3.0 AFFECTED ENVIRONMENT

3.1 Geographic Location

The Western Arctic stock of bowhead whales occurs in the Bering, Chukchi, and Beaufort Seas. The Bering Sea is in the northernmost region of the Pacific Ocean, bordered on the north and west by Russia, on the east by mainland Alaska, and on the south by the Aleutian Islands. The Bering Sea is connected to the Arctic Ocean, which includes the Chukchi Sea on the northern side of the Bering Strait and the Beaufort Sea to the east of the Chukchi Sea.

3.2 The Western Arctic Stock of Bowhead Whale

Bowhead whales are distributed in seasonally ice-covered waters of the Arctic and near-Arctic, generally north of 54°N and south of 75°N in the Western Arctic Basin (Moore and Reeves, 1993). For management purposes, five bowhead whale stocks are currently recognized by the IWC (IWC, 1992). These stocks occur in the Okhotsk Sea (Russian waters), Davis Strait and Hudson Bay (Greenland and Canadian waters), in the eastern North Atlantic (the Spitsbergen stock near Svalbard) and in the Bering-Chukchi-Beaufort Seas (Figure 3.2-1). The latter is the Western Arctic stock, the largest remnant population and only stock found within U. S. waters (Rugh et al., 2003).

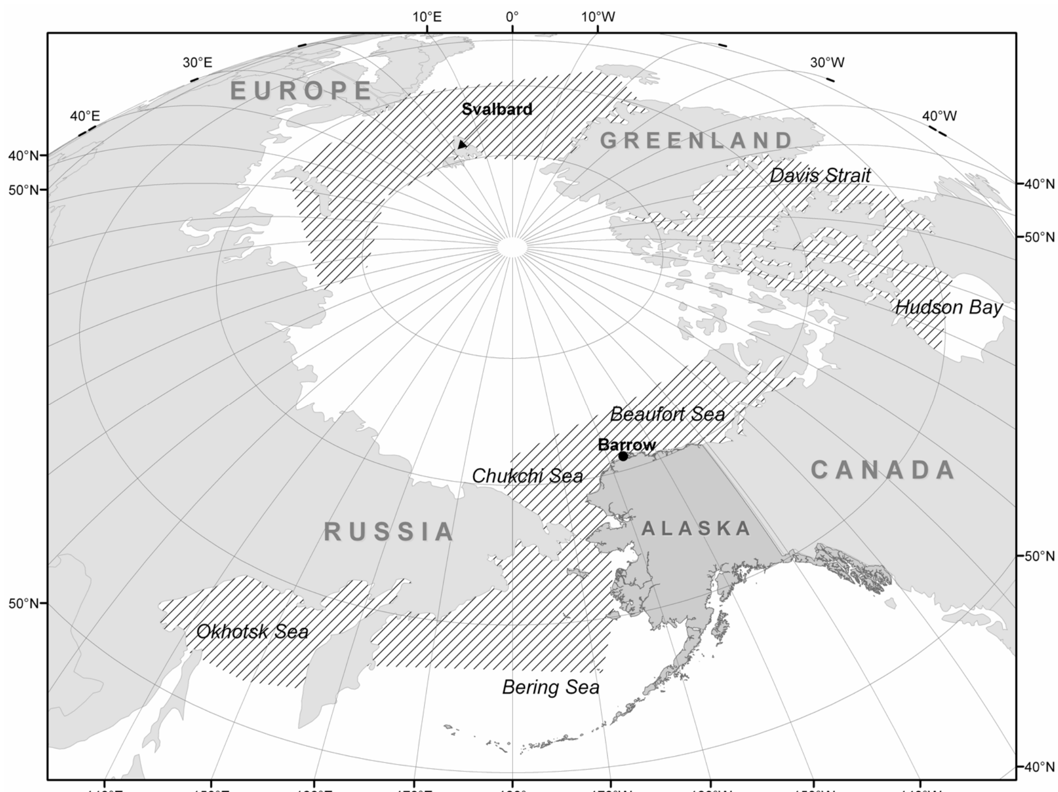


Figure 3.2-1 Circumpolar area occupied by the five bowhead whale stocks

3.2.1 Current Abundance, Trends, Genetics, and Status

Abundance and Trends. All stocks of bowhead whales were severely depleted during intense commercial whaling prior to the twentieth century, and most of these stocks have not shown significant evidence of recovery even though a century has passed since commercial whaling stopped (Woodby and Botkin, 1993). Only the Western Arctic stock has recovered significantly (Zeh et al., 1993). In order to assess the size of this stock, NMFS began a study of abundance in 1976 by conducting visual counts of whales during the spring while they were migrating past ice-based sites north of Point Barrow, Alaska (Krogman, 1980). The traditional ecological knowledge (TEK) of Eskimo whalers pointed out shortcomings in the visual counts such as a lack of correction factors for whales that continued to migrate past the census site under the ice of closed leads or that migrate farther offshore (Huntington, 2000). The census counts have been conducted under the direction of the North Slope Borough Department of Wildlife Management since the mid-1980s (Dronenberg et al., 1986; George et al., 1988). These counts are corrected for whales missed by the observers, in particular through the use of acoustic arrays that detect the location of vocalizing whales (Zeh et al., 1993; George et al., 2004a). These counts continue to be the primary source of abundance information for this stock (George et al., 2004a).

The most recent ice-based counts occurred April 5, to June 7, 2001 near Barrow, Alaska (George et al., 2004a). Observers recorded 3,295 unique individuals and an additional 532 whales that may have been observed before during the 1,130 hours of watch effort. This count included 121 calves (3.7% of the unique whales). Passive acoustic surveillance was conducted almost continuously from April 16 to May 31, 2001 resulting in 27,023 locations of vocalizing bowhead whales. The estimated number of whales within 4 kilometers (km) of the perch (N[4]) was 9,025 (SE = 1,068). The estimated proportion of the whales within 4 km of the perch (P[4]) was 0.862 (SE = 0.044, computed by a moving blocks bootstrap). Combining these, the abundance estimate (N[4]/P[4]) for 2001 was 10,470 (SE = 1,351) with a 95% confidence interval of 8,100-13,500. The estimated annual rate of increase (ROI) of the population from 1978 to 2001 was 3.4% (95% Cl 1.7%-5%) (Figure 3.2.1-1).

Zeh and Punt (2004) reviewed and revised abundance estimates from 1978 to 2001 (Angliss and Outlaw, 2006: Table 41) increasing the 2001 estimate slightly from 10,470 to 10,545 bowhead whales. The current estimate of 10,545 (Zeh and Punt, 2004) is between 46% and 101% of the abundance prior to the onset of commercial whaling in the mid-19th century estimated at 10,400-23,000 (Woodby and Botkin, 1993; see also Bockstoce et al., 2005). Some analyses suggest the population may be approaching carrying capacity though there is no sign of slowing in the population growth rate (Brandon and Wade, 2006).

Genetics. Rooney et al. (2001) analyzed patterns of genetic variability among bowhead whales. Samples were taken from whales from the northern coast of Alaska, and from whales landed on St. Lawrence Island in the Bering Sea. The results of the research indicated that there was no genetic bottleneck (an evolutionary event that occurs when a population is reduced to a level insufficient to maintain diversity) in the Western Arctic stock and that the level of genetic variability has remained relatively high (nucleotide diversity = 1.63%) in spite of the depletion of the stock by commercial whalers in the 1800s. The stock reached its lowest abundance around 1914, when commercial whaling ceased; it is estimated that at that time there were 1,000 to 3,000 bowhead whales in the stock (Woodby and Botkin, 1993).

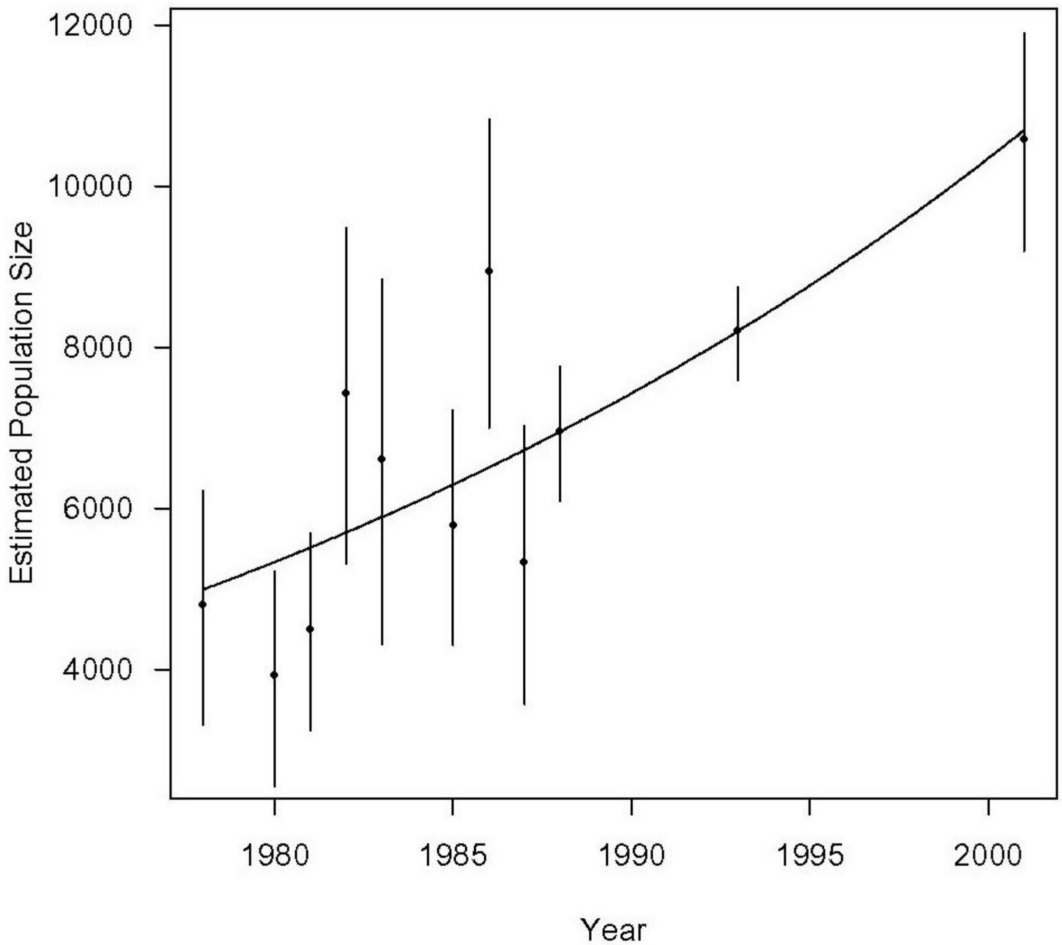


Figure 3.2.1-1 Abundance and trends of the Western Arctic bowhead whale population, 1978-2001 (from George et al., 2004a).

Comparisons between the Western Arctic stock and the Okhotsk Sea stock showed a much greater haplotypic diversity[6] (0.93) in the Western Arctic samples than in the Okhotsk Sea samples (0.61). Analyses of microsatellite and sequence data revealed significant genetic differences between the two populations, indicating that the populations represent discrete gene pools (LeDuc et al., 2005). These differences indicate that the two populations should be considered genetically and demographically separate for management purposes; geneflow between them is negligible at most. The results also seem to parallel those for gray whales (LeDuc et al., 2002), another North Pacific species with a large eastern population showing high diversity and a small western population with considerably lower diversity.

[6] Haplotypic diversity is a measure of the genetic variation between individuals or populations and is one way to describe the degree of relatedness between them. Most organisms have two sets of chromosomes (diploidy), one set inherited from each parent. Thus different versions of each gene (alleles) may be present (Aa, Bb, Cc, etc.). The haplotype describes the genes on one set (ABC). Populations may have several haplotypes, or combinations of different alleles (ABC, ABc, AbC, etc). Comparison of haplotypes between populations is typically done by examining mitochondrial DNA (mtDNA), which is inherited from one parent only (mother), counting the number of differences in the nucleotide base pairs between them. This is used to calculate haplotypic diversity (h). High values, as in this case, indicate that the populations may be genetically distinct.

Status and Management. Since 1931, bowhead whales have been protected from commercial whaling internationally, first under the League of Nations Convention, and since 1949 by the ICRW. Under the IWC, an important feature of the Convention is the emphasis it places on scientific advice. The Convention requires that amendments to the Schedule 'shall be based on scientific findings.' To this end, the Commission has established a Scientific Committee. The Scientific Committee comprises up to 200 of the world's leading whale biologists. Many are nominated by member governments. In addition, in recent years it has invited other scientists to supplement its expertise in various areas. The size of the Committee, as well as the subject matter it addresses, has increased considerably over time. In 1954, it comprised 11 scientists from 7 member nations. At the IWC annual meeting in Berlin in 2003 it comprised over 170 participants (including some 39 invited participants); 30 member nations were represented. The U.S. delegation is the largest with over half of its scientific representation coming from NMFS.

The IWC Schedule establishes the following principles for aboriginal subsistence harvests: (1) for stocks above the Maximum Sustained Yield (MSY) level, aboriginal subsistence catches shall be permitted so long as total removals do not exceed 90% of MSY; (2) for stocks below MSY level, but above a certain minimum level, aboriginal subsistence catches shall be permitted so long as they are set to allow stocks to increase to the MSY level; (3) catches will be kept under review; and (4) for bowheads, it is forbidden to strike, take, or kill calves or any whale accompanied by a calf. In addition, the IWC Scientific Committee advises the IWC on a range of rates of increase to the MSY level. To achieve the goals of these principles, the IWC assesses aboriginal whale harvests under various catch control rules. The most important of these rules is replacement yield (RY), which estimates the number of animals that can be killed and leave the population the same size at the end of the year as at the beginning of the year. Another catch control rule, designated Q, was developed to give an appropriate catch limit across any population level to meet these principles (Wade and Givens, 1997). The Q catch control rule allows the proportion of net production allocated to recovery to increase as a population becomes more depleted and decrease for a population above MSY and approaching carrying capacity (K). For populations above the MSY level, Q is capped at 90% of MSY, as required by IWC sub-paragraph 13(a).

The 1998 stock assessment of bowhead whales (IWC, 1999) reported that the RY value ranged between 108-123 animals and the Q value ranged between 102-120 animals. The IWC Scientific Committee reported that the population "appears to be near MSY, and would very likely increase under catches of up to 108 animals" (IWC, 1999). The 2004 stock assessment of bowhead whales (IWC, 2005a) reported that the population was close to K with a high probability of being above the MSY level based on the most recent abundance estimate from the 2001 bowhead whale census. Therefore, the use of Q (estimated to range between 137-324 animals, capped at 90% of MSY) was more appropriate than RY. After further analyses, the best estimate of Q was determined to be 257 bowhead whales (range: 155-412 animals; Brandon and Wade, 2006). The annual number of whales landed and struck has always fallen well below this number (Figure 3.2.1-2).

Eskimos have been taking bowhead whales for at least 2,000 years (Marquette and Bockstoce, 1980; Stoker and Krupnik, 1993), and subsistence takes have been regulated by a quota system under the authority of the IWC since 1977. Alaska Native subsistence hunters take approximately 0.1-0.5% of the stock per year (Philo et al., 1993). Yet with a subsistence take that averages between 40 to 50 strikes per year, the Western Arctic stock has continued to grow at

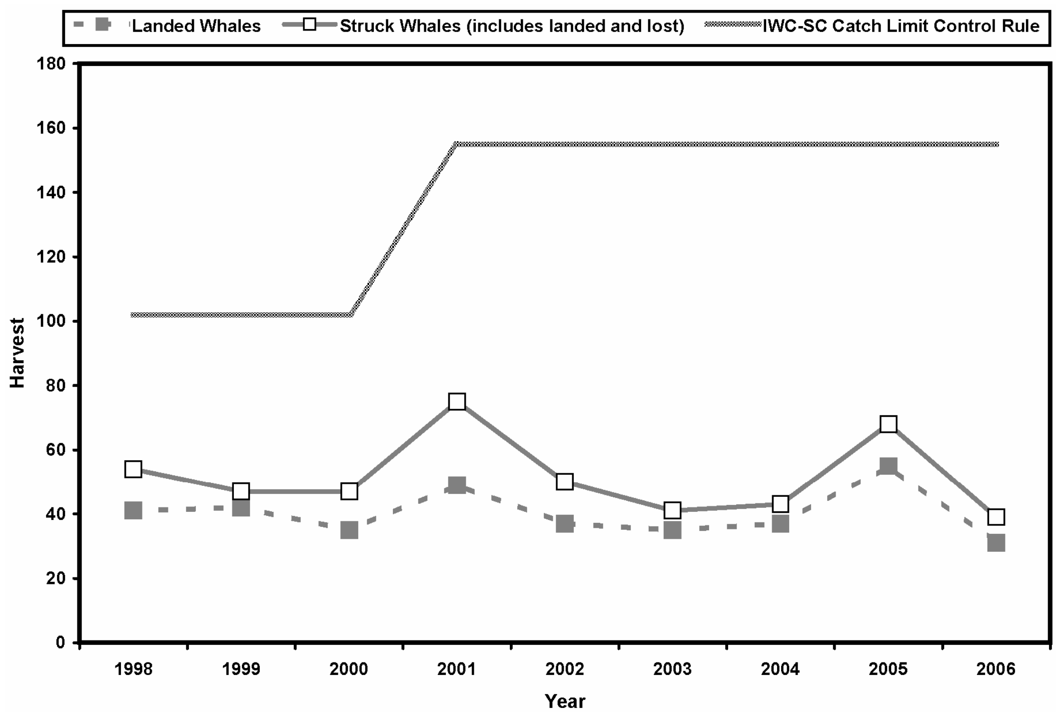


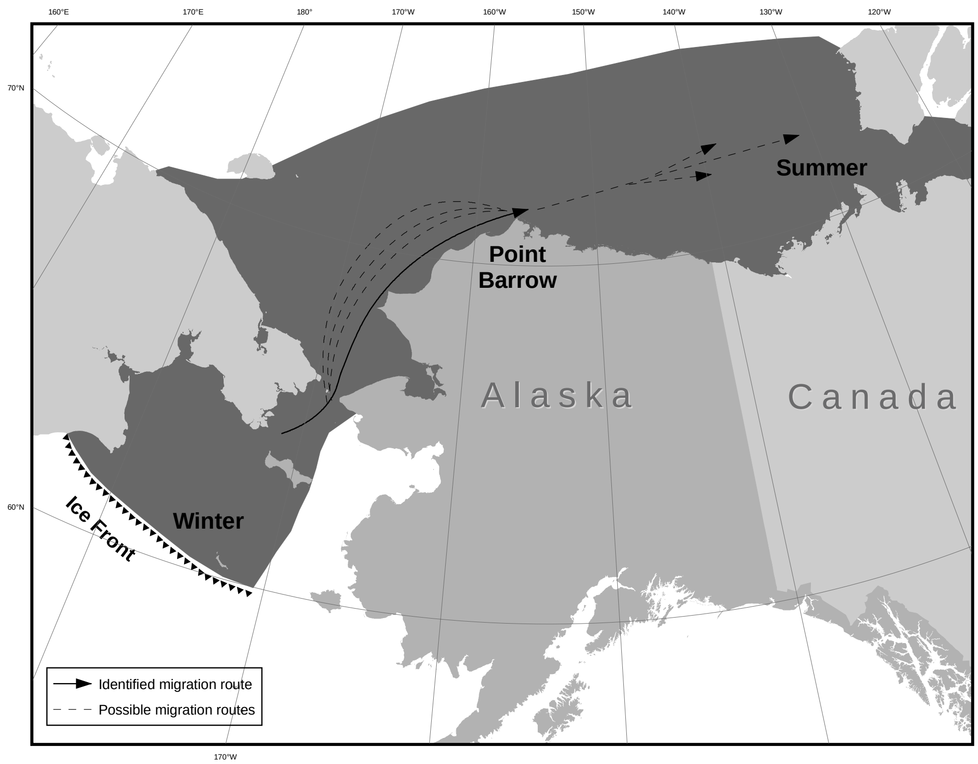
Figure 3.2.1-2 Annual number of Western Arctic bowhead whales landed and struck by Eskimo villages in Alaska, 1998-2006, compared to the IWC-SC catch limit control rule for the population Q1998-2001 = 102 whales (lower bound) and Q2002-2006 = 155 whales (lower bound).

3.4% annually, adding roughly 356 bowhead whales to the population in 2001 (0.034 x 10,470 whales).

The Western Arctic stock of bowhead whales remains listed as endangered under the ESA. Because of the ESA listing, the stock is classified as a depleted and a strategic stock under the MMPA. However, the Western Arctic bowhead whale population is healthy and growing under a managed hunt and has recovered to historic abundance levels. NMFS will use criteria developed for the recovery of large whales in general (Angliss et al., 2002) and bowhead whales in particular (Shelden et al., 2001) in the next five-year ESA status review to determine if a change in listing status is needed (Gerber et al., 2007).

3.2.2 Migration and Distribution

General Migration Pattern. The Western Arctic stock is widely distributed in the central and western Bering Sea in winter (November to April), generally associated with the marginal ice front and found near the polynyas of St. Matthew and St. Lawrence Islands and the Gulf of Anadyr (Bogoslovskaya et al., 1982; Brueggeman, 1982; Braham et al., 1984; Ljungblad et al., 1986; Brueggeman et al., 1987; Bessonov et al., 1990; Moore and Reeves, 1993; Mel'nikov et al. 1998) (Figure 3.2.2-1). From April through June, these whales migrate north and east, following leads in the sea ice in the eastern Chukchi Sea until they pass Point Barrow, where they travel



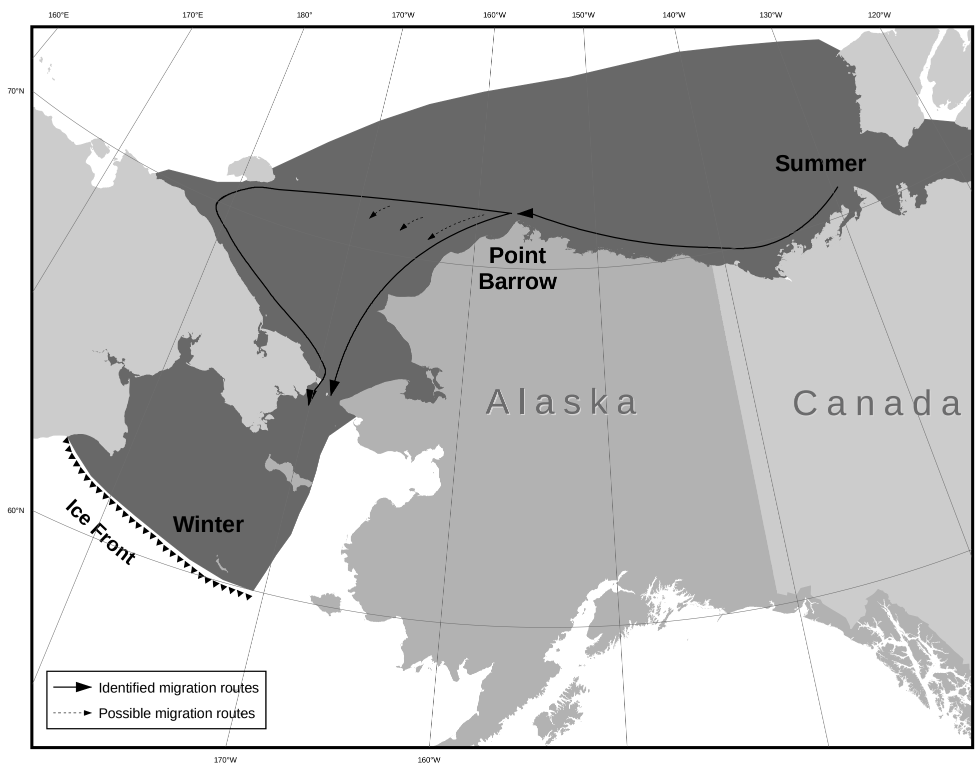


Figure 3.2.2-1 Western Arctic bowhead whale distribution and migratory patterns during the spring (a) and autumn (b) (from Angliss and Outlaw 2005).

east towards the southeastern Beaufort Sea (Braham et al., 1980; Braham et al., 1984; Marko and Fraker, 1981). Most of the summer (June through September), bowhead whales are found in the Beaufort Sea (Hazard and Cubbage, 1982; Richardson, 1987; McLaren and Richardson, 1985; Richardson et al., 1986a, 1987a, b; Moore and Clarke, 1991), predominantly over outer continental shelf and slope habitats (Moore et al., 2000a). Spatial distribution seems to vary between years (Richardson et al., 1987b; Davis et al., 1983; Thomson et al., 1986), affected in part by surface temperature or turbidity fronts and anomalies (Borstad, 1985; Thomson et al., 1986).

During the autumn (early September to mid-October), bowhead whales migrate across inner shelf waters (Moore et al., 2000a), moving west out of the Beaufort Sea, as evidenced during aerial surveys (Richardson, 1987; Ljungblad et al., 1987; Moore et al., 1989a; Moore and Clarke, 1991), radio-tracking (Wartzok et al., 1990) and satellite-tracking (Mate et al., 2000; Krutzikowsky and Mate, 2000) (Figure 3.2.2-1). From mid-September to mid-October bowheads are seen in the northeast Chukchi Sea, some as far north as 72°N (Moore et al., 1986; Moore and Clarke, 1992). Whales migrate into the Chukchi Sea, with some whales turning southwest along the axis of Barrow Canyon (Moore and Reeves, 1993), while others head toward Wrangel Island (Mate et al., 2000; Krutzikowsky and Mate, 2000). When they reach the Siberian coast, they follow it southeast to the Bering Strait (Bogoslovskaya et al., 1982; Zelensky et al., 1995). Autumn migrants begin arriving on the northern coast of the Chukotka Peninsula in mid-September (Mel'nikov et al., 1998), October (Mel'nikov et al., 1997), or November (Mel'nikov and Bobkov, 1994), with large inter-year differences in the timing of the autumn migration through the Chukchi Sea (Mel'nikov et al., 1998). Whales continue to arrive along the Chukotka coast even in December (Mel'nikov et al., 1998). There appears to be a split in the migration across the Chukchi Sea, with some whales crossing from Point Barrow westward toward Wrangel Island (Mate et al., 2000), and others heading more directly from Point Barrow to the Bering Strait (Moore and Reeves, 1993; Mel'nikov et al., 1998). By late October and November, many whales arrive in the Bering Sea (Kibal'chich et al., 1986; Bessonov et al., 1990), where they spend the winter.

Bowheads in the Bering or Chukchi Seas in the Summer. Very few bowhead whales are found in the Bering or Chukchi Seas in summer (Dahlheim, et al., 1980; Miller et al., 1986); however, there have been enough sightings to indicate that not all bowhead whales migrate to the Beaufort Sea (Mel'nikov et al., 1998). Many have been seen in summer in the northeastern Chukchi Sea (Moore, 1992), and small groups have been observed traveling northwest along the Chukchi Peninsula in May (Bogoslovskaya et al., 1982; Bessonov et al., 1990; Ainana et al., 1995; Zelensky et al., 1995), June (Mel'nikov and Bobkov, 1993) and July (Mel'nikov et al., 1998). Studies conducted in 1994 have shown the presence of bowhead whales throughout the summer along the southeastern portion of the Chukchi Peninsula (Ainana et al., 1995) and the easternmost portion of the peninsula (Zelensky et al., 1995). Moore et al. (1995) suggested that bowheads seen in the Chukchi Sea in early October could have migrated from the Beaufort Sea three weeks earlier, as whales seen in the Alaskan Beaufort Sea in August and early September were often swimming in a westerly direction (Moore et al., 1989b).

Segregation by Size and Sex. During the spring migration, temporal segregation by size and sex class occurs in three overlapping pulses, the first consisting of sub-adults, the second of larger whales, and the third composed of even larger whales and cows with calves (Nerini et al., 1987; Rugh, 1990; Angliss et al., 1995; Suydam and George, 2004). Along the Chukchi Peninsula, Russian Chukotkan Natives noted the appearance of large numbers of mothers with calves in late-March and early April followed by immature and adult animals (Bogoslovskaya et al., 1982). In the Beaufort Sea in summer, aggregations have usually consisted of only juveniles or of large whales that may include calves (Richardson, 1987; Davis et al., 1986). In 1983, Cubbage and Calambokidis (1987) found a significant inverse correlation between longitude and size class; encounter rates for larger whales increased moving west to east in the Beaufort Sea. Onshore and offshore distributions varied annually, suggesting that "sex- or age-class segregation patterns are temporally and spatially fluid and cannot be defined rigidly for any region or period" (Moore and Reeves, 1993). Segregation by size also occurs during the autumn migration (Braham, 1995; Suydam and George, 2004). George et al. (1995) showed a clear trend in progressively smaller whales harvested between August and November. Along the Chukchi Peninsula, the autumn migration splits into two pulses (Bogoslovskaya et al., 1982; Mel'nikov and Bobkov, 1993; 1994), though segregation by size or sex class was not confirmed as the cause.

3.2.3 Commercial Whaling

Bowheads were first commercially hunted in the Bering Sea in 1848, and in the following year more than 40 vessels took part in the hunt. Total catches were quite variable during the early years of commercial whaling. After low catches in 1853 and 1854, the fleet abandoned the Bering Strait and arctic grounds for the Okhotsk Sea grounds in 1855, 1856 and 1857. As hunting continued and the population was reduced, the whalers went farther and farther north and east. After decimating the Okhotsk Sea population, the fleet returned to the Bering Strait in 1858, remaining there and farther north for the next half-century. In 1889, steamships reached the summer feeding grounds off the Mackenzie River Delta, Canada, which remained the major focus of the industry until 1914, about the time that commercial whaling collapsed (Bockstoce and Botkin, 1980).

3.2.4 Subsistence Hunts

Eskimos have been taking bowhead whales for at least 2,000 years (Stoker and Krupnik, 1993). Although early historical records were not kept, it is estimated that Alaska Eskimos may have taken 20 whales a year (Ellis, 1991), and this level was not detrimental to the bowhead population:

> Subsistence hunting is not a new contributor to cumulative effects on this population. There is no indication that, prior to commercial whaling, subsistence whaling caused significant adverse effects at the population level. However, modern technology has changed the potential for any lethal hunting of this whale to cause population-level adverse effects if unregulated (Minerals Management Service [MMS], 2006a:201).

Partly as a result of concerns about sustainability, subsistence takes have been regulated by a catch limits under the authority of the IWC since 1977. The annual number of bowheads landed by Alaska Natives has ranged from 8 (in 1982) to 55 (in 2005) from the time records were first kept in 1973, while bowheads struck and lost have ranged from 5 (in 1999) to 82 (in 1977) (Figure 3.2.4-1). Hunters from the western Canadian Arctic community of Aklavik (Figure 1.1.2-1) killed one whale in 1991 and one in 1996 (kills that were not approved by the IWC). As

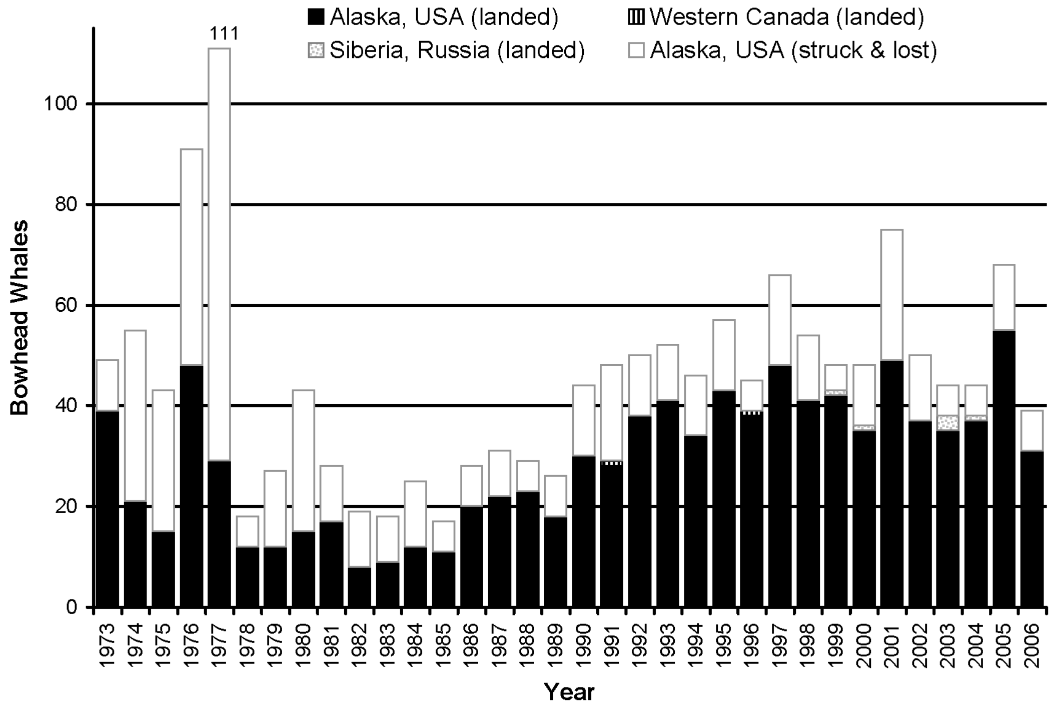


Figure 3.2.4-1 Number of bowhead whales landed and struck and lost by subsistence hunters in the United States, Canada and Russia, 1974-2006.

part of the shared quota with the Russian Federation, one animal was killed by Russian subsistence hunters in each of 1999 and 2000, 3 in 2003 (Borodin, 2004) and 1 in 2004 (Borodin, 2005) (Figure 3.2.4-1). Descriptions of the Alaska hunts and their management are provided in Sections 3.4 and 3.5, respectively.

3.2.5 Natural Mortality

Little is known about naturally occurring diseases and death in bowhead whales (e.g., Heidel and Albert, 1994). Studies of harvested bowhead whales have discovered bacterial, mycotic and viral infections but not at a level that might contribute to mortality and morbidity (Philo et al., 1993). Skin lesions, found on all harvested bowhead whales, were not malignant or contagious. However, potentially pathogenic microorganisms inhabit these lesions and may contribute to epidermal necrosis and the spread of disease (Shotts et al., 1990). Exposure of these roughened areas of skin to environmental contaminants, such as petroleum products, could have significant effects (Albert, 1981; Shotts et al., 1990); Bratton et al. (1993), however, concluded that such encounters were not likely to be hazardous.

Evidence of ice entrapment and predation by killer whales, *Orcinus orca*, has been documented in almost every bowhead whale stock. The percentage of whales entrapped in ice is considered to be small, given that this species is so strongly ice-associated (Tomilin, 1957; Mitchell and Reeves 1982; Nerini et al., 1984; Philo et al., 1993). The ice may also provide some protection from killer whale attacks. The frequency of attacks is unknown and killer whale distribution in northern waters has not been well documented (George et al., 1994). Of 195 whales examined during the Alaskan subsistence harvest (1976-92), eight had been wounded by killer whales (George et al., 1994). Seven of the eight bowhead whales were greater than 13 meters (m) in length, suggesting either that scars are accumulated over time or that young animals survive a killer whale attack. Overall, the frequency of attacks on bowhead whales in the Bering Sea stock appears to be low (George et al., 1994). However, from the available data, it is not possible to assess the level of predation on bowhead whales by killer whales, particularly in terms of size-class selection and encounter rates.

3.2.6 Contaminants

A number of contaminants persist in the Arctic marine environment including polychlorinated biphenyls (PCBs), Dichlorodiphenyltrichloroethanes (DDTs), organochlorines and chlordanes. However, very limited data are available on baseline hydrocarbon concentrations in prey or tissues of bowhead whales or on the “normal” biochemical and histologic (microscopic) determinants used to assess oil related exposure and impacts. Organochlorines (OCs) are ubiquitous, persistent contaminants and are lipophilic (fat loving) and tend to bioaccumulate in lipid-rich tissues (i.e., blubber). Recent analyses were presented at a bowhead health and physiology workshop held in Barrow, Alaska, in 2002 (Willetto et al., 2002). Similar to other mysticetes, bowhead whale samples showed that among different blubber strata there may be differences in vertical distribution of organochlorines as well as lipid content. OC concentration levels varied from the Bering-Chukchi-Beaufort Seas suggesting that contaminant levels varied along the migratory range of the bowhead whale (Hoekstra et al., 2002a). The OC levels consistently fluctuated with seasonal migration between the Beaufort and Bering Seas over a 3.5-year period indicating that active feeding must be occurring in both areas to alter contaminant levels and profiles in tissues (discussed in Willetto et al., 2002).

Approximately 350 high quality blubber samples from bowhead whales were analyzed for lipid content, and the proportion of neutral lipids (i.e., triglycerides, non-esterified free fatty acids) that are key factors affecting the accumulation of lipophilic OCs (discussed by Ylitalo in Willetto et al., 2002). Lipid concentrations of bowhead blubber ranged from 25 – 83%, primarily triglycerides (94 – 100%). The mean lipid concentrations were significantly different among the three collection years (1998, 1999, 2000) and by season (autumn versus spring) (discussed by Zeh in Willetto et al., 2002). Blubber and liver samples were analyzed for selected OCs (toxaphene [TOX], PCBs, DDT, hexachlorocyclohexanes (HCHs), chlordanes, chlorobenzenes) to investigate bioaccumulation and biotransformation (Hoekstra et al., 2002a,b). In general, concentrations of OCs significantly increased with body length in male bowhead whales (Hoekstra et al., 2002a). Concentrations also increased with body length (i.e., age) in female whales but only up to the length of 13m. Adult females (> 13m) had generally lower concentrations than juvenile whales, which was attributed to the transfer of OCs from mother to young during gestation and lactation.

Geographic differences in contaminant exposure and accumulation (contamination varied by region) were reflected in OC concentrations in blubber of the bowhead whale, which was very likely a result of feeding in the respective regions, i.e., the Bering and Beaufort Seas (Hoekstra et al., 2002a). Age, gender, and concentration levels influence PCB biotransformation (Hoekstra et al., 2002b). The sum of PCB concentrations in bowhead whales was relatively low compared to levels found in other cetaceans. Heavy metal concentrations (i.e., cadmium [Cd], mercury [Hg], selenium [Se]) increased with age and tended to be high in Arctic marine mammals; however, Hg and Se were comparably very low in bowhead whales (Woshner et al., 2001; 2002; O’Hara et al., 2006). In summary, contaminant levels for bowhead whales varied by gender, length (i.e., age), and season, but were relatively low compared to other marine mammals.

3.2.7 Fishery Interactions

The NMFS National Observer Program has no records of bowhead whale mortality incidental to commercial fisheries in Alaska (Angliss and Outlaw, 2005). However, several cases of rope or net entanglement have been reported from whales taken in the subsistence hunt (Philo et al., 1993), including those summarized in Table 3.2.7-1. Further, preliminary counts of similar observations based on reexamination of bowhead harvest records indicate that entanglements or scarring attributed to ropes may include over 20 cases (J.C. George, Department of Wildlife Management, North Slope Borough, personal communication). Some bowhead whales have had interactions with crab pot gear, one in 1993 and one in 1999. The average rate of entanglement in crab pot gear for 1999-2003 was 0.2 whales per year (Angliss and Outlaw, 2005).

Table 3.2.7-1
Evidence of Bowhead Whales Interacting with Ropes, Fishing Gear and Vessels, 1978-2004

Year	Number of Whales	Location	Description
1978	1	Wainwright	6 scars on caudal peduncle
1986	1	Kaktovik	Scars on caudal peduncle and anterior margin of flukes
1989	1	Barrow	12 scars on ridges of caudal peduncle
1989	1	south of Gambell	Rope wrapped around head, through mouth and baleen
1989*	1	Barrow	Rope ~32m long trailing from mouth
1990	1	Barrow	Scars on caudal peduncle; 2 ropes trailing from mouth.
1991*	1	Barrow	Apparent rope scar from mouth, across back
1993**	1	Barrow	Large female with crab pot line wrapped around flukes
1998**	1	NW of Kotzebue; near Red Dog Mine dock	Stranded - dead with line on it
1999**	1	Barrow	Whale entangled in confirmed crab gear. Line wrapped through gape of mouth, flipper, and peduncle. Severe injuries.
2003**	1	Near Ugashik	Stranded with rope tied around the peduncle; entangled?
2004**	1	Kaktovik	Boat propeller marks

Philo et al. 1993; * D. Rugh, National Marine Fisheries Service, personal communication; ** J.C. George, North Slope Borough, personal communication

3.2.8 Offshore Activities, Petroleum Extraction

Oil and gas exploration and development are increasingly active in the Chukchi and Beaufort Sea in portions of the Western Arctic bowhead whale stock habitat. Extensive information about the effects of oil and gas activities on bowhead whales is discussed in four documents: (1) a Biological Opinion prepared by NMFS for the MMS pursuant to section 7 of the Endangered Species Act on Oil and Gas Leasing and Exploration Activities in the Beaufort Sea, Alaska (NMFS, 2006); (2) Environmental Impact Statement prepared pursuant to the National Environmental Policy Act for the Beaufort Sea Planning Area, Oil and Gas Lease Sale, Sales 186, 195, and 202 (MMS, 2002); (3) an Environmental Assessment prepared by the MMS for proposed Outer Continental Shelf (OCS) Lease Sale 202 - Beaufort Sea Planning Area (MMS, 2006b); and (4) Final Programmatic Environmental Assessment Arctic Ocean OCS Seismic Surveys 2006 (MMS, 2006c). Additional information is presented on the MMS Alaska OCS Region website: www.mms.gov/alaska.

There have been approximately seven federal oil and gas leases sales within the Alaskan Beaufort Sea beginning with the Joint State of Alaska (State)-Federal Sale held in December 1979. The most recent federal sale was Sale 195 in March 2005. Beaufort Sea Sale 202 is currently scheduled for September 2007, while MMS's proposed five-year lease plan for 2007-2012 schedules additional sales in 2009 and 2011. Prior to 2000, no permanent facilities, or oil production, existed on the Beaufort Sea OCS outside of state waters. There are presently two offshore production facilities within state waters in the Beaufort Sea: Northstar and Endicott.

The potential effects of those projects and leasing and development of the OCS have been considered in the biological opinions regarding oil and gas leasing and exploration activities and oil production facilities (NMFS, 1999, 2001a, 2006). These oil and gas activities introduce noise into the marine environment that may disturb bowhead whales. Multiple marine geophysical (seismic) projects are planned for the Beaufort and Chukchi Seas in 2007. There are also plans to drill several exploration wells near Camden Bay in 2007 using 2-Drill ships, each requiring support vessels, including ice breakers. Additional information on recent and planned oil and gas exploration and development activity is found in Sections 4.6.11 and 4.6.1.2.

Sound has been shown to cause avoidance behavior in migrating bowhead whales. Seismic activities and the use of ice breakers to support OCS activities present the highest probability for avoidance of any of the activities associated with oil exploration (NMFS, 2006). Studies have shown noise from ice breakers may be detected by acoustic instruments at distances exceeding 50 km (NMFS, 2003). It is reasonable therefore, to assume that bowheads could also detect this noise at this distance. The distance at which bowheads may react to noise is poorly described, but may exceed 20 km for marine seismic surveys as described below. Elevated sound levels in the marine environment could alter the hearing ability of whales, causing temporary or permanent threshold shifts if the sound levels are sufficiently high and the bowheads are in close proximity to the noise source. At present, researchers have insufficient information on the hearing ability and sensitivities of bowhead whales to adequately describe this potential. Information suggests most continuous and impulsive underwater noise levels would be at levels or durations below those expected to injure hearing mechanisms. Nonetheless, marine seismic activities may present concerns with respect to hearing.

Seismic surveys. Seismic surveys in Alaska are scheduled in the summer and fall and are accomplished by sending sound waves down into the substratum (through the use of airguns) and receiving information about its oil-bearing potential based on the speed and strength of the returning echoes (National Research Council [NRC], 2003). Three types of offshore seismic surveys occur on the North Slope: marine streamer 3-D and 2-D surveys, ocean-bottom-cable seismic surveys, and high-resolution site-clearance surveys. Marine streamer 3-D and 2-D surveys involve a marine vessel that tows source arrays (airguns to generate acoustic energy) and passive-listening receiver equipment (called "streamers") to obtain geophysical data (MMS, 2006c). Streamers consist of long cables with multiple hydrophones that receive the echoes from the source energy as it bounces off the various substrata of the ocean floor. Airguns are the acoustic source for 3-D and 2-D seismic surveys.

Airgun arrays for both 3-D and 2-D seismic surveys emit pulsed rather than continuous sounds (MMS, 2006c). Airgun output usually is specified in terms of zero-to-peak or peak-to-peak levels (MMS, 2006c; Richardson et al., 1995a). Peak-to-peak values are about 6 decibels (dB) higher than zero-to-peak values (Richardson et al., 1995a). Airgun sizes are quoted as chamber volumes in cubic inches, and individual guns may vary in size from a few tens to a few hundreds of cubic inches (MMS, 2006c). The sound-source level (zero-to-peak) associated with both 3-D and 2-D seismic surveys ranges between 233 and 240 decibels re 1 microPascal at 1 meter (dB re 1μPa at 1 m)[7] (MMS, 2006c). Seismic sounds vary, but a typical 2-D/3-D seismic survey with multiple guns would emit energy at about 10-120 hertz (Hz), and pulses can contain energy up to 500-1,000 Hz (Richardson et al., 1995). Goold and Fish (1998) recorded a pulse range of 200 Hz-22 kilohertz (kHz) from a two-dimensional (2-D) survey using a 2,120 in^3 array. While most of the energy is directed downward (toward the ocean bottom) and the short duration of each pulse limits the total energy, the sound can propagate horizontally for several kilometers (Greene and Richardson, 1988; Hall et al., 1994). In waters 25-50 m deep, sound produced by airguns can be detected 50-75 km away, and these detection ranges can exceed 100 km in deeper water (Richardson et al., 1995a).

These studies show that although high noise levels may cause temporary or permanent effects to bowhead whale hearing, or impact the whales' use of sound to communicate or navigate, the effects appear to be temporary and unlikely to prevent the survival and recovery of this species. The deflection of bowheads from known migratory routes, however, does affect bowhead whale hunters. According to TEK, hunters were unable to find whales or bearded seals during seismic activities (B. Rexford, former chairman, Alaska Eskimo Whaling Commission, personal communication; H. Aishanna, Kaktovik Whaling Captain, personal communication, Kaktovik Whaling Captains Association, personal communication).

Site-Clearance Survey Activities. High-resolution seismic surveys primarily are used by the oil and gas industry to locate shallow hazards; obtain engineering data for placement of structures (e.g., proposed platform locations and pipeline routes); and detect geohazards, archaeological resources, and certain types of benthic communities (MMS, 2006c). All involved ships are designed to be quiet, as the higher frequencies used in high-resolution work are easily masked by the vessel noise if special attention is not paid to keeping the ships quiet. Airgun volumes for high-resolution surveys typically are 90-150 cubic inches (in^3), and the output of a 90 in^3 airgun ranges from 229-233 dB re 1μPa at 1 m (MMS, 2006c). Airgun pressures typically are 2,000 pounds per square inch (psi), although they can be used at 3,000 psi for more output (MMS, 2006c). Marine geophysical research or other activities involving seismic airguns may introduce significant levels of noise into the marine environment and have been demonstrated to alter the behavior of bowhead whales. Research on the effects of offshore seismic exploration in the Beaufort Sea, supported by the testimony of Inupiat hunters based on their experience, has shown that bowhead whales avoid these operations when within 20 km of the source and may begin to deflect at distances up to 35 km (Richardson et al., 1999).

Drilling. After seismic surveys indicate that commercially feasible quantities of oil or gas are present, exploratory drilling begins. Underwater noise levels from drill sites on natural or

[7] Sound is typically measured in decibels, which measure the reduction of a sound's intensity over distance. Because sound travels differently through different media, the measurement of sound must also take into account a medium's impedance (or resistance) to sound pressure to be meaningful. A standard reference point for sound pressure in water (through which sound waves propagate more efficiently than through air) is one microPascal (1μPa), a measure of pressure. In underwater acoustics, the *source level* of a sound represents the intensity of a sound at a certain distance, usually one meter, from the source, referenced to one microPascal; this is the meaning of the scientific phrase dB re 1μPa at 1 m.CC The *received level* is the intensity of the sound at the listener's actual distance from the source; this is the value represented by the scientific phrase dB re 1μPa rms (rms = root mean square, a statistical measure of the average amplitude of the variable intensity of a sound wave).

manmade islands are low, and inaudible at ranges beyond a few kilometers (Richardson et al., 1995a). Noise is transmitted very poorly from the drillrig machinery through land into the water (Richardson et al., 1995a). Drilling noise from icebound islands is generally confined to low frequencies and has a low source level. It would be audible at range 10 km only during unusually quiet periods; the usual audible range would be approximately 2 km (Richardson et al., 1995a). Davies (1997) concludes that bowheads avoided an active drilling rig at a distance of 20 km.

Under open water conditions, drilling sounds from islands may be detectable somewhat farther away, but the levels are still relatively low (Richardson et al., 1995a). Drilling noise from caisson-retained islands is much stronger than natural or manmade islands (Richardson et al., 1995a). At least during open water conditions, noise is conducted more directly into the water at caisson-retained islands than at island drill sites. Noise levels are generally higher near drill ships than near semisubmersibles or caissons. The drill ship hull is well coupled to the water and semisubmersibles lack a large hull area. Machinery on semisubmersibles is mounted on decks raised above the sea on risers supported by submerged floating chambers. Sound and vibration paths to the water are through either the air or the risers, in contrast to the direct paths through the hull of a drill ship (Richardson et al., 1995a).

Acoustic research for the Northstar project, one of the activities covered under prior Biological Opinions, estimated that the numbers of bowhead whales that may have been deflected more than 2 kilometers offshore due to that noise source ranged from 0 to 49 during 2001-2004. In any year in which offshore seismic activities occur in the Beaufort Sea, many bowheads may be “taken” by harassment. NMFS estimated the level of seismic “takes” between 1,275 and 2,550 in 2000. However, considerable variability is associated with any such estimate; NMFS would not expect this number of bowhead whales to be harassed year after year. No estimation of bowhead whale takes due to noise from the Endicott project is available (NMFS, 2001a). However, Endicott is near shore and in relatively shallow waters, through which noise propagation into areas used by bowhead whales would be greatly attenuated. Bowhead whales are not likely to be affected by noise from the Endicott project due to its distance from the bowhead’s autumn migration route and the limited distance that noise travels from gravel structures into the marine environment.

In summary, more sound is radiated underwater during drilling operations from drill ships than from semisubmersibles. In contrast, noise from drilling on islands radiates very poorly to water, making such operations relatively quiet. Noise levels from drilling platforms and certain types of caissons have not been well documented, but are apparently intermediate between those from vessels and islands (Richardson et al., 1995a). By far, the noisiest exploratory activity is seismic surveys.

Development. Once an economically viable discovery is made, development begins. This phase involves additional drilling, and the subsequent construction of roads; airstrips; and waste disposal, seawater treatment, gas handling, power generation, storage, maintenance, and residential facilities (NRC, 2003). Greene (1983) measured noise under shorefast ice during winter construction of an artificial island near Prudhoe Bay. Roads were built on the sea ice and trucks hauled gravel to a site in water 12 m deep. At distances less than 3.6 km, there was no evidence of noise components above 1,000 Hz, and little energy below 1,000 Hz (Richardson et al., 1995a). Construction-related sounds did not propagate well in shallow water under the ice during winter (Richardson et al., 1995a).

Oil Spills. MMS investigated the probability of spilled oil contacting bowhead whales (MMS, 2002). Specific offshore areas, termed Ice/Sea Segments were identified and modeled for probability of contact and overlay the migratory corridor of bowheads. Using data from the MMS oil spill analysis for Sale 170, and assuming an oil spill of 1,000 barrels or more occurred at any of several offshore release areas during the summer season, the chance of that oil contacting these regions within 30 days during the summer season ranged from 5-82%. Therefore, there is high variability from the effects of an oil spill impacting Ice/Sea Segment areas.

If an oil spill were concentrated in open water leads, it is possible that a bowhead whale could inhale enough vapors from a fresh spill to affect its health. The effects of oil contacting skin are largely speculative, but may include pre-disposing whales to infection. It has been suggested that if oil gets onto the eyes of bowhead whales it would enter the large conjunctival sac (Zhu, 1996) and move inward 4 to 5 inches (10 to 13 centimeters [cm]) and get behind most of the eye (T. Albert, North Slope Borough, personal communication). The consequences of this event are uncertain, but some adverse effects are expected. Bowhead whales may ingest oil encountered on the surface of the sea during feeding, resulting in fouling of their baleen plates. Albert (1981) suggests that broken off baleen filaments and tar balls are of concern because of the structure of the bowhead's stomach and could cause a blockage within a narrow passage of the digestive system.

Engelhardt (1987) stated that bowhead whales are particularly vulnerable to effects from oil spills due to their use of ice edges and leads where spilled oil tends to accumulate. The impacts of oil exposure to the bowhead whale population would also depend upon how many animals contacted oil. If oil found its way into leads or ice-free areas frequented by migrating bowheads, a significant proportion of the population could be affected.

Most whales exposed to spilled oil could be expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals may be killed as a result of exposure to freshly spilled oil. However, the combined probability of a spill occurring and also contacting bowhead habitat during periods when whales are present is considered to be low, and the percentage of the bowhead whale stock so affected is expected to be very small. Contaminated food sources and displacement from feeding areas also may occur as a result of an oil spill, but NMFS has concluded it is unlikely that the availability of food sources for bowheads would be affected given the abundance of plankton resources in the Beaufort Sea (Bratton et al., 1993; NMFS, 2001a).

3.3 Other Wildlife

A wide variety of marine mammals, birds, and other marine organisms occurs in the area where Alaskan Natives hunt for bowhead whales. These species are identified and discussed briefly below. Additional information about each marine mammal species can be found in Angliss and Outlaw (2005).

3.3.1 Other Marine Mammals

Under the MMPA, marine mammals are protected by a prohibition on take; however, section 101(b) of the MMPA generally provides that the provisions of the MMPA do not apply to subsistence hunting of marine mammals by Alaskan Natives. The ESA contains a similar provision with respect to endangered or threatened species. Many Alaskan villages hunt a variety of marine mammals including the bearded seal, ringed seal, spotted seal, ribbon seal, beluga whale, bowhead whale, polar bear, and walrus (MMS, 2002). A discussion of the current status and trends of all marine mammals that inhabit the area where Alaska Eskimos hunt for bowhead whales follows.

Spotted Seal. Spotted seals (*Phoca largha*) are distributed along the continental shelf of the Beaufort, Chukchi, Bering, and Okhotsk Seas south to the northern Yellow Sea and western Sea of Japan (Shaughnessy and Fay, 1977). Of eight known breeding areas, three occur in the Bering Sea. Satellite tagging studies indicate that spotted seals summering along the Chukchi Sea coast migrate south in October and pass through the Bering Strait in November (Lowry et al., 1998), moving south into the Bering Sea with the ice edge through December (Lowry et al., 2000). Preferred habitat for spotted seals in Alaska during January-April is the transition zone of pack ice between the southern fringe of ice and the heavier southward-drifting pack ice (Burns et al., 1981a; Lowry et al., 2000). Pups are born in the pack ice during March-April; during April-May, spotted seals inhabit the southern margin of the ice edge (Braham et al., 1984), and move to coastal habitats after the ice retreats (Fay, 1974; Shaughnessy and Fay, 1977). During August-October, spotted seals inhabit coastal and estuarine habitats in the northern Bering and Chukchi Sea (Braham et al., 1984; Lowry et al., 2000). Availability of food and freedom from disturbance seem to be important criteria for selection of coastal haulout sites (Lowry, 1982).

A reliable estimate of spotted seal population abundance, abundance trends, and stock structure is currently not available (Rugh et al., 1997; Angliss and Outlaw, 2005). Burns (1973) estimated 200,000 to 250,000 animals in the Bering Sea stock, including Russian waters, based on the distribution of "family" groups (mother and pup, with attending male) on ice during the mating season. However, comprehensive systematic surveys were not conducted to obtain these estimates. Spotted seals are an important species for Alaskan subsistence hunters, primarily in the Bering Strait and Yukon-Kuskokwim regions, with estimated annual harvests ranging from 850-3,600 seals taken during 1966-1976 (Lowry, 1984). From September 1985 to June 1986, the combined harvest from five Alaska villages was 986 animals (Quakenbush, 1988). The mean annual subsistence take of spotted seals in the northern part of Bristol Bay from 1993-1995 was 244. As of August 2000, the subsistence harvest database indicated that the estimated number of spotted seals harvested for subsistence use per year was 5,265 animals (Angliss and Outlaw, 2005).

Bearded Seal. Bearded seals (*Erignathus barbatus*) are circumpolar in their distribution, extending from the Arctic Ocean south to Hokkaido in the western Pacific. In Alaskan waters, bearded seals occur on the continental shelves of the Bering, Chukchi, and Beaufort Seas (Burns, 1981a; Johnson et al., 1966; Ognev, 1935). The majority of bearded seals move south with the seasonally advancing sea ice in winter (Burns, 1967). Pups are born in the pack ice from March through mid-May (Burns, 1967). In summer, many of the seals that winter in the Bering Sea move north through Bering Strait during April - June, and are distributed along the ice edge in the Chukchi Sea during the summer (Burns, 1967; 1981a). Some seals, particularly juveniles, may spend the summer in open-water areas of the Bering and Chukchi seas (Burns, 1981a).

Reliable estimates of abundance, abundance trends, and stock structure are not available. Early estimates of the Bering-Chukchi Sea stock range from 250,000 to 300,000 animals (Popov, 1976; Burns, 1981a; Burns et al., 1981a). Bearded seals are an important species for Alaskan subsistence hunters, with estimated annual harvests of 6,788 (Angliss and Outlaw, 2005).

Ribbon Seal. Ribbon seals (*Phoca fasciata*) inhabit the North Pacific Ocean and adjacent fringes of the Arctic Ocean, most commonly in the Okhotsk and Bering seas (Burns, 1981b). During the breeding season, ribbon seals are found only in the pack ice of the Okhotsk and Bering seas (Kelly, 1988a). In Alaska waters, ribbon seals are found in the open sea, on the pack ice, and only rarely on shorefast ice (Kelly, 1988a). Ribbon seals in Alaska range northward from Bristol Bay in the Bering Sea into the Chukchi and western Beaufort Seas (Burns, 1970; 1981b; Braham et al., 1984; Moore and Barrowclough, 1984), inhabiting the northern part of the Bering Sea ice front from late March to early May (Burns, 1970; 1981b; Braham et al., 1984), and moving north with the receding ice edge in May to mid-July (Shustov, 1965; Tikhomirov, 1966; Burns, 1970; 1981b; Burns et al., 1981a). Ribbon seals usually haul out on thick pack ice (Shustov, 1965; Tikhomirov, 1966; Burns, 1981b; Burns et al., 1981a) and only rarely on shorefast ice (Bailey, 1928). In April, they have been found throughout the ice front but most abundantly over deep water south of the continental shelf (Braham et al., 1984). As the sea ice recedes in May-June, two major rafted remnants of the pack ice remain: the Alaskan massif (from Bering Strait to eastern St. Lawrence Island and south to Nunivak Island) and the Anadyr massif (from the Gulf of Anadyr toward St. Matthew Island); ribbon seals are thought to be associated with the Anadyr massif (Burns et al., 1981b). Little is known of the distribution of ribbon seals after the ice recedes from the Bering Sea (Kelly, 1988a); they are presumed to be solitary and pelagic in summer and autumn but their distribution is unknown (Burns, 1981b). Many ribbon seals may migrate north to the Chukchi Sea during the summer (Kelly, 1988a), while others may remain pelagic in the Bering Sea, near the edge of the continental shelf (Burns, 1970; 1981b). Single ribbon seals have been observed during the summer (June-August) within 84 miles of the Pribilof Islands (Burns, 1981b), near Cordova, Alaska (Burns, 1981b) and south of the Aleutian Islands (Stewart and Everett, 1983).

A reliable estimate of abundance, abundance trends, and stock structure for the Alaska stock of ribbon seals is currently not available (Angliss and Outlaw, 2005). The worldwide population of ribbon seals was estimated at 240,000 in the mid-1970s, with an estimate of 90,000 to 100,000 in the Bering Sea (Burns 1981b). Ribbon seals are also taken by Alaska Native subsistence hunters, primarily from villages in the vicinity of the Bering Strait and to a lesser extent at villages along the Chukchi Sea coast (Kelly, 1988a). The annual subsistence harvest was estimated to be less than 100 seals annually from 1968 to 1980 (Burns, 1981b). The more recent annual subsistence harvest in Alaska is estimated to be 193 (Angliss and Outlaw, 2005).

Ringed seal. Ringed seals (*Phoca hispida*) are found throughout the arctic in areas of seasonal sea ice as well as in areas covered by the permanent polar ice cap (McLaren, 1958; Smith, 1987; Kelly, 1988b; Ramsay and Farley, 1997; Reeves, 1998). In the North Pacific Ocean, they are found in the Bering Sea and range as far south as the seas of Okhotsk and Japan. Most ringed seals overwinter, breed, give birth, and nurse their young within the shorefast sea ice (McLaren, 1958; Smith and Stirling, 1975), although some breeding seals (and pups) have been observed in pack ice (Finley et al., 1983). In the Chukchi and Beaufort seas, ringed seals haul out in highest densities in shorefast ice during the May-June molting season, immediately following the March-April pupping season (Johnson et al., 1966; Burns and Harbo, 1972; Frost et al., 1988; 1997; 1998; 1999). Little is known about the distribution of ringed seals during the “open water” season, July-October, but ringed seals have been seen both hauled out on pack ice and foraging in open water some distance away from the nearest sea ice (Smith, 1987). Ringed seals migrate north and south with the retreat and advance of the sea ice edge, but some seals in areas of seasonal shorefast sea ice may be sedentary (Burns, 1970; Smith, 1987; Heide-Jørgensen et al., 1992; Kapel et al., 1998; Teilmann et al., 1999). In addition to ice-associated migrations, ringed seals can also travel long distances east or west, particularly young seals (Smith, 1987; Kapel et al., 1998).

A reliable estimate of abundance, abundance trends, and stock structure for the Alaska stock of ringed seals is currently not available (Angliss and Outlaw, 2005). Crude estimates of population in Alaskan waters include 1-1.5 million (Frost, 1985) or 3.3-3.6 million, based on aerial surveys conducted in 1985, 1986, and 1987 (Frost et al., 1988). Surveys conducted in the Beaufort Sea in the 1990s (Frost et al., 2002) and the eastern Chukchi Sea in 1999 and 2000 (Bengtson et al., 2005) resulted in a total of approximately 249,000 seals (Angliss and Outlaw, 2005). This is a minimum population estimate because it does not include much of the geographic range of the stock and the estimate for the Alaska Beaufort Sea has not been corrected for the number of ringed seals not hauled out at the time of the surveys. Ringed seals are an important species for Alaska Native subsistence hunters. The most recent annual subsistence harvest in Alaska is estimated to be 9,567 (Angliss and Outlaw, 2005).

Pacific Walrus. The Pacific walrus (*Odobenus rosmarus*) occurs primarily in the shelf waters of the Bering and Chukchi Seas (Allen, 1880; Smirnov, 1929). Most of the population congregates during the summer in the southern edge of the Chukchi Sea pack ice between Long Strait, Wrangell Island, and Point Barrow (Fay et al., 1984). The remainder of the population, primarily adult males, stays in the Bering Sea during summer (Brooks, 1954; Burns, 1965; Fay, 1955; Fay, 1982; Fay et al., 1984). Females and sub-adult males migrate toward Bering Strait in the autumn when the pack ice begins to re-form (Fay and Stoker, 1982). Walruses use terrestrial haulout sites when suitable haulout sites on ice are unavailable. The major haulout sites are located along the northern, eastern, and southern coasts of the Chukchi Peninsula, on islands in the Bering Strait, on the Punuk Islands, on Round Island in Bristol Bay (Lentfer, 1988), and at Cape Seniavan on the north side of the Alaska Peninsula.

The current size and trend of the Pacific walrus population is unknown (Gorbics et al., 1998). The total initial estimate of 270,000 to 290,000 animals in 1980 was later adjusted to about 250,000 (Fay et al., 1984; Fedoseev, 1984). Subsistence harvest mortality levels are estimated at 5,789 animals per year (Angliss and Outlaw, 2005).

Polar bear. Polar bears (*Ursus maritimus*) are circumpolar in their distribution in the northern hemisphere. Two stocks occur in Alaska: the Chukchi/Bering seas stock and the southern Beaufort Sea stock. Polar bear movements are extensive and individual activity areas are enormous. A reliable abundance estimate for the Chukchi/Bering seas population currently does not exist. The most recent estimate, made by the IUCN Polar Bear Specialist Group in 1998 estimated this population to be approximately 2,000-5,000 animals. The abundance of the southern Beaufort Sea stock is estimated to be 2,272 animals (Angliss and Outlaw, 2005).

Prior to the twentieth century, when Alaska's polar bears were hunted primarily by Alaskan Natives, both stocks probably existed near carrying capacity. The size of the Beaufort Sea stock appeared to decline substantially in the late 1960's and early 1970's due to excessive harvest rates when sport hunting was legal. Similar declines could have occurred in the Chukchi Sea, although data are unavailable to test that assumption. Since passage of the MMPA, harvest rates have declined and both stocks appear to have increased. Polar bear stocks in Alaska have no direct interaction with commercial fisheries activity (Angliss and Outlaw, 2005).

The 1991-2000 mean U.S. harvest from the Chukchi/Bering sea stock was 44.8 animals per year. Development of a management agreement for this stock between Native representatives of Alaska and Russia, and the United States and Russian governments, is ongoing. In 1997, a Cooperative Agreement was developed between the U.S. Fish and Wildlife Service and the Alaska Nanuuq Commission to facilitate local participation in activities related to the conservation and management of polar bears pursuant to Section 119 of the MMPA (Angliss and Outlaw, 2005). The 1995-2000 mean U.S. harvest from the Beaufort Sea stock was 32.2 animals per year. A management agreement between Canadian Inuit and Alaskan Inupiat of the North Slope has been in place since 1998. Since initiation of this local user agreement, the combined Alaska/Canada mean harvest from this stock has been 55.1 animals per year, which is less than an annual allocation guideline of 81 and PBR level of 95 animals per year (Angliss and Outlaw, 2005).

Gray whale. Gray whales (*Eschrichtius robustus*) occur across the coastal and shallow water areas of both the eastern and western reaches of the North Pacific Ocean, as well as the Bering, Chukchi, and Beaufort Seas. Two stocks are recognized: the western Pacific or Korean stock (listed as endangered under the ESA) and the eastern North Pacific stock (removed from the ESA in 1994, Rugh et al., 1999). Only the eastern North Pacific stock is found in the Bering Sea/Aleutian Islands and Gulf of Alaska. This population migrates annually along the coast of North America from summer feeding areas in the Bering, Chukchi, and Beaufort Seas to winter grounds in sheltered waters along the Baja Peninsula (Rice and Wolman, 1971).

The eastern North Pacific gray whale population has made a remarkable recovery since its depletion in the early 1900s caused by commercial whaling. Gray whales were listed as endangered under the ESA on June 2, 1970 (35 FR 8495). Then, following a comprehensive evaluation of their status (Breiwick and Braham, 1984), NMFS concluded on November 9, 1984 (49 FR 44774), that this population should be listed as threatened, instead of endangered, under the ESA. However, no further action was taken until 1991 when a subsequent review was completed and made available to the public on June 27, 1991 (56 FR 29471). The latter review showed the best available abundance estimate (in 1987/88) was 21,296 whales with an average annual rate of increase of 3.29% (Buckland et al., 1993). Calculations indicated that this population was approaching carrying capacity (Reilly, 1992). Therefore, NMFS proposed, on November 22, 1991 (56 FR 58869), that this population be removed from the list of endangered and threatened wildlife under the ESA. After an extensive review period, NMFS published a final notice of determination (58 FR 3121, January 7, 1993) that this population should be removed from the list because the population had recovered to near its estimated original population size and was neither in danger of extinction throughout all or a significant portion of its range, nor likely to again become endangered within the foreseeable future. On June 16, 1994 (59 FR 31094), the eastern North Pacific gray whale population was formally removed from the list of endangered and threatened wildlife under the ESA.

The most recent abundance estimates are based on counts made during the 1997/98, 2000/01, and 2001/02 southbound migrations. Analyses of these data resulted in abundance estimates of 29,758 for 1997/98, 19,448 for 2000/01, and 18,178 for 2001/02 (Rugh et al., 2005). Most of these surveys started in mid-December and ran until mid-February; however, the 2001 southbound migration continued for another three weeks. Consequently, the systematic counts were extended until March 5, 2001. In 2002, migration timing returned to normal with the southward migration ending in mid-February (Rugh et al., 2005).

Previous analysis of abundance estimates from shore-based counts indicates that the population increased by approximately 2.5% per year (SE=0.3%) between 1967/68 and 1995/96 (Buckland and Breiwick, 2002). A Bayesian analysis of gray whale population dynamics for the same period suggested the rate of increase of the population could have been 3.4% (95% CI=2.54.2%), if the Russian Chukotkan Natives had not continued a harvest of roughly 40-80 whales per year (Wade and DeMaster, 1996). A provisional analysis incorporating the preliminary data from 2000/01 and 2001/02 speculates that the low estimates could have been a result of an unusual number of whales that did not migrate as far south as Granite Canyon in these years or that the high mortality rates observed in 1999 and 2000 may indicate a decline in gray whale abundance (Rugh et al., 2002).

Although the estimates show that migrating gray whales seemed to be decreasing between 1997/98 and 2000/01 to 2001/02, this decline in abundance appears to be temporary and related to the unexplained gray whale mortality event that occurred in 1999 and 2000. The population is estimated to currently be at 99% to 100% of carrying capacity (Wade and Perryman, 2002). However, it is impossible to determine how much of the drop in the estimates is due to a real decline in the population and how much is sampling error in the estimate. Evidence that the decline is temporary comes from stranding data (Norman et al., 2000; Gulland et al., 2002; Gulland et al., 2005), calf production data (Perryman et al., 2002; Perryman et al., 2004; Urban et al.,2002), and a change in body condition of whales during the southward migration (LeBoeuf et al., 2000, Perryman and Rowlett, 2002).

Subsistence hunters in Alaska and Russia have traditionally harvested whales from this stock (Angliss and Outlaw, 2005). The U.S. and the Russian Federation have agreed that the IWC quota would be shared with an average annual harvest of 120 whales by the Russian Chukotka people and 4 whales by the Makah Indian Tribe, subject to the satisfaction of domestic legal requirements under NEPA and the MMPA, with respect to any subsistence hunt by the Makah Tribe. Russian aboriginals harvested 121 (+2 struck and lost) in 1999 (IWC, 2001), 113 (+2 struck and lost) in 2000 (Borodin, 2001), 112 in 2001 (Borodin et al., 2002), 131 in 2002 (Borodin, 2003), and 126 (+2 struck and lost) in 2003 (Borodin, 2004), while the Makah Tribe harvested 1 whale in 1999 (IWC, 2001). Based on this information, the annual subsistence take averaged 122 whales during the five-year period from 1999 to 2003.

Beluga whale. Beluga whales (*Delphinapterus leucas*) are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich, 1980), and some stocks are closely associated with open leads and polynyas (nonlinear openings in the sea ice) in ice-covered regions (Hazard, 1988). Depending on season and region, beluga whales may occur in both offshore and coastal Alaskan waters, with concentrations in areas now designated as separate stocks: Bristol Bay, eastern Bering Sea, eastern Chukchi Sea, and Beaufort Sea (Angliss et al., 2001). Most beluga whales from these summering areas are assumed to overwinter in the

Bering Sea, but few data exist to support this conclusion (O'Corry-Crowe et al., 1997; O'Corry-Crowe and Lowry, 1997). The Bristol Bay and eastern Bering Sea stocks occur within the Bering Sea/Aleutian Islands and Gulf of Alaska.

The population abundance estimate for the Bristol Bay stock is 2,133 animals, 18,142 animals in the eastern Bering Sea stock, 3,710 animals in the eastern Chukchi Sea stock, and 39,258 animals in the Beaufort Sea stock (Angliss and Outlaw, 2005). Current population trends for the Beaufort Sea and eastern Bering Sea stocks are unknown (Angliss and Outlaw, 2005). The Bristol Bay stock is considered stable and may be increasing and there is no evidence that the eastern Chukchi Sea stock is declining (Angliss and Outlaw, 2005). The annual subsistence take by Alaska Natives between 1999-2003 averaged 53 animals per year from the Beaufort Sea stock, 65 animals per year from the eastern Chukchi sea stock, 209 animals per year from the eastern Bering Sea stock, and 19 animals per year from the Bristol Bay stock. These estimates may be negatively biased because of unreliable estimates of struck and loss rates during subsistence hunts. The Alaska Beluga Whale Committee monitors the subsistence harvest of beluga whales (Angliss and Outlaw, 2005).

Minke whale. Minke whales (*Balaenoptera acutorostrata*) are distributed worldwide. Sightings range from Point Barrow, Alaska, in the Chukchi Sea, through the Bering Sea and Bristol Bay, and in coastal and offshore waters of the Gulf of Alaska (Leatherwood et al., 1982; Mizroch, 1992; POP, 1997). Few data are available on migratory behavior and apparent "home ranges" of the Alaska stock of minke whales (e.g., Dorsey et al., 1990). In the central Bering Sea, an estimated 936 minke whales (95% CI 473-1,852, CV = 0.35) were observed during the summer of 1999 (Moore et al., 2000b). However, this covers only a small portion of the Alaska stocks range. Seabird surveys around the Pribilof Islands indicated an increase in local abundance of minke whales between 1975-78 and 1987-89 (Baretta and Hunt, 1994). No data exist on trends in abundance in Alaskan waters (Angliss et al., 2001).

Subsistence takes of minke whales by Alaska Natives are rare, but have been known to occur. Only seven minke whales are reported to have been taken for subsistence by Alaska Natives between 1930 and 1987 (C. Allison, International Whaling Commission, personal communication). The most recent harvest (2 whales) in Alaska occurred in 1989 (IWC, 1991).

Killer whale. Killer whales (*Orcinus orca*) have been observed in all oceans and seas of the world (Leatherwood et al., 1982) and are found throughout Alaska waters from the Chukchi Sea to southeast Alaska (Braham and Dahlheim, 1982). They occur primarily in coastal waters, although they have been sighted well offshore (Heyning and Dahlheim, 1988). Seasonal movements in polar regions may be influenced by ice cover and in other areas primarily by availability of food. An estimated 1,123 killer whales belong to the eastern North Pacific Alaska resident stock (Angliss and Outlaw, 2005). Resident killer whales are not known to eat other marine mammals. Population trends for the entire stock are currently unknown though portions of the stock in Prince William Sound and Kenai Fjords have increased 3.3% per year from 1984 to 2002 (Matkin et al., 2003). Transient killer whales are the only known predators of bowhead whales (Angliss and Outlaw, 2005). In a study of marks on bowheads taken in the subsistence harvest, 4.1% to 7.9% had scars indicating the bowhead whales had survived attacks by killer whales (George et al., 1994). A minimum number of 314 transient killer whales have been photographed from the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock

(Angliss and Outlaw, 2005). There is no reported subsistence harvest of killer whales in Alaska (Angliss and Outlaw, 2005).

Harbor Porpoise. Harbor porpoises (*Phocoena phocoena*) are found in the eastern North Pacific Ocean from Point Barrow, along the Alaskan coast, and down the west coast of North America to Point Conception, California (Gaskin, 1984; Suydam and George, 1992; Dahlheim et al., 2000). They occur primarily in coastal waters, but are also found where the shelf extends offshore (Gaskin, 1984; Dahlheim et al., 2000). In 1999, aerial surveys were conducted in Bristol Bay resulting in an abundance estimate of 47,356 for this portion of the Bering Sea. Currently, there is no reliable information on population trends (Angliss and Lodge, 2003). Subsistence hunters in Alaska have not reported to take from this stock of harbor porpoise (Angliss and Lodge, 2003).

3.3.2 Marine Birds

Many species of birds occur in substantial numbers in the Arctic Coastal Plain and Beaufort Sea habitats and nearly all are migratory, present sometime during the period from May to early November. Species include waterfowl, shorebirds, loons, seabirds, hawks and eagles, ptarmigan, and songbirds (MMS, 2002). Birds hunted by Alaska Eskimos in Barrow, Kaktovik, and Nuiqsut include the snowy owl, red-throated loon, tundra swan, eiders (common, king, spectacled, Steller(s), ducks, geese, and ptarmigan (MMS, 2002). Three bird species that are listed under the ESA and that inhabit the areas where Alaska Eskimos hunt for bowhead whales are short-tailed albatross, spectacled eider, and Steller's eider.

Short-tailed Albatross. The short-tailed albatross (*Phoebastria (=Diomedea) albatrus*) is listed as endangered under the ESA and by the State of Alaska (65 FR 46643). The short-tailed albatross was originally listed in 1970, under the Endangered Species Conservation Act of 1969, prior to the passage of today's Endangered Species Act (35 FR 8495). However, as a result of an administrative error (and not from any biological evaluation of status), the species was listed as endangered throughout its range except within the United States (50 CFR 17.11). On July 31, 2000, this error was corrected when the U.S. Fish and Wildlife Service (USFWS) published a final rule listing the short-tailed albatross as endangered throughout its range (65 FR 46643). These birds mate for life, laying eggs in October or November and incubating them for 65 days. The species is known to breed on only two remote islands in the western Pacific. Chicks leave the nest after 5 months to go to the North Pacific. Adults also spend the summer at sea, feeding on squid, fish, and other organisms. Most summer sightings of these birds are in the Aleutian Islands, Bering Sea, and Gulf of Alaska. During the late 1800s and early 1900s, hunters killed an estimated five million birds, stopping only when the species was nearly extinct. Protection of their nesting grounds has lead to an increased number of short-tailed albatross, from fewer than 50 birds in the late 1940s to over 600 birds in 1993 (Alaska Department of Fish and Game [ADF&G], 2001a). Presently, fewer than 2000 short-tailed albatrosses are known to exist (USFWS 2005). Critical habitat has not been designated for this species.

Spectacled Eider. The spectacled eider (*Somateria fischeri*) is a threatened species under the ESA and also listed as a species of special concern in Alaska. An estimated 7,370 spectacled eiders occupied the Arctic Coastal Plain of Alaska in June 2001, about 2% of the estimated 363,000 world population (MMS, 2002) of spectacled eiders nest in wet tundra near ponds on the Arctic coasts of Alaska and Russia and on the coast of the Yukon-Kuskokwim (Y-K) Delta in

Alaska. Nesting pairs arrive together each spring, but the males leave after egg incubation begins. In late summer, the females and young join the males at sea (ADF&G, 2001b). The only known wintering area lies south of St. Lawrence Island in the Bering Sea. Because few eiders are observed in marine areas along the Beaufort coast in spring, a majority may migrate to the nesting areas overland from the Chukchi Sea (MMS, 2002). Spectacled eiders have declined dramatically in Alaska since the 1960s (ADF&G, 2001, Spectacled Eider). Causes for this decline are not known but may include some combination of reduced food supplies, pollution, overharvest, lead shot poisoning, increased predation, and other causes (ADF&G, 2001b).

The breeding population on the North Slope is currently the largest breeding population of spectacled eiders in North America. The most recent population estimate, uncorrected for aerial detection bias, is 4,744 ± 907 pairs (arithmetic mean plus or minus two times the standard error associated with the sample) (Larned et al., 1999). However, this breeding area is nearly nine times the size of the Y-K Delta breeding area. Consequently, the density of spectacled eiders on the North Slope is about one quarter that on the Y-K Delta (Larned and Balogh, 1997; USFWS, 1996; 66 FR 9146). Based on USFWS survey data, the spectacled eider breeding population on the North Slope does not show a significant decline throughout most of the 1990s. The downward trend of 2.6% per year is bounded by a 90% confidence interval ranging from a 7.7% decline per year to a 2.7% increase per year (66 FR 9146). In February 2001, USFWS designated critical habitat on the Y-K Delta, in Norton Sound, Ledyard Bay, and the waters between St. Lawrence and St. Matthew Islands (66 FR 9146). All areas designated as critical habitat for the spectacled eider contained one or more of these physical or biological features: space for individual and population growth, and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

Steller's Eider. The Steller's eider (*Polysticta stelleri*) is a threatened species under the ESA and an Alaska species of special concern. Steller's eiders are diving ducks that feed on mussels in marine waters during the winter and insect larvae in freshwater ponds during the breeding season of spring and summer. Their current breeding range includes the arctic coastal plain in northern Alaska and northern coastal areas of Russia, where they nest on the tundra near small ponds (ADF&G, 2001c). In winter, most of the world's population of Steller's eiders range throughout the Alaska Peninsula and eastern Aleutian Islands. Aerial surveys provide the only currently available means of objectively estimating Steller's Eider population size in northern Alaska. Population size point estimates based on annual waterfowl breeding pair surveys from 1989 to 2000 ranged from 176 to 2,543 (Mallek, 2002). These surveys likely underestimated actual population size, however, because an unknown proportion of birds were missed when counting from aircraft, and no species-specific correction factor has been developed and applied (USFWS, 2002a). Nonetheless, these observations indicated that hundreds or low thousands of Steller's Eiders occur on the Arctic Coastal Plain. These surveys do not demonstrate a significant population trend from 1989-2000.

The current world population estimate is 150,000 to 200,000 birds, but the population is thought to have declined by as much as 50% between the 1960s and 1980s. When the Alaska breeding population of the Steller's Eider was listed as threatened, the factor or factors causing the decline was (were) unknown. Factors identified as potential causes of decline in the final rule listing the population as threatened (62 FR 31748) included predation, hunting, ingestion of spent lead shot in wetlands, and changes in the marine environment that could affect Steller's Eider food or other resources. Since listing, other potential threats, such as exposure to oil or other contaminants near fish processing facilities in southwest Alaska, have been identified, but the causes of decline and obstacles to recovery remain poorly understood (USFWS, 2002a). In February 2001, USFWS designated critical habitat for the Alaska-breeding population of Steller's eiders in one terrestrial and four marine areas: Y-K Delta, Kuskokwim Shoals, Seal Islands, Nelson Lagoon (including Nelson Lagoon and portions of Port Moller and Herendeen Bay), and Izembek Lagoon (66 FR 8849).

3.3.3 Other Species

Arctic coastal waters support a diverse community of planktonic and epontic species that are prey for fish, birds, and marine mammals. Both marine and anadromous fish inhabit coastal arctic waters. Marine fish include arctic cod, saffron cod, two-horn and four-horn sculpins, Canadian eelpout, arctic flounder, capelin, Pacific herring, Pacific sand lance, and snailfish. Migratory (anadromous) fish common to the arctic environment include arctic cisco, least cisco, Bering cisco, rainbow smelt, humpback whitefish, broad whitefish, Dolly Varden char, and inconnu. Although uncommon in the North Slope region, salmon are present in arctic waters and used by Alaska Eskimos (MMS, 2002).

Fish species used by Alaska Eskimos in Barrow, Kaktovik, and Nuiqsut include Pacific salmon (chum, pink, silver, king, and sockeye), whitefish (round, broad, humpback, least cisco, Bering/Arctic cisco), Arctic char, Arctic grayling, burbot, lake trout, northern pike, capelin, rainbow smelt, arctic cod, tomcod, and flounder (MMS, 2002).

Terrestrial mammals hunted by Alaska Eskimos in Barrow, Kaktovik, and Nuiqsut include caribou, moose, brown bear, Dall sheep, musk ox, arctic fox, red fox, porcupine, ground squirrel, wolverine, weasel, wolf, and marmot (MMS, 2002).

3.4 Socio-economic Environment

The proposed action has effects on the human environment, notably the ten member communities of the AEWC. This section describes the population size and ethnic composition, along with a key indicator of economic status, as a basis for the Environmental Justice analysis found in Section 4.8.5.

These communities are small, predominantly Alaska Native villages, with the exception that Barrow, as a regional service center is larger and more diverse. In 2005, the ten AEWC communities counted a total 8,131 residents, of whom 6,333 or 77.9% are Alaska Native or part Alaska Native (Table 3.4-1). Barrow accounts for just over half of the total population, and is more diverse, with Alaska Native residents making up 64% of the community. The recent trend in population for these communities is a slight decline since the 2000 census, when the total population for these communities was 8,577 residents (5.2%) and 6,633 Alaska Native residents (4.5%) (U.S. Census Bureau, 2007).

Table 3.4-1
2005 AEWC Community Population and Ethnicity

Community	Total Population	Percent Alaska Native	Alaska Native Population
Barrow	4199	64.0%	2687
Diomede	132	93.8%	124
Gambell	660	95.8%	632
Kaktovik	276	84.0%	232
Kivalina	385	96.6%	372
Nuiqsut	411	89.1%	366
Point Hope	702	90.6%	636
Savoonga	695	95.5%	664
Wainwright	520	93.0%	484
Wales	151	90.1%	136
Total	8131	77.9%	6333

Source: ADEC, 2007

The most current information concerning income and poverty levels is the 2000 Census. Table 3.4-2 shows that, using the federally defined poverty level, two of the AEWC communities have low levels (< 9% of residents), while three communities have intermediate rates (12% - 18% of residents). The remaining five communities have higher rates, ranging from 26% through 35% of residents living below the poverty level. Barrow has the lowest rate of household below the poverty level, resulting from higher levels of employment available in this service hub community. All but two of these communities exceed the average rate of Alaska residents living below the poverty level, which is 9.4%, and in most cases these are two and three times the Alaska average.

Table 3.4-2
Portion of Residents Living Below Poverty Level in 2000

Community	Percent
Barrow	8.62%
Diomede	35.44%
Gambell	28.47%
Kaktovik	28.47%
Kivalina	26.40%
Nuiqsut	2.37%
Point Hope	14.83%
Savoonga	29.06%
Wainwright	12.54%
Wales	18.30%
State of Alaska Rate	9.4%

3.5 Eskimo Tradition of Subsistence Hunt of Bowhead Whales

Bowhead whale hunting has been a part of Alaska Eskimo culture for at least 2,000 years (Stocker and Krupnik, 1993). Subsistence hunting communities along the western and northern coasts of Alaska participate in annual bowhead whale hunts and rely on the hunts for both cultural and subsistence needs (Braund et al., 1997). Historically, residents of the villages participate in one or more of the semi-annual hunts (Stocker and Krupnik, 1993). This section describes the importance of the on-going bowhead subsistence hunt, in relation to the overall pattern of subsistence production, in its key social organization features, and as a foundation of Inupiat and Siberian Yupik cultural identity and ceremonial life.

Bowhead subsistence whaling represents an especially important source of subsistence food among the AEWC communities. During the past 10 years (1997 - 2006), the AEWC villages have landed 410 bowhead whales, or an average of 41 whales per year. As shown in Table 3.5-1, the largest AEWC community of Barrow takes over half of the total, with an average of 23.4 bowhead whales landed per year in the last decade. Most of the rest of the communities take 1-3 whales per years, while the small communities of Wales and Little Diomede have highly intermittent harvests, and Kivalina has taken no whales in this period.

Table 3.5-1
Bowhead Whales Landed 1997 - 2006

	Gambell	Savoonga	Wales	Little Diomede	Kivalina	Point Hope	Wainwright	Barrow	Nuiqsut	Kaktovik	Total
Total Landed	14	25	2	2	0	30	38	234	33	32	410
Annual Ave.	1.4	2.5	0.2	0.2	0	3	3.8	23.4	3.3	3.2	41

Source: AEWC and NSB, 2007

Bowhead whales provide exceptionally large quantities of food. During the late 1980's, a method was developed to estimate the edible pounds produced from bowhead whales of various sizes (Braund and ISER 1993). After weighing crew shares of *maktak* and meat from a number of harvests in Barrow, the authors established the average pounds of food produced per foot of length for small, medium, and large bowhead whales. As shown in Table 3.5-2, using the detailed data on length of harvested whales, the 1993 method was applied to derive an estimate that an average of 1.03 million pounds of bowhead whale *maktak* and meat was produced annually over the past decade. Using the 2000 Census figures for the population of the AEWC villages (noted in Section 3.4), this suggests an annual harvest level of 121 pounds per capita, if the total population is counted, or 157 pounds per capita if the Alaska Native population is taken as the basis of the calculation.

Table 3.5-2
Estimated Edible Pounds of Bowhead Whale 1997 - 2006

	Number Taken	Total Edible Pounds	Average Annual Edible Pounds
Small whales (17 - 34 ft.)	225	3,170,845	317,084
Medium whales (35 - 45 ft.)	100	3,237,857	323,786
Large whales (46 - 63 ft.)	81	3,892,129	389,243
Total	406	10,301,129	1,030,113

Source: AEWC and NSB, 2007

Additional facets of the importance of bowhead whale within the total annual round of subsistence harvests can be shown through the comprehensive household surveys, conducted in the period from 1987 through 1993, and reported in the ADFG Subsistence Division subsistence harvest database. Surveys of this sort permit a more detailed perspective on the variation in bowhead harvest levels between participating communities and of the variation in the proportion of bowhead food in relation to other major subsistence resources. As displayed in Table 3.5-3, per capita harvest levels for bowhead whales, during the years studied, ranged from as high as 560 pounds in Kaktovik in 1992, to about 200 pounds per capita in several communities, and a very low level of bowhead harvest in Kivalina in 1992 at 39 pounds. Total subsistence production levels also varies among the communities, with the more heterogeneous community of Barrow having the lowest annual per capita total at 289 pounds, while the other ranged from 740 pounds to 885 pounds during the study years. In viewing these results, it is important to note that bowhead subsistence harvests vary from year to year, particularly for some of the smaller communities, so these results are indicative, and do not define a stable pattern. In addition, the period covered in these studies had lower bowhead harvest levels, on the whole, than those of the past decade. From 1987 - 1993, the communities averaged 28.6 bowheads whales landed per year, whereas in the past decade the average has been 41 bowhead whales landed per year, an increase of approximately 44%. This trend is even more important for Barrow, which average harvests of 13.7 whales per year in the period 1987 - 1993, compared to an average annual take of 23.4 whales per year in the past decade, an increase of 73%.

Table 3.5-3
Community Subsistence Harvest Levels by Species Group (Pounds per Capita)

Village	Bowhead whale	Other marine mammals	Game	Fish & marine invertebrates	Birds & eggs	Vegetation	Total
Barrow 1989	125.21	43.29	71.18	39.28	9.76	0.44	289.16
Kaktovik 1992	560.35	38.78	148.71	118.91	16.83	1.18	884.76
Kivalina 1992	38.55	279.47	165.25	253.29	10.79	14.03	761.38
Nuiqsut 1993	213	23.02	242.03	250.62	11.98	1.1	741.75
Wainwright 1989	218.23	302.27	178.18	37.15	15.41	ND	751.24
Wales 1993	188.19	392.14	25.53	121.99	11.62	4.69	744.16

Source: ADF&G, 2001d

In addition to this high reliance on bowhead whales, Inupiat and Siberian Yupik communities harvest many species throughout an intricate annual cycle of subsistence activities. The species composition of subsistence harvests in selected AEWC communities gives an indication of the flexible adaptation of subsistence patterns to ecological patterns of abundance and access to various resources. For example, while bowhead, caribou, and fish make up the majority of subsistence foods in most of the Inupiat communities, the Chukchi Sea communities rely more heavily on walrus and seal than do the Beaufort Sea villages (MMS, 2006a:168). In Table 3.5-4, the communities of Kaktovik, Barrow, and Nuiqsut have high proportions of total subsistence food derived from the bowhead harvest, and lower proportions from other marine mammals, while the communities of Wainwright, Kivalina, and Wales show much greater harvests of other marine mammals.

Table 3.5-4
Proportion of Subsistence Food Provided by Various Species Groups

Village	Bowhead whale	Other marine mammals	Game	Fish & marine invertebrates	Birds & eggs	Vegetation	Total Percent
Barrow 1989	43.3%	15.0%	24.6%	13.6%	3.4%	0.2%	100.0%
Kaktovik 1992	63.3%	4.4%	16.8%	13.4%	1.9%	0.1%	100.0%
Kivalina 1992	5.1%	36.7%	21.7%	33.3%	1.4%	1.8%	100.0%
Nuiqsut 1993	28.7%	3.1%	32.6%	33.8%	1.6%	0.1%	100.0%
Wainwright 1989	29.0%	40.2%	23.7%	4.9%	2.1%	ND	100.0%
Wales 1993	25.3%	52.7%	3.4%	16.4%	1.6%	0.6%	100.0%

Source: ADF&G, 2001d

Households in the AEWC communities have very high rates of participation in production and consumption of bowhead subsistence foods. The comprehensive household surveys also documented the percentage of households using bowhead, trying to harvest, actually harvesting, receiving bowhead food from others, and giving bowhead food to other households. As seen in Table 3.5-5, for the five smaller communities with data, 74% to 97% of households use bowhead whale foods. Note too that this is the result of widespread sharing of food, since rather small proportion of households (4.8% - 21.2%) have actually harvested bowhead whales in the study years. For the larger communities of Barrow and Wainwright, the available data are more limited, demonstrating that 45% to 66% of household are involved in harvesting. If sharing and use data were available, it is likely that these two communities would also show extremely high proportions of households using bowhead whale foods. More detailed accounts of the subsistence harvest patterns of Kaktovik, Nuiqsut, Barrow, Wainwright, and Point Hope are found in Appendix C of MMS (2006a).

Table 3.5-5
Rates of Participation in Bowhead Subsistence Activities

	Percentage of Households				
	Using	Trying to Harvest	Harvesting	Receiving	Giving
Barrow 1989	n/a	n/a	45.0	n/a	n/a
Kaktovik 1992	87.2	53.2	6.4	85.1	61.7
Kivalina 1992	90.3	64.5	4.8	88.7	48.4
Nuiqsut 1993	96.8	37.1	4.8	96.8	75.8
Pt. Lay 1987	87.5	21.2	21.2	84.4	21.2
Wainwright 1989	n/a	n/a	66.0	n/a	n/a
Wales 1993	73.8	26.2	11.9	64.3	40.5

Source: ADF&G, 2001d

Subsistence harvests occur within traditional use areas, for which hunters have accumulated detailed knowledge of the physical geography of landscape and waters, the social geography of place names and the associated stories, and the wildlife ecology of likely animal distributions by seasons and under varying weather conditions. Hunters have a repertoire of effective harvest strategies to draw upon as they hunt throughout these traditional harvest areas. Bowhead subsistence whaling occurs in U.S. waters primarily during the spring and autumn migrations as the bowhead whales move north and east through near shore leads in the spring, and then west and south as ice forms in the autumn. The bowhead migration patterns are conducive to spring harvests for westerly AEWC communities, while Barrow's location provides for successful spring and fall hunts, and the villages of Nuiqsut and Kaktovik participate in the fall hunts. The St. Lawrence Island communities of Gambell and Savoonga take bowhead in the fall migration, continuing as late as December. For an overview of community whaling areas and migration patterns, see Figure 3.5-1.

Subsistence activities are often centered in family groups, with widespread sharing of financial resources and equipment to support hunters, sharing of labor in harvesting, processing and distributing subsistence foods, and sharing of knowledge as elders provide practical information and ethical understandings for successful subsistence pursuits. The social organization of subsistence activities binds generations and families together across and even between communities. Subsistence whaling and the roles of whaling captains and whaling crews are especially prominent in the social organization of the Inupiat and Siberian Yupik whaling

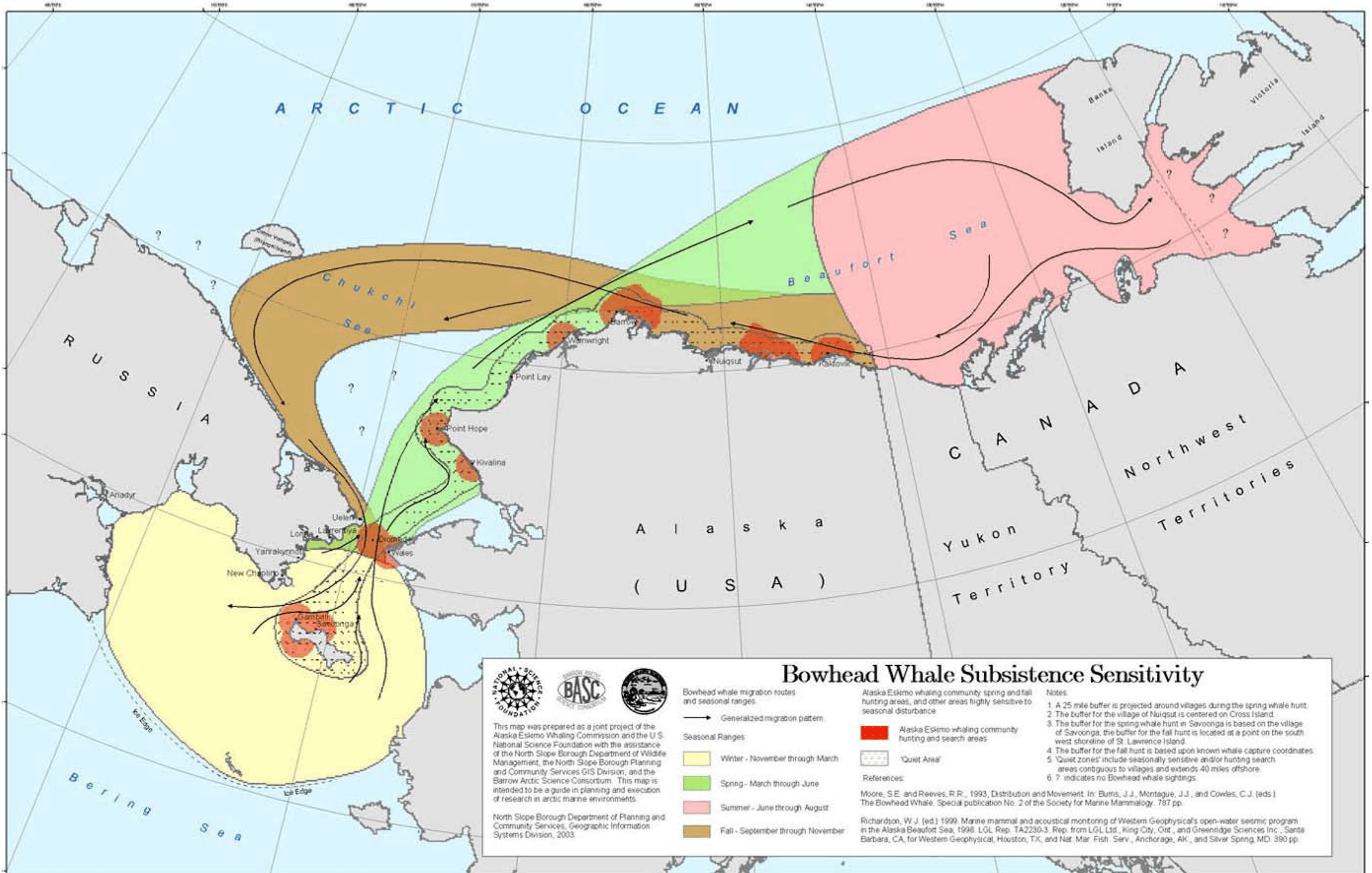


Figure 3.5-1 Bowhead whale subsistence sensitivity. Draft prepared by the National Science Foundation, the Barrow Arctic Science Consortium, and the North Slope Borough (2003).

communities. The wives of whaling captains and whaling crew members also have an intricate set of interlinked responsibilities. These are particularly important in the preparation of bearded seal (*ugruk*) skins for the *umiaks*, still preferred in Barrow for the spring hunts due to their silence in the water (see Bodenhorn (2000) for additional discussion). From aboriginal times, the whaling captain, or *umailik*, was recognized as a leader for his knowledge, success at hunting, support for the needs of his whaling crews throughout the year, and generosity in sharing the fruits of a successful hunt. Cooperation among whaling crews was critically important in the success of any hunt, and customary laws prescribed how a captain would distribute portions of the whaling to the crews that helped in the capture as well as to the entire community (Worl 1979). Hauling a whale onto the ice edge and processing the enormous amount of food provided required the cooperative labor of virtually the entire community.

Spiritual and moral values, beliefs, and cultural identity are expressed and recreated through subsistence harvest activities. The great gifts of food from bowheads are recognized in the ceremonies of the Nalukatak festival at the conclusion of spring whaling.

Since the late 1970s, subsistence bowhead whaling has been governed in the formal structures of international treaties, national legislation, and the cooperative agreement between NOAA and the AEWC. The IWC has determined catch limits for bowhead whale harvests, after considering the nutritional and cultural need for bowhead whales by Alaska Eskimos and the level of harvest that is sustainable. In 1986, the IWC accepted a method to calculate subsistence and cultural need of Alaska Eskimos for bowhead whales. This method incorporates the historic and current size of the Eskimo population residing in Alaskan subsistence hunting villages and the number of bowhead whales historically landed by each community (Appendix 8.1).

Because bowhead subsistence hunts are a community-wide activity, it is appropriate to consider the community population in association with the historic harvest levels. Besides abundance of bowhead whales, community population levels are a critical factor that influences harvests because the community population dictates the number and size of subsistence hunt crews and the amount of meat and *maktak* needed to feed the community, share with others, and provide for annual celebrations (Braund et al., 1997).

The first calculation of nutritional and cultural need was submitted to the IWC in 1983 and was accepted by the IWC in 1986 (U.S. Government, 1983). Using the same method for calculating need, the second calculation was submitted to and accepted by the IWC in 1988, when more extensive research provided additional historical subsistence hunting and human population data. The 1988 study used the most recent Eskimo population data available at that time, ranging from 1983 to 1987, to calculate then-current need (Braund et al., 1988). The third calculation of need was submitted to and accepted by the IWC in 1994, based on July 1, 1992 human population data generated by the State of Alaska, Department of Labor. The fourth calculation, submitted to the IWC in 1997, used the same method accepted by the IWC in 1986 for calculating need, presenting revised calculations based on July 1, 1997 human population data generated by the State of Alaska, Department of Labor (Braund et al., 1997). This same calculation was submitted to the annual IWC meeting in 2002. This need statement demonstrated a documented nutritional and cultural need for 56 landed bowhead whales per year. The 2005 Alaska Native population in the AEWC villages, as described in Section 3.4, was 6,333 residents, which is slightly below the population figure of 6,472 Alaska Native residents used as the basis for the calculation of need in the 1997 report. Most recently, a 2007 calculation of subsistence need was submitted to the IWC, based on 2000 census data (Appendix 8.1). This need statement again demonstrated a documented nutritional and cultural need for 57 landed bowhead whales per year.

3.5.1 Methodology of Eskimo Subsistence Hunt

The hunting of bowhead whales by Alaska Eskimos is believed to date back several thousand years with the use of harpoons and lances fashioned from stone, ivory, and bone. Seal-skin or walrus-skin covered whaling vessels known as *umiaks* were employed from aboriginal times and remain the most commonly used vessel for the spring hunt (Stocker and Krupnik, 1993). Crew sizes currently average six persons per vessel (www.mms.gov/alaska/native/rexford/rexford.htm). Before the whales arrived during each migration, ritual ceremonies were performed in special houses known as *karigi*, to ensure a successful hunt and to honor the whale (Ellis, 1991).

Alaska Eskimos continue to use traditional methods to take whales today, but have also incorporated new technologies such as darting and shoulder guns as a method of improving efficiency and humane killing methods (Stocker and Krupnik, 1993). The harpoon with line and float attached is always used first since it is the forward part of the darting gun. Once the darting gun is thrown, the shoulder gun is almost always used as a back-up. The AEWC has convened a Weapons Improvement Program in order to work towards improving humane killing methods (i.e., reducing time to death) and the efficiency of the hunt (i.e., struck to landed ratio)[8]. Contemporary hunts occur twice a year in the spring and autumn seasons based on ice and weather conditions. In the autumn season, aluminum skiffs or small open boats with outboard motors are used for the hunt due to the open water conditions. In the spring, traditional skin-covered *umiaks* are preferred because they are quieter and therefore more effective in the ice leads.

Traditionally, most of the whale was used for food, though other parts of the whale were used to make whaling gear, fishing equipment, traps, tools, and for many other practical day-to-day uses (Ellis, 1991). The gut was made into waterproof clothing and translucent windows, and the oil was used for heating, cooking and lighting (Ellis, 1991). The bones were used for fences, house construction and sled runners (Ellis, 1991). Baleen and bone are used in many forms of handicraft, including baleen baskets, scrimshaw, and carvings. Today, bowhead is still an important source of subsistence, where the skin and blubber, known as *maktak*, are either eaten raw or boiled in salted water (Ellis, 1991).

3.5.2 Results of Recent Hunts

Suydam and George (2004) summarize Alaskan subsistence harvests of bowheads from 1974 to 2003. Hunters landed a total of 832 whales during this time period. Subsequently, the number of bowheads landed by Alaska Natives was reported as 37 in 2004 (Suydam et al., 2005; 2006), 55 in 2005 (Suydam et al., 2006), and 31 in 2006 (Suydam et al., 2007). Barrow consistently landed the most whales (n = 490) while Little Diomede landed two (Figure 3.5.2-1). Shaktoolik, a village located on the coast of Norton Sound, Alaska, harvested one whale in 1980 but has not been a regular participant in the hunt. The number of whales landed at each village varied greatly

[8] The efficiency of the hunt is also expected to improve as a result of the passage of an emergency towing assistance provision contained in section 403 of the Hydrographic Services Improvement Act Amendments of 2002. Pub. L. 107-372.

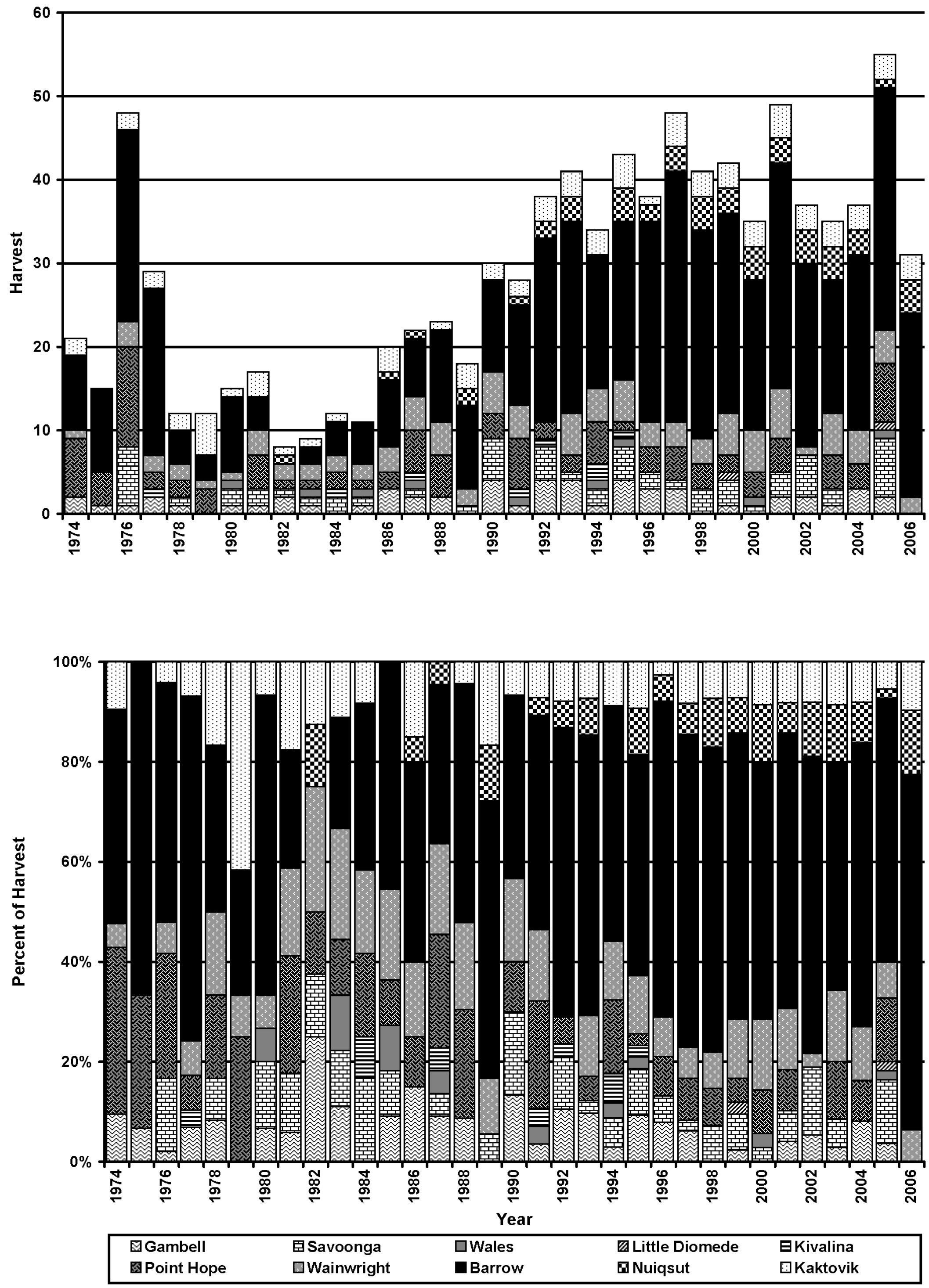


Figure 3.5.2-1 Number (a) and cumulative percent (b) of Western Arctic bowhead whales landed by Eskimo villages in Alaska, 1974-2006 (from AEWC and NSB 2007).

from year to year (Figure 3.5.2-1), as success was influenced by village size and ice and weather conditions. The annual average subsistence take during the 8-year period from 1999 to 2006 is 40 bowhead whales. The efficiency of the hunt (i.e. the number of whales landed compared to the number of whales struck) has increased since the implementation of the bowhead quota in 1978. Before 1978 the efficiency was about 50%; in recent years efficiency has averaged about 75% (Figure 3.5.2-2).

The size of landed whales differs among villages. Gambell and Savoonga (two villages on St. Lawrence Island) and Wainwright typically harvest larger whales than Point Hope and Barrow. These differences were likely due to hunter selectivity, whale availability and season. For example, during spring in Barrow, smaller whales were caught earlier in the season than larger whales while the opposite was true in the autumn (Suydam and George, 2004). Villages along the western coast of Alaska harvest bowhead whales primarily during the spring migration (Figure 3.5.2-3), while villages along the Beaufort Sea hunt during the autumn migration. In recent years, the villages on St. Lawrence Island have been able to hunt bowhead whales when they overwinter in the Bering Sea (Figure 3.5.2-3). Overall, the sex ratio of the harvest has been equal.

3.6 Co-management of Subsistence Whaling with AEWC

The purposes of the NOAA-AEWC Cooperative Agreement are to protect the Western Arctic population of bowhead whale and the Eskimo culture, to promote scientific investigation of the bowhead whale, and to effectuate the other purposes of the WCA, the MMPA, and the ESA, as these Acts relate to the aboriginal subsistence hunts for whales. Cooperative Agreements have been in place between NOAA and the AEWC since the first agreement was signed in March 1981, and have been renewed regularly thereafter.

3.6.1 Description of Management

The NOAA-AEWC Cooperative Agreement establishes a structure of relationships between the authorities and activities of NOAA and the AEWC. The Cooperative Agreement generally represents a functional delegation of on-the-ground management from NOAA to the AEWC, subject to NOAA oversight. The provisions of the Cooperative Agreement build on the provisions of the AEWC Management Plan (adopted in November 1977, renewed on March 4, 1981, and continuously since) (Appendix 8.4). The authority and responsibilities of the AEWC are contained in and limited by the Cooperative Agreement and Management Plan, as amended, to the extent that the Management Plan is not inconsistent with the Agreement. If AEWC fails to carry out its responsibilities, NOAA may assert its federal management and enforcement authority to regulate the hunt after notifying the AEWC of its intent, and providing an opportunity to the AEWC to discuss the proposed action. The AEWC Management Plan provides that the AEWC is empowered to administer the following regulations: (1) insure an efficient subsistence harvest of bowhead whales; (2) provide a means within the Alaska Eskimo customs and institution to protect bowhead whale habitat and limit harvest to prevent extinction of the species; and (3) provide for Eskimo regulation of all whaling activities by Eskimo members of the AEWC (subsection 100.1). The AEWC may deny any person who violates these regulations the right to participate in the hunt, make civil assessments, and act as an enforcement agent (subsection 100.11(b)). In addition to administering and enforcing regulations within the Management Plan, the AEWC also provides village education programs including training

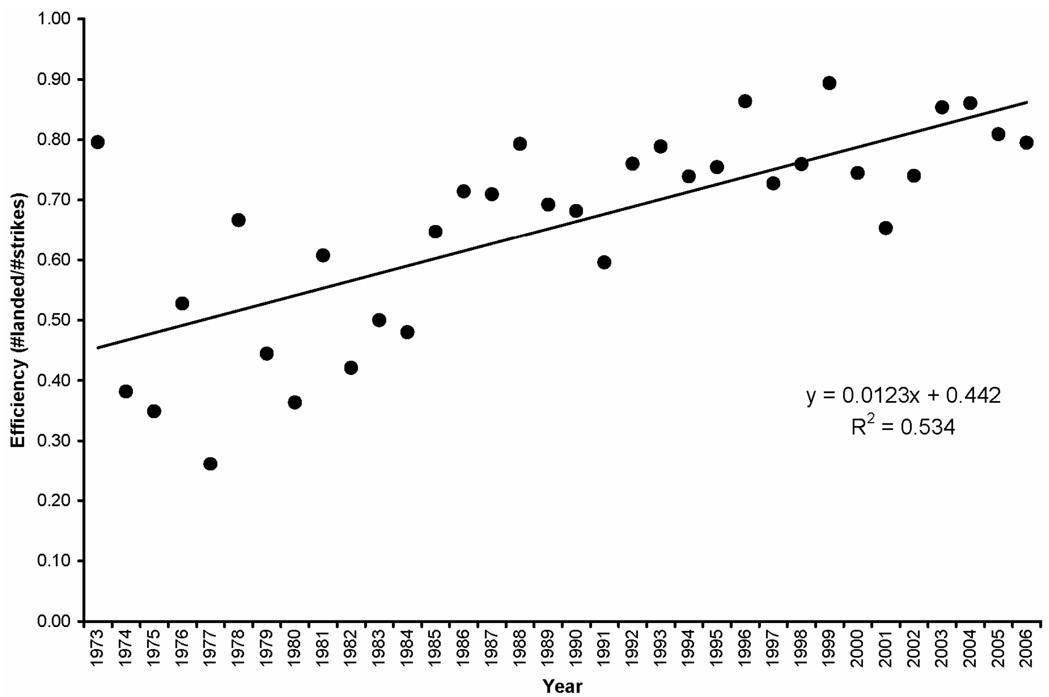


Figure 3.5.2-2 Efficiency of the Western Arctic bowhead whale subsistence hunt, 1973-2005 (from AEWC and NSB 2007).

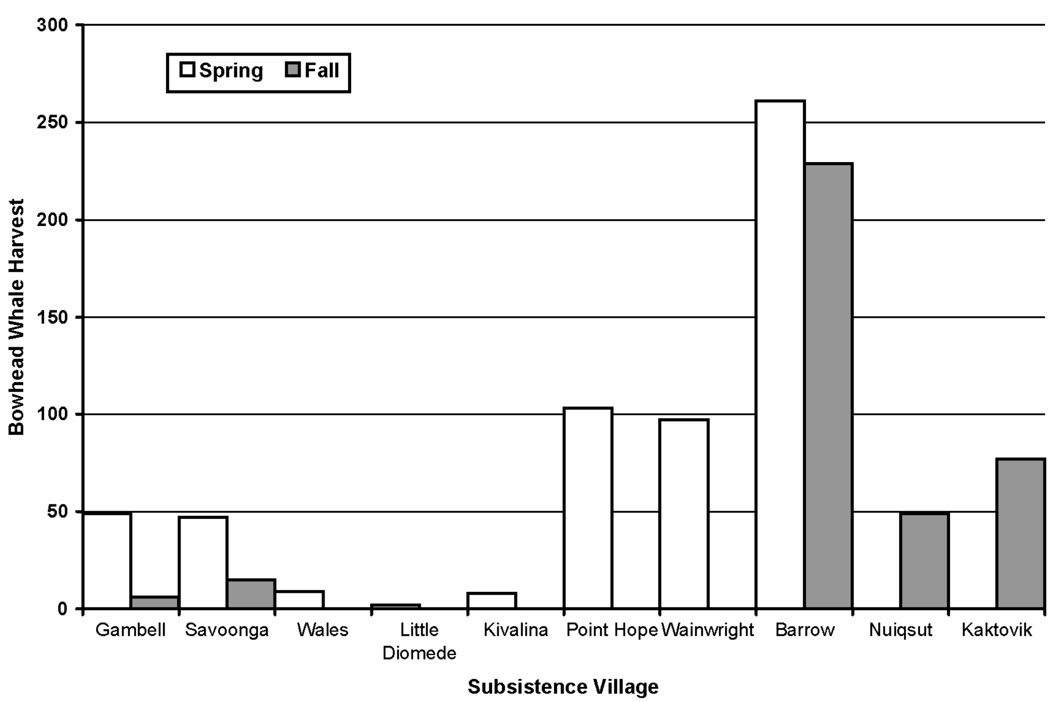


Figure 3.5.2-3 Western Arctic bowhead whale harvest by season for each Eskimo village in Alaska, 1974-2006 (from AEWC and NSB 2007).

programs for whaling captains and crews, and initiates research to improve the accuracy and reliability of weapons used to hunt bowhead whales (subsection 100.12).

3.6.2 Quota Distribution among Villages

Under the AEWC Management Plan, the AEWC consults with each whaling village before establishing the level of harvest for each whaling village during each season (subsection 100.26) and adjustments may be made during the season, if a village does not use its allocation. Each whaling captain registers with the AEWC on forms that disclose name, address, age, qualifications as a captain, and willingness to abide by and require the crew to abide by AEWC regulations (subsection 100.22).

3.6.3 Monitoring and Enforcement of Hunting Regulations

Reports of each hunt must include the date, place, time of strike, size and type of bowhead whale, reasons if struck and lost, and condition of struck and lost whales (subsection 100.23). Whaling crews must use traditional harvesting methods (as defined under subsection 100.24). Meat and edible products must be used exclusively for consumption and not be sold or offered for sale. Violators, after opportunity for a hearing before the AEWC, are prohibited from hunting or attempting to hunt for a period of not less than one whaling season nor more than five whaling seasons and/or may be subject to a fine not to exceed $10,000. Should a dispute between NOAA and AEWC occur over any of these matters, and resolution does not occur after consulting with AEWC, the dispute will be referred to an administrative law judge (15 CFR 904.200-904.272).

From the earliest years of the Management Plan, the AEWC has shown a willingness to intervene with whaling captains to enforce the quota and other provisions. Langdon (1984:51) refers to examples from 1981 and 1982, while Freeman (1989:151) describes a 1985 incident. More recently, on approximately May 25, 2003, a female bowhead whale was taken in the Beaufort Sea off Barrow, Alaska, by the crew of an AEWC registered bowhead subsistence captain. On taking the whale, the crew realized it was accompanied by a calf, which then swam away. The USA elected to report two infractions to the IWC as the disposition of the calf was unknown (IWC, 2005b). The taking of a whale calf or a cow accompanied by a calf is prohibited by Alaska Eskimo hunting tradition, by the AEWC management plan for the bowhead subsistence hunt, the Whaling Convention Act (WCA) regulations, and by the IWC Schedule. The AEWC considers the taking of a whale calf or a cow with a calf to be a very serious infraction. On May 30, 2003, the Commissioners of the AEWC convened a hearing to receive testimony from the members of the crew and from the members of other crews who were in the vicinity when the whale was taken. While testimony indicated that the taking might have been accidental, the Commissioners concluded that the crew knew a cow/calf pair was in the vicinity and did not act with proper caution under the circumstances. Therefore, the Commissioners voted to rescind the bowhead subsistence captain’s registration with the AEWC for two years (four seasons) beginning with the autumn 2003 bowhead subsistence hunt. The AEWC also confiscated the baleen taken from the whale and donated it to a local organization that supports Native artists. Under the WCA, it is illegal for anyone who is not a registered captain with the AEWC, or a member of the crew of a registered captain, to hunt bowhead whales. Anyone attempting to take a bowhead whale without being properly registered with the AEWC, or being a crew member of a registered captain, is subject to penalties under U.S. law.

Another calf taking occurred during the Fall 2006 hunt, Whale ID 06B101, 9/29/2006 (Male, 6.3m), Barrow. This whale was landed and then deemed to be a calf. It had milk in its stomach and very short baleen (Suydam et al., 2007). On November 16, 2006, the Commissioners of the AEWC convened a hearing on this incident. After receiving testimony from the members of the crew and other crews in the area when the whale was taken, the Commissioners determined that this taking was an accident resulting from the fact that no cow was seen in the vicinity and the animal was large for a lactating calf.

3.6.4 Reporting requirements to NOAA and IWC

It is the responsibility of the whaling captains and crew to report to the commissioner of their village on a daily basis when they are whaling. The commissioner then reports to the AEWC central office in Barrow. The AEWC office takes a report which is passed on to the NMFS office in Anchorage. After completion of the whaling season, the AEWC office submits a final report to the U.S. Department of Commerce, NOAA office in Washington, D.C. According to the Cooperative Agreement, on the first of each month during the whaling seasons, the AEWC must inform NOAA of the number of bowhead whales struck during the previous month. The final report is due within 30 days to NOAA after the conclusion of the whaling season.