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INTERNATIONAL WHALING COMMISSION

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[1]Robert Suydam, [1]John C. George, [1]Brian Person, [1]Dave Ramey, [1]Raphaela Stimmelmayr, [1]Todd Sformo, [1]Leslie Pierce and [2]Gay Sheffield

[1] Department of Wildlife Management, North Slope Borough, Box 69, Barrow, AK 99723 USA
[2] University of Alaska Fairbanks, Marine Advisory Program, Box 400, Nome, AK 99762 USA
Contact email: robert.suydam@north-slope.org

ABSTRACT

In 2015, 48 bowhead whales (*Balaena mysticetus*) were struck during the Alaskan subsistence hunt resulting in 38 animals landed. Two other whales were found dead. Skin with blubber was removed from both for human consumption resulting in a total of 50 bowheads used in 2015. The total number of whales landed and struck in 2015 was a bit lower than the average for the previous 10 years (2005-2014: mean of landed = 41.8; *SD* =8.5; mean struck = 55.9; SD =11.9; respectively). The efficiency (# landed / # struck) of the hunt (79%) was a bit higher than the average over the past 10 years (mean of efficiency = 75.3%; *SD* =0.1%). Total mortality of the hunt for 2015 was estimated at 44 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. In 2015, the efficiency of the spring hunt (67%) was considerably lower than the autumn hunt (92%). This was largely due to mechanical/technical difficulties and the presence of ice during spring. At least one of the struck whales was lost under the ice, two sank and the harpoon came out when being pulled to the surface, and at least four were lost due to equipment failures/technical difficulties. Of the harvested whales, 19 were females and 19 males. The two whales found dead included a male (15B22) and female (2015-FD). Based on total length, 12 of the 19 females were presumed mature (>13.4 m in length). Ten of the mature females were examined. Of those, two had recently given birth, 3 were pregnant with term fetuses (found during the spring hunt), and 2 were pregnant with small fetuses (found during the autumn hunt) suggesting a high pregnancy rate in 2015.

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 2015 under a six-year block quota that began in 2013 (IWC, 2013).

The subsistence hunt typically occurs during spring and autumn as whales generally 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 2015, 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 were to document: (1) the number, location (village), and dates of landed and struck-and-lost bowhead whales during 2015 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, (5) relevant additional observations (hunting conditions, unusual findings about landed whales, other whales found dead, etc.), and (6) a brief summary of a proposed bowhead survey in 2017.

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 in 2015. Biologists also collected tissue samples, detailed morphometric data, and documented evidence from scarring 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 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 2015, 48 whales were struck and of those, 38 were landed during the Alaskan subsistence hunt. Two other whales were found dead and salvaged (i.e., butchered—skin and blubber and baleen were removed) resulting in a total of 50 bowheads used in 2015. The total number of whales that were struck and the total number landed in 2015 was lower than the average number of whales struck and the average number landed over the previous 10 years (2005-2014: mean struck= 55.9 whales; *SD* = 11.9; mean landed= 41.8; *SD* = 8.5; respectively).

Spring Hunting Success and Conditions

Sixteen bowheads were landed during the spring (Table 1). As during 2014, hunting conditions during much of spring 2015 were difficult in the Bering and Chukchi seas, primarily because of sustained wind and the poor quality and quantity of sea ice.

Savoonga and Gambell, on Saint Lawrence Island in the Bering Sea, each landed a whale during late April and early May, respectively. More typically, each village lands about two whales per year (Suydam and George 2012). Strong winds of unusual duration limited hunting crew's time on the water during the whale migration, which limited harvest opportunities. Sea ice and weather conditions prevented hunters from Little Diomede, Wales, and Kivalina from striking a whale.

Point Hope landed three whales in the spring, two during the middle of April, and one in early May. No whales were landed at Point Lay during the spring. Wainwright and Barrow were able to land two and nine whales, respectively. Hunts were limited by winds and ice conditions in 2015 in these villages. At Barrow, whale hunters had good access to leads but several of the camps were set on unstable ice west of Barrow which essentially disintegrated by 20 May. Conditions immediately southwest of Barrow were more stable but access required traveling long distances and ice conditions deteriorated in May. Whale hunting ended on 25 May as ice degraded substantially along all areas of the coast near Barrow.

Autumn Hunting Conditions

Twenty-two whales were struck and landed by four villages during the autumn (Barrow, Kaktovik, Nuiqsut, and Wainwright; Table 1). Four whales were landed at Kaktovik between the middle of September and early October. Hunting at Kaktovik was delayed because of strong winds in early September. Nuiqsut landed two whales during early September but subsequent strong winds prevented further harvest efforts.

At Barrow, 16 bowheads were struck and landed, between 25 September and 4 October. One additional whale was found floating dead ~15-20 kilometers to the east of Point Barrow. The whale was still in good enough condition that it was towed back to Barrow and butchered. The maktaq (i.e., the black skin and outer blubber) and baleen were taken. This whale was not reported as a strike (i.e., not reported as part of the total harvest mortality) but we report its biological data in this manuscript (Table1; 15B22). It was not clear what caused its death but rake marks on its flukes and flipper indicate a potential killer whale predation event, although its lips and tongue were still present. There was also a large "rip" in its ventral surface possibly from a ship strike. We carefully looked for entry wounds or harpoon injuries but found no evidence of a previous strike.

Wainwright landed one whale in mid-September. Hunting bowheads in the autumn by Wainwright hunters is becoming more common, especially because spring hunting conditions are increasingly difficult primarily due to thinner and less predictable shorefast sea-ice.

Weather conditions were generally good near Barrow and Wainwright in the autumn although strong winds prevented hunting for only short periods of time.

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 2015 by Gambell or Savoonga due to a sustained period of strong North winds.

Struck and Lost and Hunting Efficiency

Of the 10 whales struck and lost in 2015, four had an excellent chance of survival, two a poor chance of survival and four died. 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 Captains' assessment of survival, the total hunting mortality for 2015 was 44 whales (i.e., 38 landed, plus four whales that died but were lost, and two whales with a poor chance of survival; based on criteria in Suydam et al. 1995).

The overall efficiency of the hunt (#landed/#struck) in 2015 was 79%, which is slightly higher than the average efficiency over the past 10 years (2005-2014: mean = 75.3%; *SD* = 0.1%). Since the mid-1970s, the efficiency of the harvest increased steadily until about the mid-1990s when it stabilized at about 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 2015, the efficiency of the spring hunt was 67%. Whales were lost in the spring due to escaping or dying under the ice (n≥2), mechanical and technical difficulties (n≥3), or for other unknown reasons.

The autumn hunts were successful and very efficient (92%) in 2015. Twenty-two whales were struck and landed and only two 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 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 resulting 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
Nineteen (50%) of the landed whales were males. The longest male was 14.5 m and the shortest was 7.0m. Based on a length of >13m (O'Hara *et al*., 2002), three males were presumably sexually mature and 4 others were near maturity (12.5m to 13m long).

Nineteen (50%) of the landed whales were females. The longest female was 18.3m and the shortest was 5.7m. The smallest female (5.7m long) was a calf that was accidentally struck near Point Hope. The 7.6m female that was found dead (Table 1; 15B22) was also likely a calf. It had short baleen that was 46cm long, which is characteristic of a calf (George and Suydam 2006). Based on a length >13.4 m (George *et al*., 2004), 12 of the females were estimated to be sexually mature. Only 10 of these were examined for pregnancy. Seven (64%) of the 10 whales >13.4m that were closely examined were pregnant or had just given birth. Two of these seven had small fetuses, while another 2 had recently given birth and 3 carried term fetuses. Discounting the two females with short fetuses because they would have given birth in the following year (i.e., 2016), five (50%) had recently or were about to give birth. This pregnancy rate is considerably higher than the long-term average of about 33% (George et al., 2004; George et al., 2011). The long-term estimate from George et al (2004) agrees well with our 2005-2014 average (34.9%; SD = 24.7%; Suydam et al. 2014). High variation in annual bowhead calf production, and presumably pregnancy rates, is well established in the literature (Koski et al. 2008; Clarke et al. 2014).

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 13.1 m female landed at Gambell in the spring 2013 was pregnant. The two shortest mature females landed to date were 12.6 m; however, the longest immature female is 14.4 m (George et al. 2004; NSB unpublished field notes). The pregnant whales harvested during 2015 were all longer than 13.4 m.

Pathological findings
Similar to 2014 (Suydam et al. 2015; Stimmelmayr, 2015), a number of unusual findings (abnormal; pathological) were observed in four subsistence harvested bowhead whales in 2015. Briefly, abnormal findings included: (1) a small hepatic fatty tumor in one immature and one mature whale; (2) multiple (~100) discrete pedunculated small sized (0.5-1cm) mesovarian leiomyomas (benign smooth muscle cell tumor) in a pregnant mature female; (3) a single well encapsulated mass (infarcted adipose tissue) from the thorax of an immature whale, and (4) *chronic thoracitis* with ~ 100 well encapsulated abscesses of variable sizes (~50 – 1500 g) in conjunction with a chronic whale bomb related tail stock wound in a mature whale. Hunters and elders decided this whale posed a potential human health risk and was unfit for human consumption due to the large number of abscesses in the thoracic cavity in conjunction with the ongoing chronic tail stock wound.

With the exception of case (4), we considered the other pathological findings were incidental and did not pose a significant negative effect to bowhead whale health and/or human consumption of these animals. Hepatic lipoma in bowhead whales have been previously reported (Migaki and Albert 1982; Stimmelmayr 2015; Suydam et al. 2015). Uterine leiomyomas have been reported in toothed whales (Newman and

Smith, 2006; Diaz-Delgado et al. 2015), but not mesovarial. This is the first report of leiomyomas in a baleen whale.

A recent harmful algal bloom (HABS) exposure study (Lefebvre et al. 2016) provided evidence that bowhead whales, and other Arctic marine mammals foraging in Alaskan waters, have been exposed to toxins from harmful algae. Currently, there is no evidence that present exposure levels have negative health consequences to bowhead whales or to subsistence hunters or others who consume the whales. However, results have raised concerns among subsistence communities and scientists about potential future health impacts. NOAA-Wildlife Algae Toxin Research and Response Network for the US West Coast (WARRN-West), in partnership with the NSB DWM and the AEWC, is conducting a large scale retro and prospective screening survey for domoic acid in feces of subsistence-harvested bowhead whales to better understand past and current exposure risk for Arctic marine mammals and subsistence communities. Preliminary analyses of domoic acid exposure data (2002-2015) showed great interannual variability. The contribution of biological, physical, and climatic variables on domoic acid trends in bowhead whales as an Arctic sentinel species are being explored using a modeling approach.

Non-Harvest Related Human Interaction and Found Dead Bowheads
During July 2015, one dead floating adult female bowhead whale (2015-FD2) was observed near Saint Lawrence Island in the Bering Strait. This whale was entangled in lines, two floats, and an attached color coded/numbered permit tag confirming the gear was from the 2012/2013 winter commercial Blue King Crab fishery in Saint Matthew Island waters of the northern Bering Sea (Sheffield and Savoonga Whaling Captains Association, 2015).

Multiple (~11whales) dead and floating bowheads were reported in the Chukchi and Beaufort seas by the Aerial Survey of Arctic Marine Mammals project (ASAMM; funded by the Bureau of Ocean Energy Management). Most of these were small whales and some appeared to have died from killer whale attacks. The number of observations of floating dead bowheads suggests that mortality was higher in 2015 for smaller bowheads. However, the number of sightings might be due to the substantial aerial survey efforts that included considerable autumn coverage by ASAMM particularly in the Chukchi Sea. None of the reported floaters were retrieved, so assessments of external signs of trauma or potential cause of death were based on examination of photos. Two animals had evidence of killer whale predation (i.e. rake marks, jaw and tongue missing etc.).

Scars from killer whale predation/attacks have been previously documented in subsistence-harvested and stranded bowhead whales (George et al. 2015; Stimmelmayr 2015). The rate and hence importance of killer whale predation/attacks on bowhead whales appears to be increasing. As discussed by Clarke et al. (2014): " *Reasons for this increase might include: better reporting and/or sampling bias, increase in killer whale population size, an increase in occurrence of killer whales at high latitudes (Clarke et al. 2013), and a longer open water period offering more opportunities to attack bowheads*". Maintaining beach and aerial survey monitoring efforts for stranded bowhead whales in Alaska is warranted to better understand the importance of non-harvest related mortality in BCB bowhead whales.

Proposed bowhead survey in 2017
Plans are underway to conduct an abundance estimate in 2017 or 2018. The method used will either be an ice-based visual/acoustic survey or aerial photo capture-recapture survey, both of which have been reviewed and approved by the SC in the past. We will not be able to conduct both types of surveys as was done in 2011 due to financial constraints. The final decision about which approach to use will depend on funding, environmental conditions, (i.e., specifically shorefast ice conditions) and scientific considerations.

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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 2015 subsistence hunt.

Village	Whale ID#	Date Landed	Length (m)	Sex
Barrow	15B1	3 May	8.4	M
	15B2	7 May	12.9	M
	15B3	8 May	15.4	F
	15B4	16 May	14.4[1]	F
	15B5	18 May	14.9[1,2]	F
	15B6	19 May	13.7[1,3]	F
	15B7	19 May	14.6[1]	F
	15B8	19 May	13.8	F
	15B9	25 May	18.3[1,4]	F
	15B10	25 Sep	9.6	F
	15B11	25 Sep	10.5	M
	15B12	25 Sep	9.0	F
	15B13	27 Sep	9.0	M
	15B14	27 Sep	8.7	M
	15B15	27 Sep	12.8	M
	15B16	28 Sep	10.9	M
	15B17	2 Oct	11.5	M
	15B18	2 Oct	11.6	F
	15B19	3 Oct	8.2	M
	15B20	3 Oct	11.9	F
	15B21	3 Oct	12.6	M
	15B22	4 Oct	7.6[5]	M
	15B23	4 Oct	8.9	M
	15B24	4 Oct	14.5[6]	F
	15B25	4 Oct	9.0[7]	F
Gambell	15G1	2 May	15.2[8]	F
Kaktovik	15KK1	13 Sep	12.8	M
	15KK2	22 Sep	12.7	M
	15KK3	23 Sep	13.6	M
	15KK4	5 Oct	14.5	M
Nuiqsut	15N1	2 Sep	14.7[9]	F
	15N2	8 Sep	7.5	M
Point Hope	15H1	11 Apr	8.0	M
	15H2	12 Apr	9.0	M
	15H3	5 May	5.7[10]	F
Savoonga	15S1	25 Apr	13.7	F
Wainwright	15WW1	2 May	14.3	M
	15WW2	7 May	14.9[11]	F
	15WW3	20 Sep	8.7	F

[1] Approximate length—ice conditions or equipment failure did not allow the entire whale to be pulled onto the ice.
[2] Lactating; regressing corpus luteum (~6cm in diameter); likely gave birth earlier in the season.
[3] Accompanied by a new born calf, which was not seen by harpooner when the whale was struck.
[4] Pregnant—female fetus, 422 cm long.
[5] Found dead; towed to Barrow and partially butchered; possible killer whale predation or ship strike. Not counted as a strike. It was likely a calf based on its baleen length; 46cm.
[6] Pregnant—female fetus, 175 cm long.
[7] Struck on 2 October but found dead, landed and butchered on 4 October.
[8] Pregnant—female fetus, 455cm long.
[9] Pregnant—male fetus, 118 cm long.
[10] Calf—very short whale, light gray in color.
[11] Pregnant—fetus, sex not determined, 366cm 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 2015. Data provided by the Alaska Eskimo Whaling Commission.

Village	Date	Season	Estimated Survival
Barrow	17 Apr	Spring	Poor
	24 Apr	Spring	Died
	17 May	Spring	Excellent
	18 May	Spring	Died
	18 May	Spring	Excellent
	28 Sep	Autumn	Died
Gambell	31 Mar	Spring	Poor
Point Hope	1 May	Spring	Excellent
	7 May	Spring	Excellent
Wainwright	16 Oct	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 2015. Data provided by the Alaska Eskimo Whaling Commission.

Village	Landed	Struck & Lost	Total Struck	Estimated Survival[1]
Barrow	24[2]	6	30	2E; P; 3D
Gambell	1	1	2	P
Kaktovik	4	0	4	-
Nuiqsut	2	0	2	-
Point Hope	3	2	5	2E
Savoonga	1	0	1	-
Wainwright	3	1	4	D
				-
Totals	38	10	48	4E; 2P; 4D

[1] E=excellent; F=fair; P=poor; D=died; U=unknown.
[2]One other whale was found floating east of Barrow, likely due predation from killer whales or to a collision with a ship. It was landed and butchered.