunting or fishing rights that may exist” through the Alaska Native Claims Settlement Act (ANCSA) (Case and Voluck, 2012:292). This act

included no provisions to protect subsistence fishing and hunting rights. Instead, in its report to Congress, the Conference Committee stated that it expected “both the Secretary [of the Interior] and the State [of Alaska] to take any action necessary to protect the subsistence needs of the Natives” (Case and Voluck, 2012:292).

In the 1970s, the Alaska legislature authorized regulatory boards to establish subsistence hunting areas and regulations, noting that “traditional dependence on fish and game resources is a continuing and necessary way of life in many areas of the state” (Kelso, 1981:3). In 1976, following a severe decline in the Western Arctic caribou herd, the Board of Game adopted an emergency regulation to authorize the issuing of permits in Northwest Alaska villages on the basis of population, need, and availability of other food sources and employment. However, in *State v. Tanana Valley Sportsmen's Association*, a state superior court invalidated the regulation, ruling that the board had no authority to issue permits on the basis of need and that the regulation violated the common use clause of the Alaska Constitution. This case highlighted the vulnerability of regulations intended to protect subsistence uses by communities dependent upon wild foods (Kelso, 1981:4; Norris, 2002:66). It also underscored competing perspectives about how subsistence should be understood in Alaska—as a matter of individual rights, or as a key feature of local, community-based ways of life (Morehouse and Holleman, 1994; Wolfe, 2004:52–55).

In 1978, the Alaska legislature passed the first state subsistence statute, which established a subsistence preference in law, recognizing that “fish and wildlife resources are not inexhaustible” (ADF&G, 1979:7). This state law first defined subsistence as customary and traditional uses of fish and wildlife (State of Alaska, 2014: Alaska Statute 16.05.940(26)), thereby acknowledging the continuing role of subsistence fishing and hunting in sustaining long-established ways of life in Alaska.

Correspondingly, in 1980, Congress in ANILCA Title VIII established a subsistence priority on federal lands for rural Alaska residents. ANILCA recognized that subsistence harvests play a central economic and sociocultural role in certain areas of Alaska with no viable alternatives to replace food supplies, and that this role is threatened by increasing demands placed on fish and wildlife by recreational and commercial harvests and Alaska's population growth (Case and Voluck, 2012:295–301). ANILCA allowed the state to implement Title VIII if it enacted regulations that were consistent with the federal law. The state did so in 1982 (Kelso, 1981, 1982).

Neither ANILCA nor the 1978 state law defined “rural.” In 1979, a U.S. Senate report (No. 96-413) accompanying the final draft of ANILCA provided five examples of rural communities: Barrow (population 2267 in 1980), Bethel (3576), Dillingham (1563), Kotzebue (2054), and Nome (2301). Significantly, all five examples are regional service centers with moderate population sizes, relatively diverse populations, and mixed economies with cash and subsistence sectors (Wolfe et al., 1986:3). The report identified four places as non-rural: Anchorage (population 174431 in 1980), Fairbanks (48663), Juneau (19528), and Ketchikan (11316).

In 1978, the Alaska Legislature created the Division of Subsistence (“the division”) within the Alaska Department of Fish and Game (ADF&G) to conduct research on subsistence fishing and hunting. The division's social science research focuses on community patterns of subsistence use (Lonner, 1979, 1980a, b; Fall, 1990; Wolfe and Utermohle, 2000). An early study that addressed the rural concept within the context of contemporary Alaska subsistence activities found no consensus among social scientists or administrative agencies on a single definition of “rural” or “urban”; there were multiple definitions, each linked to the purpose served by defining the words. The study concluded that if rural and urban definitions were to be framed for Alaskan communities, the concepts must be validly related to the state's diverse systems of fishing and hunting (Wolfe and Ellanna, 1983).

This research advanced the concept of a mixed, subsistence-based economy with market and non-market subsistence sectors as an identifying feature of rural Alaska (Wolfe and Ellanna, 1983:2–3). A set of characteristics was proposed to identify subsistence-based socioeconomic systems—that is, rural places for the purpose of implementing the state law and ANILCA. These included relatively high harvest levels, a domestic mode of production, a complex seasonal round of harvest activities, noncommercial sharing networks, traditional systems of land use, and systems of belief and knowledge tied to harvest activities (Wolfe, 1983:272). Research over the next decades supported these early findings (e.g., Wolfe, 2001, 2004; Magdanz et al., 2002; Brown et al., 2012; Fall, 2014).

When the Alaska Legislature revised the subsistence statute in 1986, it added a definition of “rural area” as “a community or area of the state in which noncommercial,

customary, and traditional use of fish or game for personal or family consumption is a principal characteristic of the economy of the community or area” (State of Alaska, 2014: AS 16.05.940(28)). On the basis of division research findings (Fall, 1990:81–84), the Joint Board of Fisheries and Game adopted a regulation (5 AAC 99.012) listing 12 factors to evaluate the role of noncommercial harvests and identify rural and nonrural areas.

In 1988, in *Kenaitze Indian Tribe v. Alaska*, the federal Ninth Circuit Court of Appeals invalidated the state's rural definition, ruling that the Kenai Peninsula, the Kenaitze Tribe's homeland, was rural “under the ordinary meaning of the term” (Case and Voluck, 2012:302). Before the state could appeal this decision, in 1989 the Alaska Supreme Court in *McDowell v. State of Alaska* ruled that the rural preference in state law violated equal access clauses of the Alaska Constitution; thus all Alaska residents became eligible to participate in subsistence harvests (Case and Voluck, 2012:302–303). Efforts by several Alaska governors failed to amend the constitution to enable the state to regain subsistence management on federal lands and waters.

In 1992, the Alaska Legislature adopted a new subsistence statute (State of Alaska, 2014: AS 16.05.258(c)), that directed the Joint Board to identify by regulation the boundaries of nonsubsistence areas, where “dependence upon subsistence is not a principal characteristic of the economy, culture, and way of life,” using 12 characteristics related to harvest levels, employment and income patterns, cost of living, sharing patterns, and cultural values based on the factors the Board had adopted in 1986 to identify rural areas. Thus the 1992 state law retained the key premise that the role of subsistence fishing and hunting is not uniform throughout Alaska, linking back to the observations of the Federal Field Committee, the Alaska Legislature, and the U.S. Congress decades earlier. In 1995, the Alaska Supreme Court, in *State of Alaska v. Kenaitze Indian Tribe*, upheld the constitutionality of the nonsubsistence area provision of the state law (Case and Voluck, 2012:309).

In 1992 and 1993, the Joint Board defined five nonsubsistence areas: Anchorage-Matanuska Susitna Valley-Kenai, Fairbanks, Valdez, Juneau, and Ketchikan (Fig. 1). The Board found that the economies of the five areas had relatively stable cash sectors, diverse employment, and cash incomes at or above state averages; that costs of goods and services were lower than in more remote areas of the state; and that harvests were well below those of less developed areas and were generally recreational in character (ADF&G, 1992; Fall, 2013:164–192).

Following the McDowell decision, the FSB attempted to conform to the Ninth Circuit Court's Kenaitze ruling by identifying rural and nonrural areas primarily by population size. In response to questions from regional advisory councils, the federal Office of Subsistence Management contracted with the University of Alaska's Institute of Social and Economic Research to recommend methods for identifying rural and nonrural areas. Two alternatives were proposed, each focusing on subsistence food production and

population density (Wolfe and Fischer, 2003). Although the FSB did not adopt either alternative at that time (FSB, 2005), in November 2015, following another review of the rural determination process, the board adopted a new regulation that eliminated the population thresholds and other specific guidelines for rural determinations (FSB, 2015).

In 2013, the Joint Board considered public proposal 38 to eliminate the five nonsubsistence areas as being legally unnecessary and unfair to urban residents (ADF&G, 2013:49). To inform the review, ADF&G updated harvest and socioeconomic information on the 12 characteristics presented in 1992 (Fall, 2013). Following agency reports, public testimony, and deliberations, the Board unanimously rejected proposal 38 and any changes to nonsubsistence areas because no significant changes had occurred in the role of noncommercial hunting and fishing in these areas. This action also affirmed the continuing significance of subsistence harvests in the remainder of the state.

POPULATION TRENDS

In 2012, Alaska had an estimated population of 732 298 (Table 2). Urban areas, including the five nonsubsistence areas and the industrial enclave of Prudhoe Bay, had an estimated population of 607 442, 83% of the state's total. The population of rural areas was 124 856 (17%) (Table 2). Urban areas included 71% of Alaska's population of 226 167 in 1960. The urban population grew 36% from 1990 (432 729) to 2012, compared to rural areas, which grew just 6% (population of 117 314 in 1990) (Fall, 2013:7–8). In 1980, 72% of Alaska's Native population (46 305 of 64 103) lived in rural Alaska (U.S. Bureau of the Census, 1984). In 2010, the majority (52%; 71 288 of 138 312) of Alaska Natives lived in urban areas (ADLWD, 2013).

HARVEST ESTIMATION METHODS

Harvest Categories

Alaska regulations categorize harvests of fish and wildlife as subsistence, personal use, sport, general (applying to wildlife populations for which subsistence hunting is not distinguished from other hunting), or commercial. In this paper, subsistence includes fish and wildlife harvests by Alaska's rural residents, estimated through household surveys; fish taken under subsistence regulations by urban residents; and wildlife taken by urban residents in hunts specifically classified as subsistence hunts. Personal use includes fish taken in personal use fisheries and wildlife taken under general hunting regulations by urban residents. Personal use fisheries involve fishing with efficient gear (gill nets or dip nets) in nonsubsistence areas or fishing for stocks that are not customarily or traditionally used. Sport harvests include wildlife harvested by nonresidents, fish harvested by nonresidents of the state as permitted by

sport fishing regulations, and fish harvested by urban Alaskans (generally with rod and reel gear) under those same regulations. Harvests in commercial fisheries are intended for sale in markets.

Comprehensive Household Harvest Surveys

The division conducts household surveys in communities to collect harvest information for all finfish, shellfish, wildlife, and wild plants (Fall, 1990). Following community approval, voluntary, confidential surveys are administered, usually in people's homes. Knowledgeable individuals report their household's harvests for the previous year. A census survey is attempted in smaller communities (up to 50 households), and random samples are selected in larger communities. Harvests for home use include all wild resources taken under subsistence, personal use, general, and sport regulations, including harvests that are shared, bartered, or exchanged in customary trade. They include fish removed from commercial harvests for personal use, but not fish that are sold. Resources purchased in stores and catch-and-release fish are not included. For most resources, harvests reported in numbers of animals or other units (e.g., gallons) are converted into usable weights using standard factors based upon yields from average round weights (Fall et al., 1995:249–253). Harvests reported by surveyed households are expanded according to the sampling fraction to estimate community totals.

Harvest data are compiled in an online database, the Community Subsistence Information System (CSIS) (ADF&G, 2014). In addition to ADF&G research, the CSIS includes data from other studies employing similar methods. Although there is no regular schedule for updating the data, the time range and geographic coverage are extensive. As of mid-2014, the CSIS included 488 comprehensive harvest data sets for rural communities. Each data set includes harvest estimates for all available fish, wildlife, and wild plants for a community in a specific study year. In 2014, at least one year of data was available for 214 of the 264 rural Alaska communities (81%) (Table 2).

Annual Harvest Monitoring Programs

Responsibility for monitoring subsistence harvests in Alaska is spread over multiple agencies (Table 1). Little coordination occurs among these programs; they differ in sampling strategies, data collection, analysis, and reporting procedures. No annual monitoring exists for most non-salmon fish, marine invertebrates, and small game.

Subsistence and personal use salmon fisheries usually require a permit and harvest reporting. Several large subsistence salmon fisheries, including fisheries in the Kuskokwim and Yukon areas, do not require permits, and for these ADF&G conducts post-season harvest surveys. Since 1999, ADF&G has produced annual reports summarizing subsistence and personal use salmon harvests by species, location of harvest, and community (Fall et al., 2014). The ADF&G

TABLE 2. Alaska population by census area in 2012, number of communities, and availability of comprehensive survey data. Source for census data: ADLWD, 2013.

Region/Census area	Comprehensive survey coverage ²							
	U.S. Census communities ¹			Total estimates ³	U.S. Census communities represented in all studies	Studies included in 2012 estimate		
	Population in 2012	Total	Revised			U.S. Census communities	Population	% of Population ⁴
Rural areas	124856	269	264	488	214	198	101468	81.3%
Arctic	25138	37	35	79	31	31	19320	76.9%
Nome Census Area	9869	17	16	18	12	12	4846	49.1%
North Slope Borough (portion)	7553	8	8	39	8	8	7126	94.3%
Northwest Arctic Borough	7716	12	11	22	11	11	7348	95.2%
Interior	10027	63	62	77	47	40	6870	68.5%
Yukon Koyukuk Census Area	5682	39	38	54	27	25	3696	65.0%
Denali Borough (portion)	240	1	1	1	1	1	240	100.0%
Southeast Fairbanks Census Area	2592	14	14	13	10	5	1473	56.8%
Aniak Census Subarea	1513	9	9	9	9	9	1461	96.6%
Kodiak	14041	11	12	48	11	11	14004	99.7%
South-central	7454	37	36	113	36	36	7285	97.7%
Denali Borough (portion)	207	1	1	3	1	1	207	100.0%
Kenai Peninsula Borough (portion)	1043	6	6	27	6	6	1043	100.0%
Matanuska-Susitna Borough (portion)	395	6	6	10	6	6	395	100.0%
Copper River Census Subarea	3115	20	19	48	19	19	2946	94.6%
Chugach Census Subarea (portion)	2694	4	4	25	4	4	2694	100.0%
Southeast	27653	38	38	65	32	32	25970	93.9%
Haines Borough	2620	6	6	5	2	2	2043	78.0%
Prince of Wales-Hyder Census Area	5771	14	14	28	14	14	5088	88.2%
Sitka City and Borough	9084	1	1	2	1	1	9084	100.0%
Hoonah-Angoon Census Area	2210	10	10	18	9	9	2088	94.5%
Skagway Municipality	961	1	1	1	1	1	961	100.0%
Petersburg Census Area	3937	4	4	6	3	3	3636	92.4%
Wrangell City and Borough	2448	1	1	2	1	1	2448	100.0%
Yakutat Borough	622	1	1	3	1	1	622	100.0%
Southwest	16756	44	43	84	39	35	15868	94.7%
Aleutians East Borough	3227	6	6	9	5	5	3,124	96.8%
Aleutians West Census Area	5881	7	6	5	5	5	5382	91.5%
Bristol Bay Borough	987	3	3	7	3	3	987	100.0%
Dillingham Census Area	4988	10	10	17	9	9	4920	98.6%
Lake and Peninsula Census Area	1673	18	18	46	17	13	1455	87.0%
Western	23787	39	38	22	18	13	12151	51.1%
Lower Kuskokwim Census Subarea	16087	26	25	12	11	8	9133	56.8%
Kusilvak Census Area	7700	13	13	10	7	5	3018	39.2%
Urban areas	607442	86	86	35	25	0	0	0
Anchorage Nonsubsistence Area	447961	55	55	27	20			
Anchorage Municipality	298842	1	1	0	0			
Kenai Peninsula Borough (portion)	55713	31	31	21	16			
Matanuska-Susitna Borough (portion)	93406	23	23	6	4			
Fairbanks Nonsubsistence Area	106393	25	25	2	2			
Fairbanks Northstar Borough	100343	17	17	0	0			
Denali Borough (portion)	1424	3	3	2	2			
Southeast Fairbanks Census Area (portion)	4626	5	5	0	0			
Juneau	32832	1	1	0	0			
Ketchikan	13938	3	3	3	2			
Prudhoe Bay	2174	1	1	0	0			
Valdez	4144	1	1	3	1			
State	732298	355	350	523	239			

¹ U.S. Census communities = incorporated places or census designated places defined by United States decennial census; revised total deletes places with no population in 2010.

² Comprehensive survey = a survey that collected harvest data on all available wild resources.

³ Estimates = total number of census community/year combinations.

⁴ Some areas have 100% community coverage but not 100% population coverage because populations outside of communities were not surveyed.

Division of Sport Fish conducts annual, statewide mail surveys of a random sample of sport fishing license holders to estimate harvests by water body and species (Jennings et al., 2011). Estimates of commercial fisheries' harvests are available from the ADF&G Division of Commercial Fisheries and the National Marine Fisheries Service (NMFS) (McDowell Group, 2013).

Most big game harvests must be reported to the ADF&G Division of Wildlife Conservation. Data are compiled in the Wildlife Information Network database (WinfoNet), which is not publically accessible. Reported harvests are not expanded to account for nonreporting. Big game harvests are underreported for many rural communities (Andersen and Alexander, 1992; Schmidt and Chapin, 2014).

Since 2004, the Division of Subsistence, through a contract with the U.S. Fish and Wildlife Service (USFWS), has conducted an annual harvest assessment program for subsistence harvests of birds and their eggs on behalf of the Alaska Migratory Bird Co-Management Council (Naves and Braem, 2014). The assessment is based on in-person interviews. However, because of budget limitations, the annual survey effort rotates among regions; thus the program does not produce statewide harvest estimates. This program reports at the region and subregion levels and generally does not release data at the community level.

New federal regulations authorizing subsistence halibut fishing in Alaska were implemented in 2003. In 2003–12, the division, through a contract with the National Oceanic and Atmospheric Administration (NOAA), estimated subsistence halibut harvests primarily from data gathered in a mail survey (Fall and Koster, 2014).

Annual harvests of sea otters, walrus, and polar bears are monitored through a marking and tagging program administered by the USFWS (2014). The Alaska Eskimo Whaling Commission monitors subsistence harvests of bowhead whales, and NMFS and the tribal governments of St. Paul and St. George monitor subsistence harvests of northern fur seals in the Pribilof Islands and sea lions on St. Paul Island (NOAA, 2014). There are no other annual monitoring programs for marine mammals, although occasional post-season harvest surveys take place. The most systematic of such monitoring efforts was an annual program to estimate harbor seal and sea lion harvests conducted in 1992–2008 (except 1999) by ADF&G and the Alaska Native Harbor Seal Commission (e.g., Wolfe et al., 2009). The Ice Seal Committee (2014) compiles harvest data for spotted, bearded, ringed, and ribbon seals in selected communities.

Estimating Rural Harvests

Data used to estimate current harvests in rural communities were derived from research conducted by the division (174 community-years, ADF&G, 2014) and also included data for 24 additional communities collected by other entities (Ahmasuk and Trigg, 2007; Bacon et al., 2009; Reedy-Maschner and Maschner, 2012; Wolfe and Scott, 2010). Data from 16 communities included in the CSIS were

omitted from analyses because they have not been resurveyed since the first statewide harvest estimate in the 1980s (Wolfe and Walker, 1987). The data available for 198 rural communities represented 81% of Alaska's rural population and 75% of rural communities (Table 2). At least one year of data was available for a majority of communities in all regions but the Western region (34%). Data were available for a majority of the population of all regions. Of 198 communities in the dataset, 44% are represented by data collected in 2008–12, while the rest are represented by older data (Table 3).

Total harvests for each resource category were first computed for each subregion (borough or census area) from per capita harvest estimates and population estimates, as follows.

$$\begin{aligned} Pop_u &= \sum_{ui=1}^{N_u} pop_{ui} \\ C_u &= \frac{\sum_{ui=1}^{n_u} (k_{ui} \times pop_{ui})}{\sum_{ui=1}^{n_u} pop_{ui}} \\ X_u &= C_u \times Pop_u \end{aligned}$$

where: X_u = estimated total harvest of a resource category for subregion u , C_u = estimated per capita harvest of a resource category for subregion u , n_u = total number of communities where per capita estimates are available for subregion u , pop_{ui} = population estimate for community i in subregion u , k_{ui} = most recent available per capita value of a resource category for community i in subregion u , N_u = total number of communities in subregion u , and Pop_u = total population in subregion u .

Harvest totals and per capita estimates for regions were generated by:

$$\begin{aligned} X_r &= \sum_{ru=1}^{U_r} X_{ru} \\ C_r &= X_r \div \sum_{ru=1}^{U_r} Pop_{ru} \end{aligned}$$

where: X_r = estimated total harvest for resource categories for region r , X_{ru} = estimated total harvest for subregion u in region r , C_r = estimated per capita harvest for region r , U_r = total number of subregions in region r , and Pop_{ru} = total population for subregions u in region r .

Statewide estimates of harvest by rural residents were created by summing the rural regions.

$$\begin{aligned} X_w &= \sum_{r=1}^R X_r \\ C_w &= \frac{X_w}{Pop_r} \end{aligned}$$

where: X_w = Estimated total harvest of a resource category for all rural Alaska places, C_w = estimated per capita

TABLE 3. Percentage of rural Alaska communities in each of the seven regions represented in the 2012 harvest estimate, classified by the number of years since the last study was conducted.

Region	Number of communities	Number of years since last comprehensive survey			
		≤ 5 years	6–10 years	11–20 years	20–25 years
Arctic	31	35.5%	48.4%	12.9%	3.2%
Interior	40	85.0%	2.5%	2.5%	10.0%
Kodiak Island	11	0.0%	45.5%	9.1%	45.5%
South-central	36	41.7%	19.4%	5.6%	33.3%
Southeast	32	18.8%	0.0%	56.3%	25.0%
Southwest	35	25.7%	48.6%	14.3%	11.4%
Western	13	92.3%	0.0%	7.7%	0.0%
State	198	43.9%	22.7%	16.2%	17.2%

harvest of a resource category for all rural Alaska places, R = the total number of rural Alaska regions, and Pop_r = the total population of rural Alaska places.

Population estimates for 2012 were used as the demographic reference (ADLWD, 2013). It is assumed that populations of military or industrial CDPs (Census Designated Places; e.g., Attu Station, Red Dog Mine) and populations living in group quarters (primarily seafood processing facilities occupied by seasonal workers) did not engage in subsistence harvests, and subregional population totals were adjusted accordingly.

No comprehensive data were available for the regional center of Nome (2012 population = 3759, or 38% of the Nome Census Area). Usually, regional center harvests are lower than those of smaller communities. For example, in 2012, Bethel's per capita harvest (76 kg/person) was 26% of the average harvest for smaller communities in the Lower Kuskokwim Census Subarea (289 kg/person). Therefore, applying average harvest estimates of small communities to regional centers likely results in overestimating total harvests. Nome's total subsistence harvest was calculated as 28.1% of the harvests in smaller communities in the census area (from the ratio of its average subsistence salmon harvest for 2004–08 to the average salmon harvest of the smaller communities).

Estimating Rural Alaska Harvests for 1986 and 2000

Alaska patterns of fish and wildlife harvests for home use were first described in the mid-1980s by Wolfe and Walker (1987). These estimates were based on household surveys in 89 rural communities conducted in 1980–86. For the urban areas of Anchorage, Fairbanks, the Matanuska-Susitna Borough, and Juneau, estimates were based on harvest ticket and permit records and the Division of Sport Fish Statewide Harvest Survey.

Wolfe and Walker (1987) reported harvest estimates for four ecological zones and 14 regions, but did not report a statewide estimate for rural communities. To facilitate comparisons with current harvest estimates, the data used by Wolfe and Walker (1987) were reanalyzed to produce statewide estimates and estimates for seven rural regions. In these analyses, 1986 population data were used as the

demographic reference. To more closely match methods used for 2012, calculations accounted for regional centers (Bethel, Nome, Unalaska), group quarters, and military communities.

In 1999, ADF&G estimated regional and statewide harvests on the basis of survey data for 146 communities combined with harvest estimates for 78 other rural communities, which were calculated using the multiple regression model described in Wolfe and Walker (1987) and Wolfe (2000). For comparison with the 2012 estimates, data for these 224 communities were reanalyzed using the methods described above, with 2000 as the reference year (Table 4).

Estimating Harvests for 2012 from a Subset of Rural Communities

Differences exist in the sets of rural communities represented in the datasets (Table 4). The Arctic region was particularly underrepresented in the 1986 estimates, and estimates for three of the five communities appear relatively high compared to other available information (Gambell: 594 kg/person, Stebbins: 459 kg/person, and Kivalina: 374 kg/person, according to Wolfe and Walker, 1987:63–64). For the Western region, harvest data for five out of nine communities used for 1986 and 2000 estimates were from studies that may have overrepresented active harvesters (Wolfe, 1981:21–22; Wolfe et al., 1984:24). To assess the effect of inconsistencies in community representation in harvest estimates, harvests for 1986 and 2012 were also estimated using only the 85 communities included in both datasets (Table 5).

Estimating Urban Harvests

The CSIS includes 35 community-years for 25 urban communities, representing 29% of all urban communities but only 6% of the urban population (Table 2). These data were not used in this study because they incompletely represent urban harvests. Instead, data from annual harvest monitoring programs for fish, big game, and marine mammals were used to estimate noncommercial harvests by residents of urban areas. For each nonsubsistence area, harvest estimates were calculated on the basis of the 2007–11

TABLE 4. Sample sizes (number of communities and percent of regional total they represent) for estimates of rural Alaska harvests in 1986, 2000, and 2012.

	1986		2000				2012			
	Survey		Survey ¹		Model ¹		Total		Survey	
	No.	%	No.	%	No.	%	No.	%	No.	%
Arctic ²	5	14	14	40	21	60	35	100	31	89
Interior	13	21	20	32	24	39	44	71	40	65
Kodiak Island	7	64	11	92	0	0	11	92	11	92
South-central	28	85	35	97	0	0	35	97	36	100
Southeast	9	26	30	79	5	13	35	92	32	84
Southwest	18	42	27	63	2	5	29	67	35	81
Western ²	9	24	9	24	26	68	35	92	13	34
All Rural Alaska	89	34	146	55	78	30	224	85	198	75
										Total no. communities
										35
										62
										12
										36
										38
										43
										38
										264

¹ “Survey” means estimate based on household surveys; “model” means estimate developed using regression model in Wolfe and Walker (1987).

² Stebbins was classified as a Western region community in Wolfe and Walker (1987), but here it is classified as an Arctic region community because it is included in the Nome Census Area.

TABLE 5. Estimated harvests of wild resources, by Alaska region, 1980s and 2012, based on all available community estimates and a subsample of those communities for which estimates are available for both study years.

	Full samples ¹			Communities in Subsample	Subsample ²		
	kg per person		Change		kg per person		Change
	1986	2012			1986	2012	
Arctic	318.5	198.7	−37.6%	4	296.1	220.6	−25.5%
Interior	328.1	145.3	−55.7%	10	309.9	148.0	−52.3%
Kodiak Island	79.7	72.0	−9.6%	7	79.7	73.7	−7.5%
South-central	62.5	83.3	33.3%	33	62.5	84.4	35.0%
Southeast	85.5	90.8	6.2%	9	85.5	107.0	25.1%
Southwest	99.7	92.5	−7.3%	17	100.6	103.5	2.9%
Western	271.2	192.6	−29.0%	5	278.0	140.5	−49.5%
All Rural Alaska	180.2	134.0	−25.7%	85	175.6	134.0	−23.7%

¹ See Table 4 for sample sizes.

² Communities included in the 1986 sample for which an updated harvest estimate is available.

average per capita harvests and the 2012 populations. Subsistence and personal use fish harvests were estimated from permit returns. The Division of Sport Fish analyzed the angler survey data to produce estimates of sport harvests by residents of nonsubsistence areas, the remainder of the state, and nonresidents. Big game harvest data from the WinfoNet were aggregated by place of residence of hunters. Data from annual programs are not available for birds, small mammals, and wild plants, but these are unlikely to contribute a substantial portion of urban harvests (Fall, 2013:159–160).

RESULTS

Alaska Harvests: Rural and Urban, Noncommercial and Commercial

It is estimated that in 2012, residents of rural Alaska harvested for subsistence uses 16.7 million kg (36.9 million lb), or 134 kg/person (295 lb/person) (usable weight), of fish,

wildlife, and wild plants (Table 6). Per capita harvests were highest in the Arctic (199 kg/person) and Western (193 kg/person) regions (Fig. 2). In most regions, fish composed the majority of harvests, from 55% in Southeast Alaska to 73% in Kodiak Island. In the Arctic, marine mammals ranked first with 40% of the harvests. Statewide, more than half of the rural subsistence harvest was composed of fish (32% salmon, 21% other fish).

For residents of Alaska’s urban areas, the total estimated annual fish and wildlife harvest was 6.1 million kg (13 million lb) or 10 kg (22 lb) per person (Table 6). Among urban areas, the annual harvest ranged from 8 to 20 kg/person (Fig. 3). By weight, sport fisheries provided 48% of the total salmon urban harvests, followed by personal use fisheries (45%) and subsistence fisheries (7%).

Combined harvests for residents of rural and urban Alaska were about 22.8 million kg (50 million lb) in 2012, about 31 kg (69 lb) per person (Table 6). Commercial fisheries produced 98.2% of the estimated total harvest of 1.5 billion kg of fish and wildlife in Alaska in 2012 (Fig. 3). Subsistence fisheries and hunts accounted for 1.1%,

TABLE 6. Estimated harvests of wild resources for home use in Alaska by census area, region, and category, 2012.

Census area	Per capita harvest, kilograms usable weight ¹							All resources
	Salmon	Other fish	Shellfish	Land mammals	Marine mammals	Birds and eggs	Wild plants	
Nome Census Area	29.8	21.0	1.0	30.1	102.7	9.0	9.1	202.7
North Slope Borough ²	3.8	11.8	0.1	54.4	81.1	4.3	0.4	155.9
Northwest Arctic Borough	29.0	78.0	0.1	80.0	47.4	4.5	6.2	245.2
Arctic Region Subtotal	21.4	34.8	0.5	51.7	78.6	6.1	5.5	198.7
Aniak Census Subarea	85.0	20.3	0.0	22.7	0.3	1.9	6.4	136.6
Denali Borough (portion)	39.5	5.9	1.6	13.5	0.0	1.6	1.0	63.1
Koyukuk-Middle Yukon	74.8	26.3	0.0	67.3	0.0	4.2	3.0	175.6
Southeast Fairbanks (portion)	21.8	12.6	0.2	51.1	0.0	1.6	4.2	91.4
Interior Region Subtotal	61.8	21.4	0.1	55.1	0.1	3.1	3.7	145.3
Kodiak Island Borough	25.1	27.3	5.1	10.3	0.4	0.4	3.3	72.0
Cook Inlet (portion) ³	59.6	20.3	6.5	16.7	2.1	0.8	5.2	111.1
Denali Borough (portion)	6.9	2.9	0.0	33.1	0.0	0.5	2.3	45.7
Chugach Census Area (portion)	35.2	14.5	1.7	22.7	3.5	1.1	2.7	81.3
Cooper River Census Subarea	45.1	4.4	0.4	21.3	0.0	0.6	2.8	74.6
South-central Region Subtotal	43.3	11.0	2.0	21.2	1.7	0.8	3.2	83.3
Haines Borough	21.9	17.1	5.4	13.9	0.0	0.4	4.6	63.3
Prince of Wales/Hyder	31.4	26.5	15.4	18.0	3.8	0.6	6.4	102.0
Sitka Borough	26.2	24.4	12.5	23.1	3.3	0.3	3.2	93.0
Hoonah/Angoon Census Area	31.4	45.6	14.8	27.9	3.3	0.5	11.5	135.0
Petersburg Census Area	26.1	19.3	15.7	11.2	0.8	0.3	2.4	75.7
Wrangell Borough	11.6	15.4	27.0	17.6	0.0	0.6	3.6	75.9
Yakutat Borough	66.0	39.5	24.6	15.3	15.7	1.3	12.4	174.9
Skagway Municipality	8.0	7.0	4.1	1.7	0.0	0.2	0.9	21.8
Southeast Region Subtotal	26.3	24.1	14.3	18.4	2.6	0.4	4.7	90.8
Aleutians East Borough	64.6	23.1	8.5	9.2	2.2	3.6	4.2	115.4
Aleutians West	11.7	32.8	10.2	5.4	4.1	0.8	4.7	69.6
Bristol Bay Borough	93.8	5.8	1.9	14.5	4.2	2.0	5.5	127.7
Dillingham Census Area	76.3	15.7	1.3	33.0	5.2	4.7	9.9	146.0
Lake and Peninsula Borough	121.4	16.9	4.8	38.8	4.7	3.3	7.4	197.3
Southwest Region Subtotal	47.4	14.7	3.6	16.1	3.2	2.3	5.2	92.5
Lower Kuskokwim	96.3	49.7	0.0	36.6	6.2	10.1	9.6	208.5
Kusilvak	66.9	31.8	0.0	34.6	17.1	5.1	3.9	159.4
Western Region Subtotal	86.8	43.9	0.0	35.9	9.7	8.5	7.8	192.6
Rural State Subtotal	43.4	28.1	4.5	30.4	18.8	3.6	5.2	134.0
Anchorage Municipality	4.1	1.8	0.1	1.6	0.0			7.7
Kenai Peninsula Borough (portion)	8.5	6.0	0.4	4.2	0.0			19.1
Matanuska-Susitna Borough (portion)	5.1	1.9	0.1	4.8	0.0			11.9
Anchorage Nonsubsistence Area Subtotal	4.9	2.4	0.1	2.6	0.0			10.0
Fairbanks Nonsubsistence Area ⁴	3.2	1.1	0.0	4.5	0.0			8.9
Juneau Borough	3.6	3.0	0.3	3.0	0.0			9.9
Ketchikan Gateway Borough	6.0	5.2	0.5	3.6	0.1			15.4
Valdez	9.8	3.3	0.4	6.4	0.3			20.3
Urban State Subtotal⁵	4.6	2.3	0.1	3.0	0.0			10.0
State Total	11.2	6.7	0.9	7.7	3.2	0.6	0.9	31.1

¹ Harvest estimates for birds, eggs, and wild plants, are not available for urban places.² Does not include Prudhoe Bay CDP, which for this analysis is classified as an urban place.³ Includes rural portions of Kenai Peninsula Borough and Matanuska-Susitna Borough.⁴ Includes Fairbanks North Star Borough and portions of the Denali Borough and Southeast Fairbanks Census Area.⁵ Includes Prudhoe Bay.

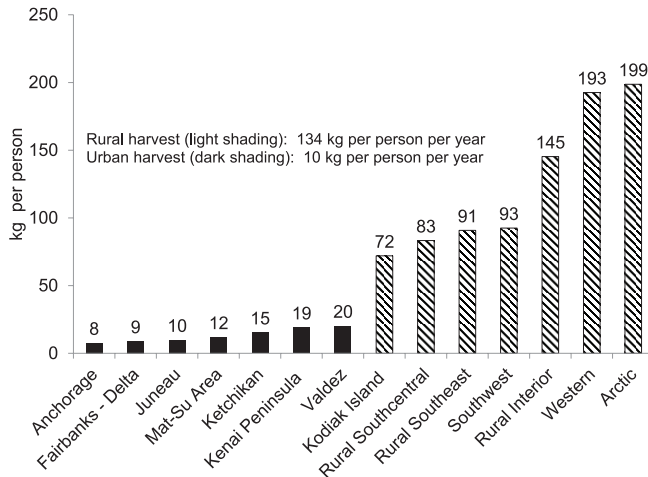


FIG. 2. Wild food harvests (kg/person usable weight) in Alaska, 2012

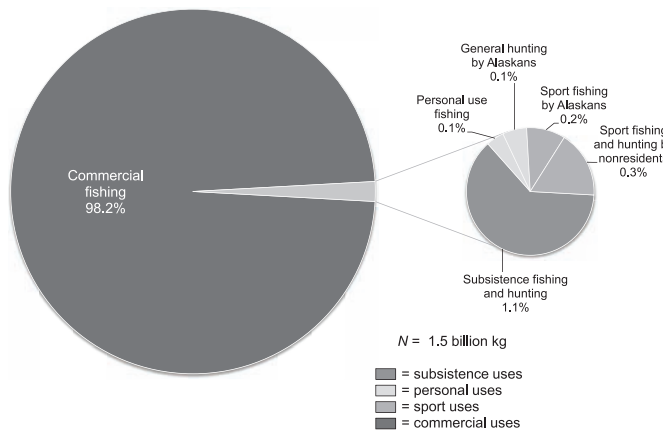


FIG. 3. Resource harvests in Alaska in 2012, by regulatory category.

personal use fisheries and general hunts by urban Alaska residents accounted for 0.2%, and sport fisheries and non-resident sport hunting produced 0.5%. Groundfish compose much of the commercial fisheries production but very little of the subsistence or sport harvests. Excluding groundfish, commercial harvests still account for 92.8% of the total Alaska harvest of 366.9 million kg, subsistence 4.5%, personal use and general hunting 0.8%, and sport fisheries and sport hunts 1.9%.

Comparisons with Earlier Harvest Estimates

For all rural areas combined, estimated subsistence harvests were 180 kg (397 lb) per person in 1986, 161 kg (356 lb) per person in 2000, and 134 kg (295 lb) per person in 2012 (Fig. 4). The 2012 estimate is 26% lower than the 1980s estimate and 17% lower than that for 2000. Across time, fish composed more than half the total harvest, although the contribution of salmon was lower in 2012 (53%) than in the two previous estimates (Fig. 5).

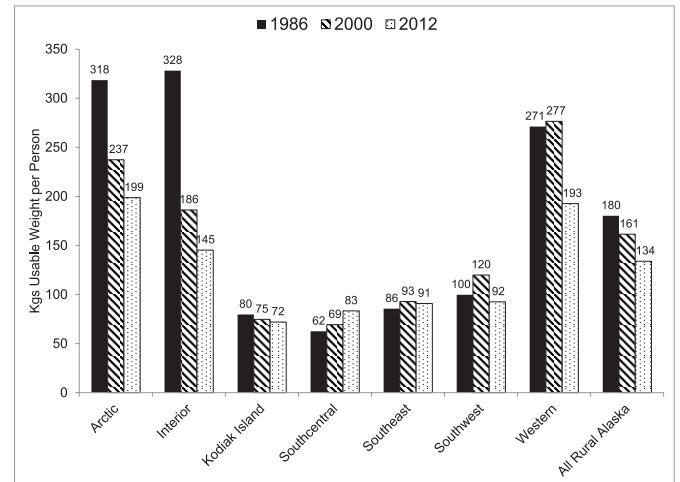


FIG. 4. Estimated harvests of wild resources for home use in 1986, 2000, and 2012, by Alaska rural region.

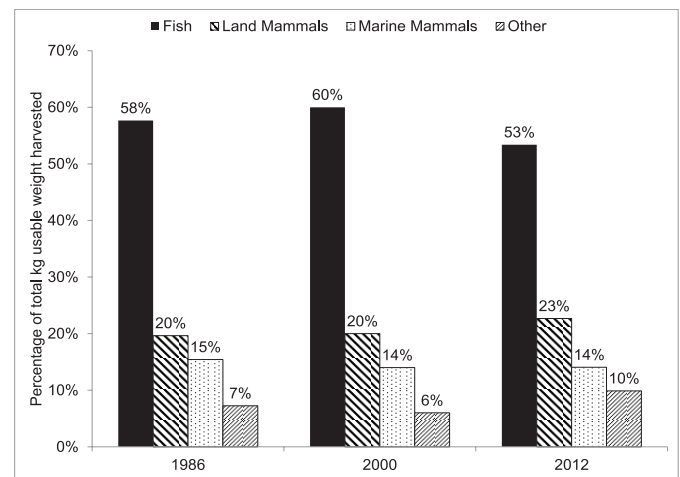


FIG. 5. Composition of rural subsistence harvests in Alaska, 1986, 2000, and 2012.

Comparing 2012 with 1986, harvest levels were notably lower for the Arctic, Interior, and Western regions. Harvest estimates for Kodiak, Southeast, and Southwest remained relatively stable across the three reference years. The 2012 estimate for the South-central region was 33% higher than the 1986 estimate (Table 5).

Comparisons of harvest estimates for 1986 and 2012 based on the 85 communities common to both datasets support results based on the full dataset (Table 5). The 2012 statewide estimates based on the full dataset and on the subset were virtually identical at 134 kg/person, and estimates were within 12% for five regions. A difference of 18% for the two Southeast estimates for 2012 is likely due to the absence of two mid-sized communities in the subset (Petersburg and Wrangell). For the Western region, a difference of 27% between the two estimates results from sharp declines in harvests for all five communities in the subset.

Harvest estimates based on the subset of communities were 24% lower in 2012 than in 1986, while estimates based on the full dataset were 26% lower. As with the full

dataset, estimates based on the subset of communities showed lower harvests in the Arctic, Interior, and Western regions in 2012, and similar to moderately higher estimates for the other four regions (Table 5).

Harvest Trends from Annual Harvest Assessment Programs

Several annual harvest assessment programs depict declining subsistence harvests in Alaska. In 1992–98, the statewide annual harbor seal harvest was relatively stable (average 2368 seals/year), but then it began a steady decline: harvests in 2000–08 averaged 1397 seals, down 41%. The drop was stronger in Southeast Alaska (–59%; 1992–98 annual average = 1468 seals; 2004–08 annual average = 600 seals) (Wolfe et al., 2009). The 2012 harvest estimate in Southeast Alaska was 523 seals, the lowest since 1992 (Wolfe et al., 2013). Subsistence halibut harvests declined by 38% from an annual average of 505 000 kg (net weight) in 2003–07 to 314 000 kg in 2011–12 (Fall and Koster, 2014).

As a category, salmon make up the largest portion of the statewide subsistence harvest and rank first in five of the seven regions. Assessing trends in subsistence salmon harvests is complex because multiple species and user groups are involved, and harvests occur over a wide geographic area. Total estimated harvests averaged 942 000 salmon in 1994–2014. However, the average harvest for 2008–12 (870 000 salmon/year) was 20% lower than the average for 1994–99 (1.1 million salmon/year) (Fig. 6).

In 1994–2010, chinook salmon composed 17% of Alaska's subsistence salmon harvest by number and 34% by weight. Most chinook subsistence harvests occur in the Kuskokwim (53% for 1994–2008), Yukon (30%), and Bristol Bay (9%) areas (Fall, 2012; Fall et al., 2014). Subsistence harvests averaged 172 000 chinook salmon in 1994–2008, but had fallen to 74 000 by 2012 (Fig. 7). Although some substitution of other salmon for chinook has occurred, the decline in chinook harvests in the Kuskokwim and Yukon Rivers likely accounts for much of the recent drop in total subsistence harvests in the Interior and Western regions.

In contrast to subsistence harvests, personal use salmon harvests increased steadily from the mid-1990s to 2012 (Fig. 6). The 2008–12 average harvest was about 656 000 salmon/year, about 143% higher than the average of 269 000 salmon/year in the 1990s. Most of this increase was due to the implementation of liberal harvest regulations in the mid-1990s for the personal use dip net fisheries of the Kasilof and Kenai Rivers in the Kenai Peninsula nonsubsistence area. About 95% of the Cook Inlet personal use salmon harvest is taken by residents of nonsubsistence areas (Fall et al., 2014:185–188). This increase illustrates the harvest potential of the growing population of urban Alaska, even while the per capita harvest remains relatively low.

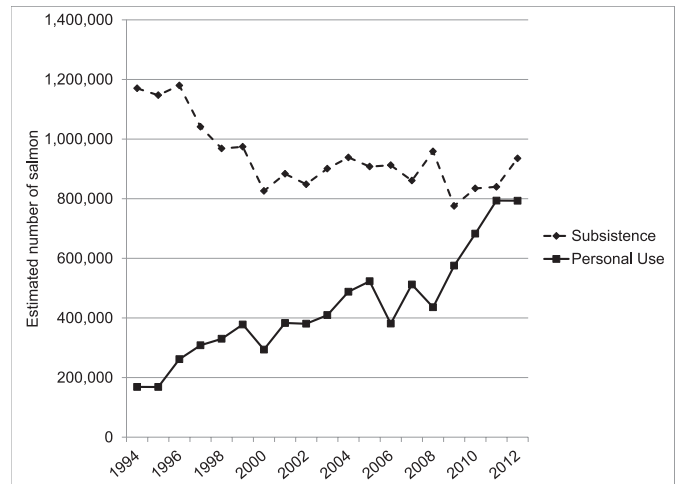


FIG. 6. Estimated subsistence and personal use harvests of salmon in Alaska, 1994–2012.

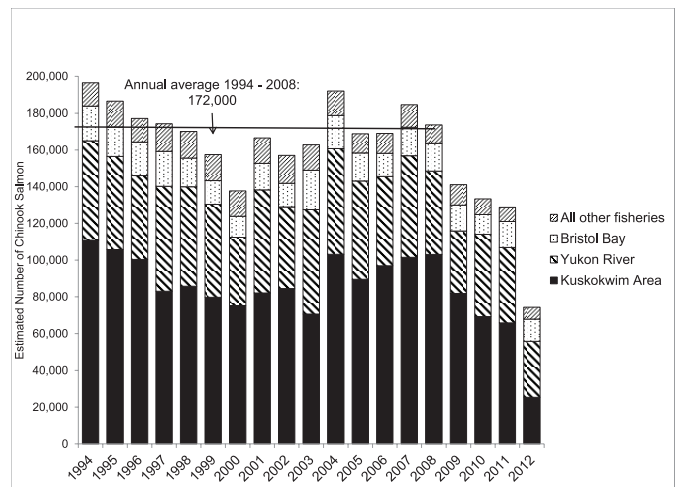


FIG. 7. Alaska chinook salmon subsistence harvests, 1994–2012, by management area.

Changes in Urban Harvests

For all urban Alaska areas combined, the estimated harvest of 10.0 kg per person in 2012 was similar to the estimate of 10.3 kg in 1990 (ADF&G, 1992) and 10.2 kg in 2000 (Wolfe and Fischer, 2003:10). Because of the increase in Alaska's urban population, total harvests increased by 27% from 1990 (4.5 million kg) to 2012 (6.1 million kg). Over the same period, estimated rural harvests decreased by 17%, from 21.1 million kg to 16.7 million kg (Fig. 8).

DISCUSSION

Subsistence Harvests Retain Key Role in Rural Alaska's Economy

In 1987, Wolfe and Walker (1987:56) noted that subsistence hunting and fishing were a “hidden component of Alaska's economy,” unmeasured in indices of economic

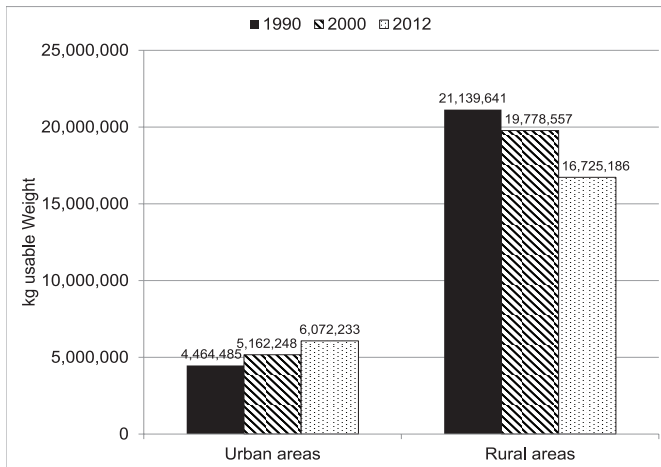


FIG. 8. Total estimated noncommercial harvests of fish and wildlife by residents of Alaska urban areas and rural areas, 1990, 2000, and 2012.

growth or social welfare and unaddressed in development policies. Two decades later, Goldsmith (2007:37–45) reached a similar conclusion: the subsistence sector of local rural economies was still not captured by indicators designed to measure activity in the cash sector. Furthermore, laws directly protecting rural subsistence uses were invalidated in state courts, and legislative attempts to restore a rural preference failed (Morehouse and Holleman, 1994:5–7, 17–19). A consequence was reduced protection for traditional subsistence fishing and hunting (Caldwell, 1998; Thornton, 1998; Fall and Simeone, 2010), although examples of a responsive, if sometimes slow, regulatory system exist (Fall and Chythlook, 1998).

Nevertheless, Alaska's process for identifying non-subsistence areas is one example of formal affirmation of the key role of subsistence uses of wild foods in particular portions of the state. The data, derived primarily from systematic household surveys and presented to the Joint Board in 2013, confirmed the substantial nutritional value of subsistence harvests in rural Alaska. While the average protein requirement as established by the U.S. Department of Agriculture (2010) is about 46 grams/person/day, the annual rural Alaska harvest contributes about 87 grams of protein/person/day, 189% of the requirement. An average 2100 kcal/person/day is the caloric requirement; the rural Alaska subsistence harvest provides about 554 kcal/person/day (26% of the requirement).

Progress has been made in acknowledging the continuing importance of subsistence harvests in other arenas. Following a review of data in the CSIS, an overview of food security in Alaska concluded that subsistence gathering is a primary source of local food and recommended fostering subsistence harvesting and related skills (Meter and Goldenberg, 2014:9, 11). Several studies documented the nutritional, cultural, and physical benefits associated with harvesting and preparing traditional foods (Alaska Native Tribal Health Consortium, 2008; Johnson et al., 2009:121).

When a new Alaska governor took office in December 2014, his transition team's working groups recommended a return to a unified subsistence management system with a rural priority for all lands in Alaska and a more meaningful role for tribes as steps to support sustainable rural communities. Also recommended was a state policy that articulates the importance of subsistence harvesting in permitting and land-use planning (Alaska Office of the Governor, 2015), as is currently the case under federal laws (Braund and Kruse, 2009; Himes-Cornell et al., 2011).

Understanding Changing Subsistence Harvests

Despite this continuing importance of fish and wildlife, estimated harvests for rural Alaska in 2012 overall are lower than estimates for the 1980s and 1990s. Several recent studies discuss the replacement of wild foods by store-bought foods in northern rural communities, often at a cost to nutrition and health (Fazzino and Loring, 2009; Ford, 2009; Johnson et al., 2009; Loring and Gerlach, 2009). As noted by Moerlein and Carothers (2012), understanding these changing harvest patterns requires an examination of the “total environment of change,” a combination of economic, sociocultural, and environmental factors (Ford and Smit, 2004; Huntington et al., 2007; Himes-Cornell and Kasperski, 2015).

Wolfe and Walker (1987:56–69) noted that the road building and settlement entry by non-Natives that accompany resource development may increase competition for wild resources in rural areas, which in turn causes more restrictive fishing and hunting regulations. Settlement entry also results in privatization of lands and reduced fish and wildlife populations. Continuing allocation debates over wildlife resources in the Copper River Basin, a rural area connected by roads to Alaska's population centers, are a prime example (Fall and Simeone, 2010).

The role of cash in northern mixed economies has increased the vulnerability of subsistence harvesting to rising costs of equipment and supplies, especially fuel (Ford, 2009; Wolfe and Spaeder, 2009; Wolfe and Scott, 2010; Brinkman et al., 2014). Increased costs of living and scarce jobs are reasons for the migration of Alaska Natives to urban areas, although subsistence opportunities are also cited as a reason for staying in rural communities (Berman, 2009). As more Alaska Natives move to cities, subsistence fishing and hunting traditions are placed at risk because nonrural residents are ineligible to participate in federal subsistence fisheries and hunts, and subsistence fisheries and hunts are not available in state nonsubsistence areas. There are almost no data on the harvest and use patterns of urban Alaska Natives.

Alaska's chinook salmon stocks have declined since 2008 for unknown reasons (ADF&G Chinook Salmon Research Team, 2013), resulting in severe regulatory restrictions on subsistence fishing and consequent reduced harvests (Wolfe and Spaeder, 2009). Allocation decisions in the federal fisheries management process, such as chinook

and chum salmon by-catch in the Bering Sea pollock commercial trawl fishery, are perceived by rural communities to favor commercial interests, resulting in reduced runs and subsistence fishery restrictions and closures (NOAA, 2009:1). Declines in halibut abundance and in size at age likely account for much of the decade-long drop in subsistence harvests (Stewart et al., 2012:101; Fall and Koster, 2014:34–35).

Declining fish harvests for use as dog food have also influenced subsistence harvest trends. Annual monitoring programs and dedicated studies showed lowered harvests for dog food in Yukon River communities as snow machines replaced, but did not eliminate, dog teams in the 1970s and 1980s (Andersen, 1992; Wolfe and Spaeder, 2009:366–367; Andersen and Scott, 2010). For six Yukon River communities (Beaver, Galena, Stevens Village, Tanana, Fort Yukon, and Huslia) surveyed in the 1980s, harvests for dog food made up almost half of the average annual subsistence harvest (254 of 511 kg/person). In contrast, in four Yukon River communities surveyed in 2010–12 (Galena, Anvik, Grayling, Minto), harvests for dog food averaged just 8% (9 of 118 kg/person) of total harvests (Marcotte, 1986, 1990; Sumida, 1988, 1989; Case and Halpin, 1990; Sumida and Andersen, 1990; ADF&G, 2014).

Cultural factors also play a role in changing harvest patterns. Regarding declining subsistence harvests of harbor seals, while seal populations throughout their range have been stable, hunters report decreased demand for seal meat and oil, which reflects changing food preferences. There are also difficulties in recruiting and training new seal hunters. Economic factors, especially the increasing costs of equipment and fuel, likely also result in less hunting (Wolfe et al., 2013:22).

Numerous studies have identified potentially severe and persistent effects of global climate change on subsistence harvests (e.g., Trainor et al., 2007; Crate and Nuttall, 2009; Kofinas et al., 2010; Fall et al., 2013; Huntington et al., 2013). Such changes affect the abundance and migration patterns of fish and wildlife, as well as conditions for traveling and for processing wild foods (Moerlein and Carothers, 2012). Certainly, Arctic and Subarctic communities have adapted to changing environmental conditions for many centuries, but the speed of current climate change within 21st century political and economic contexts challenges these communities' flexibility and adaptive capacity (Ford and Smit, 2004; Wenzel, 2009; Himes-Cornell and Kasperski, 2015).

Clearly, reliable, comprehensive, and accessible data that track the size and composition of subsistence harvests are necessary to understanding the vulnerability and adaptability of northern communities. A set of recommendations for harvest monitoring based on a review of existing programs (Fall and Shanks, 2000; Fall, 2003) noted that the collection of accurate harvest data is an essential component of effective resource management programs. Both baseline harvest studies (comprehensive community surveys) and time series data for key species developed through annual

harvest monitoring programs are necessary. Progress will rely on building upon successful existing programs; paying attention to program costs; developing programs through partnerships with users; collecting contextual information, including traditional knowledge; protecting users' confidentiality to foster communication and build trust; and timely release of findings in public reports and databases (Fall and Shanks, 2000:B-8).

CONCLUSIONS

Alaska's current state subsistence law requires the regulatory boards to classify areas according to the economic and sociocultural role of subsistence hunting and fishing. The provisions of the 1992 law represent a balance between state court decisions that established an individual right to participate in subsistence uses and a process that focuses the subsistence priority law on areas where subsistence harvests are necessary for the sustainability of local economies and ways of life. In 2013, the Joint Board rejected elimination of nonsubsistence areas, affirming longstanding findings of the significance of fish and wildlife resources in rural Alaska. This process provided a context for updating and communicating information on subsistence harvests and socioeconomic and demographic data for rural and urban areas of the state and could serve as a model for future resource allocation and development deliberations.

Calls for long-term monitoring of environmental and social conditions in the North (Polar Research Board, 2006) cite a broad array of applications, including social impact assessments, food security, and community sustainability. Programs for subsistence harvest assessment and monitoring face multiple challenges, which include diverse species, hundreds of communities, multiple authorities, cultural differences, and political divisions. Building upon effective ongoing efforts, annual harvest monitoring programs for key species are necessary to support management decisions that are responsive to needs of rural communities while ensuring the long-term viability of the resources upon which they depend. Periodic comprehensive surveys are also needed to understand the economic and cultural context of contemporary subsistence hunting and fishing. Only through community-focused, collaborative, and comprehensive research can the full dimensions of contemporary subsistence-based traditions be understood and communicated.

In conclusion, more than 30 years of research support the justifications voiced to establish Alaska's subsistence laws in the 1960s, 1970s, and 1980s. Rural Alaska remains highly dependent on subsistence harvests of fish and wildlife resources for economic and cultural survival. As throughout the Arctic and Subarctic, these harvests and the ways of living that they support are under increasing pressures from many environmental, demographic, economic, cultural, and political factors. An appropriate goal of harvest assessment research is to inform policies and decisions

that are responsive to local traditions and needs and which support subsistence fishing and hunting opportunities to sustain communities' ways of life.

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