

Subsistence harvests of bowhead whales (*Balaena¹ mysticetus*) at Kaktovik, Alaska (1973-2000)

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ABSTRACT

Kaktovik is a small community located on Barter Island in the extreme northeast of Alaska. The bowhead whale hunt is important to the community from both an economic and cultural perspective. Harvests were generally 1-2 bowheads per year in 1973-1988 and 2-4 bowheads per year in 1989-2000. The hunt normally begins on the first Monday in September and historically 83% of harvested whales have been taken in September. In recent years, typical harvest dates have been significantly earlier even though the quota and number of whales taken have increased. The core whaling area extends from 15km west to 25km east of Kaktovik, and offshore as far as 32km. Most whales have been taken within 30km of the village and the mean distance of harvest locations from Kaktovik has not changed from the 1970s to present. Whaling captains select small whales over large whales and there has been a marginally significant decrease in the average size of whales harvested from the 1970s to the present. The size of whales harvested does not increase with date, although other data show that smaller whales become less common in the area as the season progresses. Male and female bowhead whales are harvested in very similar numbers, but females make up 67% of whales harvested early in the season and 32% late in the season.

KEYWORDS: WHALING-ABORIGINAL; BOWHEAD WHALE; ARCTIC; BEAUFORT SEA; MIGRATION; NORTHERN HEMISPHERE; SEX RATIO; NORTH AMERICA

INTRODUCTION

Kaktovik, also referred to as Barter Island, is a small community located on Barter Island in the extreme northeast of Alaska, within the boundaries of the Arctic National Wildlife Refuge (ANWR) (Fig. 1). The 2000 US Census enumerated 293 people, most of whom (247, or 84%) are native. Household economies rely upon both wage labour (and other income sources) and subsistence activities as vital components of an integrated system. Subsistence whaling is of high importance to the Kaktovikmiut, the 'people of Kaktovik', from both economic and cultural perspectives (Kaktovikmiut and Francis, n.d.). Subsistence activities in Kaktovik make use of a unique set of resources. Due to Kaktovik's location, hunters have access to terrestrial, riparian and marine resources, and make substantial use of all three. Jacobson and Wentworth (1982) summarised literature indicating that a prehistoric village existed at Kaktovik where 'many whale bones could be found'. Thus, the prehistoric people of the area, the 'Qanmaliurat', were certainly whale hunters, which suggests that bowhead whale (*Balaena mysticetus*) migratory patterns in the area have been similar for centuries. Of the marine mammals, the bowhead whale is the primary subsistence resource, but seals and polar bears are also taken (Jacobsen and Wentworth, 1982; Impact Assessment Inc, 1990). Subsistence activities, and especially activities surrounding the bowhead whale hunt, are central to the structural organisation and cultural identity of Kaktovik residents.

People from Kaktovik hunt whales only in the autumn, as the spring migration of bowheads past Kaktovik occurs far offshore, beyond the landfast ice zone. At Kaktovik, whaling is done from powerboats. These boats vary in characteristics, from an 18ft open Lund skiff to a 24 or 25ft cabin-cruiser type vessel. As speed is a much desired characteristic, motor size has tended to increase through

time. Depending on the year, there are up to 11 whaling crews in Kaktovik. With a minimum of four or five people to a crew, most adult men are involved with whaling. Most other people in the village are involved in some support or processing capability. Whaling is an important community-wide activity.

Information from bowhead whales captured during subsistence harvests has been investigated as input to population models but it was concluded that the availability of whales to the hunters was not uniform (Punt *et al.*, 2003). If harvested whales are not a random sample of the population as a whole, then allowance must be made for the biases. Hunters from villages in northern Alaska prefer small whales to larger whales because they are easier to handle and the meat and blubber is said to be softer and better tasting (Braham *et al.*, 1980; McCartney, 1995). Thus, harvested whales do not represent a random sample of the population. This paper describes the bowhead whale harvest at Kaktovik and examines the size, sex, timing information and locations of bowhead whales harvested to assess whether they are a random sample of the population, and if not, to describe the biases.

METHODS

The data on the bowhead whale harvest at Kaktovik have been collected by the North Slope Borough (NSB) Department of Wildlife Management (Suydam *et al.*, 1995), Alaska Department of Fish and Game (ADF&G) (Lowry *et al.*, 2004), and the National Marine Fisheries Service (NMFS) (Marquette, 1977; Braham, 1987; Withrow *et al.*, 1992). The data are archived in a database maintained by the North Slope Borough. Postmortem examinations at Kaktovik are sometimes conducted by biologists, unlike many of the other villages along the Alaskan coast. The postmortem examinations include data on sex, body length,

¹ Spelling corrected from the published version.

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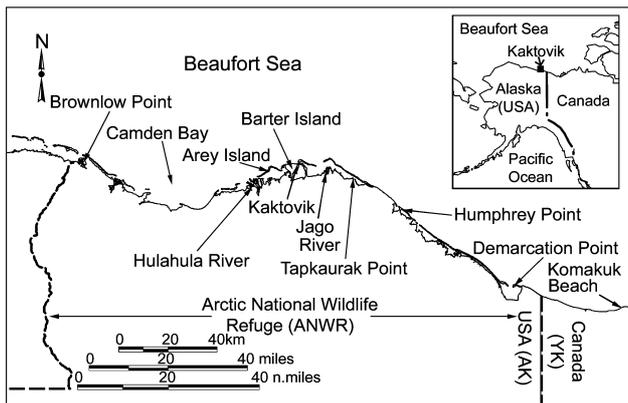


Fig. 1. Kaktovik and vicinity. Place names are according to USGS Geographic Names Information System (<http://geonames.usgs.gov>).

harvest date, a series of morphometric measurements, prey items in the stomach, reproductive status and scarring. Numerous tissue samples are also collected.

The size distribution of whales near Kaktovik was obtained by taking calibrated vertical aerial photographs of bowhead whales during studies based at Kaktovik during 1985-1986 and 1998-2000. Details of the photography methods are found in Koski *et al.* (1993) and Koski and Miller (2002).

RESULTS AND DISCUSSION

Numbers taken by year

Recent bowhead whale harvests at Kaktovik commenced in 1964, when two whales were harvested. NMFS records of harvests in 1964-72 are incomplete, and do not list any whales harvested at Kaktovik in 1965-72 (Marquette, 1977). However, a map in Oil/Whalers Working Group (1986) indicates that single whales were harvested there in 1968 and 1969. It is unlikely that many additional whales were harvested during this period because Kaktovik residents would remember an event as rare as a bowhead whale harvest during that period.

There was no quota on the number of bowhead whales that could be harvested before 1978, but rapid increases in bowhead harvest levels in Alaska during the mid-1970s caused concern that harvest levels were not sustainable. The International Whaling Commission (IWC) decided to impose quotas on the number of bowhead whales that could be taken by Alaskan native hunters, starting in 1978. The IWC quota is administered and monitored by the Alaska Eskimo Whaling Commission (AEWC). From 1978-1991, no more than two bowhead whale strikes or kills were allocated per year to Kaktovik. From 1992-2001, Kaktovik has been allocated three strikes or kills per year. In most years when Kaktovik reached its quota, the Kaktovik Whaling Captains Association (KWCA) could have applied for additional strikes because some strikes were not used by spring whaling villages. The most recent year when a 4th strike was transferred to Kaktovik was 2001 (and before that, 1997). During 1998-2000, additional strikes were available, but the KWCA decided not to request additional strikes because village requirements were met by the three whales landed in each of those years.

Since 1973, data on bowhead harvests have been collected by NMFS, ADF&G and the NSB, including information on numbers of whales landed, dates when whales were landed, and the sizes and sex of those whales. Fig. 2 summarises harvests at Kaktovik from 1973-2000.

From 1973-1988, one or two whales were generally harvested, reflecting the village quota. In 1979 and 1981, whaling crews from Nuiqsut joined the Kaktovik whalers and the higher catches of five and three, respectively, in those years reflect the quotas from both villages. From 1989-2000, generally 2-4 whales were harvested per year.

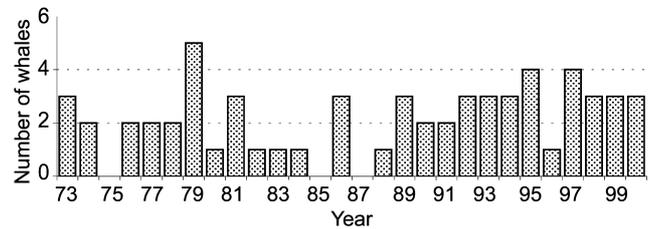


Fig. 2. Numbers of bowhead whales landed at Kaktovik each year (1973-2000). Main sources: Marquette (1977); Braham (1987); Withrow *et al.* (1992); Lowry *et al.* (2004); J.C. George (unpublished data).

Timing of the harvest

Each year, the KWCA decides at a meeting shortly before the start of the whaling season, the date at which the hunt will begin (weather permitting). In recent years, the bowhead whale hunt at Kaktovik has normally begun on or after the first weekend in September. The scheduled start dates for the 1997-2001 hunts were 3, 4, 11, 2 and 2 September respectively. The start date of the 1999 hunt was delayed by a local emergency – a fatal boating accident. However, the hunt has started earlier in some years (e.g. by 22 August in 1992). In most years, relatively few bowhead whales are present near Kaktovik until the beginning of the westward migration of whales from summering areas east of Kaktovik (see Miller *et al.*, 2002). In addition, in recent years the KWCA has voted to delay the hunt until September, when temperatures are cooler and so the whale meat is less likely to deteriorate. Thus, the start of the hunt is usually timed to coincide with the early part of the main westward migration in early September. The whales accessible then tend to consist primarily of the small sub-adult whales that are preferred by hunters (Koski and Miller, 2002).

The dates when whales landed at Kaktovik during 1976-2000 were struck are shown in Fig. 3, organised by year (panel A) and 10-day period (panel B). The date is unknown for one of the 61 whales landed during these years. The majority (83%) of the whales landed during this period were struck during September. Thirty-two percent of the whales were struck in each of the 1-10 and 11-20 September periods, 20% were struck 21-30 September, 10% were struck 1-10 October and 3% were struck in each of 22-31 August and 11-20 October (Fig. 3B).

In recent years, the typical harvest dates have become earlier although the quota and the number of whales taken have increased. The trend for an earlier harvest is significant ($r = -0.46$, $df = 58$, $p < 0.001$). Based on personal observations, this change is at least partially due to an increase in the efficiency of the Kaktovik hunters in harvesting whales due to improvements in hunting techniques and equipment (boats, global positioning system (GPS), etc.). Another contributing factor may be the increase in the bowhead whale population (e.g. George *et al.*, 2004b). As a result, whales presumably are now more numerous near Kaktovik early in the hunting season than they were during the 1970s and 1980s. Changes in whale

utilisation of the general Kaktovik area (see Miller *et al.*, 2002) may also be involved. Average sighting rates during aerial surveys increased markedly in the 1990s relative to the 1980s (Miller *et al.*, 2002).

Harvest locations

Since 1973, all bowhead whales harvested by residents of Kaktovik for which the harvest locations have been reported were struck within 43km of the village. Most of these whales were struck within 30km (Fig. 4). The core area where whalers search for whales is from Hulahula River in the west to Tapkaurak Point in the east and offshore as far as 32km (Fig. 1). Although a few of the most distant harvest locations were during the 1970s (Fig. 4), the mean distance of reported harvest locations from Kaktovik was not significantly different between the 1970s (17.0km, $n=16$), 1980s (17.9km, $n=14$) and 1990-2000 (15.2km, $n=21$) (Kruskal-Wallis test, $p>0.05$). It should be noted that the locations where 10 bowheads were struck are not known, and some reported locations, especially for years before GPS units were widely used, are approximate.

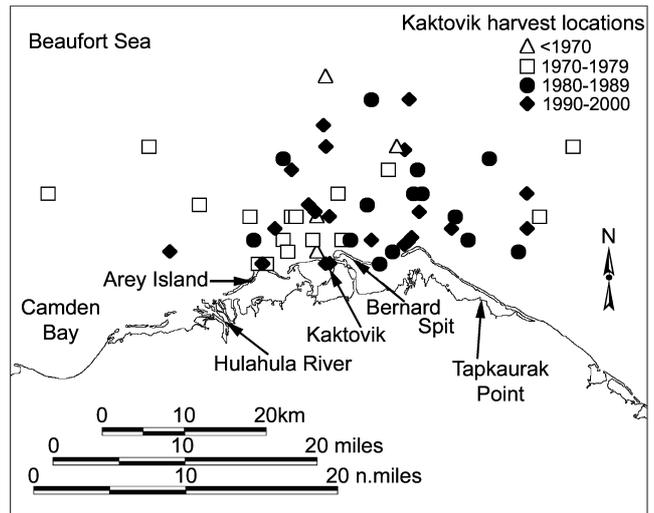


Fig. 4. Locations where bowhead whales were reported to have been harvested by residents of Kaktovik (1976-2000). Not shown are two whales taken ~170km west of Kaktovik in 1937 and 1940. Major Sources: Oil/Whalers Working Group (1986), Kaleak (1996), Lowry *et al.* (2004), J.C. George (unpublished data).

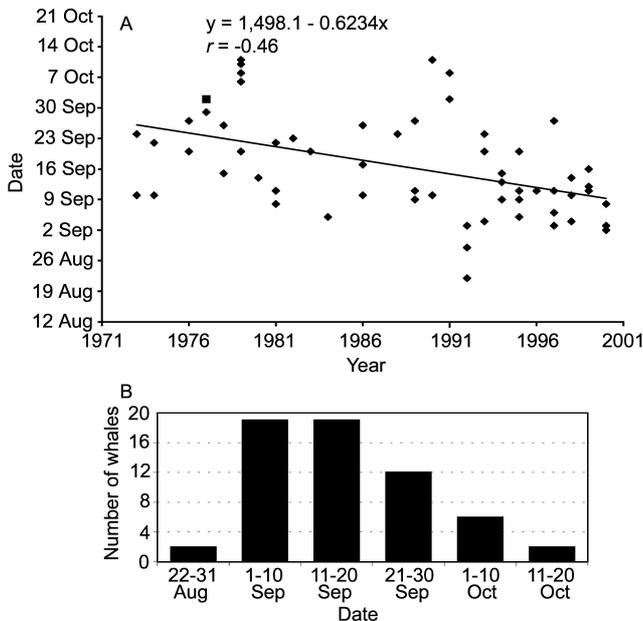


Fig. 3. Strike dates for bowhead whales landed at Kaktovik (A) by year and (B) by 10-day period, 1973-2000. The square symbol near the upper left side of panel A represents a young-of-the-year calf (approx. 5 months old). Main sources same as Fig. 2.

Sizes of harvested bowhead whales

As noted earlier, the Kaktovik whalers attempt to harvest small whales because they are easier to handle and are considered to taste better. Thus, although the lengths of the harvested whales partly reflect the length distribution of the whales near Kaktovik at the dates in question, they are strongly influenced by hunter selectivity. The frequency distribution for the lengths of whales landed at Kaktovik is shown in Fig. 5. The reported lengths of harvested whales in Fig. 5 and subsequent figures have been reduced by 8.2% to account for the stretching that occurs when the whale is dragged onto land (see George *et al.*, 2004a). The overall range of the whales landed at Kaktovik is similar to that of the living whales whose lengths have been measured in the Arey Island to Humphrey Point area during September (Fig. 5B vs 5A).

However, small whales constitute a higher percentage of the landed whales than of the whales photographed in the area. Of the bowhead whales harvested by Kaktovik whalers, 23.6% were longer than 13m (after allowance for stretching), and therefore were considered to be adults (Koski *et al.*, 1993). This compares to 43.4% adults in the overall bowhead whale population, if calves are excluded (Angliss *et al.*, 1995), and 50% adults among whales photographed near Kaktovik, calves excluded (Koski and Miller, 2002). The proportion of adults was significantly lower among the harvested whales than among the population as a whole during 1973-2000, regardless of which abundance estimate was used in the analysis, (χ^2 test, $p < 0.01$) and among the whales that were photographed near Kaktovik (χ^2 test, $p < 0.001$). These data confirm that the whales landed by Kaktovik whalers tend to be smaller than those in the population as a whole.

The autumn migration is partially segregated according to size, with the smaller whales tending to occur earlier in the autumn (Braham *et al.*, 1984; Moore and Reeves, 1993; Koski and Miller, 2002). However, there was no significant correlation between date and the size of a whale harvested ($r = -0.064$, $df=53$, $p > 0.05$; Fig. 6). This indicates that whalers were able to select small whales throughout the whaling season even though the small whales become proportionally scarcer as the season progresses.

Fig. 7 shows the lengths of the harvested whales by the year harvested. There has been a marginally significant decline in the average size of whales harvested over the 1976-2000 period ($r = -0.33$, $df=53$, $p < 0.05$). This suggests that the whalers have become more selective about the sizes of whales that they have harvested in recent years. This increased selectivity has probably been possible through some combination of two factors: increased availability of whales associated with the bowhead whale population increase, and increased efficiency of the hunters in capturing whales (allowing them to be selective while still filling their quota).

Sex of harvested bowheads

The sex of a whale cannot generally be determined by whalers before they strike it unless it is a female accompanied by a calf, which hunters avoid taking. The sex

of 55 bowhead whales harvested at Kaktovik has been recorded. Twenty-eight were males and 27 were females, which is not significantly different than 1:1 (χ^2 test, $p > 0.05$). However, during the first half of the harvest (22 August-13 September), 67% of the harvested whales were female, and during the last half of the harvest (14 September-11 October) only 32% were female (Figs 6 and 8). This difference is significant (χ^2 test, $p < 0.05$). From 1990 to the present, females have been more common among the harvested whales (18 females and 13 males), but before 1990 more males than females were harvested (15 males and 8 females). This difference was not significant (χ^2 test, $p > 0.05$) and is due to the tendency for earlier harvests in recent years, and the preponderance of females early in the season (Figs 6 and 7). The reason for segregation by sex near Kaktovik is not known.

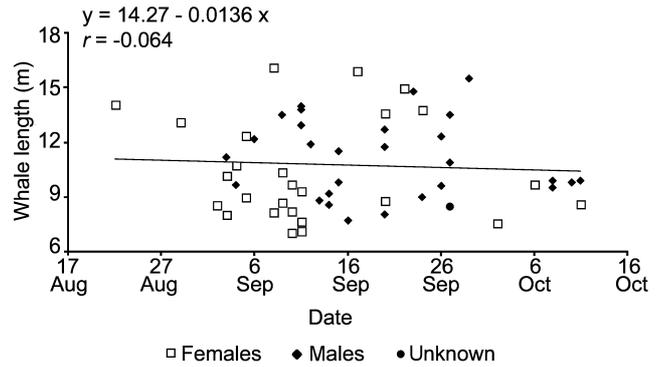


Fig. 6. Whale length vs date for whales harvested at Kaktovik (1976-2000); females and males are distinguished. A 6.2m calf harvested on 2 October 1977 is excluded. Whale lengths are adjusted downward to allow for stretching (see text).

Conclusions

The subsistence harvest at Kaktovik during recent years is not a random sample of the bowhead population. The autumn migration of bowhead whales past Kaktovik is segregated by age and sex. The harvest, especially in recent years, has been primarily during the early part of the migration. Hunters have purposely and successfully selected

small whales from among those present near Kaktovik even during periods when primarily larger whales were present. There were also sex related biases in the harvest because females appear to be more common early in the season, and males more common later in the season. Why this pattern might occur is unknown.

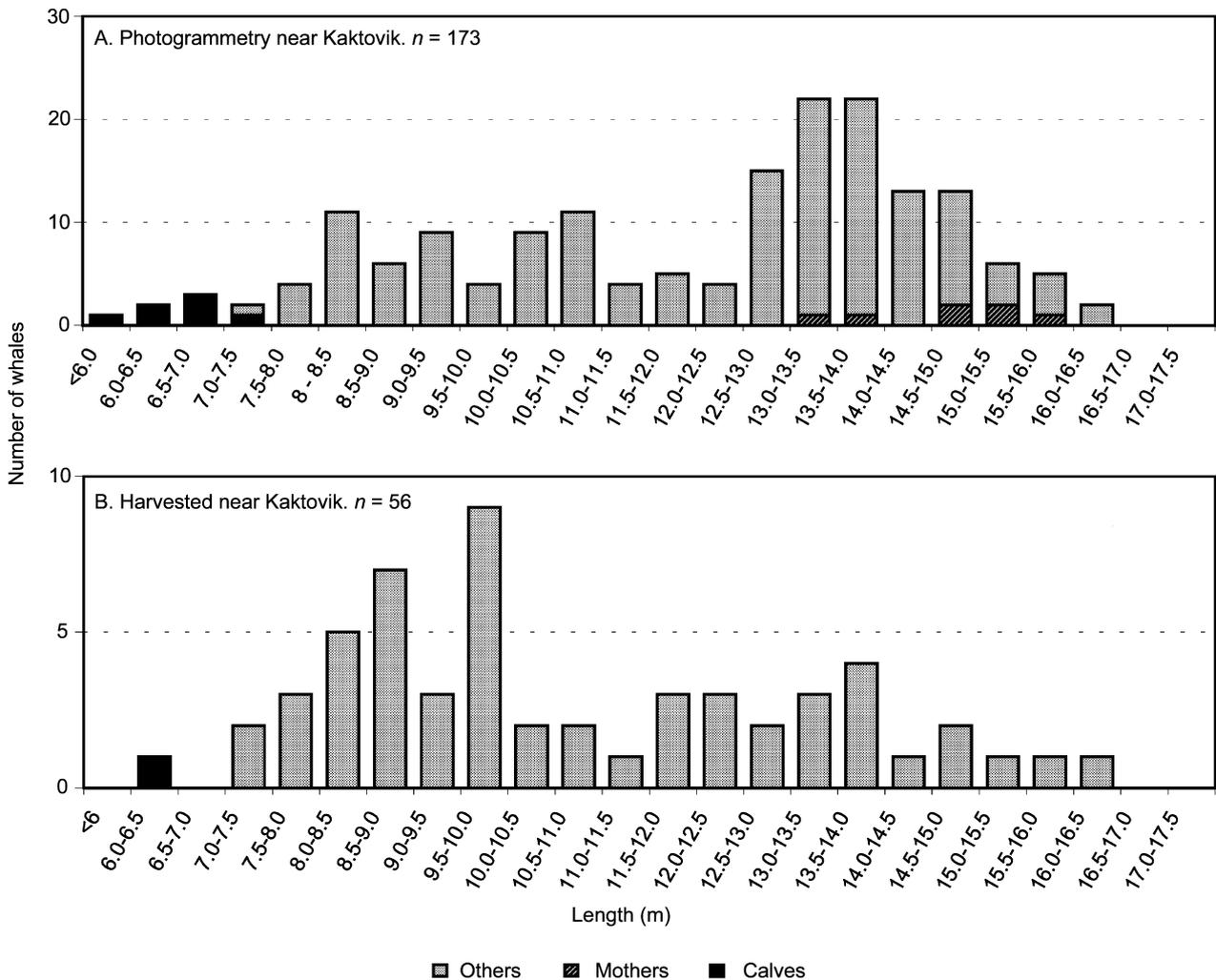


Fig. 5. Length frequency distributions of bowheads (A) photographed near Kaktovik 1982-2000 (from Koski and Miller, 2002) and (B) harvested near Kaktovik 1976-2000 (same sources as Fig. 2). In (B), lengths have been adjusted downward by 8.2% to account for stretching (see text and George *et al.*, 2004a).

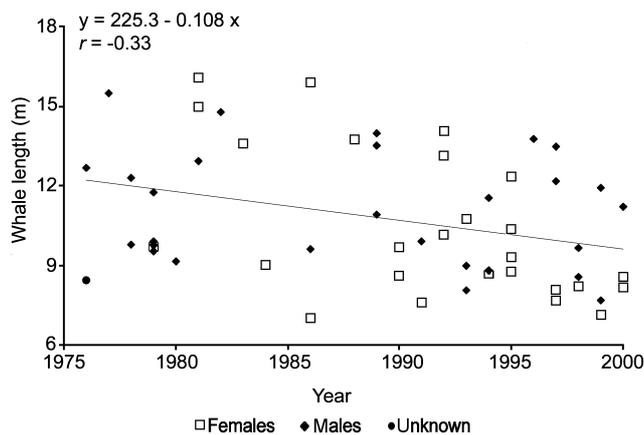


Fig. 7. Whale length vs year for whales harvested at Kaktovik (1976-2000); females and males are distinguished. A 6.2m calf harvested in 1977 is excluded. Whale lengths are adjusted downward to allow for stretching (see text).

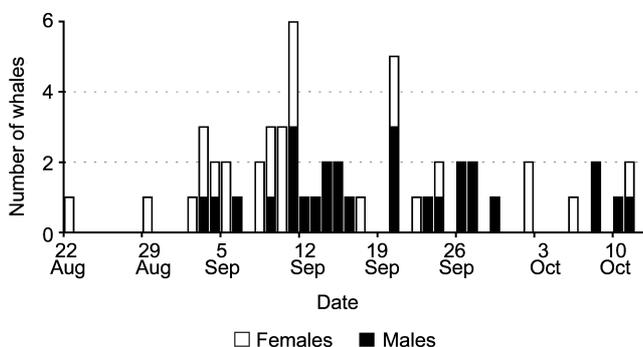


Fig. 8. Sexes of whales vs date for whales harvested at Kaktovik (1976-2000).

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REFERENCES

- Angliss, R.P., Rugh, D.J., Withrow, D.E. and Hobbs, R.C. 1995. Evaluations of aerial photogrammetric length measurements of the Bering-Chukchi-Beaufort Seas stock of bowhead whales (*Balaena mysticetus*). *Rep. int. Whal. Commn* 45:313-24.
- Braham, H.W. 1987. The take of bowhead whales, 1973-1984: sex and length distribution of the catch, and recovery of 'stinkers'. Paper SC/39/PS22 presented to the IWC Scientific Committee, Bournemouth, UK, June 1987 (unpublished). 13pp. [Paper available from the Office of this Journal].
- Braham, H.W., Durham, F.E., Jarrel, G.H. and Leatherwood, S. 1980. Ingutuk: a morphological variant of the bowhead whale, *Balaena mysticetus*. *Mar. Fish. Rev.* 42(9-10):70-3.
- Braham, H.W., Krogman, B.D. and Carroll, G.M. 1984. Bowhead and white whale migration, distribution and abundance in the Bering, Chukchi and Beaufort Seas, 1975-78. *NOAA Technical Report NMFS SSRF-778* 39pp. NTIS PB84-157908. [Available from: www.nmfs.gov].
- George, J.C., Koski, W.R., Suydam, R. and Rugh, D. 2004a. Body stretching of bowhead whales during hauling and butchering during the subsistence hunt. Paper SC/56/BRG9 presented to the IWC

- Scientific Committee, July 2004, Sorrento, Italy (unpublished). 5pp. [Paper available from the Office of this Journal].
- George, J.C., Zeh, J., Suydam, R. and Clark, C. 2004b. Abundance and population trend (1978-2001) of western Arctic bowhead whales surveyed near Barrow, Alaska. *Mar. Mammal Sci.* 20(4):755-73.
- Impact Assessment Inc. 1990. Subsistence resource harvest patterns: Kaktovik. Alaska OCS Social and Economic Studies Program Special Report 9. Marine Minerals Management Service, Alaska Outer Continental Shelf Region, Anchorage, AK. 420pp. NTIS PB91-121228. [Available from: www.mms.gov].
- Jacobsen, M.J. and Wentworth, C. 1982. Kaktovik subsistence: land use values through time in the Arctic National Wildlife Refuge Area. US Fish and Wildlife Service, Northern Alaska Ecological Service, 101 12th Ave., Fairbanks, AK 99701. 142pp.
- Kaktovikmiut and Francis, K. n.d. In this place: a guide for those wishing to work in the country of the Kaktovikmiut. Kaktovik Impact Project, Kaktovik, AK. 92pp. [Available from City of Kaktovik, Box 27, Kaktovik, AK 99747].
- Kaleak, J. 1996. History of whaling by Kaktovik village. pp.69-71. In: Proceedings of 1995 Arctic Synthesis Meeting, Anchorage, Alaska, October 1995. OCS Study MS 95-0065. US Minerals Management Service, Anchorage, AK. 206pp + Appendices.
- Koski, W.R. and Miller, G.W. 2002. Habitat use by different size classes of bowhead whales in the central Beaufort Sea during late summer and autumn. Chapter 10. In: W.J. Richardson and D.H. Thomson (eds.) *Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information*. 21pp. OCS Study MMS 2002-012; LGL Rep. TA2196-7. Rep. from LGL Ltd, King City, Ontario, for US Minerals Management Service, Anchorage, Alaska and Herndon, Virginia, USA. xlv+420pp. [Available from National Technical Information Service, Springfield, Virginia, USA, Rep. No. NTIS PB2004-101568].
- Koski, W.R., Davis, R.A., Miller, G.W. and Withrow, D.E. 1993. Reproduction. pp. 239-74. In: J.J. Burns, J.J. Montague and C.J. Cowles (eds.) *The Bowhead Whale*. 1st. Edn. Society for Marine Mammalogy, Lawrence, Kansas. Special Publication. No.2. 787pp.
- Lowry, L.F., Sheffield, G. and George, J.C. 2004. Bowhead whale feeding in the Alaska Beaufort Sea. *J. Cetacean Res. Manage.* 6(3):215-23.
- Marquette, W.M. 1977. The 1976 catch of bowhead whales (*Balaena mysticetus*) by Alaskan Eskimos with a review of the fishery, 1973-1976, and a biological summary of the species. Unpublished report, Northwest and Alaska Fisheries Center, Seattle. 96pp.
- McCartney, A.P. 1995. Whale size selection by precontact hunters of the North American Western Arctic and Subarctic. pp. 83-108. In: A.P. McCartney (ed.) *Studies in Whaling*. 3. *Hunting the Largest Animals. Native Whaling in the Western Arctic and Subarctic*. Canadian Circumpolar Institute, University of Alberta. Occasional Pub. No. 36. 345pp.
- Miller, G.W., Elliot, R.E., Thomas, T.A., Moulton, V.D. and Koski, W.R. 2002. Distribution and numbers of bowhead whales in the eastern Alaskan Beaufort Sea during late summer and autumn, 1979-2000. Chapter 9. In: W.J. Richardson and D.H. Thomson (eds.) *Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information*. 39pp. OCS Study MMS 2002-012; LGL Rep. TA2196-7. Rep. from LGL Ltd, King City, Ontario, for US Minerals Management Service, Anchorage, Alaska and Herndon, Virginia, USA. xlv+420pp. [Available from National Technical Information Service, Springfield, Virginia, USA, Rep. No. NTIS PB2004-101568].
- Moore, S.E. and Reeves, R.R. 1993. Distribution and movement. pp. 313-86. In: J.J. Burns, J.J. Montague and C.J. Cowles (eds.) *The Bowhead Whale*. Special Publications No. 2. Society for Marine Mammalogy, Lawrence, KS. 787pp.
- Oil/Whalers Working Group. 1986. Cooperative programs for the Beaufort Sea. 79pp. [Available from North Slope Borough Department of Wildlife Management, Box 69, Barrow, AK].
- Punt, A.E., Breiwick, J.M. and George, J.C. 2003. Including age- and length-composition information in the assessment of the B-C-B Seas stock of bowhead whales. Paper SC/55/BRG10 presented to the IWC Scientific Committee, May 2003, Berlin (unpublished). 12pp. [Paper available from the Office of this Journal].
- Suydam, R.S., Angliss, R.P., George, J.C., Braund, S.R. and DeMaster, D.P. 1995. Revised data on the subsistence harvest of bowhead whales (*Balaena mysticetus*) by Alaska eskimos, 1973-1993. *Rep. int. Whal. Commn* 45:335-8.
- Withrow, D., Burke, R., Jones, L. and Brooks, J. 1992. Variation in $\delta^{13}C$ carbon isotope ratios in bowhead whale baleen plates used to estimate age. *Rep. int. Whal. Commn* 42:469-73.

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