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INTERNATIONAL WHALING COMMISSION

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ABSTRACT

In 2016, 59 bowhead whales (*Balaena mysticetus*) were struck during the Alaskan subsistence hunt resulting in 47 animals landed. The total number of whales landed and struck in 2016 was higher than the average for the previous 10 years (2006-2015: mean of landed = 40.1; *SD* =7.2; mean struck = 53.9; SD =11.3). The efficiency (# landed / # struck) of the hunt (80%) was also higher than the average over the past 10 years (mean of efficiency = 75%; *SD* =7%). Total mortality of the hunt for 2016 was estimated at 59 animals after the fate of the struck and lost whales was considered. Spring hunts are logistically more difficult than autumn hunts because of challenging environmental conditions, difficulty in accessing open water, and sea ice dynamics. Typically, hunting efficiency during spring is lower than autumn; however, in 2016 the spring hunt was more efficient than the autumn hunt. In 2016, the efficiency of the spring hunt was 83% and the autumn hunt was 74%. Of the six struck and lost whales during the spring, four were lost in broken ice, a fifth whale sank and the harpoon pulled out when that whale was being pulled to the surface, and the sixth was lost for unknown reasons. During the autumn a total of six whales were lost: two whales were lost in the fog, a third sank and the harpoon came out when that whale was being pulled to the surface, the harpoon pulled out of a fourth during the hunt, the harpoon failed on a fifth, and on a sixth whale the float line became tangled in the flukes and it was not possible for the hunters to follow the float because it did not remain at the surface. Of the harvested whales, 28 were females, 18 males, and sex was not determined for one animal. Based on total length or pregnancy, nine of the 28 females were presumed mature (>13.4 m in length). One female that was 12.6 m in length was pregnant with a small fetus (10 cm long). Eight of the mature females were examined. Of those, five were pregnant, three with term fetuses and two with small fetuses, which suggests a high pregnancy rate in 2016.

KEYWORDS: ARCTIC; *BALAENA MYSTICETUS*; BOWHEAD WHALE; STATISTICS; WHALING-ABORIGINAL

INTRODUCTION

The subsistence harvest of bowhead whales (*Balaena mysticetus*) meets important nutritional and cultural needs for many Native communities in northern and western Alaska (United States) and eastern Chukotka (Russian Federation). The Alaska Eskimo Whaling Commission (AEWC), comprised of 11 communities, locally manages the Alaskan harvest through an agreement with the U.S. National Oceanic and Atmospheric Administration (NOAA). The level of allowable harvest is determined under a quota system in compliance with the International Whaling Commission (IWC, 1980; Gambell, 1982). The quota is based on the nutritional and cultural needs of Alaskan Eskimos as well as on estimates of the size and

growth of the Bering-Chukchi-Beaufort seas stock of bowhead whales (Donovan, 1982; Braund, 1992). Whales were harvested in 2016 under a six-year block quota that began in 2013 (IWC, 2013).

The subsistence hunt typically occurs during spring and autumn as whales migrate between the Bering and Beaufort seas. Hunters on Saint Lawrence Island in the northern Bering Sea may harvest whales during the winter (i.e., December and January) as well. Bowhead harvests are subjected to considerable environmental interference from weather (wind speed and direction, fog, and temperature), stability of landfast ice, and sea ice concentration, type, and dynamics. The success of each hunt is greatly affected by these factors and shows considerable annual and regional variation.

Since 1981, the North Slope Borough Department of Wildlife Management (NSB DWM) has gathered basic data on landed whales in several communities, especially Barrow. In 2016, we were also able to measure and sample whales landed at Point Hope. Further, with assistance from the UAF-Marine Advisory Program, we have collected detailed information and tissue samples from harvested whales landed at Kaktovik, as well as Gambell and Savoonga on Saint Lawrence Island. We assisted the AEWC in compiling statistics on landed and struck and lost whales (Albert, 1988). The objectives of this paper are to document: (1) the number, location (village), and dates of landed and struck-and-lost bowhead whales during 2016 in Alaska, (2) the estimated fate of struck and lost bowhead whales, (3) basic morphometric data and the sex composition of the harvest, (4) the hunting efficiency, and (5) relevant additional observations (hunting conditions, unusual findings about landed whales, other whales found dead, etc.).

METHODS

Data on sex, standard length, harvest and landed dates, as well as the fate of struck and lost whales for all whaling villages were obtained from the AEWC. Biologists recorded similar information for many of the whales taken at Barrow, Gambell, Kaktovik, Nuiqsut, Point Hope, and Savoonga during 2016. Biologists also collected tissue samples and detailed morphometric data from many of the harvested whales. They also documented scar patterns, as described in George et al. (2017), for evidence of previous non-lethal human interactions (i.e., ship strikes or line entanglements) and killer whale attacks.

We estimated the approximate animal age and reproductive status based on several published criteria. Females with a total body length that is greater than 13.4 m are considered to be sexually mature; however, females shorter than this can be pregnant, and females greater in length can be immature (George *et al*., 2004). Previously, we assumed sexual maturity at a total length of 14.2 m for females (Tarpley and Hillmann, 1999) but additional data helped better define the length at sexual maturity. Males with a total body length greater than 13 m are considered to be sexually mature (O'Hara *et al*., 2002).

RESULTS AND DISCUSSION

During 2016, 59 whales were struck, and of those, 47 were landed during the Alaskan subsistence hunt. The total number of whales struck and the total number landed in 2016 were higher than the average number of whales struck and the average number landed over the previous 10 years (2006-2015: mean struck= 53.9 whales; *SD* = 11.3; mean landed= 40.1; *SD* = 7.2).

Spring Hunting Success and Conditions

Thirty bowheads were landed during the spring (Table 1). Hunting conditions during much of spring 2016 were favorable in the Bering and Chukchi seas; most of the villages that are typically successful in the spring were successful in 2016.

Savoonga and Gambell, on Saint Lawrence Island in the northern Bering Sea, each landed whales during spring. Savoonga landed a whale in late March and another in early April while Gambell landed a whale in early May. This was the first landed whale during March for Savoonga. It was a result of the Savoonga Whaling Captains decision to begin whaling several weeks earlier in an attempt to have strong shorefast ice that is better suited for landing whales for butchering. Unfortunately, sea ice thickness, quality, and extent were less than anticipated. The first landed whale broke through the only ice available causing dangerous butchering conditions and the second whale was butchered while in the water because of continuing

concerns about the stability of the ice. By early May at Gambell, shorefast ice was almost non-existent and the whale was butchered in shallow water and on sand with deteriorating shore ice to stand on. Sea ice, weather conditions, and logistical constraints prevented hunters from Little Diomede, Wales, and Kivalina from striking a whale.

Point Hope had a very successful spring hunting season. They landed seven whales between 10 April and 18 May. Point Lay landed one whale in early May. Wainwright landed seven whales during the last two weeks of April. Barrow was able to land 12 whales during the spring, from late April to mid-May. Hunting conditions for these villages were generally good during the early portion of the season, which had relatively little sea ice in the eastern Chukchi Sea. For example, there was only about 100 m of shorefast ice at Point Lay. They landed and butchered their whale on this unusually narrow band of fast ice. After mid-May, shorefast sea ice in the northeastern Chukchi Sea was unsafe, difficult to travel over, or open water was not accessible resulting in no whales being struck after mid-May.

Autumn Hunting Conditions

Seventeen whales were struck and landed by three villages during the autumn (Barrow, Kaktovik, and Nuiqsut; Table 1). Three whales were landed at Kaktovik between late August and early September. Hunting at Kaktovik began in late August when the environmental conditions were favorable and many whales were present. Nuiqsut landed four whales during late August. There were a large number of bowheads in the central Beaufort Sea at that time. The presence of many whales and good weather conditions allowed Nuiqsut to land whales about a week or so earlier than is typical.

At Barrow, 10 bowheads were landed between 20 September and 6 October. Hunters went out on 19 September, but faced heavy seas and no bowheads were seen. The first whales landed were about 45 or 50 km to the northeast of Point Barrow (e.g., 71^{o} 40N 155^{o} 21W). It is not clear why whales were farther to the east than normal, but it could have been due to the distribution of prey or possible disturbance from industrial activity (i.e., trenching and cable laying) that occurred about 150 km to the east. No whales were landed between 27 September and 4 October because of adverse weather.

Since about 2000, hunters on Saint Lawrence Island more frequently hunt for whales in the late autumn and early winter (Suydam and George, 2012; Noongwook *et al.*, 2007). However, no whales were landed in the autumn or early winter of 2016 by Gambell or Savoonga due to a sustained period of strong winds, which is typical for the northern Bering Sea and Strait in autumn. Yankee Whalers greatly feared the weather in the Bering Strait in autumn as well (Bockstoce 1986).

Struck and Lost and Hunting Efficiency

Of the 12 whales struck and lost in 2016, seven had a poor chance of survival, two died, and estimates of survival were unknown for the other three. The estimates of survival are primarily based on the Captain's assessment but may be based on our assessment of the Captain's description of the circumstances of the struck and lost whale (Table 2 and 3). Based on the number of landed whales and the assessment of survival, the total hunting mortality for 2016 was 59 whales (i.e., 47 landed, plus the 12 whales that were struck and lost, which all died, had a poor chance of survival, or had unknown fate but were categorized as died or poor based on the whales with an estimated fate; see criteria in Suydam *et al.*, 1995).

The overall efficiency of the hunt (#landed/#struck) in 2016 was 80%, which is slightly higher than the average efficiency over the past 10 years (2006-2015: mean = 75%; *SD* = 7%). Since the mid-1970s, the efficiency of the harvest increased steadily until about the mid-1990s when it stabilized around 75 to 80%. The increase was due to many factors, including enhanced communication (i.e., improved marine radio capabilities) among hunting crews, education/training of younger hunters, and improved weaponry (Suydam and George, 2012). However, efficiency can vary substantially from year to year, primarily due to environmental conditions but also to equipment failures. For example, 2010 had a relatively low efficiency of 63% (Suydam *et al.*, 2011) while 1999 had a high efficiency of 89% (George *et al.*, 2000).

The success of the spring hunt is quite sensitive to variable environmental conditions (George *et al.*, 2003). As such, efficiency varies between seasons and among years. The efficiency of the spring harvest is on average lower than the autumn harvest due to more demanding ice and weather conditions as well as struck

whales escaping under the ice. In 2016, the efficiency of the spring hunt (83%) was higher than the 2016 autumn hunt (74%) and higher than the previous 10-year average for the spring hunt (2006-2015: mean=64%, SD=0.10). Of the six struck and lost whales during the spring, four were lost in broken ice, a fifth whale sank and the harpoon pulled out when that whale was being pulled to the surface, and a sixth whale was lost for unknown reasons.

Seventeen whales were struck and landed and six were lost in the autumn 2016. Thus, the efficiency of the autumn hunt was 74%, which is considerably lower than 10-year average for the autumn hunt (2006-2015: mean=89%, SD=0.07). During the autumn a total of six whales was lost: two whales were lost in the fog, a third sank and the harpoon came out when that whale was being pulled to the surface, the harpoon pulled out of a fourth whale during the hunt, the harpoon failed on a fifth, and the float line got tangled in the flukes on a sixth whale resulting in the hunters not being able to follow that whale because the float did not remain at the surface.

Autumn hunts typically occur in more open water conditions, thus sea ice is less of an influence on success. However, high wind speeds with the larger fetch of the open water period in the autumn can make hunting opportunities extremely difficult (George *et al.*, 2003). As climate change causes a larger and longer open water period, the increased fetch contributes to larger swells that even persist after strong winds have abated. The overall hunting period has increased in recent years due to sea ice retreat, which possibly offsets inclement weather that results in poor hunting conditions. Hunters at Barrow in particular have responded to the changing hunting conditions by purchasing larger boats (~8-9 m long) capable of handling larger seas.

Sex and Maturity

Eighteen (39%) of the landed whales were males. The longest male was 17.1 m and the shortest was 7.1 m. Based on a length of >13 m (O'Hara *et al*., 2002), four males were presumably sexually mature, and three others were near maturity (12.5 m to 13 m long; see Table 1).

Twenty-eight (61%) of the landed whales were females. The longest female was 16.7 m and the shortest was 7.8 m. Based on a length >13.4 m (George *et al*., 2004) and the pregnancy of one whale that was 12.6 m long (Table 1; 16B9), nine of the females were sexually mature. Eight of those were examined for pregnancy. Five were pregnant, three with term fetuses (3.8 to 4.3 m long) and two with small fetuses (0.1 to 0.3 m long). Discounting the two females with small fetuses because they would have given birth in the following year (i.e., 2018), three (37.5% of examined mature females) were about to give birth. This pregnancy rate is about the same or slightly higher than the long-term average of 33% (George *et al.*, 2004; George *et al.*, 2011). Interestingly, a pregnant female was harvested at Point Hope on 10 April and one was also harvested at Wainwright on 26 April. More typically, pregnant females or newly born calves are not seen by hunters or during surveys at Barrow until mid- to late May (e.g., Koski et al 2006). The timing of migration in 2016 appeared to be early, at least for pregnant females.

The point estimate we use for the length of maturity is 13.4 m; however, we know some animals may become mature at shorter or longer lengths. For example, a 12.6 m female landed at Barrow in spring 2016 was pregnant. Two other short mature females that were harvested were also 12.6 m in length but were not pregnant. The longest immature female that we have examined was 14.4 m (George *et al.*, 2004; NSB unpublished data).

High variation in annual bowhead calf production, and presumably pregnancy rates, is well established (Koski *et al.*, 2008; Clarke *et al.*, 2014). However, bowheads had high pregnancy rates in both 2015 (Suydam *et al.*, 2016) and 2016. During aerial surveys (Aerial Surveys for Arctic Marine Mammals, conducted by the U.S. National Marine Fisheries Service with funding from the U.S. Bureau of Ocean Energy Management) in the Beaufort Sea in the autumn of 2016, 104 bowhead calves were observed during the summer and autumn (J. Clarke, personal communication). This number was not corrected for effort, thus there were likely many more calves present but not observed. We do not have an estimate of pregnancy rate for the population but based on data from harvested whales and aerial surveys, BCB bowheads had a strong year for reproduction in 2016.

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Table 1. Village, whale identification number, date landed, standard length (meters) and sex of bowhead whales landed by Alaskan Eskimos during the 2016 subsistence hunt.

Village	Whale ID#	Date Landed	Length (m)	Sex
Barrow	16B1	23 Apr	8.0	F
	16B2	24 Apr	9.0	F
	16B3	25 Apr	13.9	M
	16B4	30 Apr	9.1	F
	16B5	4 May	15.1[1]	F
	16B6	5 May[2]	10.2	M
	16B7	7 May[3]	8.6	F
	16B8	9 May[4]	15.1	F
	16B9	10 May	12.6[5]	F
	16B10	11 May	8.1	M
	16B11	11 May	13.0	F
	16B12	12 May[6]	15.6[7]	F
	16B13	20 Sep	12.1	F
	16B14	22 Sep	9.7	F
	16B15	25 Sep[8]	12.0	F
	16B16	26 Sep	9.3	M
	16B17	27 Sep	8.1	F
	16B18	27 Sep	12.8	M
	16B19	4 Oct	8.5	M
	16B20	4 Oct	9.0	M
	16B21	6 Oct	7.8	F
	16B22	6 Oct	14.8	F
Gambell	16G1	6 May[9]	16.7	F
Kaktovik	16KK1	27 Aug	8.0	M
	16KK2	1 Sep	7.1	M
	16KK3	6 Sep	8.0	M
Nuiqsut	16N1	25 Aug	9.5	F
	16N2	26 Aug	9.1	F
	16N3	26 Aug	10.8	F
	16N4	27 Aug	8.8	F
Point Hope	16H1	10 Apr	14.6[10]	F
	16H2	18 Apr	9.7	F
	16H3	28 Apr	16.0	M
	16H4	2 May	13.5	M
	16H5	4 May	11.6	M
	16H6	6 May[11]	7.8	U
	16H7	18 May	17.1	M
Point Lay	16PL1	1 May	11.2	M
Savoonga	16S1	27 Mar	12.9[12]	M
	16S2	5 Apr	12.6[13]	F
Wainwright	16WW1	16 Apr	12.6	M
	16WW2	22 Apr	8.2	F
	16WW3	22 Apr	10.1	M
	16WW4	24 Apr	8.7	F
	16WW5	24 Apr	16.5	F
	16WW6	26 Apr	14.3[14]	F
	16WW7	30 Apr	9.2	F

[1] Pregnant; female fetus, 4.3 m long.
[2] Struck on 2 May 2016 but recovered as a "stinker" on 5 May.
[3] Struck on 6 May but landed on 7 May.
[4] Struck on 8 May but landed on 9 May.
[5] Pregnant; sex of fetus was not determined, 0.1 m long.
[6] Struck on 11 May but landed on 12 May.

[7] Pregnant; sex of fetus was not determined, 0.3 m long.
[8] Struck on 24 Sep but landed on 25 Sep.
[9] Struck on 5 May but landed on 6 May. Length is approximate.
[10] Pregnant; male fetus, 3.8 m long.
[11] Struck on 4 May and recovered as a "stinker" on 6 May.
[12] Estimated length, based on our equation for body length (cm) = 0.388 * fluke width-46.45.
[13] Estimated length.
[14] Pregnant; sex of fetus was not determined, 3.8 m long.

Table 2. Locations, dates, season, and Captains' estimate of survival or our assessment based on the Captain's description, for whales struck and lost during 2016. Data provided by the Alaska Eskimo Whaling Commission.

Village	Date	Season	Estimated Survival
Barrow	2 May	Spring	Poor
	7 May	Spring	Died
	21 Sep	Autumn	Poor
	22 Sep	Autumn	Died
	22 Sep	Autumn	Poor
	24 Sep	Autumn	Poor
	25 Sep	Autumn	Poor
	27 Sep	Autumn	Poor
Point Hope	18 Apr	Spring	Poor
	29 Apr	Spring	Unknown
	3 May	Spring	Unknown
	5 May	Spring	Unknown

Table 3. Summary of the number of landed bowhead whales and the Captains' estimate of survival (or our assessment based on the Captain's description) for whales struck and lost during 2016. Data provided by the Alaska Eskimo Whaling Commission.

Village	Landed	Struck & Lost	Total Struck	Estimated Survival[1]
Barrow	22	8	30	6P; 2D
Gambell	1		1	-
Kaktovik	3		3	-
Nuiqsut	4		4	-
Point Hope	7	4	11	1P; 3 U
Point Lay	1		1	-
Savoonga	2		2	-
Wainwright	7		7	-
				-
Totals	47	12	59	7P; 2D; 3U

[1] P=poor; D=died; U=unknown.