AN OVERVIEW OF CROSS ISLAND SUBSISTENCE BOWHEAD WHALING, BEAUFORT SEA, ALASKA

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ABSTRACT

Native Iñupiat constitute the majority of the residents of Alaska's North Slope. Bowhead whales contribute a substantial part of the Iñupiaq diet, but perhaps more importantly embody Iñupiaq culture and ethos. Although the bowhead is classified as an endangered species, the Alaskan hunt is co-managed by the U.S. federal government and the Alaska Eskimo Whaling Commission as a sustainable activity under a quota determined by the International Whaling Commission. All coastal North Slope communities hunt the bowhead and share their harvests across the region. Iñupiat have hunted bowhead whales from Cross Island, located about 24 km offshore of Prudhoe Bay, from "time immemorial." Whalers from Nuiqsut continue this tradition. Recently collected and historical data are used to describe Cross Island whaling since 1973.

INTRODUCTION

This paper describes bowhead whaling as conducted out of the Iñupiaq village of Nuiqsut, 1973 to 2011, in regional (mid-Beaufort Sea) historical perspective. Nuiqsut whalers currently operate from Cross Island during the fall (open-water) season, and so are those whalers closest to and most likely to be directly affected by current and projected offshore oil development in the Beaufort Sea off the coast of Alaska. Little systematic descriptive information on Alaskan subsistence whaling currently exists in the published literature, and most ethnographic descriptions of subsistence whaling focus on spring whaling to the almost complete exclusion of fall whaling. This paper provides a case study of Nuiqsut/Cross Island whaling, comparable to that presented for Kaktovik in Koski et al. (2005), including timing of the hunt, characteristics of whales landed at Cross Island, and harvest locations. In addition, technological change and adaptations to industrial and other activities co-occurring in the area are described, based on longitudinal ethnographic information.

Below, I discuss historical information on subsistence whaling from published and unpublished documents, supplemented by fieldwork conducted intermittently since 1982, mostly on projects funded by the U.S. Bureau of Ocean Energy Management (BOEM).[1] First, I introduce the community of Nuiqsut and review what is known about bowhead whaling in the mid-Beaufort prior to 1973. The next section describes the harvest of bowhead whales near Cross Island since 1973.[2] The third section is a narrative discussion of the harvest data, in the context of Cross Island subsistence whaling seasons (2001–2011) and the trends and changes in Nuiqsut whaling since 1973.

NUIQSUT

Nuiqsut, a small Iñupiaq community in Alaska's North Slope Borough (NSB), is located about 28 km (16 mi) inland from the Beaufort Sea on the Nigliq Channel of the Colville River, and about 117 km (73 mi) southwest of Cross Island (Fig. 1). The 2010 U.S. census enumerated 402 people (87% Native). Household participation in subsistence activities is fully integrated with the "mainstream" monetized economy, with major income sources being

wage labor, transfer payments, and dividends (Galginaitis et al. 1984; Impact Assessment Inc. [IAI] 1985, 1990a, 1990b). Nuiqsut's location provides its residents with access to a wide spectrum of subsistence resources (IAI 1990b). Current use patterns, while variable from year-to-year, can be generalized as equally divided among terrestrial mammals (primarily caribou and moose), marine mammals (primarily bowhead whale [*Balaena mysticetus*] and seals), and fish. Subsistence activities provide a majority of the meat consumed in the community—100% of the protein and 68% of the caloric requirements of the local population (Alaska Department of Fish and Game [ADF&G] 1991, 2012; IAI 1990b; Stephen R. Braund Associates [SRB&A] 2010: app. D). Whaling not only provides a significant part of this food, but is also a key social organizational activity for North Slope Iñupiat. Whaling crew composition reflects kinship and social relationships, and the redistribution of whale and other subsistence foods by successful whaling crews is a fundamental component of the major celebrations during Thanksgiving, Christmas, and Nalukataq, a community-wide celebration held in June, hosted by each whaling captain whose crew was successful in landing a whale the previous season. Whaling is thus a central ideological expression of key cultural values and an important vehicle for the transmission of those values (Dumond 1984; Rexford 1998; Stoker and Krupnik 1993; Worl 1980).

BOWHEAD WHALING IN THE MID-BEAUFORT BEFORE 1973

The history of whaling in the mid-Beaufort Sea has four distinct divisions—aboriginal whaling, contact through the collapse of commercial whaling, post-commercial whaling through 1972, and 1973 through 2011. Unfortunately, information for the first three time periods is sparse, at best.

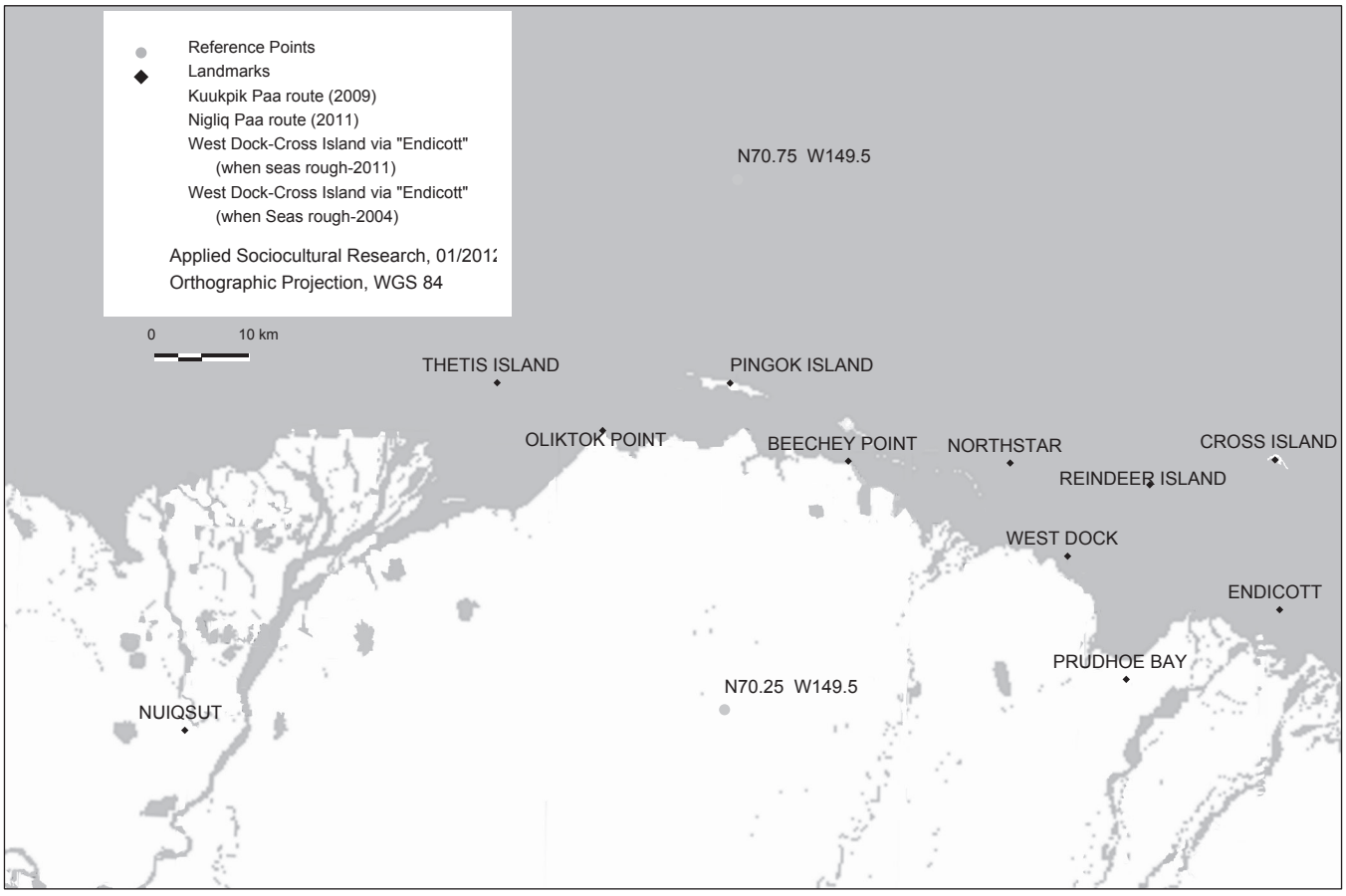

Figure 1. Map of the mid-Beaufort Sea showing Nuiqsut and Cross Island, with surrounding landmarks and typical routes used to travel between Nuiqsut and Cross Island. The Nigliq Paa route is used when the water level via the Kuukpik Paa route is too shallow for the boats used by the Nuiqsut whalers.

According to Hall (1981:48), archaeological evidence available in the early 1980s provides only the most meager cultural history for the mid-Beaufort region:

> Essentially, there is no unequivocal evidence of occupation in the area previous to 4,000 years ago, precious little data on the nature of human adaptation in Arctic Small Tool tradition times, and only enough information from the more recent sites to broadly outline a picture of human occupation in the past 600 years [the late prehistoric period].

While confining "unequivocal evidence of occupation" to the last 600 years may be questionable, the major point is that archaeological evidence on the time depth of human habitation in this area, and the types of activities in which humans engaged, is relatively thin. Almost all archaeological work in the area has been survey in nature and focused on areas likely to be affected by oil and gas exploration. For the late prehistoric period, there are few well-documented sites, and the published dates may be suspect.

Thetis Island prehistoric remains have been dated to AD 1350–1500 (Hall 1981:13), but have eroded away (Lobdell and Hall 1982). There was evidence of whaling activity, but both the nature of the tools and faunal remains found there supported a subsistence pattern oriented toward caribou (50%) and seal (25%), so that whales must have been a relatively infrequent catch, given their large size relative to the other resources being harvested. Prehistoric remains from Pingok Island have been dated to AD 1550–1700 (Hall 1981:16; Hall and Lobdell 1985:15, 93, 95). Terrestrial resources are well represented in this archaeological assemblage, but common seals (mostly unidentified to species) and baleen whales (not further identified) are as well. Bearded seal and walrus are not well represented, but overall it appears that whaling was a significant activity, although it was not necessarily conducted from Pingok Island. The interpretation of this information in terms of cultural history is far from clear (Hall 1981:4–49, 71–73; Hall and Lobdell 1985). Nuiqsut whalers report that sod houses and old whale skulls could in the past be seen on several barrier islands, notably Pingok Island and Cross Island, but that most of these features have since eroded away. Irving (as cited by Hall and Lobdell 1985: dedication) reported that Simon Paneak and Alvik Tukle (in separate interviews) related that Pingok Island had been a whaling site in the past.

Most information on Iñupiaq participation in commercial whaling starting in the mid-1800s, and incidental information on "subsistence" whaling, is found in: 1) discussions of Chukchi Sea shore-based whaling stations (Allen 1978; Brower 1942); 2) narratives of the ship-based whale fishery (Bodfish 1936); and 3) in oral history data collected by the North Slope Borough in the Traditional Land Use Inventory (Smith 1980) and the North Slope Borough Elders Conferences (e.g., Kean 1981). The indirect effects of commercial whaling (1848–1914, and especially after 1880) on the Iñupiat were profound, due to depopulation, shifting "settlement" and socioeconomic patterns due to the introduction of at least a partially monetized economy, and the reduction of food supplies (Foote 1964; Murdoch 1885). The full effect of the commercial overharvest of bowhead whales and walrus was not fully evident until the collapse of commercial whaling after 1910.

Until about 1888, commercial whaling was completely pelagic, operating from autonomous large ships manned by almost exclusively non-Iñupiaq crews, so that the organization of Iñupiaq whaling for local consumption continued as before. The success rate of subsistence whaling during this period is not documented quantitatively, but the whale population was increasingly depleted by the commercial fleet (Bockstoce 1980; Marquette and Bockstoce 1980:6) and thus less available to subsistence whalers. Once commercial shore-based stations began operating in 1885, and hiring predominately Iñupiaq work forces, in 1888, documented subsistence landings in those areas declined rapidly (Cassell 2000:120). Almost all capable Iñupiat were employed by the shore-based whaling stations (Cassell 2003, 2005; Foote and Williamson 1966:1048). Since baleen was the principal target of these stations, the bulk of commercially landed whales were available for Iñupiaq consumption (Bockstoce 1986:328; Foote and Williamson 1966:1048). The commercial shore-based bowhead harvest was, until 1910 or so, comparable to and for some years considerably higher than the Native harvest prior to 1885. Bowheads thus provided substantial food resources for the Native populations near the shore-based whaling stations. In Alaska, Barrow was the westernmost station, and Native use of the mid-Beaufort area occurred only on a seasonal basis by a relatively small number of people. In a sense, there were no incentives for "subsistence" whaling during this period, because of commercial shore-based whaling.

Iñupiaq whaling crews operated for purely local consumptive use were probably rare or non-existent. Some crews operated as "salvage" operations (e.g., Bockstoce

[1986:328] notes the schooner *Penelope* sailed behind the whale ships "picking up carcasses") or on the commercial model of selling baleen while retaining the carcass for local consumption (Stefansson [1913] 1951:60–61). Iñupiaq whaling in the mid-Beaufort (except perhaps for the *Penelope*) seems to be undocumented for this period, and was probably low, due to population shifts to Barrow and other communities. Most commercial pelagic whaling took place to the east or west of the mid-Beaufort, with the peak pelagic activity in the mid-Beaufort occurring in 1869–1878, just before the introduction of steam technology (Bockstoce and Botkin 1983). Pelagic catch in the 1879–1888 period was very low, and continued to be low even after the fleet had moved into the Canadian Arctic (1889–1908).

After the collapse of commercial whaling in western Arctic waters, the consensus is that the subsistence harvest of bowhead whales continued at a relatively constant and low level until the 1970s (Marquette and Bockstoce 1980:6). The catches documented for shore-based whaling stations east of Barrow are all for subsistence harvests after 1914; they reflect some activity in the mid-Beaufort Sea region and specifically for Cross Island (Durham 1979; Marquette and Bockstoce 1980:13). Many families ancestral to current Nuiqsut residents lived on Cross Island seasonally during the first half of the twentieth century. Although several Iñupiat whaling captains are reported to have landed single whales at or near Cross Island, perhaps most important was Taaqpak, who used Cross Island as a whaling base through the late 1940s. Taaqpak's crew landed a number of whales near Cross Island from the 1920s through the 1940s (Carnahan 1979:25–31; Smith 1980:72–73). Taaqpak maintained that Iñupiat had hunted whales near Cross Island for centuries (Carnahan 1979:21–31).

Documentation for early twentieth-century whaling harvests is incomplete, but includes accounts of whales taken near Cross Island/Prudhoe Bay in 1921, 1922, 1927, 1928, 1931, 1935, 1937, 1938 and 1940, plus at least one prior to 1921—mostly by Taaqpak, but also by Pausanna and Akpik (Carnahan 1979; Long 1996; Shapiro and Metzner 1979; Smith 1980:72). It is not clear why subsistence whaling was suspended in this area after 1940. The decline of the reindeer industry and the lure of opportunities in settled communities (employment, schools, churches, stores) prompted many residents to relocate to Barrow or Barter Island (Kaktovik). Certainly, this made the mid-Beaufort area effectively more distant for the purposes of whaling, since there were few, if any, residents in the immediate area (Galginaitis et al. 1984). At any rate, the last documented whale taken in the mid-Beaufort before the resettlement of Nuiqsut was in 1940 by Taaqpak.

NUIQSUT SUBSISTENCE BOWHEAD WHALE HARVEST, 1973–2011

Information on the harvest of bowhead whales near Cross Island is available since 1973 for the number, size, and sex of whales landed and the date and location (often approximate for earlier years) of the harvest. This information is discussed here in a format comparable to that of Koski et al. (2005) for Kaktovik, although not all parallel graphics are presented. More detailed measures of Cross Island whaling activity and level of effort, derived from the BOEM-sponsored study, are available for 2001 through 2011 in the annual reports prepared for that project. The final report for the BOEM project (Galginaitis 2013) discusses these measures, and also the minor modifications that incorporation of the data requires in the following description. The North Slope Borough database, supplemented by qualitative ethnographic information from BOEM studies since 1982, and especially since 2001, provides most of the data for this section.

NUMBER OF WHALES TAKEN BY YEAR

Alaskan subsistence whaling effort and harvest increased in the 1970s, for a variety of reasons. For the 1978 season, the International Whaling Commission (IWC) instituted an overall quota of twelve strikes[3] for the Alaska bowhead whale subsistence hunt (Huntington 1989, 1992). Although Nuiqsut whalers were not limited by a quota during 1973–1977, only one crew whaled from Nuiqsut during this period, landing a single whale in 1973. For the 1978 season, the Alaska Eskimo Whaling Commission (AEWC) (formed in 1977 as a local response to the IWC initially banning the subsistence hunt) allocated one strike to Nuiqsut.

Although the bowhead is still listed as "endangered" under the Marine Mammal Protection Act, better data, better management of the hunt, and a steadily increasing bowhead population (George et al. 2004; Zeh and Punt 2005) have reduced concern for the Bering–Chukchi–Beaufort stock (NMFS 2013). The overall quota of annual strikes for Alaska subsistence whalers steadily increased from twelve, when it was established in 1978, to 60 to

75 strikes a year under a more complicated and flexible multiyear quota in 1997. It has been renewed at that level since then, most recently in 2012 for six years. Nuiqsut's allocation of strikes from the AEWC increased from one to two in 1986, three in 1989, and four in 1995—roughly parallel with the increase in whaling crews in Nuiqsut (see Huntington 1989, 1992; NMFS 1977, 1978 on the development and current management of the subsistence bowhead hunt in Alaska).

Table 1 summarizes the harvest of whales for Nuiqsut for 1973–2011. Prior to 1995, and especially before 1989, Nuiqsut whalers had relatively little success landing whales, averaging .25 whales annually for 1973–1988, when their quota was one, two, or unlimited, and 1.33 whales for 1989–1994, when their quota was three. For the years 1995–2011, with an annual quota of four, Nuiqsut whalers landed an average of 3.2 whales, and fewer than three whales only in three of those seventeen years. Details of the 1996 season, when two whales were landed, have not been recovered. Only one whale was landed in 2005, due to ice conditions, which prevented access to whales on all but two days, and possible interference from commercial vessel traffic. The 2009 season, when only two whales were landed and one was struck and lost, had rough sea conditions and other complicating factors. The full quota of four strikes was completed

Table 1. Documented harvest of bowhead whales near Cross Island, 1973–2012. Years of no harvest and no "struck and lost" are not listed. This does not mean that no whaling effort was made in those years. Quotas were not applicable prior to 1978. It is unclear from the records when the quota for Nuiqsut increased to two and then three whales. Data compiled from AEWC records, personal communications with Nuiqsut whalers, and field notes from the 2001–2011 whaling seasons. See also AEWC and NSB 2007; Galginaitis 2012.

Year	Whales			Notes
	Quota	Landed	Struck and Lost	
1973	NA	1	0	Butchered in water near Flaxman Island/Canning River delta
1982	1	1	0	
1986	2	1	0	
1987	2	1	0	
1989	3	2	2	Oil industry vessel disturbance noted by whalers
1990	3	0	1	Oil industry disturbance noted; rough seas
1991	3	1	2	Poor weather; adverse ice conditions
1992	3	2	1	
1993	3	3	0	Very favorable whaling conditions
1995	4	4	0	
1996	4	2	0	
1997	4	3	1	
1998	4	4	1	
1999	4	3	0	
2000	4	4	0	Very favorable whaling conditions
2001	4	3	0	Whalers report whales tended to be "skittish" and distant
2002	4	4	1	Whales not as skittish and closer than in 2001
2003	4	4	0	Poor weather; whales close to Cross Island
2004	4	3	0	Poor weather; whales close to Cross Island
2005	4	1	0	Very poor weather; adverse ice conditions; disruption
2006	4	4	0	Adverse ice conditions first half of season
2007	4	3	1	Overall poor weather; little ice; whales close
2008	4	4	0	No ice; generally poor weather and rough/variable sea conditions; whales close to Cross Island
2009	4	2	1	No ice; swells and difficult conditions for seeing whales; whales relatively distant
2010	4	4	0	Favorable whaling conditions
2011	4	3	0	No ice; difficult conditions for seeing whales; large whales

in 10 of those 17 seasons (and three whales landed with three strikes in the other four years).

Nuiqsut whalers have only requested an extra strike three times, in 1989, 1998, and 2002 (Table 1), when they felt they needed to make up for a struck and lost whale in order to satisfy the needs of the community. In four other seasons when they used their quota of strikes and had a "struck and lost" whale (1991, 1992, 1997, and 2007), they did not make such requests, either because the season was too advanced or the whales already landed were sufficient for community needs. 2011 was the only season when the Nuiqsut whalers chose not to use their fourth strike because their needs were satisfied with the three whales already landed. For all other years when Nuiqsut whalers used fewer than their full quota of strikes, adverse whaling conditions was the explanation given by the whalers. Thus, the harvest record indicates that Nuiqsut's community needs can be met with three to four whales, depending on the size of the whales. Nuiqsut whalers have consistently landed sufficient animals to meet their community needs since 1995, while their harvest before 1995 was much more irregular.

TIMING OF THE CROSS ISLAND WHALE HARVEST

The five-day periods when Nuiqsut whalers landed whales near Cross Island during 1982–2011 are shown in Figure 2 (the 1973 whale is excluded since only partial documentation is available). The vast majority (89%) were landed during September. October landings (6%) occurred during 1986–1991 and no later than 10 October. August landings (5%) occurred in 2007 and 2010, and no sooner than 29 August. Most whales taken near Cross Island were landed before 19 September, with 5 September as the most common date.

Figure 3 indicates that dates for bowhead harvests near Cross Island have become earlier since 1982 (when Nuiqsut has fielded more than one crew), even though quotas (and average number of whales taken) have increased. The trend is significant ($r^2 = 0.503$; $r^2 = 0.5424$ for

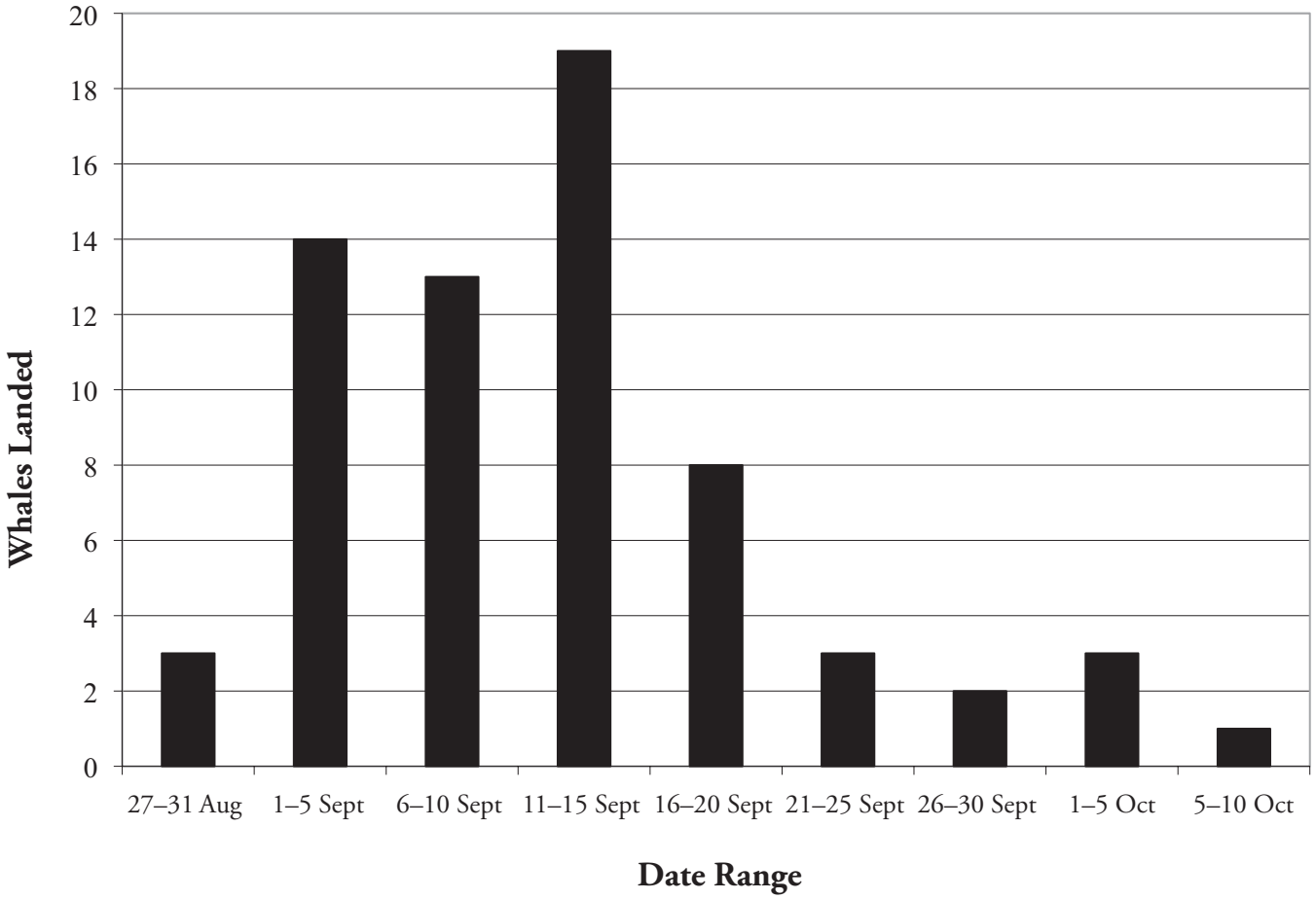

Figure 2. Number of whales landed near Cross Island, 1973–2011, by 5-day date ranges. Sources: AEWC and NSB 2007; Galginaitis 2012.

females and $r^2 = 0.4578$ for males).[4] Local explanations for this trend emphasize the availability of better and more powerful equipment for the hunt since the early 1990s, whereas in the 1980s (and earlier) the whalers had to wait for cold weather so that the whale would not spoil before they could transport it back to the village. Also contributing to this trend are the desires to avoid harsher weather and sea conditions later in the season, and for shorter and more compact seasons. An increase in the bowhead whale population and possible changes in the timing of the bowhead migration may also be factors.

Active Nuiqsut whalers state that the Cross Island subsistence whaling season normally begins on Labor Day, but crews in practice often leave for Cross Island before that date, depending on weather conditions, the state of preparedness of the crews, and especially the reported presence or absence of whales near Cross Island. The Nuiqsut Whaling Captains' Association (NWCA) meets annually, usually in early to late August, to set a preliminary date when crews can "open fire" for the season. This date is for planning purposes only and can be changed. Most crews leave for Cross Island before the "open fire" date in order to be ready to scout for whales as soon as the season opens.

It is unusual, although not unheard of, for a crew to leave Cross Island before the season ends. For the last eleven seasons, 2001–2011, "open fire" has ranged from 15 August to 3 September (median 29 August), and "cease fire" from 1 to 25 September (median 13 September). The date the last crew has left Cross Island for the last eleven seasons has ranged from 6 to 26 September (median 15 September). Since Nuiqsut whalers hunt far from their community and cannot stay through the entire bowhead migration period, they have a narrower window of opportunity for fall whaling than do whalers in Kaktovik or Barrow.

While Nuiqsut whaling seasons in the 1970s and 1980s may have lasted six to eight weeks, and started later, more recent seasons have been, for the most part, limited

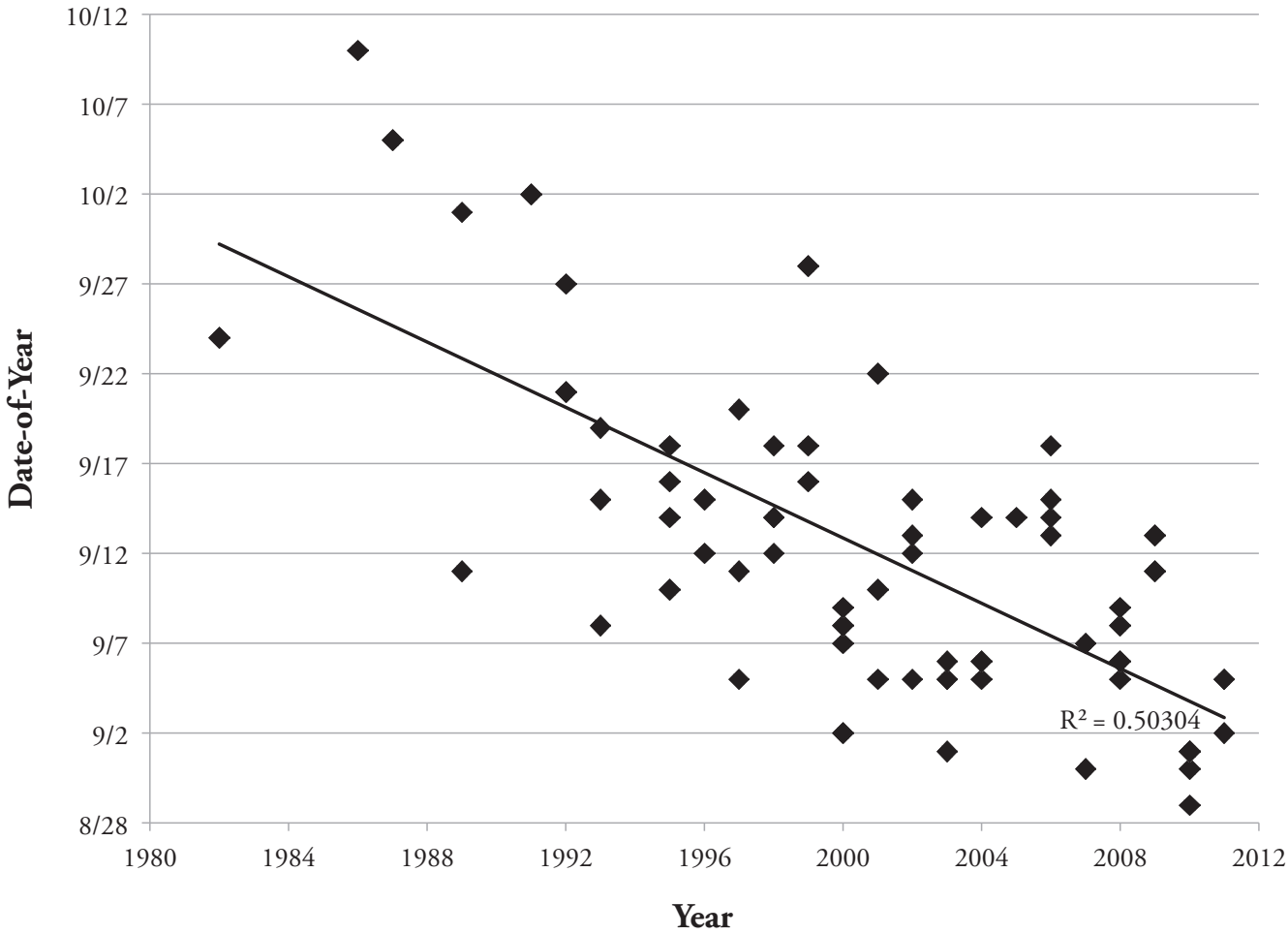

Figure 3. Day-of-year of harvest plotted by year for bowheads landed near Cross Island, 1972–2011. There is no significant difference between landing dates for males and females. Sources: AEWC and NSB 2007; Galginaitis 2012.

to two to three weeks. Nuiqsut whalers have always tried to balance several factors when determining when to start their whaling season. The whalers do not want to be at Cross Island if the whales are not yet there, or if it is too warm, even if the whales are there. The last week of August has usually met this requirement. Active Nuiqsut whalers state they also want to avoid staying at Cross Island too long past mid-September, since in their experience the weather deteriorates badly late in the month. Nuiqsut whalers express a preference for "smaller" whales (25–35 feet, or 7.6–10.7 meters). They report this size class is predominate in the first of three "pulses" during the fall whale migration, with the largest whales in the third and last pulse. Also, there are greater employment constraints on individual whalers than in the past. Thus, contemporary Nuiqsut whaling crews usually plan on being on Cross Island no later than the first week of September, and leaving no later than mid-September, in contrast with patterns in the 1970s and 1980s, discussed below.

SIZE OF WHALES LANDED AT OR NEAR CROSS ISLAND

McCartney (1995) and Braham (1995) present evidence that aboriginal whalers in the western Arctic harvested predominately smaller (sub-adult) rather than larger (adult) whales; they suggest that Alaska whalers were selectively hunting small whales. Nuiqsut whalers, as a group, profess a preference for smaller whales, but some whaling captains have a reputation for taking larger whales. Koski et al. (2005) provide information on the size distribution for whales photographed near Kaktovik during the fall migration. They demonstrate that the average length of the whales landed by Kaktovik hunters is significantly shorter than the average length of all whales participating in the migration. They conclude that Kaktovik whalers are selecting smaller whales, even later in the season when larger whales predominate in the migration and fewer small animals are expected to be available, assuming that the distribution of whales photographed represented the distribution of whales encountered by Kaktovik hunters.

More refined analysis of the whale distribution in relation to water depth, whale length, and date showed that subadults (less than 13 m) move primarily through shallow near-shore water and adults (13 m or greater) move primarily through deeper water, and subadults appeared earlier in the migration than did adults (Koski and Miller 2009:137, 143). Koski and Miller's study area extended from Flaxman Island (the western edge of Camden Bay) east to Herschel Island, divided into four smaller subareas. While their study area did not include Cross Island, their Camden Bay subarea may be a feasible proxy for the whales encountered near Cross Island—Nuiqsut whalers state that many whales they encounter seem to be coming from Camden Bay, and whales often congregate there. The Kaktovik subarea included the area where Kaktovik hunters find their whales. The study made systematic aerial surveys of the four subareas and recorded whale observations with geo-referenced photographs, from which length measurements were estimated. These data were then presented by subarea in terms of number of whales seen by length and water depth categories (Koski and Miller 2009:144). Length categories were subadults (two categories: less than 10 meters and 10–13 meters) and adults (greater than 13 meters). Water depth categories were less than 20 meters, 20–40 meters, 40–200 meters, and greater than 200 meters. Almost all data were obtained from waters less than 200 meters deep. About twice as many whales were documented in the "Kaktovik" subarea than in the "Camden Bay" subarea (Koski and Miller 2009:144).

Figure 4 presents the frequency distribution for the reported lengths of whales harvested near Cross Island using the same size categories, and adjusted in the same way, as Koski et al. (2005) and Koski and Miller (2009). The Cross Island and Kaktovik distributions both peak in the 9.5–9.9 m (small subadult) category. However, while 54% of whales landed in Kaktovik were "small subadults" (less than 10 m), only 41% of the Cross Island harvest met this standard. "Large subadults" (10–13 m) constituted 23% of Kaktovik's bowhead harvest, but 36% of Nuiqsut's. About 23% of Kaktovik's landed whales were longer than 13 m (Koski et al. 2005:35), about the same as the whales landed at Cross Island. The frequency distribution for Kaktovik's landed whales extends to 17 m (56 ft), while that for Nuiqsut only extends to 14.6 m (48 ft). In both cases, the whalers are taking fewer adults than are found in the migrating population in general or were photographed near Kaktovik (Koski et al. 2005:35; Koski and Miller 2009:144) and are apparently selectively targeting smaller whales. While 61% of Kaktovik's landed bowheads were smaller than the preferred maximum (with at least 11% smaller than the preferred minimum), only 47% of Nuiqsut's landed bowheads were smaller than the preferred maximum (with at least 12% smaller than the preferred minimum). On the other hand, Nuiqsut whalers apparently avoid taking very large whales more than Kaktovik whalers do.

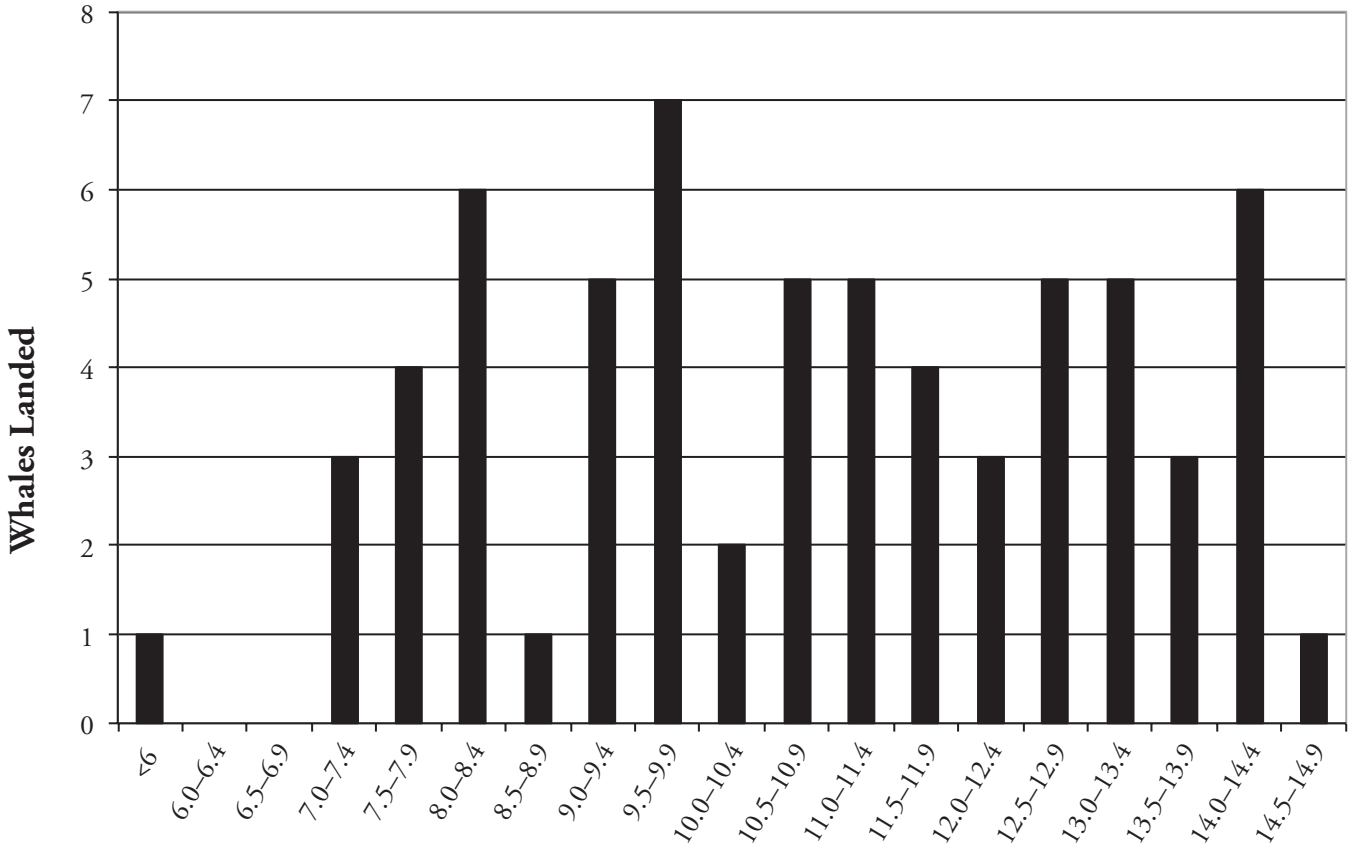

Figure 4. Number of whales landed near Cross Island by length, 1982–2011. Sources: AEWC and NSB 2007; Galginaitis 2012.

Whalers from Kaktovik and Nuiqsut rarely looked for whales in water deeper than 200 m, and typically operated in depths of 30 to 60 m. The data presented by Koski and Miller (2009) suggest that the Kaktovik and Nuiqsut whalers may encounter different size distributions of whales, with Kaktovik seeing more small subadults in a "typical" year. Also, the Beaufort Sea floor out to the shelf break is much narrower in the Kaktovik area than it is around Cross Island, so it may serve to "funnel" the migration past Kaktovik. The migration may become more dispersed as it approaches Cross Island. A greater proportion of the migration in general, and a greater mixture of whale size classes, may pass near Kaktovik than Cross Island, or Kaktovik whalers may more regularly hunt in waters with more adult whales than Nuiqsut whalers.

A larger number of whales could allow for greater selectivity, while a greater mixture of sizes could make it easier to misjudge the size of a whale. Data from Kaktovik (Koski et al. 2005:35, Koski and Miller 2009:144) may provide evidence for some degree of selection for smaller-sized whales by Kaktovik whalers (although the number of large whales taken would be anomalous), but the data for Nuiqsut would not, suggesting that Nuiqsut whalers strike the whales that they encounter. This is, in fact, what Nuiqsut whalers reply when asked—they chase the "blows" (blows are seen from farther away than whales themselves) as they see them. They usually chase whales one at a time, with all available boats concentrating on one whale, although when whale sightings are plentiful, or boats widely separated, this practice is relaxed. There is little selection in terms of size except that mothers and calves are not chased or struck, small whales that could be calves are not struck, and particularly large whales may be passed by, depending on the crew and how the season has progressed up to that point (NWCA 2011). Typically, "Moby Dick" blows are not investigated or chased, unless the people in the boat for some reason want to see a particularly big whale, but such blows are usually reported to and discussed with the other whaling boats.

While average size of Nuiqsut-landed whales has changed little over time, in the past landings tended to be larger and later in the year (when larger whales reportedly make up more of the migration). In earlier years, when logistical support was not as developed, the meat on whales

often spoiled and larger whales may have been preferred due to the greater amount of *muktuk* (fat with the thick skin attached) they provided. *Muktuk* spoils much more slowly than the meat, and can be recovered even from a "stinker" whale. Better logistics and an increased number of crews/boats improved towing and butchering efficiency and the recovery of meat. Some captains preferred larger whales for the larger baleen, which brought a higher price when sold. The one active captain with a known preference for larger whales simply says, "You know me, I like *everything* big!" Still, the majority of the data seem to indicate that Nuiqsut whalers strike and land the whales that they encounter, with the qualification that some captains were (and are) more likely to strike large whales. Captains may have individual preferences, but are constrained by the size of the whales they actually encounter. Some captains, with stated preferences for smaller whales, have landed large whales.

The fall bowhead whale migration is believed to be partially segregated according to size, with smaller whales tending to migrate earlier than larger ones—an observation made by both scientists (Koski and Miller 2009) and Iñupiaq whaling experts (Galginaitis and Koski 2002; Koski et al. 2005). However, both Kaktovik and Nuiqsut whalers state that all sizes of whales are present during their hunts, and Huntington and Quakenbush (2009:3) report that Kaktovik whalers, based on the whales they saw, reported no temporal pattern of size distribution for the fall bowhead whale migration, other than for a few large whales to be the first through the area to "set the trail" for the others. Size segregation during the fall migration may thus have a more distinct spatial manifestation (smaller whales closer to shore) and less of a sharp temporal aspect ("wave" or "pulse") than in the spring.

Barrow whalers, on the other hand, observed that the fall migration, like the spring migration, came in three "waves"—large whales, followed by mid-size whales, and then by small whales (Huntington and Quakenbush 2009:7). Barrow whalers also reported that the fall three-wave pattern is less distinct than that of the spring. Nuiqsut whalers also report that the fall migration occurs in "pulses," but with the larger whales predominating at the end of the migration and smaller ones at the beginning. One reason Nuiqsut whalers give for trying to land whales early in the season is so they can target the early "small" whales or the middle wave of "mid-size" whales, and avoid the large whales at the end of the migration (NWCA 2011).

There is only a slight correlation between the date of harvest near Cross Island and the size of a whale (r^2 = 0.0312), and a small probability that a late harvest near Cross Island will be larger than an early harvest. There is no significant correlation between the year of harvest and length of the animal harvested for the 1973–2011 period (r^2 = 0.0063). These findings are somewhat surprising, given that Nuiqsut whalers now start their hunt significantly earlier than they did in the past and recognize temporal size segregation in the bowhead migration. This may reflect the higher success rate of hunts since 1995, but more likely the relative non-selectivity of the Nuiqsut hunting strategy. That is, the harvest pattern may reflect the distribution of whales that Nuiqsut whalers encounter, rather than the population of whales in the Cross Island area in general. Over time this has been relatively constant, as variations tend to "average out." In 2010, for instance, Nuiqsut whalers encountered floating ice to a distance of 13 to 19 km (8 to 12 mi) from Cross Island. They saw some smaller whales in or near this ice, but did not approach them since the ice made a successful harvest less likely. In more open water they saw more, but larger, whales. They filled their quota with three relatively large whales and one small whale.

In 2011, Nuiqsut whalers encountered no ice, but swells and waves combined to make it very difficult to sight whales in general, and small whales in particular. Whalers saw few whales, and those seen were large (Galginaitis 2012). The three large whales landed satisfied the community's needs, so the fourth strike was not used. Nuiqsut whalers operating out of Cross Island have less flexibility than do fall whalers based in Kaktovik or Barrow in waiting for conditions (weather, ice) to change to improve access to preferred animals, since they are more time restricted. Thus, they may be more likely to strike the animals available, regardless of size. In addition, some whaling captains strike larger animals, regardless of community preference, and it may be that the selective force of preferred whale size operates with less effect in Nuiqsut than in other communities.

SEX OF WHALES LANDED NEAR CROSS ISLAND

Nuiqsut whalers say they cannot tell the sex of a whale in the water, unless it is a mother with a calf, which by AEWC regulations (AEWC 1995) and personal experience they avoid. For any single season, the harvest may be composed of only one sex, or any mixture of the two. Of

the 67 whales landed by Nuiqsut whalers since 1972, 32 have been female, 32 male, and 3 did not have their sex recorded. Koski et al. (2005) discuss the Kaktovik data in terms of the first and second halves of the season, and indicate that more females are landed in the first half of the season, and more males in the second. For the Cross Island harvest, 33 whales (19 female and 14 male) were taken before 12 September and 31 whales (13 female and 18 male) were taken after 11 September. The difference is not significant (χ^2 test, $p > 0.05$). There is significant variability in bowhead behavior from year-to-year—whether whales travel rapidly through the area or take more time and feed, distance from Cross Island, relative numbers and how easily they can be spotted, and in the timing of the migration itself. This variability may or may not have a bearing on the sexual distribution of whales.

HARVEST LOCATIONS OF WHALES LANDED NEAR CROSS ISLAND

Harvest locations of whales landed by Nuiqsut whalers (1973–2011) are displayed in Figure 5, along with the GPS tracks collected for Nuiqsut whalers for 2001–2011 (Galginaitis 2012). The most striking aspect of this figure is the extent to which whaling effort overlaps from year-to-year. Nuiqsut whalers say they find and strike most of their whales in the geographical quadrant northeast of Cross Island, as the concentration of tracks indicates. Harvest location is unknown for seven whales, all from the 1990s.

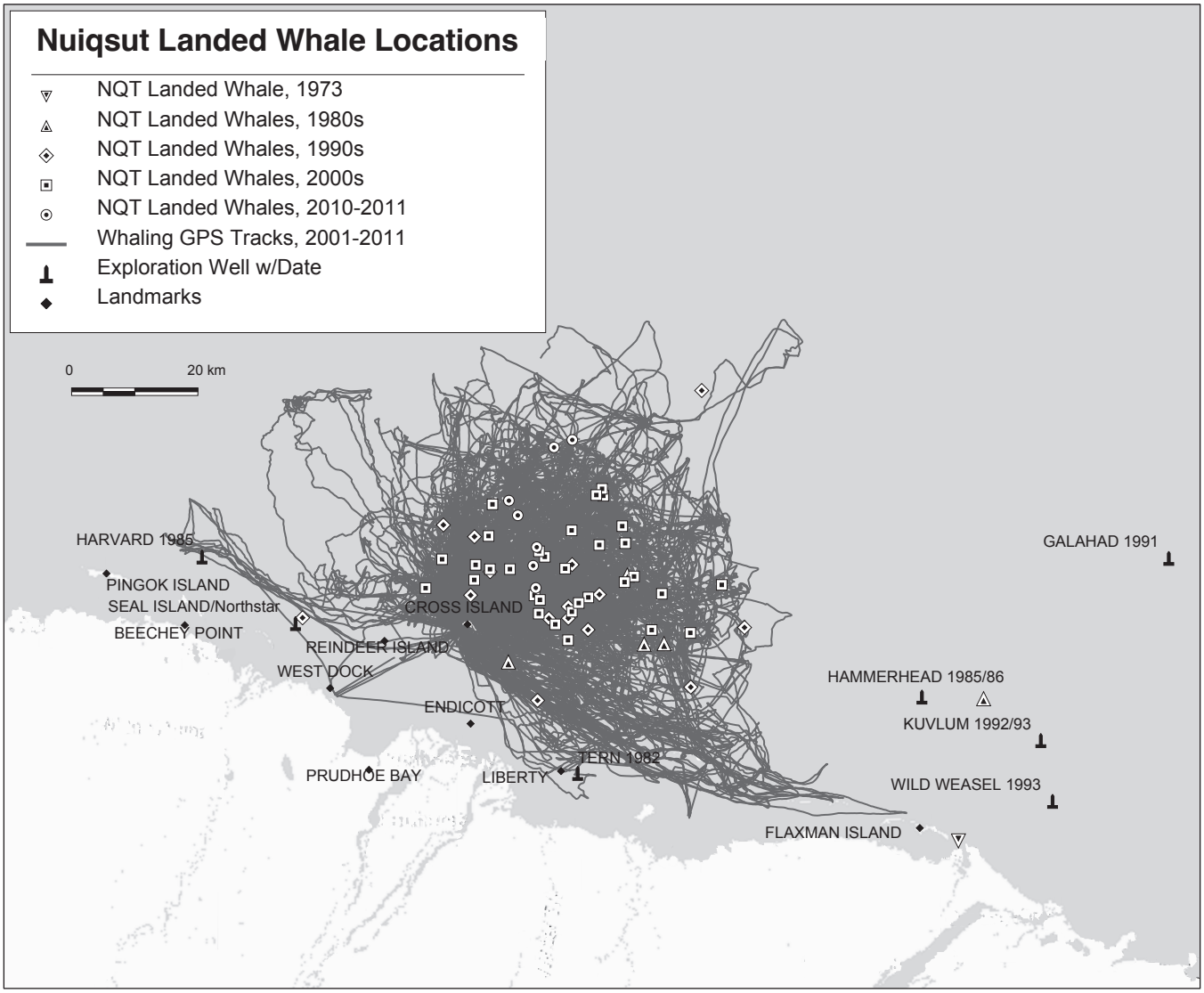

Figure 5. Harvest locations of bowheads landed near Cross Island, 1973–2011, with GPS tracks for most whaling trips for the 2001–2011 Cross Island seasons. Sources: AEWC and NSB 2007; Galginaitis 2012.

Although the area delimited by the 2001–2011 GPS tracks does not represent the full extent of the area important to Nuiqsut whalers, all but two of the sixty whales with documented landings fell within the boundaries of those tracks. The two known exceptions are the first two whales, landed in 1973 and 1982. The first was butchered on or near Flaxman Island. The second was probably towed to Cross Island, as were all but one of the subsequent whales landed by Nuiqsut whalers. The single whale landed in 1987 was towed to West Dock and butchered there. The whalers found butchering at West Dock to be inefficient, and industry found it disruptive to "normal" oilfield activities (although all accounts of these effects are anecdotal rather than systematic). All accounts agree that the butchering activities attracted a large number of polar bears to West Dock and thus presented a significant safety issue for oilfield workers, and this is generally cited as the primary reason why this experiment was never repeated.

Nuiqsut whalers commonly state that they scout for whales as far as 48 km (30 mi) from Cross Island on a regular basis. In fact, the documented tracks for 2001–2011 cover an area greater than that—53 km (33 mi) east, 70 km (43 mi) northeast, 77 km (48 mi) southeast (Flaxman Island), 50 km (30 mi) north, 44 km (29 mi) northwest, and 50 km (31 mi) west. Nuiqsut whalers state that whales can commonly be found within 16.1 km (10 mi) of Cross Island. Of the 58 strikes within the "tracked" area of Figure 5, 33 percent were made within that range. Most (90 percent) were within 32 km (20 mi) of Cross Island, while 10 percent were 34 to 53 km (21 to 33 mi) from Cross Island. The 1973 and 1982 strikes were about 85 km (53 mi) and 83 km (52 mi) from Cross Island, respectively. The quality of the data displayed in Figure 5 was not robust enough for statistical analysis. Relatively few whales were landed before 1991, and all missing data (harvest locations for seven whales) are from the 1990s. Data from the 2000s are complete and represent 56 percent of all whales landed, and 63 percent of all landed whales with known locations. Locations for landed whales from the 2000s are known by GPS coordinates, whereas the locations of earlier whales are much less precise, usually plotted on a map during an interview well after the event.

Figure 5 shows that Nuiqsut whalers have been more willing to scout for and strike whales farther north from Cross Island (but not farther east or west) in the last eleven years than before 2000. While far from definitive, whalers' accounts of the development of Nuiqsut whaling support such a generalization. Koski et al. (2005) did not find any significant differences for Kaktovik in the location of landed whales over time—but the circumstances and history of whaling for the two communities are quite different.

DYNAMICS OF NUIQSUT/CROSS ISLAND WHALING, 1973 TO 2011

Many of the patterns described above are at least partially explained by an examination of the development of Nuiqsut whaling, and how it has changed over time. Most of this history resides in the memories of the whalers. Thus, much of the information contained in this section is from the author's notes from conversations with Nuiqsut whalers between 1982 and 2012, with some additional information from AEWC records, published and unpublished sources.

1973 TO 1986: NUIQSUT WHALING "BEFORE CROSS ISLAND"

Nuiqsut's inland location presents challenges for whaling and is atypical, as all other Alaska whaling communities are coastal. To whale, Nuiqsut residents must first reach the ocean, and all channels of the Colville River limit the draft of boats that can be used to whale from Nuiqsut. Once in the ocean, a suitable location from which to scout for and butcher whales must be located. Until 1986, Cross Island was only one of several possible locations for Nuiqsut whalers, although it was probably the most promising location. The present community of Nuiqsut has a relatively short history, having been resettled in 1973 in an area with a history of seasonal occupations.

Nuiqsut's current residents trace their ancestry to people who historically and prehistorically pursued mobile subsistence strategies in the mid-Beaufort Sea area (Brown 1979; Carnahan 1979; Galginaitis et al. 1984; Hoffman et al. 1978, 1988; IAI 1990b; Long 1996; Smith 1980). Many of those who resettled Nuiqsut in 1973 had been living in Barrow, having moved there during the period of population consolidation (Brown 1979), and had participated in whaling there. At least three men who resettled in Nuiqsut had been whaling captains and landed whales in Barrow. Most who continued whaling returned to Barrow seasonally to do so.

The exception was Thomas Napageak, Sr., who had been a whaling captain in Barrow and at the time of resettlement was serving as the first mayor of Nuiqsut as

well as the first president of Kuukpik Corporation, the village Native corporation. He can be called the father of contemporary Nuiqsut whaling (IAI 1990b). He and his crew went out whaling in the fall of 1973 to "look around" and landed a small whale near the mouth of the Canning River, in very shallow water. This first whale was important for several reasons. It was the first bowhead landed in the mid-Beaufort for several decades. It established Nuiqsut as a whaling village, even with its inland location and terrestrial orientation. This enabled Nuiqsut representatives to participate in the founding of the AEWC in 1977–78 and obtain an annual quota. When Nuiqsut was incorporated in 1975, the city seal included a bowhead whale.

Nuiqsut's whale hunt takes place in the fall, since the spring migration of bowhead whales is too far offshore and thus inaccessible to Nuiqsut hunters. Fall whaling differs significantly from spring whaling. Spring whaling takes place on the ice from camps set up offshore on the edge of the nearest open water lead. Landed whales are hauled out onto the ice using block and tackles and manpower, butchered on the ice, and transported back to the community by snow machine and sled.

In the fall, the edge of the ice pack is generally far from the Beaufort Sea coast, recently over 160 km. Floating ice may be present closer to shore, and may affect the general route of the whale migration, but does not necessarily limit hunter access to the whales or influence the general movement of whale migration in the same way that the spring leads do. Floating ice may be an aid or a hindrance to whalers. Fall whalers use aluminum or fiberglass boats with outboard motors, and must tow killed whales back to land (either shore or a barrier island), sometimes 32 km or more, where the whales are butchered either on the beach or in the water. Mechanical equipment is usually necessary for the first (block and tackles can deal with small whales), since whales do not slide easily over sand and gravel beaches, and butchering in the water is a cold and difficult process. Butchering on land also requires care to minimize contamination with sand and gravel. The butchered products are then transported to ice cellar storage facilities in the community, but since snow cover is seldom present, this can be a difficult and time-consuming task in the absence of heavy equipment and motor vehicles. Such heavy equipment has been present and used to assist butchering in fall whaling, at least in Barrow, since the mid-1960s (Durham 1974:6) and on Cross Island since 1992–93 (loader in 1992, winch to haul up whales in 1993).

For these reasons, fall whaling from Nuiqsut was difficult in this early period. The Napageak crew whaled alone until a second crew joined them, perhaps as early as 1982. Several more crews formed in the years soon after that. The first Nuiqsut whaling boat was a 27-foot wooden boat with an 85 horsepower (HP) motor. This was replaced with a fiberglass boat with a 55 HP motor sometime after 1982, but most other Nuiqsut boats through the 1980s were wood—although one crew did use an aluminum boat.

Nuiqsut whalers indicate that they used various barrier islands as logistical bases in these early years, and perhaps especially Pingok Island, since it already had National Arctic Research Lab (NARL) cabins that could be used for shelter. However, the 1973 and 1982 whales were taken well to the east in the Flaxman Island area. While Pingok and other locations may have been used for temporary bases, the pattern for these early years seems to have been one of slow travel, generally near shore, camping on barrier islands and on the shore, and looking for whales in the shallower water (Long 1997).

During these early years, there were few crews and boats were heavier and slower, with smaller motors. Whalers had to carry the gas they needed. Refueling often depended on finding abandoned barrels on the beach at industrial or military sites. Ice was much more prevalent and often restricted where crews could look for whales. Because of boat limitations, the need to find fuel, and the need to hunt for seal and caribou to sustain themselves, the whalers tended to stay fairly close to shore and near the barrier islands. Because of ice and the relative scarcity of gas, one strategy for scouting was to tie up to an ice floe and wait for whales to come by. In contrast, the current practice is to actively seek whales. The crew that used Narwhal Island as a logistical base until 1992 used a 50-foot tower on the island as a perch to look for whales. This "waiting" technique saved gas and was similar to some aspects of spring whaling. Crews would sometimes be confined to one spot (Pingok Island, Cross Island, a camp site) for long periods of time due to weather or ice. Some seasons ended with the whalers frozen in by pack ice, so they had to leave their boats until the spring.

Success in the early years of Nuiqsut whaling was infrequent, and the crews would often "settle" for bearded seal, once they had decided that they were unlikely to encounter a whale. Crews reportedly based themselves on Pingok Island for 1982–83 with trips as far east as Flaxman Island. Since they had not seen many whales

near Pingok Island and were hearing noise from construction and drilling activities at Seal Island, they decided to move whaling operations farther east (Long 1997). In 1984, one crew went to Narwhal Island and one to Cross Island. In 1985 there were three crews at Cross Island and one at Narwhal Island. Beginning in 1985 and 1986, crews started to see more whales. Oil and gas exploration activities were also peaking in the Beaufort Sea to the east of Cross Island in the mid-1980s (seismic surveys and exploratory drilling). Because of the perceived interference of industrial activities with Cross Island whaling, industry and the whalers, represented by AEWC, formed the Oil/Whalers Working Group and signed the Oil/Whalers Agreement (OWA) in 1986 (Long 1996, 1997; Oil/Whalers Working Group 1986).

1986 to 2011: Cross Island, the Oil/Whalers Agreement, and Change

The 1985 season was a very difficult one for Nuiqsut whalers, due to a combination of heavy ice conditions and what they perceived as extremely disruptive effects from petroleum industry activities. This led to a series of discussions between representatives of the whalers and industry, resulting in a cooperative agreement between the two groups. The first year of the Oil/Whalers Agreement (OWA) was 1986, the same year that Nuiqsut whalers began to consistently use Cross Island as their logistical base.

The OWA established a mechanism for avoiding conflict between industry and the whalers, primarily through a communications system, along with a method for dispute resolution. The OWA also provided logistical assistance to the whalers as mitigation for the unavoidable effects of petroleum industry activities (Oil/Whalers Working Group 1986). An early benefit of the agreement was industry assistance in transporting whales in 1986 and 1987 (Armstrong and Banks 1988). The OWA was renewed for several years, and then apparently lapsed due to the decline of oil and gas activity in the mid-Beaufort Sea associated with declining oil prices (Brower 2009). Exactly when it was reborn as the Conflict Avoidance Agreement (CAA) is unclear, as documentation for the 1990s is sparse.

A CAA is a private agreement between industry and the AEWC, and although recognized in the management process, is not required by or a formal part of the process (Aiken 2011). How much of the exploration and drilling activity of the 1990s was covered by CAAs is unknown, although the AEWC states: "Since 1986 [with a very few recent exceptions] every offshore operator working in the Beaufort or Chukchi Seas during the Open Water Season has signed the CAA. Northstar, Oooguruk, Nikaitchuq, [offshore oil fields] and Badami [requiring extensive coastal barging activities during construction] were developed under the CAA" (AWEC 2012). It may have been interest in the development of the Northstar prospect that revitalized the CAA process, since a CAA is known to have been renegotiated annually since 1999/2000 (the start of Northstar development), although copies of the documents are not generally available.

Another provision of the original OWA was that the whalers could haul gas from West Dock to Cross Island, and from Endicott to Narwhal Island. This may have facilitated the growth in the number of active crews and increased success rates. Butchering was still hampered by the lack of facilities and whalers were limited to using a come-along or block and tackle to haul whales onto the beach. The first year that the whalers used a loader appears to have been 1992. The loader was used to haul the whale ashore and to assist in butchering. A diesel-powered winch was installed on Cross Island for the 1993 season.

These additions may have fostered the formation of more crews (up to eleven by the mid-1990s), but probably were also the reason Nuiqsut crews have been whaling from Cross Island since 1992, when their harvest rate also began to increase. Nuiqsut whalers started to scout for whales farther north of Cross Island in the 1990s with more capable boats, a more secure gas supply, better butchering facilities, and faster and more efficient logistics for transporting the harvest to Nuiqsut.

Nuiqsut whalers note that in the 1970s and 1980s, they tended to start whaling in late September, when the weather was cool enough to prevent spoilage. However, once the loader and winch were available on Cross Island, harvest dates became somewhat earlier in September, perhaps because some of the butchering constraints had eased. Nuiqsut whalers now expect to start their season no later than the beginning of September. In 2010, they actually *ended* their season on September 1. The whalers attribute this contraction of their whaling season to increasingly bad weather after mid-September, as well as the relative lack of ice, their desire for short seasons, better technology, and increased logistical support.

Nuiqsut whalers no longer "take time off" while whaling in order to hunt for food—they generally bring enough food for their stay on the island. They will take the occasional bear, seal, or duck—but only if no whaling

activity is imminent and they have their captain's permission. Whaling, at least the active hunting component as conducted from Cross Island, is a more focused activity and separate task now than in the past, in part because the pace of life in Nuiqsut has increased so that many whalers can no longer afford to be away from town for an indefinite period of time. Most crew members now plan for a two-week season.

The most significant changes current Nuiqsut whaling captains recall from their early years of whaling at Cross Island is the lack of ice in most recent seasons, the increased capabilities and speed of their boats, and the importance of the CAA (NWCA 2011). The switch from wooden to fiberglass and aluminum boats probably resulted in an actual decrease in the size of the boats, but a vastly greater power-to-weight ratio and probably a more efficient hull design. Nuiqsut whalers are almost certainly traveling farther offshore now than in the past, due to more capable boats, a more reliable fuel supply, and GPS navigation systems. The lack of ice has increased the need for speed to find and chase whales, as well as for boats able to handle rougher sea conditions. Captains stress the importance of the CAA to their whaling success thanks to a communications system, stipulations minimizing industry activities that might interfere with whaling, and better logistical support.

ADAPTATION IN CROSS ISLAND WHALING

In an earlier paper based on more limited data from 2001–2007 (Galginaitis 2009a), I concluded that seasons Nuiqsut whalers labeled as "good" were those perceived as short and efficient in terms of the level of effort expended per strike. The factor thought to be most significant was that whales were closer to Cross Island than in other seasons. What becomes evident with four more years of data (2008–2011) is that a "good" whaling season is about two weeks long, with a harvest of three or four whales. Whales tended to be found and struck closer to Cross Island than in other seasons, but this was not necessary for a "good" season if weather conditions were generally favorable. For "good" seasons with relatively poor weather and sea conditions, whales were found and struck closer to Cross Island than in other seasons. Three weeks was as long a season as most crews desired, no matter how few whales had been landed.

There are at least three major factors affecting the length of the Cross Island whaling season. While there is an ethos of cooperation on Cross Island, living conditions are close. A whaling season that extends into a third week is usually one in which there have been some delays or problems, poor weather and sea conditions, few whales or at least few whale sightings, and social tensions ("island fever"). Most Nuiqsut whalers are employed or have community responsibilities that make an absence of more than two weeks inconvenient. Further, Nuiqsut whalers have been feeling some pressure from the oil and gas industry to complete their seasons quickly in order to avoid delaying planned industrial activities. Nuiqsut whalers also report that weather becomes increasingly unpredictable after mid-September, with longer periods of high winds and bad seas. A start date in late August or early September means, from the whalers' experience, that there is only a two- or three-week time window for whaling from Cross Island with a reasonable expectation of success.

One Nuiqsut strategy that appears to be effective in assuring a short and productive season is to modify whaling guidelines, including: when to scout for whales; how many whales to strike in a day; how to butcher a whale; and who should butcher it. The whalers reported 2000 to be an ideal season, in terms of both conditions for whaling and their results. The pattern was to land a whale, finish butchering it, and then go out and land another whale and repeat the process until they had four whales. Although this is not a complete portrayal of the 2000 Cross Island whaling season, it exemplifies the normative, or "old" rules for Cross Island whaling.

First, once a whale is struck, all crews should assist in killing that whale, towing it to Cross Island, and butchering it. Second, only one whale should be landed on any given day, to ensure that butchering each whale is done as quickly as possible to minimize waste. The labor pool available for butchering on Cross Island is, for the most part, confined to the crews themselves, since the whaling site is so far from the community.[5] Third, whalers cited a rule that no crews should go scouting for another whale until butchering the whale on shore had been finished, or at least reached the stage where the head had been cut off (a relatively advanced butchering state). If possible, the butchered whale should be divided into crew shares before the next whale is landed. Whalers often summarized a "perfect" season as consisting of a day when a whale is landed followed by a day when butchering is completed and the *niniq* (front portion of a whale) is divided into crew shares, repeated until the quota is filled. For a quota of four, with two traveling days, this would result in a season of ten days.

Depending on the size of the whale, the time of day it is pulled up on Cross Island, and the motivation of the crews butchering the whale, a whale can sometimes be completely butchered and divided into crew shares on the same day it is landed. In those cases, or if butchering can be completed early the next day, crews may go out scouting and try to land whales on successive days. If conditions are suitable for scouting and no butchering remains to be done,[6] captains are generally free to scout whenever they wish. That is, there is no collective decision to go out scouting, and crews do not necessarily go out together.

On marginal days, some captains will choose to go out while others will stay on the island. Once "on the water," boats will usually coordinate with other boats to find and chase whales, and once a whale is struck all boats are expected to help with the kill. The degree to which whaling behavior for each Cross Island whaling season (1973–2012) followed the normative "old rules" described above varies. Departures from the normative rules demonstrate how Cross Island whaling has adapted to changing conditions (both physical and social). Time and space does not allow a detailed account of each season, so only seasons judged significant for this discussion are highlighted. More detail can be found in the Cross Island project annual reports (e.g., Galginaitis 2011, 2012) and the final report (Galginaitis 2013).

All Nuiqsut whaling seasons prior to 1998 are consistent with the normative pattern described above, although for most of those seasons the harvest was zero or one, and there were other significant differences among them. Information on whether there was scouting for whales (with no strikes or harvest) on the days after whales were landed in those years is unavailable. In none of those years were whales landed on successive days. Nuiqsut whalers first landed multiple whales in the same season in 1989, when they took two and had two struck and lost. Since Nuiqsut had a quota of two, this indicates that the whalers requested an additional strike twice from the AEWC, after each struck and lost, before finally landing their second whale. The two landed whales were separated by several days, as were multiple whales landed in the 1990s.

Little is known about the 1998 season, other than the dates strikes were used and characteristics of landed whales. Two whales were landed (and one struck and lost) on 14 September. Cross Island-specific weather is not available for 1998, but historical data from the Prudhoe Bay weather station indicates that the wind speed was quite high (20–25 knots) from 8 to 12 September, about 10 knots for 12 through 14 September, increasing to very high wind speed (30+ knots) on 15 September and with only short periods of wind speeds less than 15 knots thereafter. It is likely that the whalers attempted to land three whales on 14 September, anticipating the poor weather to come, and were fortunate to obtain a fifth strike and be able to use it on 18 September. This was the first Nuiqsut whaling season to depart from what I am calling the "old rules" (Table 1).

In 2000, four whales were landed, the last three on successive days. From the accounts of this season, it is probable that these three whales were butchered to a fairly complete state (Deadhorse Communications Log 2000[7]), but not divided into crew shares, before scouting resumed. That is, the first whale was butchered completely and divided, but for the next two whales division into crew shares was probably delayed until the fourth was landed.

In 2003, four whales were landed: one on 1 September, two on 5 September, and one on 6 September. The whalers were worried about the poor weather. Both whale strikes on the fifth were early in the morning. The first was butchered by the end of the day, the second was finished on the sixth, late in the afternoon. Since conditions for scouting were fairly good, three of the four crews went out to look for another whale (the fourth crew had already landed two whales). The fourth whale was struck late the evening of 6 September and arrived at Cross Island about 11:50 PM. It was left in the water overnight. This season reinforced the practice of landing multiple whales on one day and/or on successive days and documented the delay in butchering if the whale arrived at Cross Island late at night. Nuiqsut whalers have found that this is preferable to trying to butcher all night with minimal light and tired crews. Usually all of the internal organs and sometimes the tongue can be saved, although the recovery rate of the meat on the "bottom" of the whale, the last part to be butchered (actually usually one of the sides of the whale) is often low. Apparently, in 2003 the division into crew shares was done as each whale was butchered.

Nuiqsut whalers only landed three whales in 2004, due to poor weather. The first two were taken on 5 and 6 September. The first whale was large, but was butchered to the stage where the internal organs and tongue had been removed ("guts out") by the end of the day; the head was still on. The captain who landed the second whale explicitly told the other captains that they could go out scouting while conditions were still good, before the wind came up. All three of the crews that had not landed whales went

out scouting and landed a third whale on 14 September. This is the first documented instance of crews returning to scout even though butchering had not been completed. The captains called a cease fire, due to projected poor weather and an adequate harvest for community needs.

Only one whale was landed in 2005, due to very poor whaling conditions (localized ice). Four whales were landed in 2006, the first three on successive days, but only after the whalers had been on Cross Island for eleven days without being able to whale, due to the same local ice conditions as in 2005. The whalers had removed the internal organs of the first whale by the end of the day. The next day three of the four crews went out scouting, following the 2004 precedent, and landed the second whale in mid-afternoon. Butchering of this whale was nearly complete by 11:30 PM. This allowed three crews to go out scouting the next day and land a third whale late in the afternoon, arriving at Cross Island late at night. This whale was left in the water overnight. All crews helped butcher the whale to completion, waited out a weather day, and the next day all four crews went scouting and landed the fourth whale. It appears that all four whales were divided into crew shares on 20 September, after the last whale was butchered. Thus the 2006 season used modified practices from the 2003 and 2004 seasons, and may have delayed the division of crew shares to allow crews to scout for whales while conditions were good.

Scouting, butchering, and division practices from 2007 through 2012 demonstrate the same trends described for 2001–2006. While crews with landed whales butchered, the other crews continued to scout for whale, sometimes leaving a few crew members onshore to assist with butchering (all seasons 2006–2012). If it was late in the season or future conditions were expected to deteriorate, two whales were landed on the same day (2007, 2010–2012). A whale arriving at Cross Island late in the day was most often left in the water so butchering could begin in the morning (2007, 2010). The division of the *niniq* into crew shares was deferred (2007–2011) or took place without all crews being represented (2012). When several whales were landed within a short period, butchering practices were modified by "chunking" the whale so that larger sections of *uati* and *niniq* were left for the secondary processing stage (2008 and some subsequent seasons; see Galginaitis 2013 for further detail).

All of these modifications of Cross Island whaling behavior represent departures from "old" normative whaling practices. All represent responses to at least three factors: the whalers' increased time constraints due to employment and other responsibilities; the increased uncertainty and instability of whaling conditions; and the desire to minimize the time spent whaling in order to avoid disruption of the oil and gas industries, in accordance with the annual Conflict Avoidance Agreement.

CONCLUSIONS

One major goal of this paper was to provide an overview of fall whaling as it has been conducted from Cross Island by residents of Nuiqsut, through the presentation of historical harvest data within the context of Nuiqsut whaling over time. Nuiqsut's whalers have been adapting to timing constraints (whale migration, limited open-water period for industry operations, work and other village responsibilities) and physical, logistical, and regulatory challenges of Cross Island whaling since 1973 and can articulate their experiences succinctly. As one Nuiqsut whaling captain remarked when asked to characterize contemporary Cross Island whaling: "Lots of whaling today [in Nuiqsut] is about boats—faster and better. For a short time of hunting, you need better equipment." Of course, he was talking about more than boats. Contemporary Cross Island whaling practices have changed in significant ways, especially since the 1970s and 1980s, and this section summarizes the most important of these changes.

Whaling from Nuiqsut from 1973 through at least the early 1980s was an exploratory activity, with no established logistical bases and relatively few time constraints, other than those of the bowhead whale migration. Crews were required to be self-sufficient and carried everything that they needed during the hunt, or took time from the whale hunt in order to find or otherwise satisfy those needs, e.g., looking for abandoned gas, or harvesting other subsistence resources such as caribou, seal, and fish. Whalers tended to stay close to or shoreward of the barrier islands. While the early years of Cross Island whaling are not well documented, from the whalers' accounts and harvest records, fall whaling started in mid- or late-September and could extend through October. Ice was encountered more frequently in the 1970s and early 1980s than it was in later years. The need to wait for cooler weather, so that the whale would not spoil, is cited as an explanation for both the later start and frequent presence of ice during these seasons.

Oil and gas exploration activities pushed Nuiqsut whaling eastward, and the establishment of the Oil/Whalers Agreement (and later the Conflict Avoidance

Agreement) mitigated at least some of the potential effects of the industrial activity by providing logistical support. Cross Island would probably have become the logistical base for Nuiqsut whaling in any event, but the availability of the loader and winch under the CAA in 1991 and 1992 was probably instrumental in the consolidation of all Nuiqsut crews on Cross Island. Perhaps as important was the CAA provision for a dependable supply of gas, which was essential for the establishment of a base. A dependable gas supply was also required for a shift from a "gas conservative" hunting strategy most suitable to hunting in heavier ice conditions to a high-consumption strategy of pursuing whales in open water. The gas supply also enabled the whalers to make full use of larger boats and more powerful motors as they became available, which made scouting for whales farther offshore feasible. Adverse ice conditions were last noted in the Alaska Eskimo Whaling Commission's records for the 1991 season and locally for Nuiqsut whalers in 2005. Whalers report that they have encountered progressively less ice, beginning in the 1990s. This in turn reinforced the usefulness of big boats, powerful motors, and a dependable gas supply.

Bigger and faster boats also made transporting the butchered whale easier; the OWA and especially the CAA were particularly important in this regard. Once most Nuiqsut whalers made Cross Island their logistical base in the mid-1980s, industry found it advantageous to facilitate the transportation of the butchered whale through West Dock as expediently as possible, to avoid attracting polar bears to the area. The whale landed in 1987 was towed to West Dock, where it was butchered. This was not repeated, although emergency assistance in towing whales to Cross Island has been provided since then. However, butchered whales have been staged (usually in refrigerated vans) at West Dock until transportation to Nuiqsut has been arranged. In earlier years this was by truck transport to Oliktok Point, where whale meat was stored until the whalers could either take it upriver by boat or until there was sufficient snow cover to use snow machines and sleds. The U.S. Air Force found this arrangement unsatisfactory due to the proximity of the former DEW-line site at Oliktok, and now the butchered whale is flown from Deadhorse to Nuiqsut as freight, usually a day or two after the season ends. This serves the needs of the whalers, industry, and the military by expediting the whaling season, reducing waste due to spoilage, and minimizing the number of polar bears at industrial and military sites.

Coinciding with the increase in Nuiqsut's bowhead quota was an increase in industrial development and exploration activity with a concomitant increase in local employment opportunities—most with NSB or support services for the petroleum industry (and a few directly with industry). One of the provisions of the CAA is a constraint on industry activities during the subsistence whaling season; thus, there is industry interest in keeping the season as short as possible. Since many whalers now have full-time jobs, and leave policies generally restrict them to two-week absences for major subsistence activities, many if not most Nuiqsut whalers also desire relatively short seasons. The start of the season is constrained by the ambient temperature and the timing of migration, generally around 1 September. The length of the season is dependent on the conditions discussed above, and the quota of four strikes.

Since Nuiqsut's quota increased to four strikes, changes in scouting and butchering practices have tended to shorten the whaling season. The whalers' concerns about less predictable and less favorable weather for whaling, combined with employment and industry time pressures favor shorter seasons starting as early as possible. In order to fit a quota of four strikes within a two-week season, Nuiqsut whalers now: 1) consider landing more than one whale on the same day; 2) scout for whales the day after a whale is landed even if that whale has not been fully butchered; 3) will strike a whale late in the day and leave it in the water to start butchering the next day; and 4) will adapt procedures to speed up the initial butchering process in order to clear the beach for the next whale. In a real pinch, Nuiqsut crews will butcher two whales at the same time.

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NOTES

1. Information on the bowhead whale harvest near Cross Island has been collected by the North Slope Borough (NSB) Department of Wildlife Management and the Alaska Eskimo Whaling Commission (AEWC) (AEWC and NSB 2007). The data are archived in a database maintained by the NSB (and for Nuiqsut-landed whales only, in a different format by BOEM for 2001–2012). Basic morphometrics for whales landed at or near Cross Island were recorded by the whalers; information before the 1990s includes more estimates. Harvest location and GPS information for 2001–2012 was collected by a BOEM-sponsored project (Galginaitis 2009a, 2009b, 2010, 2011, 2012). Harvest location information prior to 2001 is a mixture of GPS and estimation (NSB)—the older the information, the greater the degree of estimation.
2. Data were derived from the North Slope Borough database, which includes the date of harvest, size of whale, sex of whale, and location of harvest (often only approximate). Nuiqsut whalers have given their permission for harvest locations to be published as described here.
3. Not all whales that are struck by hunters are actually landed. Some are struck but are ultimately lost to the whalers. The fate of these "lost" whales is not always known, but for the purposes of the quota and management of the hunt, all are presumed to die and thus count as an expended strike. Hypothetically, a village may use its entire annual "strike quota" without successfully landing a single whale. Villages may request additional strikes from the "bank" of unexpended strikes maintained by the AEWC when their harvest does not meet subsistence needs.
4. R^2 is the proportion of variability in a data set that is accounted for by the model, and is a measure of how well a regression line fits (or describes) the data. Values can range from 0.0 (no correlation) to 1.0 (perfect correlation). This trend is even more significant (r^2 is larger) for the date of the first strike, but the data are somewhat less precise and the sample size is much smaller.
5. Additional Nuiqsut labor was necessary for the first several whales taken due to the small number of crews whaling at that time and the need for additional boats to transport the butchered whale products. Once the whalers established a logistical base on Cross Island, and after the advent of the loader and winch, additional labor was unnecessary. For the eleven years documented by the BOEM project, Nuiqsut residents assisted with butchering only one or two seasons.
6. The flag of the captain who lands the whale is raised over the winch shack after the whale is hauled onto the beach. The whale is divided into three major portions: *uati* (back of the whale, for the community), *niniq* (front of the whale, for the crews helping with the whale), and *tavsi* ("belt" located by the whale's naval, used to "feed the village" as soon as possible after the whale is landed). Some parts are designated for specific individuals, e.g., one flipper for the harpooner. As the whale is butchered, the pieces are spatially segregated into these three categories. Usually, the crew that landed the whale will prioritize butchering and processing in order to have enough of the *tavsi* to send to Nuiqsut within a day or two of the landing. Since not all the *tavsi* can be taken off the whale immediately, some may be treated as *uati* (although kept spatially separate, even after transport to Nuiqsut).

   Once the primary butchery is complete, the unused and spoiled parts are disposed of in the bone yard. The skull and upper jaw are given special treatment and are placed in the row of skulls of previously landed whales between the whalers' cabins and the boneyard. The captain sometimes recovers the eardrums from the skull the same year the whale is landed, but more frequently waits until the next season. All other bones remain in the boneyard, although a few vertebrae and shoulder blades may be taken by individuals to use for craft projects after they have "aged" in the boneyard for at least a year. The head,

flukes, and flippers are always separated from the body. If the flippers are butchered on Cross Island, the bone is taken to the boneyard—but in recent years most flippers have been transported whole to Nuiqsut to be butchered (and the bone taken to the dump). In a few cases when the harpooner did not want the fluke, it was disposed of in the boneyard unbutchered.

After butchering, the spine and ribs are usually still articulated and may have a significant amount of meat remaining on them. If many whale bombs were required to kill the whale, at least some of the meat will probably have been rendered unfit for human consumption (especially on the *niniq*, or front half of the whale, where bombs should ideally be directed). If the time required for the tow and/or butchering was too long, some of the meat may have spoiled, especially on the last part of the whale to be butchered.

Once the whale is taken to the boneyard, the captain's flag is taken down and there is a division of responsibilities. The crew that landed the whale is responsible for the secondary butchering of the *uati* into smaller portions and packing it for transport to Nuiqsut. Other crews process the *niniq* into smaller portions and divide it into equal shares, one for each crew that helped with the whale. (But for the first whale landed each season on Cross Island, all crews whaling that season receive a share, whether they helped with the whale or not). Generally it is said to be better to finish this process completely before going out scouting for another whale. In recent seasons, when multiple whales are landed on the same day or on successive days, this division is often delayed. Each whale's *uati* and *niniq* are kept separate from that of other whales, but the division into crew shares may all take place (sequentially) on the same day, once all whales have been landed and processed to the stage of *uati*, *niniq*, and *tavsi*.

7. The Deadhorse Communications Center (DCC) logbook is an unpublished source generally available only to industry and whaler participants in the Conflict Avoidance Agreement (CAA). Copies of logs may be available to qualified researchers through the Alaska Eskimo Whaling Commission or through BP Exploration Alaska. In 2000, Alaska Telecom was probably subcontracted to BPXA to operate the DCC.

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