ISSN 1198-6727

Fisheries Centre
Research Reports
2008 Volume16 Number 9

MARINE FISHERIES CATCHES IN ARCTIC ALASKA

Fisheries Centre, University of British Columbia, Canada

MARINE FISHERIES CATCHES IN ARCTIC ALASKA

Shawn Booth and Dirk Zeller

Fisheries Centre Research Reports 16(9)
59 pages © published 2008 by

The Fisheries Centre,
University of British Columbia

2202 Main Mall
Vancouver, B.C., Canada, V6T 1Z4

ISSN 1198-6727

Fisheries Centre Research Reports 16(9)
2008

MARINE FISHERIES CATCHES IN ARCTIC ALASKA

Shawn Booth and Dirk Zeller

CONTENTS

A Research Report from the Fisheries Centre, UBC and the Lenfest Ocean Program

Fisheries Centre Research Reports 16(9)
59 pages

FISHERIES CENTRE RESEARCH REPORTS ARE ABSTRACTED IN THE FAO AQUATIC SCIENCES AND FISHERIES ABSTRACTS (ASFA)
ISSN 1198-6727

DIRECTOR'S FOREWORD

The huge area which makes up the Amerasian Arctic, from Novaya Zemlya Island and the Kara Sea, off north-western Siberia in the west to the Canadian Arctic Archipelago and Hudson Bay in the east, is fully encompassed in FAO Statistical Area 18, one of the 19 large statistical areas through which the United Nations Food and Agriculture Organization documents the marine fisheries catches of the world, based on reports filed since 1950 by FAO's member countries.

In the case of FAO Area 18, the member countries did not do their job. Thus, catches for the north of Siberia were not reported to the FAO by the USSR and later Russia (which can perhaps be forgiven since the USSR was not a member, and Russia joined the FAO only in 2006). Similarly, Canada's catches from its Arctic waters were desultorily reported to the FAO. We reported on this for both USSR/Russia and Canada in *Fisheries Centre Research Reports*, 15(2), published in 2007.

The present report, which covers the fishery of arctic Alaska, thus completes our coverage of the Amerasian Arctic, i.e., of FAO Area 18, for which the total catch, as reconstructed by members of the *Sea Around Us* Project from 1950 to 2005, is over 50 times that reported by FAO.

As is here illustrated for Alaska, this is because the statistical reporting systems at the national (and hence international) level for fisheries on Russia, the USA and Canada do not pay any attention to their small-scale fisheries, even when these provide all the fish consumed in vast areas. In this, unfortunately, Russia, the USA and Canada do not differ much from other countries, which all tend to underestimate their small-scale fisheries catches. But more could have been expected, given that these three countries have the resources, one would think, to document one of the major food-producing sectors of the economy along their Arctic coasts. The present report also highlights the USA-specific problem of missing data as they relate to state-level jurisdiction, as fisheries data collected and reported by the State of Alaska from their 3 nautical mile jurisdiction are not incorporated into national catch reports.

Be that as it may, these catch time series should now become important baselines, e.g., for assessing gains and losses due to the warming now raging in the Arctic, which will not fail to impact on fisheries. This is also the reason why the documentation of the bottom-up process used to arrive at the catch data presented therein is given in such great details.

This report is based on work funded by the Lenfest Oceans Program (www.lenfestocean.org), and we thank Ms Margaret Bowman for having understood the need to establish a historic baseline for fisheries which may change radically in the next decades, as the ice of the Arctic recedes and its waters become accessible to industrial fishing fleets. These fleets have wreaked havoc on the fish stocks and ecosystems further south. Let us hope that they do not get to undermine the fisheries documented here.

Daniel Pauly, Director

UBC Fisheries Centre

October 2008

MARINE FISHERIES CATCHES IN ARCTIC ALASKA[1]

Shawn Booth and Dirk Zeller
Fisheries Centre, University of British Columbia, Vancouver, BC V6T 1Z4
e-mail: s.booth@fisheries.ubc.ca; d.zeller@fisheries.ubc.ca

ABSTRACT

The Food and Agriculture Organization of the United Nations (FAO) provides global data on fisheries catches based on reports by member countries. Interestingly, for FAO Statistical Area 18 (Arctic), the USA reports no fish catches to the global community. In Alaska, it is the communities found north of Cape Prince of Wales that fall within FAO area 18. However, the State of Alaska's Department of Fish and Game has collected time series of commercial data, and undertakes community fisheries subsistence studies that are temporally and spatially intermittent. At the regional level, the National Oceanic and Atmospheric Administration (NOAA, Alaska) do not report on either of these fisheries, as they take place within state waters. The *Sea Around Us* Project, at the University of British Columbia's Fisheries Centre, undertakes catch reconstructions to account for discrepancies between globally reported and likely total catches. Our catch reconstruction includes both subsistence and commercial fisheries of marine and anadromous species from 1950-2006 for 15 coastal and near-coastal communities in arctic Alaska. Total catches over this time period were estimated to be 89,000 tonnes (196.2 million pounds), with subsistence catches contributing 54 % (48,200 tonnes or 106.4 million pounds), and commercial catches estimated at over 40,700 tonnes (89.8 million pounds). Subsistence catches averaged 847 tonnes·year^{-1} (1.8 million pounds·year^{-1}, range: 589-1,139 tonnes·year^{-1}). It is only since the late 1980s that subsistence catches have exceeded those from the 1950s, when there was a higher reliance on fisheries resources. Despite a small increase in subsistence catches, the human population has increased from approximately 3,550 to approximately 12,650, which resulted in *per capita* catch rates falling from 237 kg·person^{-1}·year^{-1} (523 pounds·person^{-1}·year^{-1}) in 1950 to 78 kg·person^{-1}·year^{-1} (171 pounds·person^{-1}·year^{-1}) in 2006. One of the main drivers for this was the decrease in the amount of fish used for dog feed, when the snowmobile replaced the dogsled as the main form of transportation. The more holistic historical perspective of total reconstructed fisheries catches presented here is important, in view of the impacts of global climate change, given the significance of these resources for the food security of arctic peoples.

INTRODUCTION

Alaskan marine fisheries in the arctic area are those that operate north of Cape Prince of Wales on the Seward Peninsula (Figure 1). This area falls within the United Nations Food and Agriculture Organization's (FAO) Statistical Area 18. The National Marine Fisheries Service's Alaska branch (NMFS-Alaska) does not report on these fisheries, because they take place within state waters. At the federal level, the National Marine Fisheries Service (NMFS-National) reports on Alaska's fisheries, but they do not include catches taken in the arctic. As a consequence, the United States currently reports zero catches to FAO for the arctic area. The state agency, the Alaska Department of Fish and Game (ADF&G), has collected time series of commercial data and has also undertaken community subsistence studies that are intermittent in space and time. However, no complete time series of total marine catch estimates exist for the arctic coast of Alaska. Here, we present reconstructed estimates of total commercial and subsistence catches taken by the 15 coastal and near-coastal communities in Alaska's arctic waters that form part of FAO Statistical Area 18 for the years 1950 to 2006.

Fisheries in 1950 were under the mandate of the US federal government. However, driven in part by the desire of Alaskans to have control over their salmon resources, statehood was achieved in 1959. At this point, the State of Alaska took control of its own fisheries management. With the implementation of the Magnuson-Stevens Act in 1976, the federal government gained responsibility for fisheries taking place from 3-200 nautical miles from shore and the state retained responsibility for the fisheries occurring within 3 nm of the coast. After Alaska gained statehood, its subsistence use of fish and wildlife was given priority over all other uses. However, in subsequent years the Alaska Board of Fisheries and Game created

[1] Cite as: Booth, S. and Zeller, D. (2008) Marine fisheries in arctic Alaska. Fisheries Centre Research Reports 16(9). Fisheries Centre, University of British Columbia [ISSN 1198-6727].

a rural subsistence priority, which was later ruled to be in violation of the state's constitution, and thus subsistence use and personal use fisheries are currently given priority. In 1999, the federal government also extended its jurisdiction to include fisheries on all public lands and waters under the Federal Subsistence Management Program (Woodby *et al.*, 2005).

The people of arctic communities have always relied on the Arctic Ocean for a large part of their sustenance. The area is sparsely populated, and the 15 communities represented in this study (Wales, Shishmaref, Deering, Buckland, Selawik, Kotzebue, Noatak, Kivalina, Point Hope, Point Lay, Wainwright, Barrow, Atqasuk, Nuiqsut, and Kaktovik) have an estimated total population of over 12,000 that grew at an average annual rate of 5.2 % per year from 1950 to 2000. The total population has since been slightly decreasing (Figure 2). Two communities, Atqasuk and Nuiqsut, were founded in the 1970s by people moving from existing communities to traditional lands. These 15 communities form part of three Alaska Native Regional Corporations—the Bering Straits Native Corporation (Wales and Shishmaref), NANA Regional Corporation (Deering, Buckland, Selawik, Kotzebue, Noatak, and Kivalina) and the Arctic Slope Regional Corporation (Point Hope, Point Lay, Wainwright, Barrow, Atqasuk, Nuiqsut, and Kaktovik). Marine commercial fisheries are important in Kotzebue Sound, with chum salmon (*Oncorhynchus keta*) the most important component of the catch, while marine subsistence fisheries are an important component throughout the area, and target a variety of species including chum salmon, whitefish (Coregonidae) and Dolly varden (*Salvelinus malma*).

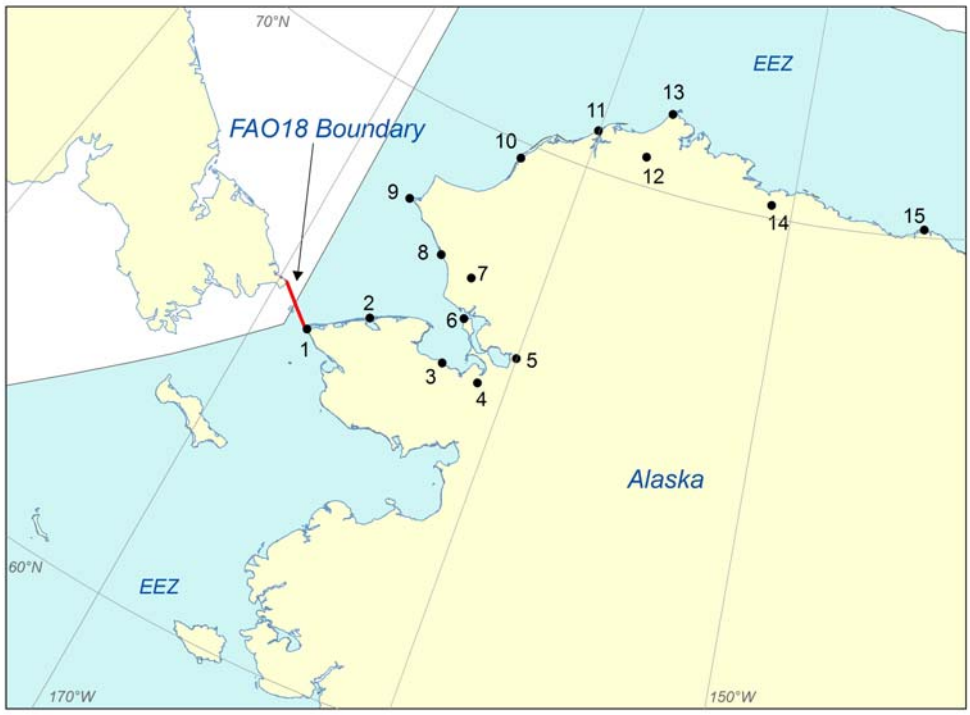

Figure 1. The U.S. State of Alaska, showing the 200 nm Exclusive Economic Zone (EEZ) and southern boundary of FAO Statistical Area 18 (Arctic). Indicated also are the arctic communities of 1) Wales, 2) Shishmaref, 3) Deering, 4) Buckland, 5) Selawik, 6) Kotzebue, 7) Noatak, 8) Kivalina, 9) Point Hope, 10) Point Lay, 11) Wainwright, 12) Barrow, 13) Atqasuk, 14) Nuiqsut and 15) Kaktovik.

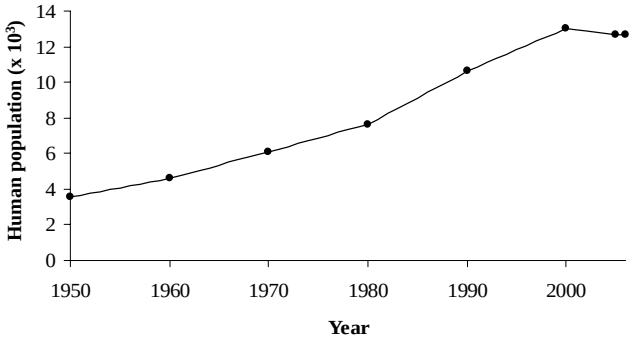

Figure 2. Human population for the 15 communities of arctic Alaska 1950-2006. Solid circles indicate census data taken from the website of the Division of Commerce, Community and Economic Development's website (www.dced.state.ak.us/). Intervening years are linearly interpolated. For individual community information, see Appendix 3.

The coastal communities in arctic Alaska have relied on a mixed economy since the late 19th century, when American government and business expanded into the territory and developed commercial industries (Wolfe, 2004). Whaling, reindeer herding, and fur-trapping were important early contributors. After World War Two, the building of military stations (e.g., the DEW line) also provided the opportunity for people to earn wages. More recently, the discovery of oil on the North Slope in 1968 has enabled people to participate in a

mixed economy with the cash income helping some maintain a subsistence lifestyle. Since the mid-1960s, people have also largely replaced the dog sled with motorized transport (see also Booth and Watts, 2007, for the Canadian arctic). Furthermore, the development of oil fields has had effects on some animal populations, including Bowhead whales and caribou (National Research Council, 2003).

MATERIALS AND METHODS

Time series estimates of commercial catches were taken mainly from the 2004 and 2005 Annual Management Reports (Kohler *et al.*, 2005; Banducci *et al.*, 2007), with additional unreported catches being estimated (see 'Commercial fisheries data' below). The Annual Management Reports detail the catch in numbers of individuals taken and average weights that were used to convert numbers of fish to round weight. A time series average for weight was used to estimate the weight of the catch in years when the report did not detail average weights. Arctic cisco taken in the Colville River fishery were assigned an average weight of 1 pound (0.45 kg; Daigneault and Reiser, 2007). Estimates of subsistence catches were taken from a variety of sources (see 'Subsistence fisheries data' below) and were expanded using a range of approaches to incorporate communities and years when no data were available. Subsistence catches in Alaska are often reported in terms of edible weight. If the edible weight to round weight conversion factors were not given, a standard conversion factor of 1.3 was used (i.e., round weight * 0.75 = edible weight; Anonymous, 2001)

Human population data

The Alaska Department of Commerce, Community and Economic Development maintains the Alaska community database that provides population data for the first year of every decade (www.dced.state.ak.us), as well as estimates for 2005 and 2006. To estimate the population for each community and year, linear interpolations were performed between years of reported data. For Point Lay (the above data source did not report population for this community between 1940 and 1980), we used Point Lay Biographies (Impact Assessment Inc., 1989) to estimate the population between 1950 and 1980. Total population for the 15 arctic communities grew from approximately 3,550 in 1950 to 13,000 in 2000 at an average rate of 5.2 % per year, before declining to about 12,650 in 2006 (Figure 2).

Commercial fisheries data

Administratively, commercial fisheries for this area take place in the Arctic-Yukon-Kuskokwim region. This region encompasses the drainages of the Kuskokwim, the Yukon and Colville Rivers, and includes both Norton Sound and Kotzebue Sound. However, the areas of the region that coincide with FAO Statistical Area 18 are Kotzebue Sound and the northern district of the Yukon-Northern area. Within these two areas, there are few commercial fishing opportunities, although a fishery that mainly targets chum salmon takes place in Kotzebue Sound, while another fishery in the Colville Delta targets whitefish. The commercial fishery for chum salmon in Kotzebue Sound is stated to have officially started in 1962 and the Colville River fishery officially commenced in 1967. Commercial catches were taken from the 2005 Annual Management Report and the 2007 Kotzebue Sound salmon season summary (Banducci *et al.*, 2007; Menard and Kent, 2007).

The commercial fishery in Kotzebue Sound for chum salmon, along with incidental takes of Dolly varden (*Salvelinus malma*), other species of salmon, and the fishery for sheefish (*Stenodus leucichthys*) is reported by the commercial fisheries department within ADF&G. Recent and historical data for these species were taken from the 2004 Annual Management Report (Kohler *et al.*, 2005) and the 2005 Annual Management Report (Banducci *et al.*, 2007). However, data for the commercial fishery that targets Arctic cisco largely in estuarine waters near the Colville River were taken from data supplied by Stephen Murphy (pers. comm.[2]). For the period 1974-1976 and 1981, unreported catches of Dolly varden were estimated using the respective average decadal catches.

However, although it is reported in official documents that the commercial fishery in Kotzebue Sound started in 1962, there were local commercial fisheries taking place prior to this. The commercial fishery taking place prior to that date was an informal one, whereby local people sold their catch for dog feed to people who ran dog-sled teams, the transportation link prior to the introduction of the snowmobile (C.

[2] Stephen R. Murphy, ABR, Inc. P.O. Box 80410, Fairbanks, Alaska 99708-0410, (907)-455-6777 [date information received: October 19, 2007].

Lean, pers. comm.[3]). Similarly, Stefanich (1973) reported that commercial fisheries taking place in the Colville River prior to 1967 were taking approximately 64,000 whitefish and ciscos each year; Wilimovsky (1956) estimated that 10,000 pounds of whitefish were taken in one instance in 1952. Thus, these two commercial fisheries had unreported catches estimated for the period prior to their official reporting by ADF&G.

There was also a Japanese fishery in the Chuckchi Sea beginning in 1966, with most fishing effort taking place between 66-67^{O} N and 166-169^{O} W, an area largely within the current boundaries of the US Exclusive Economic Zone. This fishery's peak catches were similar to those for Kotzebue Sound, and thus, this fishery may have been intercepting large numbers of Kotzebue area chum salmon. Commercial data for the Japanese fishery are reported for 1966 and 1967 (Anonymous, 1967, 1968).

Subsistence fisheries data

Here, we define subsistence fisheries as those targeting fish species that rely on marine waters as part of their life history. Thus, subsistence fisheries include both anadromous and marine fish species that are taken in marine, estuarine or freshwater environments, but exclude fish species that are solely reliant on freshwater for their life-cycle. Anadromous species including chum salmon, sheefish, whitefish and Dolly varden, and marine species, including herring (*Clupea pallasii*) and cod (*Boreogadus saida* and *Eleginus gracilis*), are the main species of importance.

Subsistence fisheries catch data come from a variety of reports that are spatially and temporally intermittent (Table 1) and form the basis for data 'anchor' points (see Zeller *et al.*, 2007). Early studies such as those by Patterson (1974) quantify fisheries catches for several communities representing an average annual catch of important species. The State of Alaska, through its Community Profiles Database (www.subsistence.adfg.state.ak.us), maintains a database on subsistence fish catch and wildlife harvests that includes fisheries data for eleven of the fifteen communities, with most information derived from household surveys. Other studies mostly focus on a given community in a given year, although it is worthy to note that Burch (1985) presents data for Kivalina for two distinct time periods (1964-1965 and 1982-1983). The data sources used to derive estimates of non-commercial, subsistence catches also indicated that the reported catch totals incorporated catches used for dog-feed.

In order to account for catches that were not reported during these studies, yearly catches were estimated using several methods. The most common method involved interpolating between data anchor points via *per capita* catch rates. This method involves dividing reported catches of a year by the human population of the same year and then interpolating linearly between the *per capita* catch rates. Another method involved using average catches, whereby a community's catch for reported years was divided by the number of years of reported data to derive an average catch, which was applied to other years when there were no data reported. This method was used in those cases where there was known to be large variations, including zero catches, due to ice in lagoon areas (Burch, 1985). The third method was to use the same reported catch for other years that lacked reported data; this was mostly done in carrying catches forward in time from the last reported catch amount, but was also used in some cases to carry catches backwards in time from the earliest reported catches.

The two final methods involved scaling a community's catch to either another community's reported catch or to another species catch in the same community. Point Hope, Point Lay and Wainwright had only one reported anchor point for most species, and thus other anchor points in time were derived using reported changes for the same species in Kivalina. In Kotzebue, Dolly varden catches were estimated as a percentage of chum salmon catches, since there is some indication that higher catches of Dolly varden are associated with higher catches of chum. Chum salmon catches in Shishmaref were estimated by linearly interpolating the exploitation rate between two data anchor points (average 1971-1975 and 1989); for later years missing reported data the average exploitation rate was used. In Wales, chum catches were derived for 1971-1975 and 1989 using the reported change in catches for Shishmaref. For the intervening time periods, catches were estimated by linear interpolation of the exploitation rate. Eggers and Clark (2006) provide estimated total run sizes for Kotzebue District chum for 1962-2004. Catch data were converted into exploitation rates by dividing the number of chum salmon caught in reported years by the estimated

[3] Charlie Lean, Norton Sound Fisheries Research and Development Director, P.O. Box 358, Nome, Alaska, 99762, 1-888-650-2477 [date information received: January 24, 2008].

Table 1. Sources used to construct time series anchor points of subsistence fisheries catches by taxa for 15 communities in Arctic Alaska.

Community	Source	Year(s)	Common name
Atqasuk	Craig (1987)	1983	broad whitefish, humpback whitefish, least cisco
	Anon. (2005b)	1994	broad whitefish, chum salmon, humpback whitefish, whitefish
Barrow	Patterson (1974)	1971	Arctic cod, Bering cisco, broad whitefish, chum salmon, Dolly varden, humpback whitefish, least cisco, pink salmon, round whitefish, saffron cod
	Anon. (2001)	1987-1989	Arctic cod, Bering cisco, broad whitefish, capelin, chum salmon, Dolly varden, humpback whitefish, least cisco, pink salmon, rainbow smelt, round whitefish, saffron cod, sculpin
Buckland	Raleigh 1957 in Mattson (1962)	1957	chum salmon
	Anon. (1967)	1967	chum salmon, sheefish
	Anon. (1968)	1968	chum salmon
	Moore (1979)	1972	pink salmon, smelt, whitefish
	Banducci *et al.* (2007)	1970-1975, 1979, 1981	chum salmon
	Mason *et al.* (2007)	2003	chum salmon, smelt
Deering	Raleigh 1957 in Mattson (1962)	1957	chum salmon
	Patterson (1974)	1972	Bering cisco, coho salmon, Dolly varden, least cisco, pink salmon, saffron cod
	Sobelman (1984)	1974, 1975	chum salmon
	Magdanz and Utermohle (1994)	1994	chinook salmon, coho salmon, pink salmon, sockeye salmon
	Anon. (2001)	1994	Arctic cod, Bering cisco, broad whitefish, Dolly varden, flounder, herring, humpback whitefish, least cisco, Pleuronectidae, round whitefish, saffron cod, sculpin, sheefish, smelt
	Kohler *et al.* (2005)	1994	chum salmon
	Banducci *et al.* (2007)	1965-1977, 1979, 1981-	chum salmon
Kaktovik	Patterson (1974)	1971	Arctic cisco, Dolly varden, least cisco
	Anon. (2001)	1985, 1986, 1992	salmon, pink salmon, saffron cod
	Pedersen (2005)	2001, 2002	Arctic cisco, Dolly varden
Kivalina	Raleigh 1957 in (Smith *et al.* 1966)	1957	chum salmon, pink salmon
	Saario 1959 in (Burch, 1985)	1959	Arctic cod, saffron cod
	Saario and Kessel (1966)	1959, 1960	Dolly varden, whitefish
	Patterson (1974)	1972	Arctic cod, chum salmon, whitefish
	Braund & Burnham in (Burch, 1985)	1982	whitefish
	Burch (1985)	1964, 1965, 1982, 1983	Arctic cod, chum salmon, coho salmon, Dolly varden, pink salmon, saffron cod
	Anon. (2001)	1992	Arctic cod, chinook salmon, chum salmon, Dolly varden, flounder, herring, pink salmon, rainbow smelt, saffron cod, sheefish, sockeye salmon, whitefish
	Kohler *et al.* (2005)	1981-1984	chum salmon
	Banducci *et al.* (2007)	1968-1972, 1979, 1981, 1982, 1984-1986	Dolly varden
Kotzebue	Raleigh 1957 in (Smith *et al.* 1966)	1957	chum salmon
	Anon. (1967)	1967	sheefish
	Anon. (1968)	1968	sheefish
	Patterson (1974)	1972	chinook salmon, Dolly varden, flounder, saffron cod, sheefish, smelt
	Georgette and Loon (1993)	1986	Bering cisco, broad whitefish, Dolly varden, flounder, herring, humpback whitefish, least cisco, saffron cod, sculpin, sheefish, smelt
	Anon. (2001)	1991	Bering cisco, broad whitefish, chinook salmon, coho salmon, Dolly varden, flounder, herring, humpback whitefish, least cisco, pink salmon, Pleuronectidae, saffron cod, sheefish, smelt, sockeye salmon
	Eggers and Clark (2006)	1962-2004	chum salmon

Table 1 (cont'd). Sources used to construct time series anchor points of subsistence fisheries catches by taxa for 15 communities in Arctic Alaska.

Community	Source	Year(s)	Common name
Noatak	Raleigh 1957 in Mattson (1962)	1957	chum salmon
	Anon. (1968)	1968	chum salmon
	Patterson (1974)	1972	Bering cisco, broad whitefish, chum salmon, Dolly varden, humpback whitefish, least cisco, round whitefish
	Georgette and Utermohle (2000)	1999	Sheefish
	Georgette and Utermohle (2001)	2000	Bering cisco, broad whitefish, humpback whitefish, least cisco, round whitefish, sheefish
	Anon. (2001)	1994	Arctic cod, Bering cisco, broad whitefish, chinook salmon, chum salmon, coho salmon, Dolly varden, humpback whitefish, least cisco, round whitefish, saffron cod, sheefish, smelt
	Georgette *et al.* (2003)	2002	Bering cisco, broad whitefish, chinook salmon, coho salmon, humpback whitefish, least cisco, pink salmon, round whitefish
	Banducci *et al.* (2007)	1969-1971, 1973-1984, 1986,	chum salmon, Dolly varden
Nuiqsut	Anon. (2001)	1985, 1993	Arctic cisco, Arctic cod, broad whitefish, chinook salmon, chum salmon, coho salmon, Dolly varden, humpback whitefish, least cisco, pink salmon, rainbow smelt, round whitefish
Point Hope	Raleigh 1957 in Smith *et al.* (1966)	1956	pink salmon
	Raleigh 1957 in Mattson (1962)	1957	chum salmon
	Foote and Williamson (1966)	1959, 1960	Arctic cod
	Patterson (1974)	1971	Arctic cod, Dolly varden, pink salmon, smelt, whitefish
Point Lay	Anon. (2001)	1987	broad whitefish, chum salmon, Dolly varden, flounder, herring, pink salmon, smelt
Shishmaref	Raleigh 1957 in Mattson (1962)	1957	chum salmon
	Patterson (1974)	1973	broad whitefish, chum salmon, Dolly varden, flounder, herring, humpback whitefish, pink
	Conger and Magdanz (1990)	1989	Arctic cod, broad whitefish, chum salmon, coho salmon, Dolly varden, flounder, herring, humpback whitefish, king crab, pink salmon, round whitefish, saffron cod, sculpin, smelt, sockeye salmon
	Anon. (2001)	1995	Arctic cod, Bering cisco, broad whitefish, chinook salmon, coho salmon, Dolly varden, flounder, herring, humpback whitefish, king crab, least cisco, pink salmon, round whitefish, saffron cod, sculpin, sheefish, smelt, sockeye salmon
	Banducci *et al.* (2007)	1967, 1968, 1971, 1972, 1974, 1975, 1995	chum salmon
Wainwright	Patterson (1974)	1971	chinook salmon, Dolly varden, pink salmon, smelt
	Anon. (2001)	1988, 1989	Bering cisco, chinook salmon, chum salmon, flounder, least cisco, pink salmon, round whitefish, saffron cod, sculpin, smelt
Wales	Raleigh 1957 in Mattson (1962)	1957	chum salmon
	Patterson (1974)	1973	Arctic cod, broad whitefish, coho salmon, Dolly varden, flounder, humpback whitefish, pink salmon, round whitefish, saffron cod
	Magdanz and Utermohle (1994)	1994	chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon
	Anon. (2001)	1993	Arctic cod, Bering cisco, broad whitefish, chinook salmon, chum salmon, coho salmon, Dolly

total run size of that year. Average reported weights from the commercial fishery for chum in Kotzebue Sound were used to convert the number of salmon to live weights. Detailed data and all sources used are presented in Appendix 1.

Human vs. dog feed component of subsistence catches

Prior to the introduction of the snowmobile in the early 1960s, dog-teams provided the main mode of transportation. The first snowmobiles were sold in Kotzebue in the early 1960s and by the winter of 1965-66 the first snowmobiles were brought into Noatak (Hall, 1971). Therefore, we assumed that for communities other than Kotzebue, the snowmobile was introduced in 1965 and for Kotzebue in 1963. Fish were one of the main sources of feed for the dog-teams in some communities. Abrahamson (1968) reported that a dog would need at least 2 pounds of dried fish per day over the winter. C. Lean (pers. comm.) indicated that in the past a dog would be fed half a chum salmon (approximately 4 lbs, given an average weight of 8 lbs per chum) during the winter, and during the rest of the year, they would be fed with other protein sources (e.g., caribou). Thus, we considered that, prior to the introduction of the snowmobile, each dog would be fed 4 pounds of fish each day over a 6 month period prior to the introduction of the snowmobile.

Raleigh (1957, in Mattson 1962), gave estimates for the number of dogs in the 1950s in each community excluding Wainwright, Barrow, Kaktovik, Selawik and Point Lay. Estimates of the number of dogs for communities lacking data were based on the average dogs-to-people ratio for those communities that had reported data. Patterson (1974) also provided an estimate for the total number of dogs in 1972 for the NANA region, which includes communities outside the scope of this work. However, Raleigh (1957 in Mattson 1962) also provided estimates for these communities and thus, the number of dogs in 1972 for each of the communities was based on the percentage decline of total dogs between 1957 and 1972. For 1957, we assumed that each dog was fed 4 pounds of fish per day over a 6 month period. For 1972, Patterson (1974) estimated that each dog was fed 327 pounds (round weight) of fish per year. Georgette and Loon (1993) estimated the amount of fish fed to dogs for the community of Kotzebue in 1986 and estimates are also provided for Noatak in 1999 (Georgette and Utermohle, 2000) and 2000 (Georgette *et al.* 2001). These data were transformed into anchor points based on the amount of fish used for dog-feed (as a percentage) in relation to the total estimated fish catch. The 1957 estimate of the amount of fish used for dog-feed (as a percentage of the total estimated fish catch) was held constant until the year the snowmobile was introduced (Kotzebue 1963, all others 1965) and then scaled linearly to the 1972 estimate. For the communities that did not have any data available past the 1972 estimate, we scaled the amount of fish used for dog feed on the percentage change for Noatak because Kotzebue, as a regional centre, has a much larger population. Thus, it was possible to estimate, for each community, what percentage of catch through time was fed to dogs by linearly interpolating between anchor points.

However, for some communities the estimates of fish used for dog-feed exceeded the reported catch for the anchor years of 1957 and 1972. On further investigation, it was found that these communities relied far less on fish as a protein source and relied more heavily upon land or marine mammals. Estimates of total protein availability for each community were based on the report of Patterson (1974), who provided estimates on the weight of caribou, deer/reindeer, moose, seals, walrus, beluga, bowhead whales and birds taken in each community. The estimated amount of fish caught was added to these amounts and a percentage contribution to the available protein by fish was determined. The communities of Wales, Shishmaref, Point Hope and Kaktovik were found to have a negative balance, and they also had fish contributing less than 15 % to their protein availability, and therefore we assumed that they did not rely heavily on fish for dog-feed. Therefore, we were also able to determine that the communities of Wainwright and Barrow, which were missing information on the number of dogs, were not heavily dependent on fish as dog-feed because they had fish contributing 3 % and 5 %, respectively to their total protein availability. No data were available for Point Lay, quantifying the number of dogs or contributions to protein availability, although the community is known for its beluga harvest (B. White, pers. comm.[4]); therefore it was assumed that fish were not relied upon for dog-feed for the following communities: Barrow, Kaktovik, Point Hope, Point Lay, Shishmaref, Wainwright, and Wales.

Thus, for each community that was reliant upon fish for dog-feed (Deering, Buckland, Kotzebue, Noatak,

[4] Bruce Wright, Senior scientist, Aleutian Pribilof Islands Association, 1131 East International Airport Rd., Anchorage Alaska 99518, (907)-276-2700 [date information received: January 24, 2008].

Kivalina and Selawik) we were able to determine through time what percent of the estimated catch was used for dog-feed. For the communities of Atqasuk and Nuiqsut, that were established on traditional lands in the 1970s, the average percentage (excluding Kotzebue) was used to determine what proportion of fish was used for dog-feed in the first year that people re-settled traditional lands and the decline was based on changes represented by the community of Noatak. Although Deering in 1957 had a positive protein availability balance, the protein availability balance was negative in 1972, and therefore the change in the amount of fish fed to dogs was based on the average percent decline for the other communities, excluding Kotzebue.

RESULTS

Total catch time series

Prior to 1962, when commercial fisheries were part of the informal economy, total estimated catches averaged approximately 1,230 t·year^{-1} (2.7 million lbs·year^{-1}; 1950-1961), with the informal commercial sector accounting for on average 31 % of the yearly catch (Figure 3). For the first years when the commercial fishery was considered to be part of the formal economy (1962-1969), total catches were estimated to average approximately 1,080 t·year^{-1} (2.4 million lbs·year^{-1}). From 1970-1989, there were two peak periods of catches, 1974-1975 with catches of 3,178 and 2,909 tonnes (7.0 and 6.4 million lbs) respectively, and then in 1981-1982 with catches of 3,529 and 2,609 tonnes (7.8 and 5.8 million lbs), respectively. Catches for 1970-1989 averaged approximately 1,981 t·year^{-1} (4.4 million lbs·year^{-1}). During the 1990s, catches averaged approximately 1,651 t·year^{-1} (3.6 million lbs·year^{-1}) and in the early 2000s estimated total catches had declined to 1,355 t·year^{-1} (3.0 million lbs·year^{-1}; Figure 3).

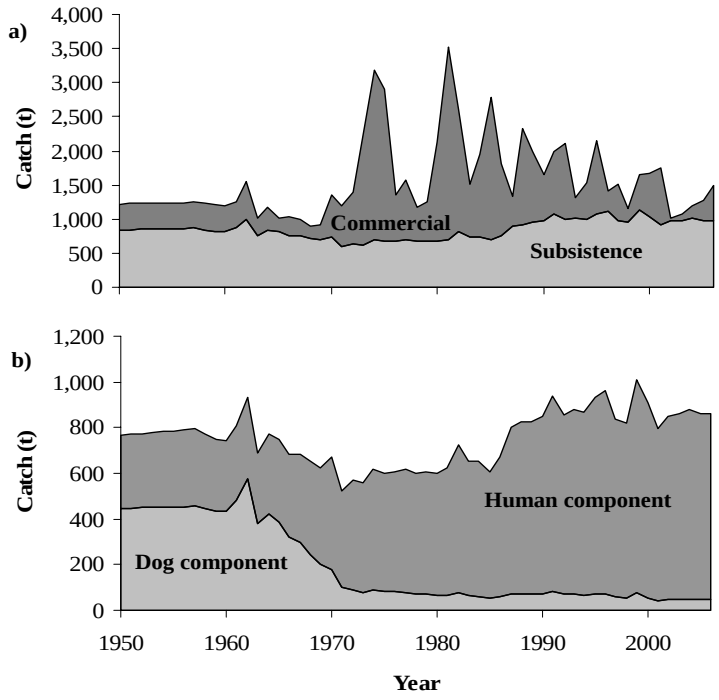

Figure 3. a) Estimated total marine and anadromous fisheries catches (excluding marine mammals) by fishing sector for 15 coastal and near-coastal communities of Arctic Alaska, and b) breakdown of subsistence catch into estimated amounts destined for human consumption and for dog-feed.

Total commercial and subsistence catches over the time period considered here amount to approximately 89,000 tonnes (196 million lbs). The most important species is chum salmon, which accounts on average for 55 % of the total yearly catch. The whitefish complex (whitefish + ciscos) is the next most important taxon, accounting for on average 21%, while sheefish and Dolly varden account for 12 % and 8 % of the total yearly catch, respectively (Figure 4).

Subsistence catches

Subsistence catches account for approximately 54 % of the estimated total catches (Figure 3a). From 1950-1965, prior to the Japanese high seas fleet fishing in the Chuckchi Sea, subsistence catches averaged 850 t·year^{-1} (1.9 million lbs·year^{-1}), but declined to around 685 t·year^{-1} (1.5 million lbs·year^{-1}) from 1966-1979. Catches increased to average 791 t·year^{-1} (1.7 million lbs·year^{-1}) during the 1980s and it was only since the late 1980s that subsistence catches have consistently surpassed catches from the 1950-1966 time period. Since 1990, subsistence catches have averaged 1,000 t·year^{-1}. Despite increases in subsistence catches, subsistence *per capita* catch rates have declined from 237.0 kg·person^{-1} (522.6 lbs·person^{-1}) in 1950 to 77.8 kg·person^{-1} (171.5 lbs·person^{-1}) in 2006. The sharpest drop in subsistence *per capita* catch rates came from 1950-1971, with an estimated decline of approximately 60 %. Between the 1950s and 1990s, there has been a 2.4-fold drop in subsistence *per capita* catch rates (Figure 5).

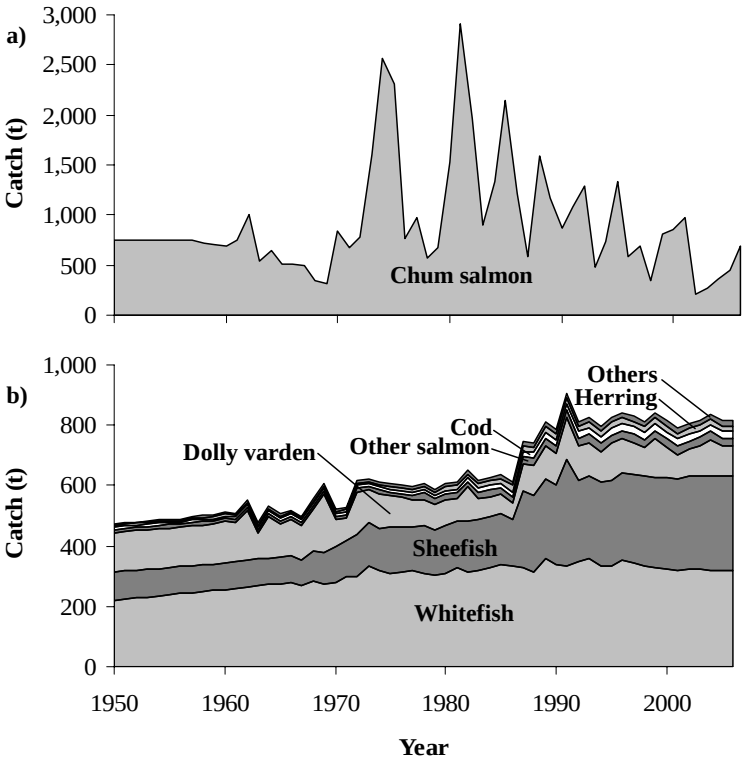

Figure 4. Taxonomic distribution of fisheries catches for the 15 coastal communities of arctic Alaska (by common names, marine mammals excluded) for 1950-2006 for a) chum salmon; and b) all other species. Note the difference in scale between the two panels. Whitefish includes both ciscos and whitefish; pink, coho, chinook, and sockeye salmon comprise the group 'Other salmon'; Cod includes both Arctic cod and saffron cod; while capelin, king crab, flounder and other Pleuronectidae, rainbow smelt, smelt and sculpin comprise the group 'Others'. See Appendix 2 for all common, local and scientific names.

Use of fish for dog-feed

For the eight communities that we determined were reliant on fish for dog-feed, the percentage of fish for dog-feed accounted for 58 % of the catch total in 1950 declining to 6 % in 2006. Prior to the introduction of the snowmobile (1950-1962), it was estimated that the amount of fish fed to dogs averaged 459 t·year^{-1} (1 million lbs·year^{-1}). From 1963 to 1975, the amount of fish required for feed dropped from an estimated 387 t·year^{-1} (843,000 lbs·year^{-1}) to 82 t·year^{-1} (181,000 lbs·year^{-1}) or from 56 to 14 % of the estimated total subsistence catches for the eight communities. Since 1976, catches for dog-feed have averaged 65 t·year^{-1} (143,000 lbs·year^{-1}) and have declined from 13 % to 6 % of total catches (Figure 4).

Commercial catches

Commercial fisheries that were part of the informal economy from 1950-1961 were estimated at 382 t·year^{-1} (842,000 lbs·year^{-1}). Commercial fisheries catches in 1962 were estimated at 553 tonnes (1.2 million lbs), but did not reach that level again until 1970. From 1963-1969 commercial catches averaged 249 t·year^{-1} (548,000 lbs·year^{-1}); during the 1970s reported catches averaged 1,097 t·year^{-1} (2.4 million lbs·year^{-1}), rising to around 1,408 t·year^{-1} (3.1 million lbs·year^{-1}) in the 1980s, before declining in the 1990s to average 621 t·year^{-1} (1.4 million lbs·year^{-1}). In 2000-2001, catches averaged 732 t·year^{-1} (1.6 million lbs·year^{-1}), but due to market conditions recent commercial catches have been low, averaging 226 t·year^{-1} (497,000 lbs·year^{-1}) from 2002-2006. Chum salmon are the main contributors to the commercial catch totals accounting for an average of 93 % of total commercial catches. Peak years for chum occur every 3 to 4 years (Figure 4).

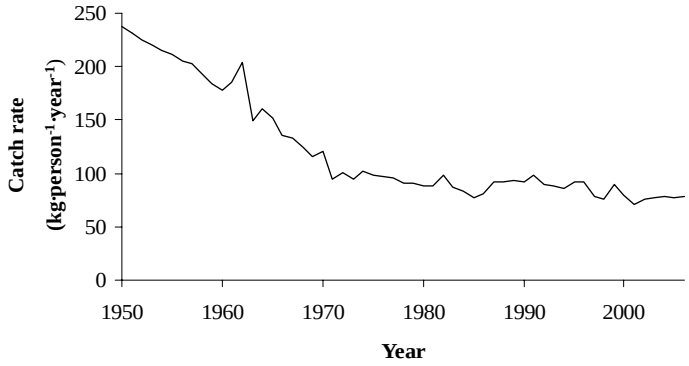

Figure 5. Estimated subsistence *per capita* catch rates (total catches/total human population) for arctic Alaska, 1950-2006 for 15 communities.

DISCUSSION

The data presented here are estimates of fisheries catches for species that spend at least a portion of their life-cycle in marine waters (excluding marine mammals) taken from 1950-2006 by 15 coastal and near-coastal communities in arctic Alaska. The data estimated here more likely represent total catches than those presented by reporting agencies, and may serve as baseline data for this area, which is also lacking adequate baseline data for marine mammals (Hovelsrud *et al.*, 2008). Furthermore, it may also be wise to heed the call for a ban on commercial fishing in this area to prevent fishing fleets from expanding into this area

as the ice recedes (Biello, 2008). This would also allow the local people to maintain food security in the face of climate change and a changing ecosystem; the loss of resources that the people have always relied on would have dramatic effects on the culture of the people.

Although the state agency, the ADF&G, reports on both fishery sectors, these data do not make it to either the national (NMFS) or international (FAO) organizations. A catch-reporting system more transparent to the public, including data transfer information between the state, regional, national, and international agencies is needed so stakeholders can more easily access and understand data and their limitations for policy and decision-making processes. Having a baseline of information available on total fisheries catches is also important in light of global warming, and impacts from ongoing developments.

Commercial catches have been in decline since peaking in the early 1980s. However, the drop since 2000 is due to a limited market situation (one buyer only), and subsistence catches have increased during this time. However, the increase in subsistence catches is small compared to the growth in human population, thus resulting in a declining *per capita* subsistence catch rate and hence *per capita* supply. There has been a 3.3 fold decline in subsistence *per capita* rates from the 1950s to 2006. This value is much lower than that for the Canadian arctic, where subsistence *per capita* rates in coastal communities in the Inuvialuit region dropped approximately 15 fold between 1950 and 2001 (Booth and Watts, 2007). The difference is due to the higher reliance on fish for dog-feed in the Mackenzie Delta area, where it was reported that catches of marine and anadromous fishes were approximately 4 times higher in 1960 compared to the data source study years, 1988-1997 (Usher, 2002).

Although it appears that the commercial fisheries are well-monitored, a more regular, systematic survey method would lead to a better understanding of subsistence fisheries. It is interesting that the commercial fishery sector appears to report all catches. However, it is the subsistence use, which is given priority in the state constitution, which seems to be lacking consistent, detailed and comprehensive data. A subsistence survey design incorporating each community in a specified time interval, with abundance indices for species in non-survey years would assist in clarifying actual subsistence catches. Specific attention to all salmon species would also benefit the efforts to track global warming effects, since species' distributions will be affected. Coho salmon in Norton Sound have been increasing in abundance over the last two decades, but tracking similar changes in areas further north is currently difficult since salmon species, besides chum, are often described as 'other' salmon in reports. However, it should be noted that chinook salmon do appear to have extended their historical distributions northwards because they have been appearing in Barrow since the mid-1990s and there is no local Inupiaq name for them (C. George, pers. comm.[5]). Previously, the furthest reported extent of this species was Wainwright.

The data anchor points used here are from a variety of sources. These sources may not have scaled up catches to a community level, and thus our estimates may be missing data. This is because early reported catches may be observed amounts, whereas later reports are based mainly on a household survey method, which includes estimates for non-reporting households. However, these anchor points do allow an assessment of more likely catches for the years when no data have been collected at all. The estimates of catches presented here are likely conservative, since no marine catches have been estimated for inland communities that may still have summer camps for fishing near marine waters or that fish for anadromous species further inland.

ACKNOWLEDGEMENTS

We would like to thank Jim Menard, Jim Magdanz and Jim Simon of ADG&G, Stephen Murphy of ABR, Inc. and Bill Wilson, North Pacific Fishery Management Council, for providing us with additional data and insights. We would also like to thank Oceana, and especially Susan Murray and Jonathan Warrenchuk, for local and logistic support, assistance and active contributions to this work and to the associated data workshop conducted in Anchorage, Alaska on 24th of January, 2008. This project has been funded by the Lenfest Ocean Program and forms part of the *Sea Around Us* Project, funded by the Pew Charitable Trusts, Philadelphia, and located at the Fisheries Centre, University of British Columbia.

[5] Craig George, Division of Wildlife Management, North Slope Borough, P.O. Box 69, Barrow, Alaska 99723, (907)-852-2611 [date information received: January 24, 2008].

REFERENCES

Abrahamson, J.D. (1968) Westward Alaska: The native economy and its resource base. United States Federal Field Committee for Development Planning in Alaska. Anchorage, Alaska, vii + 184 p.

Anonymous (1967) 1967 Annual Report, Arctic-Yukon-Kuskokwim area. Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage, Alaska, 123 p.

Anonymous (1968) 1968 Annual Report, Arctic-Yukon-Kuskokwim area. Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage, Alaska, 110 p.

Anonymous (2001) Community Profiles Database. Alaska Department of Fish and Game, Division of Subsistence, Anchorage. Available at: www.subsistence.adfg.state.ak.us/geninfo/publctns/cpdb.cfm [Accessed: October 15, 2007].

Anonymous (2004) Remedial investigation/feasibility study report for sites LF001. ST003, and LF002. Anchorage, Alaska, 289 p. Available at: http://hoeflernet.com/uploads/oliktok_final.pdf [Accessed February 23, 2008].

Anonymous (2005a) Fish and Wildlife of Alaska's North Slope: Fisheries. ConocoPhillips, Anchorage, Alaska. 4 p. Available at: www.conocophillipsalaska.com/environmental/Fisheries%20Fact%20Sheet.pdf [Accessed: February 15, 2008].

Anonymous (2005b) Northeast National Petroleum Reserve-Alaska: Final amended integrated activity plan/environmental impact statement. Bureau of Land Management, Anchorage, Alaska, 1698 p.

Anonymous (2007) Northeast national petroleum reserve-Alaska (NPR-A) draft supplemental integrated activity plan/environmental impact statement (IAP/EIS). Bureau of Land Management, Anchorage, Alaska, 1698 p.

Banducci, A., Kohler, T., Soong, J. and Menard, J. (2007) 2005 Annual Management Report: Norton Sound, Port Clarence, and Kotzebue. Fishery Management Report No. 07-32, Department of Fish and Game, Division of Commercial Fisheries, Anchorage, Alaska, vii + 194 p.

Biello, D. (2008) Preserving Arctic fisheries before harvesting them. Scientific American. Available at: www.sciam.com/article.cfm?id=preserving-arctic-fisheries-before-harvesting-them [Accessed: May 5, 2008].

Booth, S. and Watts, P. (2007) Canada's arctic marine fish catches. p. 3-15 *In*: Zeller, D. and Pauly, D., (eds.), Reconstruction of marine fisheries catches for key countries and regions (1950-2005).Fisheries Centre Research Report 15(2). Fisheries Centre, University of British Columbia, Vancouver, British Columbia.

Burch, E.S. (1985) Subsistence production in Kivalina, Alaska: A twenty-year perspective. Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska, xii + 341 p.

Conger, A.O. and Magdanz, J. (1990) The harvest of fish and wildlife in three Alaska communities: Brevig Mission, Golovin and Shishmaref. Technical Paper No. 188, Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska, viii + 77 p.

Craig, P.C. (1987) Subsistence fisheries at coastal villages in the Alaskan arctic, 1970-1986. Minerals Management Service, Alaska Outer Continental Shelf Region, Leasing and Environment Office, Springfield, Virginia, iii + 63 p.

Daigneault, M.J. and Reiser, C. (2007) Colville River fall fishery monitoring. Unpublished report prepared by LGL Alaska Research Associates, Inc. for ConocoPhillips, Anchorage, Alaska, 42 p.

Eggers, D.M. and Clark, J.H. (2006) Assessment of historical runs and escapement goals for Kotzebue area chum salmon. Fishery Manuscript No. 06-01, Alaska Department of Fish and Game, Anchorage, Alaska, 45 p.

Foote, D.C. and Williamson, H.A. (1966) A human geographical study. p. 1041-1107 In: Wilimovsky, N.J. and Wolfe, J.N., (eds.), Environment of the Cape Thompson region, Alaska. United States Atomic Energy Commission Division of Technical Information, Oak Ridge, Tennessee.

Georgette, S., Caylor, D. and Tahbone, S. (2003) Subsistence salmon harvest summary Northwest Alaska 2002. Alaska Department of Fish and Game, Division of Subsistence, and Kawerak, Inc., Kotzebue, Alaska, 44 p.

Georgette, S. and Loon, H. (1993) Subsistence use of fish and wildlife in Kotzebue, a Northwest Alaska Regional Centre Technical Paper No. 167, Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska, ix + 211 p.

Georgette, S. and Utermohle, C. (2000) Subsistence salmon harvest summary Northwest Alaska 1999. Alaska Department of Fish and Game, Division of Subsistence, Kotzebue, Alaska, 35 p.

Georgette, S. and Utermohle, C. (2001) Subsistence salmon harvest summary Northwest Alaska 2000. Alaska Department of Fish and Game, Division of Subsistence, Kotzebue, Alaska, 46 p.

Hall, E.S. (1971) The "Iron Dog" in northern Alaska. Anthropologica 13: 237-254.

Hovelsrud, G.K., McKenna, M. and Huntington, H.P. (2008) Marine mammal harvests and other interactions with humans. Ecological Applications 18: S135-S147.

Impact Assessment Inc. (1989) Point Lay Biographies. OCS Study MMS 89-0094, La Jolla, California, 149 p.

Kohler, T., Banducci, A., Soong, J. and Menard, J. (2005) Annual Management Report 2004: Norton Sound, Port Clarence, Kotzebue. Regional Information Report No. 3A05-04, Department of Fish and Game, Division of Commercial Fisheries, Anchorage, Alaska, xii + 171 p.

Magdanz, J. and Utermohle, C. (1994) The subsistence salmon fishery in the Norton Sound, Port Clarence and Kotzebue Districts, 1994. Technical Paper No. 237, Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska, vi + 63 p.

Mason, R., Magdanz, J. and Craver, A. (2007) Subsistence Production and Family Networks in Buckland, Alaska. University of Washington. 10 p. Available at: www.cfr.washington.edu/research.cesu/newsletters/PNWCV_Summer2007.pdf [Accessed: February 27, 2008]

Mattson, C.R. (1962) Chum salmon resources of Alaska from Bristol Bay to Point Hope. United States Fish and Wildlife Service, Washington, D.C., iii + 22 p.

Menard, J. and Kent, S. (2007) 2007 Kotzebue Sound salmon season summary. Alaska Department of Fish and Game, Division of Commercial Fisheries, Nome, Alaska, 4 p.

Moore, G.D. (1979) Issue Background: Buckland Food Shortage. Technical Paper Number 7, Alaska Department of Fish and Game, Division of Subsistence, Kotzebue, Alaska, ii + 16 p.

National Research Council (2003) Cumulative environmental effects of oil and gas activities on Alaska's North Slope. The National Academy Press, Washington, xiii + 288 p.

Patterson, A. (1974) Subsistence harvests in five native regions. The Joint Federal-State Land Use Planning Commission for Alaska, Resource Planning Team, Anchorage, Alaska, 48 p.

Pedersen, S. and Alfred, L., Jr. (2005) Kaktovik 2000-2002 Subsistence Fishery Harvest Assessment. Alaska Department of Fish and Game Kaktovik, and Inupiat Corporation, Fairbanks, Alaska, viii + 58 p.

Saario, D.J. and Kessel, B. (1966) Human ecological investigations at Kivalina. p. 969-1039 In: Wilimovsky, N.J. and Wolfe, J.N., (eds.), Environment of the Cape Thompson region, Alaska. United States Atomic Energy Commission, Division of Technical Information, Oak Ridge, Tennessee.

Smith, H.D., Seymour, A.H. and Donaldson, L.R. (1966) The Salmon Resource. p. 861-876 In Willimovsky, N.J. and Wolfe, J.N., (eds.), Environment of the Cape Thompson Regions, Alaska. United States Atomic Energy Commission, Division of Technical Information, Oak Ridge, Tennessee.

Sobelman, S. (1984) Background paper on subsistence salmon fishery, Inmachuk River, Deering. Alaska Department of Fish and Game, Division of Subsistence, Fairbanks, Alaska, 12 p.

Stefanich, F. (1973) Resources inventory Arctic Region: Fisheries resources, preliminary draft. Joint Federal-State Land Use Planning Commission, Anchorage, Alaska, 8 p.

Usher, P.J. (2002) Inuvialuit use of the Beaufort Sea and its resources, 1960-2000. Arctic 55: 18-28.

Wilimovsky, N.J. (1956) The utilization of fishery resources by the Arctic Alaskan Eskimo. Occasional Papers of the Natural History Museum of Stanford University 2: 1-8.

Wolfe, R.J. (2004) Local traditions and subsistence: A synopsis from twenty-five years of research by the State of Alaska. Technical Paper No. 284, Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska, v + 81 p.

Woodby, D., Carlile, D., Siddeek, S., Funk, F., Clark, J.H. and Hulbert, L. (2005) Commercial fisheries of Alaska. Department of Fish and Game Special Publication No. 05-09, Anchorage, Alaska, iv + 66 p.

Zeller, D., Booth, S., Davis, G. and Pauly, D. (2007) Re-estimation of small-scale fisheries catches for U.S. flag island areas in the Western Pacific: The last 50 years. Fisheries Bulletin 105:266-277.

APPENDIX 1: METHODS OF EXPANSION AND ANCHOR POINTS

Anchor points of reported catch were determined from the indicated references and are identified as 'Source'. Anchor points are all presented in pounds (lbs), and a conversion factor of 0.4536 was used to convert pounds to kilograms. Methods of expansion include the manner in which interpolations were done between anchor points, and are as follows:

Derived anchor from another community: this method used information from another community to scale catches for the present community. For example, Atqasuk had catches of Broad whitefish scaled to the catch changes noted in Barrow from 1983 to 1977 to derive a catch anchor for the first year of catches in Atqasuk.

Avg taxa % * total catch: this method involved using the interpolated catch value for a community and in order to derive taxonomic entities, the reported taxa amount for anchor years was summed and an average taxonomic percentage was calculated. This taxonomic percentage was applied to all years that had interpolated catch data to derive catch by species.

(Year) catch: this method used the stated catch for other years when there were no anchor points.

Pop * per cap scaled: this method accounts for scaling a *per capita* rate between two anchor points. Catch data were first transformed into *per capita* rates (catch/human population) and then linearly interpolated between anchor years. The *per capita* rate was then multiplied by the population to estimate catches.

Avg catch: the reported catch over the number of years indicated that had reported data.

Pop * avg per cap: reported catch data were transformed into *per capita* rates and an average *per capita* rate was calculated to use in conjunction with the population data to estimate catches.

Proportion of a species: this method was used in some cases where the taxonomic entities were not well defined or reported through time inconsistently; largely a problem with the whitefish/cisco complex. In these cases, the taxonomic entities were pooled across years, and one taxon's catch was based as a proportion of another. For example, reported data for Kaktovik included whitefish in 1971; cisco in 1985 & 1986; Bering, least and, Arctic cisco in 1992; and only Arctic cisco was reported in 2001 & 2002. Knowing that historically the main fishery is for Arctic cisco and that some least cisco are caught incidentally , the catch of least cisco was estimated as a proportion of the catch of Arctic cisco based on the year 1992, when there is full taxonomic accounting.

Raised anchor's avg catch: this involved raising the calculated average catch of one species to account for the average weight of a single fish and was used for sockeye salmon in Noatak. The average catch for the reported years (2.6 lbs) was less than a single individual (5 lbs) and thus this value was raised to account for the average weight of a single sockeye salmon in non-anchor years.

Scaled to changes presented in (source): reported catch totals (anchor points) were scaled to catch data presented in the source document, which presented a time series of subsistence data.

Scaled as proportion of another community's catches: One community's catches were scaled as a proportion of another community's catches for the same taxon; used to scale Selawik's catches of chum salmon and Dolly varden to Kotzebue.

Scaled via exploitation rate: total run size (by number) of chum salmon was estimated for Kotzebue area chum salmon by Eggers and Clark (2006). Thus, it was possible to calculate an exploitation rate (number salmon taken/total run size) for anchor years. For periods of no data, catches were estimated by linearly interpolating between exploitation rates and multiplying by the total run size.

Table A1.1. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Atqasuk.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Atqasuk	broad whitefish	1977	Derived anchor from Barrow	1,502	
		1978-1982	Avg taxa % * total catch		
		1983	Anchor	190	Craig (1987)
		1984-1993	Avg taxa % * total catch		
		1994	Anchor	3,423	Anon. (2005b)
		1995-2006	Avg taxa % * total catch		
	chum salmon	1977	Derived anchor from Barrow	47	
		1978-1982	Avg taxa % * total catch		
		1983	Anchor	0	Craig (1987)
		1984-1993	Avg taxa % * total catch		
		1994	Anchor	113	Anon. (2005)
		1995-2006	Avg taxa % * total catch		
	humpback whitefish	1977	Derived anchor from Barrow	2,371	
		1978-1982	Avg taxa % * total catch		
		1983	Anchor	4,795	Craig (1987)
		1984-1993	Avg taxa % * total catch		
		1994	Anchor	911	Anon. (2005)
		1995-2006	Avg taxa % * total catch		
	least cisco	1977	Derived anchor from Barrow	1,697	
		1978-1982	Avg taxa % * total catch		
		1983	Anchor	4,083	Craig (1987)
		1984-1993	Avg taxa % * total catch		
		1994	Anchor	0	Anon. (2005)
		1995-2006	Avg taxa % * total catch		
	whitefish	1977	Derived anchor from Barrow	2,199	
		1978-1982	Avg taxa % * total catch		
		1983	Anchor	0	Craig (1987)
		1984-1993	Avg taxa % * total catch		
		1994	Anchor	5,292	Anon. (2005)
		1995-2006	Avg taxa % * total catch		

Table A1.2. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Barrow.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Barrow	chum salmon	1950-1970	1971 catch		
		1971	Anchor	4,500	Patterson (1974)
		1972-1988	Pop * per cap scaled		
		1989	Anchor	14,941	Anon. (2001)
		1990-2006	1989 catch		
	capelin	1950-1986	Avg catch ('87-'89)		
		1987-1989	Anchors	1,056; 0; 92	Anon. (2001)
		1990-2006	Pop * avg per cap		
	rainbow smelt	1950-1986	Avg catch ('87-'89)		
		1987-1989	Anchors	25; 0; 237	Anon. (2001)
		1990-2006	Avg catch ('87-'89)		
	sculpin	1950-1986	Avg catch ('87-'89)		
		1987-1989	Anchors	0; 9; 0	Anon. (2001)
		1990-2006	Avg catch ('87-'89)		
	Dolly varden	1950-1970	1971 catch		
		1971	Anchor	600	Patterson (1974)
		1972-1986	Pop * per cap scaled		
		1987-1989	Anchors	126; 256; 452	Anon. (2001)
		1990-2006	Avg catch ('87-'89)		
	pink salmon	1950-1970	1971 catch		
		1971	Anchor	500	Patterson (1974)
		1972-1988	Pop * per cap scaled		
		1989	Anchors	1,384	Anon. (2001)
		1990-2006	1989 catch		
	saffron cod	1950-1970	1971 catch		
		1971	Anchor	625	Patterson (1974)
		1972-1986	Pop * per cap scaled		
		1987-1989	Anchors	0; 259; 0	Anon. (2001)
		1990-2006	Pop * avg per cap ('87-'89)		
	Arctic cod	1950-1970	1971 catch		
		1971	Anchor	394	Patterson (1974)
		1972-1986	Pop * per cap scaled		
		1987-1989	Anchors	0; 2,119; 4,539	Anon. (2001)
		1990-2006	Avg catch ('87-'89)		
	round whitefish	1950-1970	1971 catch		
		1971	Anchor	1,403	Patterson (1974)
		1972-1986	Pop * per cap scaled		
		1987-1989	Anchors	3,534; 970; 21	Anon. (2001)
		1990-2006	Avg catch ('87-'89)		

Table A1.2 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Barrow (cont'd)	humpback whitefish	1950-1970	1971 catch		
		1971	Anchor	4,289	Patterson (1974)
		1972-1986	Pop * per cap scaled		
		1987-1989	Anchors		Anon. (2001)
		1990-2006	Avg catch ('87-'89)	5,102; 2,178; 12,159	
	broad whitefish	1950-1970	1971 catch		
		1971	Anchor	45,243	Patterson (1974)
		1972-1986	Pop * per cap scaled		
		1987-1989	Anchors	45,825; 39,576; 105,228	Anon. (2001)
		1990-2006	Avg catch ('87-'89)		
	Bering cisco	1950-1970	1971 catch		
		1971	Anchor	890	Patterson (1974)
		1972-1986	Pop * per cap scaled		
		1987-1989	Anchors	2,180; 203; 1,884	Anon. (2001)
		1990-2006	Avg catch ('87-'89)		
	least cisco	1950-1970	1971 catch		
		1971	Anchor	5,360	Patterson (1974)
		1972-1986	Pop * per cap scaled		
		1987-1989	Anchors	11,697; 10,095; 3,905	Anon. (2001)
		1990-2006	Avg catch ('87-'89)		

Table A1.3. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Buckland.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Buckland	chum salmon	1950-1956	1957 catch		
		1957	Anchor	98,900	Mattson (1962)
		1958-1966	Pop * per cap scaled to avg ('67, '68, '70-'75)		
		1967-1968	Anchor	1,507; 359	Anon. (1967, 1968)
		1969	Avg per cap ('67, '68, '70-'75)		
		1970-1975	Anchors	Range: 533-15,670	Banducci *et al.*(2007)
		1976-1978	1970's anchors avg per cap		
		1979	Anchor	8,800	Banducci *et al.* (2007)
		1980	Avg per cap ('70-'75, '81)		
		1981	Anchor	455	Banducci *et al.* (2007)
		1982-2002	Pop * per cap scaled		
		2003	Anchor	33,042	Mason *et al.* (2007)
		2004-2006	2003 catch		
	smelt	1950-1971	1972 catch		
		1972	Anchor	9,333	Moore (1979)
		1973-2002	Pop * per cap scaled		
		2003	Anchor	15,250	Mason *et al.* (2007)
		2004-2006	2003 catch		
	sheefish	1950-1966	Pop * 1967 per cap		
		1967	Anchor	46,566	Anon. (1967)
		1968-2006	1967 catch		
	pink salmon	1950-1971	Pop * 1972 per cap		
		1972	Anchor	240	Moore (1979)
		1973-2006	1972 catch		
	whitefish	1950-1971	Pop * 1973 per cap		
		1972	Anchor	2,000	Moore (1979)
		1973-2006	1972 catch		

Table A1.4. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Deering.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Deering	chum salmon	1950-1956	1957 catch		
		1957	Anchor	213,833	Mattson (1962)
		1958-1964	Pop * per cap scaled		
		1965-1977	Anchors	Range: 3,358-63,004	Kohler *et al.* (2005)
		1978	Avg catch ('70-'77)		
		1979	Anchor	17,600	Kohler *et al.* (2005)
		1980	Avg catch ('81-'83)		
		1981-1985	Anchors	Range: 2,059-15,908	Kohler *et al.* (2005)
		1986-1993	Pop * per cap scaled		
		1994	Anchor	26,387	Kohler *et al.* (2005)
		1995-2006	1994 catch		
	chinook salmon	1950-1993	1994 catch		
		1994 catch	Anchor	560	Magdanz and Utermohle (1994)
		1995-2006	1994 catch		
	sockeye salmon	1950-1993	1994 catch		
		1994 catch	Anchor	30	Magdanz and Utermohle (1994)
		1995-2006	1994 catch		
	Pleuronectidae[1]	1994	Anchor	5	Anon. (2001)
		1995-2006	1994 catch		
	herring	1950-1993	Pop * per cap ('94)		
		1994	Anchor	16	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	sculpin	1950-1993	Pop * per cap ('94)		
		1994	Anchor	17	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	sheefish	1950-1993	Pop * per cap ('94)		
		1994	Anchor	27	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	smelt	1950-1993	Pop * per cap ('94)		
		1994	Anchor	4	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	flounder	1950-1993	Pop * per cap ('94)		
		1994	Anchor	1	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	coho salmon	1950-1971	Pop * avg per cap ('72 & '94)		
		1972	Anchor	2,000	Patterson (1974)
		1973-1993	Pop * per cap scaled		
		1994	Anchor	204	Magdanz and Utermohle (1994)
		1995-2006	Pop * per cap ('94)		

[1]: originally identified as halibut

Table A1.4 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Deering (cont'd)	Dolly varden	1950-1971	Pop * avg per cap ('72 & '94)		
		1972	Anchor	333	Patterson (1974)
		1973-1993	Pop * per cap scaled		
		1994	Anchor	54,11	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	pink salmon	1950-1971	Pop * avg per cap ('72 & '94)		
		1972	Anchor	267	Patterson (1974)
		1973-1983	Pop * avg per cap ('72 & '94)		
		1984	Pop * per cap ('94)		
		1985-1993	Pop * avg per cap ('72 & '94)		
		1994	Anchor	6,976	Magdanz and Utermohle (1994)
		1995-2003	Pop * avg per cap ('72 & '94)		
		2004	Pop * per cap ('94)		
		2005-2006	Pop * avg per cap ('72 & '94)		
	humpback whitefish	1950-1993	Pop * per cap ('94)		
		1994	Anchor	167	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	round whitefish	1950-1993	Pop * per cap ('94)		
		1994	Anchor	1	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	broad whitefish	1950-1993	Pop * per cap ('94)		
		1994	Anchor	51	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	Bering cisco	1950-1971	Pop * per cap ('72)		
		1972	Anchor	659	Patterson (1974)
		1973-1993	Pop * per cap scaled		
		1994	Anchor	965	Anon. (2001)
		1995-2006	1994 catch		
	least cisco	1950-1971	Pop * per cap ('72)		
		1972	Anchor	11	Patterson (1974)
		1973-1993	Pop * per cap scaled		
		1994	Anchor	11	Anon. (2001)
		1995-2006	1994 catch		
	Arctic cod	1950-1993	Pop * per cap ('94)		
		1994	Anchor	5	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	saffron cod	1950-1971	Pop * per cap ('72)		
		1972	Anchor	659	Patterson (1974)
		1973-1993	Pop * per cap scaled		
		1994	Anchor	965	Anon. (2001)
		1995-2006	1994 catch		

Table A1.5. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Kaktovik.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Kaktovik	Dolly varden[1]	1950-1970	1971 per cap*pop		
		1971	Anchor	12,500	Patterson (1974)
		1972-1984	Pop * per cap scaled		
		1985-1986	Anchors	11,481; 6,601	Anon. (2001)
		1987-1991	Pop * per cap scaled		
		1992	Anchor	20,617	Anon. (2001)
		1993-2000	Pop * per cap scaled		
		2001-2002	Anchors	6,492; 9,891	Pedersen (2005)
		2003-2006	Avg per cap ('01-'02)*pop		
	Arctic cisco	1950-1970	1971 per cap * pop		
		1971	Anchor	2,933	Patterson (1974)
		1972-1984	Pop * per cap scaled		
		1985-1986	Anchors	3,106; 2,105	Anon. (2001)
		1987-1991	Pop * per cap scaled		
		1992	Anchor	7,572	Anon. (2001)
		1993-2000	Pop * per cap scaled		
		2001-2002	Anchors	1,271; 2,135	Pedersen (2005)
		2003-2006	Pop * avg per cap ('01-'02)		
	least cisco	1950-1970	Proportion of Arctic cisco		
		1971	Anchor	192	Patterson (1974)
		1972-1991	Proportion of Arctic cisco		
		1992	Anchor	465	Anon. (2001)
		1993-2006	Proportion of Arctic cisco		
	pink salmon	1990-1991	1992 catch		
		1992	Anchor	23	Anon. (2001)
		1993-2006	1992 catch		
	salmon	1990-1991	1992 catch		
		1992	Anchor	117	Anon. (2001)
		1993-2006	1992 catch		
	Arctic cod	1950-1991	1992 catch		
		1992	Anchor	157	Anon. (2001)
		1993-2006	1992 catch		
	saffron cod	1950-1991	Pop * per cap ('92)		
		1992	Anchor	243	Anon. (2001)
		1993-2006	1992 catch		
	flounder	1950-1984	1985 catch		
		1985	Anchor	1	Anon. (2001)
		1986-1991	1985 catch		
		1992	Anchor	1	
		1993-2006	1992 catch		

[1]: identified in sources as Arctic char until 1992 anchor

Table A1.6. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Kivalina.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Kivalina	Dolly varden	1950-1958	Pop * avg per cap ('59 & '60)		
		1959-1960	Anchors	96,200; 112,300	Saario and Kessel (1966)
		1961-1963	Pop * per cap scaled		
		1964-1965	Anchors	93,995; 28,140	Burch (1985)
		1966-1967	Pop * per cap scaled		
		1968-1972	Anchors	Range: 68,518; 152,750	Banducci *et al.* (2007)
		1973-1978	Pop * per cap scaled		
		1979	Anchor	73,000	Banducci *et al.* (2007)
		1980	Avg catch ('79 & '81)		
		1981-1982	Anchors	87,450; 127,222	Banducci *et al.* (2007)
		1983	Anchor	68,467	Burch (1985)
		1984-1986	Anchor	Range: 50,565; 73,500	Banducci *et al.* (2007)
		1987-1991	Pop * per cap scaled		
		1992	Anchor	93,057	Anon. (2001)
		1993-2006	1992 catch		
	chum salmon	1950-1955	Pop * avg per cap ('56&'57)		
		1956-1957	Anchors	4,300; 4,300	Smith *et al.* (1966); Mattson (1962)
		1958-1963	Pop * per cap scaled		
		1964-1965	Anchors	1,425; 116	Burch (1985)
		1966-1971	Scaled via per cap		
		1972	Anchor	800	Patterson (1974)
		1973-1980	Pop * per cap scaled		
		1981-1984	Anchors	1,001;1,953; 1,880; 1,640	Kohler *et al.* (2005)
		1985-1991	Scaled via per cap		
		1992	Anchor	5,571	Anon. (2001)
		1993-2006	Avg catch ('84 & '92)		
	coho salmon	1950-1981	Pop * avg per cap ('82 & '83)		
		1982-1983	Anchors	260; 40	Burch (1985)
		1984-1991	Pop * per cap scaled		
		1992	Anchor	435	Anon. (2001)
		1993-2006	1992 catch		
	pink salmon	1950-1956	Pop * per cap avg ('57, '82 & '83)		
		1957	Anchor	8,750	Smith *et al.* (1966)
		1958-1981	Pop * avg per cap scaled		
		1982-1983	Anchors	4; 32	Burch (1985)
		1984-1991	Pop * per cap scaled		
		1992	Anchor	485	Anon. (2001)
		1993-2006	1992 catch		
	chinook salmon	1950-1991	Pop * per cap ('92)		
		1992	Anchor	171	Anon. (2001)
		1993-2006	1992 catch		

Table A1.6 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Kivalina (cont'd)	sockeye salmon	1950-1991	Pop * per cap ('92)		
		1992	Anchor	113	Anon. (2001)
		1993-2006	1992 catch		
	Arctic cod	1950-1958	1959 catch		
		1959	Anchor	634	Burch (1985)
		1960-1963	Pop * per cap avg ('59, '64 & '65)		
		1964-1965	Anchors	0; 0	Burch (1985)
		1966-1971	Pop * per cap avg ('64, '65 & '71)		
		1972	Anchor	1,200	Patterson (1974)
		1973-1981	Pop * per cap scaled		
		1982-1983	Anchors	0; 3,259	Burch (1985)
		1984-1991	Pop * per cap scaled ('82 & '83)		
		1992	Anchor	2,849	Anon. (2001)
		1993-2006	Anchor's catch avg		
	saffron cod	1950-1958	1959 catch		
		1959	Anchor	766	Burch (1985)
		1960-1963	Pop * per cap avg ('59, '64 & '65)		
		1964-1965	Anchors	0; 6,955	Burch (1985)
		1966-1971	Pop * per cap avg ('64, '65 & '71)		
		1972	Anchor	0	Patterson (1974)
		1973-1981	Pop * per cap scaled		
		1982-1983	Anchors	9; 1,040	Burch (1985)
		1984-1991	Pop * per cap scaled ('82 & '83)		
		1992	Anchor	2,984	Anon. (2001)
		1993-2006	Anchor's catch avg		
	whitefish	1950-1958	1959 catch		
		1959-1960	Anchors	12,000; 12,000	Saario and Kessel (1966)
		1961-1971	same catch between anchors		
		1972	Anchor	12,000	Patterson (1974)
		1973-1981	Pop * per cap scaled		
		1982	Anchor	7,717	Burch (1985)
		1983-1991	Pop * per cap scaled		
		1992	Anchor	6,216	Anon. (2001)
		1993-2006	1992 catch		
	flounder	1950-1991	Pop * per cap ('92)		
		1992	Anchor	59	Anon. (2001)
		1993-2006	1992 catch		

Table A1.6 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Kivalina (cont'd)	rainbow smelt	1950-1991	Pop * per cap ('92)		
		1992	Anchor	29	Anon. (2001)
		1993-2006	1992 catch		
	herring	1950-1991	Pop * per cap ('92)		
		1992	Anchor	187	Anon. (2001)
		1993-2006	1992 catch		
	sheefish	1950-1991	Pop * per cap ('92)		
		1992	Anchor	93	Anon. (2001)
		1993-2006	1992 catch		

Table A1.7. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Kotzebue.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Kotzebue	chum salmon	1950-1956	1957 catch		
		1957	Anchor	314,072	Mattson (1962)
		1958-1961	Scaled to 1960s avg catch		
		1962-2004	Anchors	Range (92,329-639,270)	Eggers and Clark (2006)
		2005-2006	2004 catch		
	chinook salmon	1950-1971	1972 catch		
		1972	Anchor	100	Patterson (1974)
		1973-1990	Pop * per cap scaled		
		1991	Anchor	7,565	Anon. (2001)
		1992-2006	1991 catch		
	Dolly varden	1950-1971	Proportion of chum catch		
		1972	Anchor	10,000	Patterson (1974)
		1973-1985	Scaled via chum proportions		
		1986	Anchor	35,264	Georgette and Loon (1993)
		1987-1990	Avg of chum proportions ('86 & '91)		
		1991	Anchor	88,724	Anon. (2001)
		1992-2004	Avg of chum proportions		
		2005-2006	2004 catch		
	flounder	1950-1971	1972 catch		
		1972	Anchor	30	Patterson (1974)
		1973-1985	Pop * per cap scaled		
		1986	Anchor	16,017	Georgette and Loon (1993)
		1987-1990	Pop * avg per cap		
		1991	Anchor	1,555	Anon. (2001)
		1992-2006	1991 catch		
	Pleuronectidae[1]	1991	Anchor	142	Anon. (2001)
		1992-2006	1991 catch		
	herring	1950-1985	Avg per cap * pop		
		1986	Anchor	14,135	Georgette and Loon (1993)
		1987-1990	Avg per cap * pop		
		1991	Anchor	28,495	Anon. (2001)
		1992-2006	Avg per cap * pop		
	saffron cod	1950-1971	1972 catch		
		1972	Anchor	8,000	Patterson (1974)
		1973-1985	Pop * per cap scaled		
		1986	Anchor	20,170	Georgette and Loon (1993)
		1987-1990	Pop * per cap scaled		
		1991	Anchor	28,532	Anon. (2001)
		1992-2006	1991 catch		

[1]: originally identified as halibut

Table A1.7 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Kotzebue (cont'd)	sculpin	1950-1985	Per cap * pop		
		1986	Anchor	2,003	Georgette and Loon 1993
		1987-2006	1986 catch		
	sheefish	1950-1966	Avg catch ('67 & '68)		
		1967-1968	Anchors	65,390; 131,226	Anon (1967, 1968)
		1969-1971	Pop * per cap scaled		
		1972	Anchor	138,300	Patterson (1974)
		1973-1985	Pop * per cap scaled		
		1986	Anchor	185,186	Georgette and Loon (1993)
		1987-1990	Pop * avg per cap ('86 & '91)		
		1991	Anchor	568,856	Anon. (2001)
		1992-2006	Pop * avg per cap ('86 & '91		
	smelt	1950-1971	1972 catch		
		1972	Anchor	840	Patterson (1974)
		1973-1985	Pop * per cap scaled		
		1986	Anchor	3,377	Georgette and Loon (1993)
		1987-1990	Pop * per cap scaled		
		1991	Anchor	4,096	Anon. (2001)
		1992-2006	1991 catch		
	coho salmon	1950-1990	Pop * per cap ('91)		
		1991	Anchor	216	Anon. (2001)
		1992-2006	1991 catch		
	sockeye salmon	1950-1990	Pop * per cap ('91)		
		1991	Anchor	1,079	Anon. (2001)
		1992-2006	1991 catch		
	pink salmon	1950-1991	1991 per cap * pop		
		1991	Anchor	1,295	Anon. (2001)
		1992-2006	1991 catch		
	Bering cisco	1950-1985	1986 catch		
		1986	Anchor	4,321	Georgette and Loon (1993)
		1987-1990	Pop * avg per cap ('86 & '91)		
		1991	Anchor	5,848	Anon. (2001)
		1992-2006	1991 catch		
	least cisco	1950-1985	1986 catch		
		1986	Anchor	72	Georgette and Loon (1993)
		1987-1990	Pop * avg per cap ('86 & '91)		
		1991	Anchor	97	Anon. (2001)
		1992-2006	1991 catch		

Table A1.7 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Kotzebue (cont'd)	broad whitefish	1950-1985	1986 catch		
		1986	Anchor	4,142	Georgette and Loon (1993)
		1987-1990	Pop * avg per cap ('86 & '91)		
		1991	Anchor	5,605	Anon. (2001)
		1992-2006	1991 catch		
	humpback whitefish	1950-1985	1986 catch		
		1986	Anchor	15,451	Georgette and Loon (1993)
		1987-1990	Pop * avg per cap ('86 & '91)		
		1991	Anchor	20,910	Anon. (2001)
		1992-2006	1991 catch		

Table A1.8. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Noatak.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Noatak	chum salmon	1950-1956	1957 catch		
		1957	Anchor	253,012	Mattson (1962)
		1958-1959	Pop * per cap scaled		
		1960	Avg catch ('61-'69)		
		1961-1968	Anchors	Range: 51,039-420,454	Anon. (1968)
		1969-1971	Anchors	108,435; 33,372; 80,344	Banducci *et al.* (2007)
		1972	Anchor	70,264	Patterson (1974)
		1973-1984	Anchors	Range: 1,966-50,955	Banducci *et al.* (2007)
		1985	Avg of '80s catch anchors		
		1986-1987	Anchors	10,840; 23,952	Banducci *et al.* (2007)
		1988	Avg of '80s catch anchors		
		1989-1993	Anchors	Range: 13,588-34,844	Banducci *et al.* (2007)
		1994	Anchor	59,386	Anon. (2001)
		1995-1998	Anchors	Range: 20,912-80,728	Banducci *et al.* (2007)
		1999	Avg of '90s catch anchors		
		2000-2004	Anchors	Range: 18,722-62,720	Banducci *et al.* (2007)
		2005-2006	Avg catch ('00-'04)		
	Dolly varden	1950-1961	Pop * avg per cap ('62 & '63)		
		1962-1963	Anchors	182,312; 27,258	Banducci *et al.* (2007)
		1964-1968	Pop * per cap scaled		
		1969-1971	Anchors	213,510; 24,420; 32,452	Banducci *et al.* (2007)
		1972	Anchor	97,600	Patterson (1974)
		1973-1978	Pop * per cap scaled		
		1979-1984	Anchors	Range: 15,506-45,300	Banducci *et al.* (2007)
		1985	Avg of '80s catch anchors		
		1986-1987	Anchors	313; 9,494	Banducci *et al.* (2007)
		1988-1990	Avg of '80s catch anchors		
		1991-1993	Anchors	31,722; 26,370; 30,353	Banducci *et al.* (2007)
		1994	Anchors	20,368	Anon. (2001)
		1995-1998	Anchors	Range: 29,427-36,301	Banducci *et al.* (2007)
		1999	Avg of '90s catch anchors		
		2000-2004	Anchors	Range: 17,023-87,312	Banducci *et al.* (2007)
		2005-2006	Avg catch ('00-'04)		
	Arctic cod	1950-1993	Pop * per cap ('94)		
		1994	Anchor	21	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	saffron cod	1950-1993	Pop * per cap ('94)		
		1994	Anchor	153	Anon. (2001)
		1995-2006	Pop * per cap ('94)		

Table A1.8 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Noatak (cont'd)	chinook salmon	1950-1993	Avg anchors' catch ('94-'99)		
		1994	Anchor	81	Anon. (2001)
		1995-1996	Anchors	0; 0	Georgette and Utermohle (2000)
		1997-1998	Anchor	65; 82	Georgette *et al.* (2003)
		1999	Anchor	0	Georgette and Utermohle (2000)
		2000-2006	Avg anchors' catch ('94-'99)		
	coho salmon	1950-1993	Pop * avg per cap ('94-'02)		
		1994	Anchor	1,285	Anon. (2001)
		1995-2002	Anchors	Range: 0-800	Georgette *et al.* (2003)
		2003-2006	Avg catch ('00-'02)		
	pink salmon	1950-1993	Avg anchors' per cap ('94-'99)		
		1994	Anchor	0	Anon. (2001)
		1995-2002	Anchors	Range: 0-35	Georgette *et al.* (2003)
		2003-2006	Avg catch ('00-'02)		
	sheefish	1950-1993	Pop * avg per cap ('94, '99 & '00)		
		1994	Anchor	716	Anon. (2001)
		1995-1998	Pop * avg per cap ('94, '99 & '00)		
		1999-2000	Anchors	840; 1033	Georgette and Utermohle (2000)
		2001-2006	Pop * avg per cap ('94, '99 & '00)		
	smelt	1950-1993	Pop * per cap ('94)		
		1994	Anchor	15	Anon. (2001)
		1995-2006	Pop * per cap ('94)		
	sockeye salmon	1950-1993	Raised anchors' avg catch ('94-'02)		
		1994-2002	Anchors	Range: 0-10	Georgette *et al.* (2003)
		2003-2006	Raised anchors' avg catch ('94-'02)		
	broad whitefish	1950-1971	1972 catch		
		1972	Anchor	183	Patterson (1974)
		1973-1993	Pop * per cap scaled		
		1994	Anchor	116	Anon. (2001)
		1995-1999	Pop * avg per cap ('94, '00 & '02)		
		2000	Anchor	119	Georgette and Utermohle (2000)
		2001	Pop * avg per cap ('94, '00 & '02)		
		2002	Anchor	130	Georgette *et al.* (2003)
		2003-2006	2002 catch		

Table A1.8 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Noatak (cont'd)	humpback whitefish	1950-1971	1972 catch		
		1972	Anchor	8,864	Patterson (1974)
		1973-1993	Pop * per cap scaled		
		1994	Anchor	5,639	Anon. (2001)
		1995-1999	Pop * avg per cap ('94, '00 & '02)		
		2000	Anchor	5,768	Georgette and Utermohle (2000)
		2001	Pop * avg per cap ('94, '00 & '02)		
		2002	Anchor	6,320	Georgette *et al.* (2003)
		2003-2006	2002 catch		
	round whitefish	1950-1971	1972 catch		
		1972	Anchor	331	Patterson (1974)
		1973-1993	Pop * per cap scaled		
		1994	Anchor	210	Anon. (2001)
		1995-1999	Pop * avg per cap ('94, '00 & '02)		
		2000	Anchor	215	Georgette and Utermohle (2000)
		2001	Pop * avg per cap ('94, '00 & '02)		
		2002	Anchor	236	Georgette *et al.* (2003)
		2003-2006	2002 catch		
	Bering cisco	1950-1971	1972 catch		
		1972	Anchor	555	Patterson (1974)
		1973-1993	Pop * per cap scaled		
		1994	Anchor	353	Anon. (2001)
		1995-1999	Pop * avg per cap ('94, '00 & '02)		
		2000	Anchor	361	Georgette and Utermohle (2000)
		2001	Pop * avg per cap ('94, '00 & '02)		
		2002	Anchor	396	Georgette *et al.* (2003)
		2003-2006	2002 catch		
	least cisco	1950-1971	1972 catch		
		1972	Anchor	226	Patterson (1974)
		1973-1993	Pop * per cap scaled		
		1994	Anchor	144	Anon. (2001)
		1995-1999	Pop * avg per cap ('94, '00 & '02)		
		2000	Anchor	147	Georgette and Utermohle (2000)
		2001	Pop * avg per cap ('94, '00 & '02)		
		2002	Anchor	161	Georgette *et al.* (2003)
		2003-2006	2002 catch		

Table A1.9. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Nuiqsut.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Nuiqsut	Arctic cisco	1973-1984	Pop * avg per cap ('85-'87)		
		1985	Anchor	31,489	Anon. (2001)
		1986-1992	Scaled to changes presented in (Anonymous, 2005a)		
		1993	Anchor	42,221	Anon. (2001)
		1994-1998	Scaled to changes presented in (Anonymous, 2005a)		
		1999	Avg catch ('98 & '00)		
		2000-2003	Scaled to changes presented in (Anonymous, 2005a)		
		2004-2006	Pop * avg per cap ('01-'03)		
	least cisco	1973-1984	Pop * avg per cap ('85-'87)		
		1985	Anchor	7,649	Anon. (2001)
		1986-1992	Scaled to changes presented in (Anonymous, 2005a)		
		1993	Anchor	4,369	Anon. (2001)
		1994-1998	Scaled to changes presented in (Anonymous, 2005a)		
		1999	Avg catch ('98 & '00)		
		2000-2003	Scaled to changes presented in (Anonymous, 2005a)		
		2004-2006	Pop * avg per cap ('01-'03)		
	Dolly varden	1973-1984	Pop * per cap 1985		
		1985	Anchor	3,959	Anon. (2001)
		1986-1992	Pop * per cap scaled		
		1993	Anchor	2,252	Anon. (2001)
		1994-2006	1993 catch		
	broad whitefish	1973-1984	Pop * per cap 1985		
		1985	Anchor	35,815	Anon. (2001)
		1986-1992	Pop * per cap scaled		
		1993	Anchor	55,273	Anon. (2001)
		1994-2006	1993 catch		
	humpback whitefish	1973-1984	Pop * per cap 1985		
		1985	Anchor	4,635	Anon. (2001)
		1986-1992	Pop * per cap scaled		
		1993	Anchor	1,699	Anon. (2001)
		1994-2006	1993 catch		
	round whitefish	1973-1984	1985 catch		
		1985	Anchor	13	Anon. (2001)
		1986-2006	1985 catch		
	rainbow smelt	1973-1984	Pop * per cap 1985		
		1985	Anchor	585	Anon. (2001)
		1986-1992	Pop * per cap scaled		
		1993	Anchor	56	Anon. (2001)
		1994-2006	1993 catch		

Table A1.9 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Nuiqsut (cont'd)	Arctic cod	1973-1992	1985 catch		
		1993	Anchor	9	Anon. (2001)
		1994-2006	1985 catch		
	chinook salmon	1993	Anchor	140	Anon. (2001)
		1994-2006	1993 catch		
	chum salmon	1973-1992	Pop * per cap ('93)		
		1993	Anchor	618	Anon. (2001)
		1994-2006	1993 catch		
	coho salmon	1993	Anchor	99	Anon. (2001)
		1994-2006	1993 catch		
	pink salmon	1973-1984	Pop * per cap 1985		
		1985	Anchor	1,821	Anon. (2001)
		1986-1992	Pop * per cap scaled		
		1993	Anchor	488	Anon. (2001)
		1994-2006	1993 catch		

Table A1.10. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Point Hope.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Point Hope	chum salmon	1950-1956	Pop * per cap ('57)		
		1957	Anchor	21,672	Mattson (1962)
		1958-1963	Pop * per cap scaled		
		1964-1965	Derived anchors from Kivalina	7,182; 585	
		1966-1971	Pop * per cap scaled		
		1972	Derived anchor from Kivalina	3,024	
		1973-1980	Pop * per cap scaled		
		1981-1984	Derived anchors from Kivalina	5,045; 9,843; 9,475; 8,266	
		1985-1991	Pop * per cap scaled		
		1992	Derived anchor from Kivalina	28,076	
		1993-2006	Avg of derived anchors ('84 & '91)		
	pink salmon	1950-1955	Pop * avg per cap ('56 & '72)		
		1956	Anchor	1,680	Smith *et al.* (1966)
		1957-2006	Pop * avg per cap ('56 & '72)		
	Arctic cod	1950-1958	Pop * avg per cap ('59 & '60)		
		1959-1960	Anchors	6,775; 4,000	Foote & Williamson (1966)
		1961-1970	Pop * per cap scaled		
		1971	Anchor	3,750	Patterson (1974)
		1972-2006	1971 catch		
	Dolly varden	1950-1958	Pop * per cap ('59 & '60)		
		1959-1960	Derived anchors from Kivalina	14,040; 16,390	
		1961-1963	Pop * per cap scaled		
		1964-1965	Derived anchor from Kivalina	13,718; 4,107	
		1966-1967	Pop * per cap scaled		
		1968-1970	Derived anchors from Kivalina	17,545; 22,923; 11,591	
		1971	Anchor	10,000	Patterson (1974)
		1972	Derived anchor from Kivalina	16,731	
		1973-1978	Pop * per cap scaled		
		1979	Derived anchor from Kivalina		
		1980	Avg catch ('79 & '81)		
		1981-1986	Derived anchors from Kivalina	Range: 7,380-18,568	
		1987-1991	Pop * per cap scaled		
		1992	Derived anchor from Kivalina	13,581	
		1993-2006	1992 catch		
	smelt	1950-1970	Pop * per cap ('71)		
		1971	Anchor	1,000	Patterson (1974)
		1971-2006	1971 catch		
	whitefish	1950-1970	1971 catch		
		1971	Anchor	2,500	Patterson (1974)
		1972-1981	Pop * per cap scaled		
		1982	Derived anchor from Kivalina	1,608	
		1983-1991	Pop * per cap scaled		
		1992	Derived anchor from Kivalina	1,295	
		1993-2006	1992 catch		

Table A1.11. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Point Lay.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Point Lay	chum salmon	1950-1956	1957 catch		
		1957	Derived anchor from Kivalina	134	
		1958-1963	Pop * per cap scaled		
		1964-1972	1963 catch		
		1973-1980	Pop * per cap scaled		
		1981-1984	Derived anchors from Kivalina	83; 172; 173; 158	
		1985-1986	Pop * per cap scaled		
		1987	Anchor	323	Anon. (2001)
		1988-1991	Pop * per cap scaled		
		1992	Derived anchor from Kivalina	720	
		1993-2006	1992 catch		
	pink salmon	1950-1986	Scaled to chum salmon		
		1987	Anchor	243	Anon. (2001)
		1988-2006	1987 catch		
	herring	1950-1986	1987 catch		
		1987	Anchor	7	Anon. (2001)
		1988-2006	1987 catch		
	smelt	1950-1986	Pop * per cap ('87)		
		1987	Anchor	49	Anon. (2001)
		1988-2006	1987 catch		
	broad whitefish	1950-1958	Pop * per cap ('59)		
		1959-1960	Derived anchors from Kivalina	57; 47	
		1961-1964	Pop * per cap scaled		
		1965	Derived anchor from Kivalina	7	
		1966-1971	Pop * per cap scaled		
		1972	Derived anchor from Kivalina	6	
		1973-1981	Pop * per cap scaled		
		1982	Derived anchor from Kivalina	123	
		1983-1986	Pop * per cap scaled		
		1987	Anchor	111	Anon. (2001)
		1988-1991	Pop * per cap scaled		
		1992	Derived anchor from Kivalina	116	
		1993-2006	1992 per cap * pop		

Table A1.12. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Point Lay.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Selawik	sheefish	1950-1966	Avg catch ('67 & '68)		
		1967-1968	Anchors	46,566; 30,480	Anon. (1967, 1968)
		1969-1971	Pop * per cap scaled		
		1972	Anchor	113,439	Patterson (1974)
		1973-1985	Pop * per cap scaled		
		1986	Derived anchor from Kotzebue	108,605	
		1987-2006	Pop * avg per cap ('72 & '86)		
	whitefish	1950-1971	Pop * per cap ('72)		
		1972	Anchor	472,467	Patterson (1974)
		1973-2006	1972 catch		
	smelt	1950-1971	Pop * per cap ('72)		
		1972	Anchor	84	Patterson (1974)
		1973-2006	1972 catch		
	flounder	1950-1971	Pop * per cap ('72)		
		1972	Anchor	11	Patterson (1974)
		1973-2006	1972 catch		
	herring	1950-1971	Pop * per cap ('72)		
		1972	Anchor	67	Patterson (1974)
		1973-2006	1972 catch		
	chum salmon	1950-1971	Scaled as proportion of Kotzebue catches		
		1972	Anchor	933	Patterson (1974)
		1973-2006	Scaled as proportion of Kotzebue catches		
	Dolly varden	1950-1971	Scaled as proportion of Kotzebue catches		
		1972	Anchor	133	Patterson (1974)
		1973-2006	Scaled as proportion of Kotzebue catches		

Table A1.13. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Shishmaref.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Shishmaref	chum salmon	1950-1956	1957 catch		
		1957	Anchor	1,462	Mattson (1962)
		1958-1966	Pop * per cap scaled		
		1967-1968	Anchors	930; 359	Banducci *et al.* (2007)
		1969-1970	Pop * per cap scaled		
		1971-1972	Anchors	1,061; 264	Banducci *et al.* (2007)
		1973	Anchor	3,640	Patterson (1974)
		1974-1975	Anchors	1,700; 1,978	Banducci *et al.* (2007)
		1976-1988	Scaled via exploitation rate		
		1989	Anchor	6,783	Conger and Magdanz (1990)
		1990-1994	Avg exploitation rate ('89 & '95)		
		1995	Anchor	56,000	Banducci *et al.* (2007)
		1996-2004	Avg exploitation rate ('89 & '95)		
		2005-2006	2004 catch		
	Dolly varden	1950-1972	1973 catch	360	Patterson (1974)
		1973	Anchor		
		1974-1988	Pop * per cap scaled		
		1989	Anchor	2,039	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	5,959	Anon. (2001)
		1996-2006	1995 catch		
	sockeye salmon	1950-1972	1973 catch		
		1973	Derived anchor from pink salmon	17	
		1974-1988	Pop * per cap scaled		
		1989	Anchor	280	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	3,058	Anon. (2001)
		1995-2006	1995 catch		
	pink salmon	1950-1972	1973 catch		
		1973	Anchor	53	Patterson (1974)
		1974-1988	Pop * per cap avg ('89 & '95)		
		1989	Anchor	871	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	3,868	Anon. (2001)
		1996-2006	1995 catch		
	coho salmon	1950-1972	1973 catch		
		1973	Derived anchor from pink salmon		
		1974-1988	Pop * per cap scaled		
		1989	Anchor	6,608	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	5,194	Anon. (2001)
		1996-2006	1995 catch		

Table A1.13 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Shishmaref (cont'd)	chinook salmon	1950-1972	1973 catch		
		1973	Derived anchor from pink salmon		
		1974-1994	Pop * per cap scaled		
		1995	Anchor	1,285	Anon. (2001)
		1996-2006	1995 catch		
	king crab	1989	Anchor	3,000	Conger and Magdanz (1990)
		1990-1994	Avg catch ('89 & '95)		
		1995	Anchor	1,289	Anon. (2001)
		1996-2006	Avg catch ('89 & '95)		
	flounder	1950-1972	Pop * per cap ('73)		
		1973	Anchor	320	Patterson (1974)
		1974-1988	Pop * per cap scaled		
		1989	Anchor	675	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	36	Anon. (2001)
		1996-2006	Pop * avg per cap ('89 & '95)		
	herring	1950-1972	1973 catch		
		1973	Anchor	2,667	Patterson (1974)
		1974-1988	Pop * per cap scaled		
		1989	Anchor	5,226	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	12,989	Anon. (2001)
		1996-2006	1995 catch		
	sculpin	1950-1988	Pop * avg per cap ('89 & '95)		
		1989	Anchor	101	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	743	Anon. 2001
		1996-2006	1995 catch		
	smelt	1950-1972	1973 catch		
		1973	Anchor	267	Patterson 1974
		1974-1988	Pop * per cap scaled		
		1989	Anchor	1,017	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	6,161	Anon. (2001)
		1996-2006	1995 catch		
	sheefish	1950-1972	1973 catch		
		1973	Derived anchor	58	
		1974-1994	Pop * per cap scaled		
		1995	Anchor	548	Anon. (2001)
		1996-2006	1995 catch		

Table A1.13 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Shishmaref (cont'd)	broad whitefish	1950-1972	1973 catch		
		1973	Anchor	94	Patterson (1974)
		1974-1988	Pop * per cap scaled		
		1989	Anchor	142	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	133	Anon. (2001)
		1995-2006	1995 catch		
	humpback whitefish	1950-1972	1973 catch		
		1973	Anchor	2,029	Patterson (1974)
		1974-1988	Pop * per cap scaled		
		1989	Anchor	3,054	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	2,940	Anon. (2001)
		1995-2006	1995 catch		
	round whitefish	1950-1972	1973 catch		
		1973	Anchor	543	Patterson (1974)
		1974-1988	Pop * per cap scaled		
		1989	Anchor	817	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	769	Anon. (2001)
		1995-2006	1995 catch		
	Arctic cod	1950-1972	1973 catch		
		1973	Anchor	667	Patterson (1974)
		1974-1988	Pop * per cap scaled		
		1989	Anchor	243	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	329	Anon. (2001)
		1995-2006	1995 catch		
	saffron cod	1950-1972	1973 catch		
		1973	Anchor	646	Patterson (1974)
		1974-1988	Pop * per cap scaled		
		1989	Anchor	7,710	Conger and Magdanz (1990)
		1990-1994	Pop * per cap scaled		
		1995	Anchor	10,452	Anon. (2001)
		1995-2006	1995 catch		
	Bering cisco	1950-1972	1973 catch		
		1973	Derived anchor	491	
		1974-1994	Pop * per cap scaled		
		1995	Anchor	4,604	Anon. (2001)
		1996-2006	1995 catch		
	least cisco	1950-1972	1973 catch		
		1973	Derived anchor	31	
		1974-1994	Pop * per cap scaled		
		1995	Anchor	291	Anon. (2001)
		1996-2006	1995 catch		

Table A1.14. Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Wainwright.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Wainwright	Chum salmon	1950-1956	Pop * per cap ('57)		
		1957	Derived anchor from Kivalina	342	
		1958-1963	Pop * per cap scaled		
		1964-1965	Derived anchors from Kivalina	113; 9	
		1966-1971	Pop * per cap scaled		
		1972	Derived anchor from Kivalina	64	
		1973-1980	Pop * per cap scaled		
		1981-1984	Derived anchors from Kivalina	80; 155; 149; 130	
		1985-1987	Pop * per cap scaled		
		1988-1989	Anchors	41; 553	Anon. (2001)
		1990-1991	Pop * per cap scaled		
		1992	Derived anchor from Kivalina	443	
		1993-2006	1992 catch		
	Pink salmon	1950-1970	Pop * per cap ('71)		
		1971	Anchor	125	Patterson (1974)
		1972-1987	Pop * per cap scaled		
		1988-1989	Anchors	25; 215	Anon. (2001)
		1990-2006	Avg catch ('88 & '89)		
	Chinook salmon	1950-1970	Pop * per cap ('71)		
		1971	Anchor	488	Patterson (1974)
		1972-1988	Pop * per cap scaled		
		1989	Anchor	216	Anon. (2001)
		1990-2006	1989 catch		
	Dolly varden	1950-1958	Pop * avg per cap ('69 & '60)		
		1959-1960	Derived anchors from Kivalina	1,713; 2,000	
		1961-1963	Pop * per cap scaled		
		1964-1965	Derived anchors from Kivalina	1,674; 501	
		1966-1967	Pop * per cap scaled		
		1968-1970	Derived anchor from Kivalina	2,140; 2,720; 1,414	
		1971	Anchor	1,220	Patterson (1974)
		1972	Derived anchor from Kivalina	2,041	
		1973-1978	Pop * per cap scaled		
		1979	Derived anchor from Kivalina	1,300	
		1980	Avg catch ('79 & '81)		
		1981-1986	Derived anchor from Kivalina	Range: 900-2,265	
		1987-1991	Pop * per cap scaled	1,832	
		1992	Derived anchor from Kivalina	1,657	
		1993-2006	1992 catch		
	Smelt	1950-1970	1971 per cap * pop		
		1971	Anchor	1,250	Patterson (1974)
		1972-1987	Pop * per cap scaled		
		1988-1989	Anchors	3,231; 8,653	Anon. (2001)
		1990-2006	Avg catch ('88-'89)		

Table A1.14 (cont'd). Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Wainwright.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Wainwright (cont'd)	Saffron cod	1950-1958	1959 catch		
		1959	Derived anchor from Kivalina	137	
		1960-1963	Pop * avg per cap ('59, '64, '65)		
		1964-1965	Derived anchors from Kivalina	0; 683	
		1966-1971	Pop * avg per cap ('64, '65, '72)		
		1972	Derived anchor from Kivalina	118	
		1973-1981	Pop * per cap scaled		
		1982-1983	Derived anchors from Kivalina	1; 422	
		1984-1987	Pop * per cap scaled		
		1988-1989	Anchors	305; 179	Anon. (2001)
		1990-2006	Avg catch ('88 & '89)		
	Sculpin	1950-1987	Avg catch ('88 & '89)		
		1988-1989	Anchors	3; 7	Anon. (2001)
		1990-2006	Avg anchors' catch		
	Flounder	1950-1987	Avg catch ('88 & '89)		
		1988-1989	Anchors	0; 3	Anon. (2001)
		1990-2006	Avg catch ('88 & '89)		
	Bering cisco	1950-1970	1971 catch		
		1971	Derived anchor from Kivalina	411	
		1972-1987	Pop * per cap scaled		
		1988-1989	Anchors	15; 568	Anon. (2001)
		1990-2006	Avg catch ('88 & '89)		
	Round whitefish	1950-1970	1971 catch		
		1971	Derived anchor from Kivalina	381	
		1972-1987	Pop * per cap scaled		
		1988-1989	Anchors	540; 0	Anon. (2001)
		1990-2006	Avg catch ('88 & '89)		
	Least cisco	1950-1970	1971 catch		
		1971	Derived anchor from Kivalina	10,627	
		1972-1987	Pop * per cap scaled		
		1988-1989	Anchors	6,161; 8,901	Anon. (2001)
		1990-2006	Avg catch ('88 & '89)		

Table A1.15. . Methods, anchor points and data sources used for expansion of reconstructed catches by taxon for Wales.

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Wales	chum salmon	1950-1956	1957 catch		
		1957	Anchor	1,290	Mattson (1962)
		1958-1966	Pop * per cap scaled		
		1967-1968	Derived anchors from Shishmaref	821; 317	
		1969-1970	Pop * per cap scaled		
		1971-1975	Derived anchors from Shishmaref	936; 233; 803; 1,500; 1,745	
		1976-1992	Scaled via exploitation rate		
		1993-1994	Anchors	7,194; 6,295	Anon. (2001); Magdanz and Utermohle (1994)
		1995-2004	Avg exploitation rate ('93 & '94)		
		2005-2006	2004 catch		
	pink salmon	1950-1972	Pop * avg per cap ('73 & '94)		
		1973	Anchor	160	Patterson (1974)
		1974-1992	Pop* avg per cap ('73 & '94)		
		1993-1994	Anchors	5,414; 5,474	Anon. (2001); Magdanz and Utermohle (1994)
		1995-2006	Po p* avg per cap ('73 & '94)		
	chinook salmon	1950-1972	1973 catch		
		1973	Derived anchor from coho		
		1974-1992	Pop * per cap scaled		
		1993-1994	Anchors	1,136; 851	Anon. (2001); Magdanz and Utermohle (1994)
		1995-2006	Avg catch ('93 & '94)		
	sockeye salmon	1950-1992	Pop * avg per cap ('93 & '94)		
		1993-1994	Anchors	178; 135	Anon. (2001); Magdanz and Utermohle (1994)
		1995-2006	Avg catch ('93 & '94)		
	coho salmon	1950-1972	1973 catch		
		1973	Anchor	100	
		1974-1992	Pop * per cap scaled		
		1993-1994	Anchors	1,903; 2,000	Anon. (2001); Magdanz and Utermohle (1994)
		1995-2006	Avg catch ('93 & '94)		
	Dolly varden	1950-1972	Pop * per cap ('73)		
		1973	Anchor	800	Patterson (1974)
		1974-1992	Pop * per cap scaled		
		1993	Anchor	1,508	Anon. (2001)
		1994-2006	1993 catch		
	flounder	1950-1972	Pop * per cap ('73)		
		1973	Anchor	400	Patterson (1974)
		1974-1992	Pop * per cap scaled		
		1993	Anchor	427	Anon. (2001)
		1994-2006	1993 catch		

Table A1.15 (cont'd).

Community	Common name	Year(s)	Method	Reported catch (lbs)	Source
Wales (cont'd)	herring	1950-1992	Pop * per cap ('93)		
		1993	Anchor	143	Anon. (2001)
		1994-2006	Pop * per cap ('93)		
	sculpin	1950-1992	Pop * per cap ('93)		
		1993	Anchor	11	Anon. (2001)
		1994-2006	Pop * per cap ('93)		
	Bering cisco	1950-1972	Pop * per cap ('73)		
		1973	Derived anchor from whitefish	519	
		1974-1992	Pop * per cap scaled		
		1993	Anchor	404	Anon. (2001)
		1994-2006	1993 catch		
	broad whitefish	1950-1972	Pop * per cap ('73)		
		1973	Anchor	790	Patterson (1974)
		1974-1992	Pop * per cap scaled		
		1993	Anchor	615	Anon. (2001)
		1994-2006	1993 catch		
	humpback whitefish	1950-1972	Pop * per cap ('73)		
		1973	Anchor	386	Patterson (1974)
		1974-1992	Pop * per cap scaled		
		1993	Anchor	300	Anon. (2001)
		1994-2006	1993 catch		
	round whitefish	1950-1972	Pop * per cap ('73)		
		1973	Anchor	158	Patterson (1974)
		1974-1992	Pop * per cap scaled		
		1993	Anchor	123	Anon. (2001)
		1994-2006	1993 catch		
	Arctic cod	1950-1972	Pop * per cap ('73)		
		1973	Anchor	108	Patterson (1974)
		1974-1992	Pop * per cap scaled		
		1993	Anchor	68	Anon. (2001)
		1994-2006	1993 catch		
	saffron cod	1950-1972	Pop * per cap ('73)		
		1973	Anchor	425	Patterson (1974)
		1974-1992	Pop * per cap scaled		
		1993	Anchor	267	Anon. (2001)
		1994-2006	1993 catch		

APPENDIX 2: INUPIAT NAMES, COMMON NAMES AND SCIENTIFIC NAMES FOR SPECIES REPORTED

Common name	Scientific name	Inupiat name	Source
Arctic cisco	*Coregonus autumnalis*	Qaataq	Anon. (2007)
Bering cisco	*Coregonus laurettae*	Tiipuq	Anon. (2007)
least cisco	*Coregonus sardinella*	Iqalusaaq	Anon. (2007)
Arctic cod	*Boreogadus saida*	Uugaq/Iqalugaq	Anon. (2007)
saffron cod	*Eleginus gracilis*	Uugaq	Anon. (2007)
chinook salmon	*Oncorhynchus tshawytscha*	Iqalugrauq	Anon. (2007)
chum salmon	*Oncorhynchus keta*	Iqalugrauq	Anon. (2007)
coho salmon	*Oncorhynchus kisutch*	Iqalugrauq	Anon. (2004)
pink salmon	*Oncorhynchus gorbuscha*	Amaqtuuq	Anon. (2007)
sockeye salmon	*Oncorhynchus nerka*	-	
broad whitefish	*Coregonus nasus*	Aanaaqliq	Anon. (2007)
humpback whitefish	*Coregonus pidschian*	Piquktuuq	Anon. (2007)
round whitefish	*Prosopium cylindraceum*	Aanaaqliq/Savigunaq	Craig (1987)
sheefish	*Stenodus leucichthys*	Sii	Magdanz *et al.* (2002)
Dolly varden	*Salvelinus malma*	Iqalukpik	Anon. (2007)
capelin	*Mallotus villosus*	Panmigriq	Anon. (2007)
flounder	*Liopsetta glacialis*	Nataagnaq/Puyyagiaq	Anon. (2007)
herring	*Clupea pallasii*	Uqsruqtuuq	Anon. (2007)
rainbow smelt	*Osmerus mordax*	Ilhaugniq	Anon. (2007)
sculpin	*Triglopsis quadricornis*	Kanayuq	Anon. (2007)

APPENDIX 3: COMMUNITY INFORMATION

Atqasuk

Atqasuk is a community that was re-established on traditional lands around 1977 primarily by former residents of Barrow (www.dced.state.ak.us). Estimated population grew from 74 in 1977 to 237 in 2006 (Figure 3.1).

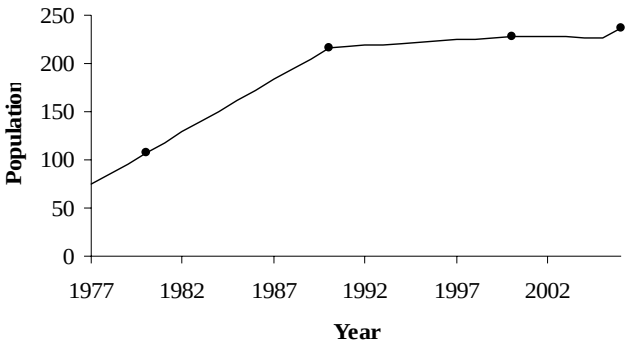

Figure A3.1. Estimated population of Atqasuk 1977-2006; solid circles indicate census years.

Atqasuk had the catches of all taxa summed over all years to derive a taxonomic breakdown for catches. For non-anchor years, the catches were apportioned to taxa based on the average reported proportion for the two anchor years (1983 & 1994). Atqasuk had its 1977 catch total scaled from the 1983 anchor point by using the change in Barrow's catch over the same time period. Barrow was used to scale the catches because this community was established by former residents of Barrow.

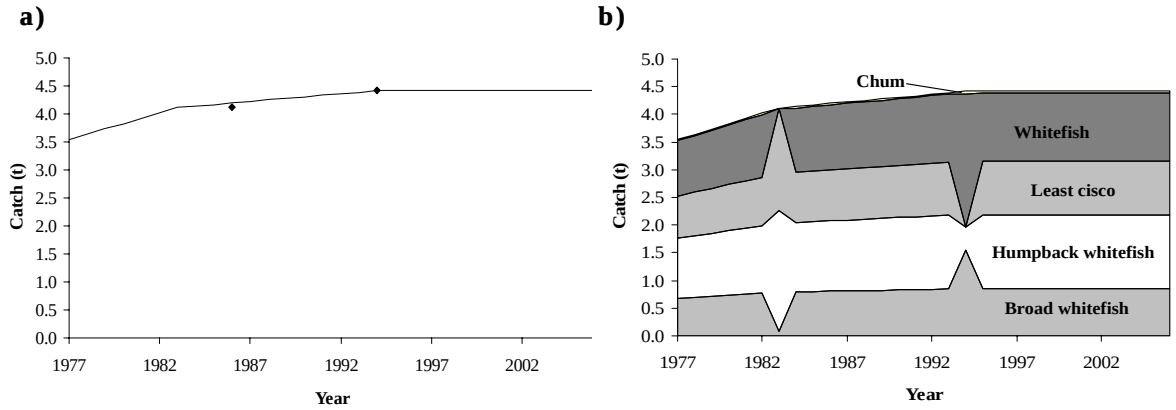

Figure A3.2. a) Anchor points (solid diamonds), and estimated reconstructed total catches (line) and, b) taxonomic breakdown of reconstructed catches.

Barrow

Barrow is the northernmost community in North America and residents still participate in traditional marine mammal hunts. The development of oil fields at Prudhoe Bay has established it as the economic center of the North Slope Borough, and tax revenues from the North Slope oil fields fund services throughout the borough (www.dced.state.ak.us). The population is estimated to have grown from 951 people in 1950 to 4,065 people in 2006.

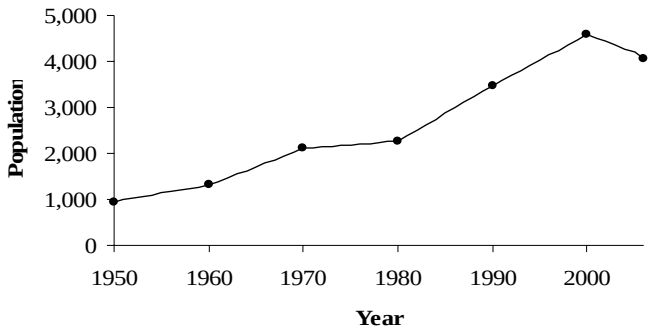

Figure A3.3. Estimated population of Barrow 1950-2006; solid circles indicate census years.

Patterson (1974) identified (6,250 lbs) of "herring" being taken. However, C. George (pers. comm.[1]) noted that Pacific herring were not caught in subsistence nets, but rather these should be identified as cisco. He also noted that it was only recently (1990s) that king salmon (*Oncorhynchus tshawytscha*) appeared in local waters and that there was no local Inupiaq name for them, and coho salmon (*O. keta*) were also likely to have been misidentified, as a result of chum salmon being called 'silver' salmon- the common name in Alaska for coho salmon.

Thus, what was originally identified as herring (Patterson, 1974) was changed to cisco in the present study, and records of coho salmon and king salmon were changed to chum salmon (Patterson, 1974; Anonymous, 2001). It should also be noted that Craig (1987) in a survey of salmon streams in this area only identified appearances of coho and king salmon as strays, usually with only one specimen being caught.

Also, Arctic charr were split between Dolly varden (anadromous) and Arctic charr (freshwater) based on information provided by Craig George. He noted that about 10% of what was formerly identified as Arctic char was taken in lakes near Barrow and that the other 90% were taken in marine waters and therefore would be Dolly varden.

Chum salmon catch data for the years 1987 and 1988 (1,587 and 853 pounds) as indicated in the CPDB were ignored. This was because the values were low in relation to the other anchor points and because the Community Profiles Database indicated that these years were not the most representative for the community.

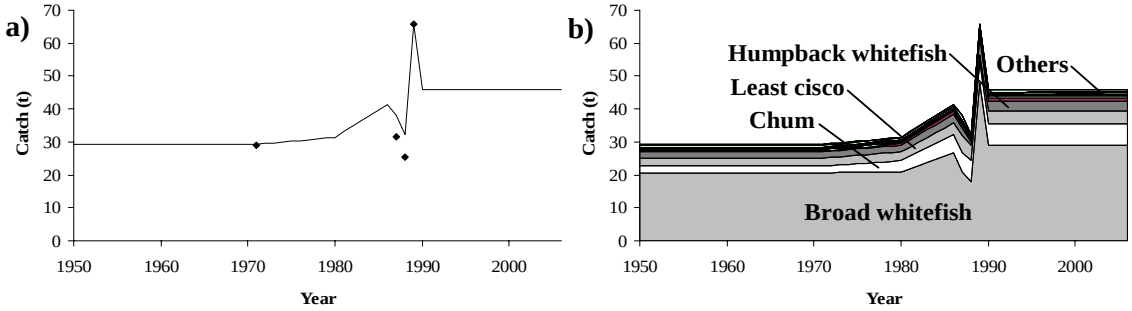

Figure A3.4. a) Anchor points (solid diamonds), and estimated reconstructed total catches (solid line), and b) the taxonomic breakdown with 'others' consisting of Arctic cod, Bering cisco, capelin, Dolly varden, pink salmon, rainbow smelt, round whitefish, saffron cod and sculpin.

[1] Craig George, Division of Wildlife Management, North Slope Borough, P.O. Box 69, Barrow, Alaska 99723, (907)-852-2611 [date information received January 24, 2008].

Buckland

Buckland is located on the Buckland River, and a herd of more than 2,000 reindeer are managed, with the workers being paid in meat (www.dced.state.ak.us). In 1972, Buckland experienced a food shortage (Moore, 1979) and was given special permits for increasing the subsistence food supply in that year. The population is estimated to have grown from 102 people in 1950 to 457 in 2006.

Buckland's reported catch of chum salmon declined dramatically after 1960. Part of this decline may have been due to the introduction of the snowmobile. However, the decrease demand for protein sources due to the introduction of the snowmobile does not seem to match with the noted food shortage in 1972. It is possible that the Japanese high-seas fishing fleet may have been catching chum salmon destined for the Buckland River, resulting in the depressed catches after 1968. However, it should also be noted that hatcheries were developed in response to record low returns of wild stocks in the 1960s and 1970s and therefore it is possible that the low production levels may signal other factors in the low returns during this period (www.lib.noaa.gov/japan/aquaculture[2]).

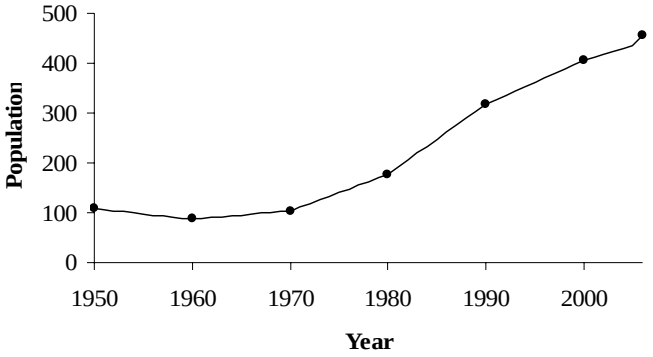

Figure A3.5. Estimated population of Buckland 1950-2006; solid circles indicate census years.

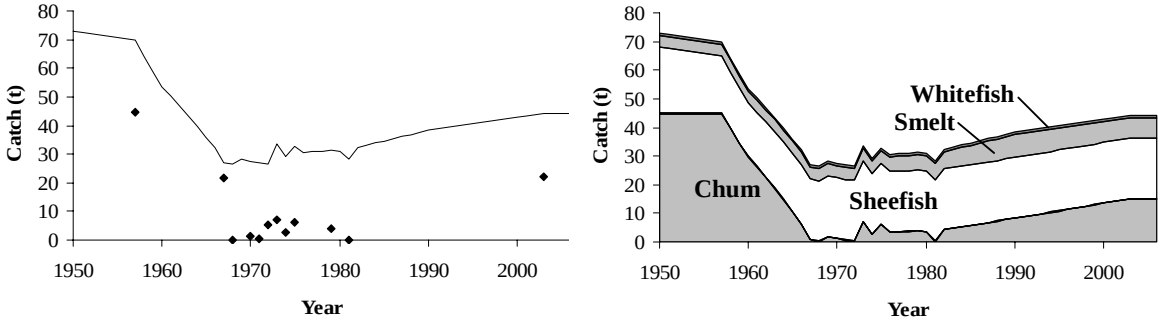

Figure A3.6. a) Anchor points (solid diamonds), and estimated reconstructed total catches (line), and b) taxonomic breakdown of the reconstructed catches.

[2] Heard, W.R. (2001) Alaska salmon enhancement: a successful program for hatchery and wild stocks. *In*: Nakamura, Y., J.P. McVey, K. Leber, C. Neidig, S. Fox, and K. Churchill, (eds.). 2003. Ecology of Aquaculture Species and Enhancement of Stocks. Proceedings of the Thirtieth U.S. – Japan Meeting on Aquaculture. Sarasota, Florida, 3-4 December. UJNR Technical Report No. 30. Sarasota, FL: Mote Marine Laboratory.

Deering

Deering is located on Kotzebue Sound at the mouth of the Inmachuk River. Moose, seal and beluga provide most meat sources (www.dced.state.ak.us). The population was estimated at 174 in 1950 and has declined to 138 in 2006. Charlie Lean[3] stated that 1984, 1994 and 2004 were record pink salmon runs; therefore, the 1994 *per capita* rate was applied to these years.

Deering's reported catch of chum salmon declined dramatically after 1960, and coincides with Buckland's decline. Part of this decline would have been attributed to the introduction of the snowmobile. However, the decrease demand for protein sources due to the introduction of the snowmobile does not seem to match with the noted food shortage in 1972. It is possible that the Japanese high-seas fishing fleet may have been catching chum salmon destined for the rivers in the area, resulting in the depressed catches after 1968. However, it should also be noted that hatcheries were developed in response to record low returns of wild stocks in the 1960s and 1970s and therefore it is possible that the low production levels may signal other factors in the low returns during this period (www.lib.noaa.gov/japan/aquaculture).

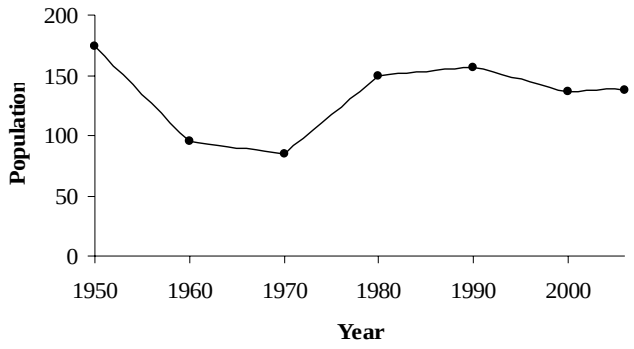

Figure A3.7. Estimated population of Deering 1950-2006; solid circles indicate census years.

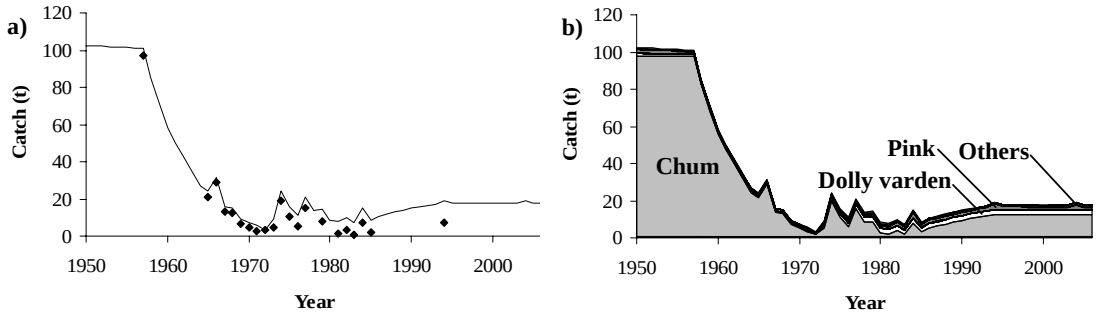

Figure A3.8. a) Anchor points (solid diamonds), and estimated reconstructed total catches (solid line), and b) taxonomic breakdown of the reconstructed catches with others consisting of Arctic cod, Bering cisco, broad whitefish, chinook salmon, coho salmon, flounder, herring, humpback whitefish, least cisco, Pleuronectidae, round whitefish, saffron cod, sculpin, sheefish, smelt and sockeye salmon.

[3] Charlie Lean, Norton Sound Fisheries Research and Development Director, P.O. Box 358, Nome, Alaska, 99762, 1-888-650-2477 [date information received: January 24, 2008].

Kaktovik

Kaktovik is located on the north shore of Barter Island along the Beaufort Sea. Previously, it was a trading center for the Inupiat and was a bartering place for the Inupiat communities in Alaska and the Inuit of Canada. Currently, the people carry out some subsistence activities within the Mackenzie Delta, which overlaps with the harvests by people of Aklavik, Canada (Pedersen *et al.*, 1985). In 1985, the main subsistence resource harvests, in order of importance, were Bowhead whale, fish, and caribou. In 1985 all households participated in fishing activities (Pedersen *et al.*, 1985). The population was estimated as 115 people in 1950 and has grown to 288 in 2006.

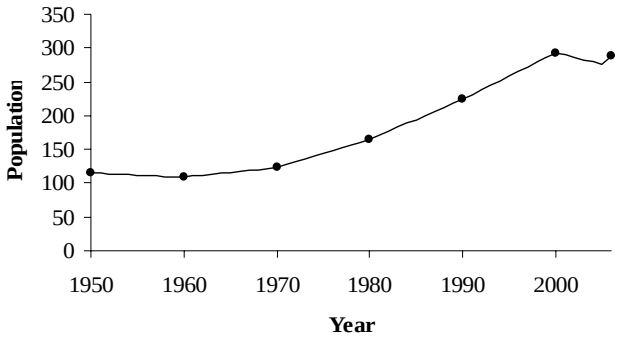

Figure A3.9. Estimated population of Deering 1950-2006; solid circles indicate census years.

The Community Profile Database for 1992 identifies 3 species of cisco being caught (Arctic cisco-7lbs edible weight; Bering cisco-5,672 lbs edible weight; and least cisco-349 lbs edible weight). Pedersen (2005) did not list Bering cisco as being harvested by Kaktovik residents and therefore the catch for Bering cisco was changed to Arctic cisco. The subsistence fishery targets Arctic cisco migrating out of the Mackenzie River and the catches are influenced by wind direction, westerly winds are associated with higher catches.

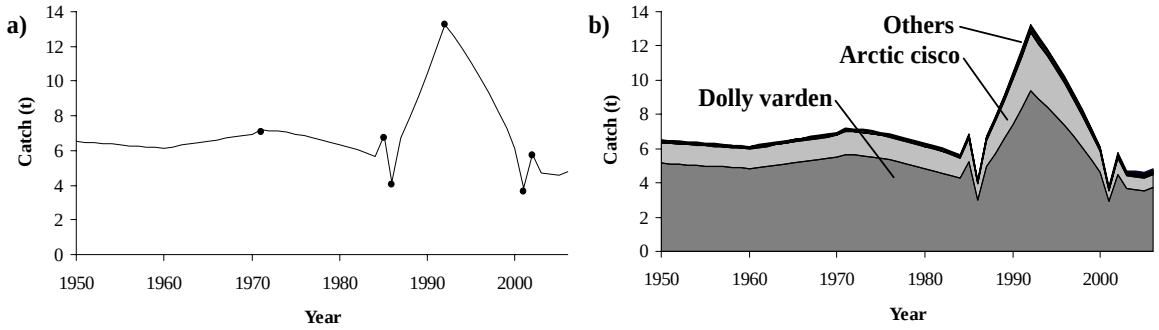

Figure A3.10. a) Anchor points (solid circles), and estimated reconstructed total catches (line), and b) taxonomic breakdown of the reconstructed catches with 'others' consisting of Arctic cod, flounder, least cisco, salmon (unidentified), pink salmon, and saffron cod.

Kivalina

Kivalina is situated on a barrier island along the Chuckchi Sea coast by the Kivalina River, but the community will re-locate due to severe coastline erosion and wind-driven ice damage (www.dced.state.ak.us). The near-by Wulik River is also important for subsistence use. Kivalina has grown from an estimated population of 117 people in 1950 to 391 people in 2006.

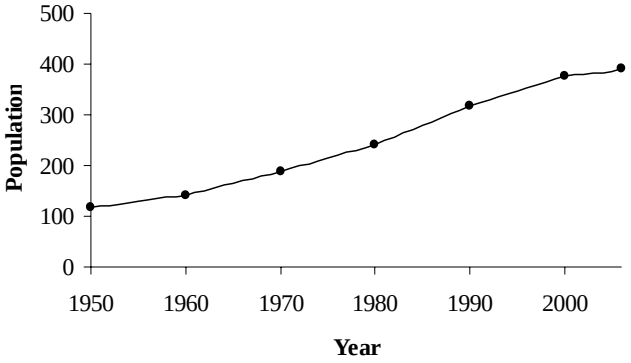

Figure A3.11. Estimated population of Kivalina 1950-2006; solid circles indicate census years.

The Wulik River supports small populations of chum, pink, and sockeye salmon. Pink salmon spawn in the lower 6 miles of the Wulik River, chum salmon spawn in the lower 15 miles of the river, while sockeye salmon spawn below Wulik Forks (www.nwabor.org/planning/4.05%20Coastal%20Mgt/Chapter%206%20Description%20of%20Designated%20Areas.htm[4]).

The early report by Saario and Kessel (1966) presents data by harvest year (Aug-July) and therefore these harvest years were used as surrogates for calendar years. Therefore, for instance, the first harvest from Aug 1959 to July 1960 was treated as the calendar year 1959. Arctic cod and Saffron cod had their catch totals combined in order to interpolate total cod catches for years of no data. This was done because depending on the year neither species was caught, only one species was caught, but in some years both species were caught. This allowed the catch to be split (by using the average proportion for each species for anchor years) between both species for years when an interpolation was done.

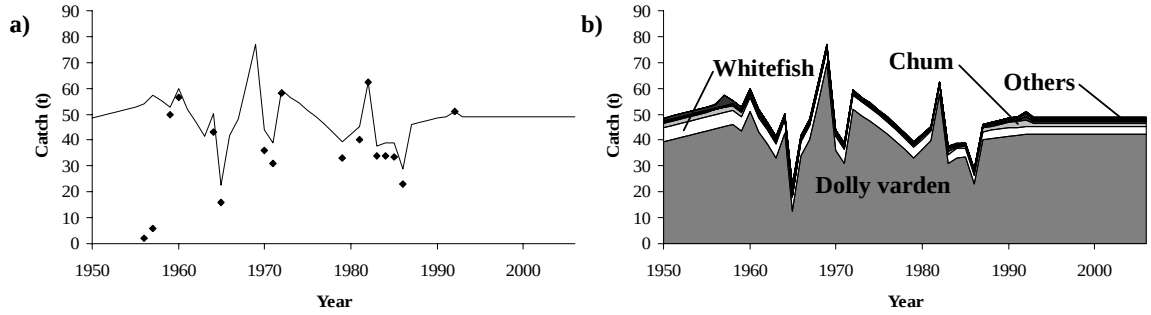

Figure A3.12. a) Anchor points (solid diamonds), and estimated reconstructed total catches (line), and b) taxonomic breakdown of the reconstructed catches with 'others' consisting of Arctic cod, flounder, herring, rainbow smelt, saffron cod, sheefish, coho salmon, pink salmon, chinook salmon and sockeye salmon.

[4] Anonymous (2005) Northwest Arctic Borough coastal management plan-public review draft. [Accessed: January, 4, 2008].

Kotzebue

The regional economic centre of Kotzebue is located on the Baldwin Peninsula, which is surrounded by Kotzebue Sound. There are three near-by rivers, the Kobuk, Noatak and Ssezawick Rivers. As well, Hotham Inlet, which is the outlet for the Kobuk and Selawik Rivers, is located on the east side of the peninsula and this inlet is linked to Selawik Lake (www.dced.state.ak.us). The estimated population has grown from 623 people in 1950 to 3,104 in 2006.

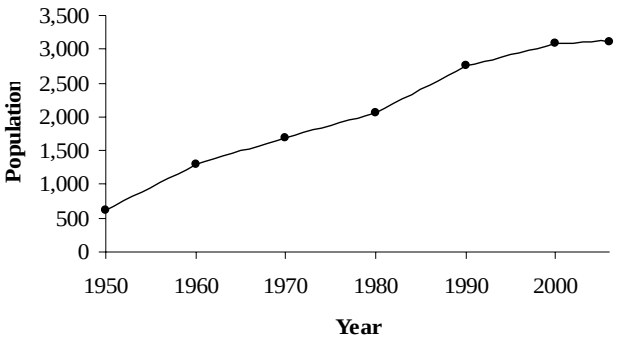

Figure A3.13. Estimated population of Kotzebue 1950-2006; solid circles indicate census years.

Although there are several reports that quantify subsistence chum catches (e.g., Patterson, 1974, Banducci *et al.*, 2007), we used the totals from Eggers and Clark (2006) for the period 1962-2004 because they accounted for underreporting of chum salmon catches for this community. Pink salmon runs in the management area fluctuate drastically between years; usually alternating between very strong and very weak returns. The current cycle is strong on even numbered years and weak on odd numbered years (www.sf.adfg.state.ak.us/Management/Areas.cfm/FA/northwestOverview.fishInfo[5]).

Patterson (1974) stated the recent average pink salmon catch as being 50 lbs (0.028 lbs·person^{-1}). Catch for pink salmon in 1991 was estimated as 1,295 lbs (0.47 lbs·person^{-1}). Patterson's catch total was not used for Pink salmon because the total seemed low, especially if the strength in cyclical abundance is for even years. The 1991 catch for halibut was assigned to the family Pleuronectidae because workshop participants believed that this was mis-identified and was likely a flounder[6]. Whitefish (excluding sheefish) had the species breakdown from 1991 applied to all other years' estimated catch, with the catch of 2,647 lbs in 1971 (Patterson, 1974) being excluded as this was for one species only.

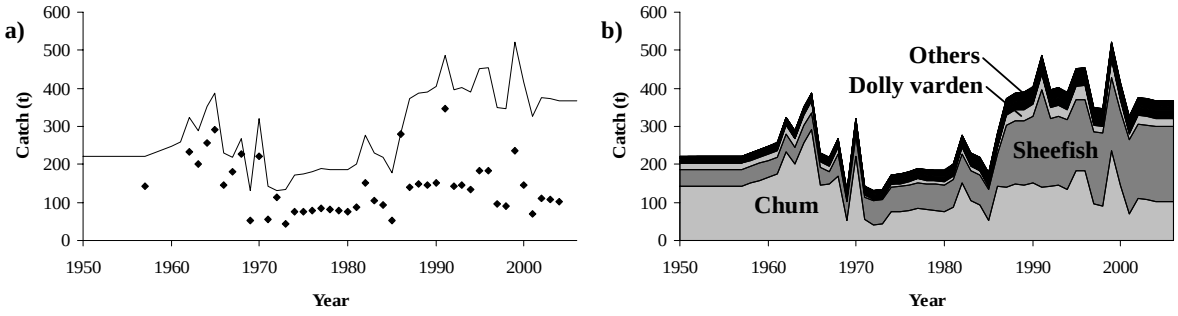

Figure A3.14. a) Anchor points (solid diamonds), and estimated reconstructed total catches (line), and b) taxonomic breakdown of the reconstructed catches with 'others' consisting of Arctic cod, flounder, herring, rainbow smelt, saffron cod, sheefish, coho salmon, pink salmon, chinook salmon and sockeye salmon.

[5] The fish of the Northwest Management Area. Alaska Department of Fish and Game, Sport Fish Division. [Accessed: February 8, 2008].
[6] Reconstruction data and validation workshop held as part of the 2008 Alaska Marine Science Symposium on January 24, 2008 in Anchorage, Alaska.

Noatak

Noatak is located on the west bank of the Noatak River. During the summer, many people still travel to Sheshalik spit to fish. The estimated population has grown from 326 people in 1950 to 470 in 2006. Catches for cisco and whitefish (excluding sheefish/inconnu) had their catch totals combined in order to interpolate total catches for years of no data. The species breakdown was based on the percent contribution of each species in 1994.

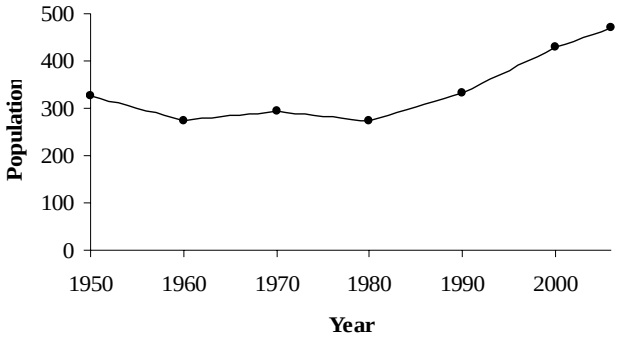

Figure 3.15. Estimated population of Noatak 1950-2006; solid circles indicate census years.

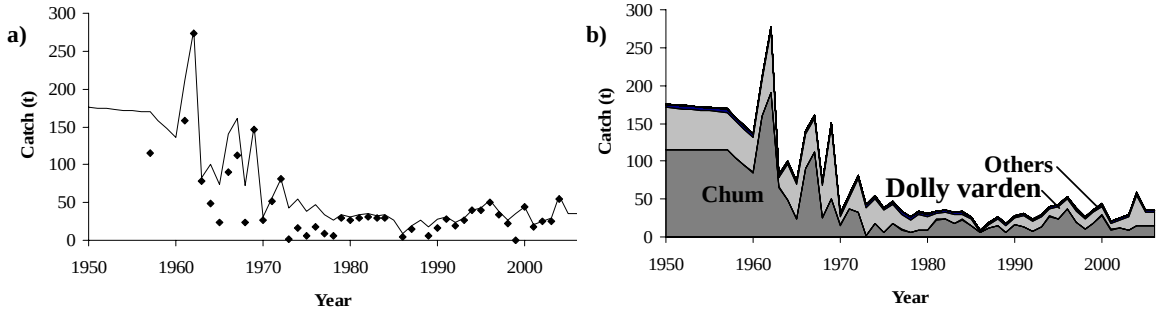

Figure A3.16. a) Anchor points (solid diamonds), and estimated reconstructed total catches (line), and b) taxonomic breakdown of the reconstructed catches with 'others' consisting of Arctic cod, Bering cisco, broad whitefish, chinook salmon, coho salmon, humpback whitefish, least cisco, pink salmon, round whitefish, saffron cod, sheefish, smelt and sockeye salmon.

Nuiqsut

Nuiqsut is located on the Nechelik Channel of the Colville River Delta, about 35 miles inland from the Beaufort Sea coast. The community was re-established in 1973 on traditional land by 27 families from Barrow (www.dced.state.ak.us). The estimated population has grown from an estimated 108 people in 1973 to 417 people in 2006.

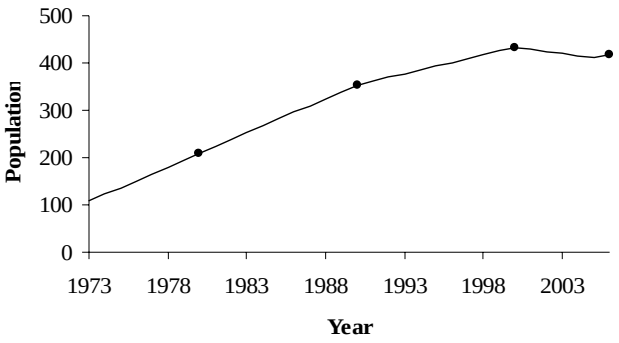

Figure 3.17. Estimated population of Nuiqsut 1973-2006; solid circles indicate census years

Nuiqsut catches are dominated by broad whitefish and two species of ciscos. Subsistence catches have increased in comparison to the commercial fishery since the Helmerick's family has limited its commercial operation. It is important to note in the context of salmonid range extension that in the 2000s, the Trapper School in Nuiqsut released coho salmon fry as part of an enhancement program (www.cf.adfg.state.ak.us/geninfo/pubs/rir/5j04-02/rir-5j04-02_p3.pdf[7]).

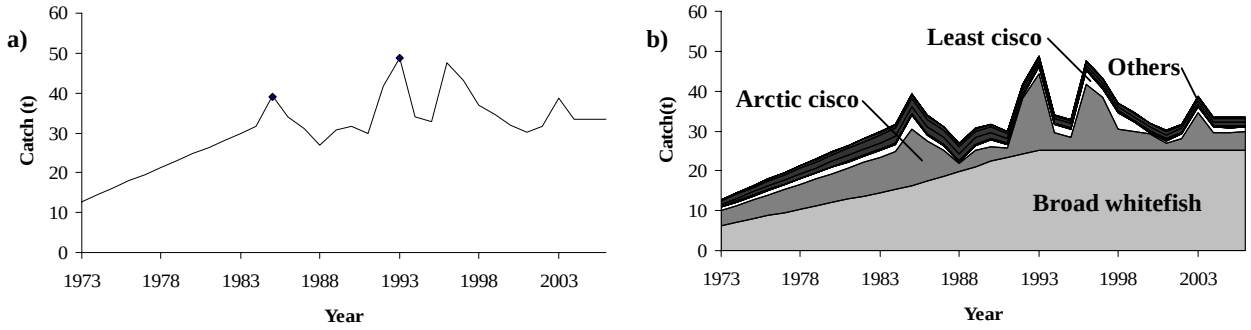

Figure A3.18. a) Anchor points (solid circles), and estimated reconstructed total catches (solid line), and b) taxonomic breakdown of the reconstructed catches with 'others' consisting of Arctic cod, chinook salmon, chum salmon, coho salmon, Dolly varden, humpback whitefish, pink salmon, rainbow smelt, and round whitefish.

[7] Farrington, C. (2004). Alaska salmon enhancement program 2003 report. Alaska Department of Fish and Game, Division of Commercial Fisehries. Juneau, Alaska, 50 p.

Point Hope

Point Hope is located along the Chuckchi Sea. The earliest studies used for this report arose from environmental studies for Project Chariot, which in the 1950s aimed to create a harbor near Point Hope by detonating nuclear material. Although this project never occurred, nuclear material from Nevada was used in some experiments and buried and forgotten until the mid-1990s, when the nuclear material was removed (http://arcticcircle.uconn.edu/SEEJ/chariotseej.html). The estimated population of Point Hope has grown from 264 people in 1950 to 737 in 2006.

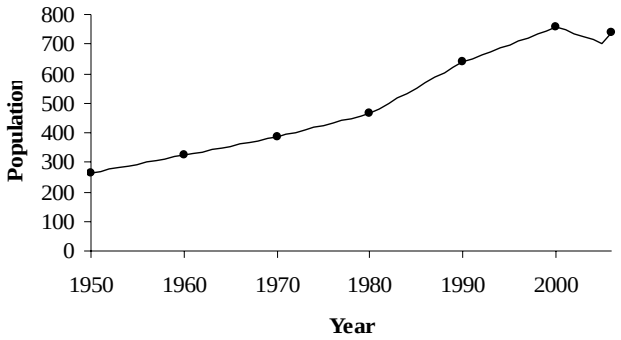

Figure A3.19. Estimated population of Point Hope 1950-2006; solid circles indicate census years.

Dolly varden, whitefish, and chum salmon catch totals had additional anchor points derived from Kivalina. Anchor years from Kivalina for these species were used to derive changes in catch totals for these species because the latest data for these species caught in Point Hope was in 1971

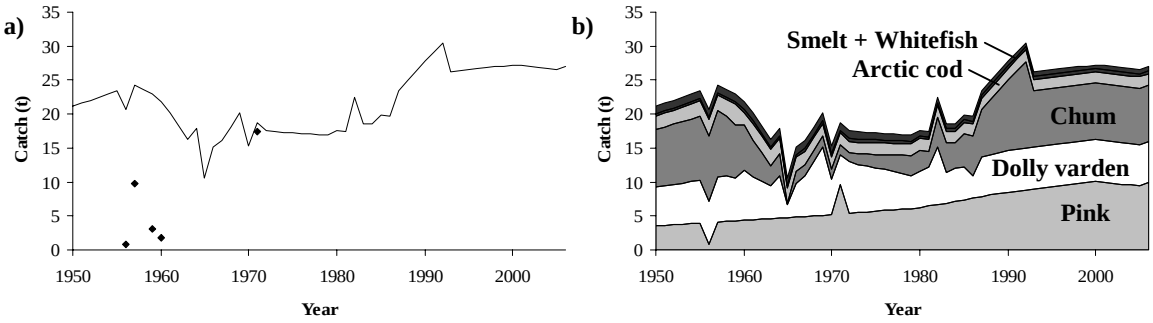

Figure A3.20. a) Anchor points (solid diamonds), and estimated reconstructed total catches (line), and b) taxonomic breakdown of the reconstructed catches.

Point Lay

Point Lay lies between the communities of Point Hope and Wainwright along the Chuckchi Sea. The village was nearly abandoned in the mid-1950s and it was not until the early 1970s that people started to move back. Point Lay Biographies (Impact Assessment Inc., 1989) states that during the intervening time period one couple lived there, whereas the state census states that no-one lived there between 1950 and 1980, the first non-zero census year. The estimated population has grown from 34 people in 1950 to 235 people in 2006.

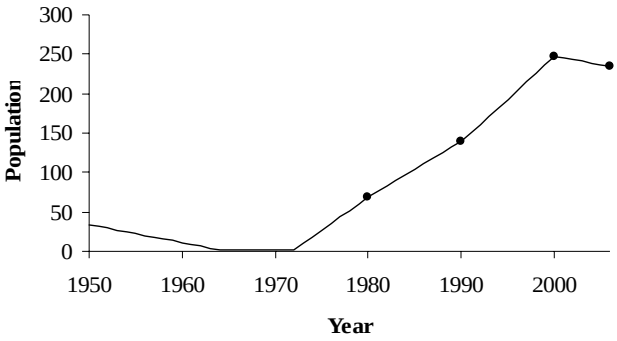

Figure 3.21. Estimated population of Point Lay 1950-2006; solid circles indicate census years.

Chum salmon, broad whitefish and Dolly varden had additional anchor points derived from Kivalina. However, in this case the derived anchor points used changes in *per capita* rates. This was done because the village was nearly abandoned in the mid-1950s.

Craig (1987) presented data for the 1983 fishery in Point Lay. Total estimated catch was 143 pounds. These data were not used for several reasons: 1) some of the average weights suggested for species were very low (e.g., Dolly varden @ 2 lbs; commercial average for the same year = 5.8 pounds); 2) camps away from the community were not monitored during the study; and 3) the camps away from the community were "conservatively assumed that the harvest away from the village was similar to that at the village"; and 4) the fall fishery was not monitored.

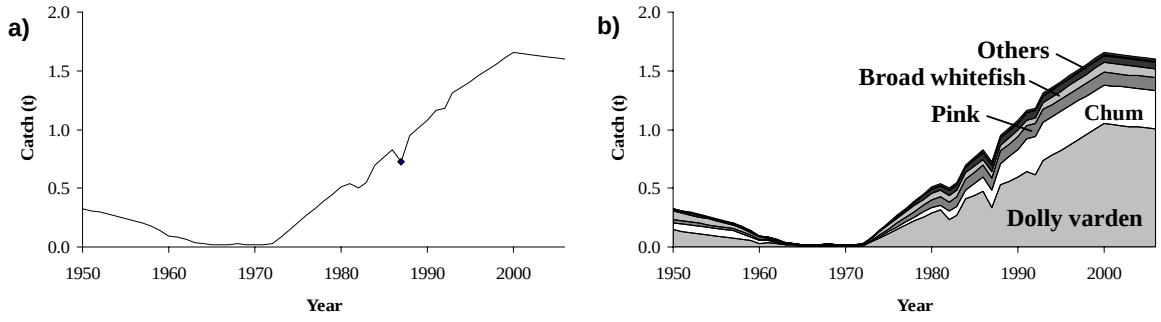

Figure A3.22. a) Anchor points (solid diamonds), and estimated reconstructed total catches (line), and b) taxonomic breakdown of the reconstructed catches with 'others' consisting of flounder, herring, and smelt.

Selawik

Selawik is located at the mouth of the Selawik River where the river meets Selawik Lake. The people of the area barter for seal and beluga with the communities that are situated along the coast (www.dced.state.ak.us). The area is well-known for sheefish; the sheefish populations in this area are slow growing, but attain larger sizes than other populations in Alaska (www.sf.adfg.ak.us). The human population was estimated to grow from 273 in 1950 to 841 in 2006.

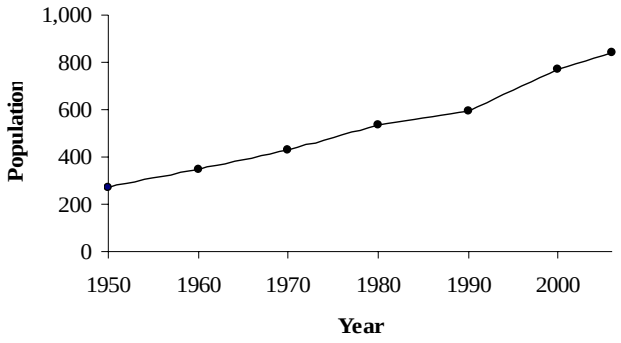

Figure A3.23. Estimated population of Selawik 1950-2006; solid circles indicate census years

The earliest reported catches presented, which were transformed into anchor points fall well below the reconstructed total catch line because the earliest reported catches only documented the catch for sheefish. Although sheefish are a species of whitefish, no whitefish, which make up the largest portion of the catches, were reported until Patterson (1974).

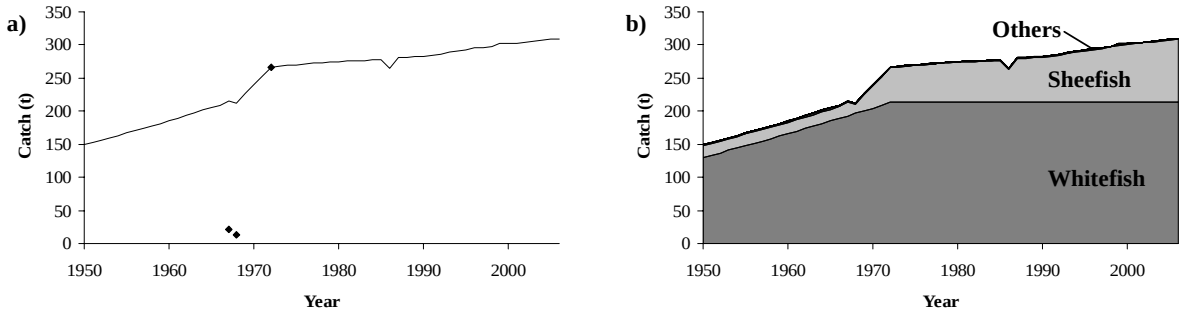

Figure A3.24. a) Anchor points (solid diamonds), and estimated reconstructed total catches (line), and b) taxonomic breakdown of the reconstructed catches with 'others' consisting of chum salmon, Dolly varden, flounder, herring and smelt.

Shishmaref

Shishmaref is located along the Chuckchi Sea on Sarichef Island. Severe impacts from storms caused erosion of 30 feet of shore in 1997, and since then the shoreline has continued to erode by an average of 3-5 feet per year. This erosion has caused several houses to be moved and in 2002 the community decided to re-locate. Two reindeer herds are managed in the area. The estimated population of the community has grown from 194 people in 1950 to 615 in 2006.

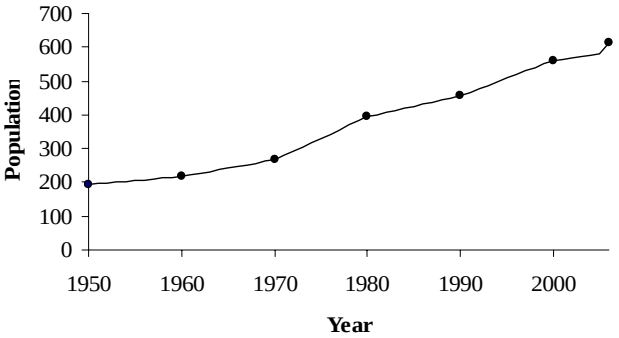

Figure 3.25. Estimated population of Shishmaref 1950-2006; solid circles indicate census years

Estimated chum salmon catches after 1975 were based on exploitation rates derived from the work by Eggers and Clark (2006) and thus, it was assumed that the community intercepts Kotzebue area chum salmon.

Whitefish (except Sheefish/Inconnu) had their catch totals combined in order to interpolate total whitefish catches for years of no data. The species breakdown from 1995 was applied to all other years' catch. Cisco had their catch totals combined in order to interpolate total catches for years of no data. The species breakdown from 1995 was applied to all other years' catch.

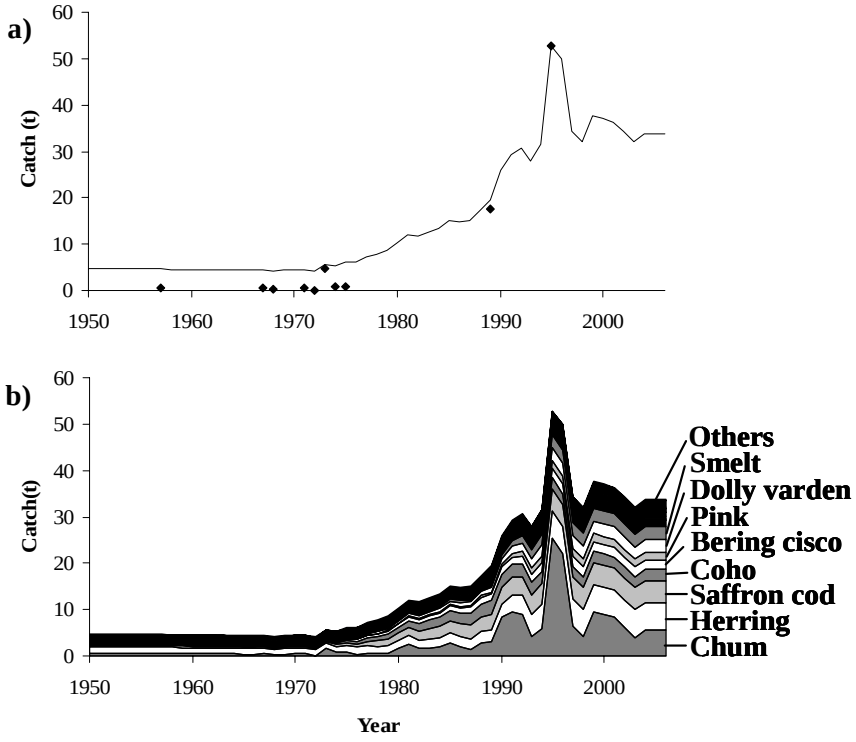

Figure A3.26. a) Anchor points (solid diamonds), and estimated reconstructed total catches (line), and b) taxonomic breakdown of the reconstructed catches with 'others' consisting of Arctic cod, chinook salmon, flounder, humpback whitefish, king crab, least cisco, round whitefish, sculpin, sheefish and sockeye salmon.

Wainwright

Wainwright is located along the Chuckchi Sea between Point Lay and Barrow. The estimated population has grown from 227 in 1950 to 517 in 2006.

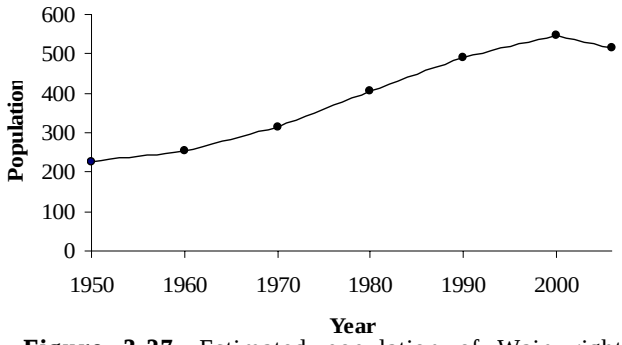

Figure 3.27. Estimated population of Wainwright 1950-2006; solid circles indicate census years

Catches of chum salmon and Dolly varden were scaled to those in Kivalina. Catches for cisco and species of whitefish (excluding sheefish/inconnu) had their catch totals combined in order to interpolate total whitefish catches for years of no data. The species breakdown was based on the per cent contribution of each species to the total catches reported over all years.

Patterson (1974) stated that 750 lbs of whitefish (shortnose) was caught. This value was not used here because it related to one type of whitefish only.

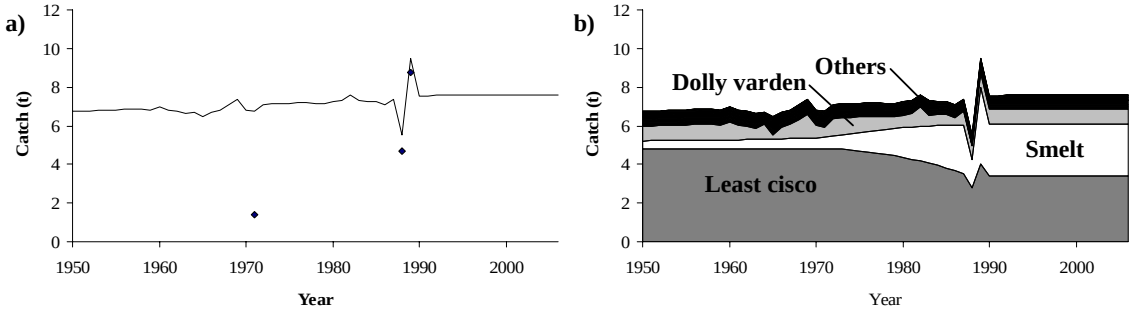

Figure A3.28. a) Anchor points (solid circles), and estimated reconstructed total catches (line), and b) taxonomic breakdown of the reconstructed catches with 'others' consisting of Arctic cod, chinook salmon, flounder, humpback whitefish, king crab, least cisco, round whitefish, sculpin, sheefish and sockeye salmon.

Wales

Wales is located on Cape Prince of Wales at the tip of the Seward Peninsula near the boundary between FAO Areas 18 (arctic) and 67 (Pacific, Northeast). Thus, the estimated total subsistence reconstructed catches for this community were split evenly between the two FAO areas (presented are the total reconstructed catches before the split). Wales was a major whaling station, and the residents still maintain a strong whaling culture, despite the large loss of life during the influenza outbreak at the turn of the 20th century. The estimated population has remained fairly constant over the time period considered her, with an average of 141 people living in the community from 1950-2006.

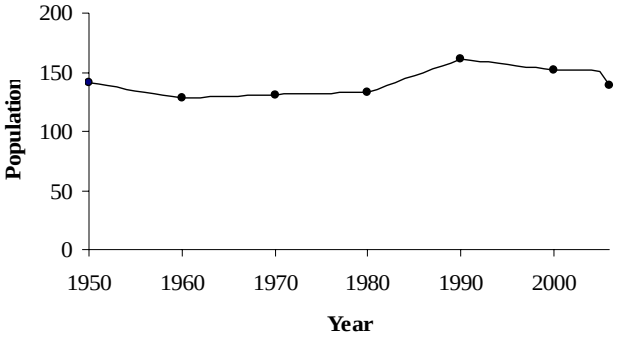

Figure 3.29. Estimated population of Wales 1950-2006; solid circles indicate census years.

Wales had the catches of chum salmon scaled to those of Shishmaref to derive other anchor points. After 1975, chum salmon catches for non-anchor years were based on exploitation rates derived from the work by Eggers and Clark (2006) and thus, it was assumed that the community intercepts Kotzebue area chum.

Catches for whitefish (excluding sheefish/inconnu) had their catch totals combined in order to interpolate total whitefish catches for years of no data. The species breakdown was based on the per cent contribution of each species to the total catches reported in 1993.

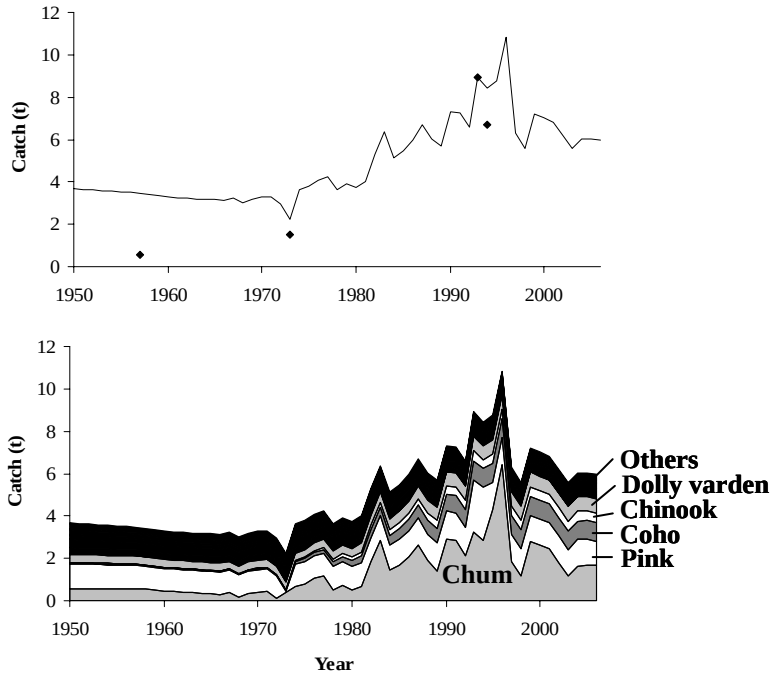

Figure A3.30. a) Anchor points (solid circles), and estimated reconstructed total catches (solid line), and b) taxonomic breakdown of the reconstructed catches with 'others' consisting of Bering cisco, flounder, least cisco, round whitefish, saffron cod, sculpin and smelt.

APPENDIX 4: DATA VALIDATION WORKSHOP HELD IN ANCHORAGE, ALASKA: PARTICIPANTS AND NOTES.

The workshop was held on January 24, 2008 immediately following the 2008 Alaska Marine Science Symposium. Local logistic and organizational support was organized by Jonathan Warrenchuk and Susan Murray of Oceana-Juneau, Alaska. Thirteen people participated in the one day workshop (Table A4.1), with opening comments by Daniel Pauly concerning the state of global fishery statistics, and Dirk Zeller expanding on the purposes and examples of why catch reconstructions are needed. Thereafter, Shawn Booth communicated the preliminary results for the individual catch reconstructions for ten marine coastal communities. After presenting the preliminary data for each community, participants were invited to give feedback on the reconstruction, which was largely related to the subsistence fisheries sector. Two general concerns arose: standardizing common names of fish species used in historical documents to the correct scientific names; and increasing the number of communities to include some which that, although not physically located on the coast, nevertheless are considered significant users of marine species, including anadromous salmon species.

Common names were standardized between communities and assigned both the scientific names and Inupiat names for the species; the catch reconstruction was expanded to include the communities of Selawik, Nuiqsut, Atqasuk, Noatak, and Buckland. However, although workshop participants suggested including catches of Little Diomede Island, the catches were not reconstructed because the island is located south of the boundary for FAO Statistical Area 18. Furthermore, the community is largely dependent on walrus and other marine mammals, and it is only recently that the people have begun to string nets around the islands (J. Menard, pers. comm.[8]). The five other communities that were included for the expanded reconstruction were located inland, but they do rely on anadromous species of fish (i.e., salmon and whitefish complex), which spend at least a portion of their life-cycle in marine waters.

Table A4.1: Participants (and affiliations) attending the Arctic Alaska Catch Reconstruction Workshop in Anchorage, January 24, 2008.

Participant	Affiliation
Booth, Shawn	University of British Columbia's Fisheries Centre
Childers, Dorothy	Alaska Marine Conservation Council
Coon, Cathy	Arctic Research Coordinator, Minerals Management Service
George, Craig	North Slope Borough, Department of Wildlife Management
Lean, Charlie	Norton Sound Fisheries Research and Development
MacLean, Steve	The Nature Conservancy
Menard, Jim	Alaska Department of Fish and Game, Commercial Division (Nome)
Morse, Muriel	Alaska Marine Conservation Council
Murray, Susan	Oceana, Juneau
Pauly, Daniel	University of British Columbia's Fisheries Centre
Warrenchuk, Jonathan	Oceana, Juneau
Wright, Bruce	Senior Scientist, Aleutian Pribilof Islands Association
Zeller, Dirk	University of British Columbia's Fisheries Centre

[8] Jim Menard, Alaska Department of Fish and Game, Division of Commercial Fisheries, P.O. Box 1148 Nome, Alaska, 99762 [date information received: January 24, 2008].