

# Preliminary analysis of subsistence harvest data concerning bowhead whales (*Balaena mysticetus*) taken by Alaskan Natives, 1974 to 2011

Robert S. Suydam and John C. George

Department of Wildlife Management, North Slope Borough, Box 69, Barrow, AK 99723 USA  
Contact email: robert.suydam@north-slope.org

## ABSTRACT

The harvest of bowhead whales (*Balaena mysticetus*) by Alaskan Natives fills important subsistence and cultural needs for several communities along the arctic coast of Alaska. In 1977, the International Whaling Commission banned hunting of bowheads because of the perceived low population abundance of bowheads, increased strikes and the increased number of hunting crews. A quota system was implemented in 1978. The quota provides for the bowhead population to increase while allowing Alaskan Natives to fill their subsistence and cultural needs. Harvest data have been collected since the mid-1970s. Between 1974 and 2011, hunters from 12 villages, extending from Saint Lawrence Island in the Bering Sea to Kaktovik near the U.S./Canada border, harvested 1149 whales. Hunters at Barrow landed the most whales (n=590) while Shaktoolik only landed one and Little Diomed and Point Lay each landed two. The efficiency (# of whales landed/# of whales struck) of the hunt has increased over this period. Currently the efficiency is about 0.75. Some villages hunt only in the spring, some only in the autumn, and Barrow, Wainwright, and the Saint Lawrence Island villages (Gambell and Savoonga) hunt in the both the spring and autumn/winter. The average size of whales differs among the villages. Gambell, Savoonga, and Wainwright harvest larger whales than do Point Hope and Barrow. It is not clear whether these differences are due to hunter selectivity or whale availability. Also, the size of landed whales changes during the migration. During the spring, larger whales tend to be taken as the migration proceeds. The opposite is true for the autumn. Larger whales tend to be taken early while small whales tend to be taken later in the migration. Overall, the sex ratio is equal. Generally, males and females do not appear to be segregated during the spring or autumn migration. Males and females are harvested throughout the migration. During spring, however, more large females and fewer large males are taken than predicted by chance. This pattern is not evident during the autumn.

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

## INTRODUCTION

Bowhead whales (*Balaena mysticetus*) are an important subsistence resource for villages of northern and western Alaska. Harvesting bowheads fills important subsistence and cultural needs for many Alaskan Natives. Whales have been harvested in Alaska for at least several thousand years. Until the mid-1800's, bowheads were hunted only for subsistence at which time Yankee commercial whalers discovered bowheads in the Bering Sea. Over the next 60 years or so, about 19,000 bowheads were harvested for oil and baleen. The discovery of petroleum, decimated stock of whales, and the discovery of alternatives for baleen caused commercial whaling for bowheads to cease in the early 1900s (Bockstoce 1986). Subsistence hunting continued.

In 1977, the International Whaling Commission (IWC) banned the subsistence harvest of bowheads because of the perceived small population size whales and the increasing number of whaling crews and strikes (Braham 1995). A small quota of 18 struck or 12 landed, whichever came first, was allowed for 1978. The purpose of the small quota was to provide for the subsistence needs of Alaska Natives while

providing time to collect additional scientific information on the bowhead population. Because of IWC actions, the Alaska Eskimo Whaling Commission (AEWC) was formed to champion the needs of the Alaskan Native hunters. The AEWC locally manages the 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 cultural and nutritional 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). Because of a documented need for whales and an increasing number of whales, the quota has been increased over the years. At the 2007 meeting of the IWC, a five year block quota was set at 67 strikes per year with a total landed not to exceed 280 animals (IWC 2008).

The subsistence hunt typically takes place in spring and autumn as whales migrate between the Bering and Beaufort seas. Most villages only hunt in the spring or the autumn while hunters at Barrow participates in both. Since 2010, Wainwright has also hunted in both the spring and autumn. Hunters on St. Lawrence Island take whales during the spring and the winter. The hunts at all the villages are subjected to considerable environmental interference from weather (strong winds, fog, extreme temperatures), stability of landfast ice and sea ice concentration. The success of the hunt is greatly affected by these factors and shows considerable variation by year and location (George et al. 2003).

In preparation for the in-depth assessment of the Bering-Chukchi-Beaufort seas stock of bowhead whales, we have summarized harvest data for bowhead whales caught in the subsistence harvest by Alaskan Eskimos between 1974 and 2011. Here we present summaries on: (1) the number of bowhead whales taken; (2) the hunting efficiency of the harvest and how it has changed since 1974; and (3) the lengths, dates and sex ratios of whales taken in the subsistence harvest.

## METHODS

Biologists from the National Marine Fisheries Service collected harvest data from 1973 until 1981. Routinely the scientists collected data at Barrow and Point Hope but only intermittently at the other villages (Braham 1995). Hunting captains or the AEWC provided data for the other villages (Braham 1995). The North Slope Borough began collecting harvest data in 1982 in collaboration with the AEWC and continues through the present. Until approximately 1984 biologists were stationed in most villages to measure and collect biological samples from harvested whales. After that time, scientists primarily measured and sampled whales harvested at Barrow. Recently, whales have been regularly and closely examined at Kaktovik and on Saint Lawrence Island with assistance from the Alaska Department of Fish and Game and the University of Alaska Marine Advisory Program. The AEWC and individual captains provided data from the other villages. Harvest data typically included sex, standard length, date landed, and fate of struck and lost whales. Whales examined by biologists often included considerably more data, such as additional measurements and biological samples. The harvest data are presented to the IWC annually. Some of those data have been published (e.g. Marquette et al. 1982), while others have remained in reports (e.g. Suydam et al. 2002). For this summary, we have relied on original data sheets, and published and unpublished records.

Statistical analyses comparing sex ratios, lengths among villages and the efficiency of the harvest were conducted using SPSS (Norusis 1993).

## RESULTS AND DISCUSSION

### *Numbers of whales harvested*

In total, 1149 whales were landed at 12 Alaskan Native villages between 1974 and 2011 (Table 1). The villages (from southwest to northeast) that hunt during the spring migration of bowhead whales include: Gambell, Savoonga, Little Diomed, Wales, Kivalina, Point Hope, Point Lay, Wainwright, and Barrow. Point Lay just became a member of the AEWC in 2008 and landed its first whale in more than 70 years in 2009. These villages typically hunt from the edge of shorefast ice with small boats covered in seal or

walrus skin. The spring hunt occurs as whales migrate northeast through the spring lead system along the northwestern coast of Alaska, typically from early April to early June (Figure 1). Barrow also hunts during the autumn migration, as do Nuiqsut, and Kaktovik. The autumn hunt occurs in open water as whales migrate west along the Beaufort Sea or southwest along northeastern Chukchi Sea coasts of northern Alaska. The autumn hunt usually occurs from August through October (Figure 1). Because of difficult environmental conditions during the spring, especially deteriorating sea ice, Wainwright, Point Lay, and Point Hope have expressed interest in hunting in the autumn. Crews have gone out hunting but of those three villages only Wainwright landed whales, one in each autumn of 2010 and 2011 (Suydam et al. 2012).

Recently Savoonga and Gambell, villages on Saint Lawrence Island, have been hunting more frequently during the late autumn and early winter (Figure 2 and 3). Hunters on Saint Lawrence Island indicate that there are more whales near Saint Lawrence Island now than in the past and there may be more of an opportunity to hunt in the late fall and early winter because of greater ice retreat in summer, which leads to later ice formation in the autumn (Noongwook et al. 2007). It is likely that Saint Lawrence Island will continue and perhaps increase their hunting during the winter months if weather and ice conditions allow.

The total number of whales landed by village during the 30-year time period ranged from 572 at Barrow to one at Shatoolik (Table 1). The bowhead quota was implemented in 1978. The average number of whales landed by village has not changed markedly between the time periods of 1974-1977 and 1978-2011 (Table 2). The most notable change was a decrease in the number of whales landed by Point Hope after the quota. The number landed at Wainwright, Nuiqsut and Kaktovik increased slightly. Even though the average number of whales landed before and since the implementation of a quota is similar, the quota caused dramatic changes in the number of whales harvested. After the implementation of the quota, the harvest immediately declined but has slowly increased over the succeeding years as the quota increased (Figure 4). The quota increased as a response to better and increasing estimates of the bowhead population (George et al. 2004). Additionally, documentation of the need for bowheads by Alaska Natives contributed to the quota increase (Braund 1988).

#### *Efficiency of the hunt*

In response to concerns expressed by the IWC, the efficiency (# of whales landed/# of whales struck) of the harvest has increased (Figure 5). The efficiency increased for several reasons: (1) enhanced training conducted by senior captains of the AEWC on where to strike a whale, (2) improved communication for alerting other crews that a whale had been struck, (3) efforts by some captains to only strike smaller whales, (4) enhanced efforts to locate and retrieve struck whales using (a) aircraft to spot struck whales and (b) dive teams to help retrieve whales that sank, and (5) a program to improve the weaponry.

#### *Timing of the harvest and size of whales*

The hunters at Barrow describe three groups that migrate past in the spring. The first group is comprised mostly of smaller, younger animals, followed by a group that consists of animals of all sizes. Finally, the last group to pass in the spring consists primarily of large females, which are often pregnant or have recently given birth. Data from the harvests at Barrow (Figure 6), Point Hope and Wainwright (Figure 7) show this same general pattern. The lengths of harvested whales increased over the season. Mostly small whales are caught early in the season and mostly large whales are caught late. The change in the length of harvested whales over the course of the season is likely representative of the availability of whales. The autumn hunt shows the reverse pattern. In Barrow, the lengths of whales decreased over the season (Figure 6) similar to observations at Kaktovik (Koski et al. 2004).

The average lengths of harvested whales differed among villages (Figure 7). Lengths of whales harvested at Barrow and Point Hope were smaller than whales harvested at Gambell, Savoonga, and Wainwright (Figure 7). The reasons for these differences are not clear. One explanation is that hunters from some villages may preferentially select larger or smaller whales. For example, many captains at Barrow tell their crews to not strike large whales but only take smaller ones (pers. obs.). Some of the reasons for choosing smaller whales are because they are easier and safer to handle and the muktuk (outer skin and thin layer of blubber) is softer to eat. Other captains may choose larger whales because there is more muktuk and muscle and longer baleen. Another possible explanation for size difference among villages is accessibility. For example, numerous larger whales may be more common near Saint Lawrence Island, thus the hunters

from Gambell and Savoonga may take those that are most available. Reilly and Nerini (1988) and Braham (1995) also observed that Wainwright hunted larger whales than the other villages.

#### *Sex ratios*

Based on the harvest, there does not appear to be sexual segregation during the spring or autumn migration, with the exception that large, often pregnant females pass late in the spring migration. Both males and females are taken throughout April and May (Figure 9) and August through October (Figure 10). Overall there was an equal sex ratio ( $\chi^2=2.47$ ,  $p=0.12$ ). A total of 573 females and 521 males were taken in the harvest. Braham (1995) found an overall equal sex ratio between 1973 and 1993; however, when broken down by sex, size (<13 m [presumed immature] and  $\geq 13$  m [presumed mature]) and season, he concluded that during spring more large females and fewer large males were taken than due to chance alone. Our results were similar (Suydam and George 2004). We found no differences in size and sex of the harvest during the fall ( $\chi^2=2.07$  with Yates continuity correction,  $p=0.15$ ) but there was a difference in the spring. More large females and fewer large males were taken than by chance ( $\chi^2=6.95$  with Yates continuity correction,  $p=0.008$ ). An explanation for this observation are unclear; however, pregnant females and females with calves are more common in late-season, hunters may be selecting large females, large males may be less available to hunters in the spring, or some combination of these factors.

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Table 1. Summary of the number of bowhead whales landed by year in each village between 1974 and 2011. Data were collected by the Alaska Eskimo Whaling Commission, the North Slope Borough and the National Marine Fisheries Service.

Year	Barrow	Gambell	Kaktovik	Kivalina	Little Diomede	Nuiqsut	Point Hope	Point Lay <sup>1</sup>	Savoonga	Shaktolik	Wainwright	Wales	Landed Total
1974	9	2	2	0	0	0	7	0	0	1	0	0	21
1975	10	1	0	0	0	0	4	0	0	0	0	0	15
1976	23	1	2	0	0	0	12	7	0	3	0	0	48
1977	20	2	2	1	0	0	2	0	0	2	0	0	29
1978	4	1	2	0	0	0	2	1	0	2	0	0	12
1979	3	0	5	0	0	0	3	0	0	1	0	0	12
1980	9	1	1	0	0	0	0	2	1	1	1	1	16
1981	4	1	3	0	0	0	4	2	0	3	0	0	17
1982	0	2	1	0	0	1	1	1	0	2	0	0	8
1983	2	1	1	0	0	0	1	1	0	2	1	1	9
1984	4	0	1	1	0	0	2	2	0	2	0	0	12
1985	5	1	0	0	0	0	1	1	0	2	1	1	11
1986	8	3	3	0	0	1	2	0	0	3	0	0	20
1987	7	2	0	1	0	1	5	1	0	4	1	1	22
1988	11	2	1	0	0	0	5	0	0	4	0	0	23
1989	10	0	3	0	0	2	0	1	0	2	0	0	18
1990	11	4	2	0	0	0	3	5	0	5	0	0	30
1991	12	1	2	1	0	1	6	0	0	4	1	1	28
1992	22	4	3	1	0	2	2	4	0	0	0	0	38
1993	23	4	3	0	0	3	2	1	0	5	0	0	41
1994	16	1	3	2	0	0	5	2	0	4	1	1	34
1995	19	4	4	1	0	4	1	4	0	5	1	1	43
1996	24	3	1	0	0	2	3	2	0	3	0	0	38
1997	30	3	4	0	0	3	4	1	0	3	0	0	48
1998	25	0	3	0	0	4	3	3	0	3	0	0	41
1999	24	1	3	0	1	3	2	3	0	5	0	0	42
2000	18	0	3	0	0	4	3	1	0	5	1	1	35
2001	27	2	4	0	0	3	4	3	0	6	0	0	49
2002	22	2	3	0	0	4	0	5	0	1	0	0	37
2003	16	1	3	0	0	4	4	2	0	5	0	0	35
2004	21	3	3	0	0	3	3	0	0	4	0	0	37

<b>2005</b>	<b>29</b>	<b>2</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>7</b>		<b>7</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>55</b>
<b>2006</b>	<b>22</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>		<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>31</b>
<b>2007</b>	<b>20</b>	<b>4</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>		<b>4</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>41</b>
<b>2008</b>	<b>21</b>	<b>2</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>		<b>4</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>38</b>
<b>2009</b>	<b>19</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>31</b>
<b>2010</b>	<b>22</b>	<b>6</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>45</b>
<b>2011</b>	<b>18</b>	<b>4</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>38</b>
<b>Total</b>	<b>590</b>	<b>72</b>	<b>92</b>	<b>8</b>	<b>2</b>	<b>66</b>	<b>114</b>	<b>2</b>	<b>80</b>	<b>1</b>	<b>112</b>	<b>9</b>	<b>1149</b>

<sup>1</sup>Point Lay became a member of the AEWC in 2008 and landed its first whale in more than 70 years in 2009.

Table 2. Average number (standard deviation) of bowhead whales landed in each village between 1974-1977 and 1978-2011 (the quota was instituted in 1978).

Village	1974-1977 Average/Year	1978-2011 Average/Year
Barrow	15.5 (7.05)	15.5 (8.23)
Gambell	1.5 (0.58)	2.00 (1.35)
Kaktovik	1.5 (1.00)	2.5 (1.00)
Kivalina	0.3 (0.50)	0.21 (0.41)
Nuiqsut	0	2.0 (1.22)
Point Hope	6.3 (4.35)	2.6 (1.54)
Savoonga	1.8 (3.50)	2.15 (1.62)
Wainwright	1.5 (1.29)	3.1 (1.41)
Wales	0	0.26 (0.47)
Average Landed	28.3	30.4

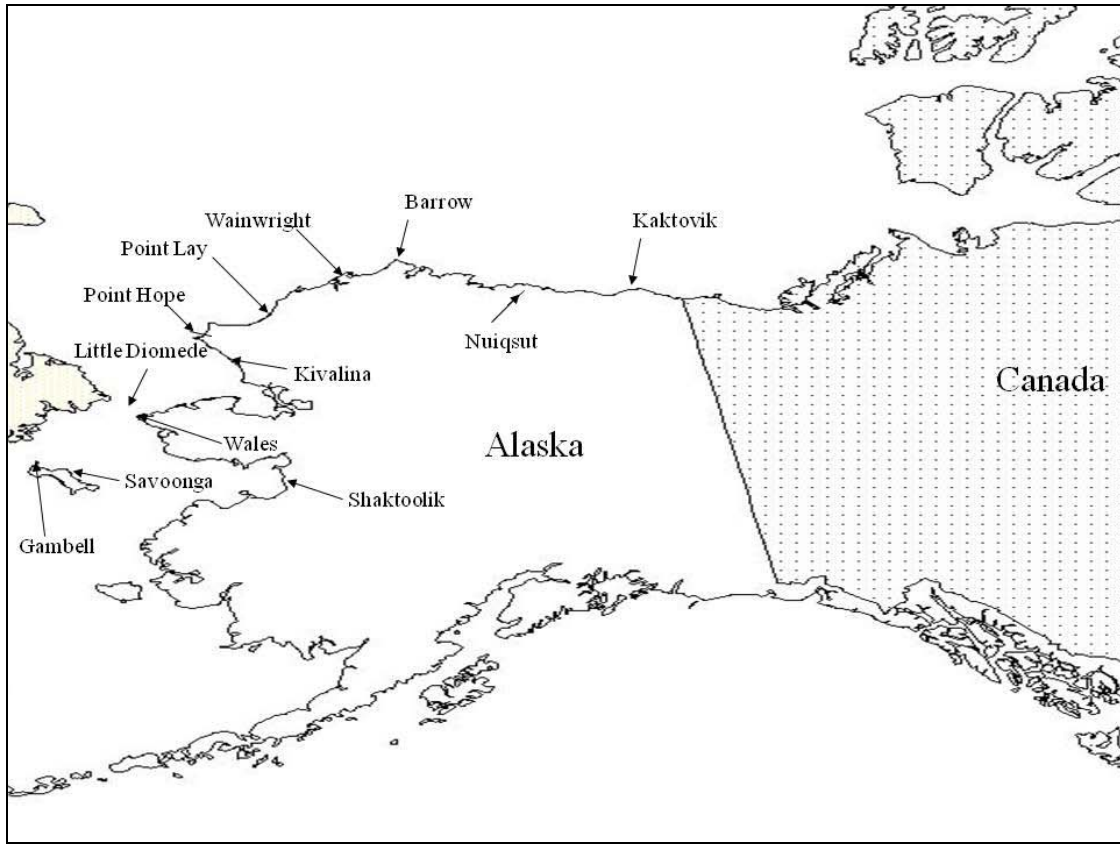


Figure 1. Locations of Alaskan village that harvested bowhead whales between 1974 and 2011.



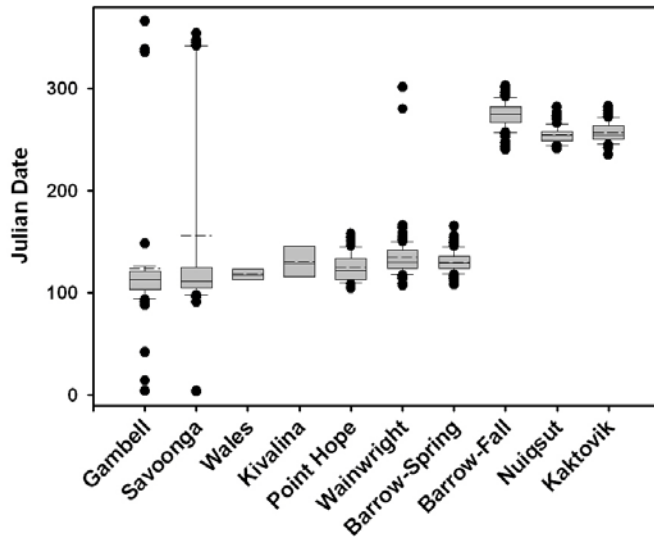


Figure 2. Box plots of bowhead whale harvest dates (Julian day) by village. Most villages hunt in the spring but three villages (Gambell, Savoonga, and Barrow) have both a spring and autumn/winter hunt. Because of the number of whales landed at Barrow, the spring and autumn hunts are plotted separately. Two villages (Kaktovik and Nuiqsut) hunt only in autumn. Shaktoolik has only landed one whale while Little Diomedede and Point Lay have only landed two. Wainwright has recently landed two whales during the autumn. Because of small sample sizes, those villages (or autumn season for Wainwright) are not included in this figure.

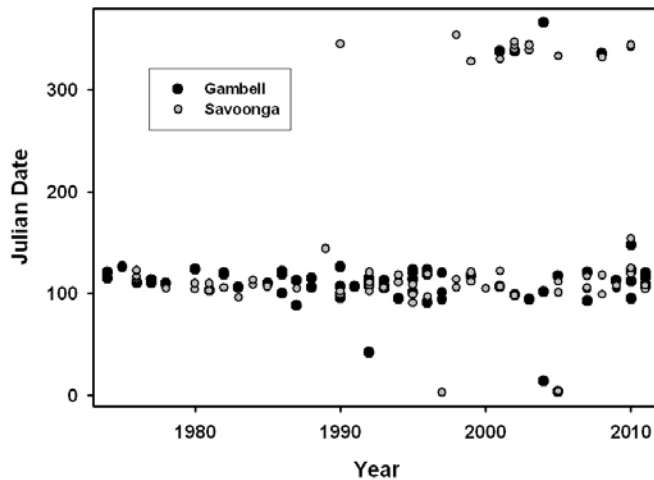


Figure 3. Julian dates that bowhead whales have been landed at Saint Lawrence Island by the villages of Gambell and Savoonga.

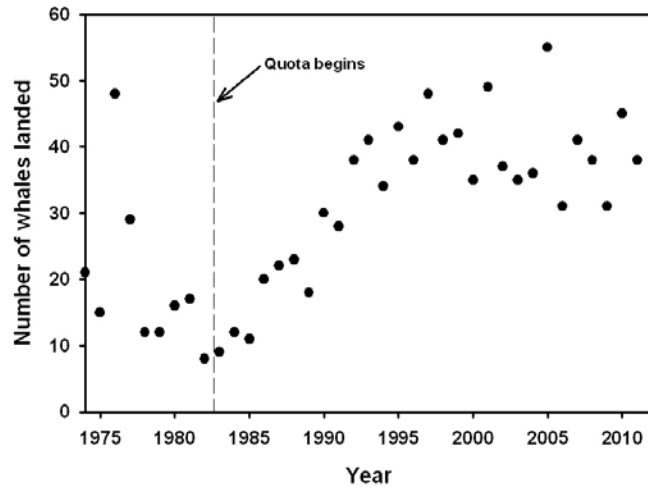


Figure 4. Number of bowhead whales landed by Alaskan Eskimos, 1974-2011. The quota was implemented in 1978.

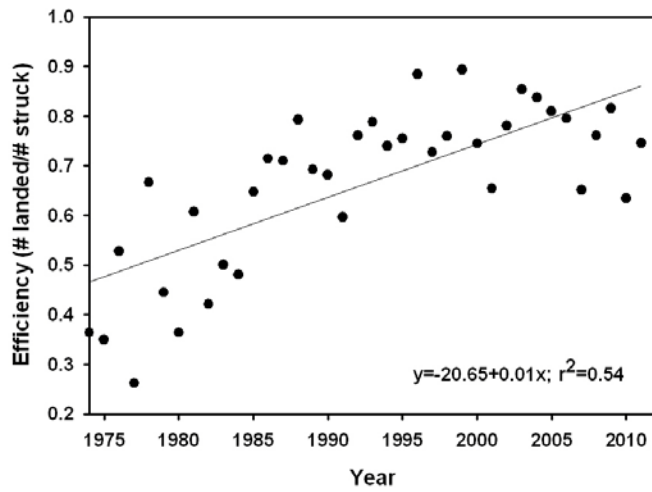


Figure 5. Efficiency (# of whales landed/#of whales struck) of the bowhead whale harvest by Alaskan Eskimos, 1974-2011.

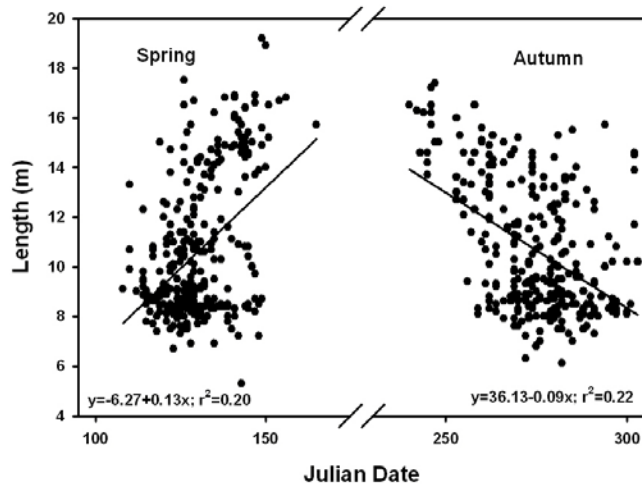


Figure 6. Julian dates and lengths of bowhead whales landed at Barrow during the spring and autumn hunts. Data from both hunts were fit with linear regression to show the increase/decrease in the size of whales landed as the season progressed.

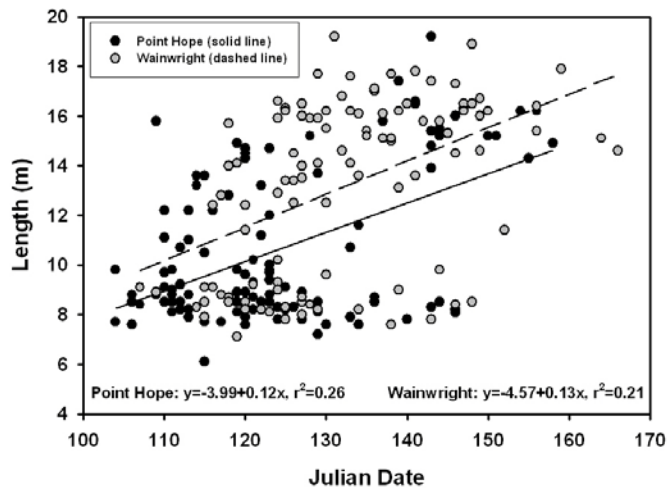


Figure 6. Julian dates and lengths of bowhead whales landed at Wainwright and Point Hope during the spring. Data from both villages were fit with linear regression to show the increase/decrease in the size of whales landed as the season progressed.

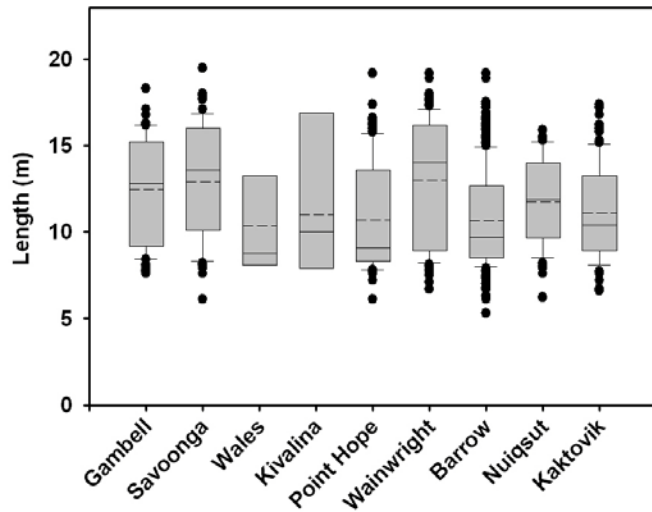


Figure 8. Box plots of the lengths of bowhead whales taken by Alaskan Eskimos in each village. Data from Little Diomedede, Point Lay and Shaktoolik were not plotted because only two, two, and one whale, respectively, were landed at each village.

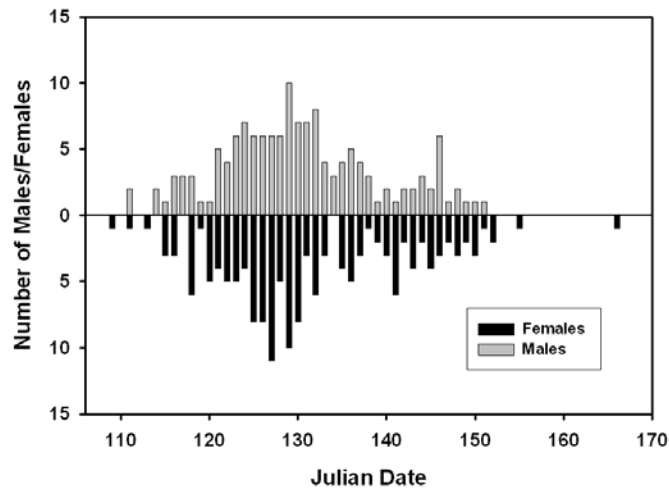


Figure 9. Number of male and female bowhead whales taken by Alaskan Eskimos at Barrow, Alaska during the spring hunt.

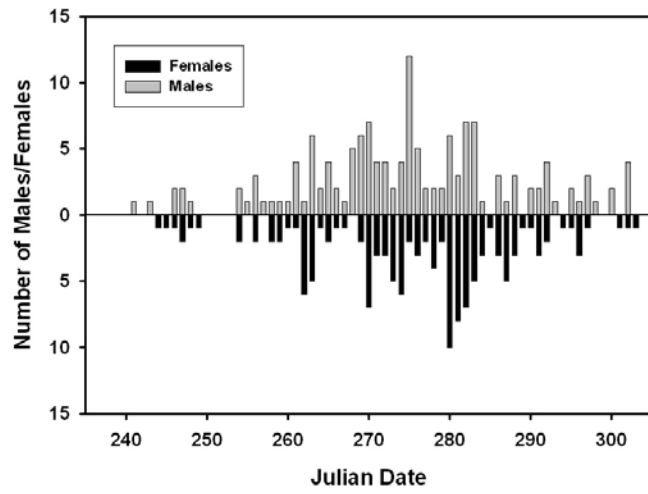


Figure 10. Number of male and female bowhead whales taken by Alaskan Eskimos at Barrow, Alaska during the autumn hunt.