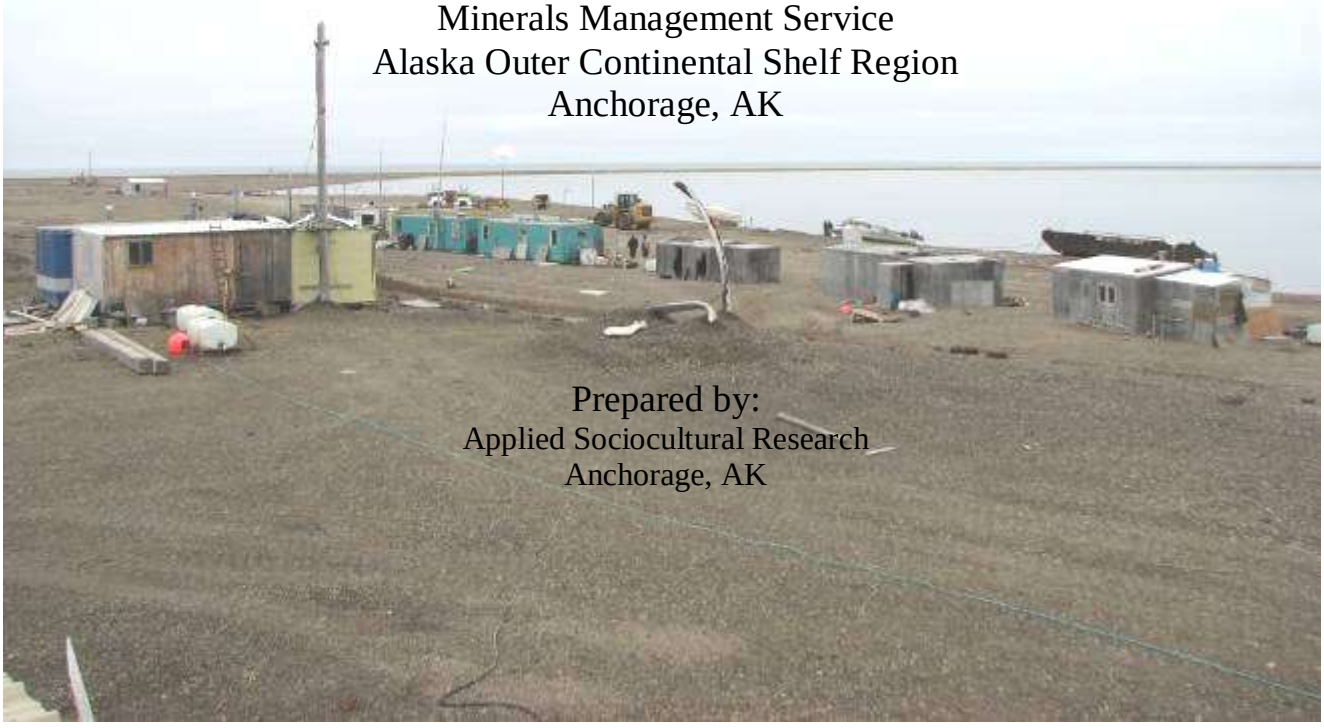
Annual Assessment of Subsistence Bowhead Whaling Near Cross Island, 2001-2007
Final Report

Contract Numbers 1435-01-04-CT-32149 and M04PC00032

Prepared for:
U.S. Department of the Interior
Minerals Management Service
Alaska Outer Continental Shelf Region
Anchorage, AK



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U.S. Department of the Interior
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cANIMIDA Task 7
Annual Assessment of Subsistence Bowhead Whaling Near Cross Island, 2001-2007

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Anchorage, AK

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Acronyms and Abbreviations Used in Tables, Text, and Appendices

Acronym or Abbreviation	Expanded Term or Reference
UA[1]	Ahkiviana Whaling Crew
BO[1]	Oyagak Whaling Crew
IAN	Aqargiun Whaling Crew
NAP[1]	Napageak Whaling Crew
NUK[1]	Nukapigak Whaling Crew
#	Number
ACS	Alaska Clean Seas
AEWC	Alaska Eskimo Whaling Commission
ANCSA	Alaska Native Claims Settlement Act
ANIMIDA	Arctic Nearshore Impact Monitoring in Development Area
BP	Barometric Pressure
BPXA	British Petroleum Exploration Alaska
cANIMIDA	continuation of ANIMIDA
CI	Cross Island
esp.	especially
F	Fahrenheit (temperature measurement)
ft	Feet
GIS	Geographical Information System
GPS	Geographic Positioning System
HAD	Human Activities Database
HCC	High Cloud Cover
HP	Horse Power
IHLC	Inupiat History, Language, and Culture Commission
IWC	International Whaling Commission
MFCI	Miles From Cross Island
mmddyy	Date Format – month/day/year
MMS	Minerals management Service
MPH	Miles Per Hour
N,S,E,W and combinations	Compass directions (north, south, east, west, northeast, etc)
NA	Not Applicable
NQT	Nuiqsut
NSB	North Slope Borough
NSB DW	North Slope Borough Department of Wildlife Management
OCS	Outer Continental Shelf
OWA	Oil/Whalers Agreement
TOT	Total Time (of individual boat trips)
UNK	Unknown
w/number or /number	With the specified number (of people)
WCA	Whaling Captains Association
WCC	Whaling Communication Center
WD	West Dock (Prudhoe Bay)
WF	Weather File (time series of weather station measurements)

[1]When whaling crews use multiple boats, each boat is differentiated by a number after the crew designation (1-4)

Note on Organization of the Report

This report is a summary and synthesis of the seven annual reports that have already been produced to describe each of the Cross Island subsistence whaling seasons from 2001-2007. Each of these annual reports, and its supporting materials, is attached on the CD-ROM that accompanies this report, in the directories indicated below. Only summary and comparative data is presented and discussed in this report. The reader is referred to the annual reports, or the GIS tracks and point files available for appropriate uses from MMS, for more detailed information.

The first half of this final report covers topics that have also appeared in each of the annual reports – an overall description of the project, an overview of contemporary subsistence whaling in Alaska, and the historical context of Cross Island whaling. The last two discussions are somewhat more complete in this document, and are supplemented with a brief treatment of trends in the Nuiqsut bowhead whale harvest. The Methodology section is much as it has appeared in the annual reports.

The second half of the report, "Results," is a comparative discussion of the 2001-2007 Cross Island whaling seasons, based on the GPS and other systematic observational data collected for the project. While relying on information contained in the annual reports, the annual report data and discussions are incorporated primarily by reference and are not replicated in this report.

The following Directories are contained on the accompanying CD-ROM, and contain the files described below:

AnRpt2001 – 2001 Annual Report as PDF
AnRpt2002 – 2002 Annual Report as PDF and weather data as Excel
AnRpt2003 – 2003 Annual Report, Appendices A & B as PDFs, weather data as Excel
AnRpt2004 – 2004 Annual Report, Appendices A & B as PDFs, weather data as Excel
AnRpt2005 – 2005 Annual Report, Appendix C as PDFs, weather data as Excel
AnRpt2006 – 2006 Annual Report, Appendices A-C as PDFs, weather data as Excel
AnRpt2007 – 2007 Annual Report, Appendices A & B as PDFs, weather data as Excel
Data – Only on MMS and NSB archival copies, GPS and Excel data, 2009 Final Report in Word2007 format
FinalRpt2002 – 2002 Final, revised 2001 & 2002 Annual Reports, 2001 & 2002 tracks by day as PDFs; weather data as Excel
FinalRpt2009 – 2009 Final Report, Technical Summary of 2009 Final Report, both in PDF format (Word2007 versions of these files are also included on the MMS archival CD-ROM)
ITM_Presentations – 2003, 2005, & 2008 presentation in PDFformat
OpenWater_Presentations – 2006, 2007, & 2008 presentations in PDF format
Other_Presentations – various presentations to AEWC, NWCA, SETAC, and workshops
Posters – ASLO Ocean Sciences (3/08) & American Cetacean Society (11/08) Conference posters in PDF format

Acknowledgments

This work would not have been possible without the assistance of a great number of people. While it is unfair to single out individual whalers when all provided essential information and support in what is after all a communal and cooperative undertaking, I must thank those whaling captains and their crews who extended me the hospitality of their cabins for the seven seasons covered by this report. Paul Kittick, as my host for the first year when the project was still an unknown quantity to the whalers, has my utmost appreciation. Archie Ahkiviana agreed to be my host the second year, when Paul did not whale, and also served as a host for the fifth and sixth seasons. Billy Oyagak served as my host the third season, when neither Paul nor Archie whaled, and also served as my host for the seventh season. The late Thomas Napageak was my host for the fourth season. I of course also thank the other crews who were out on Cross Island during the 2001-2007 seasons (Nukapigak, Aqargiun, and Ipalook), and David Pausanna for all the help he has given me over the phone and while I have been in Nuiqsut. Thomas Napageak and Archie Ahkiviana were also especially helpful during the development of the project in the year and a half prior to field work, both in suggesting what would work and be useful to the whalers, as well as in formally supporting the research by suggesting the Nuiqsut Whaling Captains' Association (NWCA) invite me to go to Cross island for the 2001 whaling season. The NWCA has continued to invite me back, for which I am most grateful. I cannot begin to list the other residents of Nuiqsut who shared so much of their time and knowledge. Maggie Ahmaogak, Harry Brower, and Teresa Judkins of the AEWC (in Barrow) have also been generous with their advice and support. Craig George and Taqulik Hepa of the North Slope Borough Department of Wildlife Management have also been strong supporters of the research.

Industry has also provided a good deal of help in various forms, from advice to more concrete logistical support. Ray Jucubczak, Concie Rock, and Bill Streever at BPXA were especially notable in this regard, although several individuals at Alaska Clean Seas and Kuukpik Carlisle were also very helpful. BPXA assisted with the transformation of the raw GPS track information into more usable GPS-based maps for the 2001-2003 data. Although these maps have since been replaced through more recent in-house software, their early assistance is much appreciated. Other industry participants in the Conflict Avoidance Agreement have also provided logistical support, and BPXA has provided supplemental financial support for the Cross island research effort in conjunction with their annual application for permits for the Northstar production unit.

MMS, as the sponsor of the project, also deserves a formal "Thank you." Dick Prentki has been an ideal COTR, even though the course of the project has not always been smooth.

Lastly, ASR performed this work as a subcontractor to LGL Limited of Alaska and Battelle for the 2001-2003 field seasons. I thank them for their willingness to trust that the work would be accomplished with a minimum of oversight. I am especially grateful to Dale Funk at LGL.

The above notwithstanding, all errors and shortcomings of this report are the responsibility of Michael Galginaitis and ASR. But again, none of this work would be possible without the cooperation and support of the Nuiqsut whalers, to whom I again give my most profound thanks – and especially to Thomas Napageak Sr. and each of the crews that were on Cross Island for 2001-2007 (pictures of Thomas and for the crews follow).

The late Thomas Napageak Sr. at home on Cross Island, 2004 – his last whaling season. Chairman of the AEWC and senior Nuiqsut whaling captain

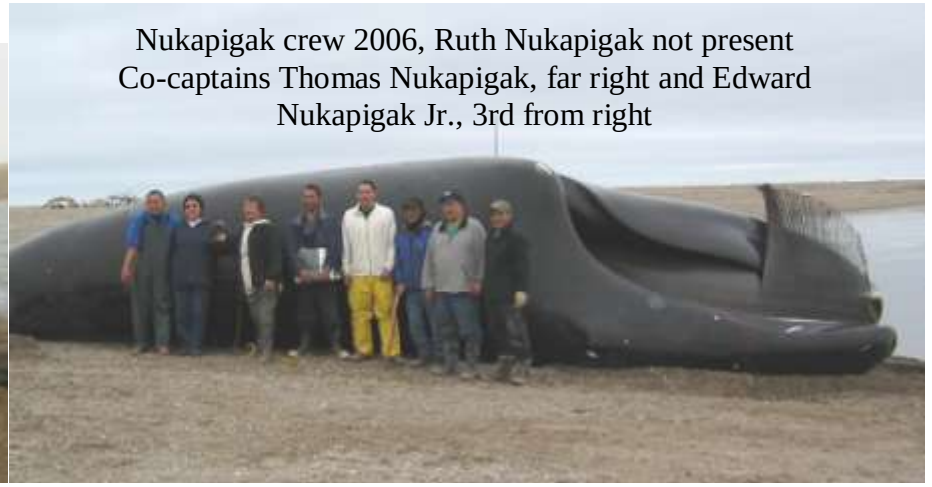
Thomas Napageak Sr. at the Cross Island butcher site, 2003

Thomas Napageak Sr. on Cross Island, 2003 – with Isaac Nukapigak, a member of his crew in 1973 when Thomas landed the first whale for Nuiqust. Isaac is now captain of the Aqargiun crew. Eli, his brother, was also a member of the 1973 crew and is now a co-captain of the Nukapigak crew.

Kittick crew 2001
Paul Kittick at left

Aqargiun crew 2006
Isaac Nukapigak in center in blue coat

Oyagak crew 2006
Billy Oyagak at left



Nukapigak crew 2006, Ruth Nukapigak not present
Co-captains Thomas Nukapigak, far right and Edward Nukapigak Jr., 3rd from right

Napageak crew 2002 – Thomas Napageak Sr. on four-wheeler
Thomas Napageak Jr. assumed the captaincy of this crew in 2005

Ipalook crew 2008 (no good 2007 photo available)
Herbert Ipalook 2nd from left

Ahkiviana crew 2006
Archie Ahkiviana in the middle

Executive Summary

This Task Order, funded by the Minerals Management Service (MMS) describes subsistence whaling as currently conducted near Cross Island by residents of Nuiqsut. While "traditional" subsistence whaling has been well documented in a number of locations, contemporary subsistence whaling is not as well documented, especially in terms of change over time. This effort is designed to measure basic parameters of Cross Island whaling so that observed changes (if any) can in the future be analyzed in relation to such factors as oil and gas activities, weather and ice conditions, or other variables. Observations, and the narrative annual report summarizing them, focus on descriptive measures of activities associated with whaling. Special attention is devoted to geospatial information through the sharing of GIS information by participating whaling crews. While this information can be analyzed as a self-contained database, it can also be examined in conjunction with the many pertinent external databases (for example, weather records, sea ice condition remote sensing photographs, AEWC historical bowhead whale harvest records). This report focuses on the former, with the addition of weather information from the Deadhorse weather station, historical (pre-2001) whale landings for Nuiqsut whalers, and whaler accounts of past whaling seasons and interactions with industrial and commercial activities in the central Beaufort Sea area. Comprehensive information on oil and gas activities in this area is limited, mostly of a confidential nature, and documents only the time period prior to that documented in this report . The project is also designed as a collaborative effort of MMS and its contractor, Applied Sociocultural Research (ASR), the subsistence whalers from Nuiqsut, and the Alaska Eskimo Whaling Commission (AEWC). Beyond the goal of the seven years of descriptive information on Cross Island subsistence whaling activities (documented in this report (and four additional field seasons funded for 2008-2011), the project will develop a system for collecting such information that local whalers themselves can adopt, adapt, and maintain.

Three primary methods of information collection were employed – systematic observations, collection of daily vessel locational information from handheld GPS units, and whalers' self-reports and perceptions. Emphasis has been placed on such measures as:

- Number of whaling crews actively whaling and number of boats used (observation)
- Size and composition of whaling and boat crews, and fluctuation over the whaling season (observation)
- Number of whales harvested (observation, self-report)
- Days spent whaling, and days prevented from whaling (observation, self-report)
- Days suitable for whaling when whaling did not occur (observation, self-report)
- Subsistence activities occurring other than whaling (self-report, observation)
- Location of whale searching, whale sightings, and whale harvest (GPS, self-report)
- Local weather and ice conditions (observation, self-report)
- Bowhead whale behavior in the Cross Island area, and differences from past experience (self-report)
- Changes in access or other issues related to the whale hunt, such as increased effort for the same (or reduced) harvest, increased risk, increased cost (self-report)

For the seven seasons documented in this report, the time at least one whaling crew was at Cross Island ranged from 13 to 30 days, and the number of whaling crews active in any one season ranged from 3 to 5. The number of boats taken to Cross Island and potentially available to whale

ranged from 7 to 10, and the seasonal maximum number of people actually physically present on Cross Island ranged from 33 to 43. Days when weather prevented the whalers from scouting for whales ranged from 3 to 15, and days when whalers went out scouting for whales ranged from 5 to 15. Whales were seen on most days when whalers went out scouting, but the percentage varied seasonally from 50 to 100 percent. The seasonal average for scouting trips ranged from 30.1 to 84.0 miles (roundtrip) and from 4 hours 31 minutes to nine hours 43 minutes. The average seasonal strike distance from Cross Island ranged from 9.3 miles to 25.9 miles. The shortest season documented (2007) had the minimal values for all these variables except average temporal duration of trip and average strike distance from Cross Island.

The annual quota for the Nuiqsut whalers was four strikes, or a potential for 28 whales landed. They landed a total of 22 whales and also had 2 struck-and-lost whales, using 86 percent of their allocated strikes and landing 92 percent of the whales they struck. Only in 2005 did they land less than 3 whales, when adverse ice conditions, poor weather conditions, and possible interference from a commercial barge limited their opportunities to physically find and approach whales. In 2005 the whalers could reach the open water where whales were swimming on only two days, and large swells made it dangerous for them to leave the protection of the floating ice to boat into the open water to find and approach whales on one of those days. On the day they could boat into the open water they landed one whale, but also encountered a commercial barge. The whalers experienced adverse conditions of one sort of another in all other seasons (whales somewhat distant from Cross Island and "skittish" in 2001 and 2002, poor weather in 2003-2007, restrictive ice conditions in 2006) but were still able to use the limited windows of suitable whaling conditions to land whales. Whales were generally closer to Cross Island (8 to 15 miles) in the seasons with poor weather and no or little ice. For the seasons when whales were more distant from Cross Island and there was some limited amount of floating ice, the weather and overall whaling conditions were somewhat more benign than in other seasons. The relationship between the location of the whale migration in relation to Cross Island and the seasonal environmental conditions is not clear. More detailed descriptions of each season is included in this report and the Annual Reports cited in the References Cited section. The report also contains a comparative discussion of the 2001-2007 Cross Island whaling seasons, and some information from earlier seasons as well.

Introduction and Objectives of the Research

Initially funded as a three-year component (task order) of a larger multi-disciplinary monitoring study, the project discussed in this report has grown into a thirteen-year (eleven field season) stand-alone effort. The details of this evolution will probably concern few readers, so only a brief summary of the highpoints (affecting project management or of interest in terms of the project's objectives) follows.

The Arctic Nearshore Impact Monitoring in the Development Area (ANIMIDA) study was funded by the Minerals Management Service (MMS) to "monitor impacts associated with development activities and initial production of oil from the Northstar and Liberty units in the nearshore portion of the Alaska OCS [outer continental shelf] in the Beaufort Sea." Phase I, starting 06/1999, did not include a Cross Island task element. Phase II, starting 07/2000, included Cross Island Subsistence Whaling as one of its seven subtasks or task orders (contract 1435-01-99-CT-30998, TO 10904. Applied Sociocultural Research (ASR) was subcontracted to LGL Alaska for this single task. LGL Alaska was in turn subcontracted to Arthur D. Little, the prime contractor for the entire study, for this as well as some other tasks. The intention was to collect data for three field seasons (2000-2002) and to produce three annual reports following each field season and a "final" report discussing all three years. Because of the need for extensive consultation with the Nuiqsut whalers as well as the Alaska Eskimo Whaling Commission (AEWC) before data collection could start, and the short period of time between contraction for the Cross Island task (July 2000) and the start of Cross Island subsistence whaling (September 2000), data collection started only with the 2001 whaling season. Although the ANIMIDA field collection formally ended with the 2002 field season, MMS provided funds (with a contract modification) to continue the work for 2003 and funded further work for the 2004-2007 seasons as a component of the Continuing Arctic Nearshore Impact Monitoring in the Development Area (cANIMIDA) study (contract 1435-01-04-CT-32149, later changed to M04PC00032). ASR was contracted directly to MMS for this component of the study, with Battelle contracted as the Core Contractor with responsibility for overall management of the study. This report represents the contractual obligation to produce a report discussing the seven years of data collected for the ANIMIDA and cANIMIDA studies. Following the last field season for the cANIMIDA study, MMS funded four additional years of data collection (2008-2011) as a stand-alone project (contract M08PC2009).

This project, funded by the Minerals management Service (MMS) has as its broad objective the description of subsistence whaling as currently conducted near Cross Island by residents of Nuiqsut. While "traditional" subsistence whaling has been well documented in a number of locations, contemporary subsistence whaling has not been as well documented, and changes in contemporary subsistence whaling have hardly been documented at all (except perhaps more recently in terms of the effects of climate change). This effort is designed to measure basic parameters of Cross Island whaling so that observed changes (if any) in subsistence whaling activities could be analyzed in relation to such factors as oil and gas activities, weather and ice conditions, or other variables. Annual reports produced soon after each whaling season summarized the data and observations from that whaling season and focused on descriptive measures of activities associated with whaling. Special attention was devoted to geospatial

information through the sharing of GIS information by participating whaling crews. Annual reports were only for the purposes of reporting information collected, with little analysis of the information either as a self-contained database or in conjunction with external databases. Among the many external databases of potential pertinence to the descriptive information collected under this task order are the Human Activities Database (another MMS project) and remote sensing information on ice cover or other geophysical parameters. Other linkages for future analysis (AEWC records, untranscribed IHLC tapes, etc.) also exist.

As a second broad objective, the project was designed as a collaborative effort among MMS (and its contractor, ASR), the subsistence whalers from Nuiqsut, and the AEWC. Beyond the initial goal of two (first expanded to three, then seven, and now eleven) years of descriptive information on Cross Island subsistence whaling activities, the project will develop a system for collecting information that local whalers themselves can adopt, adapt, and maintain.

This report represents the start of the analytical component of the project, and discusses the data collected (2001-2007) in terms of patterns and trends, as well as in terms of year-to-year variability. The annual reports by necessity considered this objective by summarizing the data collected in terms of measures likely to be useful in such analytical tasks, but did not discuss these measures or systematic comparisons except in a perfunctory way. These summary measures are also reported in this document, and the Annual Reports are included in electronic form in order to provide the data in more detailed form. The actual GIS track files are available from MMS, for appropriate uses. These report has developed measures beyond those reported in the Annual Reports, to facilitate the discussion of variability from season-to-season. These will be incorporated into future Annual Reports (2009 and beyond).

This report discusses project activities over the span of seven field seasons (2001-2007) and prior to the first field season (2000). Consultation trips to the North Slope were conducted in all years. As mentioned above, fieldwork was initially planned to start in 2000, but the timing of the contract award precluded a field effort during the 2000 Cross Island whaling season. Thus, the major effort during the first year of the project was to gain local support for the research effort and to organize the logistics required for its implementation. Successful field collection efforts were mounted in 2001 and subsequent years, and brief annual reports for each field season summarized this information (these reports are included as digital appendices to this report). This is the final overall report for contract 1435-01-04-CT-32149/M04PC00032, produced during the last year of the project. Contract M08PC20029 continues the data collection through the 2011 season and will provide another synthetic report comparing those four years to the period discussed in this report.

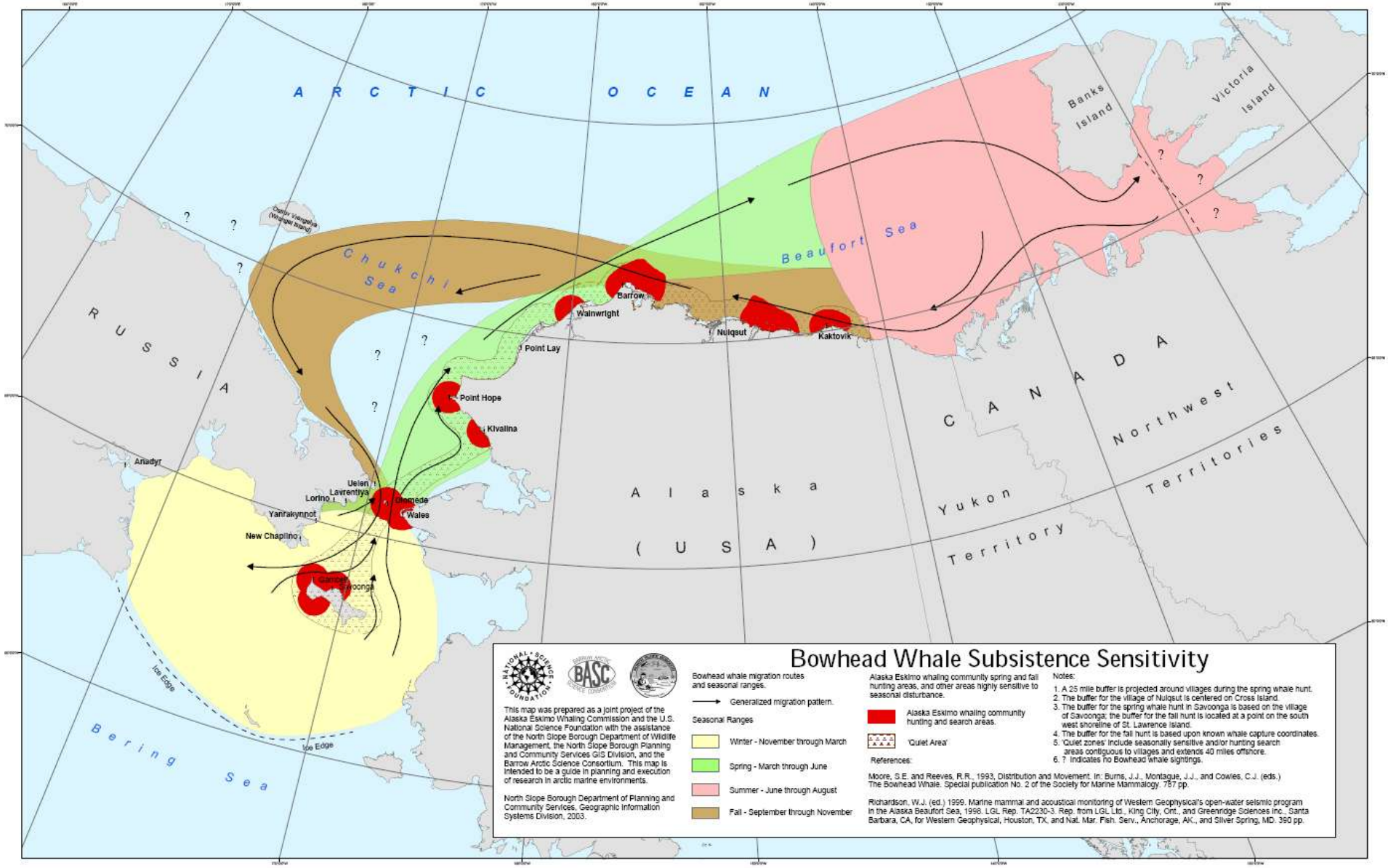
An Overview of Contemporary Subsistence Whaling in Alaska

The Inupiat of the North Slope maintain and live a vital culture -- with kinship, dependence on hunting wildlife resources, and a respectful relationship to the land as fundamental values. Hunting provides most of the meat consumed by Inupiat. Whaling not only provides a significant part of this food, but is also a key social organizational activity for North Slope Inupiat. Whaling is also a central ideological idiom for the expression of key cultural values, and an important vehicle for the transmission of those values (Worl 1979, Rexford 1997). Subsistence whaling has been (and continues to be) a key focus for Inupiat and Yupik culture and society (Bering Straits area, Northern coastal Alaska) for at least 1,000 to 1,500 years (Dumond 1984, Krupnik and Stoker 1993, McCartney 1994). However, nothing more than a brief orientation to contemporary subsistence whaling in Alaska is attempted in this report, and references are illustrative, not exhaustive. This discussion provides only a general description of some key aspects of the organization of subsistence whaling, within the context of its management regime, that are important for an understanding of this project's methods and results. This discussion proceeds from the general to the more specific.

In Alaska, eleven coastal communities (Point Lay recently being allocated a quota of one bowhead whale per season) currently field whaling crews and are members of the Alaska Eskimo Whaling Commission (AEWC). Subsistence whaling in Alaska occurs in the spring (generally April-May) in the Bering Straits/Chukchi Sea and the fall (generally September-October) in the Beaufort Sea, when the bowhead whale migration brings them reasonably close to the whaling communities in those areas. Barrow, located where the Chukchi Sea and the Beaufort Sea meet, has historically whaled in both seasons. In the spring, bowhead whales migrate north through the Bering Straits and then, in Alaskan waters, east of Point Barrow into Canadian waters, where they spend the summer (some may also go west into Russian waters). In the fall they reverse this course. Figure 1 locates the eleven Alaskan (and six Russian) whaling communities on a map and indicates the general migration path of bowhead whales and their seasonal availability to each of the whaling communities. Use areas for Point Lay and the Russian communities are not indicated on the figure since whaling for bowhead whales has only recently resumed from those locations. Much is still not known about bowhead biology and behavior, but there are indications that some bowheads may be more residential or less migratory than others and that some bowheads take alternate migratory routes.

Spring whaling differs from fall whaling. In the spring whales are migrating through relatively narrow open leads in the ice whereas in the fall the water is generally more open (although there is often thick floating ice). Spring leads do not open up close enough to Nuiqsut or Kaktovik to allow these communities to whale in the spring. In the fall, because whales are not confined by leads, it is difficult in most years for whaling communities south of Barrow to whale (although St. Lawrence Island and Wainwright whalers have taken a few whales in the fall), since the whales are so far offshore at those points. Thus most whaling communities whale in the spring, while Barrow can hunt whale in both the spring and the fall, and Nuiqsut and Kaktovik whale only in the fall. Spring whalers have traditionally and historically used only skin boats (until recently), whereas fall whalers use more durable wood, aluminum, and fiberglass boats. This is related to three general seasonal differences: the greater need to avoid unnecessary noise in the spring, the harsher environmental conditions of fall whaling (rougher seas, more floating ice), and the greater need for speed in the fall to find and pursue whales in more open water. Recent

Figure 1: Bowhead Whale Map – Generalized Bowhead Migration Route and Location of Alaskan Subsistence Whaling Communities



Draft prepared by the National Science Foundation, the Barrow Arctic Science Consortium, and the North Slope Borough (2003)

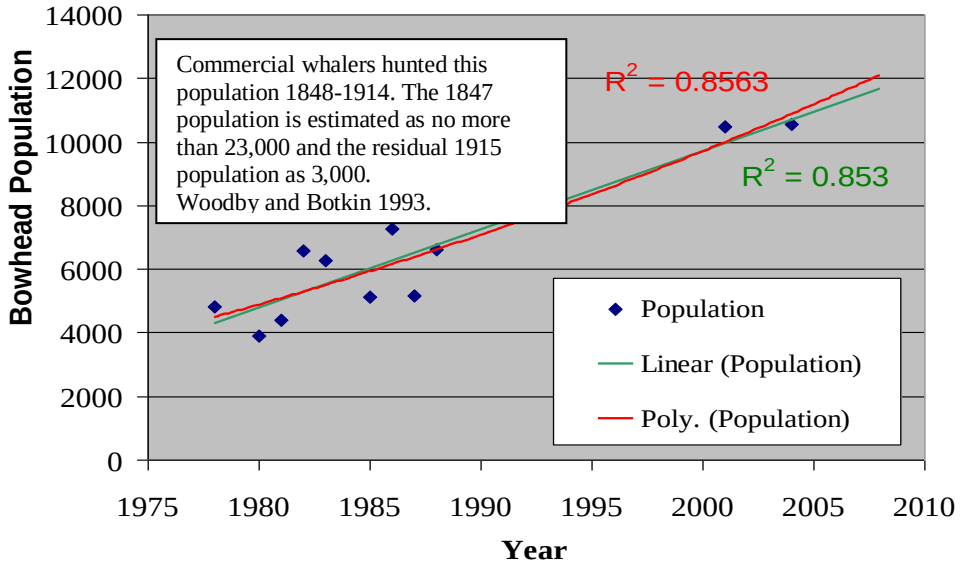
changes in spring whaling (especially in Barrow), mostly related to changing patterns of ice and weather conditions, have been described and discussed in Wohlforth (2004), and interested readers are referred to that source. This report concentrates on fall whaling by Nuiqsut residents, currently conducted from and near Cross Island, due to the specific interest in the potential effects of offshore oil and gas activities on subsistence whaling. Cross Island is the closest whaling site to most of the past exploratory offshore oil and gas activities in Alaskan waters, as well as to the only current offshore oil production unit in Alaskan waters.

The AEWC was formed in 1977 in direct response to the International Whaling Commission's (IWC) decision to ban the Alaskan subsistence bowhead whale hunt. The IWC had two main concerns – that the bowhead whale population was too small to sustain a regular harvest, and that subsistence hunting methods were too wasteful (too many animals were struck with a harpoon but then "lost"). As a result of a complicated series of negotiations, the United States and the AEWC convinced the IWC to allocate an initially small quota of bowheads that could be harvested in 1978. This quota was accompanied by a data collection program to measure and monitor the bowhead whale population and the efficiency of subsistence whaling harvest. This has resulted in an increased confidence in the robust size and health of the bowhead whale population, and an ever-increasing quota of animals available for harvest (Figures 2 and 3). It has also created an incentive for the reduction of "struck and lost" whales which has been quite successful. Currently AEWC co-manages the Alaskan subsistence bowhead whale hunt with the United States Government, and this management regime is consistently cited as one of the most successful examples of such management. Huntington 1992 provides a useful analytical discussion of these developments. The original decision documents for the 1978 IWC action (U.S. Department of Commerce 1977, 1978) also contain much of interest.

The IWC sets an overall quota for the hunt, and the AEWC in turn allocates that quota among the whaling communities. Each whaling community is represented by a local Whaling Captains Association (WCA) at the AEWC, and each local WCA is responsible for managing the hunt in its respective community. Nuiqsut initially received an allocation of one whale or one strike (whichever occurred first) for 1978. Its current allocation is four whales or four strikes. Unused strikes and quota can be transferred between communities, quota is now allocated in multi-year blocks, and there can be some "roll-over" of quota from one year to the next. Thus, the harvest in some years for any given community may be greater than the "normal" quota allocated.

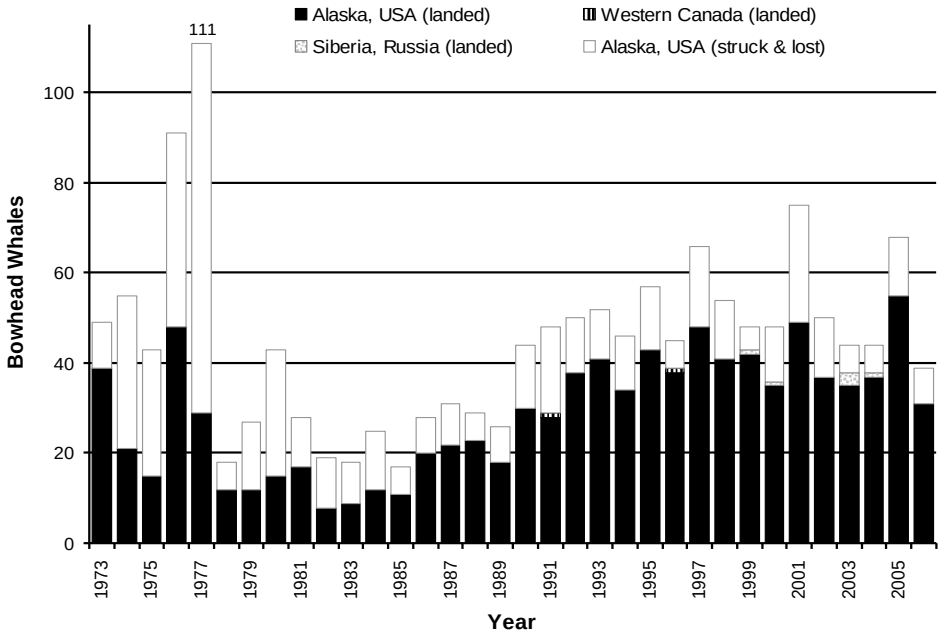
The AEWC Management Plan for the subsistence bowhead whale hunt provides definitions, rules or guidelines of conduct, and management mechanisms for subsistence whaling. It states that all subsistence whaling must be conducted in "the traditional harvesting manner," meaning that only "traditional" weapons may be used. The first strike on a bowhead whale must be made with a harpoon or a darting gun with line and float attached, which also fires an explosive projectile (or "bomb") into the whale at the same time. A fuse that is lit by a percussion hammer mechanism when the bomb first hits the whales is timed so that the bomb explodes only after it has penetrated the whale. A shoulder gun may be used to fire additional bombs into the whale (without additional harpoons and floats) only after a line has been secured to a whale, or when pursuing a wounded whale with a float already attached to it. A lance may be used after a line has been secured to the whale (AEWC 1995:7).

Figure 2: Bering-Chukchi-Beaufort Seas Bowhead Whale Population by Year, 1978-Present



Source: Zeh, J.E. and Punt, A.E. 2005. Updated 1978-2001 abundance estimates and their correlations for the Bering-Chukchi-Beaufort Seas stock of Bowhead whales. JCRM 7 (2):169-175 and Craig George, personal communication 2007.

Figure 3: Bering-Chukchi-Beaufort Seas Stock Bowhead Whales Struck By Year, Country, Landed, and Struck & Lost



Source: Diagram reproduced from National Marine Fisheries Service 2007,page 25. Compiled from Alaska Eskimo Whaling Commission and North Slope Borough 2007.

The AEWC Management Plane defines weapons for the subsistence hunt as follows:

> "[T]raditional weapons" means a harpoon with line attached, darting gun, shoulder gun, lance or any other weapon approved by the AEWC as such a weapon in order to improve the efficiency of the bowhead whale harvest. "[H]arpoon with line attached" means a harpoon with a rotating head which is attached to a line and float and which has no explosive charge. … "[D]arting gun harpoon" means a harpoon with an explosive charge and with a line and float attached. … "[S]houlder gun" means a whaling gun, adapted from the era of commercial whaling in the 19th century, which has an explosive charge and which has no attached line and float. "[L]ance means a non-explosive sharply pointed weapon without a harpoon head. "[E]xplosive charge" … means for initial strikes a penthrite-based explosive charge developed, approved, and issued to a whaling captain by the AEWC, unless such explosive charge has not been issued or is not compatible with the darting gun harpoon … (AEWC 1995:3-4).

For the most part, Nuiqsut whalers still assemble their own black powder explosive bombs (with powder, fuse, primer) rather than use penthrite bombs, which are still under development and have so far only been used on a limited basis in Barrow and a few other whaling villages.

Subsistence whalers thus use essentially the same technology used by commercial whalers in the mid- to late-1800s. Although aboriginal Alaskan whalers used toggle harpoons made from bone or ivory, commercial whalers first used a toggle iron harpoon in 1848. The Inupiat quickly adopted this material improvement on the technology. The whale bomb, shot from a shoulder gun, was invented around 1850. While effective in increasing the number of whales taken, many still escaped into nearby ice. The darting gun, designed to attach a harpoon, line, and float to the whale at the same time as shooting it with a bomb, was invented in 1865. Subsistence whalers also quickly adopted these innovations, and still use these weapons essentially as they were invented (Bockstoce 1986:61-69). The ongoing AEWC weapons improvement program, with annual reports to the IWC, has resulted in trials with a penthrite whale bomb. Delivered with a darting gun fitted with a different barrel than that used for the more standard black powder bomb, penthrite bombs are not yet in general use, and cannot be used in shoulder guns. An historical illustration of Yankee whaler weapons is provided in Figure 4, along with photographs of a Nuiqsut whaler cleaning a shoulder gun, a Nuiqsut whaler preparing a float by wrapping the harpoon line around it, new and unloaded whales bombs with quarters for scale (the shoulder gun bomb has fletches since it is shot through the air), and the remains of exploded bombs recovered from some whales landed at Cross Island.

The AEWC Management Plan defines a "whaling crew" as "…those persons who participate directly in the harvest or attempted harvest of the bowhead whale and are under the supervision of a captain" (AEWC 1995:4). This will be distinguished in this report from "boat crew," since it is not uncommon for Nuiqsut whaling crews to consist of several boat crews, all under the supervision of a single captain. Further, some whaling crew members never go out in the boat, but provide other important services (help in butchering, provision and maintenance of equipment, logistical support or other services such as cooking). "Boat crew" is thus a subset or a part of a larger whaling crew. A typical Nuiqsut boat crew consists of three or four crew members in an aluminum or fiberglass boat, as illustrated in Figure 5. The usual position for the harpooner is at the front of the boat, as is the case in Figure 5, and the darting gun and holder are typical for Nuiqsut whalers. The harpoon line is always rigged on the right side of the boat.

Figure 4: Whaling Weapons and Equipment. Left to right, top to bottom – NOAA archive photo, cleaning shoulder gun, wrapping rope on float (to attach to darting gun), unloaded new whale bombs (quarters for scale), some fragments of exploded bombs recovered from whales

Figure 5: Representative Nuiqsut Subsistence Whaling Boat Crew – three crew members, 18-foot fiberglass boat, darting gun with bomb and harpoon in front of boat, float in back until deployed, harpoon line rigged on right side of boat, bucket in front used to store and coil harpoon line not wrapped around the float.

When "crew" is used with no modification in this report it will refer to the whaling crew. For this report, "whaling crew" refers to all those persons on Cross Island directly under the supervision of a whaling captain. This report does not discuss those whaling crew members that do not actually go out to Cross Island, the number of which vary from crew to crew. Also, not all Nuiqsut crew members who go out to Cross Island will necessarily actively scout for or hunt whales on the water, but all will help in butchering and other support activities and are important for the success of Cross Island whaling. "Boat crew" will refer to those persons who actually go out in a given boat on a given day, and will generally be a subset of a whaling crew, even for those whaling crews with only one boat. Boat crews can, and do, vary from day to day, although they tend to be stable in at least the primary skill positions (driver and harpooner). The number and composition of the other people on a boat crew on a given day can be much more variable, and is more variable for some Nuiqsut whaling crews than for others. Whaling crew composition can change during the season, as people do sometimes leave or arrive at Cross Island separate from the rest of their whaling crew. In recent years most Nuiqsut whaling crews have used more than one boat, although this was evidently not as common in the past when more whaling captains (and whaling crews) were active.

The Historical Context of Cross Island Whaling

The present community of Nuiqsut has a relatively short history, having been resettled in 1973. However, Inupiat use and occupation of the Nuiqsut area has a very long history, which is the basis for Nuiqsut's status as a village recognized under the Alaska Native Claims Settlement Act (ANCSA). Nuiqsut is located about 12 miles inland on the Colville River , which is not a typical location for a whaling community. However, its residents trace their ancestry to people who whaled in the mid-Beaufort Sea (including near Cross Island) in the first half of the twentieth century, as well as prior to that time. Treatments of the complex and dynamic history of the North Slope region in general, and the Nuiqsut area in particular, can be found in Brown 1979, Galginaitis et al. 1984, Hoffman et al. 1987, Galginaitis 1990, and Long 1996. These sources are the basis for the information in this section.

Figure 6 shows the location of Nuiqsut on the Colville River, and Cross Island in the Beaufort Sea. It also shows typical routes between Nuiqsut and Cross Island, some significant landmarks in between, and GPS tracks for all documented whaling trips ("scouting" for whales) for 2001-2007. This indicates how far from Nuiqsut whalers must travel in order to set up their whaling camps, and also the year-to-year variability in how far they must go from Cross Island to find and land whales. Describing and explaining this variability is the primary focus of the body of this report. Figure 7 provides pictures of Nuiqsut and Cross Island. Nuiqsut is a recently-built community, with a regular rectangular grid of streets and modern facilities, located on a river channel. The structures on Cross Island are contemporaneous with those of Nuiqsut, but are typical of those at a hunting or fishing camp. Figure 7 also shows the four whales landed in 2006.

Cross Island is about 73 miles northeast of Nuiqsut "as the crow flies" and from 92 to 101 miles away by boat, depending on which channel of the Colville River can be used to reach the ocean. When the water level in the river is high, the more direct route can be used. When the water level

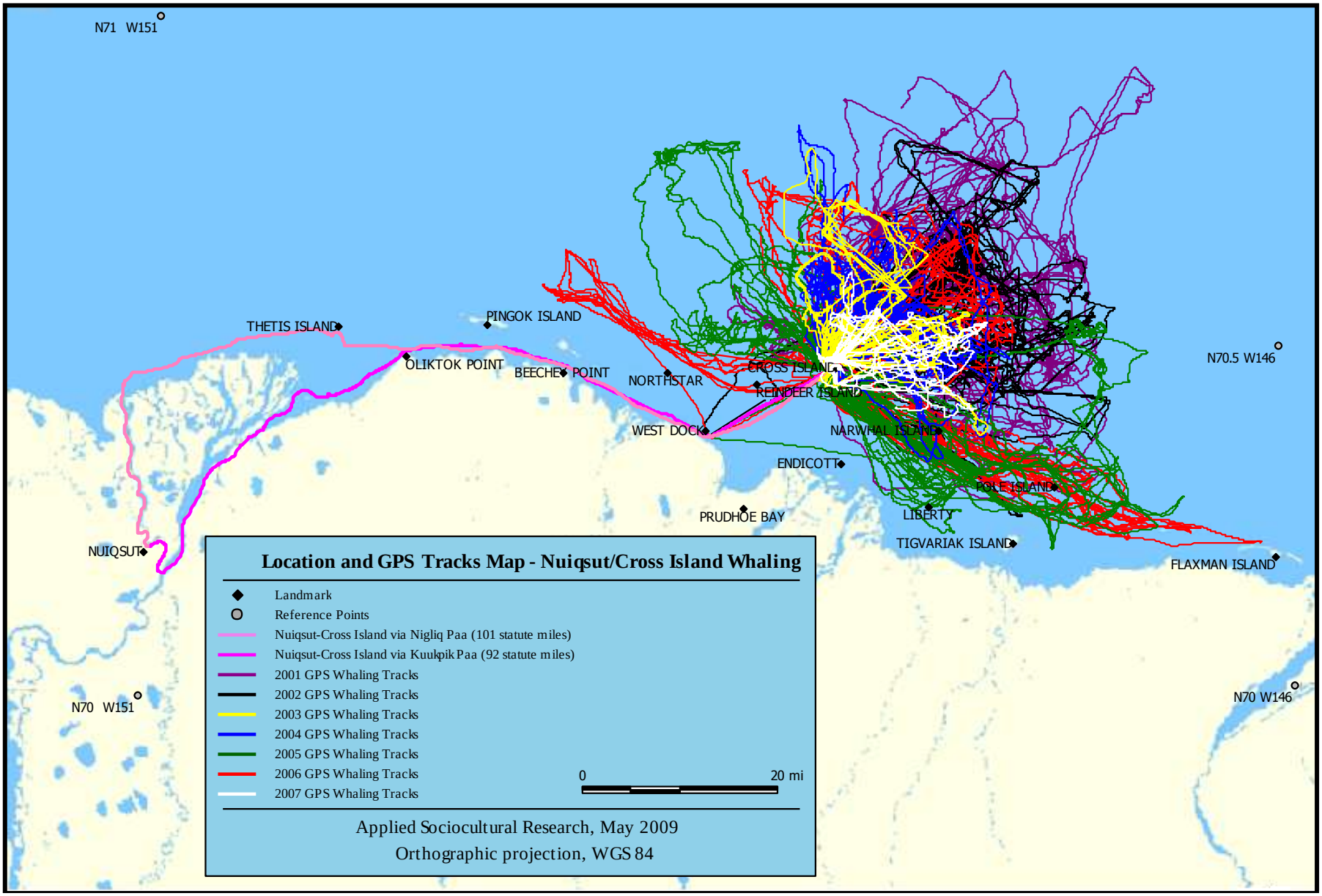


Figure 6: Nuiqsut/Cross Island Location and GPS Tracks Map, with Landmarks

Figure 7: Pictures of Nuiqsut and Cross Island. Aerial view of Nuiqsut, View of Most Cross Island cabins from the high point of the island, and the four whales landed in 2006 – the first season that every crew whaling at Cross Island landed a whale. Each whale is pictured with the crew that landed it.

is low, the more direct river channel is too shallow for most boats, so the longer route must be used. When wind and sea states present potential hazards, the shorter route also has the advantage of being more protected – the only unprotected water until West Dock is reached is around Oliktok Point. The longer route forces boats to traverse the open water off the Colville River delta until they reach the protection of Thetis Island. Both routes pose the hazards of shallow water in the delta itself. The roughest part of the trip tends to be the passage from West deeper and potentially rougher water from West Dock to Cross Island, and most crews will at least pass by West Dock, if not stop there to rest and sometimes take on additional gas. In marginal travel conditions, when the whalers still want to travel between Cross Island and the shore, they will travel more between Endicott and Cross Island, as the waves and swells pose less danger than on the more direct West Dock-Cross Island heading. Cross Island is about eleven miles offshore, but more importantly from a logistical point of view is about ten miles from the Endicott causeway and fifteen miles from West Dock. Endicott is about 14 miles east of West Dock, adding significantly to any trip between Nuiqsut and Cross Island in adverse conditions.

Prehistoric use of Cross Island has not been well documented or investigated archaeologically, but documentation for more recent use is quite extensive. Families who lived on and used Cross Island seasonally during the first half of the twentieth century included the Woods, Pausanna, Saavgaq, Ulaaq, Ahsoak, Ahgook, Ikpikuk, Ahvakana, Akpik, Sovalik, Kaigelak, Tigulak, Ahsogeak, Ahkivgak, Ekolook, and Ekowana (Smith 1980). Perhaps most important in terms of whaling was Taaqpak, who used Cross Island as a whaling base from the early twentieth century through the late 1940s. Documentation for early twentieth century whaling harvests is quite incomplete, but include accounts of whales taken near Cross Island/Prudhoe Bay in 1921, 1922, 1927, 1928, 1935, 1937, 1938 and 1940 (Carnahan 1979, Shapiro and Metzner 1979, Long 1996). Many current whalers learned from Taaqpak's crewmembers (or those who had learned from such people). In turn, Taaqpak maintained that Inupiat had hunted whales near Cross Island for centuries (Carnahan 1979:21-31), supporting the cultural continuity of Cross Island whaling.

When Nuiqsut was resettled in 1973, many of the original settlers traveled from Barrow with the supplies necessary for their life in tents for a year or more. They used a variety of means – sleds towed by a small Cat (a tractor with tracks), snow machines, and weasels (another sort of tracked vehicle, of WW II vintage). One of these original founders, Thomas Napageak, landed the first whale for Nuiqsut that fall, while on his way to Kaktovik to obtain some muktuk and meat to take back to the village. He and his whaling crew had been looking for whales and had been out about six weeks. They had not seen any whales in that time, although they had seen a great number of seals, which was about their only source of food after the third week of their trip. By the sixth week the whaling captain had concluded that they were too late – that the whales had either passed them by or were too far from the shore. On the chance that Kaktovik whalers had been more successful, he decided to go to Kaktovik to obtain some muktuk and meat to take back to Nuiqsut. They then came upon a whale in the Brownlow Point/Flaxman Island area, in shallow water. They took this whale, butchered it, and returned to Nuiqsut with as much as possible. Other boats from Nuiqsut made a second trip for more muktuk from this whale.

Of the six members of this 1973 whaling crew, two (including the captain) are now deceased, one is "retired," two are now captains or co-captains in their own right, and the status of the sixth is unknown. Until his death in 2005 Tomas Napageak was one of the most active Nuiqsut

whalers. In the years after 1973 until the early 1980s his was the only crew that regularly whaled from Nuiqsut, and Nuiqsut whalers commonly remark "Without Thomas we would not be whaling [from Nuiqsut] today." Other Nuiqsut whalers regularly went to other communities in the spring (and sometimes in the fall) to participate in whaling (a pattern that some continue up through the present – Pausanna, personal communication). The next Nuiqsut whale was not taken until 1982, also by Thomas Napageak. Crews whaled from various locations between 1973 and 1982 – Pingok Island, Narwhal Island, and Cross Island among them. Pingok Island was situated in a good location to intercept the fall migration of whales, but had no sheltered area to moor boats and the water was too shallow to easily tow and beach a whale for butchering. Once oil development started in the Prudhoe Bay area to the east, whalers state that the whale migration diverted away from Pingok Island and encouraged the whalers to find a whaling site east of the obvious center of oil development. Cross Island was the main site, but one whaling crew used Narwhal Island for several years. The logistical difficulties of the coordination of whaling crews based on islands separated by 12 miles, and the placement of a diesel-powered winch on Cross Island, convinced all crews to use Cross Island as a common logistical base.

Cross Island is now a low sandy barrier island with an artificial higher area built from gravel. When the Nuiqsut whalers started to use Cross Island as a logistical base in the 1980s, there were areas of tundra and vegetation, and the remains of old sod houses, on the island. The tundra and any obvious signs of past habitation have since disappeared. The higher area was constructed for past oil and gas exploratory drilling. Cross Island is about 3 miles long and 150 yards wide, and is constantly changing due to erosion and redeposition. Especially in the earlier years logistical support for whaling on Cross Island was very difficult. Whalers had to haul or find their own gas and water, and hunted and fished to provide most or all of their food. There was at most one cabin for however many people were whaling. Since the mid-1980s, with the advent of the Oil-Whalers Agreement (OWA) in 1986 between the oil industry and fall whalers (primarily Nuiqsut and Kaktovik, with some participation from Barrow whalers), logistical considerations have become somewhat easier. The oil and gas industry (and especially BPXA since the development of the Northstar development unit, and Shell since they have ramped up their exploration program in the Beaufort Sea) has been providing logistical support of various sorts to Nuiqsut whalers as a mitigation measure for potentially disrupting subsistence whaling by seismic or development activities.

A complete listing of subsistence Bowhead whale harvest since 1973 by Nuiqsut whaling crews, with at least some of the pre-1973 landings, is presented in Table 1. Nuiqsut whalers attribute at least part of their relative lack of success in the 1970s and 1980s to interference from oil and gas exploration, as well as poor weather and ice conditions in some years, and an overall difficult logistical situation. They were whaling far from home with much more uncertain gas and food supplies than for the years since. Weather and ice factors are also evident in the three years with the greatest incidence of "struck and lost" whales (1989- 1991 or 1992). Once Cross Island was established as a logistical center for Nuiqsut whaling, and current Nuiqsut whalers gained experience there, harvest success became much more regular – although other factors are contributing to that success are more moderate ice conditions since 1992 and the logistical support provided through the Conflict Avoidance Agreement (CAA – the successor to the OWA) between the whalers and industry. The first OWA was signed and in effect for the fall whaling season in 1986, and was followed by renewals in 1987 and 1988. There was then a gap,

Table 1: Documented Harvest of Bowhead Whales Near Cross Island

Year	Whales			Notes
	Quota	Landed	Struck & Lost	
1921	NA	1	UNK	Carnahan 1979
1922	NA	1	UNK	Carnahan 1979
1927	NA	1	UNK	Carnahan 1979
1928	NA	1	UNK	Carnahan 1979
1935	NA	1	UNK	Shapiro and Metzner 1979
1937	NA	1	UNK	Landed by Taaqpak (Long 1996)
1938	NA	1	UNK	Carnahan 1979
1940	NA	1	UNK	Landed by Taaqpak (Long 1996)
1973	NA	1	0	
1982	1	1	0	
1986	2	1	0	
1987	2	1	0	
1989	3	2	2	Oil industry vessel disturbance noted
1990	3	0	1	Oil industry disturbance, also rough seas
1991	3	1	2	Poor weather, bad ice conditions
1992	3	2	1	
1993	3	3	0	Very favorable 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 conditions
2001	4	3	0	Little ice, whales relatively distant and skittish
2002	4	4	1	Little ice, whales 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, bad ice conditions, disruption
2006	4	4	0	Ice restrictions first half of season
2007	4	3	1	No ice, generally poor weather and rough sea conditions, whales close to Cross Island

Notes: Years of no harvest and no "struck and lost" are not listed. This does not imply that no whaling effort was made that year. "Quota" was not applicable in 1973. It is not clear from the records (or informants) when the quota for Nuiqsut increased to 2 whales and then to 3 whales (1983-1991 documentation is not definitive. Values provided for these years are best guesses based on inconsistent information).

Source: Compiled from AWC records, personal communications from Nuiqsut whalers, field notes from the 2001-2006 whaling seasons, and published sources. Note that some of the information in Table 1 in Long 1996 is inaccurate in terms of year of harvest, and one whale listed as landed was actually struck and lost. More than eight whales may have been landed near Cross Island during the period 1920-1950, but firm documentation for that period is lacking.

representing a lull in oil and gas activities in the Beaufort Sea, and it is not totally clear when formal CAAs resumed. Since at least the development of Northstar, a new CAA for the Beaufort Sea is negotiated and signed for each year, with the industry participants generally composed of all those entities with plans for operations in the Beaufort for the year in question. The CAA process has been incorporated into the Incidental Harassment Authorization (IHA) and Letter of Authorization (LOA) permitting processes administered by the National Marine Fisheries Service and the Fish and Wildlife Service when proposed industry activities may have potential effects on the subsistence use of marine mammals. Chukchi Sea operations have in recently also been included in the same agreement, but this complication will not be discussed in this report.

At the most basic level, the CAA provides for the constant communication between industry and the whalers about all of their respective ongoing activities, so that each can avoid interfering with the other. The mechanism for this mutual communication is the Whaling Communication Center (WCC – also referred to as the Conflict Avoidance Communication Center or the Oil/Whalers Communications Center) in Deadhorse. The Deadhorse WCC operates during each fall whaling season and is staffed by bilingual radio operators, usually with at least one from Nuiqsut and one from Kaktovik. All industry and whaling vessels are required to report their activities to the WCC in real time (purpose, time left, time returned, significant events as they occur), and the WCC maintains a log of these reports which is archived by the AEWC. This provides a record of activities as they take place, and also documents to some extent the whaling activities. It also allows the WCC to advise industry of planned industry activities that may interfere with ongoing whaling, or to suggest windows of opportunity (when whaling is not taking place) when industry activity may have minimal potential effects. Unfortunately, vessel activity not associated with the oil and gas industry (for example, commercial barge traffic) need not coordinate with the WCC in the same way, so that this is not a totally effective mechanism for mitigation. Other sorts of logistical support have been supplied at least in part by industry. These have included low-cost connex units (converted into seasonal cabins on Cross Island); a winch to help haul whales up at Cross Island; assistance with a steadier supply of gasoline; a generator system to supply electricity to the cabins during the whaling season; diesel fuel (for the winch and generator); water, and other supplies; help with transporting the butchered whale to Nuiqsut; at least limited phone service for one or two whaling crews; help with mobilization and demobilization; and the assurance of available emergency assistance. Alaska Clean Seas (ACS) or a contractor with similar capabilities is the industry's contractor for much of this OWA support, as a small part of its overall responsibilities (which are mainly logistical and/or related to oil spill response). BPXA, Shell, and ConocoPhillips provided most of the funding for implementing the CAA, but BPXA and more recently Shell bear the majority of CAA-related costs since ConocoPhillips has relatively few offshore interests. The AEWC does pay for some of the services provided under the CAA, but the amount and exact services are not reported. Neither industry nor the whalers disclose the financial terms of the CAA. In recent years some industry proposals for exploratory and development activities have created some tensions that have complicated the negotiations for the annual CAA, with some oil and gas companies indicating that they may not wish to participate in or support the CAA process in the future.

Preparations for whaling, in one form or another, take place during the entire year. This report focuses only on the actual harvest activities at and near Cross island during the fall whaling season, and does not describe or discuss in much detail the extensive support activities and

celebratory and distribution events that take place throughout other parts of the year. During the period discussed by this report, 2001-2007, a minimum of three whaling crews, and a maximum of five, whaled from Cross Island in any one season, with an average and a median of four whaling crews per season. Seven different whaling crews were active for at least one season during this period. Only one whaling crew was active during all seven seasons. The final preparation of boats and equipment for whaling happens in Nuiqsut in August, and a meeting of the NWCA in late-July to late-August is usually conducted to set a date for the start of the hunting effort and to review the rules and regulations. Labor Day, the first Monday in September, is the normative date for all whaling crews to go to Cross Island, but whalers say it is not unusual for individual whaling crews to go out earlier, especially if Labor Day is "late." Whalers also state that normatively all whaling crews would go out to (and come back from) Cross Island together, on the same day. For the 2001-2007 seasons, as discussed below, patterns were clearly different, although Labor Day is a significant time marker for the start of whaling. Most whaling crews did leave Cross Island to return to Nuiqsut on the same day, but did not necessarily travel together. For two seasons, one whaling crew stayed on Cross Island one day longer than the others.

Usually, one day is spent in transit to and from Cross Island, unless a boat encounters mechanical or other difficulties. Once on Cross Island the focus is on whaling, with little effort devoted to other subsistence activities. There were a few instances of seal harvest, the taking of nuisance polar bears, and incidental bird hunting. None of these other subsistence activities took place every season, and only polar bear were perceived as a "likely" other harvest to occur. This was clearly due to the fact that polar bears are attracted to Cross Island by the whales that the whalers butcher. The bears represent both a nuisance and potential hazard as well as a possible opportunity for harvest, if a hunter wants to take a bear. Most of Nuiqsut's polar bear harvest takes place at Cross Island during whaling, but the understanding is that a hunter needs his whaling captain's permission to kill a polar bear and, if he does so, the captain has the right to claim the skin. This effectively limits the take of polar bears to those commonly perceived as nuisance/hazardous bears. If a whaling crew member can make a case for how he will use a bear, and that it will not detract from his whaling effort, permission may be given to kill a non-nuisance bear, but there were few instances of this during 2001-2007.

Nuiqsut whalers will generally go scouting for whales on any day when the weather is suitable for finding and striking whales unless a whale was taken the prior day, in which case butchering usually has priority. However, this pattern may be changing. In 2003, whalers landed three whales in two days (September 5 and September 6) to complete their quota during a rare period of good whaling conditions (Galginaitis and Funk 2005). In 2004 they landed two of their whales on successive days (September 5 and 6), again to take advantage of good conditions (2006). In 2006, Nuiqsut whaling crews landed single whales on three successive days, apparently because the whales were relatively small and the whalers wanted to take advantage of a period of good weather for scouting (Galginaitis 2007). In 2007, they purposely landed two whales on one day in order to complete their quota and close their season due to the uncertainty of future conditions for whaling (Galginaitis 2009). Whalers invariably use the term "scouting" rather than "hunting" to describe looking for whales to strike. Good whaling weather is determined more by wind speed and sea conditions than anything else. Whalers prefer days with no wind, but winds up to 8 to 16 km/h (5-10 mph), or even higher, can be acceptable. Sea conditions generally correspond with wind speed, but scouting can occur even with

higher winds, depending on the circumstances. Ice cover, especially when the ice edge is not too far from shore but also to some extent floating ice floes, generally moderates the effect of wind by dampening wave height. During the period of this report, 2001-2007, the ice edge has always been quite distant from shore, and significant ice floes have been mostly absent. There were some large ice floes present in 2001 (Galginaitis and Funk 2003a), fewer in 2002 (Galginaitis and Funk 2003b, 2004), and almost none of significance since then. In 2005 and 2006, localized consolidated pack ice along the north shore of Cross Island limited the area where Nuiqsut whalers could hunt for whales (Galginaitis 2008, 2007).

Boats typically scout for whales with a complement of three or four people, although since 2001 boat crews ranged in size from two to seven (average 3.9). Although solitary boats do take whales on occasion (for example the first two strikes by Nuiqsut whalers in 2007 were conducted by boats scouting alone), it is not encouraged. Nuiqsut boats almost always scout for whales with at least one other boat, in case of mechanical break down or other emergencies. Whaling crews with two or three boats are willing to whale without the support of other whaling crews, and this is one reason for a single whaling crew to use more than one whaling boat. It is still commonly agreed that five to seven boats is a preferable number to have available for scouting whales on a given day, and this was generally the case once three of four Whaling crews were at Cross Island. The availability of fewer boats decreases the efficiency, safety, and overall chance for success of the hunt. For 2001-2007 the average number of boats out scouting for whales was actually 4.2, reflecting periods when only one or two whaling crews were at Cross Island, mechanical problems, or other particular circumstances.

Once Nuiqsut whalers spot a whale and determine that it is a proper whale to take (generally 7.6 to 10.7 m [25 to 35 ft] long, and not a mother with a calf), they will approach it at high speed so that it dives. They will then estimate where it will reappear (usually in 5 to 10 min, but sometimes longer) and once they reach that area will wait and search at low speed until the whale surfaces and is spotted. They will then repeat the process. The objective is to tire the whale so that it must stay on the surface for longer periods of time, until one of the boats can get close enough to strike the whale on its left side with the darting gun. The whale is killed by the delivery of whale "bombs", which are in essence very large bullets with timed fuses (generally 4 to 8 s) that explode inside the whale. Inupiat whalers adopted this technology from the commercial Yankee whalers. The whale bombs are delivered to the whale via two methods: a darting gun attached to a harpoon, or a shoulder gun.

During fall whaling, the first bomb is delivered via a darting gun, which at the same time deploys a harpoon with an attached float. The harpoon and darting gun are both attached to a long wooden handle. This is thrown from the boat at the whale, usually at a distance of no greater than 3 or 4.6 m (10 or 15 ft), and ideally closer. Once the whale is struck, the harpoon separates from the handle. A trigger rod fires the darting gun and shoots the bomb into the whale. An internal hammer ignites the bomb's fuse once it hits and penetrates the whale's skin and the bomb explodes 4 to 8 s later (depending on how long a fuse was used). The darting gun remains on the handle and thus floats in the water until it can be recovered. It must be dried and cleaned before being used again. In extreme cases this can be done on the water, but is usually done on shore. Thus, most darting guns are effectively one-shot weapons. Each whaling boat has at least one, and sometimes two, darting guns on board. The second weapon used to deliver whale bombs is the shoulder gun—a very heavy, short barreled, high caliber "rifle" used to shoot the

same sort of black-powder bomb as is used in the darting gun, only with fletches or fins to help stabilize its flight in the air. In the fall, the shoulder gun can only be used after a float has been attached to a whale with a darting gun. The first bomb kills some whales. However, when multiple bombs are required, the shoulder gun is useful because it can be used to fire more than one shot.

Until recently, all Nuiqsut whalers used the "traditional" black powder bombs – technology adopted from the commercial Yankee whalers. All captains, or a trusted member of a captain's whaling crew, loaded and assembled these bombs each year, often only after reaching Cross Island, due to the hazards involved. As discussed above, the darting gun and shoulder gun black powder projectiles are essentially the same. The more recently developed "super bomb" can only be used on a darting gun, with a specially modified barrel. It is manufactured in Norway, uses penthrite instead of black powder, and is designed to kill whales faster than a black powder bomb. It is a product of the interest in developing more efficient weapons for subsistence whaling, but development has been somewhat delayed due to the relatively small demand and its somewhat complicated operation compared to the black powder bomb (Øen 1995, Sadler and Grønvik 2003, AEWC 2006).

The darting gun is always thrown from the right side of the boat, since it is attached to a line and the float, and this line is always rigged on the right side of the boat. If the darting gun were thrown to the left of the boat, the float line would then stream across the boat at high speed, endangering the boat crew and the structural integrity of the boat. Thus the whale is usually approached and struck on the whale's left side, since the boat normally "catches up" to the whale from behind it in order to achieve a striking position. Nuiqsut whalers report that whales are sometimes approached and struck from the front, but that this is unusual and has not been documented for this research.

When a whale is taken, it is towed to Cross Island, usually by all the boats that had participated in the chase. Depending on the size of the whale, the distance back to Cross Island, weather conditions and sea-state, and how many whales had already been landed that season, boats that had not gone scouting that day may be called in help with the tow or boats that had participated in the hunt may be given the option of trying to strike a second whale on the same day. Once at Cross Island, the whale is hauled up on the gravel beach using a loader that is on Cross Island for the duration of the whaling season and/or a diesel-powered winch, and butchered. The first cuts into the whale are made by the captain of the whaling crew that landed it (or his designated representative) and are used to delineate the *tavsi*, or captain's belt (share). This belt can vary in width from perhaps 12 to 18 inches, and some captains will designate two such belts on large whales. The back boundary of the *tavsi* is usually the "bellybutton" of the whale with the other edge forward of that, although some captains may adjust this based on the size and body configuration of the whale landed. The *tavsi* essentially divides the whale into two parts, the *uati* (forward of the *tavsi*, composed of the upper torso of the whale) and the *ningiq* (backward from the bellybutton of the whale to the tail). The *ningiq* is used for whaling crew shares and is divided equally among the whaling crews that helped land and butcher the whale. The *uati* is reserved for sharing with the community at large, primarily at celebratory feasts (Thanksgiving, Christmas, and *Nalukataq*). The tongue is divided equally between *uati* and *ningiq*. Half of the baleen belongs to the captain of the whaling crew that landed the whale, and the other half is divided among the whaling crews (generally including the whaling crew that landed the whale)

that helped to tow the whale to Cross Island. One flipper belongs to the harpooner who first struck the whale, and the other flipper is available to be shared by any and all whaling crew members of all crews. In practice, since Cross Island is fairly remote from Nuiqsut, most whaling crew members do not take portions of this flipper and it is generally processed as part of the *uati* after it has been available to all crew members for several days. Usually all whaling crews will help with the primary butchering of the whale – taking off all the usable parts and dividing them into *tavsi*, *uati*, and *ningiq*. The whaling crew that landed the whale is then responsible for the further processing of the *uati* so that it can be packed and transported to Nuiqsut. All other whaling crews, other than the one that landed the whale, are responsible for processing the *ningiq* into smaller portions that can then be divided equally among the whaling crews helping with landing and butchering the whale. The first whale is a special case, in that the *ningiq* is divided equally among all the crews that whale at Cross Island that season, even if they were not on Cross Island when the first whale was landed and did not assist in the hunt or butchering of that whale.

Select parts of the whale from the *tavsi* (captain's belt) are sent to Nuiqsut via whaling boat the same or the next day "to feed the village." The rest of the meat, muktuk, organs, and baleen is packed into containers (either plastic fish totes or more recently heavy cardboard boxes) and transported to West Dock and then to Nuiqsut (most recently via ACS barge and air freight). What is left of the whale is taken to the bone yard. Once the quota is taken or conditions threaten to prevent boats returning to Nuiqsut (formation of ice), the whalers clean up the island, pack, and leave. Most will leave for Nuiqsut on the same day. Captains who have taken whales that season will fly their flags. Whaling will generally be completed by mid- to late-September (an apparent change from the past, discussed below). In Nuiqsut, each whaling crew will process their total crew shares into smaller portions, divide each sort of item (several types of *muktuk*, meat, etc.) into the number of equal individual crew shares determined by the captain, and apportion a share to each crew member or other individual. Each whaling crew that landed a whale will store its *uati* in the captain's ice cellar.

Nuiqsut whalers first used wood boats and relatively small motors. Although they remember these vessels with fondness, and long for the economy of those motors, they also remember that they were limited in terms of speed and towing capability. Currently Nuiqsut whalers all use aluminum or fiberglass boats, 18 to 24 feet long, with motors of 80 to 225 horsepower. It is possible that a 16-foot boat may be used as a whale boat on occasion, but it would not be considered a primary boat. A few boats have cabins, but most are open. Boats typically scout for whales with a complement of three or four people, although some boat crews are as small as two and as large as eight.

In the recent past, Nuiqsut had as many as eleven active whaling captains. Currently, the number is smaller than that. Some captains who do not expect to go whaling do not register with the AEWC each year, and others have retired. When eight or more whaling crews went out whaling there was little reason for captains to run multiple whaling boats. When relatively few (three or four) captains go whaling, the number of boats available to assist in chasing and towing the whale are too limited unless some whaling crews use more than one whaling boat. Also, the only way that a whaler who is not registered as a whaling captain can take his boat out whaling is as the boat (usually a second or third boat) for a registered captain. This is one way that people with

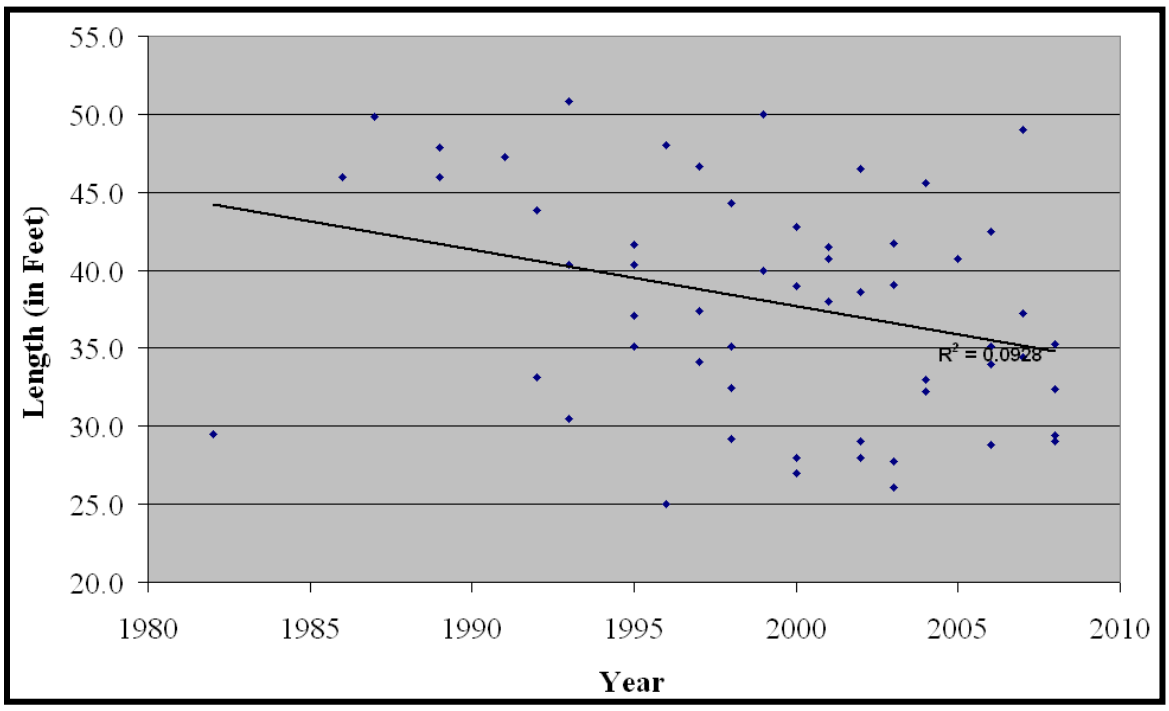
the goal of becoming whaling captains acquire the experience to support their eventual application to their local WCA and the AEWC to become a registered whaling captain. Thus part of the reason that most whaling crews (63 percent) during the study period used more than one whaling boat was probably due to the fact that only three to five whaling crews were active during any given season. This will be discussed at greater length below. Although single boats do take whales on occasion, it is not encouraged and Nuiqsut boats almost always scout for whales in pairs, in case of mechanical break downs or other emergencies. Whaling crews with two or three boats are willing to whale on their own, but it is commonly agreed that five to seven boats is a preferable number to have available for whaling on a given day. More boats would be useful, and the availability of fewer boats decreases the efficiency, safety, and overall chance for success of the hunt.

Trends in Nuiqsut Subsistence Bowhead Whale Harvest

Table 1 above lists the strikes for Nuiqsut whalers since 1973 (the date the community was resettled) as well as the historically documented whales landed in the Cross Island/Prudhoe Bay region of the mid-Beaufort region between 1920 and 1940 (whaling activity in the mid-Beaufort from 1941-1972 is not well documented). As related above, the first whale landed by residents of the current community of Nuiqsut was struck near in the Flaxman Island/Canning River area, well east of Prudhoe Bay and Cross Island. Whaling continued in subsequent years, but success from 1973 until at least the mid-1980s was intermittent, with the next whale landed in 1982 and the one after that in 1986. Starting in 1986, whales were landed on a more regular basis and Nuiqsut whalers first used their full quota of strikes (plus a "transferred" strike) in 1989. They first landed their full quota of whales in 1993 and have done so on a regular basis since then. For the period 1973-1992, they landed 9 whales and had 6 struck and lost, for a landed percentage of 60 percent. A quota was only established in 1978, so a comparison with possible harvest is not possible. For the period 1978-1992 (fully covered by a quota assigned to Nuiqsut), Nuiqsut whalers landed 8 whales, struck and lost 6 (a landed percentage of 57 percent) and had a quota of 25 strikes over the period. They used only 56 percent of the strikes and landed only 32 percent of their quota. For the period 1993-2007, Nuiqsut whalers had an aggregate quota of 55 whales and landed 45 (82 percent of their quota) and had only 4 struck and lost whales (a landed percentage of 92 percent of the strikes used). Nuiqsut whalers used 49 strikes during this period (89 percent of their quota). This demonstrates a clear improvement in efficiency, both in terms of an increased percentage of landed whales versus struck and lost whales, as well as in terms of more fully using their quota and satisfying the community's need. Most Nuiqsut whalers indicate that four whales, each about 25 to 35 feet in length, provides enough meat and muktuk for everyone in the community, with enough left over to share with people in other villages. Three whales, if they are larger than 35 feet, can be enough and in some years Nuiqsut whalers have foregone landing a fourth whale for this reason.

Whalers report that for the fall migration that the smaller whales reach Cross Island before the larger ones, and that they have a preference to land smaller whales (35 feet or less). This preference is consistent with the AEWC management guideline for whalers to strike only sexually immature animals (generally less than 38 feet). Figure 8 indicates that the historical Cross Island harvest supports a trend in this direction, although it may be skewed since most of

Figure 8: Historic Cross Island Subsistence Whales Landed – Length by Year



the whales taken in the 1980s and early 1990s were landed in late September or October, when larger animals may have composed more of the animals present than in the early- to mid-September, when Nuiqsut whalers currently whale. Current whalers may have more of a preference for smaller whales than did whalers in the past (some whalers state it the other way – that past whalers may have had more of a preference for larger whales). Another factor is that current whalers use larger boats with more powerful motors, and have more reliable gas supplies and logistical support, than whalers in the 1980s and early 1990s. While they are not able to wait for long periods of time for a "preferred" whale, they can at times decide not to chase a whale that is "too big" early in the season, with the expectation that they will have other opportunities later in the season. Nuiqsut whalers in the 1980s and early 1990s did not have the same degree of freedom and tended to chase and strike whatever whale made itself available.

Figure 9 adds some support to this conclusion, since smaller whales seem to be more likely to be landed earlier in the season than are larger whales – but the same skewing effect of current whalers hunting earlier in September than did past whalers may apply. There is little question that whalers are whaling, and landing whales, earlier than in the past (Figure 10). In the past, whalers say that it was common to hunt caribou on the way to Cross Island, or to make trips to the mainland from Cross Island to hunt caribou, to support themselves while whaling. They also say that whaling crews often took fish nets to Cross Island, and would hunt seals for food. The captain who landed the first whale for Nuiqsut in 1973 often told the story of how, after two weeks, he and his crew had run out of food except for some salt and tea, and how they lived for weeks on nothing but seal. In those days they not only hunted for food to support their whaling activities, but also for gas. Because of past military and industry activities, drums of various materials were left at numerous locations all along the coast, and Nuiqsut whalers made use of

Figure 9: Historic Cross Island Subsistence Whales Landed – Length by Day of Year

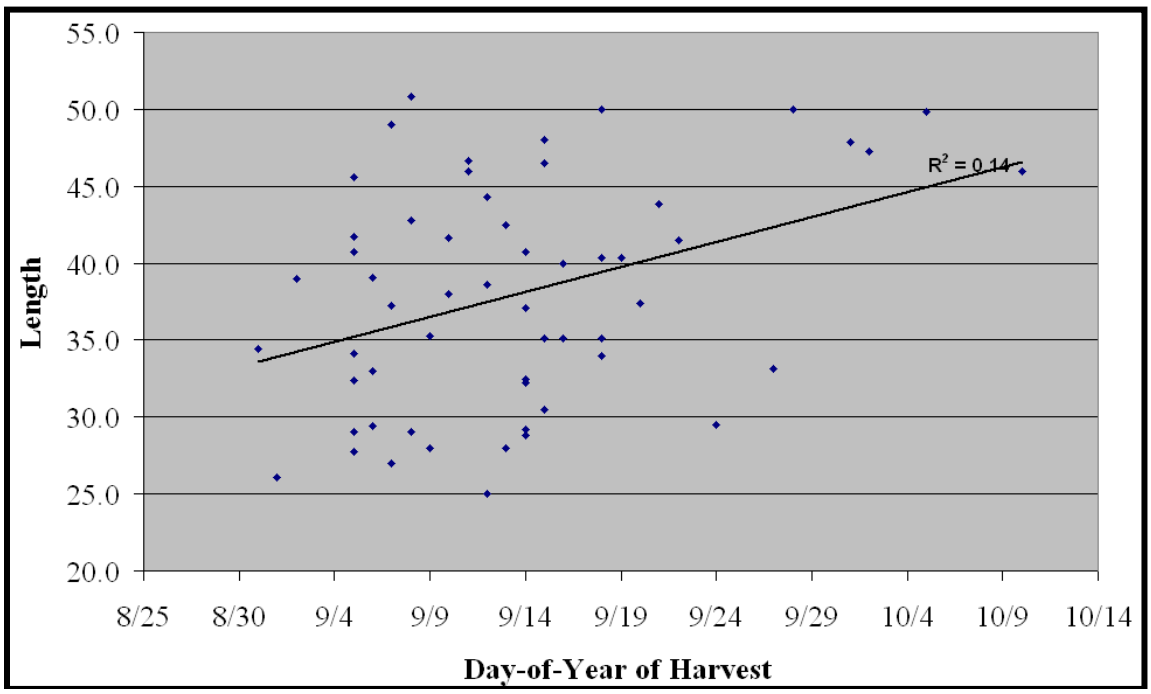
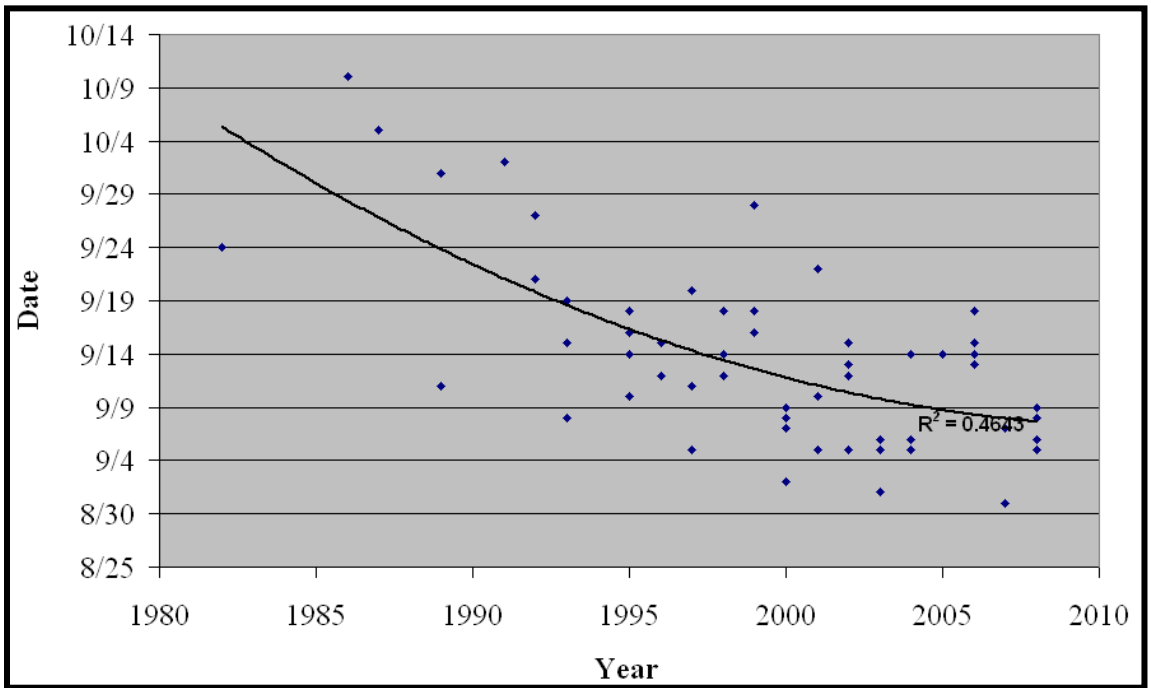


Figure 10: Historic Cross Island Subsistence Whales Landed – Day of Year by Year



the fuel that they could find. They were very limited in what they could bring from Nuiqsut, and could not always rely on being able to buy what they needed. What they did have more of in the past than they do currently is time. In many ways, increased access to economic resources and improved technology is used to decrease the time required to successfully harvest subsistence resources, in this case bowhead whales. Nuiqsut whaling captains commonly remark that it is very expensive to be a whaling captain, and that to field a whaling crew on a regular basis one needs a good job or a wide and strong support network, or preferably both.

Methodology

The methodology of the project has been described in each of the annual reports, and is repeated in much the same form here. Each component of the project will be discussed in terms of methods, with emphasis on the actual collection of descriptive information. Project components are defined primarily by the three main types of information to be collected – systematic GPS observations, systematic daily protocols, and narrative observations from whalers. Each will be discussed below, after a discussion to address the issue of "hypothesis testing" in relation to the products of the research, in terms of the data categories required to test those hypotheses.

Hypotheses Guiding Data Collection

MMS explicitly required, as part of the proposal submission, the formulation of hypotheses related to potential changes in Cross Island subsistence whaling. These hypotheses would later be tested using the information collected by this research effort. Two major hypotheses were formulated:

- H1: Subsistence whaling activity and behaviors in the vicinity of Cross Island are significantly adversely changed by offshore oil developments at Northstar and/or Liberty.
- H2: General subsistence activities on/near Cross Island are significantly adversely changed by oil and gas activities associated with Northstar and/or Liberty.

These hypotheses are not stated in the "null hypothesis" format as such a formulation is counterintuitive to at least some of the local research participants and perhaps to the general public at-large. It will be necessary to express their implementation in the null hypothesis form for quantitative testing. It was explicitly recognized that the annual reports would not test or discuss these hypotheses, as such tests require more data (longer time series) and more effort devoted to analysis than was available for the Annual Reports. A consideration tests of these general hypotheses is one component of this document.

In summary, hypotheses have been formulated as examples of possible relationships that are testable after concrete quantitative measures of empirical Cross Island whaling factors have been compiled for a number of years. The hypotheses (and the measures to test them) thus guided the practical methods of collecting and archiving the information, to ensure that they will be useful for testing these hypotheses (as well as others as they are developed).

What has become clear from an examination of the seven field seasons of data is that, at least during the period of study, there does not appear to be any clear way to test for (or demonstrate)

any adverse effects of oil and gas activities on Cross Island subsistence whaling. There are several possible components to this result. First is the existence of the CAA between the whalers and industry. The CAA, for the most part, his minimized adverse effects of industry activities on whaling activities and vice versa. This does not mean that there is no disagreement between industry and the whalers, or that specific conflict incidents did not occur during the period of the research. Such incidents were singular in nature, however, and not amenable to generalization or statistical treatment. Second, detailed information on the timing and geospatial location of oil and gas activities is not readily available. The Human Activities Database documents only the period before 2000, and not in great detail. Thus, it is difficult to articulate possible mechanisms of articulation between oil and gas activities and subsistence whaling. Third, oil and gas activities are only a subset of commercial activities that can potentially affect subsistence whaling. Commercial barge and other vessel traffic is a great concern to subsistence whalers, and the one major incident that occurred during the period of the research involved an encounter between whaling vessels and a commercial (non-oil and gas) tug and barge in 2005. At present, there are few if any reporting requirements for such commercial (or non-commercial) vessel traffic. Fourth, many subsistence whalers are most concerned about the potential effects of events or activities that have not yet taken place – offshore oil spills, or offshore development to the east (rather than the west) of Cross Island, for example. The data collected on the 2001-2007 whaling seasons does little to address such concerns, other than to provide comparative information that may be useful to gauge or measure future effects.

It is clear that Cross Island subsistence whaling is quite variable, and that the seven years of data are quite useful in describing this variability. Factors that seem to account for most of this variability are the weather (especially wind speed), ice conditions, the decision-making characteristics of individual whaling captains, and other activities going on in the vicinity of Cross Island. As discussed above, the last factor was either largely absent, or to the degree present largely undocumented, and so is not explicitly treated at any great length in this report. To the extent that these activities do take place and are documented, the variability of Cross Island whaling documented here may be attributable to them to some degree.

Descriptive Data Categories

The primary goal of data collection is the compilation of quantified measures of subsistence whaling behavior. Emphasis for the first field season was placed on such measures as:

- Number of whaling crews actively whaling and number of boats used
- Size and composition of whaling crews
- Size and composition of boat crews (as components of whaling crews)
- Fluctuations in active whaling and boat crew size and composition over the whaling season
- Number of whales harvested
- Days spent whaling
- Days prevented from whaling (weather, equipment failure or repair, etc.)
- Days suitable for whaling when whaling did not occur
- Subsistence activities occurring other than whaling
- Location of whale sightings and whale harvest (distance and bearing from Cross Island)
- Location of whale searching (GPS track)
- Local weather and ice conditions

These measures are a mixture of descriptive characteristics suggested by MMS and factors derived from or related to the perceptions of whalers on how and why whale behavior has changed, requiring that whalers change their behavior in hunting whales. For instance, size and composition of whaling and boat crews are fundamental descriptive characteristics that may have some relationship with the availability of whales. They also depend on the alternative (non-Cross Island) activities available to the crew members, such as alternative subsistence activities, wage labor opportunities, education, and so on. Because of the focus on Cross Island activities, information on the "full" range of factors that may be affecting the data collected was thus not compiled, but the range of possibilities was generally elicited from whalers during discussions of topics such as whaling crew composition or recruitment. In this sense, these generally descriptive measures are thus also characteristics identified by Nuiqsut whalers as potentially significant and variable measures from year-to-year. The locations of whale sightings, harvests, and general whale searching behavior are all important in the examination of whether whales can be found in the same locations every season, or if this changes from year-to-year. If the latter, what causes such shifts in location is important. Nuiqsut whalers have experienced such variation and have suggested a number of factors to account for it. This project develops information to examine these questions about variation and changes in Cross Island whaling behavior. For instance, this information will allow for a preliminary (albeit rough) examination of "catch per unit effort" as well as factors associated with the distance whalers need to travel from Cross Island to whale.

Nuiqsut whalers generally agreed the suggested measures were significant and pertinent to the issues to be addressed. During the first field season (2001) Nuiqsut whalers also wanted to ensure that their more general perceptions and observations of whale behavior, and especially changes in whale behavior that had implications for hunting success or safety, were adequately noted. Such perceptions are also the most likely way for Nuiqsut whalers to contribute to future hypothesis formation and testing. Thus, information categories were added to ensure that whalers' perceptions and observations were noted on:

- Bowhead whale behavior in the Cross Island area, and differences from past experience; and
- Changes in access or other issues related to the whale hunt, such as increased effort for the same (or reduced) harvest, increased risk, increased cost, and so on.

These aspects of the research assumed more importance after the 2005 whaling season. Whalers reported that commercial (non-whaling) vessel traffic interfered with their whaling activities. BP requested that the researcher present a report on these aspects of the Cross Island subsistence whaling season at the stakeholder meetings conducted to collect information during the annual agency permitting process for planned offshore activities. MMS, the sponsor of this project, determined that this was not a conflict of interest with the purposes of the research – and indeed, was a direct example of how the information from the project could be used for ongoing management decisions. Thus, the project results of the 2005 Cross Island subsistence whaling season were presented at the 2006 "Open Water" meetings in Anchorage on April 18, to an audience of stakeholders including at a minimum Government agencies, industry, whalers, scientists, and environmentalists. A similar presentation for the 2006 season was given to the Open Water meeting in April 2007, and for 2007 to the Open Water Meeting in April 2008.

The overall objective of the MMS Cross Island project is to describe Cross Island whaling using measures that document year-to-year variability in whaling and, when sufficient time series data

are available, will allow tests of hypotheses on the causes of this variability. Concern about potential effects of oil and gas development on whaling is the prime motivation for the MMS project, but it is recognized that other factors can strongly affect Cross Island whaling and thus need to be considered as well. These other factors include weather and ice conditions, equipment problems, whalers' decisions, and non-industrial human activities. During the MMS-sponsored project, information is collected on level of hunting effort, including how many boats go out each day, boat crew size, how much time is spent on the water, lengths of trips in miles, and furthest point away from Cross Island during each trip. Information is also collected on the abundance and distribution of whales, including the number and location of whales observed and/or struck by the whalers. This information will be applied to internal MMS management leasing plans and decision, as well as stipulation requirements, and has also been recognized as important for the management decisions for other agencies.

Information on the level of hunting effort was collected by systematic observations by the researcher, who was on Cross Island for most of the whaling season in each of 2001–2007. This information was supplemented by conversations with all of the boat crews. Further information on the hunting effort, and on the abundance and distribution of whales, was obtained by issuing Garmin handheld GPS (Global Positioning System) units to all boats. The whalers were given instructions on how to record the GPS coordinates (track) of the boat's trip, and how to mark waypoints of significance, including whale sightings and strikes, sightings of vessels other than whaling vessels, and other pertinent observations. This information is then mapped, and is the basis for the Figures included in this report. Whalers tended to mark relatively few points when on the water, and the points they do mark represent the boat's position at the time a whale or group of whales was seen. These whales may be quite close or miles away.

This information was supplemented by subsequent conversations with each boat crew, while reviewing the mapped GPS information on a laptop computer with them. When reviewing tracks after their return, boat crew members would often identify locations where they saw whales, and these points were added to the GPS information. Some of these points were boat positions, and some were estimated positions of whales (and thus not on a boat track). Other points were reference coordinates and may represent past whale sightings, so they also may not be on boat tracks. Galginaitis did not accompany the whalers in their boats while they were hunting, since it is not permissible for any non-Native to participate actively in hunting marine mammals.

Methods of Data Collection

Three types of data were collected during each of the field seasons. As listed above, these are GPS information; systematic observations of various components of subsistence whaling activity; and whalers' observations on whale behavior (and especially changes in such behavior). This last sort of information is often accompanied by perceptions of possible causes for such changes and the implications such changes may have for subsistence whaling activities. Each method of information collection will be discussed below, often in terms of the type of information sought, as the two are intimately related.

GPS Data

GPS information – tracks of whaling trips, the location of whale strikes, whale kills, and other subsistence activities – was considered to be the most basic and fundamental data to be collected. Before (or early in) the first field season each participating Nuiqsut whaling boat was issued, through the captain of the whaling crew for which it was being used, a "handheld" GPS unit so that they could record these observations. The first GPSs issued were Garmin 12 units (in 2001) and the latest were Garmin etrex Legend HCx units. For intermediate years Garmin 72, Garmin 60, and Garmin 60Map units were used. The greater capabilities of the later units added to the quality of the data collected in later seasons. All GPS units issued to whaling crews became the property of the whaling captains or the crew members the captains gave them to. The first year of the project a GPS was issued for each boat to be used in whaling, since three of four Nuiqsut whaling crews used more than one boat for whaling in 2001. In later seasons, one additional GPS unit was usually issued per whaling crew, to replace dysfunctional or lost units, or for whalers who had not participated in the project in prior years. Many GPS units were reused from one year to the next, but the benefits to the project of upgrading them as more capable units became available required purchasing at least five new GPS units a year. This also built up a locally-owned "GPS reserve" that functioned as a backup data collection method, as crew members tended to use as many GPS units as they had available, and some received satellites (and recorded tracks) better than others. Some whalers also used their personal GPS units, and as many of these were Garmin units, then were also useful as backup data collection devices.

Prior to the start of the project, many boat crews had at least one member already familiar with GPS units - but not all boat crews used them as a matter of course. As might be expected, the first years of the project were the most difficult in terms of the quality of the GPS data collected (Table 2). The GPS units were not as capable as in later years, the crew members were not as familiar with working with GPS units, and whalers were still evaluating whether participation in the project was really worthwhile for them. As it turned out, affordable GPS units gained in capability, whaling crews were convinced of the usefulness of GPS units and learned to use them, and most importantly the whalers became strong supporters of the project and yearly data collection. By the end of the first whaling field season, all whaling (and boat) crews had agreed to carry these units in principle.

The first two field seasons, and to some extent even the third, were still more problematic than the later seasons, in terms of the percentage of whaling boats trips for which GPS tracks were collected. For 2001, when the project was new and some captains were relatively unfamiliar with GPS units and perhaps somewhat skeptical about the usefulness of the information to them, only 83 percent of all trips were documented with GPS tracks. Some boat crews forgot to take units with them, or to turn them on, or placed them where they were blocked from receiving satellite signals. For the second year, one whaling crew was at Cross Island before the researcher, and the GPS units in use for that season did not have sufficient memory for their early tracks to be documented. Once the researcher was on Cross Island, there were still two boat crews who preferred not to use a GPS unit, relying instead on a "sister ship" that accompanied them on most days and that did use a GPS. This was a problem mainly early in the 2002 season. All boat crews were eventually convinced to at least have a GPS turned on in the boat, but only 78 percent of all

Table 2: Percentage of Boat Trips with GPS Track Documentation								
Season	2001	2002	2003	2004	2005	2006	2007	Total
Boat Trips	59	67	42	46	48	53	22	337
GPS Tracks	49	52	37	44	48	51	20	301
% of Trips with GPS Tracks	83%	78%	88%	96%	100%	96%	91%	89%

2002 whaling trips were documented. This problem persisted at the beginning of season 3 (2003) but was resolved faster than in 2002.

In 2004 the only two tracks not documented were for the boats of a whaling crew that went out scouting the day after they arrived at Cross Island, before their GPS units could be checked. They had tracking turned "off" so that these tracks were lost. All tracks for 2005 were documented. The two tracks not documented in 2006 were for similar reasons – one was for a whaling crew's third boat that went out without a GPS, while the other was for a boat that had a GPS that was not turned on. One of the two missing tracks in 2007 was due to a boat going out in a hurry and not taking a GPS unit (again a third boat for a whaling crew). The other was for a new boat with a hard top that

interfered with GPS satellite reception, so that one day's tracks were lost for this boat. Since the 2007 season was short and fast, these two tracks represented 9 percent of all possible tracks for that year. It would be of course be preferable to document all tracks, but missing fewer than two tracks for each of the last four years would appear to be a high rate of successful data collection.

Each boat crew was instructed to keep the "tracking" feature on, which recorded the path the boat traveled each time it went out. The cause of missing tracks was discussed above. Until all GPS units are checked, some loss due to whalers turning the tracking feature "off" is probably inevitable. For some whalers, such a setting is the preferred or default setting. There are also some other situations that may result in the failure to record (and collect) a GPS track for all trips - a boat's hard top, the rush of a boat crew that forgets to take a GPS unit, or loss of satellite coverage. These problems have declined as the project has gone on, however, due in part to the past experience of the whaling crews with the project and in part to the use of more capable GPS units. All boats are now provided with a power cord so that the GPS units could be operated from the boat's electrical system, so that depleted batteries were not the problem they had been in the first two years of the project. Unfortunately, not all boats are wired to use such cords. Also, all boats are provided with a boat-mounted holder for the GPS unit, so that the units would be readily available, secure, and not be mistakenly shielded from satellite signals due to being put in a pocket. Still, at times satellite coverage has been spotty and reception was sometimes lost. Whalers were instructed how to mark points, and told to mark the points where whales were seen. Whalers were also asked to mark other events such as "blows," other animals (polar bears, seals, and so on) and key points in their trip (the ice edge between "open-water and the ice pack, places where weather conditions change, and so on). Positions where whales were seen, struck, or killed were marked by a number of boat crews, but were seldom if ever labeled and so required additional discussion with the boat crew and additional processing of the "track" file.

The researcher visited each whaling crew that had gone out scouting after they came back, in order to download the information from their GPS unit into his laptop computer. This ensured that the GPS units were always available to the crews should they decide to go out at short notice. This procedure also enabled the whaling and boat crews to immediately see where they had been that day with the mapping software, and allowed the crew members an opportunity to discuss their trip with the researcher while it was very fresh in their minds. The utility of this information, as concretely represented on the mapped tracks displayed by the computer, has been obvious to the whalers since the inception of the project and is one reason for the high degree of participation. An example of the combined tracks for one day of scouting can be seen in Figure 11. This figure shows all tracks for 09/07/07, although morning tracks are not distinguished from afternoon tracks. The IAN morning and the NUK3 afternoon tracks were not recorded and IAN afternoon track was only partially recovered (for the tow). Seven boats went scouting in the morning and five in the afternoon. Two whales were landed that day, one in the morning and one in the afternoon. Only points for the Napageak boat are shown in this figure, with morning points for the morning trip distinguished from those of the afternoon trip, to correspond with the discussion of Table 3, below. The locations of the two whales struck on September 7, 2007 are indicated on Figure 11 in order to help the reader sort morning from afternoon tracks.

Tracks for all days that boats went out scouting appear in electronic Appendices to the yearly annual reports. Full electronic copies of these reports will accompany the final version of this report. The MMS Alaska OCS Region holds the processed GPS data files for all the tracks and waypoints collected for the entire project.

Hunters were also asked to report other subsistence efforts and results, in terms of time spent, species, number, and location in terms of GPS coordinates. Little such activity was reported or observed during any whaling season documented for this project. Possible reasons for this are briefly discussed below in a separate section.

Daily boat report forms were used to contextualize the GPS and associated information. The form has been modified throughout the project, but the form used for the 2007 field season was essentially the same as used for previous field seasons (the 2001 and 2002 forms were somewhat simpler). A form is completed for each boat that goes out scouting or engages in some other significant whaling activity. Table 3 below presents as example of the form completed for a boat that participated in landing the second whale on 09/07/07. Forms for the other boats out scouting that day (or the first trip of the day for this boat) are not included in the body of this report, but appear, along with all the other boat report forms, in electronic appendix B on the CD-ROM with the 2007 Annual Report (as for the Annual Reports for 2002-2006 as well). Those boats not out scouting on any given day do not have a separate form completed for each of them, but rather have their activities and status summarized on a single form. On days when no boats go out scouting, all will be on one form. Table 4, as an example, contains the information for all the boats that did not go out scouting on 09/06/07, when only two whaling crews decided to go out.

The information used in the Table 3 example was not chosen at random, but rather because it demonstrates some of the difficulties presented in the waypoint information reported in this (and the Annual Report) documents. Although instructed to mark waypoints whenever whales are spotted or where significant events take place, no boat crew in fact can mark all such points, for a

Table 3: Example Daily Boat Report Form

ANIMIDA Task 4 Data Collection Form, 2007 **Use one form for each vessel/day**

Date: 09/07/07 **Crew:** Napageak **GPS Type:** GPS60MAP

Vessel	Type	Length	HP Motor	# crew aboard/notes
NAP	fiberglass	21’	Honda 225	4

Two Scouting Trips for the day, this form just the second trip

Whaling today? Yes **If not, why not?**

Time departed: **12:37** **Time returned:** **20:35**

Second trip: Trip time of 7 hour 58 minutes; roundtrip of 43.9, furthest point from Cross Island 16.7

Waypoints or Coordinates noted

Way Point #	Lat/Long	Time	Notes (if whale - # of animals, direction of travel, behavior)
nap_090707f	N70.53714 W147.51702	14:32	NAP reported they smelt the whale in this area
NAP_090707g	**N70.53801 W147.50011**	**14:38**	**NAP reported that they first saw the whale in this area**
nap_090707h	N70.52282 W147.43519	15:04	Apparent chase event
NAP_090707i	N70.50765 W147.43508	NA	"nap-herburt" - UNK significance
NAP_090707j	N70.54176 W147.39009	15:23	Chase event - IP1 strike or soon after
nap_090707k	N70.54181 W147.38973	15:23	Chase event - IP1 strike or soon after
nap_090707l	N70.54451 W147.36991	15:31	Whale seen again to the south by whalers, other whales seen to the North and "over there" (more to the NW - points m and n)
NAP_090707m	**N70.55796 W147.39737**	**15:31**	**Whales seen to the North of the chase**
NAP_090707n	**N70.58094 W147.36225**	**15:31**	**Whales seen to the North of the chase**
nap_090707o	N70.54871 W147.31363	15:47	Float put on same whale struck by IP1 @ 15:21
nap_090707p	N70.54671 W147.29746	16:02	Chase event
nap_090707q	N70.54850 W147.29619	17:14	Tow event (unknown significance)
nap_090707r	N70.56099 W147.27901	16:50	Plane observed to fly over after kill
nap_090707s	N70.47534 W147.23413		"nap-whale2" - whale to the South?
nap_090707t	N70.53970 W147.33082	17:36	NAP developed leak, pulled out of tow

Describe the day's activity (traveling, hours searching for whales)

Direction of initial search (and explanation):	E to where they had been seeing whales that morning
Time spent actively scouting/# people looking:	2:44; 1:28 assist/chase/kill; 0:20 prepare to tow; 3:26 tow
Time spent in travel/tow/assistance to other boats/on “break”:	

Notes: NAP boat headed east to where whales had been seen on previous days. Boats were more-or-less together when NAP smelled a whale (point “f”) and then were the first to spot it (point “g”). Point “I” is probably an indicator of NAP communication to IP1 that NAP had seen a whale. Point “h” was a chase event (probable whale resighting). NAP, IP1, and BO1 boats were all together chasing the whale at this point. Points “j” and “k” indicate chase events, probably soon after the IP1 first strike on the whale. The float had come off the whale, so the boats were looking for it. It was spotted to the S (point “l”, as were several other whales (points “m” and “n”). NAP put a float on the IP1 whale at point “o” and point “p” was some chase event (perhaps a bomb). NAP did not mark the kill sight as such. NAP saw a whale to the S of the kill (point “s”) and a plane that flew overhead shortly after the kill (point “r”). During the tow NAP developed a leak and had to leave the tow and head for Cross Island at high speed (point “t”).

Observations of Whaling Crew - weather, sea state, ice-conditions

Fog or clouds?	No	**Weather notes:**	Calmest day of the season, sea swells of 4 feet but “calm” seas		
Wind Direction:	shifting	**Wind speed and other notes:**	0-10 mph, BP 29.88 and steady (but a short peak)		
% Ice Coverage:	0	**Ice Type:**		**Other Notes:**	Wind for most/all whaling <5 mph
Wave Height:	small	**Other notes on sea conditions:**			

Other pertinent notes:	The best day for scouting for whales of the season, worse conditions predicted for the next day (both the official weather forecast and downward trend of local BP). This was the main reason the captains decided to try to land two whales (and did). Wind shifted around the compass. Whalers described seas as “calm” with 4 foot rollers.

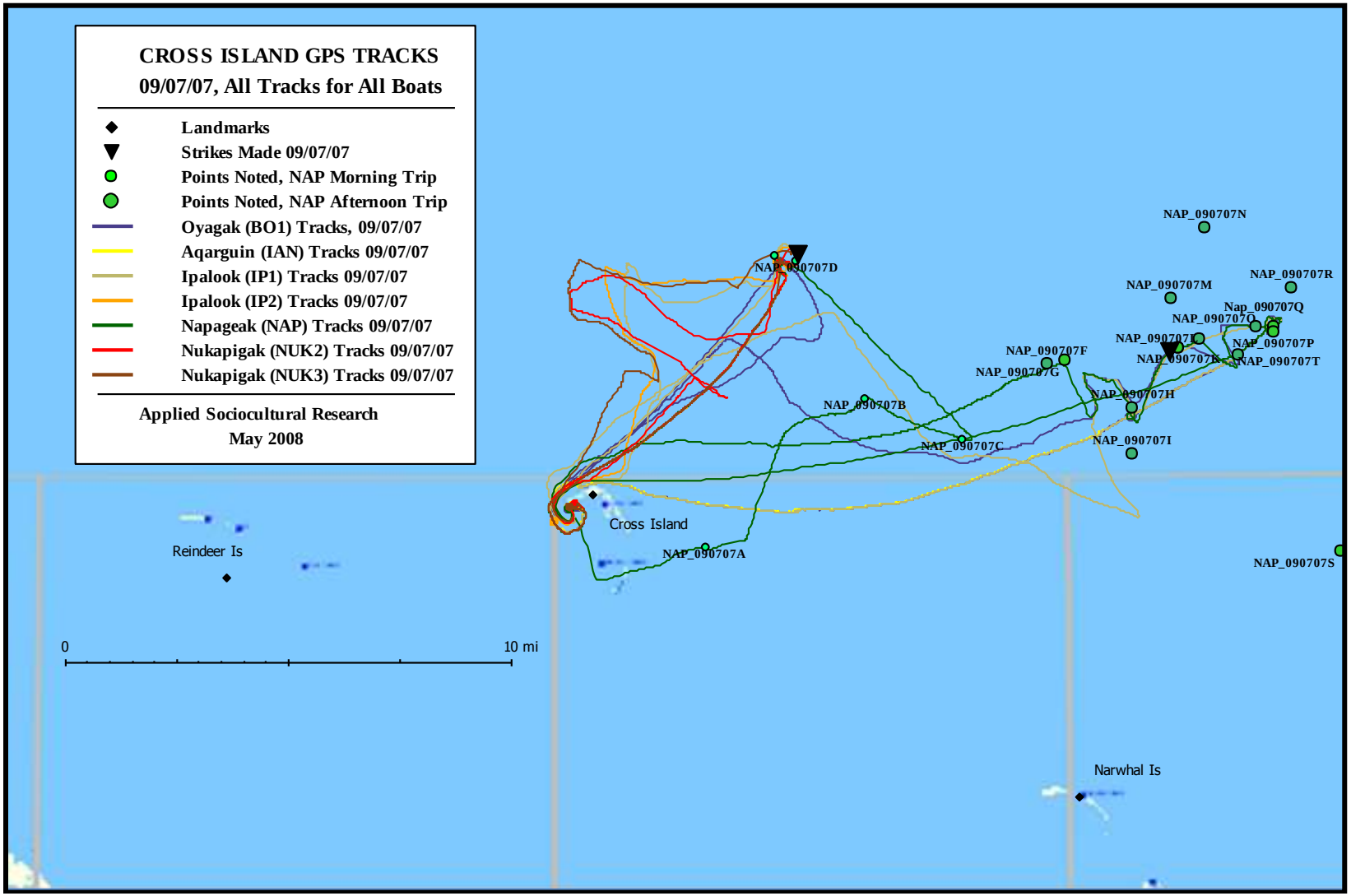
Note: Cross Island weather observations are compiled in a separate file (weather station + observer)

Engaged in any other subsistence activities? No **If yes, describe below**

GPS track? Yes **GPS File Name:** NAP_090707b.gdb

If not, why not?

Figure 11: Composite Scouting Tracks for a Single Day – 9/07/07



Note: Points NAP_090707j and nap_090707k are too close together to display labels for both

variety of reasons. Whaling events happen so quickly that crew members are fully occupied with their duties and sometimes cannot divert their attention to mark a point (or perhaps even remember to do so). When points are marked, crew members seldom take the time to assign them names, so that they are designated with "default" numbers. When waypoints are marked for whales, they still do not all necessarily represent the same thing. Waypoints indicating where a whale was struck or killed for the most part represent the immediate area where that event took place. Those indicating a whale sighting are less precise, showing the position of a boat when a whale was sighted. It may indicate a whale seen a short distance away, or the "blow" of a whale seen in the distance (up to 2 or 3 miles away). Also, a waypoint may represent one whale or multiple whales. For some tracks, there are no waypoints that were marked while the boat was on the water, but quite a few that they could be approximated when crew members later reviewed the track with the researcher. Many of these points represent whale sightings, and are not necessarily any less precise than points marked on the water – but in most cases can be assumed to represent whales or blows seen at a greater distance than for a waypoint actually marked when on the water, or events that were not marked because people were too busy at the time to do so.

In Table 3, for example, the Napageak crew marked where they first saw the whale eventually struck by the Ipalook crew (NAP_090707g), but also indicated after the fact where they had first been alerted (by smell) to the near presence of a whale (point "f"). Some chase events and other whale sightings were marked (points "i", "j", "m", "n") while others were pointed out after-the-fact while looking at the GPS track lines (points "h", "k", "l", "o" – "t"). Some points reference single animals ("g", "l", "o", "p", and "s") while others refer to multiple animals ("m" and "n"). Most points not on the track of the boat refer to whale sightings, at various distances from the boat, and can be either for multiple ("m" and "n") or single ("s") – but can also refer to other events ("r", the estimated location of an airplane that flew overhead).

Since most boat crews discussed most of their trips with the researcher, it has been possible to collect more waypoint information that is present in the raw GPS data files downloaded from the GPS units, but with a potential loss of precision for this additional information. Crew members remember how many whales they have seen on a trip (except in cases where blows were both distant and numerous), and generally where they were. When looking at the mapped tracks of their trip they are able to identify where they saw whales, so that an approximate waypoint can be generated (the sooner this is done after their return from a trip, the more precise and complete the information about that trip is likely to be). In most cases, sighting locations are associated with changes in a boat's direction. Such "generated" waypoints are differentiated from those actually marked by boat crews "on the water" by using lowercase letters in their labels. Points for whales that are located "after the fact" may also represent estimated positions of the whale rather than the position of the boat when the whale was seen. These points are likely less precise than boat positions, since they are not "anchored" by the GPS track lines from the boat's trip.

Some marked waypoints are also ambiguous in meaning, however, since crew members may assign one meaning or memory to a point when in fact it may have another. Whalers may misidentify the waypoints they do mark, especially when whales are harvested. Given that crew members have little attention to spare in this situation, the waypoints themselves are usually only numbered. The crew members may not remember exactly how many waypoints were marked, or know if all attempts to mark points actually succeeded, or if some unintended positions may have

been marked in the flurry of activity. However, since whalers communicate with each other, the Com Center, and sometimes their Cross Island base station by radio, it is often possible to note when significant events take place by what is said on the radio and noting the time. When compared to the date stamps on waypoints these notes can then aid in the interpretation of what the waypoints actually represent. It should also be noted that the researcher is also a potential source of confusion, in that his understanding of a crew member's description of trip activities and events may in fact be in error – the researcher may misinterpret what he is told. The data as presented is the result of cross-checks using the information obtained from all sources (GPS, crew member accounts, radio notes), and is the analyst's best attempt to interpret all the available information in the most mutually consistent manner possible. Not all ambiguities can necessarily be fully resolved.
Ambiguities of meaning influence or may limit how waypoints can be used and what they represent, but not to the extent that they do not have any useful meaning. Most whale sighting waypoints cannot be interpreted as point locations, as whales marked as points are usually some (variable) distance from the boat when the point is marked. Whale strike and kill locations can generally be interpreted as point locations, but not necessarily precise point locations. While boats are generally close to the whale when strikes or kills are marked as points, boats are always moving and waypoints are seldom if ever marked at the precise time that a strike is made or a whale is killed. Most waypoints should thus be interpreted as general, and not precise, locations.

Table 4 is an example of how the Daily Report Form was used to reduce the number of forms to complete for those days when not all boats went out scouting, as discussed above. Separate forms were still used to record information for those boats that did go out scouting on 09/07/07 (Table 3 above for an example, appendix B for the 2007 Annual Report for the others). A single form was used for the two boats, from two different whaling crews, that did not go out scouting that day. In general, boats used only for support purposes (to transport supplies and people to and from Cross Island, and for trips between Cross Island West Dock) are not listed on Daily Report Forms after the first day they arrive at Cross island and are noted to be "support vessels." In Table 4, "BO2" is a boat that was used primarily as a support vessel, but that also went scouting for whales in fairly calm conditions. "NUK1" was a studier aluminum vessel that had developed a leak on the way to Cross Island and spent the season at West Dock. Disabled motors were one common reason why other vessels may not have whaled on a given day. Other reasons that boats may not go out whaling on any given day, other than weather and/or sea conditions, were the captain's decision to stay in to butcher or for other chores, or to wait for a certain period of time after landing a whale to go out and try for another. For boats and whaling crews that did not go out scouting on any given day, a rough indication of what else the whaling crews did on those days (and if the boats were used for other purposes than scouting) is noted, but not in detail. Attempts were made to determine if weather, mechanical problems, or other obligations such as butchering was the major factor in a boat not going out scouting on any given day. For some days where multiple factors applied determining which was most important may not be possible.

Systematic Daily Protocols

Systematic observations were also transferred to the standardized recording forms (daily boat report forms). These observations are the basis for the summary tables that appear in the "Results" section, as well as the completed daily vessel activity forms. From these records it is

Table 4: Daily Boat Report Form for Boats Not Out Scouting

ANIMIDA Task 4 Data Collection Form, 2007 **Use one form for all non-scouting vessels/day**

Date: 09/07/07 **Crew:** Various **GPS Type:** NA

Vessel	Type	Length	HP Motor	# crew aboard/notes
BO2	aluminum	18'/19'	125 Mercury	Onshore due to conditions
NUK1	Aluminum	18'	115 Yamaha	Onshore at West Dock, disabled

Whaling today? No **If not, why not?** BO2 not suitable for conditions, NUK1 at West Dock

Time departed: **NA** **Time returned:** **NA**

Waypoints or Coordinates noted

Way Point #	Lat/Long	Time	Notes (if whale - # of animals, direction of travel, behavior)
NA			

Describe the day's activity (traveling, hours searching for whales)

Direction of initial search (and explanation):	NA
Time spent actively scouting/# people looking:	NA
Time spent in travel/tow/assistance to other boats/on "break":	NA
Notes:	

Observations of Whaling Crew - weather, sea state, ice-conditions

Fog or clouds?	No	**Weather notes:**	Calmest day of the season, sea swells of 4 feet but "calm" seas		
Wind Direction:	shifting	**Wind speed and other notes:**	0-10 mph, BP 29.88 and steady (but a short peak)		
% Ice Coverage:	0	**Ice Type:**		**Other Notes:**	Wind for most/all whaling <5 mph
Wave Height:	small	**Other notes on sea conditions:**			
Other pertinent notes:	The best day for scouting for whales of the season, worse conditions predicted for the next day (both the official weather forecast and downward trend of local BP). This was the main reason the captains decided to try to land two whales (and did). Wind shifted around the compass. Whalers described seas as "calm" with 4 foot rollers.				

Note: Cross Island weather observations are compiled in a separate file (weather station + observer)

Engaged in any other subsistence activities? No **If yes, describe below**

GPS track? NA **GPS File Name:**

If not, why not?

possible to make a basic "census" of the whaling crews on the island, and to track changes as people came to Cross Island and left. In addition, notes were made on which whaling crews went out on each day. In most cases it was possible to note who went out in each boat. From these basic observations, in combination with the information from the GPS units, most of the basic measures of subsistence whaling activity can be derived – number of active whaling crews (and boats), size and composition of whaling and boat crews, fluctuations in whaling and boat crew size and composition, and days spent whaling. The GPS data provide systematic locational information for whaling activities, on the special distance covered during each trip, and the temporal duration of each trip. This information also was recorded on the daily boat report forms. Examples of the daily boat report forms appear as Tables 3 and 4. The complete series of forms is included electronically as Appendix A for each of the Annual Reports produced for the project. A list of the acronyms and abbreviations used in these tables (and elsewhere in the report) is provided on page vii.

Very basic weather observations were made during the first field season (temperature, wind direction and strength, degree of fogginess or clarity, barometric pressure). This information was not as systematic as was desired, due in part to the difficulty in locating affordable and transportable weather measurement devices. For the second and subsequent field seasons, at least one and in some seasons more than one portable weather station was installed on Cross Island, with a remote data logger to record the information. These stations were deployed as soon as possible after the researcher arrived on Cross Island, but due to the press of other tasks such as helping the whaling crew get the cabin in shape this deployment was delayed for a day or two. Combined with the sometimes "late" arrival of the researcher due to whaling crews going out to Cross Island at different times, the weather measurements do not necessarily cover the full period of each whaling season. Generally the weather measurements consist of readings every five minutes for temperature (outdoor and indoor), wind speed, wind direction, barometric pressure, and relative humidity (weather files are included electronically as an appendix for each Annual Report). There were short periods of data gaps, due to signal interference, instruments freezing up, or other factors.

Formerly, MMS maintained a weather station at Endicott, close enough to Cross Island to be pertinent. This data is no longer available in near real-time, but may be available from BPXA, who is now responsible for the Endicott weather station. Weather records for Prudhoe Bay (Station ID 9497645) are available in real-time, as well as for the past since 09/03/92, on-line from NOAA's website at http://tidendcurrents.noaa.gov/data_menu.shtml?stn=9497645&type=Meteorological. The weather data from Deadhorse are presented below for the study period covered by this report (2001-2007), during the discussion of Cross island weather conditions, since a weather station was not always operating on Cross Island during all parts of all whaling seasons. Other potential sources of weather information and whaling activities are the communications logs of the Whaling Communications Center. Since the researcher could not go out in the boat while they scouted for whales, he had little ability to judge the degree of ice cover, although the Nuiqsut whalers did report their observations in a general way. Ice will be discussed as a factor influencing Cross Island whaling below, but in general there was much less ice during the 2001-2007 seasons (with local exceptions in 2005 and 2006) than Nuiqsut whalers had experienced historically. Ice observations are noted on the daily boat report forms. Information on ice cover may also be obtainable from remote sensing sources or the MMS aerial bowhead survey.

The need for more detailed, and ideally quantitative, information about environmental conditions affecting whaling prompted revisions of the daily boat report form after the 2002 field season, to encourage the collection of richer information. These modifications provided prompts or reminders to collect specific information in a number of areas:

- Documentation of waypoints marked – reason for marking the point, and if a whale sighting, the number of animals, direction of travel, and behavioral observations;
- Description of the day's activity – prompts for the initial direction of travel for scouting, for a finer accounting (if possible) for activity time on the water, and more general notes on that day's whaling activities;
- Short answer blocks to record whalers' observations on visibility (fog, clouds, clear, and so on), wind direction and speed, percentage of ice coverage and type, and wave height. In addition, prompts for noting longer responses if volunteered are provided. These observations are generally made from the beach or on the water prior to embarking on a scouting trip, but may also include observations made out on the water – especially if different. Ice and fog conditions especially can vary depending on location (for most years fog varied much more than ice cover, as not much ice was present, except local to Cross Island in 2005 and 2006);
- More general Cross Island weather conditions were deleted from the daily boat report form and collected as part of the more general field notes for the season. Weather condition reports for each whaling season consist of the datalog record from the weather station and limited personal observations of the researcher.

Whalers' Observations

Whalers would often make observations on whale behavior or give their thoughts on how and why whale behavior in the Cross Island area in one particular season was different than it had been in the past, or how it differed from that of previous study seasons. Much of this was recorded in the daily fieldnotes. Much was of limited immediate relevance to the central aims of the project. A summary of the most pertinent information is included in the "Results" section. This was made a formal part of the information collection and reporting process after the 2001 season, as the whalers did have some very specific observations and concerns that they wanted documented. This has also been an aid to the NWCA in subsequent years by providing them with a summary that they can use to help compose their own annual report of the season to the AEWC.

Consultation

Consultation is more a process than a result. The goal is that through consultation and a collaborative effort, Nuiqsut whalers will wish to continue at least part of this program as their own. A great deal of time and effort has been devoted to the consultation process, but this final report will provide a general summary rather than a blow-by-blow account. More detail is provided in each of the Annual Reports.

Telephone and Fax communications with the AEWC and the Nuiqsut Whaling Captains Association (NWCA) were initiated in late 2000, after award of the contract and prior to consultation (face-to-face) trips. These contacts have continued through the present, both through "official" contacts as well as contacts with individual whalers and whaling captains. Contacts were also renewed with the Inupiat History, Language, and Culture (IHLC) Commission by telephone (and later in-person), in regard to tapes and transcripts related to Cross Island archived at their facility. Several tapes reportedly contain information on whaling from Cross Island in the 1930s and 1940s. They remain unprocessed at this date and are likely to remain so until funds for that specific purpose can be procured.

Although the researcher had worked in Nuiqsut since 1982 and was known to many of the Nuiqsut whalers, it required a significant amount of time to build up the trust and rapport before formal face-to-face consultation could be initiated. The first consultation trip was arranged for June 25-30, 2001. The main contacts in Barrow were with AEWC and IHLC. Galginaitis continued on to Nuiqsut on June 27 and talked with a number of people (several whaling captains, city and corporate officials, and contacts from previous visits to Nuiqsut) about the project. However, the overall opinion was that it would be best to discuss this project in the context of all the whaling captains meeting together. Local experts suggested that this be accomplished at the Alaska Gas Producers Pipeline Team (AGPPT) meeting with the Nuiqsut and Kaktovik whaling captains, planned for July 6 at Service Area 10, and plans were modified to this effect.

The second consultation trip, to meet with Nuiqsut and Kaktovik whaling captains, took place July 5-7, 2001. The whaling captains delayed their departure for 30 minutes from their meeting to hear a presentation on the project and to ask some questions. The NWCA, through its officers, then invited Galginaitis to come to Cross Island. During the next several months, Galginaitis arranged to accompany the Kittick crew to Cross Island, through a series of phone calls with Thomas Napageak, Archie Ahkiviana, and Paul Kittick. Galginaitis arrived in Nuiqsut (via Barrow) 8/30/01, traveled to Cross Island with the Kittick crew 9/06/01, returned to Nuiqsut with the whalers on 9/26, and arrived back in Anchorage (again via Barrow) 9/29/01.

Consultation for the second field season built on that for the first, and was facilitated by the success of the 2001 field work. Whalers observed that the information being collected was reported to the local research participants as well as the sponsor, and was potentially more to their benefit than to their detriment – at least in part because observations and concerns of the whalers were incorporated to modify the research design. As might be expected, not all whalers accepted the research to the same degree and at the same speed, and the 2002 season was also one that built and increased trust and rapport. By the 2003 field season, whaler support for and participation in the Cross Island research was well established.

The 2002 consultation effort included periodic phone calls (primarily to the Native Village of Nuiqsut and whaling captains), trips to Nuiqsut to present results from 2001, and discuss the project during the periods 3/27-3/29 and 6/05-6/07, and phone calls to arrange for the final logistics of the actual field work. Galginaitis arrived in Nuiqsut 8/30/02 (via Deadhorse) and traveled to Cross Island with the Ahkiviana crew 9/05/02. He returned to Nuiqsut with most of the whalers on 9/20/02, and returned to Anchorage (via Deadhorse) 9/24/02. A trip to present the

results of the 2002 field season was made to Barrow and Nuiqsut 6/28/03-7/02/03. Nuiqsut whaling captains suggested the incorporation of information for previous years into the project reports, and two trips were made to Barrow to use AEWC records for this purpose. This information is incorporated into the discussion of the historical context of Cross Island whaling above. A trip was also made to Fairbanks 7/18/03 to present the methodology and results of the project to the Commissioners of the AEWC, at the invitation of the Executive Director of the AWEC. A trip was made to Barrow and Nuiqsut to present the final report for the project.

Consultation for the 2003-2007 field seasons followed a similar pattern:

- Telephone calls to Nuiqsut and Barrow contacts after the prior field season (October through early August)
- Talking opportunistically with people at the Alaska Federation of Natives Convention in October (generally either Anchorage or Fairbanks)
- Visit to Nuiqsut (and sometimes Barrow) in January-March of the year following fieldwork to present the draft Annual Report to the NWCA and other interested parties
- Visit to Nuiqsut (and sometimes Barrow) in June for Nalukataq to obtain final comments on project deliverables and to begin making more concrete plans for the upcoming fall whaling season. This has always started with obtaining formal permission from the NWCA to go out to Cross Island for the whaling season, and arranging for a likely host captain/crew. At this point, no captain can be sure that he will be going out whaling, so all plans are tentative until late August/early September, and making arrangements earlier than this would be both difficult and most often counterproductive.
- Presentations to the AWEC as invited to do so, but not on an annual basis. Special efforts were made to be invited to present results to the AWEC at the end of a contract, and when a contract for an additional period of field work was awarded.

Results

Results are discussed in this section in terms of the quantitative observations designed as measures of subsistence whaling activity and the less quantifiable observations and perceptions of Nuiqsut whalers about whale behavior in the 2001-2007 Cross Island whaling seasons. The primary focus is on year-to-year comparisons and the discussion of variability.

Quantitative Measures

Detailed quantitative data will not be presented here – they are available in the appendices of the Annual Reports prepared for each field season. Rather, the following discussions are based on the summary and comparison of these data presented in Table 5. Some of the discussions will reformulate portions of these data, or present supplemental details. Table 5 presents what were formulated as potentially significant quantitative measures. When composing discussions of various aspects of the 2001-2007 Cross Island whaling seasons, it became clear that other available measures were also pertinent to the discussion. Most if not all of the data for 2001-2007 was developed for this project, but of course most of the data for seasons prior to 2001 comes from other sources (although it was perhaps obtained or processed as part of this project).

All of the measures discussed in this section relate in some way to the "success" of any given season, but "success" is a relative term and may mean different things for different people. In the final analysis, Nuiqsut whalers define "success" as landing sufficient whales to satisfy the community's needs (which include a percentage for sharing with residents of other communities). Whalers will note seasons with poorer weather than others, and certainly prefer shorter seasons over long ones, but ultimately judge a season by the number of whales landed. Perhaps this is because so many factors that clearly influence the subsistence bowhead hunt are beyond the control or influence of the hunters – weather, ice conditions, and the timing and path of the bowhead migration, among other possible factors. More anthropogenic factors, such as other vessel traffic, oil and gas activities in general, mechanical and equipment failures, and accidents, also potentially influence the course of the hunt and possibly "success" in landing whales, but can at least in theory by minimized by proper planning and management. Whalers seem to differentiate the two categories of factors. Seasons may be characterized as "poor weather" years (2003, 2004, 2005, 2007) or "bad ice" years (2005, 2006) or years when the whales were farther out or behaving in a different way making the hunt more difficult (2001 and to some extent 2002). Any of these conditions, or a combination of them, can result in not landing a sufficient whales for the village – but if 3 or 4 whales are landed, whatever the natural conditions have been, the season is considered successful. The one project field season during which the whalers experienced direct disruption of their hunt by non-whaling vessel traffic (a commercial, but not petroleum industry, tug and barge) was 2005, a "bad ice" and "poor weather" season and the only project season when the Nuiqsut whalers landed fewer than 3 whales (only 1). While a single case is not sufficient to establish an argument one way or the other, Nuiqsut whalers characterized this season as much by this disruption incident as by the ice and weather conditions. As will be discussed below, absent this incident they indicated they may have been able to land at least one more whale (but would never claim that this was certain, as that would not be showing proper respect for the animals).

That said, whalers will indicate that some seasons are "better" than others, and generally "better" means "shorter" in terms of days spent out at Cross Island (with the caveat that 3 or 4 whales were landed). Good weather is preferred, but not a necessary condition, for a "better" season. The shortest seasons documented by the project were those with arguably the worst weather (2007, 2003) but other factors (whales close to Cross Island and the adaptive behavior of the whalers) allowed the whalers to use their full quota of strikes in both years. Thus these finer distinctions of what makes some seasons "better" than others – the evaluation of the variability between and among seasons - is recognized by Nuiqsut whalers. Thus the measures discussed below make sense to the whalers, but some they accept as factors they cannot change but need to adapt to (weather, sea conditions, ice conditions, whale migration) and others (anthropogenic) to which the whalers mostly (in present conditions) need to adapt. In principle, the anthropogenic factors could be (and through "mitigation" or other management practices actually are) influenced or minimized, at least in terms of timing or where they take place (oil and gas activities, other vessel traffic). The CAA between the whalers and industry is the one mechanism for reducing the potential effects of such anthropogenic factors, as are lease stipulations and lease deferral areas. It may be the sense that these factors can be limited or controlled that makes the cases where they are occur, or mitigation measures fail, so salient to the whalers. The following discussions focus on specific measures, followed by a more general examination of variability in Cross Island whaling. Figure 12 illustrates some Cross Island activities.

Table 5: Selected Measures of Cross Island Whaling, 2001-2007

Metric		Season							
Measure	Type	2001	2002	2003	2004[9]	2005[9]	2006	2007	Average
Whales Taken/Whales Struck and Lost	count	3/0	4/1	4/0	3/0	1/0	4/0	3/1	3.1/0.3
Active Whaling Crews on Cross Island (maximum)	count	4	3	4	4	5	4	5	4.1
Active Whaling Crews on Cross Island (average/day)	average	3.8	2.5	2.8	2.6	4.1	4.0	4.0	3.3
Scouting Boats on Cross Island (maximum)	count	7	9	10	8	8	7	9	8.3
Cross Island Population (Maximum/average per day)	average	35/27.7	39/26.6	33/20.4	33/18.9	43/29.8	38/29.2	36/26	24.8
Length of Season[1]	count	24	23	19	30	27	21	13	22.4
Average Length of Season/Crew (days on Cross Island)	average	22.5	19.34	13.25	19.25	21	21	10.4	18.1
Weather Days	count	8-9	4	8	10	11-15	4	3	7.6
# days scouting[2]	count	12	15	7	12	9	10	5	10.0
# days whales seen[3]	count	9	9	7	6	7	8	4	7.1
Boats scouting/day	average	4.8	4.3	4.9	3.4	4.0	4.8	3.2	4.2
# boat days[4]	count	57	65	34	41	35	48	16	42.3
Boat days/whale	average	19	16.25	8.5	13.67	35	12.0	5.33	13.45
# boat trips (possible # of GPS tracks)[5]	count	59	67	42	46	48	53	22	48.1
Actual # of GPS tracks collected	count	49	52	37	44	48	51	20	43.0
Length of trip (miles)	average	84.0	64.3	37.2	45.3	60.7	60.8	30.1	58.5
Duration of trip (hours:minutes)	average	9:43	7:58	4:31	6:51	7:07	8:13	5:39	7:32
Furthest point from Cross Island (miles)	average	23.6	19.5	11.6	12.1	19.1	22.2	10.4	18.1
Strike distance from Cross Island (miles)[6]	average	19.5	13.4	9.3	9.7	25.9	17.0	12	13.9
Strike Direction from Cross Island –degrees[6,7]	average	64°	67°	56°	36°	82°	59°	80°	62
Boat Crew Size	average	3.9	3.6	2.9	3.6	4.4	4.3	4.2	3.9
Total Seasonal Boat Effort (Boat-Hours)[8]	sum	572.9	533.6	162.9	301.2	341.3	427.1	124.3	351.9
Boat Hours/Whale	average	191	133	41	100	341	107	42	112
Boat Hours/Strike (landed + struck and lost)	average	191.0	106.7	40.7	100.4	341.3	106.8	31.1	102.7

[1]Number of days with at least one whaling crew on Cross Island - includes day of arrival at and departure from Cross Island.
[2]Number of days when at least one boat went out scouting for whales
[3]Number of days when at least one whaling crew saw whales while scouting from a boat. Blows were seen from Cross Island on a few non-scouting days, but are not included in these totals.
[4]Each boat scouting for whales on any given day counts as one "boat day" – regardless of the duration of the trip or if whales are seen or not. *Thus if 2 boats scout on one day and 4 boats scout on the next, the total for the two days would be 6 boat days.
[5]Some boats made more than one scouting trip on a single day
[6]Includes "struck and lost" whales in 2002 and 2007
[7]Due north is 0 (and 360) degrees, due east is 90 degrees – includes struck and lost as well as landed strikes
[8]Yearly total equals aggregate sum of duration of all whaling trips by all boats. Includes estimates for missing information.
[9]One whaling crew went to Cross Island well before other crews, so total season measures may be somewhat misleading. See 2004 and 2005 Annual Reports.



Figure 12: Butchering Pictures from 2004.
Top from left to tight – Peeling *Muktuk*, Taking Intestines (after taking meat), *Muktuk* after being removed from whale.
Bottom from left to tight – bags of meat (still open to cool and prevent spoilage), Banded Boxes of Meat and *Muktik*, Closeup of a Box of *Muktuk*


Whales Landed in Relation to Quota

The most obvious indicator of whaling success is the number of whales taken. The quota for Nuiqsut during the project years has been four strikes per season. This is usually expressed as "four whales" not because the whalers expect to land four whales or take this for granted, but because each strike counts as a dead whale in the bowhead population model, whether it is landed or not. This suggests two other measures of degree of whaling success – the number of whales landed versus the total number that could have been landed, and the number of whales landed versus the number of whales "wasted" or "struck and lost." Nuiqsut whalers could have landed 28 whales for the years 2001-2007. They actually landed 22, or 79 percent. They had two struck and lost whales in this period, so they landed 22 of the 24 whales they struck, or 92 percent. Both represent high rates of success, and probably Kaktovik is the only other Alaskan whaling community that may match or surpass them.

For four of the seasons in the period 2001-2007, Nuiqsut whalers completed their quota of four whales – 2002, 2003, 2006, and 2007 (Table 5 above). In both 2003 and 2006 they landed four whales, with no struck and lost. In both 2002 and 2007 they had one struck and lost whale, and landed three whales in 2007 and four in 2002 (one strike was transferred from the AEWC "bank" of unused strikes). The first three whales landed in 2002 were fairly small, so that a fourth one was desired to ensure that community needs were satisfied. In 2007 the three whales landed were sufficiently large that a fourth whale was perceived as unnecessary and potentially wasteful. It is interesting to note that the four years when Nuiqsut whalers completed their quota are also the four shortest seasons in terms of number of days for the study period – 13, 19, 21, and 23 days. This compares to the "average" season over this period of 22.4 days, and the other three seasons of 24, 27, and 30 days. Not coincidentally, the four seasons when the Nuiqsut whalers completed their quota are also the four seasons with the fewest weather days – 3, 4, 4, and 8 (although one of the other three seasons had "only" 8 weather days as well).

Although Nuiqsut whalers state that three whales can be sufficient for the needs of the community, they clearly have a preference for landing four whales. The longest seasons documented by this project are those for which the quota was not completed, whether they were seasons when only three whales were landed (2004, 2001) or only one (2005). The median case of 2002 is interesting in this regard, as the whalers requested (and received) a fifth strike to use to land a fourth whale, as they had struck and lost an earlier whale. As will be discussed in the following section, Nuiqsut whalers stay out at Cross Island until they land sufficient whales for the village or until the conditions in their judgment become untenable for whaling.

As a measure of level of effort, the number of whales landed (or strikes used) does not appear to be a very useful measure. For all but one of the seasons discussed in this report, Nuiqsut whalers landed either three or four whales, and considered the seasons successful. The number of whales landed, combined with their size, is a measure of the ultimate success of any given season. The AWEC allocates a quota to each Alaskan whaling community based on that community's needs, based on a number of factors (Braund, Stoker, and Kruse 1988; Braund & Associates 1997, 2007), and fulfilling that quota is each community's goal for any given season. Nuiqsut whalers prefer to target whales 25 to 35 feet in length, but if the first three whales they land are larger

than this (as in 2007, for example) they may choose to forego trying to land a fourth. In other years Nuiqsut whalers may essentially run out of time before completing their quota, as in 2001, 2004, and 2005. In 2001 and 2004 they landed three whales, with no struck and lost, and felt that at least the basic needs of the community were fulfilled. In 2007, Nuiqsut whalers landed three whales and also had a struck and lost whales, but the three landed whales averaged near 40 feet each and were judged to more than fulfill the community's needs. In 2005, only one whale was landed due to very adverse weather and ice conditions, and possible disruption from a commercial barge, and the whalers were forced to end their season with only this limited harvest. The whalers considered 2005 a poor whaling season due to this limited harvest (results of the season), attributed by the whalers to the conditions of the season (weather, ice, vessel encounters). The whalers distinguish between conditions and results, however. Overall physical conditions were good for whaling in 2001 and 2002, but because of the distance of whales from Cross Island more effort was expended to land each whale in those years than in other years (2003, 2004, 2007) when physical conditions were poorer but whales were more plentiful and closer.

Timing and Length of Season

This section will begin with a general discussion of the timing and the length of the 2001-2007 Cross Island subsistence whaling seasons. It will conclude with a discussion of the effectiveness of "length of season" as a measure of level of effort or a characterization of the season as a whole.

As mentioned above, Nuiqsut whalers state that they usually go to Cross Island after Labor Day (the first Monday in September) and that ideally all whaling crews would travel together and on the same day. For the seven seasons documented by this project, this was never the case although the 2006 season came very close (Table 6). For most seasons (five of seven), the first whaling crew left for Cross Island alone. In one season two whaling crews left for Cross Island on the same day, and in another season three whaling crews left for Cross Island on the same day. In only one case did the first whaling crews actually leave for Cross island on Labor Day. On average, these "first whaling crews" left for Cross Island 6.4 days before Labor Day. One season was clearly anomalous in this regard (one whaling crew leaving for Cross island a full 21 days before Labor Day, but only being able to scout for whales five times before Labor Day, with no whales seen). Not counting this season, "first whaling crews" still left for Cross Island an average of 4 days before Labor Day. In five of the seven seasons whaling crews traveled to Cross Island on three different days, and on two different days for the other two seasons. On average, the "second whaling crews" left for Cross Island 1.7 days before Labor Day, and "third whaling crews" on Labor Day. The behavioral generalization would seem to be that whaling crews try to be at Cross Island by Labor Day, with variation due to the individual characteristics of the captains making the decision for each whaling crew. Labor Day is an accepted date because the temperature tends to be lower in September than in August, which is better for maintaining the quality of the butchered products. As the first Monday in September, at the start of the week, Labor Day seems to serve as a marker for the start of September – explicitly recognized by whalers when they say that they go out to Cross Island before Labor Day when Labor Day is "late."

Table 6: Timing and Duration of Cross Island Subsistence Whaling Seasons, 2001-2007								
Season	2001	2002	2003	2004	2005	2006	2007	Average
Date Labor Day (LD)	9/03	9/02	9/01	9/06	9/05	9/04	9/03	9/03
Date 1st Crews Out (FCO)	9/03	8/30	8/23	8/15	8/30	9/02	8/30	8/28
FCO-LD[1]	0	-3	-9	-21	-6	-2	-4	-6.4
Date 2nd Crews Out (SCO)	9/06	9/01	8/29	8/30	9/04	9/03	8/31	9/02
SCO-LD[1]	3	-1	-3	-6	-1	-1	-3	-1.7
Date 3rd Crews Out (TCO)	NA	9/05	8/31	9/04	9/05	NA	9/03	9/03
TCO-LD[1]	NA	3	-1	-2	0	NA	0	0
Length of Season (Days)	24	23	19	30[2]	27	21	13	22.4

[1]A negative number represents the number of days a date occurs before Labor Day. A positive number similarly represents the number of days a date occurs after Labor Day.
[2]Not included in this total are an additional 5 days when no one was present on Cross Island. The whaling crew that had gone out early returned to Nuiqsut to wait out a period when extremely bad weather was expected.

Examining whaling crew departure dates for Cross Island strictly in terms of calendar date (and not in relation to Labor Day), there is a clear trend for "first whaling crews" to arrive on Cross Island in late August (8/28), and for all whaling crews to have arrived by early September (9/03). During the seasons documented by the project, Labor Day occurred, on average, on 9/03. This is perhaps more support for Labor Day being used as a convenient, already labeled, reference point rather than as a definitive one – or perhaps its use as a date that applied to past whaling behavior and not as much to current behavior. As will be clear when the data on Nuiqsut whaling since 1973 are presented below, whaling occurred later in the year before 1993 than it does currently. Factors that may help account for such a change will be discussed at that time.

The whale migration, at least in the past, has also been fairly predictable in terms of timing to reach Cross Island on or about September 1, or Labor Day. Some captains are now of the view that the bowhead whale migration is starting earlier in the fall than before, and this may simply be another way of stating that they know bowhead whales are usually present in the Cross Island area in August (precisely when in August is their question). Since the small whales tend to migrate first and the whalers prefer the small whales, this is an incentive to some captains to leave for Cross Island some time in August, before Labor Day. Also, although whaling is a cooperative endeavor, some captains seek at least a temporary "competitive advantage" by being the first whaling crew out at Cross Island (and once on Cross Island, the first whaling crew to leave the island to go out scouting for the day). Other factors also influence the decision of when a whaling crew leaves for Cross Island – when the boat(s) and crew members are actually ready to leave, the other obligations (usually work or meetings of some sort) that the captain and crew members may have that may limit the span of time they can stay at Cross Island, and the perception that the weather after September 20 has increasingly become more unpredictable and poor for whaling. Most Nuiqsut whalers now seem to typically "budget" two weeks for whaling at Cross Island, although historically (from whalers' accounts) most seasons have been longer than that. Recent seasons exhibit a number of characteristics that support the conclusion that Nuiqsut whalers currently incorporate more time constraints (wage employment, travel and meeting obligations) into their whaling decisions than was required in the past (also discussed below).

The relationship between the date whaling crews first go out to Cross Island and the length of the season is not clear – except for the obvious that a later start implies a season with fewer possible days than does an earlier start. The longest season documented by the project was that with the earliest starting date, 8/15 in 2004. This was probably an experiment in response to the experience of the 2003 season. In 2003, the first whaling crew arrived on Cross Island on 8/23 (the second earliest during the project), with other whaling crews arriving 8/29 and 8/31. All whaling crews were on hand when the weather broke on 9/01 and conditions were good for whaling. The whalers completed the quota on 9/06, and left for Nuiqsut on 9/10 – a season of 19 days, the second shortest documented by the project. In 2004 a captain may have hoped to duplicate this but to avoid the first week of bad weather experienced in 2003 by going out even earlier than in 2003. Instead, this whaling crew encountered worse weather than in 2003 and saw no whales on the few days they were able to go boating. Once other whaling crews arrived on Cross Island (8/29, 9/04) two whales were quickly landed (9/05, 9/06) but conditions again deteriorated and even when boats could go out few or no whales were seen. A third whale was taken 9/14 and a decision was made to call an end to the season. If the first whaling crew had not gone out so early, this would have been a fairly "typical" season in terms of duration and other factors. All other seasons were very similar in terms of the date that the first whaling crew(s) left for Cross Island, ranging from 8/30 to 9/03. The duration of these seasons ranged from 13 days (the shortest documented by the project) to 27 days (the second longest documented by the project). Clearly many factors interact and influence the duration of a Cross Island whaling season, but the available "window of opportunity" when whales are present, temperatures are fairly cool, and weather and ice conditions are acceptable is fairly well delimited as late August through middle-to-late September. This is also a change from the documented historical past, as some whales were taken by subsistence whalers in the mid-Beaufort in October.

Table 7 presents measures on the whale strikes for each season that are consistent with and support these conclusions. The first whale of the season was struck during the five seasons with no unusual ice conditions no sooner that 8/31 and no later than 9/06. The first whale of the season was struck later in 2005 and 2006 because the whalers were prevented from reaching the whales by ice conditions that blocked them from boating beyond the barrier islands. As soon as they found a way through this ice to the whales in the open water beyond the ice, they were able to strike and land a whale (the only whale for 2005, the first of 4 for 2006). Ice conditions in 2005 and 2006 clearly made these years different from the other five documented by the project. The "average strike date" for 2005 and 2006 was September 15, whereas for the other five seasons the average strike date was September 8 (and September 10 for all seven seasons).

The last whale of the season was struck over a wider range of dates, from as early as 9/06 to as late as 9/22. As would be expected, the last whale of the season was struck earliest for the two shortest seasons documented by the project, and also the two seasons when whales were arguably closest to Cross Island (discussion of Table 8 below). Whalers reported that whales were close to Cross Island in both these years. All seasons ended either a few days after the quota was filled (to allow for butchering and packing) or if the quota had not yet been filled, when the whaling captains determined that conditions were such that it was not wise to remain at Cross Island any longer (freeze-up imminent or weather inclement). Of the project seasons, only in 2001 was the day the last whale was struck for that season after the average day for the end of the season for all seven seasons. 2001 was also the season with the latest ending date.

Table 7: Cross Island Strikes, 2001-2007 – Selected Measures by Year								
Season	2001	2002	2003	2004	2005	2006	2007	Average
Average Distance	19.5	13.4	9.3	9.7	25.9	16.8	12.0	13.9
Average Bearing	64	67	56	36	82	59	80	62
Date 1st Strike	5-Sep	5-Sep	1-Sep	5-Sep	14-Sep	13-Sep	31-Aug	6-Sep
Date Last Strike	22-Sep	15-Sep	6-Sep	14-Sep	14-Sep	18-Sep	7-Sep	14-Sep
End of Season	26-Sep	21-Sep	10-Sep	18-Sep	25-Sep	22-Sep	11-Sep	19-Sep
Date Average Strike	13-Sep	10-Sep	5-Sep	9-Sep	14-Sep	15-Sep	5-Sep	10-Sep
Note: "Average Strike Date" (ASD) must be an integer value. For example, the computed ASD for 2001 of September 12.333 is a calendar date of September 13.								

Table 8 lists some measures that one might expect to influence or be related to the duration of Cross Island whaling seasons – mainly weather conditions (number of "weather days") and measures of the relative number and distance of whales in the proximity of Cross Island. Missing from this table is a quantitative measure of ice conditions. Ice as a factor will be discussed in a later section in qualitative terms, because ice was a factor mainly due to its absence. "Weather days" is a label mainly for days when the wind was too strong for the boats to go out looking for whales. In the absence of ice, any wind over 10 miles per hour (mph) can create sea conditions making seeing and striking a whale, and then towing it to Cross island, difficult. The presence of the edge of the shelf ice dampens the height of waves and swells created by wind. Nuiqsut whalers will go out scouting for whales when winds are over 10 mph and there is little or no ice, but such conditions are marginal and whalers scout in such conditions only when prospects for improved conditions are slight. Floating ice floes may have been a factor in 2001, and local ice conditions were certainly a factor in 2005 and 2006, but this discussion will be deferred to the qualitative discussion of ice below.

Of course Nuiqsut whalers observations of whales near Cross Island represent are only representative of the area where they are actually looking for whales, and are by no means a measure of the total bowhead population or of the migration route in general. The whalers report

Table 8: Measures Related to Weather and Whale Distribution, Cross Island 2001-2007								
Season	2001	2002	2003	2004	2005	2006	2007	Average
Duration (days)	24	23	19	30[1]	27	21	13	22.4
# Weather Days	8	4	8	13[1]	13	4	3	7.5
# Days Scouting	12	15	7	12	9	10	5	10.0
# Days Whales Seen	9	9	7	6	7	8	4	7.1
Av Length of Trip (miles)	83.9	64.3	37.2	45.3	60.7	60.8	30.1	58.5
Duration of Trip (Hr:Min)	9:43	7:58	4:31	6:51	7:07	8:13	5:57	7:32
Av Farthest Point from Cross Island (miles)	23.6	19.5	11.6	12.1	19.1	22.3	10.4	18.1
Average Strike Distance from Cross Island (miles)	19.5	13.4	9.3	9.7	25.9	17.0	12.0	13.9
[1]Not included in this total are an additional 5 days when no one was present on Cross Island. The whaling crew that had gone out early returned to Nuiqsut to wait out a period when extremely bad weather was expected.								

that prior to oil and gas development the whale migration passed close to Cross Island and even inside of the barrier islands sometimes. They no longer see many whales inside the barrier islands (but do see some – see the maps of GPS waypoints in the sections below) and note that some years whales are closer to Cross Island than they are in other years.

The number of "Weather Days" – days when all Nuiqsut whaling captains decided that conditions were not suitable to go out whaling – have an obvious relationship to the total length of a whaling season. They are only one factor, and not the entire story, however. While the longer duration seasons tend to have had more weather days, seasons with relatively few weather days (3-4) ranged in duration from 13 to 23 days. Overall conditions may be good for scouting, but whales may not be present. Whales could be present, but in low numbers and/or at relatively great distances so that they are relatively hard to find. The whales that are seen could be behaving in ways that make them difficult to follow and approach. Thus, season length can be expected to be quite and dependent on a number of factors, of which weather is only one.

The number of "Scouting Days" (days when the whalers go out looking for whales) is also clearly related to the duration of the season, and is not independent of "weather days." The normative expectation, as reported by whaling captains and experienced whaling crew members, is to take one whale on any given day that boats go out scouting, although in recent years two whales are not uncommonly landed at Cross Island on the same day. Thus, the minimum number of scouting days expected for a Cross Island season would be 2-4. Any number over 4 represents an extension over the ideal "shortest season". The number of scouting days does seem to correspond well with the duration of the overall season. The shortest season (2007, lasting 13 days) had 5 scouting days and 3 weather days. The next shortest season (2003, lasting 19 days) had 7 scouting days and 8 weather days. Both of these seasons had a high percentage of scouting days on which whales were actually seen (80 percent for 2007, 100 percent for 2003). The difference between the two seasons seems to be relatable to weather. The three seasons ranging from 21 to 24 days in duration (2001, 2002, 2006) had far more scouting days than the shortest two seasons, ranging from 10 to 15. Two of these seasons (2002 and 2006) had relatively few weather days while 2001 had a relatively high number of weather days. Whales were seen on only 60 percent of scouting days in 2002, and on 75 and 80 percent of such days in 2001 and 2006. The two longest seasons (2004, 2005 of 30 and 27 days in duration) had 12 and 9 scouting days, but whalers actually saw whales on only 50 and 78 percent of those days, respectively. Furthermore, each had 13 weather days. Seasons differ in the number of days on which whalers saw whales but were not able to strike one, from 1 in 2007 (the shortest season) to 6 for 2001 and 2005, one a long season but the other close to "average" in length. The longest season, 2004, had only 3 days when whales were seen that a strike was not made, but only had 6 total scouting days and 10 weather days. There are two or three factors that would seem to contribute to this sort of variation. A larger number of days when whalers go out looking for whales but do not report seeing any may be due to the relative local scarcity of whales, scouting in conditions marginal for seeing whales, or a combination of the two, for that season. A larger number of days when whales are seen but a strike is not made may be due to more difficulty in following or approaching whales for that season than for seasons with fewer such days, and could be due to weather and ice conditions, "skittish" whale behavior, or a combination of the two. An estimate of the overall "skittish" behavior of whales is difficult if not impossible to quantify, but whalers

made many more comments about skittish whale behavior in 2001 than for any other season, and also commonly remarked on such behavior in 2002.

The measures related to the distance whales were found from Cross island generally support the discussion above – although the 2005 season has some unique characteristics that must be taken into account. "Average Length of Trip" and "Average Farthest point from Cross Island" seem to be the better measures of the distance of whales from Cross island for a specific whaling season. Whalers in general do not travel further from Cross Island to find whales than necessary for a number of stated reasons. One is the often cited "principle of least effort" but at least equally as importantly is a concern with safety. Whalers constantly remind less experienced whalers (and the researcher) that the weather is very changeable and that the further from Cross Island that boats travel, the more danger they are in if conditions change and the more difficult towing a whale would be. Resources at Cross Island are also finite (fuel, food, water) and whalers have made an explicit effort in recent years to whale efficiently. There has been an increased willingness on the part of Nuiqsut whalers to land more than one whale on the same day, or multiple whales on successive days, than in the past. Good whaling conditions cannot be assumed for the future, so the most is made of current conditions when they are favorable. "Average Duration of Trip" is affected by the time required for tows (for 2007 in particular) as well as by the average speed during the other parts of the trip (some trips are almost all at "scouting speed" while others have significant periods of high speed travel). "Average Strike Distance from Cross Island" is generally not as reliable a measure since it is an average of only 3 to 5 (or in the case of 2005 only 1) boat trip versus all boat trips for the year for the first two measures discussed above.

Comparing each of the seasonal average values to the overall average value for these first two measures (58.5 miles for the average boat trip, 18.1 miles as the farthest point from Cross Island) seem to indicate that whales were closer to Cross Island in 2007 than in previous years – which supports the common observations made by the whalers in 2007 that the whales were closer to Cross Island than in previous years. The average strike made in 2007 was further out than for two other season (2003 and 2004), at 12.0 miles, however, which indicates that there were a number of shorter scouting trips in 2007. 2003 had an average boat trip of 37.2 miles and an average farthest point of 11.6 miles, with the average strike at 9.3 miles from Cross Island. 2004 had an average boat trip of 45.3 miles and an average farthest point of 12.1 miles, with an average strike distance of 9.7 miles. Both were years when weather conditions were quite poor. Whales were relatively difficult to spot and follow, but more so in 2004 than in 2003. Whales were seen on all scouting days in 2003, but only on 50 percent of scouting days in 2004. 2004 would have been about the same in terms of measures as 2003 if the first part of the season, when only one whaling crew was out at Cross Island from 8/15-8/19 and then back in Nuiqsut for 8/20-8/24 were excluded.

The 2002, 2005, and 2006 seasons are all similar in terms of average mileage of boat trip and average farthest point reached from Cross Island, ranging from 60.7 to 64.3 miles for the first and 19.1 to 22.3 miles for the second. The three seasons were quite different, however, or at least each had a different distribution of whales and other factors they had to deal with. The difference in "Average Strike Distance from Cross Island" values for the three seasons reflect these differences. In 2002 whalers reported that the whales were closer than they had been in 2001, but

still farther out than "normal." There were also far fewer whales than the whalers expected to see. Whalers only saw whales on 60 percent of the days they went out scouting. Whales were sparse and somewhat skittish (but again, not as much as in 2001). Thus in 2002 whalers had to cover a relatively big area and long distance to find whales, but when they did find them they were relatively close to Cross Island. The average strike in 2002 was 13.4 miles from Cross Island. In 2006 whales were somewhat easier to find, but also somewhat farther from Cross Island and the average strike distance was 17.0 miles. In 2005 localized ice conditions – packed floating ice against the north side of Cross Island – made it impossible for the whalers to travel beyond the barrier islands except for two days. On one of these days sea state conditions made it hazardous to boat into open water beyond the ice. On the other day, whales were seen and one was landed, but the whalers also encountered a tug and barge that they believe hindered their hunt (discussed below). When the whalers were confined within the barrier islands, they were limited in where they could travel. The one whale they struck and landed, at 25.9 miles, was understandably well beyond the average trip they made in 2005. The whaling crew that took this whale did so because it might have been their only chance to take a whale. Other whaling crews, thinking that this area was too far from Cross Island, had returned to the island before this whale was struck. These whaling crews then scouted to the NW of Cross Island and found whales at a closer distance – but only after the whale had already been struck to the east. The senior Nuiqsut whaling captains did not want to risk striking two whales on the same day, given the distances and ice conditions involved for the first whale.

2001 was the year for which average trip distance was greatest (83.9 miles) and boats on the average went farthest from Cross island (23.6 miles). The average strike was also the farthest from Cross Island than for all other years except 2005 (when only one whale was taken) at 19.5 miles. This reflects the whalers reports that 2001 was the year when whales were farthest from Cross island, were difficult to find because there were not many of them, and hard to approach because they were skittish and already traveling fast before the whalers saw them

In final summary, weather is one determinant of season length, but whalers are patient enough to wait for opportunistic "breaks" when they can go out looking for whales. Whalers cannot control the weather, but in most seasons they can expect at least a minimal number of days suitable for whaling. When those days occur, seasons during which whales are more numerous and/or closer to Cross Island tend to result in shorter seasons than when whales are fewer and/or farther away. If there is a second complicating factor, such as the ice conditions of 2005 (and the first half of 2006) that limited where the whalers (and other maritime traffic) could go, seasons are likely to be of longer duration and the chances of success are greatly diminished. The length of the season, in terms of days, is not really an estimate of the level of effort required to land however whales were taken for that season, but only the length of time that Nuiqsut whalers had to spend at Cross Island that year. The next section considers some other gross measures of Cross Island whaling activities that also may reflect more the relatively remote location of Cross Island as a whaling site from Nuiqsut than the actual level of effort required to land whales there in any one specific season. The section discussing Effort Per Unit Catch, following the next section, attempts to define a measure that is comparable for all whaling communities, and essentially defines "whaling effort" as the time spent on the water looking for and landing whales – from the time a boat leaves shore until the whale is hauled out of the water. While this measure also has deficiencies and could be improved, it seems to serve the purpose of providing a rough measure

to compare the seven seasons documented by this project, and potentially for other whaling communities as well, should comparable information be available for those communities.

GPS Information

In terms of GPS locational information, all whaling crews agreed to carry and use GPS units. The level of information obtained has varied from boat to boat, as discussed above, but for most boats and for all whaling crews at least partial tracking information (where most boats went each day) was obtained, along with the locations where whales were observed (or struck), from the start of the project. The quality of GPS information collected since the 2002 season is actually quite high (Table 2 above). Examples of GPS tracks for individual boats on a single day have been presented above (Figures 11 above) and complete tracks for all seasons are available in the appendices to the annual reports, which are attached to this report as digital appendices.

All electronic track files have been transferred to MMS and the Native Village of Nuiqsut. These electronic tracks are in several forms. As originally collected, the tracks must be viewed with Garmin's proprietary software "MapSource" ("mps" format for 2001-2003, "gdb" format for 2004-2007). For all intents and purposes, these files have been cleaned to such an extent that they are all now in "gdb" format. For the first years of the project these MapSource tracks were exported as "DXF" files so that the cartography department of BPXA could import them into their system and produce better quality figures. Since then ASR has acquired some in-house GIS capability and has produced all the figures of these reports using Manifold. Until this report, all prior documents had used the "Location" graphic supplied by BPXA. With this document, this has finally been replaced with a newer Figure 6. All track and waypoint information is available from MMS in either MPS (MapSource) or Shapefile format (as exported from Manifold).

Four main figures will be used for the following discussion of the GPS data collected for this project. The first displays some historic strike location information. The second displays all boat tracks collected for all seven years, color-coded by year. The third displays all strike locations for the seven seasons, color-coded by year and the last displays all whale sighting location information collected for the seven seasons, also color-coded by year.

Figure 13 displays the locations of the 10 whales landed and the 4 whales struck-and-lost by Nuiqsut whalers during 1986-1992. It does not display the locations of the first two whales landed by Nuiqsut whalers, in 1973 and 1982. The first was struck near Flaxman Island, within the barrier islands. The location of the second has not been specified. The information in Figure 13 has previously been published (Long 1996). The locations for the 23 whales landed by Nuiqsut whalers during 1993-2000 may be known to the NSB and AEWC, but permission to publish that information has not been obtained. The locations of whales struck by Nuiqsut whalers during 2001-2007, as documented by this project, are discussed below. Figure 13 is included primarily for historical purposes and to highlight two main points. First, the quadrant NE of Cross Island is where these strikes are concentrated, and those strikes not within this quadrant are either just south or just west of this quadrant. Second, 9 strikes occurred within 20 miles of Cross Island, of which only 1 was struck-and-lost. Of the 5 strikes beyond 20 miles, 3 were struck-and-lost. At least one of these was struck in good conditions, but was cut loose

during the tow when conditions changed and the tow could not be continued safely. The whalers attributed this at least in part to the distance of the strike from Cross Island – and said that a whale struck closer to Cross Island on that day might have been landed at Cross Island.

Figure 14 displays all the GPS tracks collected for all the whaling boats for all years, coded by year. This comparison readily shows the variability from year-to-year. The relatively "normal" years in terms of distance traveled from Cross Island and direction of travel were 2003 (yellow), 2004 (blue), and 2007 (white). Whalers reported that in a "normal" year whales could be found within 15 to 20 miles of Cross Island, and that they generally searched for whales in the quadrant NE of Cross Island. The patterns for these three years generally meet these conditions. All were years when there was little or no ice.

The tracks patterns for 2001 (purple) and 2002 (maroon) are essentially the three "normal" years except that the tracks extend farther from Cross Island, especially for 2001. Whalers reported that the whales were the farthest from Cross Island in 2001 than they had been in quite a while, and the measures reported in this document bear them out. Whales were not quite as far from Cross Island in 2002 as in 2001, but were still farther from Cross Island than in any year documented for the project other than 2001. In both 2001 and 2002 the whalers indicated that the whales were not behaving in a normal manner, but were "spooky" – traveling fast, difficult to approach, and few in number. Both 2001 and 2000 were relatively ice free, although there was more floating ice in these two years than in 2003, 2004, and 2007. Scouting effort for these years was also concentrated in the quadrant NE of Cross Island.

Ice posed severe constraint to whaling in 2005 (green), but was a localized pack of floating ice jammed against the north shore of the barrier islands. The ice shelf itself was located relatively far offshore. The whalers could not find a way through this jammed floating ice for most of the 2005 season. Winds were also relatively high on most days, which also contributed to limiting scouting activity to inside of the barrier islands. This explains the pattern of mostly SE and NW tracks within the barrier islands. Relatively few whales were seen on these scouting trips, and whales within the ice were impossible to approach. One whale was landed on one of the two days when boats could find a way through the ice to open water beyond the barrier islands. The whalers also encountered a commercial barge on this same day, which may have contributed to their only being able to land one whale on this day. On the only other day when whalers were able to penetrate through the ice to open water, high swells prevented their being able to safely travel beyond the ice, and made spotting whales (let alone following and striking them) very difficult in any event. These two days account for all 2005 tracks beyond the barrier islands. 2005 was the first year documented by the project during which the whalers traveled west of Cross Island to any extent, mainly because the ice prevented them from going NE.

The first half of the 2006 (red) season duplicated the conditions of 2005, and the NW to SE pattern of tracks within the barrier island is even more evident than in 2005. When ice conditions moderated during the second half of the 2006 season, the track patterns are similar to those of a "normal" season except that the tracks extend slightly farther from Cross Island, and a few tracks stray somewhat west of the quadrant NE of Cross Island. The whalers were able to land their full quota of whales in 2006. Of the seasons discussed in this report, Nuiqsut whalers did not fill their quota in 2001, 2004, and 2005. In 2001 the whales were relatively distant from Cross Island and

Figure 13: Historic Bowhead Whale Strike Locations in the Cross Island/Prudhoe Bay Area (through 1992)

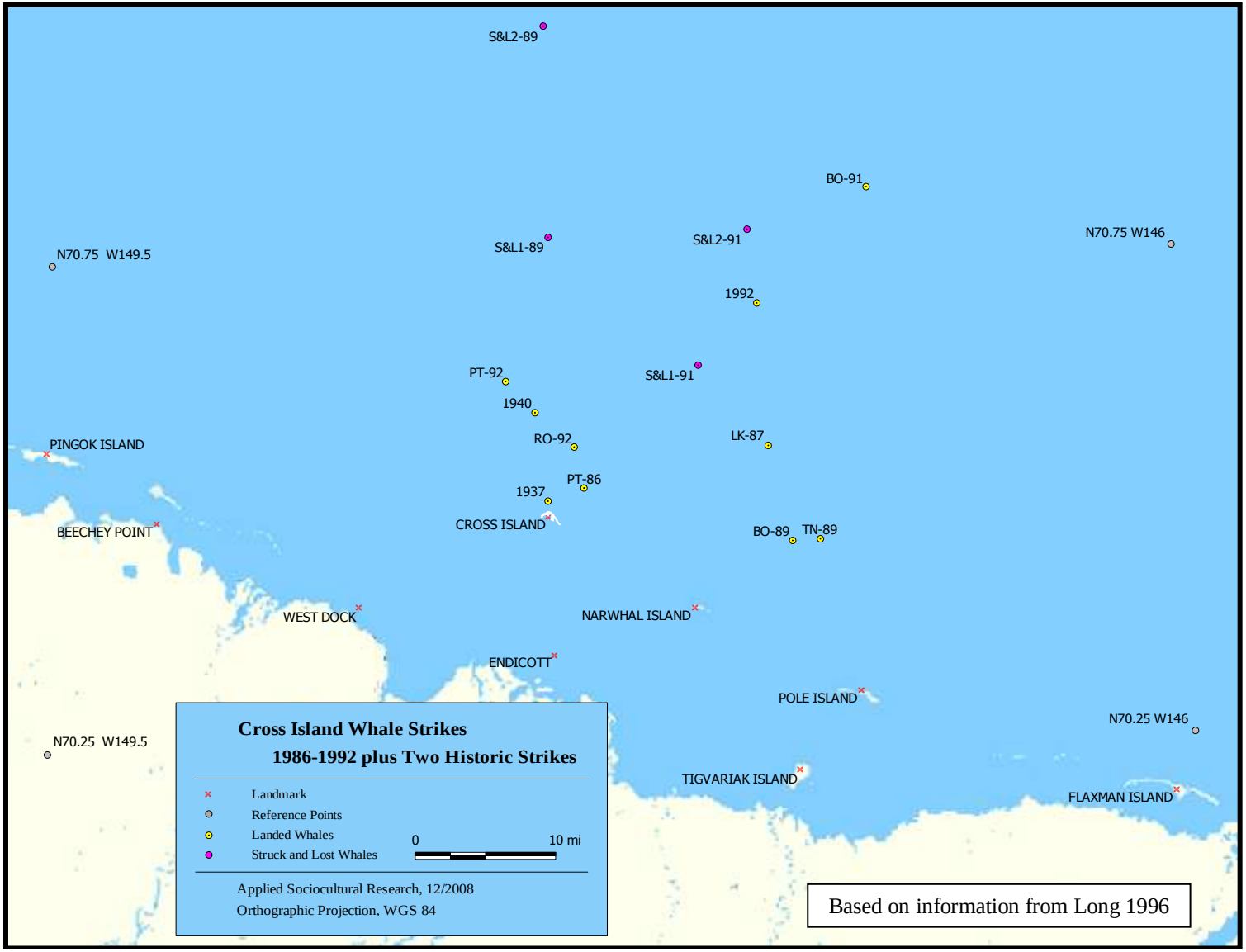
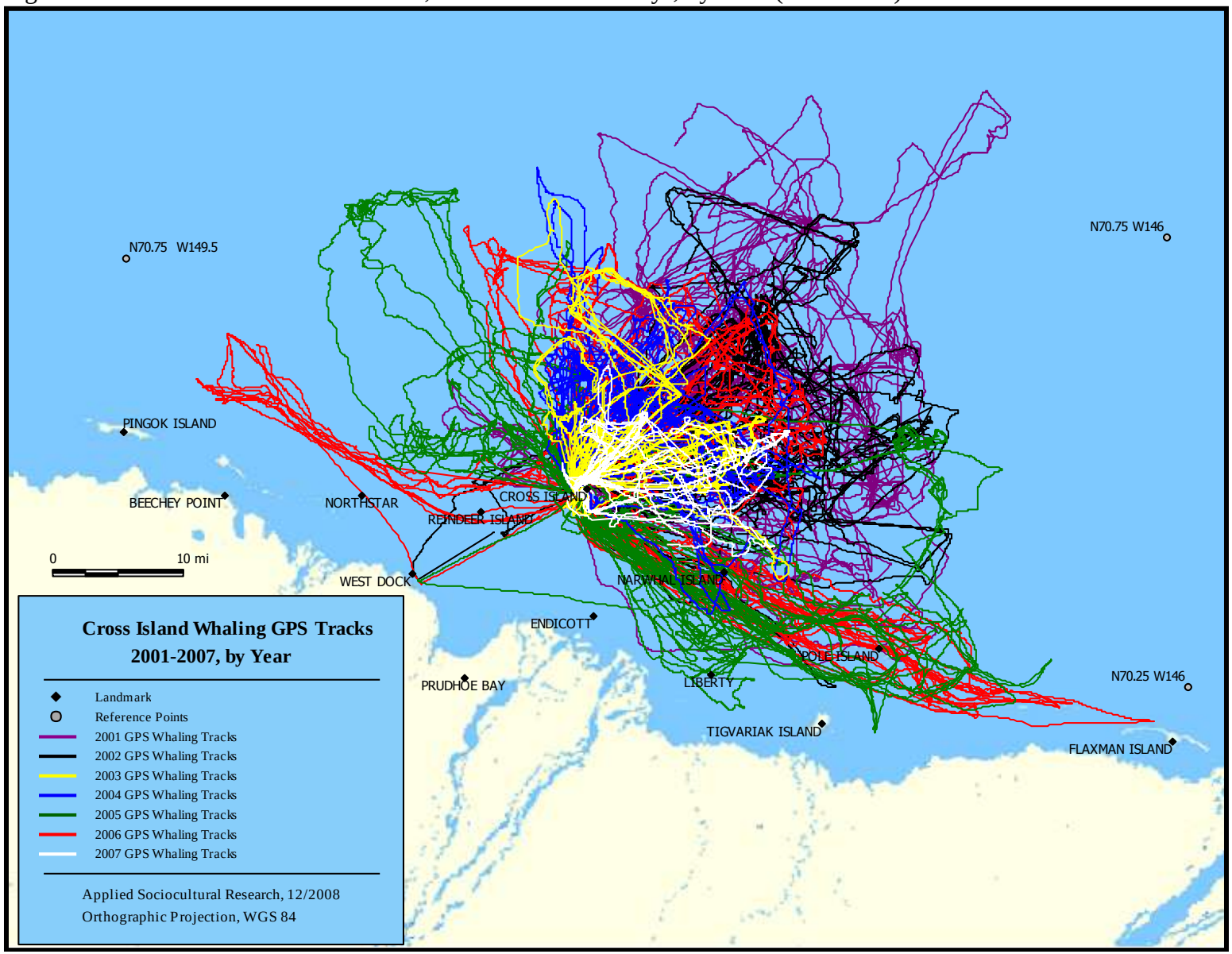


Figure 14: Cross Island GPS Boat Tracks, All Boats and All Days, by Year (2001-2007)



not very locally abundant, and the whalers essentially ran out of time and landed "only" three of their quota of four. In 2004 the whales were relatively close to Cross Island, but poor weather restricted whaling activities and the whalers again ran out of time. In 2005 ice and weather conditions allowed the whalers only two days of potential scouting beyond the barrier islands before time ran out on their season (potential feezeup) and they landed only one whale. In six of the seven years, Nuiqsut whalers landed either three or their full quota of four whales.

Figure 15, displaying the whale sighting points for all years, demonstrates several main points, and then some comparative points of one year versus another. First, whales were seen where the whalers went and looked for them. Whales could very well have been where the whalers did not go, but the whalers were not there to see them. Second, the number of points for any given year roughly reflects the whalers' assessments of the numbers of whales they saw, but can be taken only as a minimum number of whales seen. As discussed in the methodology section, not all whales seen by the whalers were marked, and some points represent more than one whale. Third, there tended to be one or two days for each season (other than 2001 and 2002) when whale sightings were much more frequent than on other days. These sightings tend to form clusters (even though duplicate sightings have been eliminated as far as possible). Fourth, whale sightings are concentrated in the quadrant NE of Cross Island, where they search for whales most frequently and where the tracks are concentrated, but sightings are also located NW and SE of Cross Island, with some inside of the barrier islands.

Discussing the whale sighting points in comparative terms can only be done in a qualitative and speculative way, since the points do not represent all the whales seen for any given year, and may represent a different percentage or sample of the whales seen for year. With that understanding, the points were collected with the same methodology and from many of the same observers from year-to-year, so that they are at least in some sense comparable.

It does appear that the whale sighting points for the "normal" years of 2007, 2003, and 2004 are closer to Cross Island than form the other years. This does not mean that for those three years that whales were not also present in the locations noted for other years of the project, since for the three years in question the whalers did not go out that far. It does indicate that for the other years of the project, not as many whales were seen close to Cross Island as for these three years, even though whalers had to traverse those waters closer to Cross Island on their way to the locations where they did note seeing whales.

Note that there are some whale sightings relatively close to Cross Island for both 2002 and 2001, but that most whale sighting points for those years are farther out (and especially for 2001). Once ice conditions moderated in 2006, whales were located somewhat farther out than during the three "normal" years. The whales seen on the two days when whalers were able to travel beyond the ice (and the barrier islands) in 2005 were also located at this general distance, both to the NW and NE of Cross Island. Comparing the 2005 and 2006 whale sighting points, it is interesting that far more whales were reported along and within the barrier islands in 2005 than in 2006, although there was far more searching effort in this area in 2006 than in 2005.

Figure 16 displays the strike locations for each of the seasons, coded by year. Nearly all strikes were within the quadrant NE of Cross Island, with the only exceptions being those slightly south of this quadrant. The average strike distance for all strikes for all years was 13.9 miles from Cross Island – which corresponds with the whalers' reports that for most years they land whales 10 to 15 miles from Cross Island, and that in "good" years they find and land whales within 10 miles of Cross Island. The years with the closest average strikes were, as might be expected, the three "normal" years of 2003, 2004, and 2007 – although strikes in 2003 and 2004 were significantly closer to Cross Island (9.3 and 9.7 miles) than those in 2007 (12.0 miles). The atypical season of 2005, when only one whale was landed, and the 2007 season were the only seasons for which the average strike distance for the season was greater than the average greatest distance away from Cross Island reached on all whaling trips. For 2005 this reflects that only one struck was made, relatively far from Cross Island. For 2007 it probably reflects the generally poor weather encountered for most of the season and the inability to follow and strike whales except on days with somewhat better conditions, when whalers were able to travel a bit farther from Cross Island. On the other hand, weather was also poor for the 2003 and 2004 seasons, so there were probably some idiosyncratic or chance factors in play as well. The average strike distance for 2002 was also less than the average for all seasons, at 13.4 miles from Cross Island.

The three seasons for which the average strike distance was greater than the average for all seasons all had some characteristics that set them apart from the other seasons. Ice restricted where the whalers could go for most of the 2005 season, and the one strike was made when they finally could get beyond the ice, nearly 26 miles from Cross Island. According to many Nuiqsut whalers, this is near the limit where a prudent Cross Island whaler will make a strike (25 to 30 miles), since beyond this range the tow becomes too long. The average tow speed under even ideal conditions is 3 to 4 miles per hour, and sea and weather conditions can change too quickly to willingly risk many long tows. In 2005, much of the tow could take place with the protection of floating ice, which dampens the effect of wind and sea state, but can present its own problems for towing a whale. In any event, in 2005 whalers could not reach whales any closer than about 26 miles from Cross Island. In 2001, the whalers reported that most whales they saw were farther from Cross Island than "normal," were traveling at a greater speed than usual, and seemed "skittish" or behavioral disturbed even before they encountered the whalers' boats. The measures of the 2001 season bear this out, as the whalers' trips for 2001 were the longest both in terms of distance and time duration of all the season documented. The average strike distance for 2001 was 19.5 miles from Cross Island. The 2006 season started out as did the 2005 season. Floating pack ice jammed against the north shore of the barrier island and prevented the whalers from reaching open water beyond the barrier islands for the first half of the season. Ice conditions moderated for the second half of the 2006 season, but whales were encountered and struck at greater distances from Cross Island than the 2002-2004 and 2007 seasons. Whether this was a residual effect of the ice conditions of the first half of the season or due to other factors was not clear. As discussed above, the whalers reported seeing whales at about the same distance from Cross Island in both 2005 and 2006, once they could travel outside the barrier islands.

Figure 15: Cross Island Whale Sighting Locations, by Year (2001-2007)

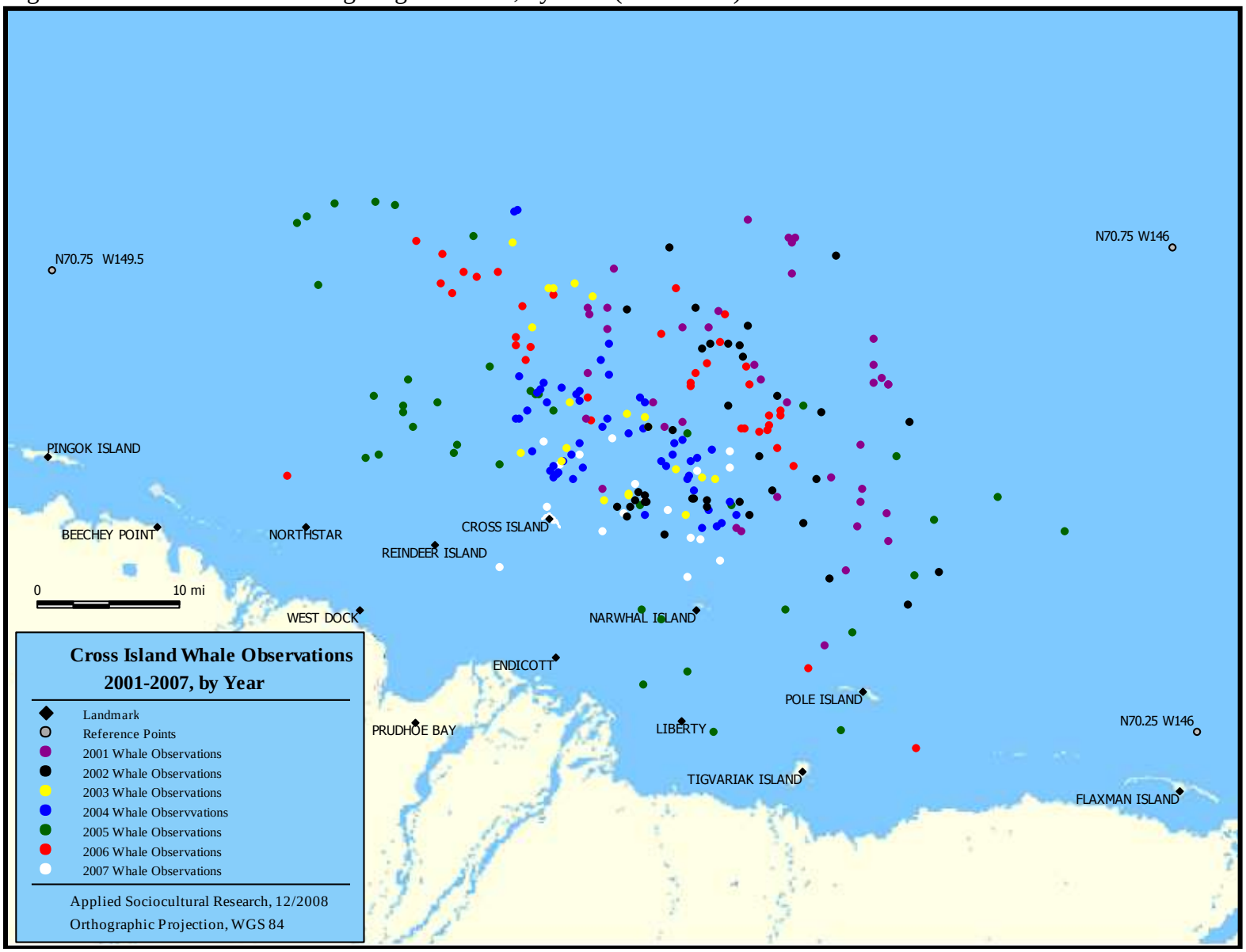
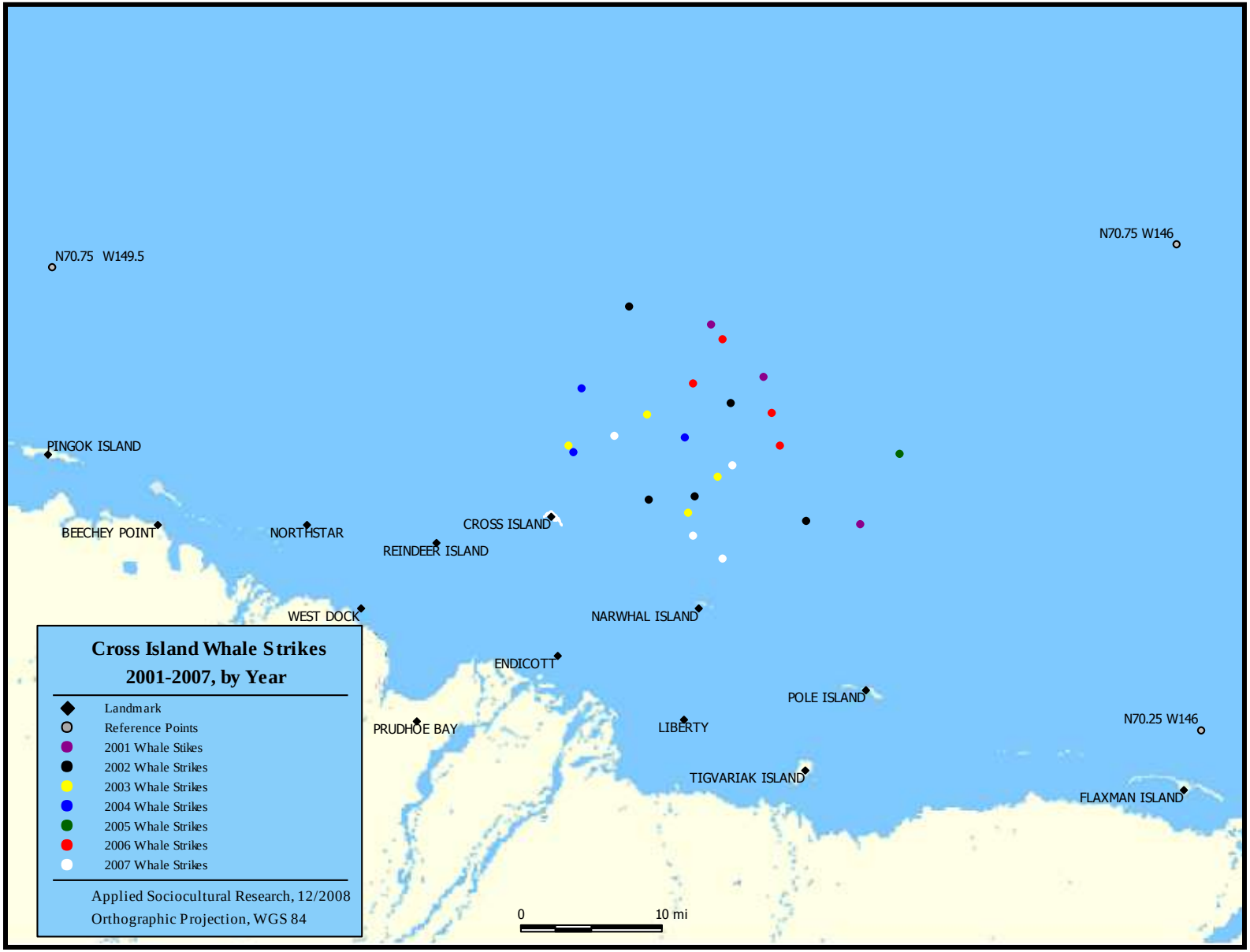


Figure 16: Cross Island Whale Strike Locations, by Year (2001-2007)



The next seven figures are graphical summaries of key characteristics for each of the Cross Island subsistence whaling seasons documented by this report, 2001-2007. Each figure presents the information for one season. The factors that influence the success and length of a Cross Island subsistence whaling season, and how they interact, may perhaps be best understood by explaining and discussing each in turn. The X-axis for each diagram represents the length of the Cross Island whaling season for the year in question, with units of 1 calendar day. Since seasons differed in length as well as starting and ending dates, the scales for the figures are not the same. The starting date of the whaling season was defined as the date that the first whaling crew arrived at Cross Island, and the ending date was the date the last whaling crew left Cross Island. The Y-axis for each figure is used to display two scales. The one on the right side of each figure denotes wind speed in miles per hour, while the left scale denotes barometric pressure in inches of mercury. Six sorts of data are plotted on each figure, except for 2001 which only has four data series plotted since there was no weather station at Cross Island in 2001:

1) Wind speed from the Deadhorse weather station (average hourly values) – in blue
2) Wind speed from the Cross Island weather station (readings every 4 minutes) – in teal
3) Barometric pressure from the Deadhorse weather station – in black
4) Barometric pressure from the Cross Island weather station – in light purple
5) Periods when Cross Island whalers were out on the water whaling, from when the first whaling crew left the island on a given day until the last whaling crew returned for the day, plotted at the value of the average wind speed for that period of time as measured by the Cross Island weather station (or if that information was lacking, the Deadhorse weather station) – in red.
6) Whale strikes, plotted at the time of the strike and the wind speed at the time of the strike, as measured by the Cross Island weather station (or in its absence, the Deadhorse weather station) – yellow triangles.

The plotted information does not provide a complete description of each season, but provides the most essential information – the length of the season, when whalers were out whaling, the time and date of strikes, and wind speed and barometric pressure when whaling could take place and when it could not. Wind direction and temperature information are also available and are included in the data appendices provided electronically for each annual report, but are not plotted as they did not seem to have much explanatory power.

The approximate nature of the time and location that whale strikes occur has been noted above. They are not precise in terms of exact time and place, but are quite close approximations based on the best reconciliation of various sorts of information – Communication Center log records of whaler reports, field notes of radio communications, and whaler GPS information. The available weather information is also only a proxy for the weather as experienced by the whalers. Wind speeds at Cross Island and Deadhorse tend to correspond with each other, especially in terms of overall patterns of increase and decrease, but as the figures show, can also often greatly diverge at times. Similarly, wind speed as experienced “on-the-water” by the whalers can differ from either of these time series records, although the whalers report that the wind speed at Cross Island does tend to correspond with what they experience while whaling. While they are out whaling they are careful to monitor the wind speed at Cross Island, however, as changes (and especially wind increases) that take place there and are not evident further offshore where they are whaling can signal sudden changes that indicate they should think about returning to the

island. Barometric pressure for the two weather stations tended to correspond well, but the Deadhorse data covered a much longer part of each season. In the interests of clearer figures, the Cross Island barometric pressure data is plotted in a light color so that it can be compared with the Deadhorse information without cluttering up the display of the other information. Increasing barometric pressure was usually associated with reduced wind speed, and vice versa, but not always. Since winds could be calm for a period of hours for any large change in pressure or weather system, whalers would sometimes whale during a period of decreasing barometric pressure, knowing that they would have a short period of good scouting conditions before facing a likely longer period when they could not go scouting.

In 2001 (Figure 17), the first whaling crews arrived on Cross Island on September 3 during a period of low winds, but wind speed increased and prevented any scouting for whales until the middle of September 5. This allowed the two whaling crews on Cross Island to land the first whale of the season on September 5 in moderate winds (about 8 miles per hour). The two other whaling crews traveled to Cross Island on September 6 as winds continued to be moderate at 10-15 mph. The whaling crew that had landed the whale the previous day stayed in to butcher, but the other crew already on Cross Island sent one of their two boats out to scout for whales while the rest of their crew stayed on the island to help butcher. On September 7, winds were moderate and remained so through September 10, below 15 mph for the most part, with barometric pressure peaking about September 9 and only starting to decrease sharply around September 11. All whaling crews went out scouting on all days from September 7-10 and a whale was landed on September 10, during a period when wind speeds were low (5 or 6 mph). All whaling crews stayed in to butcher the next two days, during a period of decreasing barometric pressure and fluctuating winds. All whaling crews went out scouting on September 13, as butchering had been completed and winds were moderate, although increasing. Two whaling crews each sent one boat out scouting the next day, but most captains chose to stay onshore, thinking that winds would increase still more. Instead, winds calmed late in the day and the barometric pressure was rising, so all whaling crews sent boats out scouting on September 15. Winds increased, however, and the boats experienced rough seas, so most came in after relatively short trips. All boats stayed onshore the next three days as winds remained above 15 mph for the most part, and peaked at just under 30 mph. Winds decreased on September 19 and two whaling crews sent boats out scouting, and all whaling crews sent boats out on September 20. On both these days conditions were not good for whaling, however, perhaps because of standing swells remaining from the past windy period. Winds peaked over 30 mph September 21 and all boat stayed onshore. On September 22 winds were less (below 10 mph, even though barometric pressure was decreasing) and all whaling crews sent out boats and a third whale was landed. All boats stayed onshore to butcher the next day (when it was windy in any event) and it remained windy (close to 25 mph) for September 24-25. With three whales landed and fully processed, and the prospects of deteriorating weather and possible feezeup, the whalers called an end to their season and reserved their last strike for a future season. They left for Nuiqsut on September 26, on a day with calm winds and had an uneventful and easy trip back to Nuiqsut.

One of the reasons this season was longer than average, even though the weather was not notably bad, was that the whale migration was relatively far from Cross Island, and the whales were difficult to find and approach. The whalers used only three of their four strikes in 2001, but went scouting on 12 different days. They saw no whales on three of these days. The whalers stated

that there seemed to be fewer whales in the area, and those that were there were farther from Cross Island than "normal" and were swimming faster and acted in a "skittish" manner. The further from Cross Island the whalers go, the rougher sea conditions for the same wind speed tend to become. In 2001 there was some floating ice offshore, but not enough to moderate the effect of the wind. Most scouting in 2001 took place when winds were 10 mph or below, and trips except on one day were when winds were below 15 mph (and that day may have been a calculated gamble). All strikes took place when wind speed was 7 mph or less.

In 2002 (Figure 18) the overall wind pattern was similar to that of 2001, at least superficially. Overall wind speed varied within the same range, but did not maintain high speeds for the periods of time it had in 2001 – until the end of the season. There were no spans of several days when scouting activity was not possible. Most scouting activity took place at wind speeds of less than 10 mph, as in 2001, again with only one day of scouting when the wind speed was over 15 mph (by only one boat). The first whaling crew arrived on Cross Island August 30, earlier than in 2001and was probably an explicit decision in order to try to avoid poor weather at the end of the season, and to have some "extra" time after the experience of the year before when the whaling crews had to leave before completing their quota. They did not see many "early" whales, but did not consider this a failed experiment in that the season did not extend past September 20.

The whalers used five strikes (their quota and the unused strike from the year before) and landed four whales, with one struck-and-lost. Two of their landed whales sank after being struck and were recovered as "stinkers." After they sink, natural processes within a stinker create gas and bloat the carcass, so that it floats to the surface. The meat and internal organs from such animals are not edible, but the *muktuk* is still good (and preferred by some Inupiat), as is the baleen. Of the five strikes, three were made when wind speeds were 7 mph or less, and all were landed (although one sank and was recovered as a stinker). The struck-and-lost whale was struck when the wind speed was about 12 mph, and the other whale that sank when the wind speed was just under 15 mph. At the time, the whalers did not indicate that wind speed or sea state was a factor in either case. When asked, they had no standard explanation for why struck whales sometimes sink, other than water entering the lungs and body cavity. The Nuiqsut whalers used their fifth strike on September 15, but did not leave Cross Island until September 20. This is explained by two of their whales sinking and not being recovered until September 17 and 18 (and this also explains the "scouting" activity for two days after the whalers used their last strike). They also endured the only period of sustained high winds while recovering the second of these whales, and would not have been able to physically leave Cross Island until September 20 anyway.

The 2002 season was, like the 2001 season, just a little longer than the average for the seven seasons documented by this report. There was less floating ice than in 2001, but still some ice present. Whales were somewhat closer to Cross Island than in 2001, but not as close as the Nuiqsut whalers had come to expect them. The combination of the wind at generally moderate (but not low) conditions, and whales at relatively low densities and farther from Cross Island than in some other years combined for even more days of scouting activity without a strike (and number of scouting days without seeing a whale) in 2002 than in 2001. The 2002 season had the highest number of both such days of any of the seven seasons discussed in this report, and also the most days of scouting effort overall (15).

Figure 17: Graphical Summary of the 2001 Cross Island Subsistence Whaling Season

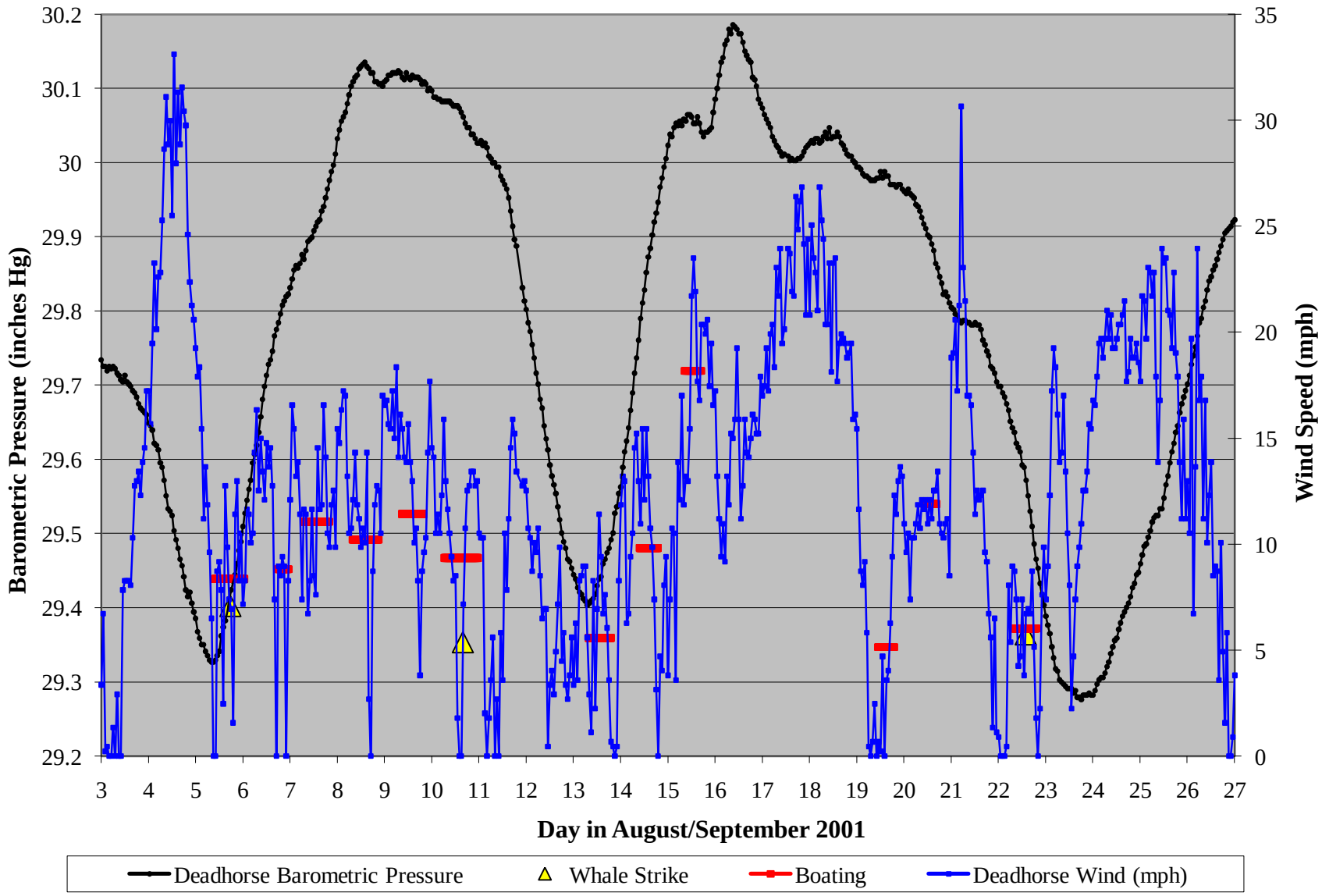
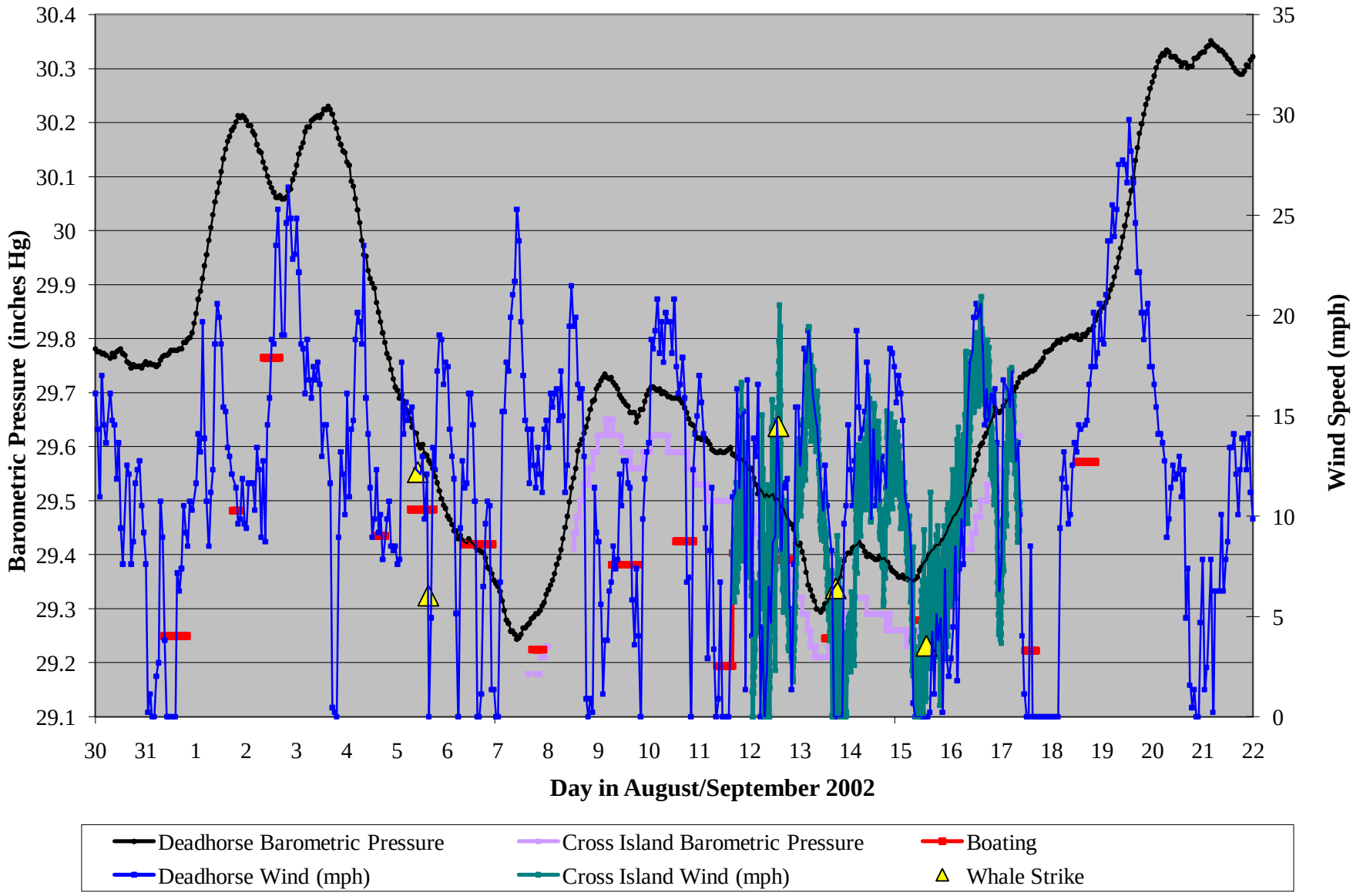


Figure 18: Graphical Summary of the 2002 Cross Island Subsistence Whaling Season



The 2003 season (Figure 19) was the second shortest of the seven discussed in this report. It was characterized by the whalers as one of poor weather, with whales "close" to Cross Island. The first whaling crew arrived on Cross Island August 23, again as an experiment to avoid poor weather in September and to determine if whales were present near Cross Island that early. Weather conditions, mainly wind over 20 mph, prevented scouting on all but two days through August 31 (winds moderated on August 25 to below 10 mph, and an attempt was made to scout on August 27 even though winds were 15-20 mph). Conditions still allowed two other whaling crews to reach Cross Island during this period. All whaling crews went scouting on September 1, with winds moderated to below 10 mph, and landed a whale close to Cross Island. Including the tow, the trip was a little over four hours for the successful whaling crew. Winds increased to almost 25 mph one this whale had arrived at Cross Island, but then decreased to less than 5 mph late on September 2 and all whaling crews except the one who had landed the whale the day before went out scouting. These trips were short, due to lack of daylight. The next day, September 3, increased winds of 10 to 15 mph kept all but one whaling crew onshore, and that crew scouted for less than 3 hours before returning to Cross Island. On September 4 winds were over 30 mph and no whaling crews went scouting. Winds decreased early on September 5 to less than 10 mph and all whaling crews took advantage of the conditions to go scouting, and, once one whale was struck and landed the captains decided to take advantage of conditions and try for a second on the same day, and were successful in doing so. Winds increased to nearly 20 mph once these whales reached Cross Island, but the wind again decreased to nearly calm very early on September 6, then increased throughout the day to almost 20 mph, and decreased to nearly calm late in the day. The captains again decided to take advantage of the period of calm, knowing that the whales were close to Cross Island, and three whaling crews went out scouting, including the crew that had landed one of the whales the day before. Butchering on both these whales had advanced reasonably far, but the whalers were also anxious not to "waste" the little good weather they were having. They landed and towed their fourth whale with winds of 5-10 mph, and again winds increased once the whale reached Cross Island. Winds remained high (15 mph or more) until September 9, when all but one whaling crews left for Nuiqsut. The last whaling crew stayed another day and left for Nuiqsut September 10. The whalers had been out scouting on only seven different days, seeing whales all seven days and striking whales on three of those days.

Although winds were consistently high during the 2003 season, the whalers were able to take advantage of relatively brief (4 to 6 hour) periods when the wind speed was lower, shifting, or variable. These periods tended to correspond with peaks in the barometric pressure prior to steep decreases. If whales had not been relatively close to Cross Island, these "weather breaks" may not have been long enough to strike, land, and tow a whale back to Cross Island. Most scouting trips in 2003 took place during winds of 10 mph or less, with one day of scouting by one whaling crew when winds were 15-20 mph. All strikes took place when the wind speed at Cross Island was 7 mph or less, three of the four with wind speeds of less than 5 mph, and one at near dead calm.

The 2004 season (Figure 20) was the longest season for the seven discussed in this report, but primarily because one whaling crew went out to Cross Island on August 15, encountered high winds and poor scouting conditions through August 26. They were only able to scout one day, on August 17, when winds were 10-15 mph. In the face of a forecast of extended poor weather and

Figure 19: Graphical Summary of the 2003 Cross Island Subsistence Whaling Season

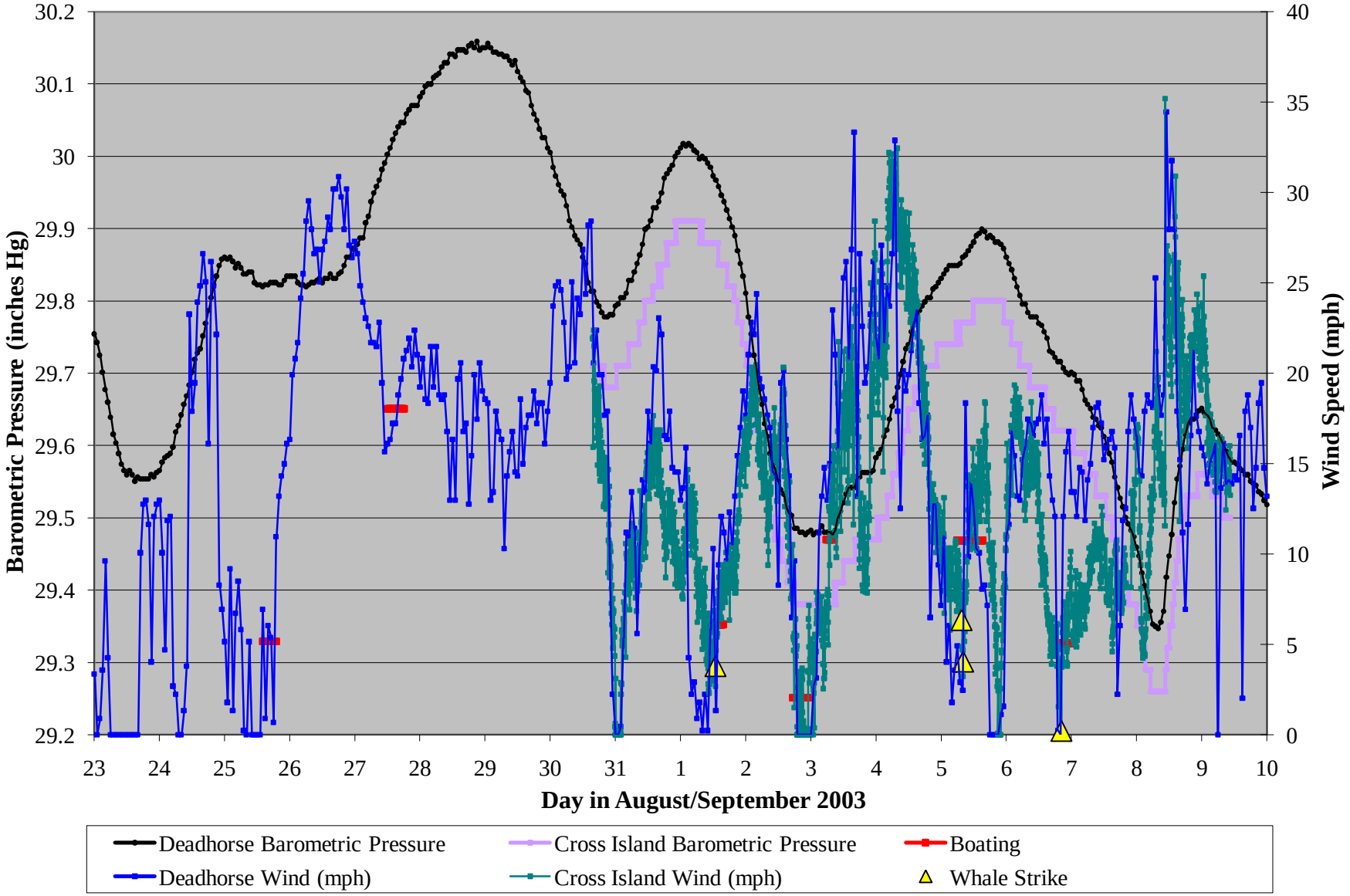
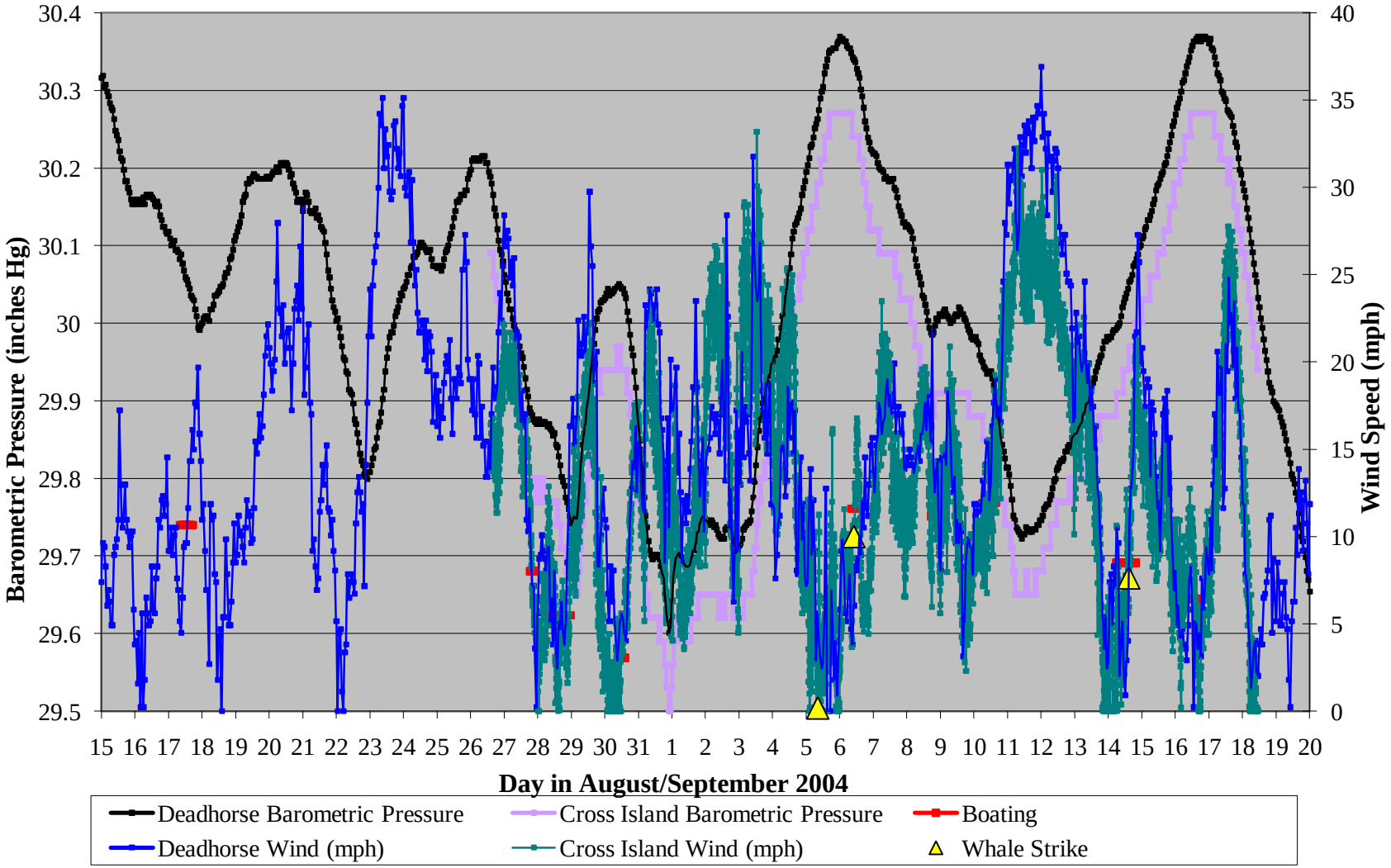


Figure 20: Graphical Summary of the 2004 Cross Island Subsistence Whaling Season



high winds, having only one boat since their second boat had been disabled and no other whaling crews were at Cross Island yet, they returned to Nuiqsut August 19. They returned to Cross Island August 25 (with winds still 20 mph or more), and were shorebound August 26. They then repaired their second boat but encountered more mechanical problems and adverse wind and weather through September 4. Of the ten days from August 26 through September 4, they were able to scout on four days, and on three of these days their trips were relatively short because the wind increased after they had gone out and conditions became too rough. This was primarily due to winds of 20 mph and more. A second whaling crew had arrived on Cross Island August 30, when there was a lull in the wind, but then was shorebound for five days through September 4. This second whaling crew did not try to scout in the marginal conditions of September 4, even though the first whaling crew did make an attempt. On September 4 two additional whaling crews were able to travel to Cross Island.

All four whaling crews scouted for whales on September 5, as winds had moderated to 5 mph or so, and a whale was landed (struck when the wind speed was close to zero). Three whaling crews scouted on September 6, even though winds had increased to 10-15 mph, as the thought was that this was perhaps as good as conditions were likely to be for the rest of the season. A second whale was struck and landed in about 10 mph winds. September 7 was too windy (winds above 20 mph) to whale and people stayed onshore to butcher. Conditions were marginally better (winds 10-15 mph with stronger gusts) on September 8 and the two whaling crews who had not landed whales went out scouting, but saw no whales. The other two whaling crews stayed onshore and continued to butcher their whales. On September 9 conditions were much the same and only one whaling crew scouted for whales, but did not see any. The wind decreased late on September 9 and was still moderate enough so that all whaling crews went out to scout on September 10, but winds increased while they were at sea and, even though they saw whales, no strikes were made. All boats were then shorebound for the next three days (September 11-13) by winds that peaked at 35 mph. All four whaling crews went scouting on September 10, as winds were below 10 mph, and a third whale was landed. The wind increased to more than 20 mph soon after this whale was towed to Cross Island, and many of the whalers were quite discouraged by the conditions. One captain, having landed a whale while only being able to go out on the water three of the fifteen days he had been on Cross Island, decided on September 15 that his season was over. All whaling crews were shorebound by high winds on September 15, and the captains jointly decided that if conditions were suitable on September 16, those whaling crews who wished to could try to complete the quota. If a whale were landed, all whaling crews would stay to help butcher it. Otherwise, all whaling crews would leave for Nuiqsut as soon as the whales already landed were butchered and packed for transport. Winds did decrease to 5-10 mph and two whaling crews decided to go scouting (one crew had already decided not to hunt anymore that season while the crew that had taken the third whale stayed in to butcher). These two whaling crews saw whales, but made no strikes. Three whaling crews finished packing on September 17 and left for Nuiqsut. The fourth whaling crew stayed on Cross Island an extra day and left September 18.

The 2004 whaling season had 10 weather days, when no scouting could take place. There were 12 days when at least one boat did go scouting, but no whale were seen on 6 of these days (the same number as in 2002). Whalers noted that whales were close to Cross island in 2004, but that the weather was poor. They again took advantage of relatively brief periods when wind speed

abated, with all strikes taking place is conditions when the wind speed was 10 mph or less. Whalers do not necessarily predict how long a lull in windy conditions will be, but consider, when they out on the water, how far they can risk traveling from Cross Island and when conditions dictate they should head back in. If the first whaling crew had not gone out to Cross Island so early compared to the other whaling crews, the 2004 season would have very similar to the 2003 season.

The 2005 season (Figure 21) was another long season characterized by very poor weather (high and variable winds) and a pack of floating ice jammed on the north shore of the barrier islands that prevented the whalers from traveling beyond the barrier islands on all but two days. There were nine days when at least one boat went scouting, but on three of these only one boat went scouting since the first whaling crew arrived on Cross Island August 30 (with only one boat) and the second and third whaling crews did not follow until September 4 (and the fourth September 6, the fifth September 8). Weather conditions were reasonably suitable for scouting prior to September 9, but the ice prevented the whalers from traveling beyond the barrier islands and although whales were seen on trips within the barrier islands, no strikes were made. After September 8 through September 25 there were only three days suitable for scouting. Winds were generally at least 20-25 mph except for September 13-14 and September 21. Ice prevented whalers from reaching open water beyond the barrier islands on September 13, but on September 14 they were able to reach open water both to the SE and NW of Cross Island. A whale was struck about 26 miles ENE from Cross Island and due to the distance and ice conditions the whaling captains decided that a second whale should not be struck by the boats following whales to the NW of Cross Island. The trip to land this whale, from leaving the beach to bringing the whale in, lasted about 19 hours. The boats to the ENE of Cross Island had encountered a commercial barge prior to finding and striking the whale that they landed, and were of the opinion that the presence of the barge contributed to the time it took them to locate and land a whale. There is also the possibility that if they had landed a whale quicker that they may have decided to try for a second whale on the same day.

Thus effort was followed by another six days of 20 to 40 mph winds, and then perhaps a 6-hour window of 0-10 mph wind within a 24-hour window of 15-20 mph wind on September 21. All five whaling crews went out scouting but made no strikes. High swells and wind prevented them from being able to safely travel beyond the ice into open water, so that they were not able to approach any whales. High winds kept all boat shorebound for September 22-24 and the whalers called an end to their season and escaped from Cross Island on September 25. This is the one season when conditions made it all but impossible for a whale to be landed. There were 11-15 weather days, and 9 days on which scouting were made. However, ice conditions made it impossible find or approach whales on 7 of these days, and heavy swells in the open water on 1 of them, so that there was only 1 day in 2005 on which Nuiqsut whalers had an opportunity to land a whale.

The 2006 season (Figure 22) began in much the same way as had the 2005 season, with floating pack ice jammed against the northern shore of the barrier islands and preventing the whalers from reaching open water. While winds were not light, they were suitable, for the most part, for scouting. Three of the four whaling crews went to Cross Island on the same day, September 2 and the fourth on September 4. All spent September 3 making final preparations to whale and

Figure 21: Graphical Summary of the 2005 Cross Island Subsistence Whaling Season

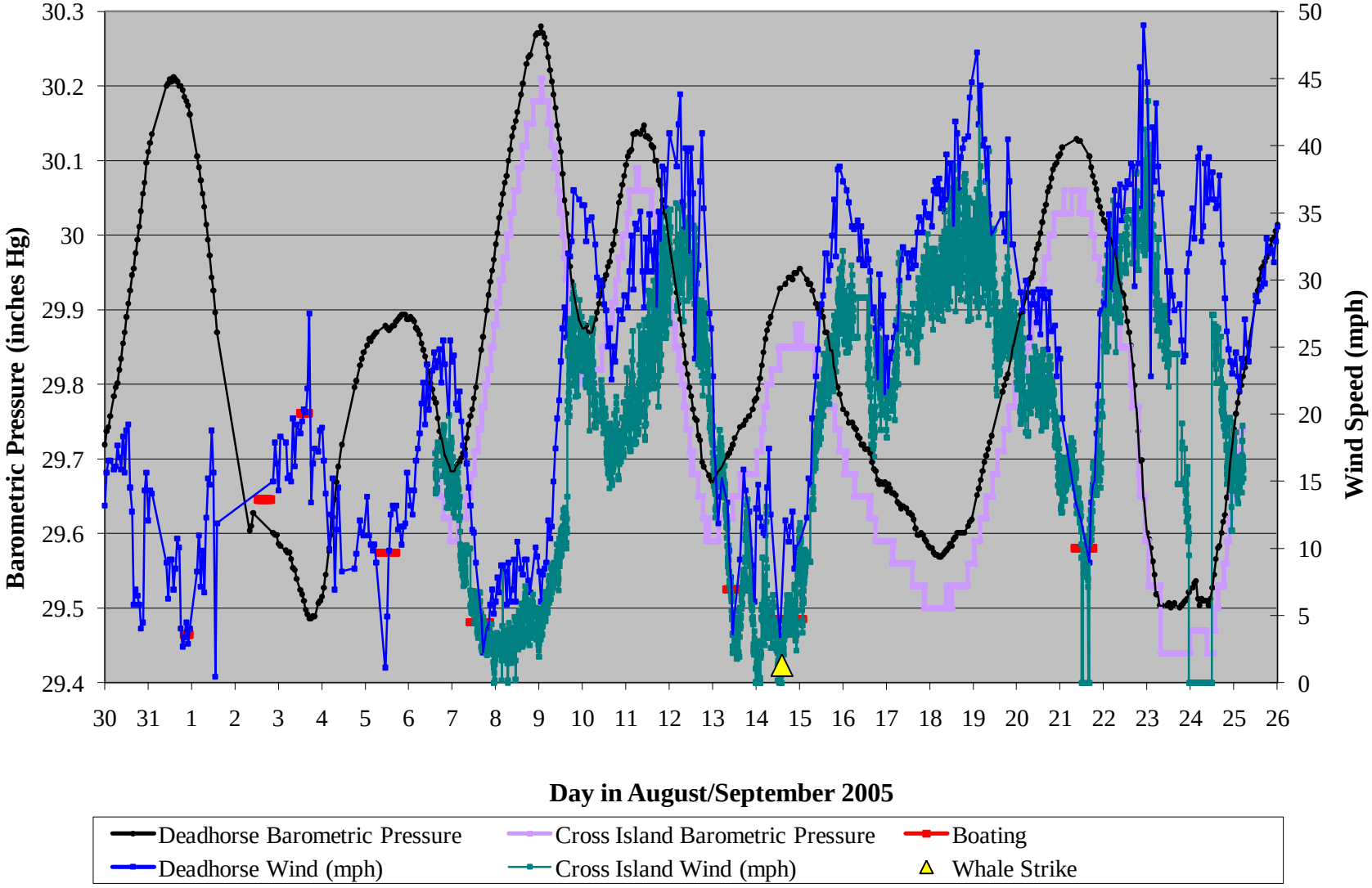
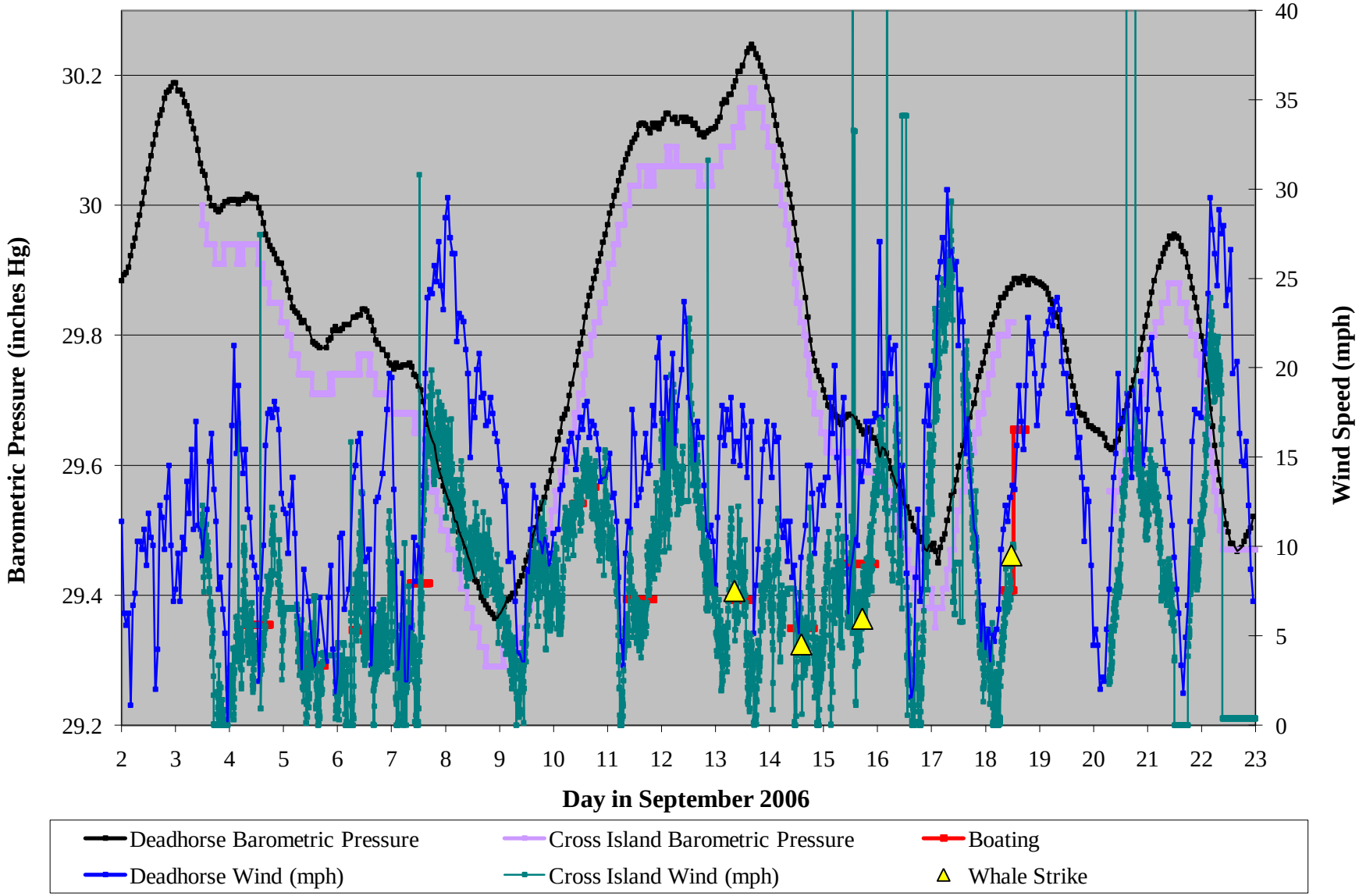


Figure 22: Graphical Characterization of the 2006 Cross Island Subsistence Whaling Season



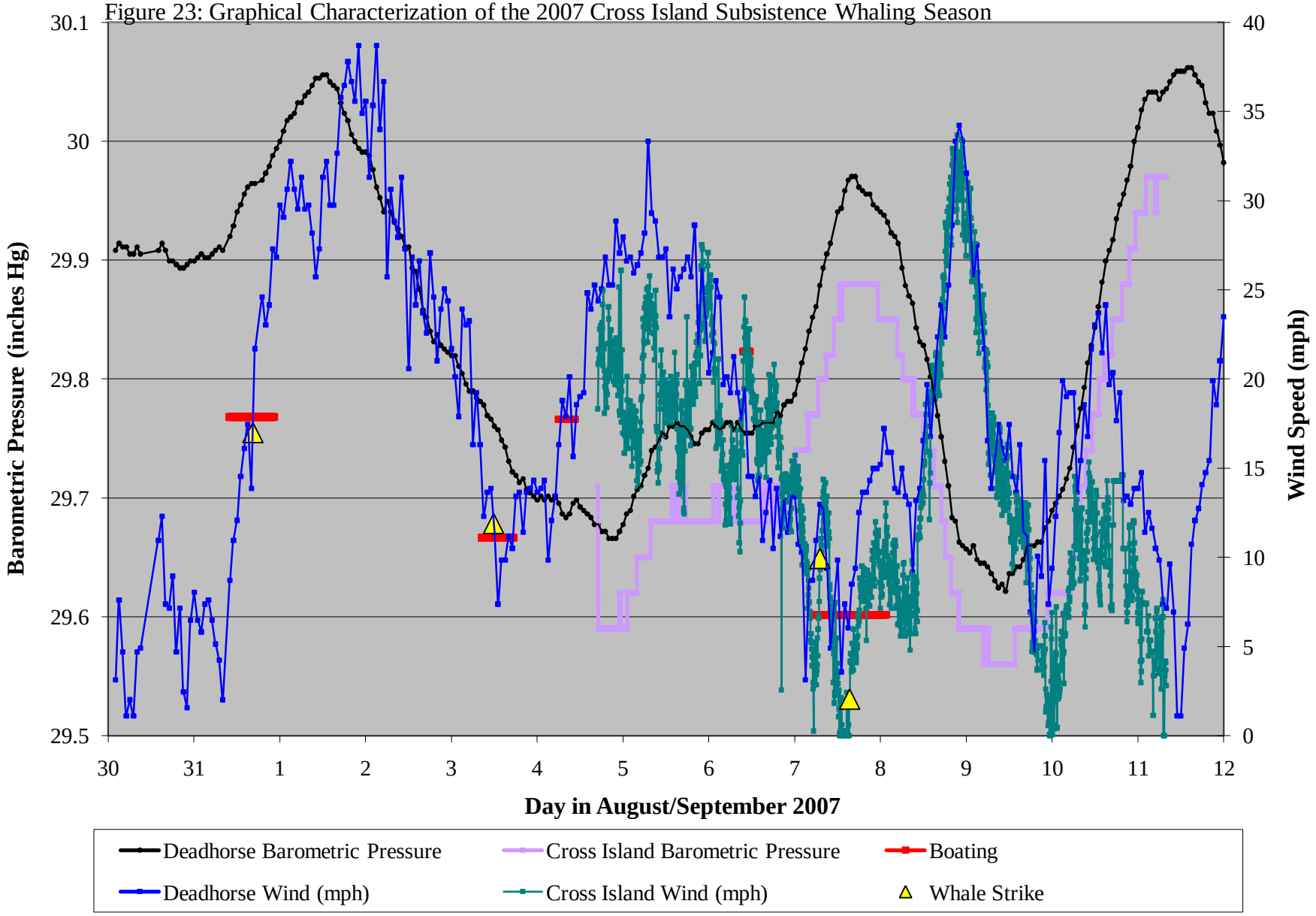
from September 6 through September 12 all whaling crews went scouting the same 6 of the 9 days, with winds generally below 10 mph for those 6 days (1 day of 10-15 mph). There were 3 weather days due to higher winds. The main problem was that the whalers were confined within the barrier islands, and could not reach the open water where most of the whales were. They could see whales, but not approach them in the ice, and could not get through the ice to the open water.

The higher winds of September 12 (no scouting that day) may have blown the ice off the barrier islands, as the whalers were able to reach open water and scout for whales for the next three days, and landed a whale on each of those days (September 13-15). The experience of the most recent past had been that poor conditions were more the rule than good conditions, and that the most should be made of good conditions. Therefore, the captains made the decision to land as many whales as they could take care of in as short a time as possible. All three whales were struck and landed in 5-10 mph winds. After the third whale was landed it was decided that scouting had to be deferred at least one day to catch up on butchering, and conditions were marginal for scouting on September 16-17 in any event. On September 18 all four whaling crews went scouting and the fourth whale was landed. Three more days, September 19-21, were devoted to butchering and packing and all whaling crews left for Nuiqsut on September 22.

The 2006 season was not one affected by weather a great deal, as there were only 4 weather days. Ice conditions, however, made whaling ineffective from September 2 through September 12. The functional whaling season in 2006 was September 13-18, after which they whalers had to finish butchering and then go back home to Nuiqsut. Most scouting and all strikes were conducted in conditions of 5-10 mph winds and although whales were seen on 8 of the 10 days when boats went scouting, whales could only be approached in the open water beyond the barrier islands September 13-18.

The 2007 season (Figure 23) was quite unusual in that while the whalers characterized the weather as generally poor and the sea conditions as rough, they completed their quota and it was by far the shortest season, in terms of days, of the seven documented for this report. The key characteristic of the season seemed to be that whales could be found close to Cross Island and that there were local areas that were not as rough as others. Whalers reported that they could see and follow whales close to Cross Island, but then had difficulty if the whales went more than 8 to 10 miles from Cross Island. Since the average strike distance in 2007 was 12 miles, whalers were able to follow some whales farther, but the general point was that beyond a certain point the whalers could not see or follow, let alone approach to strike, whales. Yet, only five scouting days were required to use the Nuiqsut quota of four strikes, and on 2 of these 5 days only three of the five whaling crews went scouting, as the other two captains thought that conditions were too marginal (winds 15-20 mph) and no strikes were made on those days. The first two strikes were used when only two whaling crews were on Cross Island, the first to land a whale on Aug 31 when the wind may have been 15-20 mph (Deadhorse) and the second on September 3 when winds appear to have been 10-15 mph (Deadhorse). The last two strikes were both landed on September 7, the only day that all five whaling crews scouted for whales in 2007 (and the only day of scouting for two of them). The wind peaked near 35 mph on September 9 but no boats had considered scouting as the whales landed on September 7 were not completely butchered until September 10. The captains met and decided that since the three landed whales were all fairly large, they did not need to land a fourth. If they had desired to do so, they could have requested an additional strike from the AEWC. As it was, they finished packing on September 10 and left for Nuiqsut on September 11.

Figure 23: Graphical Characterization of the 2007 Cross Island Subsistence Whaling Season



The 2007 season had only 3 days lost to weather, and whalers only had to go out 5 days (2 of them with marginal conditions) to use their quota of 4 strikes. Sea conditions and wind speeds were not particularly favorable, compared to previous years, according to the measures developed for this project and the accounts from the whalers. They did report more localized variability in the degree of swells in some areas than others, but made no generalizations about which areas were rougher than others. Whalers also indicated that whales were closer to Cross island than in previous years, but that beyond a certain distance they seemed to vanish. Clearly winds of 10 mph or less are conducive to Cross Island whaling success, but they are not essential given the right set of circumstances. If whales are not too far from Cross Island, whales can be landed even in winds of 15-20 mph – but this may rely on the whalers finding the localized areas where the effects of wind and swells are not as pronounced. The most general statement Nuiqsut whalers make about this is that the farther one goes from Cross Island, the rougher it gets.

Whaling Effort – Number of Whaling Crews, Number of Boats, Boat Crew Size

The relationship between "whaling crew" and "boat crew" was briefly discussed above. The "whaling crew" includes everyone who supports a captain is his whaling effort, and all members will usually receive some sort of crewshare once the whaling season is over. The number of support crewmembers who do not actually go out to Cross Island varies from one whaling crew to another – some have relatively few such members while others have quite a few. Of those crewmembers that go out to *Cross Island, all are expected to help with butchering and on-island work. For some whaling crews, all members who go out to Cross Island may potentially go out in the boat scouting for whales – and for one whaling crew the captain encouraged all crew members to go out every trip (and there were usually 6 to 8 crew members on Cross Island for this crew). Most other whaling crews took no more than 5 or perhaps 6 crew members in a boat for scouting, and the more typical number is 3 or 4. On occasion a boat will go out looking for whales with a boat crew of only two. For some whaling crews, there may crew members who go out to Cross Island and never go out in the boat.

A whaling boat normally requires a minimum of three crew members – a driver, a harpooner, and a person in charge of the float – although boats will sometimes go out with only two crew members. As discussed above, boats will often go out with more than the minimum of three crew members. A number of factors were advanced by whalers to explain their boat crew composition. For example, when conditions were rougher or more marginal, or on days when a captain felt a greater need for speed than other days, he would go out with fewer crew members in each boat. When conditions were optimal or when a captain wished to act more in support of other boats rather than to more aggressively seek a first strike, he may take more crew members in a boat. Those whaling crews with younger crew members not fully proficient in skills required for whaling tended to be larger, to facilitate the transmission of whaling knowledge. When a crew member slept late, he was left on shore. None of these relationships or reasons was determinant, however. Many interacting factors affected how many crew members went scouting in each boat on any given day.

There is no real "typical" whaling crew on Cross Island – all have unique characteristics that contribute to their size and composition. Many captains state the rule that when someone asks if

he (or she) may go whaling "I never say no." The reality is that space in the boats to go out to Cross Island are limited, since the boat must carry not only the whaling crew members but most of what they will need on Cross Island - although this is less true than in the past, due to the logistical support and help supplied through the CAA. Under terms of the CAA, almost all of the gas and diesel fuel have been provided by industry and barged to the island just before or when the whalers get there, along with a generator, water tanks, and large boxes and other materials to pack and ship the butchered whale. Some whaling captains (and the researcher) ship food and other supplies from Anchorage (or Fairbanks) to Deadhorse, so that they can also be transported to Cross Island on this barge, and so save some space on their boats. Still, space in the boats and cabins is limited. Those captains with bigger boats, and bigger cabins, are less limited than others in terms of whaling crew size. This is one reason that most whaling captains are constantly thinking of ways to improve their cabins on Cross Island.

Table 9 presents measures related to the number of whaling crews and boats physically present on Cross Island during the seasons documented by the project, as well as the average total population of Cross Island and the average boat crew size during that period. As the table shows, there was a minimum of 3 whaling crews on Cross Island (2002) and a maximum of 5 (2003, 2007) in this period, an average of 4.1 per season. To some extent this is a number without much meaning – the more meaningful number is the number of whaling boats present on Cross Island. Most Nuiqsut whaling crews (18 of 29, or 62 percent) used more than one whaling boat (and many also use additional support boats for hauling people and supplies that are not used to hunt or tow whales). This allows experienced whalers who do not want to, or are not yet able to afford to, register as a captain to essentially run a boat under the overall management of a registered whaling captain. Some individuals may have whaled as captains in the past but be currently unable or unwilling to assume the economic responsibilities of fielding a whaling crew in a particular year (which include hosting the attendant public events if their whaling crews should land a whale). Others may be individuals looking to amass more experience and equipment, so that they can eventually field an independent whaling crew. Others may have other reasons.

However that may be, the number of boats capable for whaling has varied from 7 to 11 for 2001-2007, or an average of 1.9 whaling boats per whaling crew. The numbers from Table 9 indicate that Nuiqsut whalers try to have at least 8 boats available for whaling at Cross Island. In 2002, with only 3 whaling crews, each crew operated 3 boats (whereas in most years only 1 3-boat whaling crew would be expected). In 2007, two whaling boats were disabled on the way to Cross Island and never used for looking for whales, and so were not counted as whaling boats. One reached Cross Island and was used as a support vessel. One was left (and repaired) at West Dock and was used on the trip back to Nuiqsut. This leaves only 2006 as a season when Nuiqsut whaling captains knew before they reached Cross Island that there would be fewer than 8 whaling boats. 2006 was a transitional season for one whaling crew, when one captain sat out the whaling season and reorganized his whaling crew from a multi-boat to a single-boat operation. The 2005 season was exceptional in that only one strike was made, on a day when all the whaling boats on the island were available to go out scouting. Even excluding 2005, however, there is some evidence for a trend of fewer boats available for whaling over the period of 2001-2007. There is also an apparent declining trend for the maximum number of boats present on Cross Island potentially able to whale from 2001 to 2007. This is a gross indication that total level of effort may have similarly declined. Other measures examined in the next section may indicate this is not a strong trend.

Table 9: Boat and Boat Crew Measures, Cross Island 2001-2007									
Season	2001	2002	2003	2004	2005	2006	2007	Total	Average
# of 1-Boat Whaling Crews	1	0	1	1	3	2	3	11	1.6
# of 2-Boat Whaling Crews	2	0	1	2	1	1	2	9	1.3
# of 3-Boat Whaling Crews	1	3	2	1	1	1	0	9	1.3
Total Whaling Crews (Max. #)	4	3	4	4	5	4	5	29	4.1
Average Whaling Crews on Cross Island (average for the full season)	3.8	2.5	2.8	2.6	4.1	4.0	4.0		3.3
Total Boats (Max.)	8	9	9	8	8	7	7	56	8.0
Average Boats Scouting/Day[1]	4.8	4.3	4.9	3.4	4.0	4.8	3.2		4.2
Average Boats Scouting/Strike[2]	5.3	4.8	6.3	5.7	8.0	3.8	4.3		5.1
Average Cross Island Pop	27.7	26.6	20.4	16.2	29.8	29.2	26.0		24.8
Average Whaling Crew Size	7.3	10.6	7.3	6.2	7.3	7.3	6.5		7.5
Average Boat Crew Size	3.9	3.6	2.9	3.6	4.4	4.3	4.3		3.9

[1]Average number of boats out scouting for whales for all scouting days
[2]Average number of boats participating in the hunt that resulted in a struck whale

The "Average Boats Scouting/Day" numbers indicate why captains may prefer to have eight or more boats available for whaling. Not all captains will necessarily whale on any given day. Some captains are more willing to try to whale in marginal conditions than others, but this is usually a concern only on a limited number of days. Most whaling crews will not whale the day after landing a whale, especially if they have only one boat, since they have butchering responsibilities. However, if they are using multiple boats they may send out a boat while keeping other crew members onshore to butcher. Whaling crews other than that who landed a whale will often seek to go out scouting for whales the next day, if conditions are good and the successful captain indicates that he has the butchering in hand. In the more general case, however, it is likely that at any given time there will be one or two boats that are experiencing some sort of mechanical or other problem. The overall average for each season also reflects scouting days before all whaling crews reached Cross Island. It is instructive that for all season except 2006 the average number of boats out scouting and participating in a hunt that resulted in a struck whale was larger than the general average for all scouting days of the season. What may be more remarkable is the magnitude of the difference between the number of boats on Cross Island and the number that, on average, actually go out scouting. This reflects mechanical problems that keep boats onshore, but also cases where a whaling crew needs to stay onshore to butcher while other whaling crews go out to scout, the need for captains to send a boat to Nuiqsut with their *tavsi* after a whale is landed, or the use of boats for other errands such as trips to West Dock.

The average number of people physically present on Cross Island did not vary much from one season to another, and only roughly reflects the number of whaling crews on Cross Island. In 2003, for example, when the number of whaling crews decreased to three, each whaling crew used three boats. Some crew members who would normally whale for captains who did not whale in 2003 joined other crews for that year. The increase in the average size of whaling crews in 2003 (and not in the overall number of boats at Cross island) is consistent with a minimum

number of boats being available to scout for whales, and a minimum number of people being required to go out in the boats and butcher the whales that are landed. It also reflects the dynamic that new whaling crews are created when an experienced co-captain "hives off" from an existing whaling crew to form a whaling crew of his own. The apparent lower Cross Island populations for the 2003 and 2004 seasons actually reflect the relatively long periods of time when only one whaling crew was physically present on Cross Island (6 days in 2003 and 9 days in 2004) and the relatively few days when all whaling crews were physically present on Cross Island (58 percent in 2003 and 50 percent in 2004). This is also evident in the difference between the values of the maximum number of whaling crews at Cross Island for any given season (by necessity an integer value) and the actual average number of whaling crews present at Cross Island over the entire season. This difference, in terms of percentage, ranged from 35 percent for 2004 to 0 percent for 2006. The 2001 season is the only other season with a difference as low as 5 percent – all the others have differences that are 15 percent or greater.

Whaling Effort – Boat Days, Boat Hours, and Effort Per Unit Catch (EPUC)

Table 10 displays the information that will be used to ground the discussion on estimating the effort per unit catch for Cross Island whaling, and the comparison of this metric across seasons. At best this will be a gross estimate, since there are many compromises and approximations that must be made to generate such estimates. This section will start with a discussion of these assumptions or compromises, then discuss the data and the estimates of EPUC, and end with a discussion of how the seasons group together or compare with each other.

One may ask why this discussion is phrased in terms of "Effort Per Unit Catch" (EPUC) rather than "Catch Per Unit Effort" (CPUE). Given that the annual quota caps the possible harvest, at a low level of animals, any resulting CPUE using almost any measure of effort must be a number well below 1 and not intuitively meaningful to the average person or whaler. On the other hand, the measure of effort required to produce one unit of "catch" is more intuitively obvious, almost regardless of the measure of effort used. When dealing with rough estimates based on available measures, this sort of basic comprehension is of utmost importance.

The issue of how to measure "catch" must also be addressed. The annual quota, and overall management of the subsistence hunt, is expressed in "strikes." For management purposes, all whales that are struck are assumed to die. Most struck whales are landed and butchered, but those that are struck-and-lost obviously cannot be butchered. Only landed whales represent productive "catch" although much of the whaling effort (and most of the variable whaling effort that is different from season-to-season) occurs on the water and mostly represents the effort required to achieve first strikes on whales. This will be further developed below, after the discussion of person-days and whaling-crew-days, but the net result is that for purposes of this report and in the context of the discussion of EPUC, "unit catch" will refer to a landed whale and not to a strike.

To attempt to measure such effort in terms of person-days (aggregate individual effort) would not appear to be useful. As discussed previously, the total number of people on Cross Island, while variable, is a function of many things and was actually fairly consistent for all seasons. Those seasons with lower values for the average number of people present on Cross Island per

Table 10: Measures of Subsistence Whaling Effort, Cross Island 2001-2007								
Season	2001	2002	2003	2004	2005	2006	2007	Average
# of Whales landed	3	4	4	3	1	4	3	3.1
Struck-and-Lost	0	1	0	0	0	0	1	0.3
Length of Seasons, Days	24	23	19	30	27	21	13	22.4
# of Whaling Crews (Max)	4	3	4	4	5	4	5	4.1
Average Days on Cross Island/Whaling Crew	22.5	19.3	13.3	19.3	21	21	10.4	18.1
Whaling Crew Days (total)	90	58	53	77	105	84	52	75
Whaling Crew Days/Whale	30	14.5	13.3	25.7	105	21	17.3	23.6
# of Boat-Days	57	65	34	41	35	48	16	42.3
Boat-Days/Whale	19.0	16.3	8.5	13.7	35.0	12.0	5.3	13.5
Boat-Days/Strike	19.0	13.0	8.5	13.7	35.0	12.0	4.0	13.6
Average Duration of Scouting Trip	9:43	7:58	4:31	6:51	7:07	8:13	5:57	7:32
Total Seasonal Effort (Boat-Hours)	572.9	533.6	162.9	301.2	341.3	427.1	124.9	351.9
Boat-Hours/Strike	191	107	41	100	341	107	31	103
Boat-Hours/Whale	191	133	41	100	341	107	42	112

day are those for which one or two whaling crews were on Cross Island by themselves, and thus brought the average for that season down. Further, weather days and other uncontrollable factors influencing the length of the season also influence the aggregate person days in the same direction, so that "length of season" is probably a more useful proxy measure than would be the calculated "person-days." "Whaling-crew-days" is also a defective measure, for much the same reasons as has been briefly discussed above. Table 10 (with some narrative context and explanation) displays information demonstrating why this is so.

As described previously, boat crews varied from two to eight individuals, with no obvious underlying rationale. It is not immediately obvious that a boat crew gains any large advantage by being larger than three individuals. It may be that an increased boat crew size is a disadvantage, if the increased load affects the speed and handling capability of the boat – but this difference would be difficult to measure. In any event, calculating effort in terms of person-hours would automatically increase the EPUC for boat crews of larger size. Boat crews varied in size from one day to the next, and all were chosen from the closed pool of whaling crew members on Cross Island on that day. Those whaling crew members who did not go out in the boat were still on Cross Island and in a sense engaging their labor in the whaling effort, if one were interested in the calculation of individual effort. Given the similar Cross Island population or labor pool from one year to the next, however, this would seem to provide little insight into the variability among whaling seasons, other than that longer seasons required more individual effort, and such a measure may actually obscure potential sources of such variability.

"Whaling crew days" would appear to be even more imprecise than aggregated individual effort. As discussed above, the number of whaling crews on Cross Island ranged from three in 2002 to five in 2005 and 2007, and the year-to-year composition was quite fluid. A captain generally has some crew members he can depend on whaling with him, if he decides to go out whaling in any given year. There are a few experienced whalers who have a history of whaling with different captains in different years, for a variety of reasons (the need for experienced people on one whaling crew more than another, ongoing personal relationships, last-minute decisions, and so on). First-time whalers generally join a crew of a relative, and less experienced whalers may change whaling crews from year-to-year, depending on which whaling crews need labor or have room for them. Depending on circumstances, some captains whale with more than one whaling boat (with co-captains in charge of the second, and sometimes a third, boat). One of the largest reasons for whaling crew membership changes is that not all captains choose to whale every season. In such a case, some of that captain's "regular" crew members may not whale either, but many of them can be expected to approach other captains to see if they can whale with a different whaling crew that year. There have also been cases, such as 2001 and 2002, when one captain decided not to whale as a captain himself, but did go whaling at Cross Island with another captain and ran his boat for that captain. Over the course of the project (2001-2007) there have also been two new whaling crews that have been formed, and one that whaled only in 2001 and has been inactive since then (although the captain has whaled as a member of another crew). Both of the new whaling crews formed by splitting off from an existing whaling crew, but only increased the overall number of boats whaling at Cross Island by one. The overall cumulative effect of these dynamics has been that the number of people whaling at Cross Island has been relatively constant (although the seasonal average population present at Cross Island has varied) and the number of boats potentially available for whaling has also been roughly the same (with perhaps a small downward trend).

One indication of how whaling-crew-days may not be a good measure of season-to-season variability, and especially of whaling effort, is by comparing whaling-crew-days with boat-days and also simple length of season (Table 10). Looking at the number of whaling-crew-days, 2007 appears to be quite similar to 2003 and even 2002, as seasons with the lowest values. The overall range is only 52 to 105, basically a factor of 2. The largest value is for 2005, with only 2004 near the average value, and 2006 and 2001 with above average values. Whaling-crew-days/Whale would seem to indicate that 2003 and 2002 were the most efficient seasons, with 2007 not too far behind, followed by 2006, 2004, 2001, and finally 2005. Looking at boat-days, however, 2007 has by far the lowest value, with 2003 and 2005 each having about twice the 2007 value, followed by the other four seasons pretty much evenly spaced at intervals of about half the total 2007 value. The range is 16 to 65, about a factor of 4. The boat-days/whale ratio indicates that 2007 was the most efficient season, followed by 2003 and 2006 with values below the average for all season, and the other four seasons above the average (2994, 2002, 2001, and 2005). In terms of the overall length of the season, 2007 was the shortest by far at 13 days, followed by four seasons ranging from 19 to 24 days long (2003, 2006, 2002, and 2001), and then 2005 and 2004 at 27 and 30 days. When the seasons are ranked by the average number of days each whaling crew was actually present at Cross Island, 2007 again was by far the shortest at 10.4, followed by 2003 at 13.25, and then the other five seasons with values of 19.34 to 22.5.

It can be argued that the way "whaling-crew-days" and "boat-days" are defined above makes them two different sorts of measures and thus not comparable. "Whaling-crew-days" aggregates the total number of days each whaling crew was present on Cross Island, whether they went out looking for whales or not. "Boat-days" aggregates the total number of days each boat went out scouting for whales. However, a measure for whaling-crew-days calculated the same way, aggregating the total number of days each whaling crew actually went out whaling, would suffer from the same defects of whaling crew composition and size variability discussed above, and boat-days calculated as the aggregate number of days each boat was present on Cross Island would basically represent the length of season measure (already directly known) rather than a measure of active whaling effort. Another way to approach this is to recognize these as measures of two different sorts of effort. One is a measure of the total time (including "down time" for whatever reason – weather, mechanical, support chores) devoted to an activity, while the other focuses on the time spent doing the productive aspects of the activity ("on-the-water" activities).

The question remains of how best to discuss the seasonal variability of whaling effort. Length of season and "whaling-crew-days" as discussed encompass all whaling activities (travel, daily chores, scouting and landing whales, towing, butchering and packing) as well as bad weather periods, mechanical problems, and so on. While all are significant components of the whaling experience of any one season and in combination characterize each season, not all represent "effort" in the same way or are as easy to measure.

Butchering is clearly a component of the total level of whaling effort on Cross Island, but also clearly has a direct relationship with the number of whales landed, and no relationship to struck-and-lost whales. The work required to butcher a whale is a function of its size, but to accurately record the actual labor that is devoted to butcher any given whale is quite difficult. The number of people present at the butcher site is constantly in flux, as is the number of people actually engaged in the work of butchering. The labor requirements of butchering also clearly influence the length of any given whaling season. However, given that Nuiqsut whalers have landed 3 or 4 whales in all but one of the seasons discussed in this report, the butchering component of the whaling effort is relatively constant from one season to the next. It could be argued that if fewer people were available to butcher, butchering would take longer, and the length of the whaling season would increase. In empirical terms, this has not been the case for the 2001-2007 seasons. Individual whales have typically been butchered in 1 to 2 days, with most whaling crews participating to some extent in butchering most whales. Because of this logical consistency of butchering effort from one season to the next, the difficulty of actually measuring butchering effort in any systematic and detailed fashion, and the apparent limited effect on the variability of the length of the overall subsistence whaling season, butchering has not been included in the EPUC measure discussed below.

While it can be argued that butchering is certainly a necessary component of processing the whale after it is landed, it is not really a component of "catching" the animal – essentially a restatement of the argument above. It is the actual level of effort out on the water that is variable from one season to another, given a relatively equivalent level of harvest. It is also precisely this "on-the-water" aspect of the hunt that is comparable (although not precisely the same) for both "landed" and "struck and lost" whales. There is no tow for a "struck-and-lost" whale, and the chase for a struck-and-lost whale may be, but is not necessarily, shortened from that of a landed

whale. Thus, there is a legitimate question as to whether "catch" should refer to "landed whales" or "strikes used." In the strict sense, only "landed whales" are productive results of effort. However, it is not uncommon for whalers to indicate that they did nothing different for a landed whale than for one that was struck-and-lost. Considering only landed whales as "catch" would automatically increase the EPUC in any year with a struck-and-lost whale. However, as is evident in Table 10, it makes relatively little difference in terms of how seasons compare to each other which definition of "catch" is used since Nuiqsut whalers had only two struck-and-lost whales in the seven whaling seasons considered here. Ultimately, however, it makes most intuitive sense to define "catch" as "landed whales." While the difference in the calculations of the EPUC measure using both possible definitions of "catch" would be a measure of struck-and-lost whales as a percentage of all strikes used, this is arrived at far more simply by the direct ratio of struck whales actually landed. Since the subsistence bowhead hunt is managed in terms of strikes, however, and not landed whales, there may be some justification for calculating Effort Per Strike, even if "strike" is not defined as "catch." That is, the hunt is limited to the number of animals that the whalers are allowed to land, and they end their effort when they either reach their quota and decide that they have satisfied the community's need and do not need to ask for a fifth strike, or when it is late in the season and they judge that conditions for whaling are poor or dangerous and not likely to improve. In the past, if Nuiqsut whalers had not filled their quota, they would sometimes stay out at Cross Island waiting for whales until the ocean froze. They no longer do so, since in such a case they must leave their boats and retrieve them later. The whalers have also noted that weather conditions after September 20 or so generally make whaling very difficult near Cross Island.

It will be argued here that the easiest component of whaling effort to measure, and the one that varies the most from season-to-season, is the on-the-water" effort of scouting, striking, and landing whales. While it is possible to calculate the aggregate number of days each boat is present on Cross Island, and to easily identify the subtotals of days boats went out whaling and days they did not, it has been quite difficult to always identify exactly why boats did not go out whaling. Sometimes it was for mechanical reasons, or because of adverse weather conditions, or the need to use the boat for something else. Sometimes the whaling crew had onshore chores to complete. Other cases were less clear, however. Sometimes it could have been one of several such reasons. On the other hand, when a boat goes out whaling, it is clear that it has done so. It is also clear that the completion of the quota is the limiting factor on determining the length of the season. Nuiqsut whalers do not stay at Cross Island any longer than they need to after they fill their quota or determine that it is not likely that they will be able to do so. "Boat-days" is a direct measure of the on-the-water activities required for them to fill their quota. All other onshore activities (butchering, packing, chores) are in support of and a result of landing whales. Thus, boat-days would appear to be a good proxy measure for overall seasonal whaling effort (and can be adjusted if necessary for season length due to poor weather, ice, or other conditions).

It is possible to measure the level of effort "on the water" in several different ways, with different degrees of precision or intuitive validity. Whaling-crew-days and boat-days have been discussed above, and while boat-days appear to be a reasonably good measure, the available information allows a more refined and precise measure to be developed. From Table 5, it is clear that the average boat-trip varies significantly both in terms of time duration and total distance from season-to-season, so that a "boat-day" does not represent the same amount of whaling

effort each season (for instance, 4 hours 31 minutes and 37.2 miles in 2003 compared to 9 hours 43 minutes and 84 miles in 2001). A "boat-day" includes both the temporal and spatial aspects of effort, and to refine the measure one could focus on one or the other (or a combination of the two). As a measure of effort, time appears to be a better unit than distance. Nuiqsut whalers generally scout for whales at 4 or 5 miles per hour and reserve high-speed for traveling to a likely place to spot whales or for returning to Cross Island after not deciding to stop looking for whales on any given trip. On many trips Nuiqsut whalers will maintain "scouting speed" for the entire trip, as whales can be found very close to Cross Island and could be missed if they were traveling at high speed. A measure of effort based on distance would result in larger values for seasons when whales were more distant from Cross Island, regardless of the speed of travel. A measure of effort based on time would also appear to result in larger values for seasons when whales were more distant from Cross Island, and this does appear to be the case in general, but for those seasons when whales were generally more distant from Cross Island than other seasons (2001 and 2002), whalers tended to travel at high speeds until they were out to where they had been seeing whales before they slowed to "scouting speed." Distance appears to represent more where whales were found than effort as such, and is incorporated into the time measure. Further, travel at higher speeds (when scouting for whales is less effective) contributes less to a time-based measure than to a distance-based measure, so time rather than distance may be preferable for a measure.

Table 10 displays values for total seasonal effort in terms of boat-hours, and clearly indicates that 2007 was the season of least on-the-water effort, with the 2003 season having only about 25 percent more effort than 2007. The 2004 and 2005 seasons had about twice as much effort as the 2007 and 2003 seasons, respectively, and all four seasons were below the overall average for all seven seasons documented for the project. The 2006 season had about 30 percent more effort than the average season, and both the 2002 and 2001 seasons had roughly 70 to 90 percent more effort than the average season. In terms of effort per whale landed, the 2007 and 2003 seasons were about the same, since 4 whales were landed in 2003 but only 3 in 2007 (with one struck and lost). The 2004 season has a value about 150 percent greater the 2007/2003 values, with the 2006 season value only a little higher (but again, 4 whales landed in 2006 and only 3 in 2004). The 2002 seasonal value for effort/whale is somewhat higher than for the 2006 season, but is about the same for effort/strike, because of a struck-and-lost in 2002. The 2001 season has the highest effort/whale value for seasons when 3 or more whales were landed, at somewhat less than twice the values for the 2004/2006/2002 seasons. This was the year when whalers (and other measures) indicated that whales were farther from Cross Island and seemed to be less numerous than for other seasons. The value for effort/whale is of course highest for the 2005 season, when only one whale was landed due to very poor weather and ice conditions.

Monitoring Indicator Matrix For Decision Making

As part of the original proposal for the ANIMIDA and cANIMIDA projects, a formal "monitoring indicator matrix for decision making" was constructed for each component task. This matrix is reproduced in the final report for each task. A short discussion of this matrix is useful for the Cross Island Subsistence Whaling Documentation and Monitoring task, since the central or key hypotheses were not testable from the data collected.

The motivation for the project was the question of whether Cross Island subsistence whaling had been, or was likely to be, affected by oil and gas activities. Past information was not adequate to examine this question, other than for the narratives from whalers of how seismic and drilling activities in the mid-1980s through 1990 diverted the whale migration away from Cross Island, increased the distance whalers had to travel to find and strike whales, and so decreased their success in landing whales. While this project was designed to collect quantitative measures of Cross Island whaling, and so to be capable of evaluating differences from one season to another, it was not designed to collect similar information about oil and gas activities. Furthermore, the very activities to which whalers objected in the mid-1980s through 1990 were specifically prohibited during the whaling seasons documented for this project (2001-2007). Northstar was primarily in production mode during this period, and whalers noted few if any direct effects of Northstar on their whaling activities – other than that the whalers themselves avoided scouting for whales near Northstar. The lack of effects was attributed primarily to Northstar being west of Cross Island, while the whales were coming from the east and so did not encounter any potential disturbance from Northstar until they had passed Cross Island and the Nuiqsut whalers. The whalers did not consider avoiding the Northstar area as much of an effect since their primary (preferred) search area for whales is to the Northeast of Cross Island.

The variability that the project did document was primarily due to differences in ice and wind conditions, the distribution (distance from Cross Island) and apparent abundance (how many whales the whalers could find) of whales, and the behavior ("normal" or "skittish") of whales. Further, differences among the seasons in terms of effort expended (in terms of "boat hours") could be fairly well quantified. However, the relationship between variability in terms of effort and variability of ice and wind conditions, or whale distribution, or whale behavior, were not as clear-cut. The ice conditions present during the course of the seven seasons either prevented access to whales altogether, or seemed to have no net effect (except perhaps by its absence in most seasons). Adverse weather conditions hinder whaling, but the shortest seasons were those that were measurably the worst in terms of weather. Perhaps the least ambiguous factor associated with the effort expended per landed whale was the distance of whales from Cross Island (the distance from Cross Island that whalers found whales). The two were directly related – the greater the distance, the greater the effort. That result is hardly surprising.

In order to clarify the sort of variability that this final report could address and discuss, the original "monitoring indicator matrix for decision making" was modified to incorporate three additional hypotheses related to ice and wind, whale distribution, and level of effort per landed whale. The original matrix is replicated below, followed by the modified matrix.

With additional effort, it may be possible to formulate measures of oil and gas activities to evaluate their effect on Cross Island subsistence activities. In the meantime, some of the other main factors of variability in Cross Island whaling have been documented – ice and weather, whale distribution, and whale behavior. Also important has been the changes over time in how Nuiqsut whalers whale – improved equipment and technology, the increase in wage employment by whalers and the resultant time constraints, the intended and unintended consequences of the Conflict Avoidance Agreement process, and no doubt some others. To adequately treat these topics would require much more attention to the earlier period of Nuiqsut whaling than could be allocated for this project, which was focused on 2001-2007. Another important factor is the

Original cANIMIDA Task Order 7 Monitoring Indicator Matrix For Decision Making (Continuing ANIMIDA Task Order 4)

MMS Issue Addressed	Monitoring Hypotheses	Methods	Key Monitoring Result or Parameter for Decision Making*
Will OCS oil development activities at Northstar and/or Liberty result in adverse changes to bowhead whale subsistence hunting or hunting success at Cross Island?	H1: Subsistence whaling activity and behaviors in the vicinity of Cross Island are not significantly adversely changed by offshore oil developments at Northstar and/or Liberty. H2: General subsistence activities on and near Cross Island are not significantly adversely changed by oil and gas activities associated with Northstar and/or Liberty.	Systematic retrospective (2000, prior years as possible) and observational/interview data collection (2001-2007) on: (a) number of whales taken, (b) GPS location of whale strikes (direction and distance from Cross Island), (c) number of whaling crews, composition of crews, total number of crew members, (d) periodic "census" of whaling participants on Cross Island, (e) duration of whaling (days of active whaling), (f) timing of whaling, (g) length of trips and area searched while whaling (possible GPS track), (h) "catch per unit effort," (i) observations of whaling participants. Systematic retrospective and observational/interview data collection on: (a) Non-whaling subsistence activities on and near Cross Island (who, what, where, when), (b) observations of local subsistence users. NOTE: Systematic observation and recording of weather and ice conditions will also be required, as they directly affect the subsistence behavior in question. Detailed information about industry activities at Northstar and Liberty will also need to be available, but are not part of this data collection. Will also need to consider informant explanations for changes in behavioral patterns.	Annual tabular information on harvest levels and locations of subsistence resources taken on or near Cross Island. Hard copy map appended as required for clarification of location information. Annual tabular summary of people involved in whaling – number of whaling crews, size of each crew, number of active days whaling, number of crews/people present each day, estimation of total effort. Annual tabular summary of people involved in other subsistence activities – number of people each day for each activity, estimation of total effort. Annual narrative summary of Cross Island whaling season and associated subsistence activities. Contractor will alert MMS COTR of any important trends or changes.

cANIMIDA Task Order 7 Monitoring Indicator Matrix For Decision Making As Functionally Modified for the Final Report (*in italic bold*) (Continuing ANIMIDA Task Order 4)

MMS Issue Addressed	Monitoring Hypotheses	Methods	Key Monitoring Result or Parameter for Decision Making*
Will OCS oil development activities at Northstar and/or Liberty result in significant adverse changes to bowhead whale subsistence hunting or hunting success at Cross Island?	H1: Subsistence whaling activity and behaviors in the vicinity of Cross Island are not significantly adversely changed by offshore oil developments at Northstar and/or Liberty. H2: General subsistence activities on and near Cross Island are not significantly adversely changed by oil and gas activities associated with Northstar and/or Liberty. ***H3: General subsistence activities on and near Cross Island are not significantly changed by weather and/or ice conditions*** ***H4: General subsistence activities on and near Cross Island are not significantly changed by the distribution and abundance of whales*** ***H5: Effort expended per whale landed at Cross Island does not significantly differ***	Systematic retrospective (2000, prior years as possible) and observational/interview data collection (2001-2007) on: (a) number of whales taken, (b) GPS location of whale strikes (direction and distance from Cross Island), (c) number of whaling crews, composition of crews, total number of crew members, (d) periodic "census" of whaling participants on Cross Island, (e) duration of whaling (days of active whaling), (f) timing of whaling, (g) length of trips and area searched while whaling (possible GPS track), (h) "catch per unit effort," (i) observations of whaling participants. Systematic retrospective and observational/interview data collection on: (a) Non-whaling subsistence activities on and near Cross Island (who, what, where, when), (b) observations of local subsistence users. NOTE: Systematic observation and recording of weather and ice conditions will also be required, as they directly affect the subsistence behavior in question. Detailed information about industry activities at Northstar and Liberty will also need to be available, but are not part of this data collection. Will also need to consider informant explanations for changes in behavioral patterns.	Annual tabular information on harvest levels and locations of subsistence resources taken on or near Cross Island. Hard copy map appended as required for clarification of location information. Annual tabular summary of people involved in whaling – number of whaling crews, size of each crew, number of active days whaling, number of crews/people present each day, estimation of total effort. Annual tabular summary of people involved in other subsistence activities – number of people each day for each activity, estimation of total effort. Annual narrative summary of Cross Island whaling season and associated subsistence activities. Contractor will alert MMS COTR of any important trends or changes.

decisions that whaling captains make - when to go out to Cross Island to start the season, the judgment of what conditions are suitable for scouting for whales and which are too marginal, where to search for whales, and so on. Some of these factors have been described and discussed in this report, but are very difficult to quantify. Because of the continuity of captains and whaling crews over the seven years discussed in this report, it became clear that most whaling crews and captains displayed consistent characteristics from one year to another, but that individual captains and whaling crews could differ markedly from each other in these characteristics. This is not surprising as all whaling captains are individuals and their whaling crews all display some unique characteristics. To adequately discuss this topic would require a deep and rich ethnographic description. That is far beyond the scope and intent of this project. In short, while this project has accomplished a great deal by documenting current Cross Island whaling activities, and discussing the variability and the factors accounting for it over the period 2001-2007, it has also made evident some of the other, and perhaps larger and more profound, questions that could be asked about Cross Island whaling.

It is nonetheless imperative that potential anthropogenic activities that could have adverse effects on Cross Island subsistence activities be better documented – not only oil and gas activities, but vessel traffic of any kind. This should include all commercial barge activity, recreational cruises (whether commercial or "self-guided"), research vessels, and perhaps even aircraft flights. At present, most (perhaps all) people have only the vaguest notion of how much such activity occurs in the Beaufort Sea.

"Non-Whaling" Boat Activity

In addition to searching for whales, Nuiqsut whaling vessels made trips between Cross Island and West Dock on a fairly regular basis. These trips were to pick up packages and supplies, or to do other errands. Generally, after a whale is butchered, one of the boats from the whaling crew that landed it made the trip between Cross Island and Nuiqsut to transport the meat and muktuk from the captain's *tavsi* to feed the village. Only a few other boats went to Cross Island from Nuiqsut other than the whaling boats. These boats were to bring help to butcher one of the whales in one case, and in several other cases were to bring or take away whaling crew members during the season. There were visitors of other sorts in different years – tourists, adventurers, polar bear researchers, and industry representatives on various missions or just on a sight-seeing visit. The people from these boats generally stayed for the day, or perhaps a night or two. Visitors from Nuiqsut generally stayed a bit longer - a day or two before returning to Nuiqsut, and helped with whatever tasks needed to be done (especially the butchering of the second whale in 2001). New whaling crew members generally stayed for the rest of the season.

This project focuses explicitly on Cross Island whaling activity, so little attempt was made to collect systematic information on these non-whaling activities or visitors. Also, information on preparation, support, or other whaling crew member activities that occurred elsewhere (primarily in Nuiqsut, one would assume) were not documented as part of this project. That remains for a larger project. There were two "landline" phones on the island during each whaling season (which, like the generator, operate only during Cross Island's whaling season), as well as a FAX. Thus, important business need not be put on hold while corporation and other officials are whaling on Cross Island. Contacts and interactions through telephone, FAX, or non-whaling

non-Nuiqsut vessel were not fully documented, and such information was only collected as contextual background. Whaling crew members increasingly have cell phones that work from Cross Island, but no attempt has been made to measure how this has changed patterns of behavior on Cross island (except through opportunistic observations). Similarly, the pattern of use of video-players, DVD players, computers, gameboys and other gaming systems, and other such electronic equipment has not been systematically explored.

Other Subsistence Activities

All things considered, very little non-whaling subsistence activity was reported or observed over the course of the project at Cross Island during 2001-2007. The most consistent activity of this sort is the harvest of polar bears that are attracted to Cross Island by the remains of the butchered whales. The skulls of most of the whales landed by Nuiqsut whalers are lined up on the island some distance east of the butcher site, and somewhat further is where the rest of whale is disposed of, after butchering for human consumption is finished. Sometimes the polar bears approach too closely to the butchering activities or to the cabins where the whaling crews live while on Cross Island. If non-lethal hazing does not deter these bears sufficiently, they are shot. On average, perhaps one polar bear a year is shot for being a nuisance bear. Some years, no bears are shot. Other years more than one may be shot, but this would be uncommon. There are cases where a whaling crew member will come to Cross Island with the intention to kill a polar bear, but to do so he must first obtain the permission of his whaling captain. Most whaling captains consider whaling as the first priority while out at Cross Island, and butchering a polar bear and taking care of its hide is a great deal of work that would take a crew member away from whaling duties. A whaling crew member also has to be aware that even if he kills a polar bear and takes care of the butchering and hide, his whaling captain can claim the hide for himself, should he wish to do so.

Some sealing has taken place in a few years, but not every year. Whalers will sometimes look for a seal on the way back from scouting for whales, if a whale has not been landed, or will make a trip looking for seals around the island on a day when conditions are not suitable for scouting for whales. Most such attempts have not resulted is a harvested seal, however – perhaps three or four over the seven years described in this report. Some whaling crews will try to harvest bearded seal should one appear opportunistically on the boat's return trips to Cross Island, and perhaps two have been taken in this way over the course of seven years. Similarly, one whaling crew took a walrus that happened to present itself, some twenty or more miles west of Cross Island. The boat crew members in the boat that actually shot the walrus were all young and had never taken a walrus before. They did not realize how difficult the tow back to Cross Island would be, nor how hard it is to butcher a walrus for the first time. Another walrus with a calf beached on Cross Island and died. It was disposed of, after salvaging its tusks. One young walrus followed the whalers' boats into Cross Island one year, and was eventually shot. Other walrus have been heard from Cross Island, but only in one or two of the seasons discussed here, and walrus are not commonly encountered by Cross island whalers.

One whaling crew did take a fish net out to Cross Island during one or two of the seasons described in this report, but it was never deployed. Whalers say that in the past they fished while out on Cross Island at whale camp, and that they would also sometimes go hunting for caribou on the mainland, either while traveling to Cross Island or while they were out there. Of course, in

the past, and especially before the mid-1990s, Cross Island whaling seasons tended to be longer and whalers tended to be, or needed to be, more self-sufficient than they are currently. Much more can be transported to Cross Island now than in the past, and whalers have more resources with which to purchase supplies. Also, current whalers feel more of a time crunch than did whalers of the past. Whalers with jobs must often fit their whaling season into a two-week envelope of vacation or subsistence leave, whereas whalers of the past could comfortably spend more time.

Some bird hunting also took place, but again only in one or two seasons. For the most part, the subsistence food consumed on Cross Island, other than whale, is brought to the island from Nuiqsut. The typical whaling crew will bring frozen caribou, frozen fish, perhaps some moose, and a wide assortment of "store" food, much of it canned. Perishable food is most often kept in coolers on the roofs of the cabins, but a few captains have bought and transported freezers to their cabins at Cross Island, to take advantage of the generator provided under the terms of the CAA. It may be that the implementation of the CAA has reduced the need for whalers to engage in subsistence activities other than whaling while out at Cross Island, and increased their focus on whaling and thus shortened the time required for them to fill their quota, than would be the case in the absence of the CAA.

Specific non-whaling subsistence activities take took place during each season are detailed in the annual reports for each season, and the interested reader is directed to those reports (included as electronic files on the CD-ROM accompanying this report).

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Electronic Appendices

The following Directories are contained on the accompanying CD-ROM, and contain the files described below::

AnRpt2001 – 2001 Annual Report as PDF
AnRpt2002 – 2002 Annual Report as PDF and weather data as Excel
AnRpt2003 – 2003 Annual Report, Appendices A & B as PDFs, weather data as Excel
AnRpt2004 – 2004 Annual Report, Appendices A & B as PDFs, weather data as Excel
AnRpt2005 – 2005 Annual Report, Appendix C as PDFs, weather data as Excel
AnRpt2006 – 2006 Annual Report, Appendices A-C as PDFs, weather data as Excel
AnRpt2007 – 2007 Annual Report, Appendices A & B as PDFs, weather data as Excel
Data – Only on MMS and NSB archival copies, GPS and Excel data,2009 Final Report in Word2007 format
FinalRpt2002 – 2002 Final, revised 2001 & 2002 Annual Reports, 2001 & 2002 tracks by day as PDFs; weather data as Excel
FinalRpt2009 – 2009 Final Report in PDF format
ITM_Presentations – 2003, 2005, & 2008 presentation in PDFformat
OpenWater_Presentations – 2006, 2007, & 2008 presentations in PDF format
Other_Presentations – various presentations to AEWC, NWCA, SETAC, and workshops
Posters – ASLO Ocean Sciences (3/08) & American Cetacean Society (11/08) Conference posters in PDF format

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.