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BOWHEAD WHALE (*Balaena mysticetus*): Western Arctic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Western Arctic bowhead whales are distributed in seasonally ice-covered waters of the Arctic and near-Arctic, generally north of 60°N and south of 75°N in the western Arctic Basin (Braham 1984, Moore and Reeves 1993). For management purposes, five stocks of bowhead whales have been recognized by the International Whaling Commission (IWC 1992). Small stocks occur in the Sea of Okhotsk, and the offshore waters of Spitsbergen, comprised of only a few tens to a few hundreds of individuals (Shelden and Rugh 1995, Zeh et al. 1993). Until recently, available evidence indicated that only a few hundred bowheads were in the Hudson Bay and Davis Strait stocks, but it now appears these should be considered one instead of two stocks based on genetics (Postma et al. 2006), aerial surveys (Cosens et al. 2006), and tagging data (Dueck et al. 2006), and the abundance may be in the thousands. The only stock that is found within U. S. waters, is the Western Arctic stock (Figs. 43 and 44), also know as the Bering-Chukchi-Beaufort stock (Rugh et al. 2003) or Bering Sea stock (Burns et al. 1993). The majority of the Western Arctic stock migrates annually from wintering areas (November to March) in the northern Bering Sea, through the Chukchi Sea in the spring (March through June), to the Beaufort Sea (Fig. 43) where they spend much of the summer (mid-May through September) before returning again to the Bering Sea (Fig. 44) in the fall (September through November) to overwinter (Braham et al. 1980, Moore and Reeves 1993). Most of the year, bowhead whales are closely associated with sea ice (Moore and Reeves 1993). The bowhead spring migration follows fractures in the sea ice around the coast of Alaska, generally in the shear zone between the shorefast ice and the mobile pack ice. During the summer, most of the population is in relatively ice-free waters in the southern Beaufort Sea, an area often exposed to industrial activity related to petroleum exploration and extraction (e.g., Richardson et al. 1987, Davies 1997). During the autumn migration, bowheads select shelf

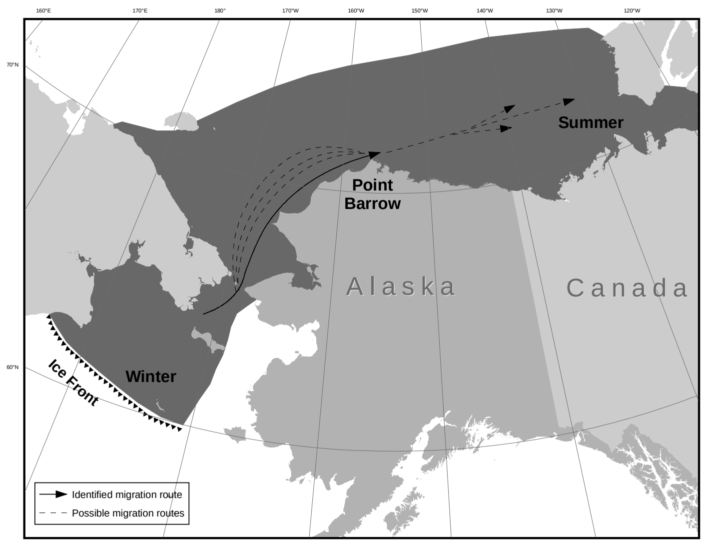

Figure 43. Shaded areas depict the approximate distribution of the western Arctic stock of bowhead whales. The spring migration represented here by lines and arrows, follows a route from the Bering Sea wintering area to the Beaufort Sea summering area, mostly along a coastal tangent that constricts somewhat as it goes east past Point Barrow.

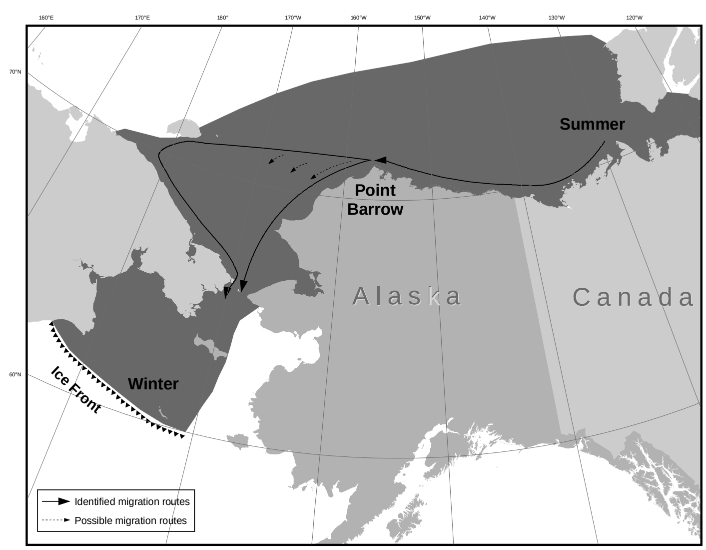

Figure 44. Shaded areas depict the approximate distribution of the western Arctic stock of bowhead whales. The fall migration of is represented here by lines and arrows showing generalized routes used to travel from the Beaufort Sea (summering area) to the Bering Sea (wintering area).

waters in all but "heavy ice" conditions, when they select slope habitat (Moore 2000). Sightings of bowhead whales do occur in the summer near Barrow (Moore 1992, Moore and DeMaster 2000) and are consistent with suggestions that certain areas near Barrow are important feeding grounds (Lowry et al. 2004). Some bowheads are found in the Chukchi and Bering Seas in summer, and these are thought to be a part of the expanding Western Arctic stock (Rugh et al. 2003). However, more research needs to be done to determine whether or not there are substocks within the Western Arctic stock (IWC 2004).

POPULATION SIZE

All stocks of bowhead whales were severely depleted during intense commercial whaling prior to the 20th century, starting in the early 16th century near Labrador (Ross 1993) and spreading to the Bering Sea in the mid-19th century (Braham 1984, Bockstoce and Burns 1993). Woodby and Botkin (1993) summarized previous efforts to approximate how many bowheads there were prior to the onset of commercial whaling. They reported a minimum worldwide population estimate of 50,000, with 10,400-23,000 in the Western Arctic stock (dropping to less than 3,000 at the end of commercial whaling).

Since 1978, systematic counts of bowhead whales have been conducted from sites on sea ice north of Point Barrow during the whales' spring migration (Krogman et al. 1989). These counts have been corrected for whales missed due to distance offshore (through acoustical methods, described in Clark et al. 1994), whales missed when no watch was in effect, and whales missed during a watch (estimated as a function of visibility, number of observers, and distance offshore; Zeh et al. 1993). A summary of the resulting abundance estimates is provided in Table 40 and Figure 45. However, these estimates of abundance have not been corrected for a small portion of the population that may not migrate past Point Barrow during the period when counts are made.

Bowhead whales were identified from aerial photographs taken in 1985 and 1986 and the results used in a capture-recapture analysis. This approach provided estimates of 4,719 (95% CI: 2,382-9,343) to 7,022 (95% CI: 4,701-12,561), depending on the model used (daSilva et al. 2000). These population estimates and their associated error ranges are

Table 41. Summary of population abundance estimates for the western Arctic stock of bowhead whales. The historical estimates were made by back-projecting using a simple recruitment model. All other estimates were developed by corrected ice-based census counts. Historical estimates are from Woodby and Botkin (1993); 1978-2001 estimates are from George et al. (2004) and Zeh and Punt (2004).

Year	Abundance estimate (CV)	Year	Abundance estimate (CV)
Historical estimate	10,400-23,000	1985	5,762 (0.253)
End of commercial whaling	1000-3000	1986	8,917 (0215)
1978	4,765 (0.305)	1987	5,298 (0.327)
1980	3,885 (0.343)	1988	6,928 (0.120)
1981	4,467 (0.273)	1993	8,167 (0.017)
1982	7,395 (0.281)	2001	10,545 (0.128)
1983	6,573 (0.345)		

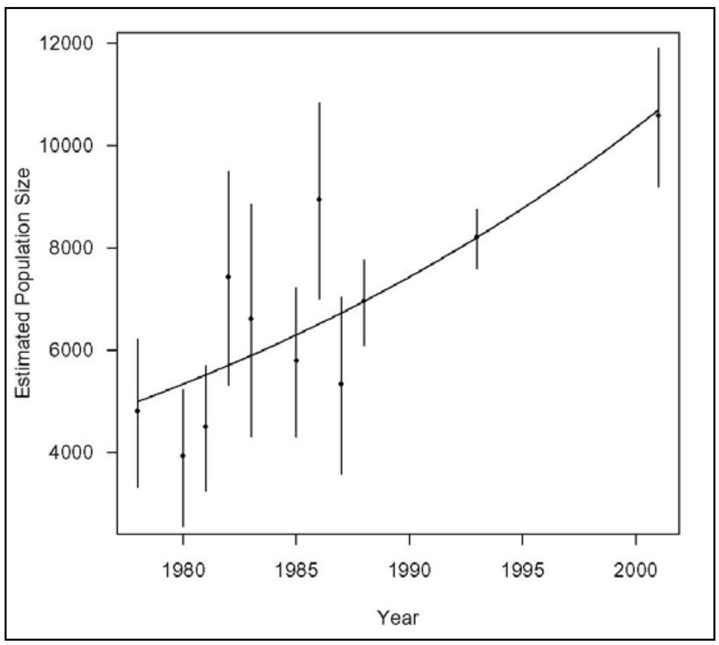

Figure 45. Population abundance estimates for the western Arctic stock of bowhead whales, 1977-2001 (George et al. 2004), as computed from ice-based counts, acoustic locations, and aerial transect data collected during bowhead whale spring migrations past Barrow, AK. Error bars show +/- 1 standard error.

comparable to the estimates obtained from the combined ice-based visual and acoustic data for 1985 (5,762) and 1986 (8,917). This study demonstrates that the use of photo-identification to estimate bowhead whale population size provides a reasonable alternative to the traditional ice-based census and acoustic techniques.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from Equation 1 from the PBR Guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842 \times [\ln(1+[CV(N)]^2)]^{½})$. Using the 2001 population estimate (N) of 10,545 and its associated CV(N) of 0.128, N_{MIN} for the Western Arctic stock of bowhead whales is 9,472.

Current Population Trend

Raftery et al. (1995) reported that the Western Arctic stock of bowhead whales increased at a rate of 3.1% (95% CI: 1.4-4.7%) from 1978 to 1993, during which time abundance increased from approximately 5,000 to approximately 8,000 whales. This rate of increase takes into account whales that passed beyond the viewing range of the ice-based observers. The inclusion of the estimate for 2001 results in a rate of increase of 3.5% (95% CI: 2.2 -4.9%; Brandon and Wade 2004) or 3.4% (95% CI: 1.7-5% George et al. 2004). The count of 121 calves during the 2001 census was the highest yet recorded, and was likely caused by a combination of variable recruitment and the large population size (George et al. 2004). The calf count provides corroborating evidence for a healthy and increasing population.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The current estimate for the rate of increase for this stock of bowhead whales (3.4-3.5%) should not be used as an estimate of (R_{MAX}) because the population is currently being harvested and because the population has recovered to population levels where the growth is expected to be significantly less than R_{MAX}. It is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be used for the Western Arctic stock of bowhead whale (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) level is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5 rather than the default value of 0.1 for endangered species because population levels are increasing in the presence of a known take (see guidelines Wade and Angliss 1997). Thus, PBR = 95 animals ($9{,}472 \times 0.02 \times 0.5$). The calculation of a PBR level for the Western Arctic bowhead stock is required by the MMPA even though the subsistence harvest quota is managed under the authority of the International Whaling Commission (IWC). Accordingly, the IWC bowhead whale quota takes precedence over the PBR estimate for the purpose of managing the Alaska Native subsistence harvest from this stock. For 2002-07, a block quota of 280 bowhead strikes will be allowed, of which 67 (plus up to 15 unharvested in the previous year) could be taken each year. This quota includes an allowance of 5 animals to be taken by Chukotka Natives in Russia.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

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 41. Further, preliminary counts of similar observations based on reexamination of bowhead harvest records indicate entanglements or scarring attributed to ropes may include over 20 cases (Craig George, Department of Wildlife Management, North Slope Borough, pers. comm.).

There are no observer program records of bowhead whale mortality incidental to commercial fisheries in Alaska. However, some bowhead whales have historically had interactions with crab pot gear (Table 41), at least one in 1993 and one in 1999. Alaska Region stranding reports document two bowhead whale entanglements between 2001 and 2005. In 2003 a bowhead whale was found dead in Bristol Bay entangled in line around the peduncle and both flippers; the origin of the line is unknown. In 2004 a bowhead whale near Point Barrow was observed with fishing net and line around the head. The estimated average annual rate of known entanglement in U.S. commercial fishing gear is 0.2 for 2001-2005, based on the entangled whale observed off Point Barrow in 2004. The total estimate annual rate of known entanglement in marine debris/gear for the past 5 years is 0.4.

Table 41. Reported scarring of bowhead whales attributed to entanglement in ropes and ship strikes and description of observations collected during subsistence harvests in Alaska since 1978. All scars referred to in the table are from entanglement in ropes or strikes from a boat, such as cuts from a propeller.

Year	Number of whales	Location	Description
1978[1]	1	Wainwright	6 scars on caudal peduncle
1986[1]	1	Kaktovik	Scars on caudal peduncle and anterior margin of flukes
1989[1]	1	Barrow	12 scars on ridges of caudal peduncle
1989[1]	1	south of Gambell	Rope wrapped around head, through mouth and baleen
1989[2]	1	Barrow	Rope ~32m long trailing from mouth
1990[1]	1	Barrow	Scars on caudal peduncle; 2 ropes trailing from mouth.
1991[2]	1	Barrow	Apparent rope scar from mouth, across back
1993[3]	1	Barrow	Large female with crab pot line wrapped around flukes
1998[3]	1	NW of Kotzebue; near Red Dog Mine dock	Stranded - dead with line on it
1999[3]	1	Barrow	Whale entangled in confirmed crab gear. Line wrapped through gape of mouth, flipper, and peduncle. Severe injuries.
2003[3]	1	Near Ugashik	Stranded with rope tied around the peduncle; entangled?
2004[3]	1	Kaktovik	Boat propeller marks

[1] Philo et al. 1993
[2] D. Rugh, personal communication, National Marine Fisheries Service
[3] C. George, personal communication, North Slope Borough

Subsistence/Native Harvest Information

Eskimos have been taking bowhead whales for at least 2,000 years (Marquette and Bockstoce 1980, Stoker and Krupnik 1993). 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 population per annum, primarily from nine Alaska communities (Philo et al. 1993). Under this quota, the number of kills has ranged between 14 and 72 per year, depending in part on changes in management strategy and in part on higher abundance estimates in recent years (Stoker and Krupnik 1993). Suydam and George (2004) summarize Alaskan subsistence harvests of bowheads from 1974 to 2003 reporting a total of 832 whales landed by hunters from 11 villages. Barrow landed the most whales (n = 418) while Little Diomede and Shaktoolik each landed only one. Since then, Alaska Natives landed 36 bowheads in 2004 (Suydam et al. 2005) and 68 in 2005 (Suydam et al. 2006). The number of whales landed at each village varies greatly from year to year, as success is influenced by village size and ice and weather conditions. The efficiency of the hunt (the percent of whales struck that are retrieved) has increased since the implementation of the bowhead quota in 1978. In 1978 the efficiency was about 50% and is currently about 85%. The size of landed whales differs among villages. Gambell and Savoonga, villages on St. Lawrence Island, and Wainright harvest larger whales than Point Hope and Barrow. These differences are likely due to hunter selectivity and/or whale availability.

Canadian Natives are also known to take whales from this stock. Hunters from the western Canadian Arctic community of Aklavik killed one whale in 1991 and one in 1996. One animal was harvested by Russian subsistence hunters in each of 1999 and 2000, three in 2003 (Borodin 2004), and one in 2004 (Borodin 2005). The annual average subsistence take (by Natives of Alaska, Russia, and Canada) during the 5-year period from 2001 to 2005 is 46.0 bowhead whales.

Other Mortality

Pelagic commercial whaling for bowheads principally occurred in the Bering Sea from 1848 to 1919. Within the first two decades of the fishery (1850-1870), over 60% of the estimated pre-whaling abundance was harvested, although effort remained high into the 20th century (Braham 1984). It is estimated that the pelagic whaling industry harvested 18,684 whales from this stock (Woodby and Botkin 1993). During 1848-1919, shore-based whaling operations (including landings as well as struck and lost estimates from U. S., Canadian, and Russian shores) took an additional 1,527 animals (Woodby and Botkin 1993). An unknown percentage of the animals taken by the shore-based operations were harvested for subsistence, and not commercial purposes. The estimated mortality likely underestimates the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994), and the lack of reports on struck and lost animals.

STATUS OF STOCK

Based on currently available data, the estimated annual mortality rate incidental to U. S. commercial fisheries (0.2) is not known to exceed 10% of the PBR (9.4), and therefore can be considered to be insignificant. The annual level of human-caused mortality and serious injury (46) is not known to exceed the PBR (95) nor the IWC annual maximum (67). The Western Arctic bowhead whale stock has been increasing in recent years; the current estimate of 10,545 is between 19% and 105% of the pre-exploitation abundance (estimates ranging roughly from 10,000 to 55,000) and this stock may now be approaching its carrying capacity (Brandon and Wade 2004). However, the stock is classified as a strategic stock because the bowhead whale is listed as “endangered” under the Endangered Species Act and therefore also designated as “depleted” under the MMPA. NMFS intends to use recovery criteria developed for large whales in general (Angliss et al. 2002) and bowhead whales in particular (Shelden et al. 2001) in the next 5-year evaluation of stock status.

Habitat Issues

Increasing oil and gas development in the Arctic has led to an increased risk of various forms of pollution to bowhead whale habitat, including oil spills, toxic and nontoxic waste. Sound produced by increased levels of vessel traffic resulting from exploration and drilling operations are also of concern. Evidence indicates that bowhead whales are sensitive to sound from offshore drilling platforms and seismic survey operations (Richardson and Malme 1993, Richardson 1995, Davies 1997), and that the presence of an active drill rig (Schick and Urban 2000) or seismic operations (Miller et al. 1999) will cause bowhead whales to avoid the vicinity. Figure 2b in Schick and Urban (2000) demonstrates, however, that the area of disturbance was localized in this instance. Studies conducted as part of a monitoring program for the Northstar project (a drilling facility located on an artificial island in the Beaufort Sea) indicate that, in one of the 3 years of monitoring efforts, the southern edge of the bowhead whale fall migration path may have been slightly (2-3 mi) further offshore during periods when higher sound levels were recorded; there was no significant effect of sound detected on the migration path during the other two monitored years (Richardson et al. 2004). Evidence indicated that deflection of the southern portion of the migration in 2001 occurred during periods when there were certain vessels in the area, and did not occur as a result of sound emanating from the Northstar facility itself. Because the bowhead whale population is approaching its pre-exploitation population size and has been documented to be increasing at a roughly constant rate for over 20 years, the impacts of oil and gas industry on individual survival and reproduction in the past have likely been minor. However, the potential impacts of widespread offshore industry exploration and possibly development in both the Beaufort and Chukchi Seas is unknown.

Another element of concern is the potential for Arctic climate change, which is predicted to affect high northern latitudes more than elsewhere. There is evidence that over the last 10-15 years, there has been a shift in regional weather patterns in the Arctic region (Tynan and DeMaster 1997). Ice-associated animals, such as the bowhead whale, may be sensitive to changes in Arctic weather, sea-surface temperatures, or ice extent, and the concomitant effect on prey availability. There are insufficient data to make reliable predictions of the effects of Arctic climate change on bowhead whales.

On 22 February 2000, NMFS received a petition from the Center for Biological Diversity and Marine Biodiversity Protection Center to designate critical habitat for the Western Arctic bowhead stock. Petitioners asserted that the nearshore areas from the U.S.-Canada border to Barrow, Alaska should be considered critical habitat. On 22 May 2001, NMFS found the petition to have merit (66 FR 28141). On 30 August 2002 (67 FR 55767), NMFS announced the decision to not designate critical habitat for this population. NMFS found that designation of critical habitat was not necessary because the population is known to be approaching its pre-commercial whaling population size, the population is increasing, there are no known habitat issues which are slowing the growth of the population, and because activities which occur in the petitioned area are already managed to minimize impacts to the population.

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