Subsistence harvest of bowhead whales (*Balaena mysticetus*) by Alaskan Eskimos during 2013

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ABSTRACT

In 2013, 57 bowhead whales (*Balaena mysticetus*) were struck during the Alaskan subsistence hunt resulting in 46 animals landed. Total number of whales landed in 2013 was higher than the average for the previous 10 years (2003-2012: mean of landed = 40.5; *SD* = 8.7) as was the number struck (2003-2012: mean struck = 53.3; SD = 13.3). The efficiency (# landed / # struck) of the hunt (81%) was slightly higher compared to the past 10 years (mean of efficiency = 77%; *SD* = 7.4%). Total mortality for 2013 was estimated at 51 animals after the estimated fate of the struck and lost whales was considered. Spring hunts are logistically more difficult than autumn hunts because of severe environmental conditions and sea ice dynamics. Typically, hunt efficiency during spring is lower than autumn. In 2013, the efficiency of the spring hunt (67%) was lower than the autumn hunt (89%). This was largely due to presence of ice during spring. At least five of the struck whales were lost under the ice. Of the landed whales, 25 were females and 21 were males. Based on total length, seven of the 25 females were presumed mature (>13.4 m in length). Of the mature females, four were pregnant. Three apparently independent calves were inadvertently taken during the autumn hunts in the Beaufort Sea. The presence of four pregnant animals and three calves in the harvest suggests that the pregnancy rate was high in 2013.

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

INTRODUCTION

The subsistence harvest of bowhead whales (*Balaena mysticetus*) meets an important nutritional and cultural need for several Native communities in northern and western Alaska (United States) and eastern Chukotka (Russia). 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 2013 under a five-year block quota that began in 2008 (IWC, 2008).

The subsistence hunt typically occurs during spring and autumn as whales generally migrate between the Bering and Beaufort seas. Hunters on St. 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 has gathered basic data on landed whales in several communities, especially Barrow. Additionally, with assistance from the UAF-Marine Advisory Program and previously with the Alaska Department of Fish and Game, we have collected detailed information and tissue samples from harvested whales landed at Kaktovik, Gambell and Savoonga on Saint Lawrence Island, and other villages in recent years. We assisted the AEWC in compiling statistics on landed and struck and lost whales (Albert, 1988). The objectives of this paper were to document: (1) the number, location (village), and dates of landed and struck-and-lost bowhead whales during 2012 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 of the harvest, and (5) relevant additional observations (hunting conditions, unusual findings about landed whales, etc.).

METHODS

Harvest data on sex, standard length, harvest and landed dates, as well as fate of struck and lost whales for all whaling villages were obtained from the AEWC. Biologists recorded similar information for most whales taken at Barrow, Gambell, Savoonga, and Kaktovik. Biologists also collected tissue samples and detailed morphometric data, and documented scars and other evidence of previous human interactions caused by ship strikes or line entanglements.

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 in length 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). 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 2013, 57 whales were struck during the Alaskan subsistence hunt. The total number of whales landed (n = 46) and struck in 2013 was higher than the average number of whales landed and struck over the previous 10 years (2003-2012: mean = 40.5 whales; *SD* = 8.7; mean = 53.3; *SD* = 13.3, respectively).

Spring Hunting Conditions

Twelve bowheads were landed during the spring (Table 1). Hunting conditions during spring 2013 were generally favorable in the Bering Sea and southern Chukchi Sea, as far north as Point Hope. Farther north, the spring conditions were not conducive to hunting.

Gambell and Savoonga, communities on Saint Lawrence Island in the Bering Sea, landed two and four whales during April, respectively. Spring 2013 in the northern Bering Sea was marked by cold conditions. Of note, bowheads were not noticeably segregated at Saint Lawrence Island by age class during the spring migration, nor was there a mid-April pulse of movement. Many young whales were observed near the island, even toward the end of April, which is somewhat unusual. Farther north the ice and weather conditions prevented hunters from Little Diomede, Wales, and Kivalina from striking a whale.

Point Hope was able to land six whales in the spring, five in early May and the sixth on 1 June. No whales were landed at Point Lay, Wainwright, or Barrow during the spring. The leads closed in mid-April and mostly remained closed through early June due to persistent west winds (Fig. 1). Thus, hunters did not have access to open water and therefore bowhead whales. This is the first time since at least 1972 that hunters at Barrow and possibly Wainwright did not at least strike a whale during the spring. Prior research has shown that easterly winds are necessity for a successful spring whale hunt for the villages along the northeast Chukchi Sea coast (i.e., Point Lay, Wainwright, and Barrow) (George et al., 2003). The spring 2001 hunt at Barrow and Wainwright was a particularly successful season with 25 whales landed under predominantly east winds (Fig. 1; Suydam et al. 2002). In contrast, May 2013 was a season with no whales struck or landed in Point Lay, Wainwright and Barrow and winds were predominately from the west (Fig. 1).

Because spring conditions were so difficult, some crews at Barrow continued to hunt for whales into early summer. They were able to access open water once the shore-fast ice started to break up in June and July. Two whales were landed during this time, one in late-June and another in mid-July. Whales are rarely landed at this time of the year. The last whales landed in early summer were in Barrow on 15 June 1987 and in Wainwright on 16 June 1995. The last whale landed in July was on 13 July 1986 in Barrow.

Autumn Hunting Conditions

Thirty-two whales were landed by five villages during the autumn (Barrow, Kaktovik, Nuiqsut, Savoonga, and Wainwright; Table 1). Kaktovik hunters landed three whales between late August and mid-September. Hunting conditions were favorable for Nuiqsut where they completed their hunt by landing four whales from 1 to 13 September.

At Barrow, 20 bowheads were landed, between 15 September and 2 October. Hunters in Barrow initiated the autumn season earlier than in the recent past, in part because of the poor hunting conditions during the spring. Weather conditions were generally good although strong winds prevented hunting from 17 to 21 September.

Beginning in 2010, for the first time in many decades, Wainwright successfully landed bowheads during the autumn. They landed three whales in late September and early October. There was strong motivation for Wainwright to hunt in autumn because no whales were landed in the spring due to the very poor conditions.

Savoonga landed two large female bowheads in early December. Since about 2000, hunters on Saint Lawrence Island have hunted more frequently for whales in the late autumn and early winter (Suydam and George 2012).

Struck and Lost and Hunting Efficiency

Of the 11 whales that were struck and lost in 2013, four had a fair chance of survival, two had a poor chance of survival, two died and an estimated survival estimate was not recorded for three whales. 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). This suggests the total hunting mortality for 2013 was 50 whales (i.e., 44 landed, two whales that likely died but were lost, two whales with a poor chance of survival, and 50%, rounded up, of the three whales with unknown survival estimates) based on criteria in Suydam et al. (1995).

The overall efficiency of the hunt (#landed/#struck) in 2013 was 81%, which is slightly higher than the average efficiency over the past 10 years (2003-2012: mean = 77%; *SD* = 7.4%). Since the mid-1970s, the efficiency of the harvest increased steadily until about the mid-1990s when it stabilized at about 80%. The increase was due to many factors, including enhanced communication (i.e., improved marine radio capabilities) among hunting crews, training of younger hunters, and improved weaponry (Suydam and George, 2012). However, the efficiency can vary substantially from year to year, primarily due to environmental conditions. For example, 2010 had a relatively low efficiency of 63% for a variety of reasons (see Suydam *et al*., 2011).

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 2010, the overall efficiency of the spring hunt was quite low at 52%. However, in 2011, the efficiency of the spring hunt improved to 69% despite difficult ice conditions. Despite difficult hunting conditions in the spring, the efficiency in 2013 was again relatively high at 67%.

The autumn hunts were successful and efficient (89%) in 2013. Thirty-two whales were landed and four were lost. 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 greater

and longer period of retreat of sea ice, 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 resulting in poor hunting conditions. Hunters at Barrow in particular have responded to the changing hunting conditions by purchasing larger boats (8 m) capable of handling larger seas.

Sex and Maturity
Twenty-one (48%) of the landed whales of known sex (n = 44) were males. The longest male was 14.6 m and the shortest was 7.0 m. Based on a length of >13 m (O'Hara *et al*., 2002), two males were presumably sexually mature.

Twenty-five (54%) of the landed whales (n = 46) were females. The longest female was 17.4 m and the shortest was 6.8 m. Based on a length > 13.4 m (George *et al*., 2004), seven of the females were estimated to be sexually mature. Four (57%) of those whales were pregnant. While the sample size is relatively low, there is again the suggestion of a high pregnancy rate in 2013. In 2012, all five of mature females that were closely examined were pregnant. In comparison, two of seven (29%) presumably mature females were pregnant in 2011, which is consistent with the long-term average of about 33% (George et al., 2004; George et al., 2011).

The point estimate we use of the length of maturity is 13.4 m; however, we know some animals may become mature at shorter or longer lengths. For example, a 13.1 m female landed at Gambell in the spring 2013 was pregnant. The other pregnant whales were longer than 13.4 m. Two were landed at Savoonga, a 15.5 m female with a 3.7 m fetus and a 16.9 m female with a 2.0 m fetus. The other was landed at Barrow, a 16.5 m female with a 2.7 m male fetus.

Three apparently independent calves were inadvertently landed in 2013 and will be reported to the IWC as infractions. We based our assessment of the whales being calves primarily on the length of baleen (< 55cm; George et al. 2014). Additional information that might be helpful for determining whether an animal is a calf includes the presence of milk in the stomach and standard length. These last two characteristics are not always definitive. Calves and occasionally yearlings can both have milk in stomachs and their standard lengths can overlap (George and Suydam 2006). Two calves were landed in Barrow in the autumn, one a 6.8m female and the other was a 7.0m male. The third calf was landed in Nuiqsut. It was 8.3m long female with short baleen; although it is not known if this was a standard or curvilinear length. The presence of three calves and four pregnant females in the harvest suggests that the Bering-Chukchi-Beaufort stock of bowheads continues to be healthy and produce many young. Results from aerial surveys also indicate 2013 was a very productive year for bowheads. Aerial surveys conducted during the autumn of 2013 observed the highest ratio of calves since surveys began in 1979 (Clarke et al. 2014).

Pathological findings
Only a few case reports on pathological findings have been published about bowheads indicating that they are very healthy with very few natural disease conditions being present. We observed the following unusual findings in 2013 that were made in otherwise healthy subsistence harvested whales: (1) a case of a single large ovarian cyst in a pregnant female, (2) multiple lipomas of the liver in a female adult whale, (3) congenital gross anatomical liver anomaly in an immature male and immature female whale, and (4) a single well encapsulated granuloma within the mesentery in a female immature whale. All findings reported here have not been documented before, with the exception of the lipoma of the liver. The latter benign tumor has been previously reported in an immature male bowhead whale (Migaki and Albert 1982). Observed pathological findings are considered incidental without a significant negative effect on overall bowhead whale health and/or human consumption of these animals.

Non-Harvest Human Interaction
At least two of the landed bowheads (13S1, 13KK3) exhibited scarring associated with line entanglements in the peduncle/tail region (Figs. 1 and 2). One whale (13S1) had scarring not only associated with an entanglement with a large diameter line, but also had injuries, still open and healing, associated with a more recent entanglement event (Fig. 1). The presence of scarring associated with 13KK3 were unusual for such a young animal and appeared to be made from a smaller diameter line (Fig. 2).

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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 2013 subsistence hunt.

Village	Whale ID#	Date Landed	Length (m)	Sex
Barrow	13B1	26 Jun 2013	16.5[1]	F
	13B2	16 Jul 2013[2]	13.5	M
	13B3	15 Sep 2013	7.9	M
	13B4	15 Sep 2013	11.7	M
	13B5	15 Sep 2013	9.9	M
	13B6	16 Sep 2013	9.4	F
	13B7	16 Sep 2013	8.6	F
	13B8	22 Sep 2013	6.8[3]	F
	13B9	22 Sep 2013	9.2	F
	13B10	22 Sep 2013	11.4	M
	13B11	23 Sep 2013	11.3	M
	13B12	25 Sep 2013	8.6	F
	13B13	25 Sep 2013	7.0[4]	M
	13B14	25 Sep 2013	9.2	M
	13B15	26 Sep 2013	9.7	M
	13B16	26 Sep 2013	10.7	F
	13B17	26 Sep 2013	9.2	M
	13B18	28 Sep 2013	11.4	F
	13B19	28 Sep 2013	8.0	M
	13B20	28 Sep 2013	8.6	F
	13B21	2 Oct 2013	8.5	F
	13B22	2 Oct 2013	8.2	F
Gambell	13G1	3 Apr 2013[5]	13.1[6]	F
	13G2	20 Apr 2013	11.4	M
Kaktovik	13KK1	30 Aug 2013	9.0	F
	13KK2	5 Sep 2013	8.5	F
	13KK3	12 Sep 2013	8.4	F
Nuiqsut	13N1	1 Sep 2013	8.3	M
	13N2	6 Sep 2013	14.8	F
	13N3	14 Sep 2013[7]	14.6	M
	13N4	13 Sep 2013	8.3[8]	F
Point Hope	13H1	1 May 2013	7.9	F
	13H2	1 May 2013	8.5	F
	13H3	2 May 2013	8.9	M[9]
	13H4	2 May 2013	9.2	M[10]
	13H5	3 May 2013	9.0	M
	13H6	1 Jun 2013	11.6[11]	M
Savoonga	13S1	11 Apr 2013	15.5[12]	F
	13S2	19 Apr 2013	12.8	F
	13S3	21 Apr 2013	8.8	M
	13S4	25 Apr 2013	9.4	M
	13S5	4 Dec 2013	16.9[13]	F
	13S6	6 Dec 2013	17.4	F
Wainwright	13WW1	27 Sep 2013	9.6	F
	13WW2	27 Sep 2013	13.8	F
	13WW3	2 Oct 2013	12.2	M

[1] Pregnant with a 2.8m male fetus.
[2] Whale struck on 10 July 2013 but lost in the ice. It was found again on 16 July 2013.
[3] Calf based on length of baleen (33.5cm) and milk in stomach.
[4] Calf based on length of baleen (39cm) and milk in stomach.
[5] Whale struck on 2 April 2013 but landed on 3 April.
[6] Pregnant; the fetus was observed but length and sex were not determined.

[7]Struck on 11 Sep 2014, it died and sank but floated and was landed on 14 Sep 2014.
[8]Reported as a calf based on short baleen.
[9]Reported as a female but it was likely a male based on a long genital groove.
[10]Reported as a female but it was likely a male based on a long genital groove.
[11]Estimated length of 11.6 based on a half measurement of fluke width ((402cm fluke+46.446)/0.388)
[12] Pregnant with ~3.7 m fetus (sex undetermined)
[13]Pregnant with a 2.0 m fetus (sex undetermined)

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 2013. Data provided by the Alaska Eskimo Whaling Commission.

Village	Date	Season	Estimated Survival
Barrow	26 Jun 2013	Summer	Fair
	26 Sep 2013	Autumn	Fair
Gambell	18 Apr 2013	Spring	Poor
	2 May 2013	Spring	Unknown
Nuiqsut	12 Sep 2013	Autumn	Fair
Point Hope	7 Apr 2013	Spring	Died
	30 Apr 2013	Spring	Fair
Savoonga	9 Apr 2013	Spring	Unknown
	21 Apr 2013	Spring	Unknown
Wainwright	27 Sep 2013	Autumn	Poor
	30 Sep 2013	Autumn	Died

Table 3. Summary of the number of landed bowhead whales and Captains' estimate of survival, or our assessment based on the Captain's description, for whales struck and lost during 2013. Data provided by the Alaska Eskimo Whaling Commission.

Village	Landed	Struck & Lost	Total Struck	Estimated Survival[1]
Barrow	22	2	24	2F
Gambell	2	2	4	P; U
Kaktovik	3	-	3	-
Nuiqsut	4	1	5	F
Point Hope	6	2	8	F; D
Savoonga	6	2	8	2U
Wainwright	3	2	5	P; D
Totals	46	11	57	4F; 2P; 2D; 3U

[1] E=excellent; F=fair; P=poor; D=died; U=unknown.

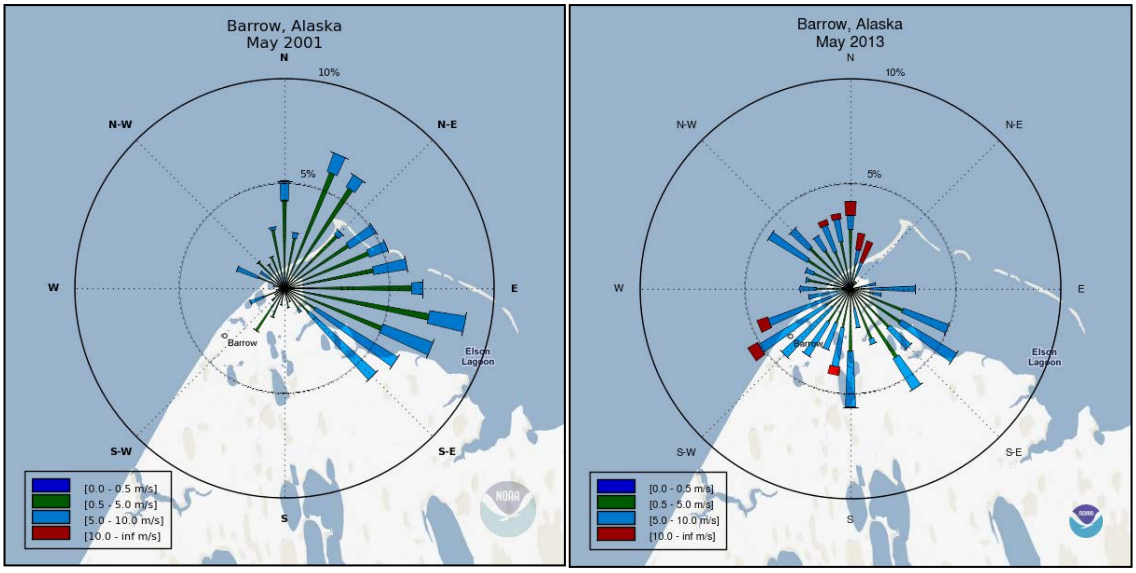

Figure 1. Wind rose diagrams for two whaling seasons at Barrow. Left panel: May 2001 in which 18 whales were landed at Barrow. Right panel: May 2013, a season with no whales were struck or landed. The correlation between a successful spring whaling season for the villages along NE Chukchi coast and persistent east winds is a well-established relationship (George et al. 2003).

Figure 2. Broad white line entanglement scars (upper photo) on the peduncle region as well as recent entanglement damage (lower photo) to the anterior edge of the fluke of a 15.5 m female bowhead whale harvested near Gambell during April 2013 (13S1).

Figure 3. Line entanglements scars (white) on the peduncle and flukes of a 8.4 m female bowhead whale harvested near Kaktovik during September 2013 (13KK3).