OCS Study
BOEM 2013-218

Monitoring Cross Island Whaling Activities, Beaufort Sea, Alaska:
2008-2012 Final Report, Incorporating ANIMIDA and cANIMIDA (2001-2007)

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Cover: Leaving Cross Island at the end of the 2012 subsistence whaling season

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PREFACE ON ORGANIZATION OF THE REPORT

This report is a summary and synthesis of the eleven annual reports (2001-2011) plus the summary 2012 data that have already been produced to describe each of the Cross Island subsistence whaling seasons from 2001-20012. These reports and supporting material are on the accompanying CD-ROM. Only summary and comparative data are 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 BOEM, for more detailed information.

There are three major narrative components to this final report. The first is a description of Nuiqsut/Cross Island subsistence whaling. The second is a discussion of the methodology used for collecting the primary data. The third is an analytical discussion of the primary data collected, within the context of the historical description of Cross Island whaling. All of the descriptive and methodological material has been presented to some degree in the Annual Reports, but most of the analytical discussion has not (although some appeared in the 2009 "final" report when the cANIMIDA funding terminated). Thus the major party of the report is the analysis that presents the major results of the project. While the detailed data from the 2001-2012 seasons documented for this project are the primary focus for these discussions, historical and archival information are incorporated when available and applicable.

Supporting material is contained in the following Directories 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
- AnRpt2008. 2008 Annual Report, Appendices A & B as PDFs, weather data as Excel
- AnRpt2009. 2009 Annual Report, Appendices A & B as PDFs, weather data as Excel
- AnRpt2010. 2010 Annual Report, Appendices A & B as PDFs, weather data as Excel
- AnRpt2011. 2011 Annual Report with Appendices A & B as PDF, weather data as Excel
- AnRpt2012. 2012 Summary Abstract with Tables as PDF, weather data as Excel
- Data. 2001-2012, Only on MMS and NSB archival copies, GPS and Excel data
- Example Field Manual Summary Data Files. Examples in Excel format
- FinalRpt2002. 2002 Final, revised 2001 & 2002 Annual Reports, plus GPS tracks by day
- FinalRpt2009. 2009 Final Report, Technical Summary of 2009 Final Report, PDF format
- FinalRpt2014. 2014 Final Report, Technical Summary
- ITM_Presentations. 2003, 2005, & 2008 presentation in PDF format
- OpenWater_Presentations. 2006, 2007, 2008, and 2009 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) in PDF format

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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 twelve seasons covered by this report. Paul Kittick, as my host for the first year (2001), when the project was still an unknown quantity to the whalers, has my utmost appreciation. Archie Ahkiviana agreed to be my host for 2002, when Paul did not whale, and also served as a host for the 2005-2007 seasons. Billy Oyagak served as my host for 2003, when neither Paul nor Archie whaled, and also served as my host for the 2007, 2008, 2009, and 2011 seasons. The late Thomas Napageak, Sr. was my host for the 2004 season, and his son Thomas Napageak Jr. for the 2010 and 2012 seasons. I of course also thank the other crews who were out on Cross Island during the 2001-2012 seasons – Nukapigak, Aqargiun, Ipalook, and Taalak. David Pausanna has been very helpful for help over the phone and while I have been in Nuiqsut, especially in the early years of the project. Thomas Napageak, Sr. 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 continued to invite me back for the duration of BOEM funding, 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. The AEWC (Maggie Ahmaogak and her successors) has been quite helpful throughout the project, as has the North Slope Borough Department of Wildlife Management (Craig George and Taqulik Hepa).

The Bureau of Ocean Energy Management (BOEM, formerly Minerals Management Service – MMS), Alaska OCS Region, provided funding for the basic 2001-2012 field seasons, and study development 2000-2001. Dick Prentki was the initial Contracting Officer's Representative (COR), followed by Dee Williams and Chris Campbell. All have been extremely helpful. Industry has also provided much help, from advice to more concrete logistical support. Through 2003, the project was conducted as a subcontractor to LGL Limited (Alaska) and Battelle (Washington). BPXA assisted with the transformation of the raw GPS track information into more usable GPS-based maps for the 2001-2003 data (appreciated, although long since replaced through in-house software). Other industry participants in the Conflict Avoidance Agreement have also provided logistical support. Meghan Larsen of ASRC Energy made the Deadhorse Communications Center logbooks available to me in a timely manner. Since 2005, 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. Bill Streever of BP and W. John Richardson of LGL have provided valuable reviews during that period.

The above notwithstanding, all errors and shortcomings of this report are the responsibility of Michael Galginaitis and ASR. But 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. Photos of some of the crews and individual whalers who participated in the project follow.


Left: Thomas Napageak Sr. in his cabin on Cross Island in 2004, his last whaling season. He was Chairman of the AEWC and senior Nuiqsut whaling captain.
Right: Thomas Napageak Sr. (far right) at the Cross Island butcher site.

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

Kittick crew in 2001, Paul Kittick at left.

Aqargiun crew in 2006, Captain Isaac Nukapigak in center in blue coat.

Oyagak crew in 2008, Billy Oyagak third from left.

Nukapigak crew in 2008, Edward Nukapigak Jr. fourth from left.

Napageak crew in 2002, Thomas Napageak Sr. on four-wheeler.

Napageak crew in 2010, Thomas Napageak Jr. on right (captain in 2005).

Ahkiviana crew in 2006, Archie Ahkiviana in the middle in front.

Ipalook crew in 2008, Herbert Ipalook Sr. second from left.

Taalak crew 2001, Captain Carl Brower (Taalak) not present.

Preparing the winch to haul up a whale, Carl Brower at right (20012).

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ABSTRACT

This Task Order, funded by the Bureau of Ocean Energy Management (BOEM) 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, Alaska Eskimo Whaling Commission 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 2001-2012. The project was also designed as a collaborative effort of the BOEM and its Contractor, Applied Sociocultural Research, the subsistence whalers from Nuiqsut, and the Alaska Eskimo Whaling Commission. Beyond the goal of the twelve years of descriptive information on Cross Island subsistence whaling activities discussed in this report, the project has developed a system for collecting such information that local whalers themselves can adopt, adapt, and maintain if they wish.

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 twelve seasons documented in this report, the time at least one whaling crew was at Cross Island ranged from 10 to 30 days, and the number of whaling crews active in any one season ranged from three to six. The number of boats taken to Cross Island and potentially available to whale ranged from seven to 14. Days when weather prevented the whalers from scouting for whales ranged from zero to 15, and days when whalers went scouting for whales ranged from three 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 four hours and 31 minutes to nine hours and 43 minutes. The average seasonal strike distance from Cross Island ranged from 9.1 miles to 25.9 miles.

The annual quota for the Nuiqsut whalers was four strikes, or a potential for 48 whales landed. They landed a total of 39 whales and also had three struck-and-lost whales, using 90 percent of their allocated strikes and landing 92 percent of the whales they struck. Only in 2005 and 2009 did they land less than 3 whales. In 2005, adverse ice conditions, poor weather conditions, and possible interference from a commercial barge limited their opportunities to physically find and approach whales. The whalers could reach the open water where whales were swimming on only two days. 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. In 2009, vessel traffic may also have been a factor, but whale sightings were few, and sighting conditions in general were difficult. Only two whales were landed, with an additional struck-and-lost, before the whalers closed their season due to deteriorating conditions. The whalers experienced adverse conditions of one sort of another in most other seasons (whales were somewhat distant from Cross Island and "skittish" in 2001 and 2002, there was poor weather in 2003-2007, and restrictive ice conditions in 2006) but were still able to use the limited windows of suitable whaling conditions to land whales. Both 2010 and 2011 were very short seasons with no days lost to weather. Whales were generally closer to Cross Island (eight 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 are included in this report and the Annual Reports cited in the References Cited section. The report also contains an historical account of the change in Nuiqsut whaling practices and discusses the variability measured in the 2001-2012 seasons in terms of environmental factors as well as possible anthropogenic impacts.

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ACRONYMS AND ABBREVIATIONS USED IN THE REPORT

Acronym or Abbreviation	Expanded Term or Reference
AA[1] or UA[1]	Ahkiviana Whaling Crew
BO[1]	Oyagak Whaling Crew
IAN[1]	Aqargiun Whaling Crew
IP[1]	Ipalook Crew
NAP[1]	Napageak Whaling Crew
NUK[1] or EMN[1]	Nukapigak Whaling Crew
PK[1]	Kittick Crew
TAL	Taalak Crew
ACS	Alaska Clean Seas
ADF&G	Alaska Department of Fish and Game
AEWC	Alaska Eskimo Whaling Commission
ANCSA	Alaska Native Claims Settlement Act
ANIMIDA	Arctic Nearshore Impact Monitoring in Development Area
AOGA	Alaska Oil and Gas Association
ASR	Applied Sociocultural Research
ASRC	Arctic Slope Regional Corporation
BOEM	Bureau of Ocean Energy Management
BP	Barometric Pressure
BPXA	British Petroleum Exploration Alaska
cANIMIDA	continuation of ANIMIDA
CAA	Conflict Avoidance Agreement
CI	Cross Island
DDC	Deadhorse Communications Center
F_PT	Furthest Point (on a scouting trip) from Cross Island
ft	Feet
GIS	Geographical Information System
GPS	Geographic Positioning System
HAD	Human Activities Database
HP	Horse Power
IHLC	Iñupiat History, Language, and Culture Commission
IWC	International Whaling Commission
Lat	Latitude
Long	Longitude
m	Meter
MFCI	Miles From Cross Island
mi	Mile
MMS	Minerals Management Service
MPH	Miles Per Hour
N,S,E,W	Compass directions (north, south, east, west, northeast, etc)

Acronyms and Abbreviations Used in the Report (Cont.)

Acronym or Abbreviation	Expanded Term or Reference
mmddyy	Date Format – month/day/year
NA	Not Applicable or Not Available
NSB	North Slope Borough
NSBDW	North Slope Borough Department of Wildlife Management
NWCA	Nuiqsut Whaling Captains' Association
OCS	Outer Continental Shelf
OWA	Oil/Whalers Agreement
RT	Round Trip
S&L	Struck-and-lost
TOT	Total Time (of individual boat trips)
UIC	Ukpeagvik Iñupiat Corporation
UNK	Unknown
w/number or /number	With the specified number (of people)
WCA	Whaling Captains Association
WD	West Dock (Prudhoe Bay)
WF	Weather File (time series of weather station measurements)
Whale ID	Identification number assigned to each landed whale by the NSBDW
whl	Whale
[1]When whaling crews use multiple boats, each boat is differentiated by a number after the crew designation (1-4)	

GLOSSARY OF IÑUIAQ TERMS USED IN THE TEXT

Iñupiaq Term	English Term
atigi	Pullover parka with the fur on the inside
atikluk	a slipcover for the atigi
Muktuk	Black skin of the bowhead whale attached to up to several inches of blubber – eaten boiled when fresh or raw when frozen
Nalukataq	Community whaling celebration hosted in June by a whaling captain who landed a whale the previous fall (for Nuiqsut)
niñiq	Part of the whale used for crew shares – the front “half” of the whale, plus half the tongue and various other parts
uati	Part of the whale used for the “community share” – the back half of the whale, plus half the tongue and internal organs and various other parts
Oogruk	Bearded seal
Tavsi	The captain’s share or “belt” of the whale, a 12 to 18 inch strip or “belt” (from the whale’s naval towards the front of the whale) cut all the way around the whale that separates the niñiq from the uati. It is used to “feed the village” at the successful captain’s house as soon as possible after the whale is landed, and is usually sent to Nuiqsut by boat from Cross Island with two crew members. The captain’s wife presides in the captain’s absence, since only under the most unusual circumstances would he accompany the tavsi to Nuiqsut. Parts of the internal organs, tongue, and various other parts of the whale also constitute part of the tavsi.

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CHAPTER 1: INTRODUCTION AND OBJECTIVES OF THE RESEARCH

Initially funded as a three-year component of a larger multi-disciplinary monitoring study, the project discussed in this report has grown into a thirteen-year (twelve-field-season) research project, most recently conducted as a stand-alone effort. Although normally a final report such as this would focus almost exclusively on the data generated during the period of the latest specific contract (in this case 2008-2012), the longitudinal nature of the overall effort requires that all twelve years of comparable data be discussed. To do otherwise would needlessly limit the discussion of continuity, variability, and change over time. Further, an artificial analytical focus comparing the results from the period of the present contract compared to the results of earlier periods would obscure, rather than illuminate, these discussions. Thus, this document will summarize, discuss, and analyze all twelve years of data collected during the three separately funded contracts.

The main analytical focus will be on interannual (year-to-year) variability and change or trends over time. A large amount of historical information, much of it appearing in annual reports prepared for the project, is reviewed for two reasons. This material provides at least some of the context required by the reader to understand the discussion of the results of the project, and it also gives a perspective to some of the long-term dynamics of Cross Island subsistence whaling. Much of this material derives from the literature, local sources such as the North Slope Borough (NSB), or from previous field work in Nuiqsut (the author first visited Nuiqsut in 1982). The more detailed data collected during the twelve field seasons at Cross Island for this project serve as the primary basis for the discussion of interannual variability, as well as for changes in Cross Island whaling behavior over time (and more specifically, for 2001-2007 period as compared to 2008-2012).

This report thus represents the analytical component of the project. The annual reports by necessity considered the reporting objective by summarizing the descriptive data collected in terms of measures likely to be useful in later analytical tasks, but did not discuss these measures or systematic comparisons except in a perfunctory way. This report discusses these measures, and others beyond those reported in the Annual Reports, to facilitate the discussion of variability from season-to-season. Most of these measures were included in the "final" report summarizing the 2001-2007 field seasons (Galginaitis 2009a) and reported in the 2009-2012 annual reports, but are discussed in a wider range of contexts in this report.

Only a brief summary of the evolution of this research effort is included here. The Arctic Nearshore Impact Monitoring in the Development Area (ANIMIDA) study was funded by the Bureau of Ocean Energy Management (BOEM, then known as 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 of ANIMIDA, 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 ANIMIDA study, for this as well as some other tasks. The intention was to collect data for three field seasons (2000-2002) and to produce an annual report 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, BOEM 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 BOEM as the prime Contractor for this component of the study, with Battelle contracted as the Core Contractor with responsibility for overall management of the study. The Cross Island component of this project was then extended through the 2012 field season, as a stand-alone project, with ASR as the prime Contractor (contract M08PC2009). This report represents the contractual obligation to produce a report discussing all twelve years of data collected for the ANIMIDA, cANIMIDA, and stand-alone studies. This is the final overall report for the series of contracts funding the study effort and terminates the project. As of the time of this report, there are no plans in place for BOEM to continue the collection of the longitudinal Geographic Positioning System (GPS) or observational data.

Units of measure are given in English units rather than metric, since those are the units used by the whalers and the original form of most of the data. Statute rather than nautical miles are used, again because that is what the whalers use (even when they refer to wind speed in "knots" they most often mean "statute miles per hour"). Metric units are used when referring to sources that used metric units. All times are given in military (24-hour) format, as this made computing various measures more straightforward. Dates are usually specified by the name of the month and the number of the day, unless the specific year is referred to, in which case a numerical format of month/day/year is used.

OBJECTIVES

This project has as its broad objective the description of subsistence whaling as currently conducted near Cross Island by residents of Nuiqsut. This focus was chosen for several reasons. Whaling is of fundamental importance for the Iñupiat, and they are keenly concerned about the potential impacts from offshore oil and gas development on their bowhead whale (and other subsistence) hunting activities. This topic is only briefly addressed in this report. Cross Island was chosen as a study site since it the closest subsistence whaling location to current (Northstar) and potential (Liberty, Camden Bay) offshore oil and gas production, and the one most likely to exhibit effects from such development. Also, while "traditional" subsistence whaling has been well documented in a number of locations, contemporary subsistence whaling, and especially fall

subsistence whaling, has not been as well documented. Changes in contemporary subsistence whaling have hardly been documented at all (except perhaps more recently in very general terms in the discussion of the effects of climate change). This research effort was 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 Geographical Information System (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. Discussion and analysis were deferred until the production of "final" reports at the end of each contract period for the project (Galginaitis and Funk 2004; Galginaitis 2009, this report). Among the many external databases of potential pertinence to the descriptive information collected under this task order are the Human Activities Database (another BOEM project) and remote sensing information on ice cover or other geophysical parameters. Other potential information linkages include AEWC records and untranscribed Iñupiat History, Language, and Culture Commission (IHLC) tapes, but the BOEM scope of work and funding did not include the incorporation of these data in this, or the other, "final" reports.

As a second broad objective, the project was designed as a collaborative effort among BOEM (and its Contractor, ASR), the subsistence whalers from Nuiqsut, and the AEWC. Beyond the initial goal of compiling information on Cross Island subsistence whaling activities, the project developed a system for collecting information (documented with a short field manual, Galginaitis 2013b) that the Nuiqsut Whaling Captains' Association or other interested parties can adopt, adapt, and maintain.

The "Scope of Work" for covering the 2008-2012 data collection was essentially a continuation of that for the earlier years of the project but did contain some modifications (primarily in terms of categories of data collection) based on the experience gained during those earlier years. Each of the listed goals and objectives (tasks) of the contract will be briefly addressed here, with more detailed discussion deferred to the appropriate section of the report:

- Project Management. The Contractor has worked closely with the designated Contracting Officer's Representative during the term of the contract. Progress reports were often handled through e-mail and phone calls, when significant events warranted such contact, rather than with formal written summaries at pre-determined times. Each invoice was accompanied by a formal narrative of project progress. The time schedule for more formal deliverables proved to be challenging throughout the contract, but all were ultimately delivered (Annual Reports, Journal paper, Field Manual, Final Report).
- Community Engagement. The success of the project depended on the engagement and participation of the whalers. Each Annual Report discusses the process of community engagement for each of the study years, and the entire process is summarized in the

"Methodology" section. That section also extends the discussion of whaler participation rates in the research, especially as related to compensation for participation.

- Field Manual. One objective of the project was to try to foster the local capacity for Nuiqsut whalers to assume the task of collecting the monitoring data themselves. This has proven to be difficult for a number of reasons. This topic is discussed as another component of community engagement. A field manual has been produced that generally sets out the procedures to continue the monitoring effort for Cross Island whaling.
- Data Collection. Most of the data categories from the 2001-2007 project years were continued for 2008-2012. The main additions were the specific inclusions of hunter perceptions of bowhead displacement, access issues, and increased effort, risk or cost associated with displacement. This information had been integrated into the data collection effort since the 2005 field season (and more informally recorded as observed in the researcher's field journal for earlier years), so that information for all years is generally comparable. Each of the specific data categories listed in Task 4 of the contract is explicitly addressed in the "Results" section of this report.
- Analyze Data. Limited data analysis, related to potential changes in whaling activities from one year to another, appeared in the Annual Reports prepared for and submitted to BOEM after each field season. For the most part, this was confined to how the whaling season most recently documented resembled or differed from previously documented whaling seasons. The possible effects of natural (environmental) conditions were addressed, as were the reported instances of interference to whaling caused by commercial vessel traffic.
- Annual Field Reports. All Annual Field Reports, with accompanying geospatial data and supporting information, were supplied to BOEM.
- Final Report and draft publication. This task has two components. First, "[f]ollowing the last field season, the Contractor shall compare and summarize in analytical narrative the significant results from this study (2008-2012) with the 2001-2207 annual reports from the ANIMIDA and cANIMIDA projects. " This report fulfills that requirement not by comparing summary results from 2008-2012 with those from 2001-2012, but rather (as described above) by treating the dataset as a whole to discuss continuity and variability over time, and especially directional change in whaling or whaling practices. The second requirement, for a draft of a scholarly article about the project, suitable for publication in a peer-reviewed journal, has been satisfied by "Iñupiat Fall Whaling and Climate Change – Observations from Cross Island." A copy was sent to the COR and the paper was presented at the 28th Lowell Wakefield Fisheries Symposium on March 28, 2012. It has been accepted to appear in the published papers of the symposium. Two peer reviews of this paper have been recently received, and a revised version has been accepted (early March 2014). Proofs will be received and reviewed shortly. The publication date is not yet known.
- Present Major Findings. Throughout the project, stakeholder groups have been advised of the latest results. The NWCA has received a presentation of results after each field season. The AEWC and all Nuiqsut whaling captains have received copies of all the reports. Project results were presented to the Open Water Meetings in Anchorage in 2009 and 2010 (but not requested for later years) and at the AOGA Environmental Studies Symposium, Anchorage AK, May 4, 2009. Most of these presentations are provided on the final report CD-ROM.

HYPOTHESES GUIDING DATA COLLECTION

BOEM 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, in principal, be tested using the information collected by this research effort and other data sources on non-whaling factors potentially affecting Cross Island subsistence whaling. These were initially formulated in an explicit matrix format specified by BOEM, and is presented in Appendix B with a short discussion of its evolution over the time span of the Cross Island project. Two major hypotheses (in "null hypothesis format") were formulated – that subsistence whaling activities near Cross Island are not significantly affected by oil and gas activities at Northstar and/or Liberty, and more broadly that subsistence activities in general in that area are not so affected. After several field seasons, several supplemental hypotheses were added, relating to the effects of natural conditions and the possible variation of certain description measures for Cross Island subsistence whaling (Appendix A).

For the practical purposes of data collection for the project, the two major hypotheses (and later the supplemental hypotheses) were reformulated as positive statements of possible effects:

- Hypothesis 1: Subsistence whaling activity and behaviors in the vicinity of Cross Island are significantly adversely changed by offshore oil developments at Northstar and/or Liberty.
- Hypothesis 2: General subsistence activities on/near Cross Island are significantly adversely changed by oil and gas activities associated with Northstar and/or Liberty.

The null hypothesis format 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. Such an analysis is also beyond the scope of this document, since the collection of information on oil and gas activities, other vessel traffic in the Cross Island area, and other potential non-whaling factors was not part of this project and is not publically available. Rather, this document will discuss the variability in Cross Island whaling historically (major developmental trends) and in terms of inter-seasonal variability using the more detailed information from the 2001-2012 seasons. A final discussion relating these dynamics to the potential impacts of other activities in the area, based on the sparse information available, will introduce a short treatment of the information required to more formally test the test hypotheses.

In summary, hypotheses have been formulated as examples of possible relationships that are testable after concrete quantitative measures of empirical Cross Island whaling factors, and the factors that may potentially influence and/or change them, have been compiled for a number of years. The hypotheses (and the Cross Island subsistence whaling 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). The detailed information on oil and gas activities required to test hypotheses about their effects on Cross

Island subsistence whaling is available neither for the period of this project, nor for earlier periods of Cross Island whaling (for which only "anecdotal" accounts from the whalers exist). The "Results" section will discuss these hypotheses in a general discussion of anthropogenic effects on Cross Island subsistence whaling. Specific hypotheses may be testable, if and when more detailed information on the other anthropogenic activities taking place in the central Beaufort Sea become available. Since much of the "Results" section will address the variability and change in Cross Island whaling through time, and especially for the 2001-2012 period, the discussion will address how other factors such as weather or the choices and preferences of the whalers may explain some of the variability and change over time in Cross Island whaling.

CHAPTER 2: CONTEMPORARY SUBSISTENCE WHALING IN ALASKA

The Iñupiat of Alaska's 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 Iñupiat. Whaling not only provides a significant part of this food, but is also a key social organizational activity for North Slope Iñupiat. Whaling is also a central ideological idiom for the expression of key cultural values and is an important vehicle for the transmission of those values (Worl 1980; Rexford 1997). Subsistence whaling has been (and continues to be) a key focus for Iñupiat and Yupik culture and society (Bering Straits area and Northern coastal Alaska) for at least 1,000 to 1,500 years (Dumond 1984; Stoker and Krupnik 1993; McCartney 1995). 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). In a very basic sense, much of the timing and methods of Iñupiat subsistence bowhead whaling depends on the seasonal migrations of the Western Arctic (or Bering-Chukchi-Beaufort) stock of the bowhead whale. Traditionally and historically, Iñupiat communities hunted for bowheads when they were close and available. This is in the spring in the Bering and Chukchi Seas (all the communities southwest of Barrow in Figure 1), when "leads" open in the ice not far offshore from the communities, and in the fall in the Beaufort Sea, when the animals are relatively close to shore in the Beaufort Sea in more open water (Barter Island, barrier island harvest sites such as Cross Island). Barrow whalers hunt both in the spring and fall, but usually with more emphasis on the spring hunt. If Barrow fills its bowhead quota during the spring season they do not whale the next fall.

Spring whaling occurs when ice covers the entire ocean, with the ice nearest the shore grounded on the sea floor, or "shorefast." Wind direction is more important than wind speed for spring whaling, since "offshore" winds are required to open leads of open water in the ice. These leads are relatively narrow in width and are bounded by the shorefast ice and the floating pack ice. Once a lead is open, whaling crews will set up camp on the shorefast ice next to the lead. "Onshore" winds will prevent the formation of these leads or, once opened, will tend to close them, with the formation of high ridges of broken and crushed ice where the pack ice collides with the shorefast ice. A shift in wind direction that may close a lead is thus one of the primary dangers to a whaling crew deployed on the ice. The relative narrow width of the open water (due to the presence of the ice) tends to dampen any effect the speed of the wind may have to increase the height of waves or swells in the leads, however.

Fall whaling occurs when there is no shorefast ice. The offshore pack ice may be relatively close, or it may be quite distant from the shore. Floating chunks of ice in the "open water" area

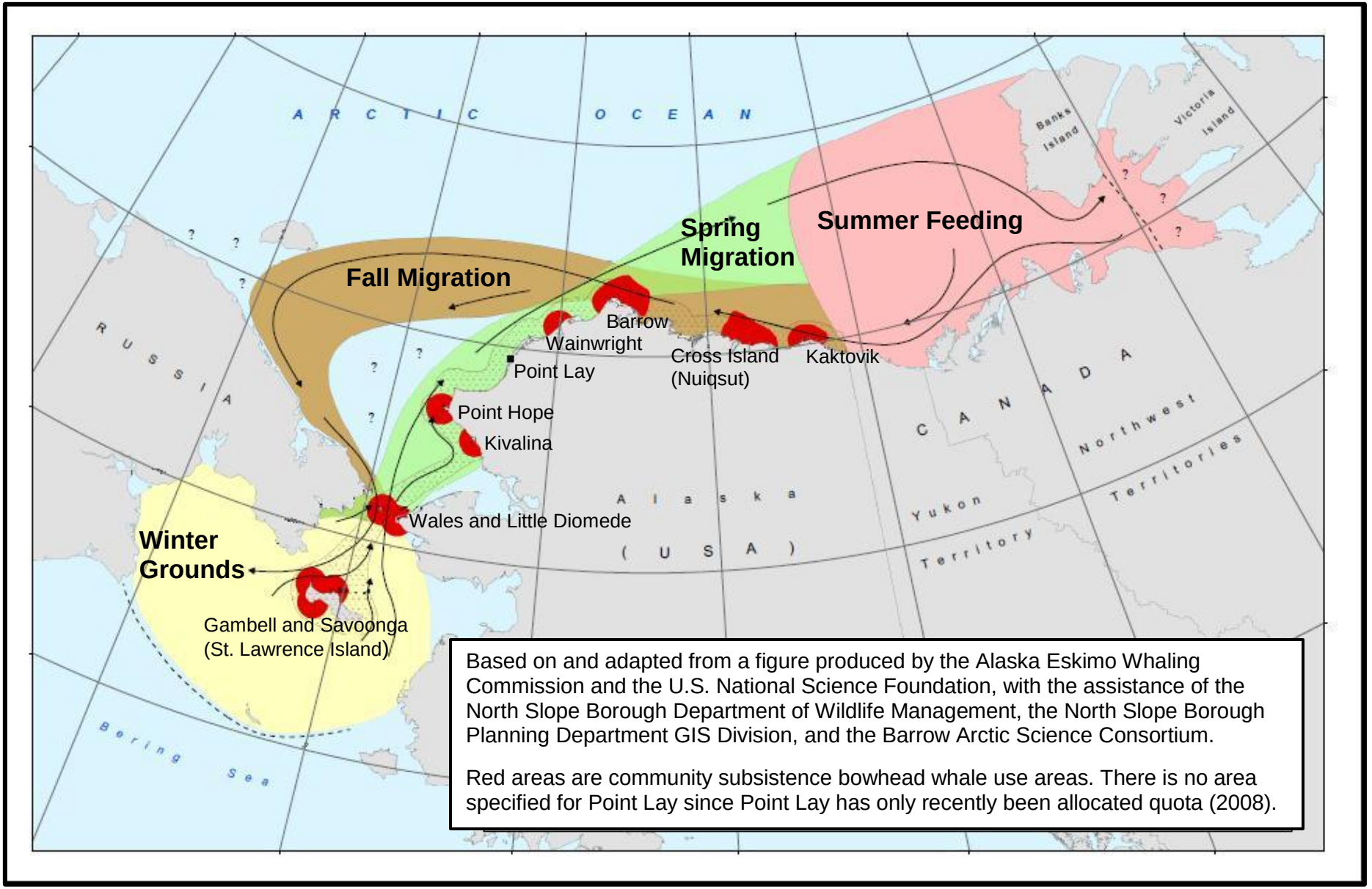


Figure 1. Bowhead whale map – generalized bowhead Western Arctic Stock migration route and location of Alaskan subsistence whaling communities' harvest areas

may range from very small to very large and may be non-existent (not present) to nearly ubiquitous. In the Cross Island area, pack ice was closer and floating ice thicker and more present during the period 1973 through the mid-1990s, and has been much less prevalent since then. For the study period (2001-2012), pack ice was quite distant from shore, and floating ice was only a significant factor (restricting access to whales) in 2005 and 2006. Wind speed is more important than wind direction for fall whaling, and especially so in the absence of floating ice and when the pack ice is relatively distant from shore. The larger the fetch (the horizontal distance over which wave-generating winds blow) and the stronger the wind, the larger the waves and swells resulting from that wind will be. The closer the pack ice is to shore, the smaller the potential fetch will be and the smaller the area the whalers need to search will be. The presence of floating ice in the open water between the shore and the pack ice reduces the "effective fetch" and thus dampens or reduces wave height and swells. Nuiqsut whalers report that bowhead whales also tend to stay near ice, if ice is available, and so will look for whales near floating ice or (in the past) the ice pack edge. However, whales that are struck may escape under the pack ice, if it is nearby, or may be able to "hide" among floating ice chunks, if the floating ice is large enough or extensive enough to hinder the speed or maneuverability of boats.

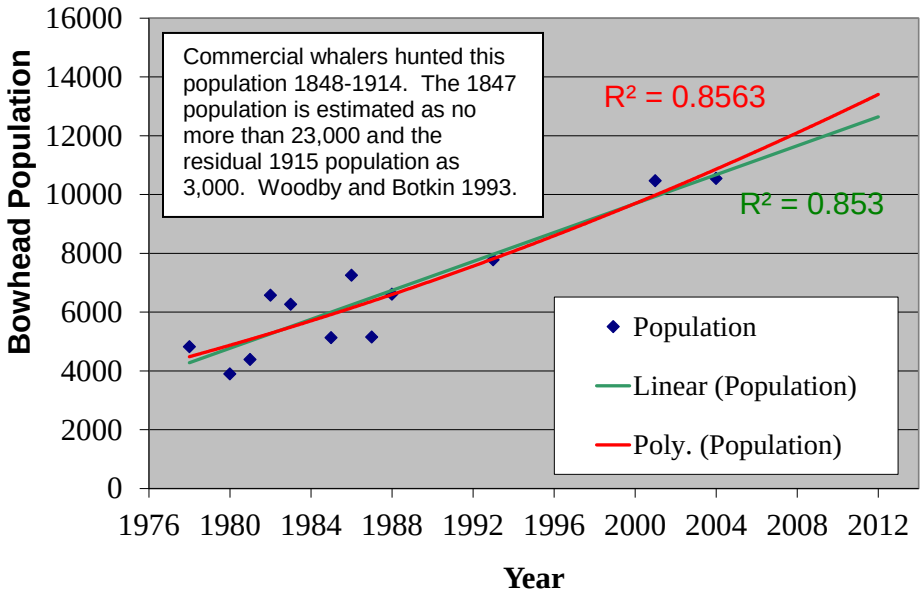
Spring whaling thus differs from fall whaling most fundamentally in the access whalers have to the whales. In the spring whalers wait for whales on the shoreward edge of relatively narrow open leads in the ice (with pack ice on the other side), and when they spot one will launch their boat and paddle to get into position to strike it. The water is generally more open in the fall (although there can be floating ice, at times quite extensive) and whalers actively search for whales and chase them once they are spotted. Gas-powered motors are required in the fall in order to get close enough to whales to strike them, whereas in the spring motors have generally only been used to help tow a whale once it is dead. Leads in the ice do not open up close enough to Nuiqsut or Kaktovik to allow these communities to whale in the spring. 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 (there is less ambient or environmental noise in the spring than in the fall), 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.

In the past, open water whaling in the Chukchi Sea in the fall was generally not possible due to high winds and rough seas. Currently this basic pattern still holds true, but with poor ice conditions in the spring, Barrow sometimes relies more on the fall hunt than the spring, and the Chukchi Sea and Bering Sea communities are sometimes trying to hunt in the fall as well (Brower 2013). Some recent changes in spring whaling (especially in Barrow) are briefly described and discussed in Wohlforth (2004) and can be summarized as the application of fall whaling strategies to marginal spring whaling conditions (poorer ice conditions and more open water than are desirable for traditional spring whaling).

Figure 1 is a simplified version of the gross aspects of the annual migration, but adequate for the purposes of this paper (it is recognized that not all Western Arctic bowhead whales follow this pattern, Rugh et al. 2003). Most overwinter in the Bering Sea, migrating north along the Chukchi Sea coast in the spring (April-May), swimming further offshore past Barrow as they

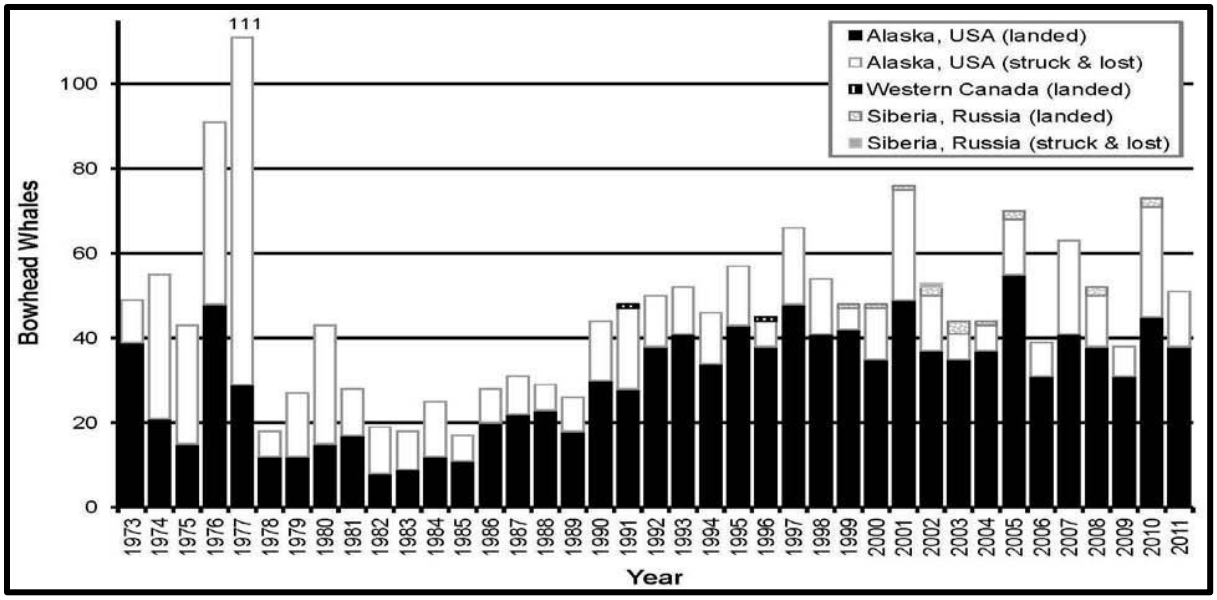
head east to their summer feeding grounds in Canadian waters. In the fall, they migrate west from Canada along the Beaufort Sea coast to Barrow (August-October), where they disperse, with many heading west to the Russian shore and then south to the Bering Sea. Some remain closer to the Alaskan-Chukchi coast (Allen and Angliss 2010; Quakenbush et al. 2010). Figure 1 also locates the eleven Alaskan whaling communities (with general whaling use areas) on a map and displays this 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, and this figure is somewhat dated.

Although the bowhead is still listed as "endangered" under the Marine Mammal Protection Act, better data, better management of the hunt, and a steadily increasing bowhead population (Figure 2) have reduced concern for the Bering–Chukchi–Beaufort stock (NOAA 2013; Reeves 2002). The overall management program has also created a successful incentive for the reduction of "struck-and-lost" whales (Figure 3). The overall quota of annual strikes for Alaskan subsistence whalers steadily increased from 12, when it was established in 1978, to 60 to 75 strikes a year under a more complicated and flexible multi-year quota in 1997. It has been renewed at that level since then, most recently in 2012 for six years. Nuiqsut's allocation from the AEWC increased from one to two in 1986, to three in 1989, and to four in 1995—roughly in parallel with the increase in whaling crews in Nuiqsut (see Huntington 1989, 1992; NMFS 1977, 1978 for a fuller account of the development and current management of the subsistence bowhead hunt in Alaska).



Source: Zeh, J.E. and Punt, A.E. 2005; George et al. 2004; and Craig George, personal communication 2007.

Figure 2. Bering-Chukchi-Beaufort Seas bowhead population by year, 1978-present



Source: Diagram reproduced from National Marine Fisheries Service 2013

Figure 3. Bering-Chukchi-Beaufort Seas Stock bowhead whales struck by year, country, landed, and struck & lost

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" – Walsh 1977; Mitchell and Reeves 1980). 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.

The IWC sets an overall quota for the hunt, and the AEWC 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. Quota is allocated in terms of "strikes," with a strike defined as "hitting a whale with a lance, harpoon, or explosive device" (50 CFR 230.2). It was, and still is, assumed for the purposes of managing the hunt's mortality that any bowhead whale struck is a dead whale, whether it is eventually landed by the whalers or not. Nuiqsut initially received an allocation of one strike for 1978. Its current allocation is 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 (which basically incorporates the explosive weapons introduced to the Iñupiat by the commercial "Yankee whalers" of the mid-1800s). 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).

The AEWC Management Plan 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).

The AEWC weapons improvement program (reporting annually 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. For the most part, Nuiqsut whalers still assemble their own black powder explosive bombs (with powder, fuse, and primer) rather than use penthrite bombs. Thus, subsistence whalers 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 Iñupiat 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 and were thus "lost." 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).

An historical illustration of Yankee whaler weapons is provided in Figure 4, with photographs of a Nuiqsut whaler cleaning a shoulder gun, a darting gun loaded with a penthrite "super bomb," blackpowder whales bombs with quarters for scale (the shoulder gun bomb has fletches since it is shot through the air), and the remains of bombs recovered from some whales landed at Cross Island. Figure 4 also shows a Nuiqsut whaler preparing a float by wrapping the harpoon line

around provides an example of a typical Cross Island boat crew about to leave for a day of scouting for whales. This boat prominently displays the darting gun as carried on the boat until the harpooner prepares to use it to strike a whale. Note that all crew members are wearing white coats and that the boat's hull is white in color. Whalers state that animals in general, and whales in particular, are wary of strange or different stimuli, and that the white hull of a boat mimics floating ice as seen from below. They report that at times whales will surface near their boats, especially in the absence of actual ice. Their white coats are similarly explained as helping them blend into the natural surroundings. It is an expectation that all crew members will have a new (and thus clean) white atigi (pullover parka with the fur side on the inside) or more commonly an atikluk (a slipcover for the atigi) – often provided by the whaling captain's spouse. The new and clean garment is a sign of respect for the whale (see next section, "Spiritual Aspects of Subsistence Whaling").

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). This will be distinguished in this report from "boat crew," since it is not uncommon for Nuiqsut whaling crews on Cross Island to consist of several boat crews, all under the supervision of a single captain. 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 – all important tasks for a successful whaling season). "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 4. The usual position for the harpooner is at the front of the boat, as is the case in Figure 4, and the darting gun and holder are typical for Nuiqsut whalers. The harpoon line is always rigged on the right side of the boat.

When "crew" is used with no modification in this report it will refer to the whaling crew as defined by the AEWC. Thus 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 varies from crew to crew. "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 for some crews more than others. On occasion, a member of one crew will go out scouting for whales in the boat of another crew. 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, not common in other whaling communities or in Nuiqsut's past. These topics are discussed in more detail in Chapter 6 ("Crew Dynamics" in "Results").

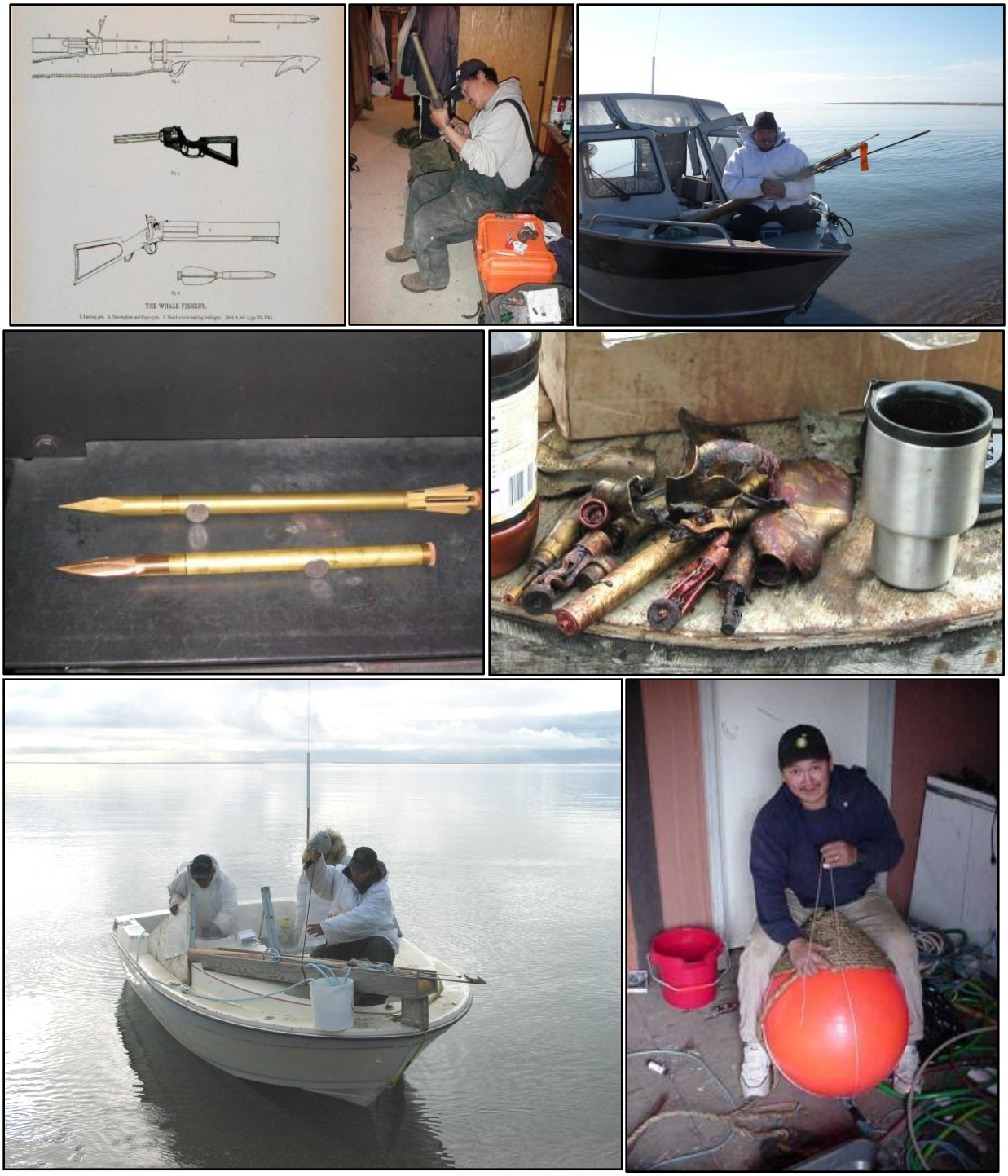


Figure 4. Cross Island whaling weapons and equipment. Left to right, top to bottom – NOAA archive photo of darting and shoulder guns, cleaning shoulder gun, harpooner holding darting gun with penthrite “super bomb” and harpoon, “traditional” blackpowder whale bombs (quarters for scale), some fragments of exploded bombs recovered from whales, whaling boat at Cross Island preparing to go scouting for whales, wrapping rope on float (to attach to darting gun, and would be located in the back of the boat in the previous photo with extra rope coiled in the bucket at the front of that boat)

CHAPTER 3: SPIRITUAL ASPECTS OF SUBSISTENCE WHALING

An examination of the spiritual underpinnings of whaling was not contemplated as part of this report, but a brief discussion explicitly focused on whaling as conducted from Cross Island is included, at the request of the Contracting Officer's Representative, to help the reader understand the fundamental importance of subsistence whaling to Iñupiat whalers. This discussion is neither comprehensive nor definitive, and is based more on the empirical observations and whalers' statements documented for the research than on an epistemological examination of ideas or philosophies. A more developed treatment of the topics and behaviors discussed below for Nuiqsut is available for Barrow subsistence whaling (Kishigami 2013). While the Barrow material is not completely applicable to Nuiqsut practices, much of it is, and especially the discussion of spirituality and Christianity and the general outline of how sharing the whales takes place. The amount distributed in Nuiqsut to each family is generally larger than in Barrow given the larger size of Barrow and the need to share the whale among a greater number of people. Crew shares in Nuiqsut also tend to be larger than in Barrow, given the lower numbers of crews participating in killing, and especially in butchering, whales on Cross Island as compared to Barrow (and this is one reason people from Barrow sometimes participate as members of Nuiqsut whaling crews). Bodenhorn (2003) also provides a brief but cogent treatment of the communal values and cultural beliefs that make whaling the iconic Iñupiaq subsistence activity.

It is an anthropological truism that subsistence activities actualize Iñupiat cultural values, and embody the fundamental relationship of the Iñupiat as a people with the place where they live. Although now integrated into a monetized economic system, subsistence activities continue to define how Iñupiat think of themselves as individuals and as a community. In a strictly utilitarian sense, Nuiqsut subsistence users procure most of their protein from subsistence resources (mammals and fish) and share these resources widely, both within Nuiqsut and with friends and relatives in other communities (ADF&G 1991, 2012).

For Nuiqsut, the subsistence harvest is about evenly split among fish, terrestrial mammals, and marine mammals. The great majority of the marine mammal harvest comes from bowhead whales because of their great size, although seals (and especially bearded seals) are a desired food (ADF&G 1991, 2012; Galginaitis 1990). Although subsistence provides an important component of the Iñupiaq diet, subsistence activities also vitally maintain the relationships of the Iñupiaq to the land and ocean and to the resources located there. These activities also maintain the social relationships of the Iñupiaq with each other, by the communal nature of harvesting the resources, and then sharing them widely. Whaling is the most iconic subsistence resource on the North Slope in these terms. Whales must be harvested and processed in a collective effort, and the butchered and processed whale is distributed during the most important community celebrations (Thanksgiving, Christmas, and Nalukataq). For the Iñupiat, "The sea is our garden" (Rexford 1997; Kaleak and Rexford 1993).

Nuiqsut whalers' respect for the bowhead whale governs much of their behavior throughout the year - while preparing for the hunt, during the hunt while they are on Cross Island, and after the hunt. These beliefs and behaviors combine and include a mixture of "traditional" and "Christian" elements. Jolles (2002) and Brower (2004) are two recent ethnographic works that explicitly and at length address Yupik and Iñupiaq belief and behavior, and the interrelationships

and dependencies between northern peoples and whales. Kawagley (1995) is a more general exposition. The truly interested reader is directed there. What is included here is a much more limited effort, confined to opportunistic observations made tangential to the much more empirically-based monitoring study actually funded by BOEM.

Nuiqsut hunters share the belief that animals "give themselves" to the worthy hunter, and bowhead whales are no exception. Whales are perhaps again the iconic example of this belief, as exemplified by Brower (2004), *The Whales, They Give Themselves*. It is especially easy to understand this idea in the context of spring subsistence whaling, where the whaling crews wait along the ice edge and only launch their skin boats when a whale appears close to their location. For fall whaling in general, and near Cross Island in particular, this model may not appear to hold so well. In such open water conditions, the whalers must actively search for whales and, when they see one or more, must actively chase them until they are tired enough for the whalers to approach and have a chance to strike. However, the same belief applies – only the worthy hunter sees the whale and obtains the opportunity to strike, even if he (or she) has to exert a considerable effort to gain the opportunity to strike. The same applies to caribou, as some people are said to be able to find (and harvest) caribou much more frequently than others, even when they hunt the same areas at about the same time. Each hunter may put in equal effort, but the "worthy" one finds more caribou.

Another shared belief is that the head must be cut off whatever animal is taken, so that its spirit is released and can return as another animal, either for the same or another hunter. Nuiqsut whalers have stated that they sometimes see the same whales in the same areas at the same time every year and explain this in two ways. The first is the obvious explanation that the whale migration takes place in a regular and predictable manner, and the same animals appear in the same areas at about the same time each year. The second is that Nuiqsut whalers land whales in the same general area each year, and that for the truly worthy whaling captain, the same whale will come back every year to give itself to him (and his wife and crew).

Another aspect of this is the concept that the whaling captain (and really all hunters) do not hunt for themselves, but for the whole community. Each hunter is supposed to give away the first of any species that he (or she) is responsible for taking and usually does so by giving it or portions of it to Elders or others who have no one to hunt for them on a regular basis. When big game is taken (moose or bearded seal especially), it is not unusual for the successful hunter to state on the radio that people can come over for a portion. It is common for a moose to be fully distributed in this way the same day it is brought back to Nuiqsut. The bowhead whale is only an extreme example of this. It is a very large animal, and the successful whaling captain is "allocated" an extraordinary portion of the animal (already described above) – but this is not for the captain to use, but is rather a responsibility that he must take care of for the benefit of the community and distribute back to the community at the proper times. One whaling captain generalized this even further, saying that a whaling captain was one whose household was able to share all sorts of subsistence resources widely through the community. Such a household thus needs to actively harvest many different subsistence resources besides whale – caribou and fish being the two other major categories, although moose and oogruk (and smaller seals) are also important. To him, a true whaling captain had to be generous and "Rich in meat," and not simply be a person able to field a whaling crew and occasionally land a whale.

Nuiqsut whalers also state that whales have keen senses of sight, smell, and especially hearing. People are urged to be cooperative and not to argue or fight, or the whales will hear them and avoid them. The whale is believed to favor, and to give itself, to the captain who behaves properly (and this included his wife and crew as well). Captains must clean their yards and ice cellars before leaving for Cross Island to whale, and if once on Cross Island the weather is poor for extended periods of time or the whales are elusive, the whalers often explain it by invoking their imperfect behavior. They may say that the different crews are arguing or not cooperating enough, or that Cross Island is "dirty" (not being kept clean and neat enough), or that they have not been treating the animals they have harvested properly (primarily whales or polar bears taken during the whaling season). As discussed above, a respectful hunter always cuts the head off any animal he or she kills (even if for some reason the animal cannot be used) so that the spirit of the animal will return. One Cross Island behavioral norm (although increasingly amended as discussed in a later section below) is that a landed whale be butchered to at least the stage where its head is cut off before whaling crews resume scouting for whales. Nuiqsut whalers do not return any part of the whale to the ocean, but have begun to curate the upper jawbones of all whales landed in an orderly row on Cross Island (Figure 5). This seems to have started from a desire to move the boneyard (the disposal area for the remains of whales after they are butchered and thus a polar bear attractant) further away from the whalers' cabins, but also was a way to occupy some time on a "weather" day early during the 2001 season, and may well have also been a manifestation of "cleaning up the island" before the main whaling effort began. At the same time, the whalers took the opportunity to memorialize the whales (and the captains who landed them) by separating the whale jawbones and arranging them in a line. The practice of adding each new jawbone to the line after the butchering of that whale is completed has continued.

All captains also remove and retain the ear drums from all the whales they land, although not always during the season the whale is landed. This again reflects the belief that whales not only have a keen sense of hearing, that they are sensitive to discord (and thus loud disputes) among humans, and that they give themselves to a captain who maintains harmonious relationships among his crew and in the community at large. Most captains retain the ear drums, but they sometimes give them away (usually to a crew member, relative, or friend). Occasionally, one can find a native craft item in Anchorage or Fairbanks that incorporates a whale's ear drum, but these seldom can be identified with a specific captain or village.

Most Nuiqsut residents will identify themselves as Christians, but in general attendance at church services is low and predominately female (Galginaitis et al. 1984). Whaling, at least in terms of crew activity on Cross Island, is predominately male (although of course much of the processing of the whale in preparation for storage and later distribution requires a great deal of female labor – to the extent that it is sometimes said that the wife is the true captain, the one to whom the whale gives itself). Thus, it may or may not be surprising that many significant stages or events in the Nuiqsut whaling cycle are marked as a communally important event with a Christian prayer or invocation (often in Iñupiaq).

Beginning the whaling cycle arbitrarily with the period just shortly before the whalers leave Nuiqsut for Cross Island, the following events have been observed to be "spiritually marked" during the course of this project:

- The NWCA meeting held in August to determine the "open fire" date for the season and to discuss other matters of importance for the upcoming whaling season (registration of captains, any new AEWC regulations or recommendations, the status of the Conflict Avoidance Agreement, logistical issues, and potential solutions) begins with a prayer or invocation, usually delivered by the oldest captain in attendance in Iñupiaq.
- A church service is scheduled several days before the first crews are expected to leave for Cross Island, for the explicit purpose of blessing all the whaling captains and their crews. Although few Nuiqsut whaling captains are regular church goers, those whaling captains present in Nuiqsut almost always attend this service.
- All crews have a "crew breakfast" at their captain's house the morning of the day they leave Nuiqsut for Cross Island, which always begins with a prayer or invocation delivered by an invited Elder, almost always in Iñupiaq.
- When a crew or crews leave Nuiqsut for Cross Island, the event is always announced beforehand on the CB and/or VHS radio, so that the community can see them off. Before the boats actually leave, all present at the boat landing form a circle, holding hands, and an Elder (or the pastor, if present in Nuiqsut) delivers a prayer or invocation. The crew or crews then get ready to depart, and candy is distributed to children and the others present.
- Once the whalers are on Cross Island, church services are normatively conducted each Sunday morning, before any scouting activities take place. In the past, no scouting activity would take place on Sundays, but this restriction has been relaxed, evidently in recognition of the need to land three or four whales within a relatively short window of opportunity.
- Some (but not all) crews will pray just before getting on their boat before each scouting trip.
- All captains deliver a prayer over the radio once they land a whale, at the time when the whale is determined to be dead (and this is most often the official time of the kill).
- While the whalers are still out at Cross Island, the tavsi (a specific part of the "captain's share" of the whale his crew landed) is sent to Nuiqsut as soon as possible to "feed the village". This takes place at the house of the captain who landed the whale, and Elders are given precedence in terms of being served first and being given space to sit and eat if they wish. Most people come and take pre-packaged "to go" portions. Before any serving starts, one of the Elders present delivers a prayer or invocation.
- The subsequent community events at which whale is distributed (along with other subsistence food) are all begun with a prayer or invocation delivered by an Elder. Each "stage" of Nalukataq (the whaling celebration held by each successful captain in June) also starts with a similar prayer or invocation.

Most of these events are illustrated with a photo or photos in Figures 5 and 6.

Figure. Photos of communal spirituality in Nuiqsut and on Cross Island. Top – row of bowhead jawbones at Cross Island; middle – two views of church service conducted for whaling captains, whaling crew breakfast, Cross Island church service; bottom – prayer at boat landing for crews leaving for Cross Island

Figure 6. Photos of communal spirituality – occasions for prayer. Top – Boat crews at Cross Island praying prior to scouting trips; bottom – Prayer before "feeding the village, prayer at the start of Nalukataq

CHAPTER 4: CROSS ISLAND (MID-BEAUFORT SEA) WHALING

The present community of Nuiqsut has a relatively short history, having been resettled in 1973. However, Iñupiat 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). Many of Nuiqsut's 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 before. 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. 1977, 1988; Galginaitis 1990; and Long 1996.

INTRODUCTION

Nuiqsut is located about 12 miles inland on the Colville River, which is not a typical location for a whaling community, and since about 1986 Nuiqsut residents have conducted subsistence whaling from Cross Island. Cross Island is about 73 miles northeast of the modern village of Nuiqsut and from 92 to 101 miles away by boat, depending on which channel of the Colville River can be used to reach the ocean (Figure 7). When the water level in the river is high, the more direct route can be used. When the water level 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 either route tends to be the 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 11 miles offshore, but more importantly from a logistical point of view is about ten miles from the Endicott causeway and 15 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. Figure 7 displays these landmarks and transit options. Figure 8 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 and are typical of those at hunting or fishing camps. Figure 8 also shows the four whales landed in 2006 (the first year all crews whaling at Cross Island each landed a whale, a significant event noted by the Nuiqsut whalers).

However, although a historically important whaling location, Cross Island was not always the focus of subsistence whaling in the mid-Beaufort Sea. The history of whaling in the mid-Beaufort Sea has four distinct divisions—aboriginal whaling, contact through the collapse of commercial whaling, post-commercial whaling through 1972, and 1973 through the present. The 1973 date is when the current community of Nuiqsut was resettled. Unfortunately, information for the first three of these time periods is relatively sparse and supports only brief discussions below. A more detailed historical account of Nuiqsut whaling, 1973 through the present, will necessarily include some 2001-20012 information, which will anticipate some of the still more detailed analysis of the "Results" section focused on the analysis of the 2001-2012 data collected by the Cross Island Subsistence Whaling Monitoring Project.

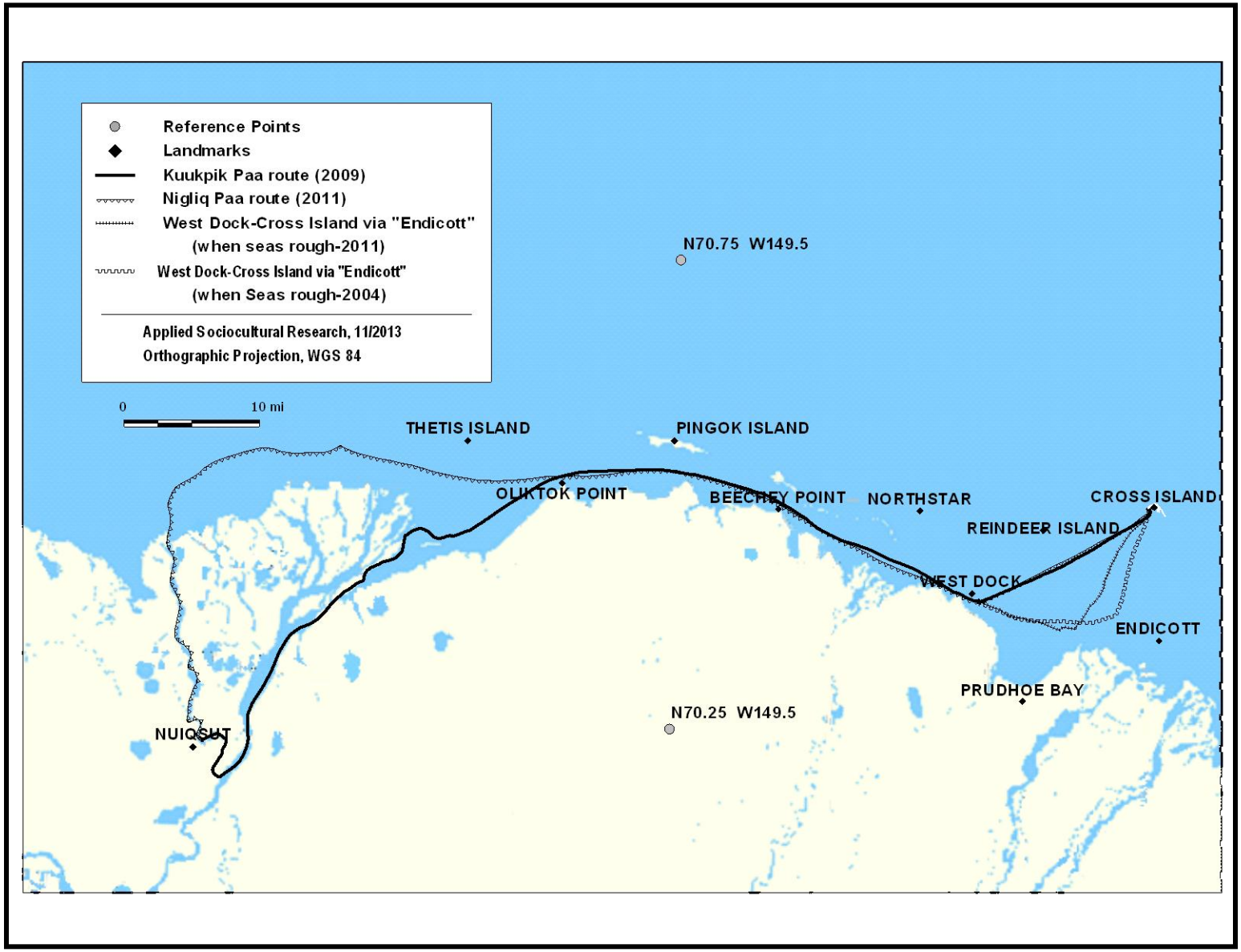


Figure 7. Nuiqsut/Cross Island location and travel routes, with landmarks

Figure 8. Pictures of Nuiqsut and Cross Island, and the 2006 harvest. Top left to bottom right: 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.

BOWHEAD WHALING IN THE MID-BEAUFORT BEFORE 1973

According to Hall and Lobdell (1981), archaeological evidence available in the early 1980s provides only the most meager cultural history for the mid-Beaufort region. Essentially, he states there is no unequivocal evidence of occupation in the area previous to 4,000 years ago, precious little data on the nature of human adaptation in Arctic Small Tool tradition times, and only enough information from the more recent sites to broadly outline a picture of human occupation in the past 600 years (the late prehistoric period).

While confining "unequivocal evidence of occupation" to the last 600 years may be questionable, the major point is that archaeological evidence on the time depth of human habitation in this area, and the types of activities in which humans engaged, is relatively thin. Almost all archaeological work in the area (before and after the 1980s) has been survey in nature and focused on areas likely to be affected by oil and gas exploration activities. For the late prehistoric period, there are few well-documented sites, and the published dates may be somewhat suspect. Extensive coastal erosion is also a relevant factor.

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

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

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

Iñupiaq whaling crews operating for purely local consumptive use were probably rare or non-existent. Some crews operated as "salvage" operations (e.g., Bockstoce [1986] notes the schooner *Penelope* sailed behind the whaleships "picking up carcasses") or on the commercial model of selling baleen while retaining the carcass for local consumption (Stefansson 1951). Iñupiaq whaling in the mid-Beaufort (except perhaps for the *Penelope*) seems to be undocumented for this period, and was probably low, due to population shifts to Barrow and other communities. Most commercial pelagic whaling took place to the east or west of the mid-Beaufort, with the peak pelagic activity in the mid-Beaufort taking place in 1869–1878, just before the introduction of steam technology (Bockstoce and Botkin 1983). Pelagic catch in the 1879–1888 period was very low and continued to be low even after the fleet had moved into the Canadian Arctic (1889-1908).

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

Documentation for early twentieth-century whaling harvests is incomplete, but include accounts of whales taken near Cross Island/Prudhoe Bay in 1921, 1922, 1927, 1928, 1931, 1935, 1937,

1938 and 1940, plus at least one prior to 1921 (Table 1). Most of these whales were landed by Taaqpak, but some were landed by Pausanna and Akpik and possibly others (Carnahan 1979; Long 1996; Shapiro and Metzner 1979; Smith 1980). Whales were of course landed at other locations as well, but documentation is even poorer and more difficult to find for them. It is not clear why subsistence whaling was suspended in this area after 1940. The decline of the reindeer industry and the lure of opportunities present in settled communities (employment, schools, churches, stores) prompted many residents to relocate to Barrow or Barter Island (Kaktovik). Certainly, this made the Mid-Beaufort area effectively more distant for the purposes of whaling, since there were few, if any, residents in the immediate area (Galginaitis et al. 1984). At any rate, the last documented whale taken in the mid-Beaufort before the resettlement of Nuiqsut was in 1940 by the famous Iñupiat whaler Taaqpak.

Table 1. Documented bowhead landings near Cross Island, pre-1973

	Whales			
Year	Quota	Landed	Struck & Lost	Notes
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)

Sources: As indicated in the "Notes" column. This is undoubtedly an incomplete list of subsistence whales landed in this area for this period, and represents only those found in the available literature.

NUIQSUT SUBSISTENCE BOWHEAD WHALE HARVEST, 1973 TO 1985

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 Caterpillar tractor with tracks, snow machines, and weasels (another sort of tracked vehicle, of World War II vintage). Nuiqsut's inland location, on the Nigliq channel of the Colville River (Figure 7), presented many advantages to the new settlers, especially better access to a wider range of subsistence resources than in Barrow – freshwater fish, terrestrial mammals, and marine resources. Nuiqsut's inland location also presents some challenges in terms of access to marine mammals and especially whales, and in this case is atypical for a whaling community. All other Alaska whaling communities are coastal. To whale, Nuiqsut residents must first reach the ocean, and all channels of the Colville River limit the draft of boats that can be used to whale from Nuiqsut. Once in the ocean, a suitable location from which to scout for and to butcher whales must be located. Until 1986, Cross Island was only one (although probably the most promising) of several possible locations for Nuiqsut whalers.

At least three men who resettled in Nuiqsut had been whaling captains and landed whales in Barrow, and quite a few others were experienced crew members. Most who continued whaling returned to Barrow seasonally to do so. The exception was Thomas Napageak, Sr., who had been a successful whaling captain in Barrow and at the time of resettlement was serving as the first mayor of Nuiqsut as well as the first president of Kuukpik Corporation, the ANCSA village

corporation. Current Nuiqsut whalers call him the father of contemporary Nuiqsut whaling (Galginaitis 1990). He went out whaling in the fall of 1973 to "look around" and landed a small whale near the mouth of the Canning River, in very shallow water (the details of the story vary with the teller and his audience and are not important here). This first whale was important for several reasons. It was the first bowhead landed in the mid-Beaufort for several decades. It established Nuiqsut as a whaling village, even with its inland location and terrestrial orientation. When Nuiqsut was incorporated in 1975, the city seal included a bowhead whale and other symbols of community identity (a caribou, a tent representing the first year the resident's spent in tents, and an Iñupiat face). As a whaling community, Nuiqsut was able to send representatives to participate in the founding of the AEWC in 1977–78 and thus obtain an annual quota when the International Whaling Commission (IWC) imposed a quota on the subsistence bowhead hunt.

As described above, Nuiqsut's whale hunt takes place in the fall. The edge of the ice pack is generally far from the Beaufort Sea coast, recently over 100 miles. Floating ice may be present closer to shore, and may affect the general route of the whale migration. Floating ice can, but does not necessarily, limit hunter access to the whales, and does not constrain whaling in the same way as leads in the pack ice do for communities that whale in the spring. Spring leads provide access to whales but also reduce the area for spotting whales – although the whale migration is not confined to the open leads, the whale hunt is and many whales travel in the leads rather than under the ice. In the fall, floating ice may be an aid or a hindrance (or both) to whalers. Ice floes may hinder whalers approaching and then chasing whales, since whales can swim under them while whalers in boats must go around them. The presence of ice tends to reduce the "dampen" wave height caused by higher wind speeds, or standing swells, and so may enable whalers to hunt in conditions that they could not in the absence of ice.

Fall whalers use aluminum or fiberglass boats with outboard motors, and must tow killed whales back to land (either shore or a barrier island), sometimes 20 miles or more, where the whales are butchered either on the beach or in the water. Mechanical equipment is usually necessary for the first (block and tackles can deal with small whales), since whales do not slide easily over sand and gravel beaches, and butchering in the water is a cold and difficult process. Butchering on land also requires care to minimize contamination with sand and gravel. The butchered products are then transported to ice cellar storage facilities in the community, but since snow cover is seldom present, this can be a difficult and time-consuming task in the absence of heavy equipment and motor vehicles. Heavy equipment has been present and used to assist butchering in fall whaling in Barrow since at least the mid-1960s (Durham 1974) and on Cross Island since 1992–93 (loader in 1992, winch to haul up whales in 1993).

For these reasons, fall whaling from Nuiqsut was difficult in the early years of Nuiqsut whaling (1973 to about 1985). The Napageak crew whaled alone until a second crew joined him, perhaps as early as 1982. Several more crews formed in the years soon after that. The first Nuiqsut whaling boat was a 27-foot wooden boat with an 85 horsepower (HP) motor. This was replaced with a fiberglass boat with a 55 HP motor sometime after 1982, but most other Nuiqsut boats through the 1980s were wood—although one crew did use an aluminum boat. Nuiqsut whalers indicate that they used various barrier islands as logistical bases in these early years, and perhaps especially Pingok Island, since it already had National Arctic Research Lab (NARL) research cabins that could be used for shelter. Few whales were landed during these years, and those that

were (in 1973 and 1982) were taken well to the east in the Flaxman Island area. While Pingok and other locations may have been used for temporary bases, the pattern for these early years seems to have been one of slow travel, generally near shore, camping on barrier islands and on the shore, and looking for whales in the shallower water (Long 1996).

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

Success in the early years of Nuiqsut whaling was infrequent, and the crews would often "settle" for bearded seal, once they had decided that they were unlikely to encounter a whale. Crews reportedly based themselves on Pingok Island for 1982–83 with trips as far east as Flaxman Island. Since they had not seen many whales near Pingok Island and were hearing noise from construction and drilling activities at Seal Island, they decided to move whaling operations farther east (Long 1997). In 1984 one crew went to Narwhal Island and one to Cross Island. In 1985 there were three crews at Cross Island and one at Narwhal Island.

Although 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 regular 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 three miles long and 150 yards wide, and is constantly changing due to erosion and redeposit ion. Especially in the earlier years logistical support for whaling on Cross Island was very difficult

Beginning in 1985 and 1986, crews reported seeing more whales. Oil and gas exploration activities were also peaking in the Beaufort Sea to the east of Cross Island in the mid-1980s (seismic surveys and exploratory drilling). Because of the perceived interference of industrial activities with Nuiqsut whaling activities, industry and the whalers (the whaling captain associations of Nuiqsut and Kaktovik and the AEWC), formed the Oil/Whalers Working Group and signed the Oil/Whalers Agreement (OWA) in 1986 (Long 1996, 1997; Oil/Whalers Working Group 1986). At the same time, industrial activities had prompted Nuiqsut whalers to focus their efforts on finding a whaling site east of the obvious center of oil development.

NUIQSUT BOWHEAD WHALE HARVEST, 1986 TO 2012 – CROSS ISLAND AND THE OIL/WHALERS AGREEMENT

The 1985 season had been a very difficult one for Nuiqsut whalers, due to a combination of heavy ice conditions and perceived disruptive effects from petroleum industry activities (Oil/Whalers Working Group 1986). This led to a series of discussions between representatives of the whalers and industry, resulting in a cooperative agreement between the two groups. The first year of the Oil/Whalers Agreement (OWA) was 1986, the same year that most Nuiqsut whalers began to consistently use Cross Island as their logistical base. One crew still maintained a logistical base at Narwhal Island until the early 1990s.

The OWA established a mechanism for avoiding conflict between industry and the whalers, primarily through a communications system, along with a method for dispute resolution. The OWA also provided logistical assistance to the whalers as mitigation for the unavoidable effects of petroleum industry activities (Oil/Whalers Working Group 1986). An early benefit of the agreement was industry assistance in towing (in emergencies) and transporting butchered portions of, whales in 1986 and 1987(Armstrong and Banks 1988). Another provision of the original OWA was that the whalers could haul gas from West Dock to Cross Island and from Endicott to Narwhal Island. This may have facilitated the growth in the number of active crews and increased success rates. Butchering was still hampered by the lack of facilities and whalers were limited to using a come-along or block and tackle to haul whales onto the beach. The OWA was renewed for several years, and then apparently lapsed due to the decline of oil and gas activity in the mid-Beaufort Sea associated with declining oil prices (Brower 2009). Exactly when it was reborn as the Conflict Avoidance Agreement (CAA) is unclear, as documentation for the 1990s is sparse.

It was not until about 1992, when the logistical difficulties of the coordination of whaling crews based on islands separated by 12 miles became too inconvenient, and the placement of a diesel-powered winch on Cross Island too compelling, that all crews began to use Cross Island as a common logistical base. It is probable that the winch and crew consolidation on Cross Island in 1992, due at least in part to increased industry logistical support, was part of the renewed OWA/CAA process – but the details are lost in the mists of time. The CAA is a private agreement between industry and the AEWC, and although recognized in the management process, it is not required by or a formal part of the management process (Aiken 2011). How much of the exploration (seismic and drilling) activity of the 1990s was covered by CAAs is not known, although the AEWC states, "Since 1986 [with a very few recent exceptions] every offshore operator working in the Beaufort or Chukchi Seas during the Open Water Season has signed the CAA. Northstar, Oooguruk, Nikiachuq, and Badami were developed under the CAA …" (AWEC 2012). The current AEWC website now describes the history of the CAA by reference to LeFevre 2013a (linked to their website). Cross Island whalers first used a front-end loader in 1992. The loader was used to haul the whale ashore and to assist in butchering. A diesel-powered winch was installed on Cross Island during the 1993 season. These additions may have fostered the formation of more crews (up to eleven by the mid-1990s), but probably were also the reason all Nuiqsut crews consolidated their activities on Cross Island and have been whaling from that location since 1992. Their harvest success rate also began to increase from that date. Nuiqsut whalers started to scout for whales farther north of Cross Island in the

1990s with more capable boats, a more secure gas supply, better butchering facilities, and faster and more efficient logistics for transporting the harvest to Nuiqsut. It is also important to note that when BP obtained the Seal Island prospect and renamed it "Northstar" the CAA process gained further salience, since a CAA is known to have been renegotiated annually since 1999/2000 (the start of Northstar development) – although copies of the CAAs are still not generally available.

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 Deadhorse Communications Center (DCC – also referred to as the Conflict Avoidance Communication Center or the Whaling Communications Center) in Deadhorse. The DCC 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 DCC in real time (purpose, time left, time returned, significant events as they occur), and the DCC 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 DCC to advise industry of planned activities that may interfere with ongoing whaling, or to suggest windows of opportunity (when whaling is not taking place) so 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 DCC 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 in connection with the CAA. 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)
- potable water (there is no water source on Cross Island) 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
- assurance of available emergency assistance.

Alaska Clean Seas (ACS), or a contractor with similar capabilities, is the industry's contractor for much of this CAA support. 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 in the future.

SUMMARY OF TRENDS IN NUIQSUT WHALING, 1973-2012

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

Nuiqsut whalers no longer "take time off" while whaling in order to hunt for food—they generally bring enough food for their stay on the island. In part, this is no doubt due to the ability to store these reserves at a safe and stable logistical base. The stable supply of gas and a desire for relatively sort seasons are probably also factors. Nuiqsut whalers will take the occasional bear, seal, or duck while on Cross Island—but only if no whaling activity is imminent, and they have their captain's permission. Whaling, at least the active hunting component as conducted from Cross Island, is a more focused activity and separate task now than in the past, in part because the pace of life in Nuiqsut has increased, so many whalers can no longer afford to be away from town for an indefinite period. Most crew members now plan for a two-week season.

The most significant changes current Nuiqsut whaling captains recall from their early years of whaling at Cross Island is the lack of ice in most recent seasons, the increased capabilities and speed of their boats, and the importance of the CAA (NWCA 2011). The switch from wooden to fiberglass and aluminum boats probably resulted not only in an actual decrease in the size of the boats, but also in a vastly greater power-to-weight ratio and probably a more efficient hull design as well. Nuiqsut whalers are almost certainly traveling farther offshore now than in the past, due to more capable boats, a more reliable fuel supply, and GPS navigation systems. The lack of ice has increased the need for speed, to find and chase whales, as well as for boats able to handle rougher sea conditions, than in the past. They stress the importance of the CAA to their whaling success thanks to a communications system, stipulations minimizing industry activities that might interfere with whaling, and better logistical support.

A complete listing of subsistence Bowhead whale harvest since 1973 by Nuiqsut whaling crews is presented in Table 2. 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 compared to previous years. 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.

Table 2. Documented harvest of bowhead whales near Cross Island

Year	Whales			Notes
	Quota	Landed	Struck & Lost	
1973	NA	1	0	Butchered in water near Flaxman Is./Canning R. delta
1982	1	1	0	
1986	2	1	0	
1987	2	1	0	
1989	3	2	2	Oil industry vessel disturbance noted by whalers
1990	3	0	1	Oil industry disturbance noted, also rough seas
1991	3	1	2	Poor weather, adverse ice conditions
1992	3	2	1	
1993	3	3	0	Very favorable whaling conditions
1995	4	4	0	
1996	4	2	0	
1997	4	3	1	
1998	4	4	1	
1999	4	3	0	
2000	4	4	0	Very favorable whaling conditions
2001	4	3	0	Whalers report whales tended to be “skittish”
2002	4	4	1	Whales not as skittish and closer than in 2001
2003	4	4	0	Poor weather, whales close to Cross Island
2004	4	3	0	Poor weather, whales close to Cross Island
2005	4	1	0	Very poor weather, adverse ice conditions, disruption
2006	4	4	0	Adverse ice conditions first half of season
2007	4	3	1	Overall poor weather, little ice, whales close
2008	4	4	0	No ice, generally poor weather and rough/variable sea conditions, whales close to Cross Island
2009	4	2	1	No ice, swells and some difficult sighting conditions, whales relatively distant
2010	4	4	0	Favorable whaling conditions
2011	4	3	0	Difficult scouting conditions, no ice, large whales
2012	4	4	0	Somewhat better conditions than 2011, more whales

Notes: Years of no harvest and no “struck-and-lost” are not listed. This does not imply that no whaling effort was made in those years. “Quota” was not applicable prior to 1978. It is not clear from the records (or informants) when the quota for Nuiqsut increased to 2 whales and then to 3 whales. **Sources:** Compiled from AEWC (2003) and NSB (2007) records, personal communications with Nuiqsut whalers, and field notes from the 2001–2011 whaling seasons.

SUMMARY OF CURRENT (2001-2012) NUIQSUT WHALING PRACTICES

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, 2001-2012, a minimum of three whaling crews and a maximum of six whaled from Cross Island in any one season, with an average of 4.83 and a median of five whaling crews per season. Eight different whaling crews were active for at least one season

during this period. Only one whaling crew participated in all twelve seasons – it was not unusual for a whaling captain (and his crew) to "take a year off," with a variety of reasons given (financial, personal, employment constraints). Crew membership generally varied from one year to the next. Variation ranged from one or two crew members to up to half of the crew.

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 return from Cross Island together on the same day. For the 2001-2012 seasons, as discussed below, patterns were clearly different, although Labor Day is a significant time marker for the start of whaling. Most crews left for Cross Island before Labor Day and while crews sometimes left on the same day, few actually traveled together. Most (but not all) whaling crews did leave Cross Island to return to Nuiqsut on the same day, but did not necessarily travel together. For five of the 12 seasons, one whaling crew stayed on Cross Island one day longer than the others.

One day is usually 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 is clearly due to the fact that polar bears are attracted to Cross Island by the whales that the whalers butcher. The bears represent not only a nuisance or potential hazard but also a possible opportunity for harvest, if a hunter had planned to take a bear while on Cross Island. 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 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. There were relatively few instances of this during 2001-2012, but probably at least an average of one per season (some seasons with none, others with several).

During the first two field seasons for this project, Nuiqsut whalers described their general whaling activities on Cross Island as follows (henceforth referred to as the "Old Rules" :

- Nuiqsut whalers 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.
- Only one whale should be landed on a given day.
- All crews on the water should assist in chasing and killing a whale that has been struck.
- All crews should assist in towing a whale, if needed (but for some whales, only a few boats are needed and more than that number would be more of a hindrance than a help).
- All crews should assist in butchering all whales until they are finished before resuming scouting for other whales (although it was not clear if this meant that it should be butchered

> to the final communal stage of division into crew shares or merely to the stage where the uati, niñiq, and tavsi were physically separated, the head cut off, and the head and remnants properly disposed of).

As will be discussed below, this description does not accurately model the 2001-2012 seasons, or even the 2000 season, which was given as the exemplar. Either the pattern of whaling has changed in response to changing conditions (the position that will be argued below) or these rules were always an "ideal" model rather than an accurate description of Nuiqsut whaling behavior. That discussion, based on a detailed examination of the 2001-2012 data and some consideration of earlier season information does not belong here and is deferred to a later section. Similarly, a detailed discussion of boat and crew numbers, and crew dynamics, is also deferred to a later section.

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 5-10 mph (or even higher in special circumstances) can be acceptable. Sea conditions generally correspond with wind speed, but scouting can occur even with higher winds. Ice cover, especially when the ice edge is not too far from shore but also to some extent if it consists of floating ice floes, generally moderates the effect of wind by dampening wave height. During the period of this report, 2001-2012, 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, fewer in 2002 (Galginaitis and Funk 2004), and almost none of significance since then (Galginaitis 2009a, 2009b, 2010, 2011, 2012, 2013a). 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 2009a).

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 3.8). 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 breakdown 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. This condition was generally met 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 2001-2012 the average number of boats out scouting for whales was actually 5.2, reflecting that for some periods of time periods only one or two whaling crews were present on Cross Island, some boats may have had mechanical problems, or other particular circumstances.

Once Nuiqsut whalers spot a whale and determine that it is a proper whale to take (generally 25 to 35 ft [7.6 to 10.7 m] 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. This technique is based on traditional Iñupiat knowledge of bowhead whales, and has developed from historical and traditional Iñupiat whaling practices modified by the availability of fast gas-powered boats and the decrease of sea ice in the fall. The whale is killed by the delivery of whale "bombs", which are in essence very large bullets or grenades with timed fuses (generally 4 to 8 seconds) that explode inside the whale. Iñupiat whalers adopted this technology from the commercial Yankee whalers (while the Yankee whalers, once they established shore-based whaling stations, adopted the Iñupiat methods and organization for whaling). Whales are struck by whale bombs via two methods: a darting gun attached to a harpoon, or a shoulder gun.

During fall whaling, the first bomb must be delivered via a darting gun, in order to attach a harpoon and float at the same time. 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 10 or 15 ft (3 or 4.6 m), 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 seconds 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. The first bomb kills some whales. However, when multiple bombs are required, the shoulder gun is useful because it can be reloaded and 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. The captain, or a trusted senior member of the crew, loaded and assembled the crew's 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; AEWC 2011).

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 usually towed to Cross Island 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 the loader that is on Cross Island seasonally for the whaling season and/or the diesel-powered winch, and butchered.

Nuiqsut whalers report that their butchering practices are based on those used in Barrow (see Kishigami 2013), but that they have been adapted to conditions on Cross Island. 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" (navel) 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's muktuk and meat into two parts, the niñiq ("crew share" – forward of the tavsi, composed of the upper torso of the whale) and the uati ("community share" – backward from the bellybutton of the whale to the tail). The internal organs (heart, kidneys, and small intestines), tongue, and baleen are treated somewhat differently. The internal organs are essentially treated as tavsi. They are preferred parts of the whale, especially by Elders, and what is not sent immediately to Nuiqsut to "feed the village" is treated as uati and distributed at public celebrations. Part of the tongue is reserved for tavsi as well, but the great majority of the tongue is evenly divided between uati and niñiq.

Whales are vary greatly in size and body configuration, so the relative proportions of uati and niñiq can vary greatly from whale to whale (figure 9). The niñiq 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). 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. Captains may retain the baleen for themselves or distribute it as they wish. One flipper belongs to the harpooner who first struck the whale, and the other flipper is available to be shared by anyone who wants part of it. In practice, since Cross Island is fairly remote from Nuiqsut and crew shares are generally large enough to meet the crew members' needs, most whaling crew members do not take portions of this flipper. It is usually processed as 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 niñiq. It should also be noted that because the target areas for all bombs are on the front part of the whale, more meat is potentially lost from the niñiq than from the uati due to contamination from the explosion of the bombs. Similarly, if a bomb strikes the heart or a kidney, that organ (or at least part of it) is made unfit for human consumption. In most cases, a bomb will not affect the quality of the muktuk significantly.

Figure 9. Whales at Cross Island, showing tavsi, uati, and niñiq. Top: Oyagak crew, September 12, 2012, 36'8" male (long slit). Bottom: Aqarguin crew, September 10, 2012, 26'3" female (short slit).

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 niñiq 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 niñiq 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 (tavsi treated as uati, uati, and niñiq divided into crew shares) is eventually packed into containers (plastic fish totes for the first few field seasons and more recently heavy cardboard "mud 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 and the upper jaw bone and skull placed in the line of previously landed whales. 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 crews 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. Some 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 at Cross Island. Currently the number is smaller than that (for 2001-2012, from three to six actually whaling at Cross Island). Some captains who do not expect to go whaling no longer register with the AEWC each year, while others have retired, and others have passed on (crews may continue under new leadership in the latter two cases, but often have not). New crews are formed, most commonly by a co-captain splitting off from an existing crew (crew dynamics are discussed in a later section). 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 is too limited unless some whaling crews use more than one whaling boat. This is also a mechanism that allows a whaler who is not registered as a whaling captain to take his boat out whaling as part of a crew (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. This also allows registered captains to field larger crews and several boats without assuming all of the capital costs of additional boats and motors (captains often still financially assist in preparing such boats for the season, and are responsible for food and other support of the crew while on Cross Island). Part of the reason that most whaling crews (63 percent) during the study period used more than one whaling boat was probably the fact that only three to six 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 minimum 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.

CHAPTER 5: METHODOLOGY

The methodology of the project has been described in each of the annual reports (included on the accompanying CD-ROM), 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. In addition, much of the discussion in this report depends on historical information derived from document research and interaction with local experts. Although this was not a major component of the project in terms of funding, the integration of this information with the primary data documented by the project is essential for understanding that data. At the same time, the methods for accessing and using that information are so general that they have not been explicitly addressed in this methodology section – they are implicit in almost all anthropological research.

DESCRIPTIVE DATA CATEGORIES

The primary goal of the data collection for this project was the compilation of quantified measures of Cross Island subsistence whaling behavior. Emphasis for the first field season (2001) 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

Descriptive measures are presented for all of these in the tables, although not all are addressed in extensive discussion in the "Results" section. They are not necessarily addressed in the order listed, and often in conjunction with each other, since many are interdependent.

These measures are a mixture of descriptive characteristics suggested by BOEM 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 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, harvest sites, 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, the causes for such shifts or variability in location are 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.
- 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 barge (non-whaling, non-oil and gas) vessel traffic interfered with their whaling activities that year. BPXA requested that the researcher present a report on these aspects of the Cross Island subsistence whaling season at the stakeholder meetings ("Open Water Meetings") conducted to collect information during the annual agency permitting process for planned offshore activities. BOEM, 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 stakeholders including Government agencies, industry, whalers, scientists, and environmentalists. Presentations were given at the Open Water meetings in April 2007, and April 2008 (but not required for subsequent years). BPXA provided supplemental funding (2005-2012) to facilitate this reporting effort in support of their permitting process for the Northstar production unit, and requested a focus on:

- whalers' encounters or concerns with non-whaling vessels.
- whalers' observations of the general offshore distribution of whales.
- whalers' observations of whaling behavior.
- whalers' observations of "skittish" or other unusual whale behavior.

These were added to the general list of topics discussed with the whalers, and especially in the days spent in Nuiqsut after each whaling season. These topics were recognized as germane to the interests of BOEM in funding the monitoring effort, although not central to the scope of the BOEM work (with the possible exception of the first), which focused on whaling behavior. All are discussed to some degree in this report, but are not the focus of any specific discussion.

The overall objective of the BOEM Cross Island project was to describe Cross Island whaling using measures that document year-to-year variability in whaling behavior that, when sufficient time series data were available, would allow tests of hypotheses on the causes of this variability. Concern about potential effects of oil and gas development on whaling was the prime motivation for the BOEM project, but it was recognized that other factors can strongly affect Cross Island whaling and thus needed to be considered as well. These other factors included weather and ice conditions, equipment problems, whalers' personal decisions, and non-industrial human activities. During the BOEM-sponsored project, information was collected on level of hunting effort, including how many boats went out each day, boat crew size, how much time was spent on the water, lengths of trips in miles, and furthest point away from Cross Island during each trip. Information was 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 BOEM management leasing plans and decision, as well as stipulation requirements, and has also been recognized as important for the management decisions for other agencies and the North Slope Borough.

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 2001–2012. 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 was then mapped, and was the basis for the geospatial figures included in this report. Whalers tended to mark relatively few points when on the water, and the points they did mark represent the boat's position at the time a whale or group of whales was seen. These whales may have been 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. The researcher 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 main 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 or Garmin Map76Cx units. For intermediate years Garmin 72, Garmin 60, and Garmin Map60 units were used. The greater capabilities of the later eTrex HCx and 76Cx units added to the quality of the data collected in later seasons, because of their larger memories and slots for removable memory card. 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 3). 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, and this cooperation continued through the end of the project.

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

Table 3. Percentage of boat trips with GPS tracks

Season	Boat Trips	GPS Tracks Collected	percent of Trips with GPS Tracks
2001	59	49	83 percent
2002	67	52	78 percent
2003	42	37	88 percent
2004	46	44	96 percent
2005	48	48	100 percent
2006	53	51	96 percent
2007	22	20	91 percent
2008	33	30	91 percent
2009	113	93	82 percent
2010	31	27	87 percent
2011	57	52	91 percent
2012	66	63	95 percent

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 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' settings 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 nine percent of all possible tracks for that year. It would be of course be preferable to document all tracks, and when the overall number of boat trips is small, missing only a few may be statistically relatively large. This was also true for 2008 and 2010, when only three and four tracks were not collected. For 2008, the three missing tracks were due to the "tracking" feature being turned "off" during the first scouting trips for three boats (and two of these trips may have been quite short). For 2010, one missing track was due to tracking being "off" and three to the GPS unit never being turned on or not being taken on the trip. The 2009 season was problematic for a number of reasons, both for the project and the whalers. Of the twenty missing tracks, fourteen were due to refusals. One captain declined, for his own reasons, to participate in the research for 2009 (but did participate in the following years) and accounted for twelve of the missing tracks. Two other refusals were due to miscommunications. The remaining six missing

tracks were due to the usual causes – tracking being "off," the GPS unit not being turned on, or no GPS unit being taken on the trip. There were many more boat trips and a higher level of overall effort for 2010 than for any other documented year, as conditions for whaling were difficult. Relatively few whales were seen (requiring more trips) and many boats made more than one trip on any given day, but the overall recovery of GPS tracks was still 82 percent. For 2011 and 2012, recovery rates were again over 90 percent and all missing tracks were due to the usual causes early in the season – tracking being "off," or the GPS not being taken on the trip or never turned on. After the whalers were reminded of the need to use a GPS to at least record the trip, these problems did not recur. Overall, the recovery rate for GPS tracks was 89 percent.

Each boat crew was instructed to keep the "tracking" feature on, which recorded the path the boat traveled each time it went out. Until all GPS units are checked, some loss due to whalers having turned the tracking feature "off" is probably inevitable. For some whalers, the "off" 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 interfering with reception, the rush of a boat crew that forgets to take a GPS unit or to turn it on, or loss of satellite coverage. These problems declined as the project went 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 were 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 were wired to use such cords. Also, all boats were provided with a boat-mounted holder for the GPS unit, so that the units would be readily available, secure, and not be 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. Relatively few points were marked, however, as this was not typically how Nuiqsut whalers use their GPS units while out scouting for whales, and few crews chose to devote a crew member to this function.

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 (an advantage of MapSource over more capable, but more complex, software). The utility of this information, as concretely represented on the mapped tracks displayed by the computer, was obvious to the whalers since the inception of the project and was one reason for the high degree of participation. An example of the combined tracks for one day of scouting can be seen in Figure 10. This figure shows all tracks for September 2, 2011. Ten boats went scouting at some point in the day, with most leaving shortly after noon. One whale was landed, even though sighting conditions were relatively poor and few whales were reported to be seen. One boat made two "scouting" trips,

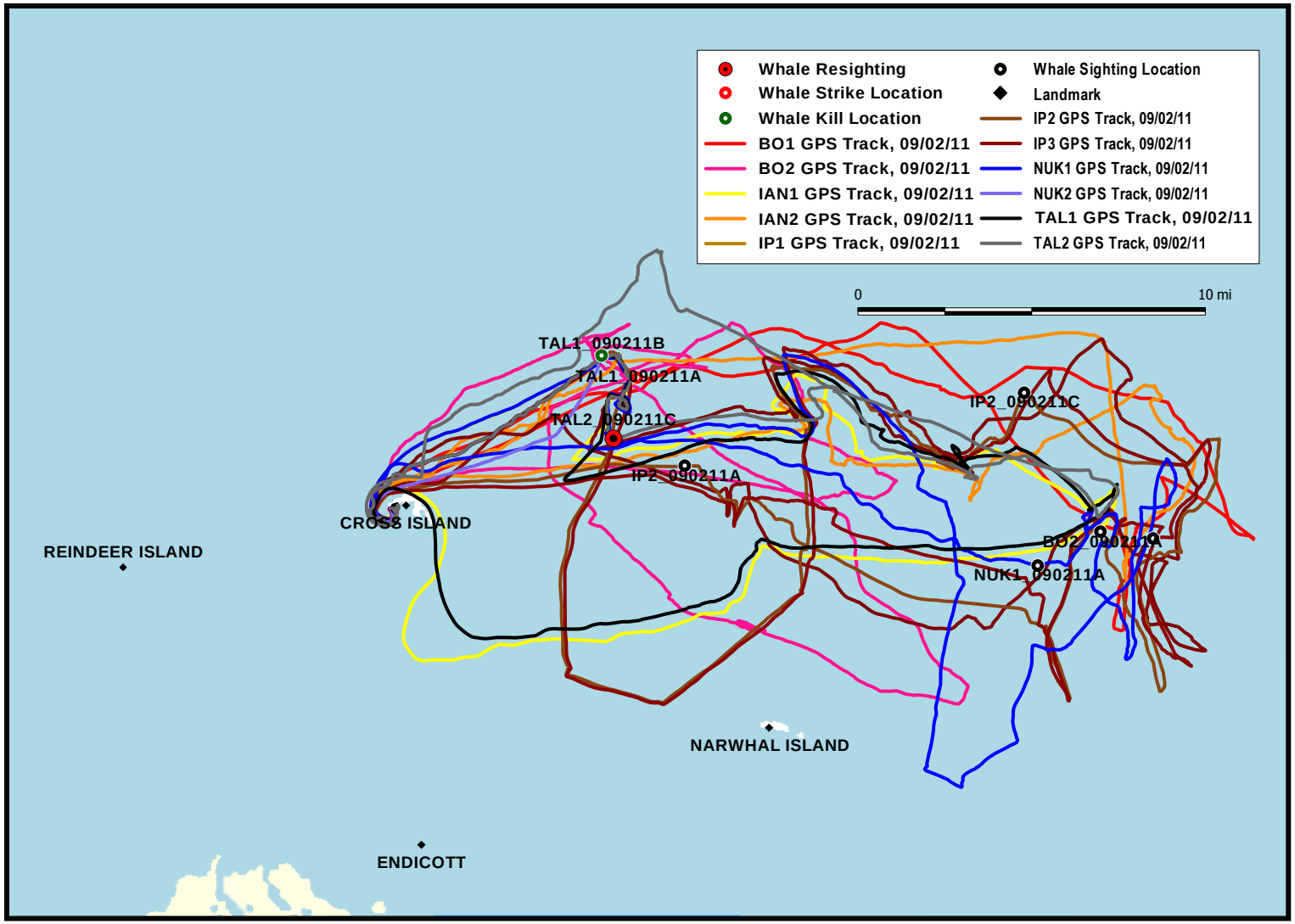


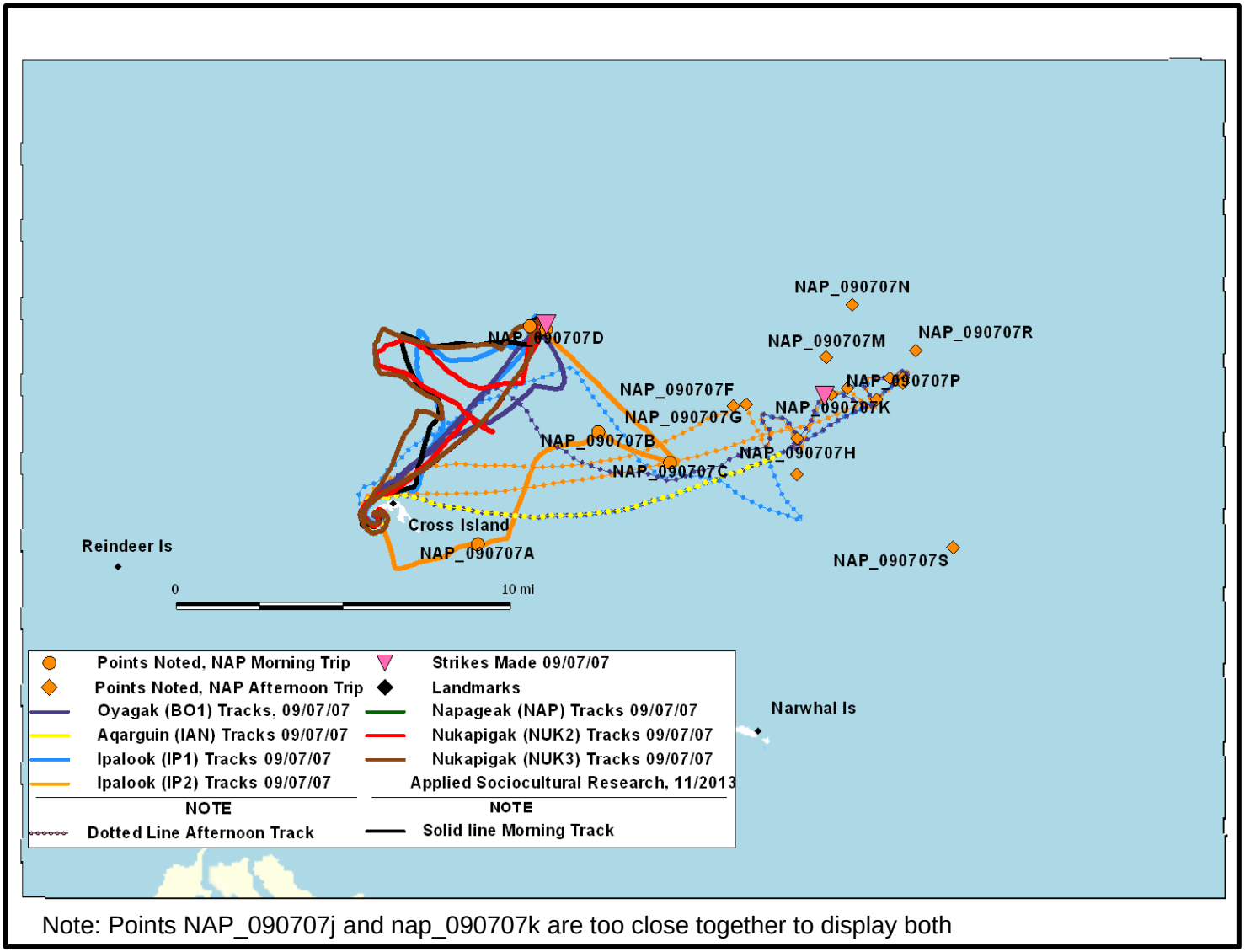
Figure 10. Composite scouting tracks for a single day – September 9, 2011

but the second was to specifically help with the tow (they had returned to Cross Island before the whale that was landed was respotted and so had not participated in the chase and kill). An eleventh boat also made two trips on September 2, 2011, but the first was a logistical trip to West Dock in the morning, while the second was to specifically help with the tow, after the whale had been landed. Only points representing the first sighting of each different whale seen that day, and a point representing the resighting of the whale that was eventually chased and killed, are included on this figure, to facilitate the discussion of point information (and track diagrams) below without obscuring the figure with too many labels. A second example of combined daily tracks from an earlier year can be seen in Figure 11, included to be able to discuss changes in how the basic information was collected and recorded in the last years of the project. This figure shows all tracks for September 7, 2007, with "morning" tracks distinguished from "afternoon" tracks for those boats that made more than one trip that day. The IAN morning and the NUK3 afternoon tracks were not recorded and the 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 4.

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 BOEM 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. A relatively simple one-page form was used for each boat that went scouting or engaged in other significant whaling or subsistence activity each day for the 2001-2010 seasons (Table 4). In practice, it was found impractical to use this form to directly collects and record the information. The researcher visited each crew's cabin to collect this information as soon as possible after the crew returned from scouting. This could be the same day, but was often delayed, either because the crew was otherwise engaged or because there was simply not enough time for the researcher to visit each crew for this purpose. The cabins at Cross Island are cramped, with most of the space devoted to sleeping quarters, and offer few good spaces to conduct formal interviews, especially when most of the crew is present. Also, "following the form" and trying to directly obtain the specific information desired proved to be both impossible and unproductive. The whalers were most interested in seeing their tracks on the computer screen, after they were downloaded, and would then "talk to" the tracks and give an account of their scouting trip. Once they had done so (and to some extent during the account) the researcher could ask questions to elicit other information or to clarify certain elements of the account. The best way to record this information was in a notebook, and then to later extract the information required on the Daily Boat Report Form. Whalers did not object to the researcher recording information in a notebook (although they often would "make fun" of his



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

Figure 11. Composite scouting tracks for a single day – September 7, 2007

Table 4. Example daily boat report form

Cross Island Whaling 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 “l” 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)	
percent Ice Coverage:	0	Ice Type:		Other Notes:	Wind for most/all whaling <5 mph
Wave Height:	small	Other notes on sea conditions:		“calm” with 4-foot rollers (swells)	

Other pertinent notes:	The best day for scouting for whales of the season, worse conditions predicted for the next day. This was the main reason the captains decided to try to land two whales (and did). Wind shifted around the compass.

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?

proclivity to write things down), but did seem uncomfortable with his recording information on a "formal" printed form. The more "informal" method of data collection resulted in obtaining a much richer and diverse body of information than was required, much of which was not strictly relevant to the Boat Report Form, but all of which was pertinent to Cross Island subsistence whaling. This method also required much more time than a conversation focused solely on obtaining the information required for the form – but was probably a factor fostering rapport between the whalers and the researcher, resulting in the high participation rate of the whalers.

While the Daily Boat Report Form was found to be useful, it became evident that it was administratively burdensome, repetitious, and inefficient in terms of information compilation for the analysis for the annual reports. Individual boat report forms were found to be redundant in terms of the information recorded. All contained the same weather and physical conditions information (for the most part – some crews experienced somewhat different conditions than others while on the water). This was especially true as crews increasingly used multiple whaling boats, as these boats tended to scout for whales together so that it was most efficient to collect and compile their information on one form (a "Daily Crew Form", as it were, although this was never formally instituted). This had become increasingly obvious as Nuiqsut participation in whaling increased in 2008 and 2009, with an increase in the number of boats at Cross Island, but became most evident in 2010 when 14 boats were at Cross Island. Since on most days most crews coordinated their scouting efforts, starting in 2011 information from all boats for each day was compiled on one form, although this was no longer a one-page form. Boat information was summarized in two blocks – a listing of "inactive" boats (not scouting for whales) and "active" boats. Other blocks were for a list of waypoints (those marked on the water as well as those located by the whalers on their tracks while reviewing them on the computer with the researcher), a narrative summary describing the conditions for the day, and summary information on the GPS tracks and waypoints for that day in relation to each other. For all previous years it had been necessary to compose such summary narratives, in addition to the boat report forms, and deleting the individual boat forms significantly reduced the administrative data tasks for the project. Several summary data forms, discussed below, were found to be an even more efficient ways to track and report these data, thus to all intents and purposes eliminating the need for daily report forms, except as a reminder to the researcher of the necessity to record comparable information for each whaling boat and crew.

Still, Table 4, representing an individual boat report form has advantages for at least a preliminary discussion of what the reported waypoint information represents, as compared to such a discussion based on the larger daily report form for all boats (with all points for all boats for that day). It allows a focus on a limited number of points related to one specific trip in order to discuss and demonstrate 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 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 had the time to assign them names, so that they are designated with "default" numbers. When waypoints were 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 less precise than points marked on the water. However, in most cases they can be assumed to represent whales or blows seen at a greater distance than for a waypoint actually marked when on the water. Some represent events that were not marked because people were too busy at the time to do so.

In Table 4, 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 can be 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 points marked while "on the water" may also be 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 Deadhorse Communications Center, and sometimes their Cross Island base station by radio, it is often possible to note when significant events take place by listening to the radio and noting the time when events occur. 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, so that the meaning of some marked waypoints cannot be determined.

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 – and a reliable estimate of that distance is usually not available. 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 5 is an example of how, prior to the 2011 field season, the Daily Report Form was used to reduce the number of forms to complete for those days when not all boats went out scouting. Separate forms were still used to record information for those boats that did go out scouting on September 7, 2007. 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 3, "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 (other than weather) were the captain's decision to stay onshore 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. For some days where multiple factors applied determining which was most important may not be possible.

Table 6 is the accompanying Boat Report Form to Figure 10 and demonstrates the usefulness of including all boats on the same form. Only the whale sighting points (bo2_090211a, ip2_090211a, ip2_090211c, IP3_090211a, and nuk1_090211a) and the resighting of the whale eventually landed (tal2_090211c) are shown and labeled on Figure 10, to avoid making the figure too busy. The most important methodological/analytical points about Table 6 and Figure 10 can be demonstrated mainly from the Table in any event. All but one of the whale sighting reports were derived from radio reports, the DCC Log, or after-the-fact mapping of the points on a computer screen by the whalers (that is, only one was marked by a whaler while on the water).

Table 5. 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)		
percent 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?

Table 6. Example Daily Boat Report Form for "active" boats

Daily Report Form, Cross Island Subsistence Whaling Documentation, 2 September 2011

"Active" Boats Summary

Date	Crew	Boat	Track #	Crew #	Time out	Time in	TOT min	HOURS	MIN	RT	F_PT	Track?
9/2/2011	BO	BO1	BO1_090211	4	12:50	20:15	445	7	25	69.5	24.9	yes
9/2/2011	BO	BO2	BO2_090211	4	12:47	20:13	446	7	26	75.9	25.3	yes
9/2/2011	IAN	IAN1	IAN1_090211	5	15:36	22:45	429	7	9	69.9	20.9	yes
9/2/2011	IAN	IAN2	IAN2_090211a	3	13:19	20:26	427	7	7	70.1	23.3	yes
9/2/2011	IAN	IAN2	IAN2_090211b	3	21:31	24:48	197	3	17	19.3	7.5	yes
9/2/2011	IP	IP1	IP1_090211	3	12:17	24:52	755	12	35	87.4	23.9	yes
9/2/2011	IP	IP2	IP2_090211	3	12:20	24:49	749	12	29	102.0	24.0	yes
9/2/2011	IP	IP3	IP3_090211	2	12:13	22:11	598	9	58	104.0	23.7	yes
9/2/2011	NUK	NUK1	NUK1_090211	4	12:43	22:46	603	10	3	50.5	9.2	yes
9/2/2011	NUK	NUK2	NUK2_090211a	4	11:08	19:56	LOGISTICAL TRIP TO WEST DOCK					no
9/2/2011	NUK	NUK2	NUK2_090211b	4	20:50	24:50	240	4	0	20.6	7.6	yes
9/2/2011	TAL	TAL1	TAL1_090211	5	15:44	24:56	552	9	12	71.5	20.9	yes
9/2/2011	TAL	TAL2	TAL2_090211	3	15:45	24:49	544	9	4	68.0	20.9	yes

"Inactive" Boats

Date	Crew	Boat	Notes
None			

Strikes Used

Date	Time Struck	Length	Sex	Whale ID	Miles from Cross Island	Bearing from Cross Island	Notes
02 Sept.	20:35	52'1"	F	11N1[2]	7.9	63° true	Taalak, landed

Waypoints

Date	Crew	Waypoint	Lat/Long	Time	Notes	Type
9/2/2011	BO1	BO1_090211a	N70 28.617 W147 06.092	15:14	Where BO1 slowed looking for a whale	C
9/2/2011	BO2	bo2_090211a	N70 28.452 W147 05.942	15:14	BO2 reported position next to mother and calf pair	W
9/2/2011	BO2	BO2_090211b	N70 28.196 W147 05.307	15:21	Marked point for mother and calf pair	C
9/2/2011	GEN	GEN_090211a	N70 28.356 W147 07.235	14:41	"Cluster" of whales, general area	C
9/2/2011	GEN	GEN_090211b	N70 27.649 W147 03.314	16:12	General location where boats slowed after the 16:07 whale sighting (not localized)	C
9/2/2011	GEN	GEN_090211c	N70 28.759 W147 00.119	17:17	General area where boats slowed, one boat reported sighting a log, but no further whale sightings	C
9/2/2011	GEN	GEN_090211d	N70 31.650 W147 18.574	18:54	General area where most boats gave up looking for the whales they had been seeing. Most headed in the direction of CI with a few taking less direct routes.	C
9/2/2011	IAN1	ian1_090211a	N70 27.412 W147 56.717	15:48	IAN1 boat position when barge sighted	Tr
9/2/2011	IAN1	ian1_090211b	N70 25.585 W148 01.563	15:48	Estimated position of barge that was sighted	B

9/2/2011	IAN1	IAN1_090211c	N70 30.338 W147 16.377	17:51	IAN1 recorded coordinates when some other boat respots whale in front of his boat. These are clearly coordinates for a later position (Com Center recorded the time of the observation, and filled in the coordinates later, when they were given)	C
9/2/2011	IAN1	IAN1_090211d	N70 30.329 W147 16.425	17:57	IAN1 reported position when he respots whale	C
9/2/2011	IAN1	ian1_090211e	N70 33.218 W147 42.940	21:01	Use of superbomb (6th or 7th bomb used)	C
9/2/2011	IAN2	IAN1_090211f	N70 33.184 W147 42.930	21:23	Marked point for location of dead whale	K
9/2/2011	IAN2	IAN2_090211a	N70 26.019 W147 04.039	15:38	Marked coordinates, significance not known	Tr
9/2/2011	IAN2	IAN2_090211b	N70 26.282 W147 03.000	0:00	Position of IP3 @ 15:42, why marked unknown	Tr
9/2/2011	IP1	ip1_090211a	N70 26.216 W147 14.244	14:49	Likely sighting or response to sighting	C
9/2/2011	IP2	ip2_090211a	N70 30.380 W147 36.909	12:52	Radio report of whale sighting (likely seen earlier)	W
9/2/2011	IP2	ip2_090211a'	N70 30.415 W147 40.814	12:48	Likely 1st sighting of ip2_090211a whale	C
9/2/2011	IP2	ip2_090211b	N70 24.318 W147 08.609	14:49	Likely sighting or response to sighting	C
9/2/2011	IP2	ip2_090211c	N70 32.007 W147 11.348	17:34	Sighting of "whale that does not blow"	W
9/2/2011	IP2	IP2_090211d	N70 30.909 W147 12.804	17:38	Report of coordinates for 17:34 whale	C
9/2/2011	IP3	IP3_090211a	N70 28.243 W147 01.999	16:29	Marked sighting of a blow and all boats went N	W
9/2/2011	NUK1	nuk1_090211a	N70 27.673 W147 10.659	14:41	Com Center recorded report of a whale	W
9/2/2011	NUK1	NUK1_090211b	N70 30.001 W147 14.845	17:57	Marked point for the mother and calf pair (must be coordinates from another boat)	C
9/2/2011	TAL1	tal1_090211a	N70 32.607 W147 40.292	20:35	Possible strike location (judged more probable)	S
9/2/2011	TAL1	tal1_090211a'	N70 32.800 W147 41.248	20:41	Alternate possible strike location	S
9/2/2011	TAL1	TAL1_090211b	N70 33.196 W147 42.956	21:20	Marked position for dead whale	K
9/2/2011	TAL1	TAL1_090211c	N70 33.186 W147 42.945	21:24	Marked position for dead whale, prayer	K
9/2/2011	TAL1	tal1_090211d	N70 33.009 W147 43.429	22:22	Start of tow	Tow
9/2/2011	TAL2	tal2_090211a	N70 29.927 W147 15.997	18:10	Resighting of a whale	C
9/2/2011	TAL2	tal2_090211b	N70 29.863 W147 15.109	18:11	Confirm that resighting is the mother and calf pair	C
9/2/2011	TAL2	tal2_090211c	N70 31.104 W147 42.247	20:15	Resighting of one of the whales	C
9/2/2011	TAL2	TAL2_090211d	N70 32.822 W147 41.138	20:51	Marked position of TAL2 @ 20:41, but marked @ 20:51 - strike event?	C

Narrative Description

The morning started very foggy and all crews waited until the fog lifted (shortly before noon) to go out scouting. BP was steady and then decreasing, with wind speed 0–10 mph (up to 14 mph at Deadhorse). Wind speed decreased late in the day, and a whale was struck. Boats were returning to Cross Island for the day (some were already there) when this whale was spotted. Most whalers believed it was a whale seen earlier in the day. NUK2 made a trip to West Dock, and did not return to Cross Island until 19:56, but did participate in the tow.

Seven whaling boats from four crews left Cross Island to go scouting between 12:17 and 13:19 (IP1-3, NUK1, BO1-2, IAN2). Three other boats from two crews (one with a boat already out scouting) left Cross Island between 15:36 and 15:45 (IAN1, TAL1-2). Conditions for sighting whales were probably somewhat better than on previous days, but were still not optimal. Although the smaller boats were able to go scouting, there were still several “false alarms” noted, and swells still presented a challenge. Crews were able to spot, follow, and recognize whales when they resighted them. However, they lost track of all whales seen until, after all boats were on their way back to Cross Island (or had already returned to Cross Island), the Taalak crew spotted a whale, struck it and landed it late in the day. The whalers reported that it was one of the whales that had been seen and chased earlier in the day, as it was quite tired when the Taalak crew went after it. The six boats that participated in the tow (IAN2, IP1-2, NUK2, TAL1-2) returned to Cross Island after midnight, around 00:49 (“24:49” in the Table). The five boats that did not participate in the tow returned to Cross Island between 20:13 and 22:46. About five whales were seen during the day, including a mother and calf pair seen in different places by different boats (GEN_090211a, bo1_090211a, bo2_090211a, BO2_090211b, tal2_090211a&b, NUK1_090211b). Most of these whales were seen more than once, and by different crews in different locations. The farthest any boat went from Cross Island was 25.3 miles. Boats went farther E (25 miles) than N (7 miles) or south (9 miles). No boat scouted west of Cross Island on Sept. 2. All whales reported were seen within a rectangle extending 3 miles N, 22 miles E, and 7 miles S of Cross Island.

All boats scouted primarily east of Cross Island. The first whale was spotted fairly close to Cross Island (ip2_090211a and ip2_090211a’, about 8.5 miles away at about 12:50), but was not resighted, or at least was not followed for very long before it was lost. All boats continued to scout to the east (with some boats just leaving Cross Island taking a jog to the south on their way east). A loose grouping of four whales was seen about 14:41 (GEN_090211a, nuk1_090211a, ip2_090211b - the proximity of the whales to each other was not clear, other than that there was a mother and calf pair). All of the boats scouting to the east at that time (IP1-3, BO1-2, NUK1, IAN2) then scouted south of the mother and calf pair for other whales. IAN1, shortly after leaving Cross Island, reported seeing a barge about 15:48 (ian1_090211a,b). About 16:06/16:07, one of the boats (unidentified) saw a whale to the north (“came up

4 times, no blow") and all boats accelerated to the north and subsequently slowed in the same general area (GEN_090211b, IP3_090211a). They saw no further evidence of the whale, however, and by 17:17 all boats generally headed north and northwest (GEN_090211c). About 17:34 IP2 reported (ip2_090211c,d) that they had seen "the whale that does not blow" (a whale they had seen before) behind them. At 17:51 someone reported that the whale is in front of IAN1 and IAN1 marked this point and a subsequent resighting (IAN1_090211c,d). The boats eventually lost track of this whale as well. Thus there were several whales that were chased by different boats (including the mother and calf, which was not chased but merely observed).

From this point (about 18:54, GEN_090211d) most boats proceeded in a general direction back to Cross Island, still scouting but at generally higher speeds. The NUK1 boat had left the other boats to scout south at 17:18 or so, on a "false alarm" sighting. After investigating this they eventually rejoined the other boats. The IP2 and IP3 boats also left the other boats to scout south, but much later at about 19:22. No additional whale sightings were reported before the time that all boats decided to head into Cross Island at high speed. The BO boats did so about 19:40, and IAN2 about 19:46, and all three got back to Cross Island before TAL2 spotted something about 20:14 (tal2_090211c). TAL1, TAL2, IAN1, IP1, IP2, IP3, and NUK1 all accelerated for Cross Island between 20:01 and 20:06, and so were in the vicinity of TAL2 when it saw something and radically changed its direction of travel, to the north. The strike for this whale was reported at 20:35 (possibly 20:41 – the most probable strike location is judged to be tal1_090211a, with alternatives tal1_090211a' and TAL2_090211d). Specific locations for chase events were not well documented. The BO boats had already reached CI and so did not participate in the chase. IAN2 and NUK2 had also returned to CI. The other boats diverted to this whale (but IP2 and IP3 were far to the south). TAL1 ended up with the strike opportunity. The first bomb may not have exploded, and the float apparently came off. A second darting gun shot missed the whale. Between 9 and 11 bombs were used on the whale, including a superbomb that was said to have effectively stopped the whale (and was the 6th or 7th bomb used, ian1_090211e). The time of death was between 21:19 and 21:23 (IAN1_090211f, TAL1_090211b, TAL1_090211c). The tow started about 22:22 from a location 7.1 miles northeast of Cross Island (tal1_090211d). Boats that helped tow were IAN2, IP1, IP2, NUK2, TAL1, and TAL2. IAN2 had gone out again to help with the tow, as had NUK2 when it returned from West Dock. The BO boats did not go out again, once they had reached Cross Island, and NUK1 and IAN1 had either mechanical problems or other reasons not to tow. The tow reached Cross Island very early in the morning of 3 September, and the decision was made to leave the whale in the water until the morning. Butchering at night at Cross Island is difficult, especially with a large whale, and the experience of the whalers is that spoilage is minimal if the whale is kept in the water overnight – while butchering at night with tired crews is most often inefficient and counterproductive.

While not evident in terms of gross effects upon the events of the day, "barge issues" were quite salient to the whalers. The day started with some of the whalers discussing the barge "incident" of the previous day with the Com Center as soon as they woke up, trying to find out who was responsible for the vessel and what it was doing. This resulted in a 10:48 announcement from Cross Island that all barge activity (including that to Badami) was stopped until the subsistence whaling season was closed. About 14:05 Cruise Marine requested permission to "cross over Cross Island" [apparently on the way to Badami] and was answered about 14:48 by a statement from the Nuiqsut AEWC Commissioner that there "will be no barging to Badami until Nuiqsut whalers has[*sic*] met their quota" (as recorded in the Deadhorse Com Center logbook). Soon after IAN1 left Cross Island to go scouting, they reported seeing a couple of barges in front of them (15:49), but were too far away to identify them. The barges were SW of Cross Island. After the boats had returned to Cross Island, those that had been scouting north of Pole Island reported that they had also seen a barge (but no whales) north of Pole Island (perhaps about 15:38 or 15:43 – the time when some otherwise unexplained points-of-interest were entered into the GPS data logger by crews on the water. These boats report turning away from the barges, and were soon called away to a whale sighting by IAN1 (16:05 or so) to the north.

Repeated sightings of the same whale(s) and other chase events (type "C" points in Table 6) are also most often "derived" points, not marked by the whalers, but very important for understanding the overall narrative of scouting activity for the day. "General" points (those with "GEN" as the "boat identifier") are also critical for understanding the coordination between boats during the day – how boats converge on a whale to chase and eventually land it (or not). Each of the reported whale sightings became a "rallying" point for all (or most) of the boats out scouting. By examining the date stamps on their GPS tacks it can be determined that all (or most) of these boats changed direction towards these points and increased speed, and then slowed in the same general area (the basis for the "GEN" points in Table 6). This is only one example of the detailed information contained in the GPS tracks, but this information must be teased out through the context of whalers' accounts of their scouting trips, information derived from listening to their radio reports, and information recorded in the DCC Log.

Table 7 is an example of how "non-active" boats were treated for the 2011 and 2012 seasons. For days when some boats went scouting and others did not, they were simply listed in different blocks on the same form, but on the days represented by these forms all boats either engaged in some whaling activity (September 2, 2011) or no boats engaged in whaling activity (September 3, 2011). The most common reasons for some boats not to go out scouting on days when other boats did were to butcher a whale already on Cross Island or because the boat was disabled in some way. Sometimes a crew that had already landed a whale would "cease fire" and stay on Cross Island until their assistance was needed to chase, kill, and/or tow a whale. Even in those circumstances, however, these boats would often go out scouting, but without the intention to be the first to strike a whale.

Table7. Example Daily Boat Report Form for “inactive” boats

“Active” Boats Summary, 3 September 2011												
Date	Crew	Boat	Track #	Crew #	Time out	Time in	TOT min	HOURS	MIN	RT	F_PT	Track?
NONE												

“Inactive” Boats			
Date	Crew	Boat	Notes
9/03/11	BO	BO1	Stayed in to butcher
9/03/11	BO	BO2	Stayed in to butcher
9/03/11	IAN	IAN1	Stayed in to butcher
9/03/11	IAN	IAN2	Stayed in to butcher
9/03/11	IP	IP1	Stayed in to butcher
9/03/11	IP	IP2	Stayed in to butcher
9/03/11	IP	IP3	Stayed in to butcher
9/03/11	NUK	NUK1	Stayed in to butcher
9/03/11	NUK	NUK2	Stayed in to butcher
9/03/11	TAL	TAL1	Stayed in to butcher
9/03/11	TAL	TAL2	Stayed in to butcher

Waypoints

Date	Crew	Waypoint	Lat/Long	Time	Notes	Type
NONE						

Narrative Description

The morning was again very foggy, and winds were higher than on 2 Sept. BP was falling sharply, with wind speed 1–11 mph (up to 15 mph at Deadhorse). Conditions may have been acceptable for scouting, but all hands were required for butchering. Since the towed whale had arrived at Cross Island early in the morning, it had been left in the water and butchering was delayed until the sun came up. The limited spot lights available at Cross Island are not really adequate to butcher at night unless absolutely necessary. Nuiqsut whalers have found that whales can usually be left in the water overnight without a great deal of spoilage. If the whale is taken out of the water and not butchered right away, however, there is a great deal of spoilage. Thus, the choice was between leaving the whale in the water and delaying the start of butchering until after all the crews had rested; or of hauling the whale out of the water and butchering to at least the point where the internal organs of the whale were removed, in the dark with limited artificial lights, with crews already tired from hunting.

Since the whale was quite large (length 52’1” or 15.9 m), it required longer than usual to haul up on the beach. It was a female with a 5” (13 cm) fetus. All crews participated in the butchering, but butchering proceeded somewhat more slowly than would normally be expected. Butchering did proceed far enough for the Taalak crew to send the *tavsi* (captain’s belt, used by Nuiqsut whalers to “feed the village” as soon as possible after a whale is landed) to West Dock to be sent to Nuiqsut by plane (under the provisions of the CAA, the *tavsi* from the first whale taken is flown to Nuiqsut). A polar bear was also harvested and processed (skinned and some meat taken) on 3 Sept.

Whalers were again concerned with barge issues. A request was made (about 08:45) for the whalers to allow a Crowley barge to go by, and the whaling captains discussed whether this would be acceptable or not. The resolution (their final decision) was not clear and is not recorded in the Deadhorse Com Center logbook, but at least one captain argued that even though it was foggy, and they had a large whale to butcher, if it cleared up they might want to allow at least a few boats to go out scouting. The researcher’s notes indicate he thought the whalers told the barge NOT to proceed.

Systematic Daily Protocols

Systematic observations for the 2001-2012 field seasons were also transferred to the standardized recording forms (daily boat report forms), and then used to construct the summary data forms discussed below. For the 2011 and 2012 field seasons these data were recorded directly on the summary data forms and in field notes. These observations are the basis for the summary Tables that appear in the "Results" section. From these records it is 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.

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, BOEM 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://www.ndbc.noaa.gov/station_page.php?station=PRDA2. The weather data from Deadhorse are presented below for the study period covered by this report (2001-2012), 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 Deadhorse 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 2001-2012 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 BOEM 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 data log record from the weather station and limited personal observations of the researcher.

After the 2010 field season, the daily boat report form was replaced with a single daily report form summarizing all boat activity, as described above. The narrative description of scouting activity incorporated the whalers' accounts of conditions encountered, and the weather station file(s) the general description of current weather conditions.

Summary Data Forms

The experience gained from producing the annual (and preliminary summary) reports for the project have shown the value of a number of summary data forms for the production of Tables and graphics. Rather than include examples and describe each in a narrative form in the body of this document, examples are discussed in Appendix C – Draft Field Manual as well as listed in this section, and example files can be found on the accompanying CD-ROM. In some cases a narrative description of the form would be rather lengthy, while the example is fairly self-explanatory for those familiar with spreadsheet software.

List of useful summary data forms, Tables, and graphics:

- Boat Trip Report Form – Excel spreadsheet compiled from GPS track information, systematic observational information, and DCC Log entries. This form listed each whaling trip for all boats, including those for which GPS information was not collected. When GPS information was collected, the information recorded would be the start and finish times of the

trip, trip duration, distance traveled, and the furthest distance traveled form Cross Island. In most cases, the number of crew members would be added from researcher observation or the whalers' report. Even when GPS information was not available for some reason, the start and finish times (and duration) of most trips was available from the researcher's observations recorded in his field notes and/or entries in the Deadhorse Communications Log.

- Waypoint List – Excel spreadsheet compiled from Processed MapSource (GPS) file information, field notes and observations, and DCC Log entries. Thus this Table was composed of points marked by the whalers while out on the water, points located on GPS tracks by the time noted in the Deadhorse Communications Log or by the researcher listening to radio reports while the whalers were out on the water, or points located by the whalers in an approximate way when reviewing their GPS tracks on the computer screen, once they had returned from their trip.
- Weather File – Excel spreadsheet containing weather measurements pertinent to the Cross Island subsistence whaling season for the Deadhorse weather station and, if deployed, a weather station on Cross Island. This file contains several worksheets that allow the construction of a graphic displaying the weather measurements and a summary of Cross Island subsistence whaling activity during that whaling season. A significant amount of processing is necessary to generate the data (both whaling and weather) in the appropriate format for this form
- Crew Report Form – Excel spreadsheet compiled from GPS track information, systematic observational information and field notes, and DCC Log entries. The example given in Appendix C has personally identifiable information removed but will be useful as a template for future work. This form is essentially a multi-sheet spreadsheet with 1) a listing of the members of each crew whaling on Cross Island during each season, 2) notations when each crew member arrived or left Cross Island, 3) notations when each crew member went out scouting for whales, and 4) a summary of the activities of each boat by day. This level of detail was not reported to or shared with BOEM, but is very useful for compiling the information useful for analytical reports.

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 from that of the historical past, or how it differed from that of previous study seasons. Much of this was recorded in the daily field notes (and was included on daily report forms). Those observations most pertinent to the goals and objectives of the study are summarized 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.

COMMUNITY ENGAGEMENT

Community engagement is more a process than a result. The goal is that through communication 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 discussing the project with

Nuiqsut residents, but this final report will provide a general summary rather than a detailed 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 for this project in late 2000, after award of the contract and prior to face-to-face meetings. The researcher had conducted research in Nuiqsut since 1982, and was already familiar with many people in Nuiqsut, including all the whaling captains. Such contacts have continued, both through "official" project contacts as well as more informal personal contacts with individual whalers and whaling captains. Contacts were also renewed with the Iñupiat 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.

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 sufficient trust and rapport before formal discussions on a Cross Island project to document the sensitive topic of subsistence whaling could be initiated. Access to Cross Island during whaling is strictly controlled by the NWCA, at least during whaling season. The first project 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). The overall opinion, expressed by most individuals, 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. The Cross Island project was not yet formally on the agenda for that meeting, but the researcher planned to attend.

The second project trip, to attend the AGPPT meeting, took place July 5-7, 2001. After completing the primary business of the meeting (which did not include the Cross island project), all of the scheduled time had been expended. However, the whaling captains delayed their chartered departure from Service Area for 10-30 minutes so that they could hear a short presentation on the project and ask questions. The NWCA, through its officers, then invited the researcher to come to Cross Island. During the next several months, arrangements were made to accompany the Kittick crew to Cross Island, through phone calls with Thomas Napageak Sr., Archie Ahkiviana, and Paul Kittick. The researcher arrived in Nuiqsut (via Barrow) August 30, 2001, traveled to Cross Island with the Kittick crew September 6, 2001, returned to Nuiqsut with the whalers on September 26, 2001, and arrived back in Anchorage September 29, 2001.

Consultation for the second field season built on that for the first, and was facilitated by the relative 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 public engagement effort included periodic phone calls (primarily to the Native Village of Nuiqsut and whaling captains), two trips to Nuiqsut to present results from 2001 and discuss the project, and phone calls to arrange for the final logistics of the actual field work. Galginaitis arrived in Nuiqsut August 30, 2002 (via Deadhorse) and traveled to Cross Island with the Ahkiviana crew September 5, 2002. He returned to Nuiqsut with most of the whalers on September 20, 2002, and returned to Anchorage (via Deadhorse) September 24, 2002. A trip to present the results of the 2002 field season was made to Barrow and Nuiqsut June 28, 2003-July 2, 2003. 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 July 18, 2003 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, when the ANIMIDA project formally ended after the 2002 field season (presentations were made to the AEWC in 2008 and 2013 in similar circumstances).

Consultation for the 2003-2012 field seasons followed a similar pattern:

- telephone calls to Nuiqsut and Barrow after the prior field season (continuous);
- talking opportunistically with people at the Alaska Federation of Natives Convention in October (generally either Anchorage or Fairbanks);
- visits 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;
- visits 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 (starting 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); and
- presentations to the AWEC as invited to do so, but not on an annual basis (usually at the end of a contract, or when a contract for an additional period of field work was awarded).

Presentations were also made to other stakeholder groups and interested parties, and are included on the project CD-ROM. They can generally be categorized as:

- annual and interim summary reports required by the contract for the research;
- presentations to the NWCA and the AEWC;
- presentations to the Open Water Meetings (oil and gas industry and regulators);
- presentations to professional audiences (Information Transfer Meetings, other professional meetings);
- Presentations to general audiences; and
- Academic papers.

One goal of the project was to develop a methodology so that local whalers could assume at least the data gathering part of the research. For this purpose, a field manual has been developed (Appendix C), discussing the various information gathering techniques and how to record the information. The NWCA was also asked (both formally at NWCA meetings and informally on

Cross Island) to recommend people who would be suitable for such a role on Cross Island (and in Nuiqsut). This produced no results. Despite the interest the whalers have in the products of the project, it was never possible to recruit a field assistant to help with data collection tasks on Cross Island. It was possible to hire temporary assistants for tasks in Nuiqsut, but once a local field assistant was on Cross Island, where by necessity he stayed in a whaling captain's cabin, he was part of a whaling crew. Research tasks took a distinct second place to whaling crew obligations. While these expectations did not fully carry over to the non-Iñupiat researcher, even he at times was expected to forego research tasks in order to contribute to on-island whaling tasks (mainly butchering and household chores). This was also true, for the most part, for attempts by the North Slope Borough to hire "polar bear watchers" to keep polar bears away from the harvested and butchered whales. Those polar bear watchers who were also experienced whalers tended to gravitate to whaling activities, to the possible detriment of their polar bear guard activities. A field assistant of use to the project would necessarily be an experienced whaler, as a knowledge of whaling would be a prerequisite for effectively collecting and recording the information desired (and probably also for the whalers to cooperate with him in the data collection process). In sum, the project was unsuccessful in recruiting a field assistant.

While whaling is constrained by economic resources, Inupiat tend not to think of it in economic terms. One example is how compensation for the whalers' participation developed. For the first year, and several years after, the whaling captains as a group did not ask for any group compensation, other than for the provision of GPS units and some supplies for the crew hosting the researcher (to defray the expenses of boarding him). Whaling, even in terms of a research situation, was not perceived as a proper context for direct monetary exchange. As the research progressed, and as the researcher established a pattern of being hosted more by some crews than others, the whaling captains expressed a strong desire for the researcher to "treat all the captains [and their crews] equally." While the researcher in all honesty had attempted to do, in reality the crew he was staying with almost always felt more comfortable asking form "favors" (usually in the form of some needed for whaling item from Anchorage – a boat propeller or head gasket, for instance) than did the other crews, and so did gain more from the research. The solution was for the researcher to supply a basic level of "store" food for all the whaling crews. The whalers preferred this to a monetary payment to each captain (or each whaler), since monetary transactions are not culturally appropriate in subsistence contexts (and perhaps would not be used for whaling, or equally distributed, while the supplies were certain to be). The details of accounting for the honoraria and budgeting for it somewhat delayed its implementation, but was accomplished in a reasonable amount of time. The range of acceptable compensation was negotiated with the sponsor and the whalers, and a shopping list constructed in consultation with and final approval by the NWCA. Once the supplies arrived on Cross Island (usually on the mobilization barge) they were scrupulously divided evenly among all the crews whaling that year. The principle of "equal shares" is adhered to so strictly that any "odd" quantity left over after the initial division (an extra box or two of pilot bread or a bag of onions) is opened and shared out in plastic bags. One year, when some cases of vegetable and fruit canned goods were lost in transit, all the cases were opened and shared out rather than simply letting different crews have whole cases of different items. Needless to say, the provision of these supplies is not only a monetary benefit to each whaling captain and his crew, but also relieved them of one logistical concern as well.

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CHAPTER 6: RESULTS

There will be four major parts to this section. The first will present a discussion of the boats used during the period of the study (2001-2012) and the number, composition, formation, and dissolution of crews over that period. This section has been added in response to comments on an earlier draft of this report. The second is a descriptive characterization of the whales landed by Nuiqsut whalers from 1973 through 2012. The third is a more detailed and longer presentation of summary 2001-2012 whaling season data in order to discuss inter-seasonal variability. The fourth discusses the effects of oil and gas activities upon Cross Island whaling, to the extent possible from the information available.

BOATS USED FOR CROSS ISLAND WHALING, 2001-2012

Our entry point will be a simple examination of the boats used for subsistence whaling in 2001 compared to those used in 2012, and the crews whaling in each of those years. The differences will be the basis for a discussion of changes over time and Nuiqsut whaling crew dynamics. A more detailed examination of changes year-by-year is possible (the information enabling the interested reader to do so is presented later in this chapter), but using the first and last field seasons represents the overall changes over the twelve years and simplifies the discussion.

Table 8 displays the summary information for boats and crews used in 2001 and 2012. It also provides the basic information needed for a limited discussion of crew formation and dissolution. A discussion of crew size will be deferred to a later section, although a general discussion of crew composition (related to crew formation) will be included here.

In 2001, four crews whaled using eight boats (Table 8, Figures 12a and 12b). NAP3 was a shallow-bottomed boat unsuitable for whaling and was used only for support services. In 2012, six crews whaled using 14 boats (Table 8, Figure 13). Almost all crews used multiple boats, with the exception being the Kittick crew in 2001. However, no crew used three whaling boats in 2001, while two crews did so in 2012, so the average number of whaling boats per crew increased from 1.75 to 2.33. Combined with the increase in number of crews from four to six, the total number of whaling boats increased from seven to 14. Although the whalers typically say that both boat length and motor horse power have increased over time, this is not so obvious for the 2001-2012 period. The average length of whaling boats has remained fairly constant, and motor horse power has only increased somewhat (although excluding the Kittick motor, used only in 2001, would make this difference larger). The differences that are obvious are that in 2001 Nuiqsut whalers used five fiberglass and two aluminum whaling boats, compared to six fiberglass and eight aluminum boats in 2012. Three of the fiberglass boats whaled in both years (two for different crews), while none of the aluminum boats whaled in both years. When Nuiqsut whalers purchase boats, they look at both the "used" and "new" markets. All of the "new" boats have been aluminum, while most "used" purchases have apparently been fiberglass. More of the new boats have cabins of some sort, whether rigid and permanent or removable (fabric of some sort). The newer boats tend to have more of an aggressive "V" hull, better for ocean conditions as they cut through waves more efficiently. Newer motors, while often rated equal or less in horse power than older motors, are more efficient in terms of fuel used and often, in the judgment of the whalers, more powerful. At any rate, the combination of newer boats with newer motors results in boats that the Nuiqsut whalers state are faster than their older boats.

Table 8. Crews whaling & boats used, 2001 and 2012 Cross Island whaling seasons

Crew and Boat		2001				2012		
		Material	Length	Power		Material	Length	Power
Ahkiviana	UA1	Fiberglass	21 ft	150 HP		Last whaled in 2008		
Ahkiviana	UA2	Fiberglass	18 ft	130 HP				
Aqarguin	IAN1	First whaled in 2003, split from EMN crew				Aluminum	22 ft	225 HP
Aqarguin	IAN2					Aluminum	20 ft	115 HP
Aqarguin	IAN3					Aluminum	20 ft	115 HP
Ipalook	IP1	First whaled in 2007, split from NAP crew				Fiberglass	18 ft	150 HP
Ipalook	IP2					Fiberglass	21 ft	200 HP
Kittick	PK1	Aluminum	21 ft	225		Only whaled in 2001		
Napageak	NAP1	Fiberglass	21 ft	115 HP		Fiberglass	21 ft	225 HP
Napageak	NAP2	Fiberglass	18 ft	115 HP		Fiberglass	18 ft	115 HP
Napageak	NAP3	Fiberglass	22 ft	150 HP		-	-	-
NAP3 used for support only								
Nukapigak	EMN1	Aluminum	22 ft	115 HP		Aluminum	20 ft	150 HP
Nukapigak	EMN2	Fiberglass	20 ft	150 HP		Aluminum	20 ft	115 HP
Nukapigak	EMN3	-	-	-		Fiberglass	20 ft	150 HP
Oyagak	BO1	"Formed" in 2003 when UA crew did not whale (split)				Fiberglass	18 ft	115 HP
Oyagak	BO2					Aluminum	18 ft	115 HP
Taalak	TAL1	First whaled in 2008 when IAN crew did not whale (split)				Aluminum	24 ft	250 HP
Taalak	TAL2					Aluminum	20 ft	115 HP
Average boat 20.13 ft, 143.8 HP						Average boat 20 ft, 154 HP		
Source: Galginaitis and Funk 2004; Galginaitis 2009a, 2009b, 2010, 2011, 2012, 2013a								

Figure 12a. Four Cross Island whaling boats with three boat crews, 2001. Top – Nukapigak 1 and 2. Bottom – Ahkiviana 1 & 2.

Figure 12b. Four more Cross Island whaling boats with boat crews, 2001. Top – Napageak 1 (left) & 2 (right). Bottom – Kittick boat (left) and Napageak 3 (right)

Figure 13. Whaling boats at Cross Island during the 2012 subsistence whaling season. Top: from the right-Aqarguin 1, 2, and 3 (with flag) preparing to leave Cross Island; Nukapigak 2 and 1. Second row: Napageak 1 going scouting (left); Taalak 2 and 1 (right). Third row: Oyagak 1 and 2 unloading at Cross Island. Bottom row: Ipalook 2 and 1 (left); Ipalook 2 still attached to whale (right). (NAP2 and NUK3 not shown)

OVERALL CREW DYNAMICS, 2001-2012

The descriptive characteristics for Nuiqsut (Cross Island) whaling crews are relatively straightforward for any single year, but surprisingly complicated for the period 2001-2012 (and one suspects also for the period since 1973, but little detailed information exists for 1973-2000). At least some of the general dynamics of crew formation, composition, and dissolution are evident even from the limited time depth of the 2001-2012 period. These aspects of Nuiqsut whaling crew characteristics will be discussed below. Crew membership is basically based on kinship, close personal relationships, and in a few cases on expediency (a captain needs another crew member or a worthy but non-relative and previously unknown person needs a crew). The central core of a crew is almost always based on kinship, however. Kishigami (2013) states that Barrow crews in the past were composed predominately of members of the captain's extended families, but now contain more non-relatives. He must mean this only in a relative way, however, since in his description of specific crews the core members are all members of the captain's extended family. Most crews in Nuiqsut also fit this pattern.

In an ideal world, all subsistence whalers would start whaling with their father at a young age, eight to ten years old or even younger. They would serve as "boyers" and do simple chores such as make coffee, or go on run-and-fetch errands. As they grew older, they would be given increased responsibilities (cooking, cleaning, taking care of non-weapon whaling gear, eventually taking care of weapons), and finally graduate to being a member of the boat crew. Thus, the "ideal" Nuiqsut whaling crew is composed of the whaling captain and his sons, or male relatives and their sons. The majority of Nuiqsut whaling crews match this model to some extent, at least at their core. Given the demographic limitations Nuiqsut's population, one could say that the degree the reality matches this model is remarkable. All Nuiqsut whaling crews have kinship relations as a primary operative membership criteria, if only because most people in Nuiqsut are related in at least some fashion. Most also have close kinship ties as a strong basis for core membership. The most obvious exceptions, the UA and the current (Thomas Jr.) NAP crews, can be relatively easily explained. The current NAP captain is too young to have sons of whaling age, and his experienced male in-law (the co-captain of the former NAP crew) wishes to whale with his own crew. The UA captain has relatives in Nuiqsut, but says that they are not in a position to help him out with the crew (meaning primarily in an economic sense, but also in terms of manpower). His one son did whale with the crew, but for the most part the UA crew had to consist of more distant relatives, in-laws, and friends. It is also common, when a captain's son is still young, to include one of his friend's in the crew as a companion. All of these factors are evident in Figure 14, a photo of what the UA captain called "the ideal crew". This photo shows a whale landed by this crew with the captain, his two senior crew members (in-laws or more distant relatives), and the sons of all three. Most captains will also include both relatives and non-relatives who ask the captain if they can go whaling with his crew. The ideal in this case is that a captain should never refuse such a request.

However, the reality is that crew size out at Cross Island must be limited, and that most aspects of subsistence whaling require physical strength and endurance. Boats can only carry a fixed number of people, gear, and supplies. The greater the number of people at Cross Island, the greater the logistical problems of providing food, water, and the other requirements becomes.

Figure 14. One captain's ideal crew – captain, two senior crew members, and their sons

Only so many crew members can fit into one cabin, although in some cases a single crew has been able to use two cabins when for some reason another crew has decided not to whale that year. On the other hand, a minimum number of crews and crew members is required for the successful landing and processing of the Nuiqsut quota (currently four strikes and in a typical year three or four whales). A boat scouting for whales requires three people – a driver, a harpooner, and a "float man" who throws out the float after the harpooner throws the darting gun with the harpoon attached. In a pinch the driver can double as the float man, but this is not considered a safe practice. A fourth person is often added as an extra set of eyes to look for whales and as a safety measure in case of injuries or other whaling accidents. If the boat and motor combination is capable of handling a greater load, sometimes more people will be taken in the boat, but since greater speed is an asset in the hunt as currently conducted, most boats go scouting with a crew or three or four.

For some crews, all crew members go out scouting. Others may leave a few crew members on shore for at least some days. The average boat crew size for 2001-2012 was 3.3 persons, with a range from two to eight (the extremes were infrequent). The average overall total crew size (the number of people actually staying in that crew's cabin) was about 4.1 people per whaling boat, although one-boat crews typically ranged from four to six, and multiple boat crews typically could run "leaner." Total crew sizes on Cross Island ranged from four to 14, and could actually be larger since for the larger crews, some members would often leave before the season was over and others would arrive on Cross Island sometime after the season had started. Thus, while crew members on Cross Island at any one time may be 14, the number of different crew members over the full term of the season could number 17 or 18. Crew size could vary over the length of a season for any crew, but such variation was more frequent for larger crews than for smaller ones.

While women play critical roles in Nuiqsut whaling, few go out to Cross Island to participate in the actual hunt. Similarly, while whalers recognize the importance of teaching whaling skills to the next generation, the youngest whalers tend to be physically mature teenagers. Few "subadults" participate in whaling as Cross Island crew members. During the 2001-2012 seasons, the number of women varied from zero to three per season and the number of subadults from zero to three or four. All subadults were male. Before 2001, women also had participated in the hunt. Their rate of participation seems to have been about the same as for 2001-2012. That

is, most whalers were male and female participation in the hunt was considered unusual, especially in the earlier period. Teenagers were known to participate in the early Nuiqsut whale hunt, but more detailed information is not available. An increased rate of female and/or youth participation at Cross Island both face the same constraints. Transporting crews to Cross Island and supporting them once they are there, limit the number of people on the island. The physical demands of whaling also place constraints on who can be taken to Cross Island as a crew member. There is some suggestive evidence that with the recent trend towards more and larger crews, the number of female and young crew members may be increasing, but the evidence is too weak (and too recent) to make any definitive statements.

There is currently one crew with a female co-captain, but she is considered quite an exceptional woman. She owns her own whaling boat and runs it out at Cross Island as the "number 2" boat for her whaling captain. All other women who have been crew members at Cross Island have served mainly in "on shore" functions, going out scouting for whales on a rotating basis with the other non-core members of the crew. Whaling boats generally go out with a relatively fixed crew of three, plus others as the captain sees fit. All whaling captains try to give all crew members an opportunity to go out on at least one scouting trip. However, the captain also weighs the costs and benefits of sending out additional crew members in the boat, and often opts to send out a lighter and faster boat with fewer crew members (three or four). These three or four will be the most skilled and thus most regular crew. Other crew members will go out as space in the boat is available. Generally, female crew members have been among the Cross Island crew members who go out scouting least frequently – but the sample size is small.

For the period 2001-2012, two crews ceased whaling and four new crews were formed. Only two crews whaled in both years, and both of these crews had a transition in leadership due to the death of the captain. Only one crew whaled during all 12 years (2001-2012). This understates the basic continuity of Nuiqsut whaling crews, however. All four new crews formed by "splitting off" from an old crew. In all four cases, the captain of the new crew had been the senior crew member of the old crew. In two cases, both the old and the new crews whaled during the first year of the new crew. In two cases, the old crew skipped whaling for a season, and this probably was one factor fostering the formation of the new crew. In all four cases, the captain of the new crew had been running his own boat as the "number 2" boat for the old crew, which then became the "number 1" boat of his own crew.

The Nukapigak (EMN) crew is perhaps the most interesting case. The crew was originally formed in the early 1980s by Edward Nukapigak Sr. (who had previously been a whaling captain in Barrow). In 2001, the captain was his widow, Ruth Nukapigak, although she no longer went out to Cross Island herself. The crew was composed of several of her sons and daughters, their children, and other relatives. Several of the sons acted as co-captains, trading off this responsibility from one year to the next. This was and continues to be one of the largest extended families in Nuiqsut. In 2003, one of the younger sons decided to form a separate crew (Aqarguin or IAN). Even with multiple boats, more members of the extended family wished to whale then could be accommodated on the old crew. The cabin at Cross Island was also becoming quite crowded. This also allowed the new captain an independence he lacked as a member of the old crew, and his sons were of an age where they could constitute a large component of his crew. His harpooner from the old crew also stayed with him as the senior crew

member. In 2008, the IAN crew did not whale, so this senior crew member in turn formed his own crew (Taalak or TAL). His crew at Cross Island was composed primarily of male in-laws. When Ruth Nukapigak passed on, the captaincy of the EMN crew was shared by her older sons, although only one registered as the official captain in any given year.

The late Thomas Napageak Sr. was the captain of the Napageak (NAP) crew in 2001. He had been a whaling captain in Barrow and formed the first whaling crew to whale from Nuiqsut in 1973. He passed away in May 2005, and his son, Thomas Napageak Jr., assumed the captaincy. The crew still whaled in 2005, landing the only whale Nuiqsut took that year. The crew did not whale in 2006. While Thomas Sr. was alive (the 2001-2004 seasons) the core of his crew consisted of one of his sons, male in-laws and other relatives, and occasional people from Barrow. For 2005, some of the old crew whaled with the NAP crew with Thomas Jr. as the captain. After 2005, none of the male in-laws continued to whale with the NAP crew. One formed his own crew in 2007 (Ipalook or IP), explaining that he and his sons had helped land the new captain's first whale in 2005 and now felt they could whale as a separate crew. The NAP crew after 2005 consisted primarily of the captain and a close group of his friends and peers. The new captain was the youngest captain in Nuiqsut and at that time had no children. For some years he recruited a more experienced whaler to act as a senior crew member, but not for all.

The Ahkiviana (UA) crew for 2001-2002 consisted of the captain and his son, a life-long friend and hunting partner his own age with some of his, and the captain's own relatives of various degrees. The UA crew did not whale during the 2003-2004 seasons, so the hunting partner formed his own crew (Oyagak or BO) with a core crew of the captain, his sons, and sometimes a nephew and other relatives. The UA crew returned to whale in 2005-2006 and 2008, but fielded a crew whose composition was more fluid than that of other crews, in that it was based less on close kinship relations. The UA captain has not whales since 2008, primarily related to health issues, and his son has not assumed captaincy of the crew so most people in Nuiqsut believe that this crew is now retired.

The Kittick (PK) crew was a special case, in that it whaled only in 2001 (although a Kittick crew under a different captain did whale from Nuiqsut in the 1980s and landed a whale in 1987). The crew consisted of the captain and his brother, two additional unrelated young recruits, and the researcher. Little information is available on the prior experience of the captain on Nuiqsut whaling crews prior to 2001, so it is not known if this crew "split" from another one, but this was probably not the case. The captain was relatively young, with a large (and young) family, and the largest and most powerful boat in Nuiqsut. He has not fielded a crew since 2001 primarily because he has had motor problems, which have had a lower priority than meeting the other economic needs of his family. He has since participated in whaling as a member of other crews (primarily the EMN crew).

The economics of being a whaling captain and running a crew was not a focus for this project, which concentrated on the harvest component of Nuiqsut subsistence whaling near Cross Island. Nonetheless, economic considerations were clearly primary factors in determining who could successfully field a crew. While to some extent a support network of close relatives can compensate for a relative lack of economic resources of a whaling captain, in all but one case Nuiqsut whaling captains have a full-time job with good pay. All but one are also shareholders in Kuukpik Corporation (the Nuiqsut village corporation) which, since the start of production

from the Alpine field in 2001, has been distributing large dividends. One successful whaling captain is a shareholder of Ukpeagvik Iñupiat Corporation (UIC - the Barrow Village Corporation) and is not steadily employed. Although UIC distributes dividends, they are quite a bit smaller than those of Kuukpik Corporation. He has relied heavily on help from one of his sons who is employed by the oil industry. Two other Nuiqsut residents who have fielded whaling crews in the past are also UIC shareholders and not steadily employed, and with no steady wage earners in their households have not been able to field crews since 2000 and 2001. Both need larger motors than they currently own, and probably needed some work on their boats (or to obtain a new boat). The households of all three of these individuals are among the most active subsistence producers in Nuiqsut, and place a priority on harvesting terrestrial mammals, fish, oogruk (bearded seal), and smaller seals, because these resources are more readily available at a lower cost (in terms of investment in equipment as well as recurring trip costs such as gas and supplies) than is whaling.

The next section presents and discusses summary descriptive information on the characteristics of the whales that have been landed by Nuiqsut whalers, and so incorporates the 2001-2012 fieldwork as well as historical and archival sources. The specific topics will be the number of whales landed, the size of whales landed, the sex of whales landed, the date of whale landings, and the location of whale landings (often approximate for earlier years) of the harvest. This information is discussed here in a format comparable to that of Koski et al. (2005) for Kaktovik, the only other Iñupiat community that whales only in the fall. Not all parallel graphics are presented. These treatments are at a relatively general level and more detailed examination of the 2001-2012 data (and inter-seasonal variation) is deferred to a later section.

NUMBER OF WHALES TAKEN BY YEAR, 1973-2012

Table 2 (above) summarizes the harvest of whales for Nuiqsut for 1973–2012, and Table 9 displays some derived measures for three relatively well-defined periods in Nuiqsut whaling. While one can quibble with the transitional dates, a significant event marks each transition. These periods will be useful in discussing changes or different characteristics of Nuiqsut/Cross Island subsistence whaling over time. For the period 1973-1985, Nuiqsut whalers landed only two whales, an average of 0.15/year, with no information about struck-and-lost whales. For the period 1986-1994, they landed 10 whales, with an additional six struck-and-lost – averages of 1.11 and 0.67 per year, respectively. For the period 1995-2012, they landed 59 whales and struck-and-lost five, averages of 3.28 and 0.28. Although not displayed in Table 9, it is clear that the "potential whales landed" increased through time. The effective "quota" for 1973-1985 was one, as butchering more than one whale would have been difficult if not impossible given the limited Nuiqsut whaling effort during that period. The actual harvest of two represented about 15 percent of the "potential whales landed" during this period. For 1986-1994, with annual quotas of two and then three whales, the actual harvest was about 42 percent (10 of 24) of the total quota for the period. For 1995-2012, with an annual quota of four, the percentage was 82 percent (59 of 72). The percentage of number of strikes used compared to the annual quota available displays a similar increase through time, from a very low success rate to one that is quite high. 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

Table 9. Summary Nuiqsut strikes and landings by period

Years	# Years	Average Quota	Average Strikes Used	Whales Total Landed	Whales Total S&L	Whales Average Landed	Whales Average S&L	Ice/Weather Notes
1973-85	13	"1"	0.15	2	UNK	0.15	UNK	Information available only for 1981-1985. 1981 no quota available (used by Kaktovik). 1982-1985, ice prevented whaling in all three years. Characterized as a period of cold, ice, rough weather
1986-94	9	2.67	1.78	10	6	1.11	0.67	Adverse ice noted one year, adverse weather one year, industry interference noted the same two years plus three others, favorable conditions noted one year, five years no ice/weather notes
1995-2012	18	4	3.56	59	5	3.28	0.28	Averse ice two seasons (but localized). Adverse weather 2003-05, 2007-08; rough seas (large swells) 2008-09, 2011-12 attributed to lack of ice cover

Sources: AEWC records, Barrow, 2003; Nuiqsut whalers, 1982-2012, pers. comm.

whales, averaging about 30 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 each 35 feet or longer, can be enough and in at least one season Nuiqsut whalers have foregone landing a fourth whale for this reason.

Nuiqsut whalers have only used an extra strike three times, in 1989, 1998, and 2002 (Table 5). These were all cases where they felt they needed to make up for a struck-and-lost whale in order to satisfy the needs of the community. In four other seasons when they used their quota of strikes and had a "struck-and-lost" whale (1991, 1992, 1997, and 2007), and so landed only three whales, they did not make such requests, either because the season was too advanced or the whales already landed were sufficient for community needs. In one season, 2011, Nuiqsut whalers chose not to use their fourth strike because their needs were satisfied with the three whales already landed. Thus, the harvest record indicates that Nuiqsut's community needs can be met with three to four whales, depending on the size of the whales. Nuiqsut whalers have consistently landed sufficient animals to meet their community needs since 1995, while their harvest before 1995 was more irregular.

TIMING OF THE CROSS ISLAND WHALE HARVEST

For this quantitative discussion and most that will follow it, the whale landed in 1973 is excluded as a likely unique case or outlier. A Nuiqsut crew did not land another whale until nine years after this landing, and between those two landings the nature of Nuiqsut whaling had changed from the explorations of one crew to the regular activities of several. Many "facts" about the first landing are uncertain, including the length and sex of the whale, and perhaps even the approximate location of the strike, so that it cannot be included in some discussions anyway.

The harvest dates for whales landed near Cross Island 1982-2010, aggregated for all years by five-day periods, are shown in Figure 15. The vast majority (89 percent) were landed during September. October landings (6 percent) occurred only during the 1986–1991 seasons and were no later than October 10. August landings (5 percent) occurred only in 2007 and 2010, and were no sooner than August 29. Most whales taken near Cross Island were landed before September 19, with September 5 as the most common date. Note that Figure 15 is heavily skewed by recent harvests in the 2000s, which represent 61 percent of whales.

Figure 16 indicates that dates for bowhead harvests near Cross Island have become earlier since 1982 (the period when Nuiqsut has fielded more than one crew), even though quotas (and average number of whales taken) have increased. The trend is significant ($r^2 = 0.59$ for females and $r^2=0.47$ for males, $r^2=0.50$ overall – but the difference between the sexes is probably not significant, due to the influence of the few data points in the 1980s). A polynomial rather than a linier regression was used since it produced a higher r^2 value and also produces a more intuitive result. It is not likely that harvest dates can become much earlier near Cross Island, due to the constraints of the beginning of the whale migration and the need to wait for reasonably cool weather to prevent spoilage (see the more detailed discussion below, based on 2001-2012 data). R^2 is the proportion of variability in a data set that is accounted for by the model, and is a measure of how well a regression line fits (or describes) the data. Values can range from "0.0" (no correlation) to "1.0" (perfect correlation). This trend is even more significant if only the first strike for each season is considered ($r^2=0.67$, Figure 17), but the quality of the data are somewhat less precise and the sample size is much smaller. Local explanations for this trend emphasize the availability of better and more powerful equipment for the hunt since the early 1990s, whereas in the 1980s (and earlier) the whalers had to wait for cold weather so that the whale would not spoil before they could transport it back to the village. Also contributing to this trend are the desires to avoid harsher weather and sea conditions later in the season, and for shorter and more compact seasons. An increase in the bowhead whale population and possible changes in the timing of the bowhead migration may also be factors.

As discussed above, contemporary Nuiqsut whaling crews usually plan on being on Cross Island no later than the first week of September, and leaving no later than mid-September, in contrast with patterns of the past. In the 1970s and 1980s, Nuiqsut whalers report that they generally did not start their season until mid-September. In contrast, current Nuiqsut whalers state that the Cross Island subsistence whaling season normally begins on Labor Day. However, crews in practice often leave for Cross Island and start the whaling season before that date. This makes the predominance of whale landings in the first half of September understandable. Fewer whales were landed during the earlier seasons (when Nuiqsut whaling seasons were later in the year) than in later seasons (when whaling seasons were earlier in the year). During the discussion of the more detailed information from 2001-2012 below, this topic will again be briefly addressed.

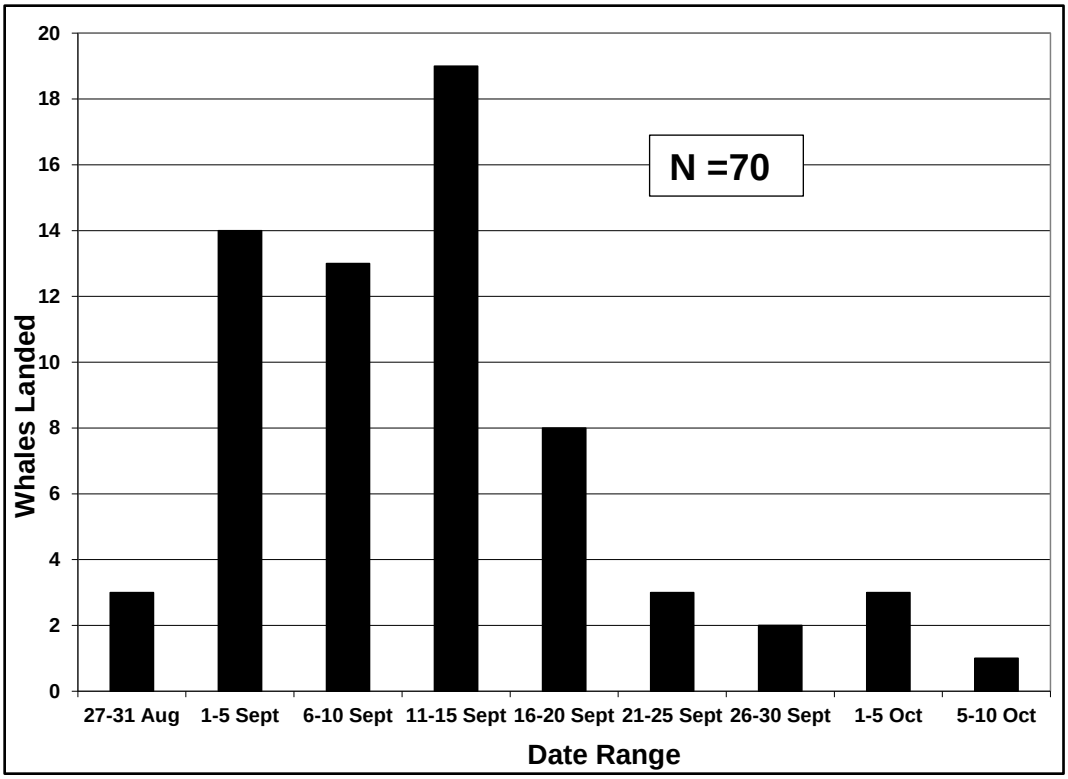

Figure 15. Bowhead whales landed near Cross Island by date range, 1982-2012

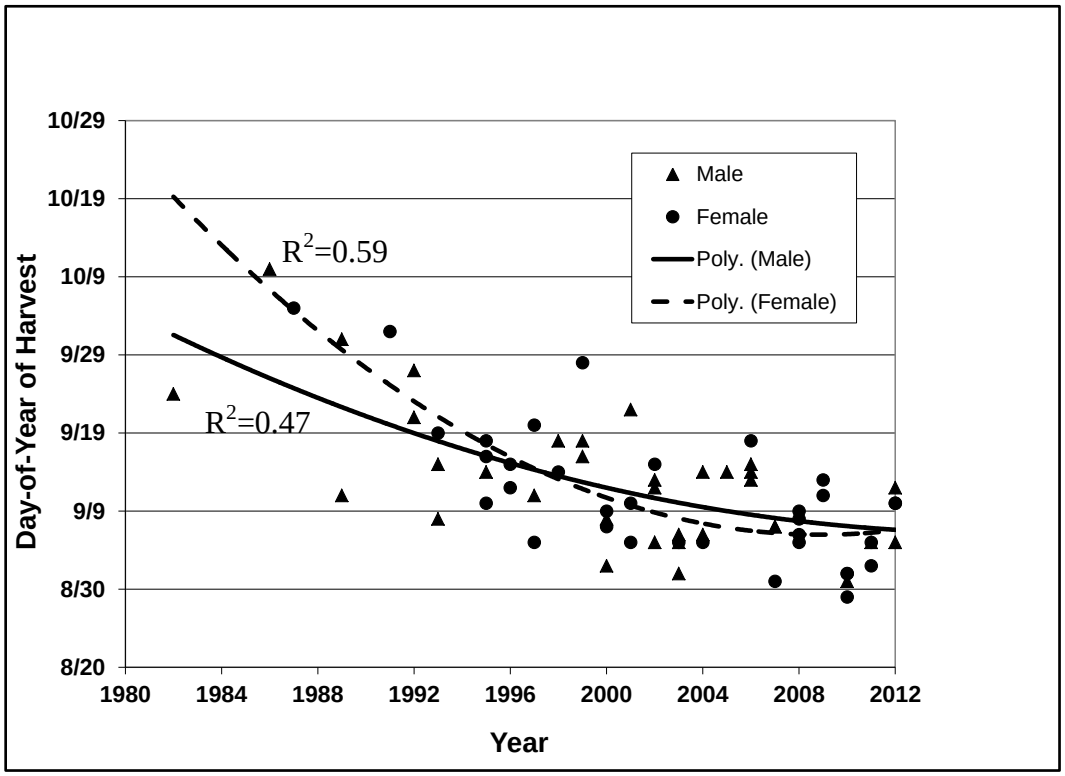

Figure 16. Cross Island bowhead whale harvest date by year and sex

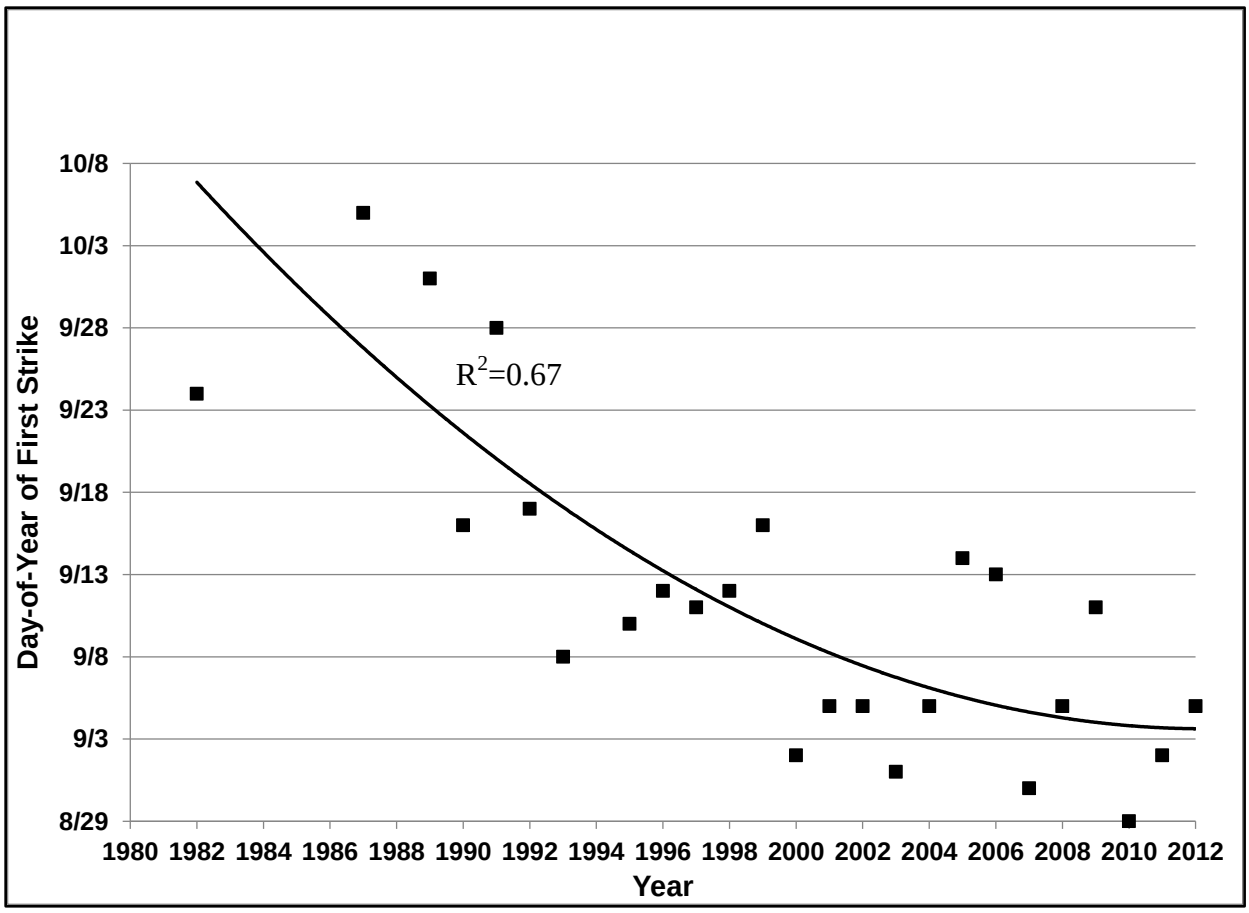

Figure 17. Date of first bowhead whale strike by year

SIZE OF WHALES LANDED AT OR NEAR CROSS ISLAND

Nuiqsut 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 (25-35 feet). This preference is consistent with the AEWC management guideline for whalers to strike only sexually immature animals (generally less than 38 feet). However, some Nuiqsut whaling captains have the reputation for taking larger whales (40+ feet), and others state that one 35-foot whale is just large enough to provide for the community distributions expected at Thanksgiving, Christmas, and Nalukataq. The lengths of whales taken near Cross Island also necessarily reflect the distribution of whales near Cross Island that are encountered and seen by the whalers. Further, the distribution of whales encountered by the whalers varies from year to year, and is difficult to document with precision, and its relationship to the distribution of all whales migrating in the area of Cross Island also is unknown.

Figure 18 displays the size distribution of whales landed by Nuiqsut whalers for 1982-2012, by size category in feet (5-foot categories). Lengths are "unadjusted" – that is, as measured by the whalers after being hauled up on the beach. This is the measurement that the whalers use (in feet), although they know that whales "stretch" when they are out of the water, due to their weight. Of the 70 whales landed, only 23 (33 percent) are in the "preferred size" range. One

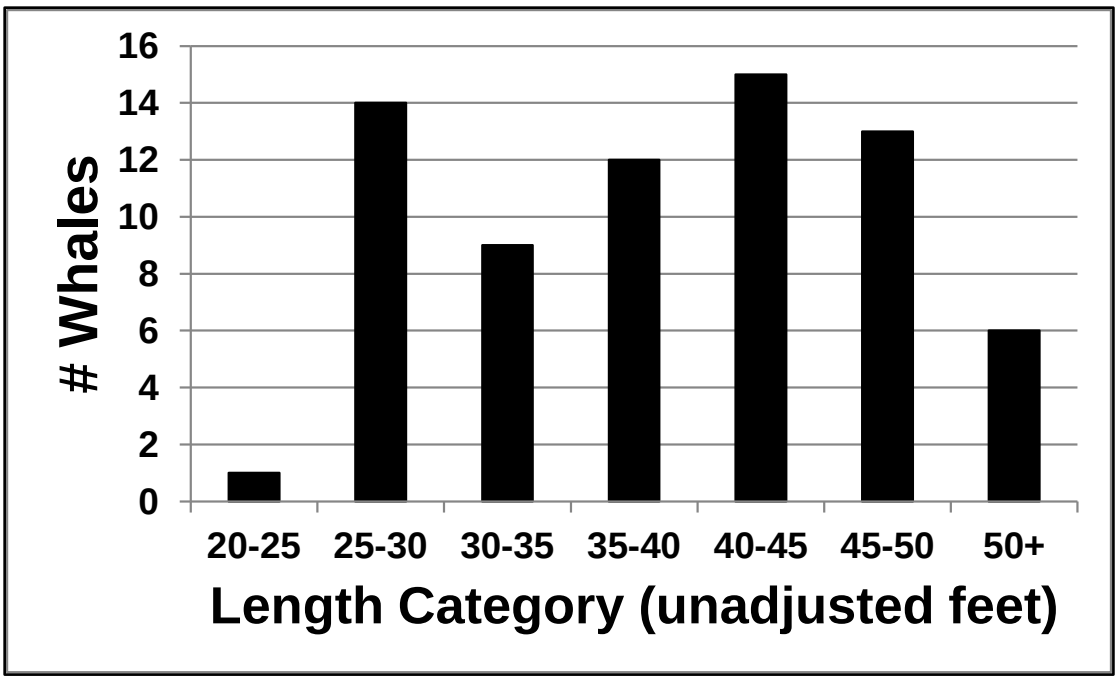

Figure 18. Length distribution of whales landed near Cross Island, 1982-2012

whale (one percent) was smaller, and 46 whales (66 percent) were larger. There is no clear size-preference or size selection evident, other than the avoidance of whales less than 25 feet, and perhaps a tendency to avoid whales 50 feet or greater. The "average" landed Nuiqsut whale was about 38.6 feet long, the median about 38.8 feet – slightly larger than the high end of the "stated preference" range.

Figure 19, displaying the length of whales landed near Cross Island by year, indicates that there has been no change in the period 1982-2012, with an "average" length of somewhat less than 40 feet, consistent with the discussion above. The very small trend towards taking smaller whales may be due to the small number of whales taken in the 1980s and early 1990s that were landed in late September or October, when larger animals likely composed more of the animals present than in the early- to mid-September, when Nuiqsut whalers currently whale. Except for the few whales landed in the 1980s (only one of which was small, landed early in the season), the distribution of points is quite dispersed and shows no evident size selection or preference.

Figure 20 adds some support to this conclusion, since again there is no apparent relationship between the date of harvest and the length of the whale landed. The points are again well dispersed, except for the few whales that were landed in very late September or early October. All but one of these whales were landed in 1992 or before – the exception was landed in 1999. Since 1999 (and probably earlier), Nuiqsut whalers rarely whale past mid-September (discussed at greater length below). It is likely that later in the bowhead migration, late September-October, large whales predominate in the migration near Cross Island. There is little question that Nuiqsut whalers are whaling and landing whales earlier than in the past (Figures 16 and 17 and discussion above).

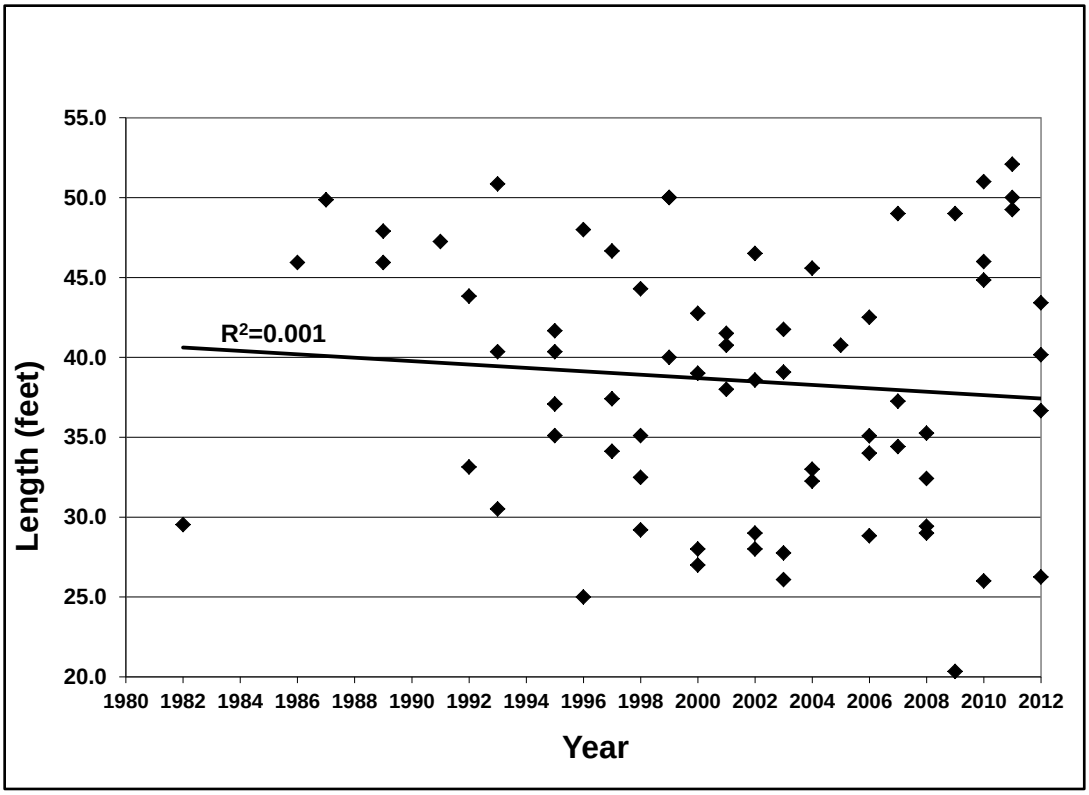

Figure 19. Cross Island subsistence bowhead whales landed – length by year

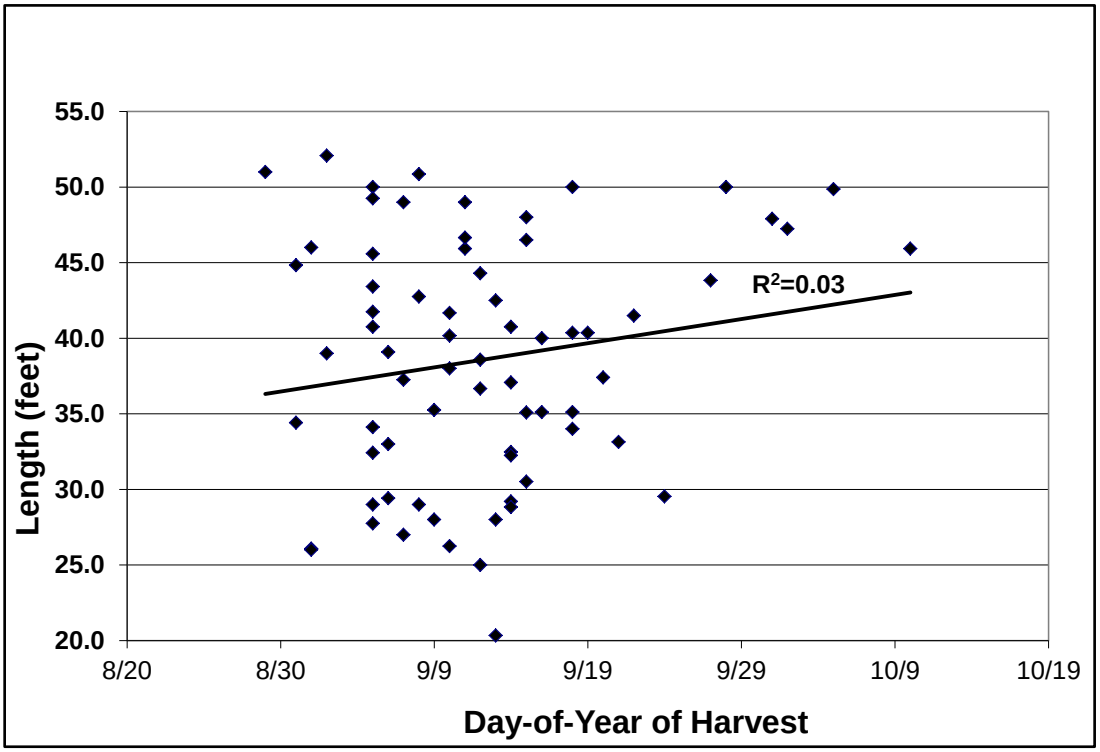

Figure 20. Cross Island subsistence bowhead whales landed – length by date

McCartney (1995) and Braham (1995) present evidence that aboriginal whalers in the western Arctic harvested predominately smaller (sub-adult) rather than larger (adult) whales; they suggest that Alaska whalers were selectively hunting for small whales. Nuiqsut whalers, as a group, profess a preference for "smaller" whales (25 to 35 feet in length). Koski et al. (2005) provide information on the size distribution for whales photographed near Kaktovik during the fall migration. They demonstrate that the average length of the whales landed by Kaktovik hunters is significantly shorter than the average length of all whales participating in the migration (as documented by their methodology). They conclude that Kaktovik whalers are selecting smaller whales, even later in the season when larger whales predominate in the migration and fewer small animals are expected to be available (with the assumption that the distribution of whales photographed represented the distribution of whales encountered by Kaktovik hunters).

More refined analysis of the whale distribution in relation to water depth, whale length, and date showed that subadults (less than 13 m [43 ft]) move primarily through shallow nearshore water and adults (13 m [43 ft] or greater) move primarily through deeper water. Subadults appeared earlier in the migration than did adults (Koski and Miller 2009). Their study area extended from Flaxman Island (the western edge of Camden Bay) east to Herschel Island (in Canada), divided into four smaller subareas. While not including Cross Island, the Camden Bay subarea may be a proxy for the whales encountered near Cross Island—Nuiqsut whalers say many whales they encounter seem to come from Camden Bay, and whales often congregate there. The Kaktovik subarea included the area where Kaktovik hunters find their whales. The study made systematic aerial surveys of the four subareas and recorded whale observations with geo-referenced photographs, from which length measurements could be estimated. These data were then presented by subarea in terms of number of whales seen by length and water depth categories (Koski and Miller 2009). Length categories were subadults (two categories – less than 10 m [33 ft] and 10-13 m [33-43 ft]) and adults (greater than 13 m [43 ft]). Water depth categories were less than 20 m (66 ft), 20-40 m (66-131 ft), 40-200 m (131-656 ft), and greater than 200 m (656 ft). Almost all data was obtained from waters less than 200 m (656 ft) deep. About twice as many whales were documented in the "Kaktovik" subarea as for the "Camden Bay" subarea (Koski and Miller 2009).

Figure 21 presents the frequency distribution for the reported lengths of whales harvested near Cross Island using the same size-categories, and adjusted in the same way, as Koski et al. (2005) and Koski and Miller (2009). Since whales "stretch" when taken out of the water, but most lengths reported are while out of the water, to compare them to whales seen in the water, these lengths must be reduced by about 8.8 percent (Koski et al 2005). The Cross Island and Kaktovik distributions both peak in the 9.5–9.9 m (31-33 ft or small subadult) category. However, while 54 percent of whales landed in Kaktovik were "small subadults" (less than 10 m [33 ft]), only 41 percent of the Cross Island harvest met this standard. "Large subadults" (10–13 m [33-43 ft]) constituted 23 percent of Kaktovik's bowhead harvest, but 36 percent for Nuiqsut. About 23 percent of Kaktovik's landed whales were longer than 13 m (43 ft) (Koski et al. 2005), about the same as for the whales landed at Cross Island. The frequency distribution for Kaktovik's landed whales extends to 17 m (56 ft), while that for Nuiqsut only extends to 14.6 m (48 ft). In both cases, the whalers are taking fewer adults than are found in the migrating population in general or were photographed near Kaktovik (Koski et al. 2005; Koski and Miller 2009) and are apparently selectively targeting smaller whales. While 61 percent of Kaktovik's landed

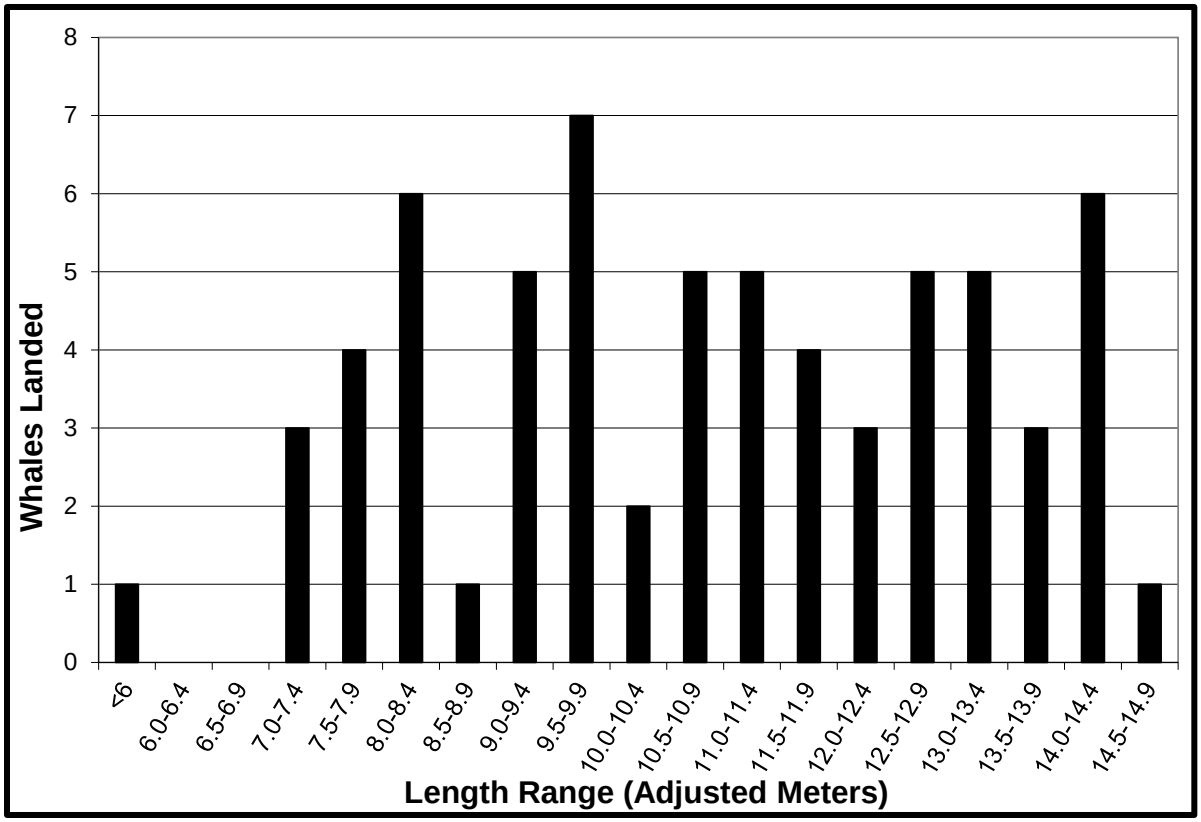

Figure 21. Whales landed near Cross Island, 1982-2012, by length category (meters)

bowheads were smaller than the preferred maximum (with at least 11 percent smaller than the preferred minimum), only 47 percent of Nuiqsut's landed bowheads were smaller than the preferred maximum (with at least 12 percent smaller than the preferred minimum). On the other hand, Nuiqsut whalers may avoid taking very large whales more than Kaktovik whalers.

Whalers from Kaktovik or Nuiqsut rarely looked for whales in water deeper than 200 m (656 ft), and typically operated in depths of 30 to 60 m (98-197 ft). The data presented by Koski and Miller (2009) suggest that the Kaktovik and Nuiqsut whalers may encounter different size distributions of whales, with Kaktovik seeing more small subadults in a "typical" year. Also, the Beaufort Sea floor out to the shelf break is much narrower in the Kaktovik area than it is around Cross Island, so that it may serve to "funnel" the migration past Kaktovik, but promote the migration to become more dispersed as it approaches Cross Island. A greater proportion of the migration in general, and a greater mixture of whale size classes, may pass near Kaktovik than Cross Island, or Kaktovik whalers may whale in waters with more adult whales than do Nuiqsut whalers.

A larger number of whales could allow for greater selectivity, while a greater mixture of sizes could make it easier to misjudge the size of a whale. The data presented by Koski and Miller (2009) thus may provide evidence for some degree of selection for smaller size in Kaktovik (although the number of large whales taken would be anomalous), but the data for Nuiqsut would not, suggesting that Nuiqsut whalers strike the whales that they encounter. This is, in fact, what

Nuiqsut whalers reply when asked—they chase the "blows" (or whales, but blows are seen at a greater distance and thus more often than are the whales themselves) as they see them. They usually chase whales one at a time, with all available boats concentrating on one whale, although when whale sightings are plentiful, or boats widely separated, this practice is relaxed. There is little selection in terms of size except that mothers and calves are not chased or struck, small whales that could be calves are not struck, and particularly large whales may be passed by, depending on the crew and how the season has progressed up to that point (NWCA 2011). Typically, "Moby Dick" blows are not investigated or chased, unless the people in the boat for some reason want to see a particularly big whale, but these blows are usually reported to and discussed with the other whaling boats.

While the average size of Nuiqsut-landed whales has changed little over time, the relatively few landings in the 1980s tended to be larger and later in the year (when larger whales reportedly make up more of the migration) than for more recent landings. In earlier years, when logistical support was not as developed, the meat on whales often spoiled and larger whales may have been preferred due to the greater amount of muktuk they provided. Muktuk spoils much more slowly than the meat, and can be recovered even from a "stinker" whale. Better logistics and an increased number of crews/boats improved towing and butchering efficiency and the recovery of meat. Some captains still preferred larger whales for the larger baleen, which brought a higher price when sold. One active captain with a known preference for larger whales simply says, "You know me, I like everything big!" Still, the majority of the data seems to indicate that Nuiqsut whalers strike and land the whales that they encounter, with the qualification that some captains were (and are) more likely to strike a large whale (rather than pass it by) than are most of the others. Captains may have individual preferences, but are constrained by the size of the whales they actually encounter. Some captains, with stated preferences for smaller whales, have landed large whales.

The fall bowhead whale migration is believed to be partially segregated according to size, with smaller whales tending to migrate earlier than larger ones—an observation made by both scientists (Koski and Miller 2009) and Iñupiaq whaling experts (Galginaitis and Koski 2002; Koski et al. 2005). However, both Kaktovik and Nuiqsut whalers state that all sizes of whales are present during their hunts, and Huntington and Quakenbush (2009) report that Kaktovik whalers, based on the whales they saw, reported no temporal pattern of size distribution for the fall bowhead whale migration, other than for a few large whales to be the first through the area to "set the trail" for the others. Size segregation during the fall migration may thus have a more distinct spatial manifestation (smaller whales closer to shore) and less of a sharp temporal aspect ("wave" or "pulse") than in the spring. Barrow whalers, on the other hand, observed that the fall migration, like the spring migration, came in three "waves"—large whales, followed by mid-size whales, and then by small whales (Huntington and Quakenbush 2009). Barrow whalers also reported that the fall three-wave pattern is less distinct than that of the spring. Nuiqsut whalers also report that the fall migration occurs in "pulses," but with the larger whales predominating at the end of the migration and smaller ones at the beginning. One reason Nuiqsut whalers give for trying to land whales early in the season is so they can target the early "small" whales or the middle wave of "mid-size" whales, and avoid the large whales at the end of the migration (NWCA 2011).

There is only a small correlation between the date of harvest near Cross Island and the size of a whale ($r^2 = 0.03$), and a small probability that a late harvest near Cross Island will be larger than an early harvest – but the sample of "late harvest" landed whales is small. There is also no significant correlation between the year of harvest and length of the animal harvested for the 1982–2012 period ($r^2=0.01$) – but again, the sample of whales landed in the 1980s and 1990s is small (and missing some data). These findings are somewhat surprising, given that Nuiqsut whalers now start their hunt significantly earlier than they did in the past and recognize temporal size segregation in the bowhead migration. This may reflect the higher success rate of hunts since 1995, but probably also the relative non-selectivity of the Nuiqsut hunting strategy. That is, the harvest pattern may reflect the distribution of whales that Nuiqsut whalers encounter, rather than the population of whales in the Cross Island area in general. When conditions are difficult or limiting, the whales Nuiqsut hunters can approach are explicitly different from the animals they know are in the area. In 2010, for instance, Nuiqsut whalers encountered floating ice to a distance of 8 to 12 miles from Cross Island. They saw some smaller whales in or near this ice, but did not approach them since the ice made a successful harvest less likely. In more open water they saw greater numbers of whales, all much larger in size. They filled their quota with three relatively large whales and one small whale. As another example, in 2011, Nuiqsut whalers encountered no ice, but swells and waves combined to make it very difficult to sight whales in general, and small whales in particular. Whalers saw few whales, and those seen were large, but they assumed that the full range of whales was present and they simply could not see the smaller whales from their small boats due to the high swells (Galginaitis 2012). The three very large whales they landed satisfied the community's needs, so the fourth strike was not used. Nuiqsut whalers operating out of Cross Island have less flexibility than do fall whalers based in Kaktovik or Barrow in waiting for conditions (weather, ice) to change to improve access to preferred animals, since they are more time-restricted. Thus, they may be more likely to strike the animals available, regardless of size, unless those animals are too small (calves) or much too large. Also, since some whaling captains tend to strike larger animals it may be that the selective force of preferred whale size operates with less effect in Nuiqsut than in other communities.

HARVEST LOCATIONS OF WHALES LANDED NEAR CROSS ISLAND

The NSB/AEWC database (AEWC/NSB 2007) reports harvest locations, although it is not always clear that the coordinates given actually represent the kill site for each whale. Whalers may sometimes have reported the general area where they first encountered the whale, the site of the first strike, or the actual kill site. Harvest location information is not known for seven whales, all from the 1990s. Given that most of these early points were not marked by GPS units while the crew was on the water, but rather located on maps after the fact, this lack of precision is not a critical factor. In most cases where the information is known, the kill site is reasonably close to the kill site, unless the first bomb delivered by the darting gun did not explode or was very off-target and did little harm to the whale. The harvest site of the 1973 whale has been placed at two different locations by members of the crew who participated in that hunt, but they are in the same general area (near Flaxman Island or the mouth of the Canning River).

For this project, it was possible to document both first-strike locations and kill sites for all landed whales with greater precision, either based on GPS coordinates marked by crews involved in the hunt or through the use of radio reports/DCC Log locations and GPS track date stamps.

However, for reasons already discussed elsewhere ("Methodology"), they are also not exact point locations. Because the "first-strike" more closely represents where the whale was encountered and thus the distribution of whales, than does the "kill" site, the "first-strike" locations is used as the "harvest site" for all Cross Island whales landed 2011-2012. The available harvest information for whales landed by Nuiqsut whalers (1973–2012), grouped into three time periods (Table 9 above) is displayed graphically in Figure 22. Also displayed on Figure 22 are the aggregated GPS tracks collected for Nuiqsut whalers for 2001–2012 and the sites of some of the early oil and gas exploratory activities (important to the Nuiqsut participants on the project). Figure 23 displays only the harvest locations documented for this project (2001-2012), but codes them by year. One of the most striking aspects of both figures is the extent to which whaling effort overlaps from year-to-year, as indicated by the density of the overlapping tracks in the quadrant NE of Cross Island. Nuiqsut whalers say they find and strike most of their whales in that geographical quadrant, and it is their preferred search area for whales. Most scouting trips begin to the NE, although a number also start north and some to the east, or even SE towards Narwhal Island. Only in unusual circumstances, or if whales have not been seen in the other locations, will a scouting trip start by heading west.

Although the area delimited by the 2001–2012 GPS tracks does not represent the full extent of the area important to Nuiqsut whalers, all but two of the 64 whales with documented locations landed by whalers fell within the boundaries of those tracks (most in the area of overlap). The two known exceptions are the first two whales, landed in 1973 and 1982. The first was butchered on or near Flaxman Island. The second was probably towed to Cross Island, as were all but one of the subsequent whales landed by Nuiqsut whalers. Both of these whales were landed before Nuiqsut whalers established Cross Island as their primary logistical base for whaling. The single whale landed in 1987 was towed to West Dock and butchered there, but only because the whalers needed and requested assistance to tow it because of adverse weather conditions (Armstrong and Banks 1988). All other whales, whether the few which required industry assistance or those towed by the whalers, have been towed to and butchered on Cross Island.

Nuiqsut whalers commonly state that they scout for whales as far as 30 miles from Cross Island on a regular basis. The documented tracks for 2001–2011 in fact cover an area greater than that—33 miles east, 43 miles northeast, 48 miles southeast (Flaxman Island), 30 miles north, 29 miles northwest, and 31 miles west. Nuiqsut whalers state that whales can commonly be found within 10 miles of Cross Island and of the 62 strikes within the "tracked" area of Figure 22, 34 percent were made within that distance. Most (90 percent) were within 20 miles of Cross Island, while 10 percent were 21 to 33 miles from Cross Island. The 1973 and 1982 strikes were about 53 miles and 52 miles from Cross Island, respectively – but they were landed before Nuiqsut whalers started to use Cross Island as their regular and only logistical base for whaling. The quality of the data displayed in Figure 22 probably are not robust enough for statistical analysis to test if where Nuiqsut whalers have landed whales has varied over time. Relatively few whales were landed before 1991, and all missing data are from the 1990s. Data from the 2000s are complete and represent 56 percent of all whales landed, and 63 percent of all landed whales with known locations. The harvest location data nonetheless support the general "period history" of Nuiqsut whaling outlined above in an impressionistic way.

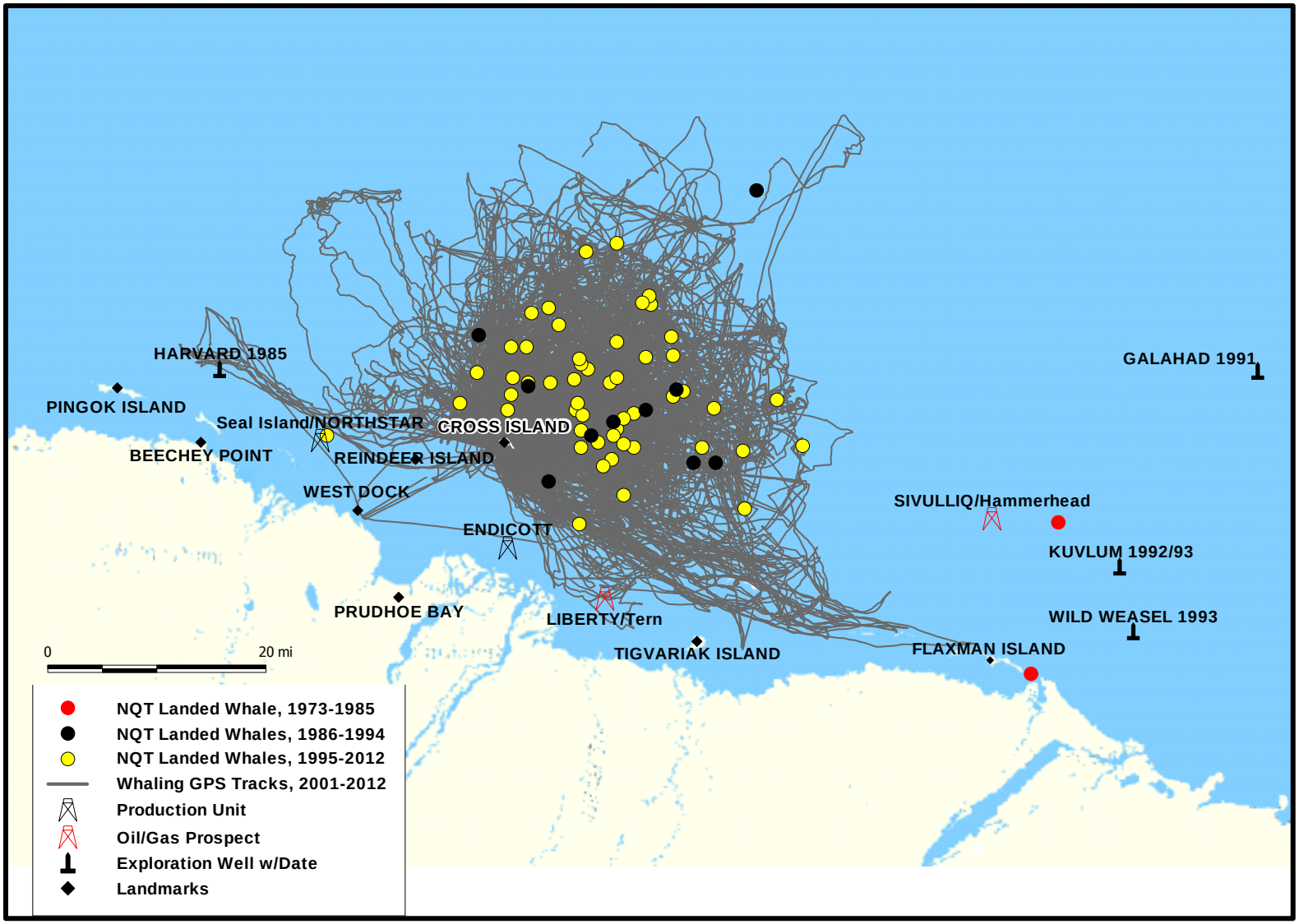

Figure 22. Documented bowhead whale harvest sites near Cross Island, 1973-2012

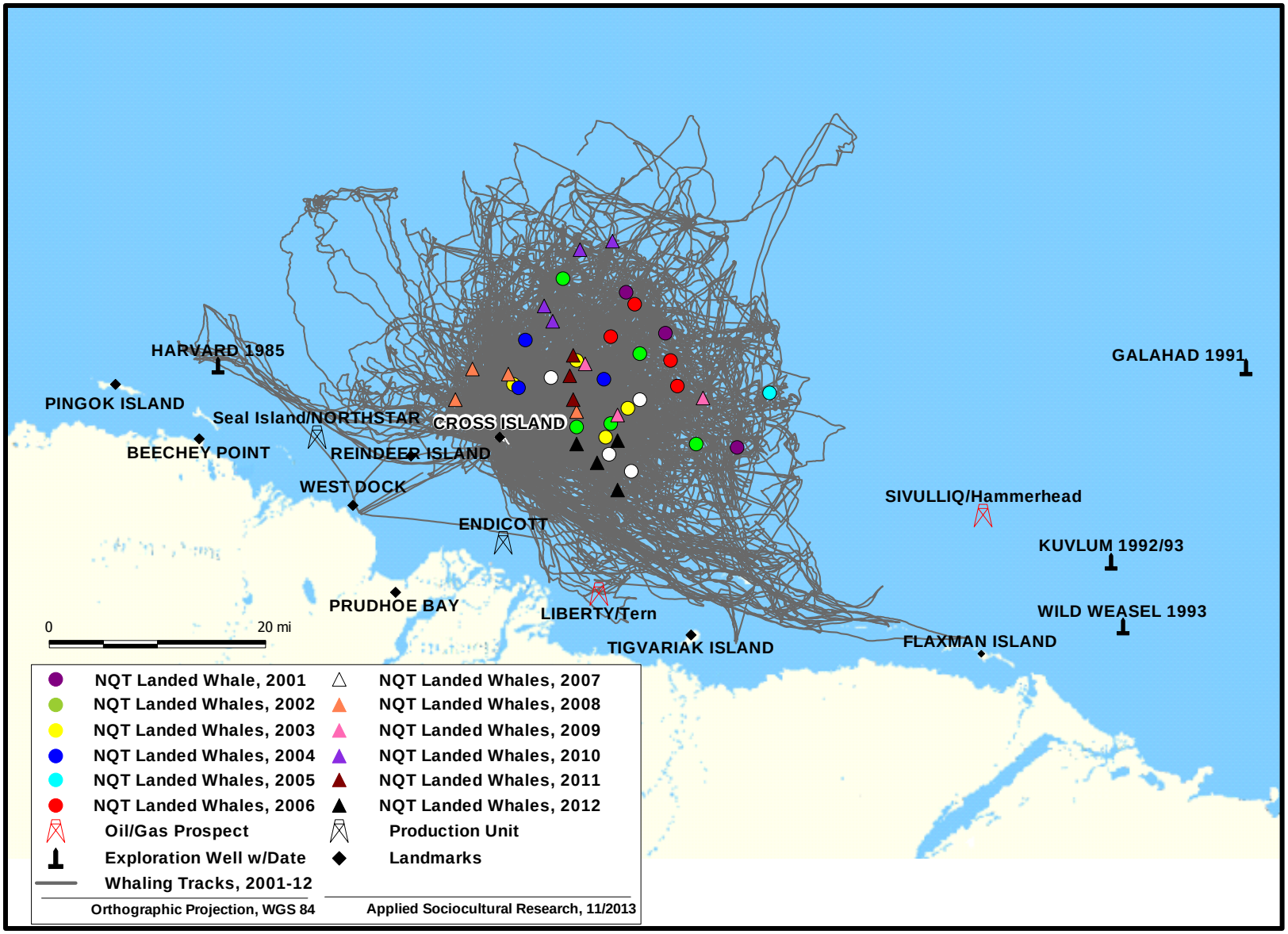

Figure 23. Documented bowhead whale harvest sites near Cross Island, 2001-2012

The first two whales landed by Nuiqsut crews (in red on Figure 22) are well to the east of all whales with documented harvest locations taken in more recent years. This is a strong indication that after Nuiqsut whalers adopted Cross Island as their logistical base, their pattern of hunting for whales changed. A logistical base provided many benefits, among them a central butchering location with equipment and support that made butchering more efficient than butchering at coastal or barrier island sites near harvest locations. Nuiqsut whalers report that that it was only in the mid-1990s that they began to recover a significant amount of meat from their whales, stating that they had only recovered muktuk and a small amount of meat and internal organ material from the first two whales they landed. The use of a regular logistical base also allowed the adoption of a more efficient method of searching for whales. Whalers could concentrate more on just whaling, rather than being required to also hunt for food and look for gas. They expanded their search area farther offshore, rather than confined near the coast, although at least in the 1986-1994 period they kept reasonably close to Cross Island (black points in Figure 22). The one exception is a strike far from Cross Island, on October 2, 1991. Nuiqsut whalers report that the whales were far offshore in 1991, at least in part due to oil and gas activity to the east of Cross Island. The season was also characterized by adverse natural conditions (AEWC 2003). Nuiqsut whalers also reported two struck-and-lost whales for 1991. For one, the strike location is unknown (date of strike September 28, 1991). The second was reported as far offshore and was lost because they had to cut the tow ropes to prevent their boats from being swamped due to high winds and seas (October 4, 1991). This event was located in the same general area as the whale they were successful in landing (AEWC 2003).

From the harvest location information in Figure 22, it appears that Nuiqsut whalers landed whales in a somewhat more expansive area than for 1986-1994. Whales were landed further to the east and to the west, but perhaps more significantly, further to the north. Nuiqsut whalers state that the farther they go from Cross Island, the rougher it gets. The ability to seek and land whales farther north of Cross Island after 1994 was probably due to the availability of better boats and motors, and perhaps a more robust CAA (Lefevre 2013b). The single whale landed far to the northeast of Cross Island in the 1990s was discussed above. The whale landed to the west of Cross Island, near the present location of the Northstar production unit, was taken in 1997, before Northstar was developed. By some accounts, whaling boats mistakenly ended up in this area due to their losing their bearings on a foggy day. Once in the clear, they saw, struck, and killed the whale. They were able to orient themselves to the coast and tow the whale to Cross Island. Since the development of Northstar, Nuiqsut whalers have avoided that area when out scouting for whales, although in 2005 and 2006 they did pass by only a few miles north Northstar when ice conditions confined them shoreward of Cross Island (Appendix A; Galginaitis 2009a).

Thus, it appears likely that the area actively scouted for whales by Nuiqsut's whalers has been in flux since 1973, primarily due to the increasing capabilities of the equipment and technology available to them and their increasing knowledge of the area. It cannot be overlooked that, although the 1973 settlers of Nuiqsut included experienced whalers, they had little or no direct experience whaling in the central Beaufort Sea near Cross Island, and at least through the mid-1980s mainly hunted inland and near Fish Creek (Edward Nukapigak, personal communication 2006). This contrasts with the case in Kaktovik, where Koski et al. (2005) did not find any significant differences over time in the location of landed whales over time. Residents of

Kaktovik had a longer history of residence during which whaling did not take place, and since they whale from the community, had a greater knowledge of the marine waters and where to find whales. The whales landed by Kaktovik are also found more reliably nearer to the coast and in the same general location than Nuiqsut whalers have found to be the case near Cross Island. In any event, the first two "periods" of Nuiqsut whaling (1973-1986, 1986-1994) exhibited limitations due to learning an unfamiliar hunting environment as well as some limitations imposed by the equipment and technology then available. Significant developments and improvements during these time periods affected boats, motors, communication and navigation (radio and GPS replaced CBs and compasses), the evolution of the OWA/CAA from a good idea to a relatively effective management tool, and the development of a relatively robust economy in Nuiqsut (based on NSB employment and Kuukpik Corporation activities and dividends). The contemporary marine use pattern for whaling appears to be relatively stable, in terms of overall area searched, but is quite variable from year-to-year in terms of where whales are found and so what part of the area is used that year. Clearly the quadrant NE of Cross Island is very significant and thus a "core" area. However, if circumstances should change in terms of Nuiqsut's economic climate and the willingness or ability of Nuiqsut whalers to conduct their hunt at a site as remote from Nuiqsut as Cross Island, the marine use pattern for Nuiqsut whaling could change rapidly. This is a speculative question that is beyond the scope of this report.

The harvest location information in Figure 23 is more precise than that of Figure 22 and will be used to address the question of year-to-year variability in harvest location. While additional data prior to 2001 may be useful, that analysis was not done for this project and will be left for a future effort. What is most apparent from Figure 23 is that for most years the harvest locations tend to cluster fairly near one another. The most obvious exceptions, 2001 and 2002, were seasons that were two of the four longest seasons documented, with good whaling conditions but relatively few whale sightings. Harvest locations were relatively distant from Cross Island (especially in 2001). The second longest documented season was 2005, when only one whale was struck, so that 2005 is not relevant for a discussion of the clustering of harvest locations. The longest documented season was 2004, with extremely poor weather conditions and scouting trips confined to near Cross Island. Only 2008 and 2012 had shorter trips in terms of distance, and as would be expected, all three years had harvest locations that clustered tightly. Seasons where landing dates were close together also had harvest locations that tended to cluster (2003, 2006, 2008, 2010, and 2011). Two aspects of the Nuiqsut whaling strategy help explain this. First, once the whalers locate an area where they see whales, on following scouting days they return to that area first. Second, the whalers report that the whale migration occurs in pulses or spurts, and that the whales in such pulses tend to travel the same general route. Such pulses can be several days in duration, so that whales landed close to each other in time would likely be part of the same pulse of the migration. It is likely that most, if not all, of the whales landed by Nuiqsut during any one year are from the same pulse of the whale migration.

QUANTITATIVE MEASURES, 2001-2012

The "final" report after the 2007 field season (Galginaitis 2009a) discussed all of the measures displayed in Tables 10 and 11, and that discussion is still for the most part germane. However, the addition of another five seasons of information has sharpened the analysis and changed at least the emphasis, and sometimes the direction, of conclusions. The overall summary measures

used to compare each of the whaling seasons with each other has also been expanded from one table to two, enabling the inclusion of additional metrics while retaining reasonably intelligible tables. Also, while the same topics discussed in the 2007 "final" report are included, they are presented in a somewhat different order, and the important topic of how Nuiqsut whalers are adapting their whaling behavior to changing conditions is much expanded.

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 Tables 10 and 11. Some of the discussions will reformulate portions of these data, or present supplemental details. Tables 10 and 11 present what were formulated as potentially significant quantitative measures at various points in the project. Some were part of the initial project design while others were developed later in the process – some in response to suggestions from the whalers and others as analytical tools during report composition. When discussions include consideration of whaling seasons prior to 2001, the data comes from sources other than the information in Tables 10 and 11 (although it was perhaps obtained or processed as part of this project).

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

The 2007 "final" report (Galginaitis 2009a) deferred the discussion of whaling effort to the end of its "Results and Conclusions" section. However, the discussion on the measurement of whaling effort will be given priority not only because of its analytical importance, but also due to some analytical or evaluative revisions based on project experience since the 2007 report. This section will also include a discussion of why the measurement of whaling effort has not been further refined since that report.

Table 11 contains all 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 is a gross estimate, since there are many compromises and approximations that must be made to generate these numbers. 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 short discussion of how the seasons group together or compare with each other. So many of the measures in Tables 10 and 11 interact and co-determine each other that categorizations of seasons based on any one of them are often difficult to interpret, except perhaps to examine the apparent "misfits" to see how different variations in various factors can interact.

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 bowhead quota for Nuiqsut caps the possible harvest at a low level of animals (four at present), any resulting CPUE, by any measure, must almost always be a number well below one and not intuitively meaningful to the average person or whaler. However, the measure of effort required to produce one unit of "catch" is more intuitively obvious, almost regardless of the metric 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, and are thus effectively classified as "catch." In any

Table 10. Selected observational measures of Cross Island subsistence whaling seasons, 2001–2012.

Metric	Type	Season											
		2001	2002	2003	2004[6]	2005[6]	2006	2007	2008[7]	2009[8]	2010	2011	2012
Whales Landed/Whales Struck & Lost	count	3/0	4/1	4/0	3/0	1/0	4/0	3/1	4/0	2/1	4/0	3/0	4/0
Length of Whales Landed, Total	total	120’ 2”	142’ 1”	134’ 8”	110’ 10”	40’ 9”	140’ 5”	120’ 8”	126’ 1”	69’ 4”	167’ 10”	151’4”	146’6”
Length of Average Whale Landed	average	40’ 1”	35’ 6”	33’ 8”	36’ 11”	40’ 9”	36’ 7”	40’ 3”	31’ 6”	34’ 8”	42’ 0”	50’5”	36’8”
Active Crews on Cross Isl. (max.)	count	4	3	4	4	5	4	5	6	6	6	5	6
Scouting Boats at Cross Isl. (max.)	count	7	9	10	8	8	7	9	12	11	14	11	12
Cross Island Population	average	27.7	26.6	20.4	18.9	29.8	29.2	26	22 (36)	41.85	44.1	37.8	48.9
Length of Season[1]	count	24	23	19	30	27	21	13	14 (8)	20	10	12[9]	16
Crew Days (total for all crews)[2]	count	90	58	53	77	105	84	52	44 (33)	115	53	56[9]	77
Length of Season/Crew (days)[3]	average	22.5	19.34	13.25	19.25	21	21	10.4	7.3(5.8)	19.2	8.8	11.2[9]	12.8
Weather Days	count	8	3	7	10	16	4	3	6 (0)	5 (6)	0	0	5
# days scouting[4]	count	12	15	7	12	9	10	5	5 (5)	12(10)	3	5	8
# days whales seen[5]	count	9	9	7	6	7	8	4	5	10(10)	3	5	7
Boats scouting/day	average	4.8	4.3	4.9	3.4	4	4.8	3.2	4.8(5.4)	7.4(8.6)	8.3	8.8	6.6
Boat Crew Size	average	3.9	3.6	2.9	3.6	4.4	4.3	4.2	3.8	3.6	3.5	3.8	3.9

[1]Number of days with at least one crew on Cross Island — includes day of arrival at and departure from Cross Island

[2]Crews do not necessarily arrive on or leave Cross Island on the same day. Each day at least one crew member from each crew is on Cross Island counts as 1 crew day. Thus, if members of 2 crews are on Cross Island on one day, and members of 3 crews are on Cross Island the next, the total would be 5 crew days for the two days.

[3]“Crew Days”/”Length of Season”

[4]Number of days when at least one boat went out scouting for whales.

[5]Number of days when at least one crew saw whales while scouting from a boat. Blows seen from Cross Island on non-scouting days are not included.

[6]One crew went to Cross Island well before other crews, so total season measures may be somewhat misleading. See 2004 and 2005 Annual Reports.

[7]Figures in parentheses ( ) are values excluding 7 days when only one crew was on Cross Island

[8]Figures in parentheses ( ) are values reclassifying 2 marginal scouting days (one a “weather day” and one a “travel/preparation day”).

[9]Does not include one day of travel for the first two crews to leave for Cross Island, as they spent the first night in Prudhoe Bay due to weather and sea conditions, so that it took them two days to reach Cross Island

Table 11. Selected analytical measures of Cross Island subsistence whaling seasons, 2001–2012

Metric	Type	Season											
		2001	2002	2003	2004[6]	2005[6]	2006	2007	2008[7]	2009[8]	2010[9]	2011	2012
# boat days[1]	count	57	65	34	41	35	48	16	29 (27)	89	29 (25)	44	53
# boat trips (possible # of GPS tracks)[2]	count	59	67	42	46	48	53	22	33 (31)	113	31 (25)	57	66
Actual # of GPS tracks collected	count	49	52	37	44	48	51	20	30	93	27 (22)	52[10]	63
Length of trip (miles)	average	84	64.3	37.2	45.3	60.7	60.8	30.1	32.1	61.6	67.2(79.2)	46.7	47.0
Duration of trip (hr:min)	average	9:43	7:58	4:31	6:51	7:07	8:13	5:39	5:03	6:43	9:01(10:43)	5:53	5:13
Furthest point from Cross Is (miles)	average	23.6	19.5	11.6	12.1	19.1	22.2	10.4	8.3	15.8	18.1 (21.3)	12.7	11.2
Strike distance from Cross Is (miles)[3]	average	19.5	13.4	9.3	9.7	25.9	17	12	6.5	13.8	16.5	9.1	10.2
Strike Direction from Cross Is (degrees)[3,4]	vector average	63˚	68˚	57˚	36˚	82˚	59˚	80˚	02˚	69˚	25˚	52°	100°
Total Seasonal Boat Effort (Boat-hr)[5]	sum	572.9	533.6	162.9	301.2	341.3	427.1	124.3	158	751.7	279.8(268.0)	335.0	338.6
Boat Hours/Strike	average	191	106.7	40.7	100.4	341.3	106.8	31.1	39.5	250.6	70.0(67.0)	111.7	84.7

[1]Each boat scouting for whales on any given day counts as one "boat day." Thus if two boats scout on one day, and four boats on the next, the total is six boat days.

[2]Some boats made more than one scouting trip on a single day.

[3]Includes "struck-and-lost" whales in 2002 and 2007.

[4]Due north is 0º (and 360º), due east is 90º – includes struck-and-lost as well as landed strikes.

[5]Yearly total equals aggregate sum of duration of all whaling trips by all boats. Includes estimates for missing information.

[6]One crew went to Cross Island well before other crews, so total season measures may be somewhat misleading. See 2004 and 2005 Annual Reports.

[7]Figures in parentheses ( ) are values excluding 7 days when only one crew was on Cross Island

[8]Figures in parentheses ( ) are values reclassifying two marginal scouting days (one a "weather day" and one a "travel/preparation day").

[9]Figures in parentheses ( ) are values excluding certain "marginal" data – one "boat trip" that only aided a tow and with no other information, one "boat trip" that only aided a tow and was only 98 min, and one "boat trip" of only 13 min terminated by engine trouble.

[10]Five boat trips were not documented with GPS information. Only partial GPS tracks were collected for two additional boat trips.

event, most whales struck by Nuiqsut whalers are landed and butchered (92 percent for 1995-2012, 93 percent for 2001-2012), 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. The measure developed will actually only include this "on-the-water" effort of the harvest process. Thus, for purposes of this report and in the context of the discussion of EPUC, "unit catch" will refer to the use of a strike, whether the whale was landed or not (the rationale for this decision follows below).

To attempt to measure such effort in terms of person-days (aggregate individual effort) would not appear to be useful. The total number of people on Cross Island, while variable, is a function of many things and was actually fairly consistent for all seasons (with a recent upward trend, related to an increase in the number of boats on the island, which in turn is reflected in the level of effort measure). Those seasons with lower values for the average number of people present on Cross Island per 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. Both also suffer from a gross lack of differentiation between levels of effort. Any amount of work accomplished on a given day qualifies as a "person-day."

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 six in 2008-10 and 2012, and the year-to-year composition was somewhat fluid around the captain and a number of core crew members. 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. Most 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 (2001-2012) there have also been three new whaling crews that have been formed, two that have experienced the transition from one captain to another, and one that whaled only in 2001 and has been inactive since then (although the captain has regularly whaled as a member of another crew). All of the new whaling crews formed by splitting off from an existing whaling crew, and have gradually increased the overall number of boats whaling at Cross Island by using multiple boats. The overall cumulative effect of these dynamics has been that the average number of people whaling at Cross Island was relatively constant until about 2009, when it essentially doubled and has remained at that level through 2012. This was the combined result of more people actually whaling (more crews and larger crews) and fewer days during recent seasons when only one or two crews are on Cross Island. The same trend is evident with the number of whaling boats available on Cross Island, although the increase was only about 50 percent.

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 (illustrated in Figure 24) 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 (but

Figure 24. Butchering pictures from Cross Island – from start to finish. Top row from left to tight – Peeling muktuk, taking Intestines (after taking meat), muktuk after being removed from whale. Bottom row from left to right – bags of meat (still open to cool and prevent spoilage), banded boxes of meat and muktuk, close-up of a box of muktuk (typically 2000 pounds).

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, a more expensive proposition than in the past. The whalers' time constraints are also greater than in the past. Also, 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 (or losing) whales. 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 an imprecise measure in the same way that "person-day" is, however. Whether a boat is used to scout for whales for 1 hour or 12 hours, that effort would be recorded as one "boat-day".

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 11, 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 and 31 minutes, traveling 37.2 miles in 2003 compared to 9 hours and 43 minutes, traveling 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 four or five 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 measuring effort in the Cross Island whaling case.

Table 11 displays values for total seasonal effort in terms of boat-hours. The average total seasonal boat effort was 360.5 boat hours, or 100.6 boat hours per strike used. Eight years were below the former, while only six were below the latter, 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, while 2004 has nearly three times as much. Without looking at the other measures, however, comparisons on this single metric do not have much meaning. Perhaps more importantly, it is most meaningful to interpret these measures in relation to whaling behavior – when whalers decide to go out scouting, when they try to strike whales, and the timing of when seasons start and end (especially in seasons when the quota is not completed). These topics are addressed at several points in this document.

Whales Landed and Total Length of Whales Landed

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). If pressed, Nuiqsut whalers will agree that some whaling seasons are "better" than others, but will resist actually ranking them specifically in order. Rather, they prefer to discuss the specific characteristics of each. 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.

Nuiqsut whalers characterized the 2001-2012 seasons in terms of all these factors (Table 2 above). "Poor weather" years occurred in 2003, 2004, 2005, 2007, and 2008. "Bad ice" years occurred in 2005and2006. Years when the whales were farther out or behaving in a different way making the hunt more difficult occurred in 2001 and to some extent 2002 and 2009. Years when whales were close occurred in 2003, 2004, 2007, and 2008. Years with difficult sighting conditions due to swells occurred in 2009, 2011, and 2012. Years with disruption from non-whaling activities occurred in 2005 and 2009. Only 2010 was characterized as a season with generally favorable conditions. Some seasons were members of several of these categories. Any of these conditions (except perhaps the last), or a combination of them, can result in not landing a sufficient whales for the village – but if three or four whales are landed, whatever the natural conditions have been, the season is considered successful. "Successful" is relative, however. From the experience of the twelve years of research, it appears that the total length of the whales landed during a season is directly related to the degree of success of that season. Minimal Nuiqsut community needs are met by a reasonably successful season during which about 120 feet of whale can be butchered, with larger whales compensating for smaller ones. This requires that three or four whales be landed (Nuiqsut whalers consistently avoid "Moby Dick" whales of above 55 feet or so – those whales that they can easily tell are very large).

Only three project whaling seasons failed to meet the three whale/120 linear feet threshold. For the 2005 season, Nuiqsut whalers only had the opportunity to strike and land one whale. This

was due to a combination of poor localized ice conditions, poor weather, and interference from non-whaling activities (a commercial tug and barge). The whalers closed their season once it was evident that conditions were not likely to improve. The one whale landed was 40+ feet, and thus adequate to host the captain's Nalukataq the following June. In 2009, Nuiqsut whalers used three strikes and landed two whales with one struck-and-lost. Weather and the presence of ice were not factors, but whales were very difficult to see due to large standing swells and most whales seen were relatively far from Cross Island. This was the one documented season when inter-crew social tensions were clearly related to the decision to close the season, along with little hope for improved whaling conditions. One of the whales was 45+ feet and the other quite small. The two captains had a joint Nalukataq the following June. In 2004, Nuiqsut whalers used three strikes and landed three whales, totaling about 111 linear feet. Weather was very poor that season, and the season was the longest of the 12 documented by the project, with more days lost to weather than any other season except 2005. One crew had arrived on Cross Island in mid-August and crews did not leave until September 18. The third whale had been landed September 14, butchered by the next day, and scouting resumed September 16. The whalers saw little, improvement in whaling conditions was considered unlikely, and most crews left the next day, and the final crew the day after. The community made do with a somewhat skimpy harvest.

Three of the documented seasons had total harvests of about 120 linear feet. Two – 2007 and 2008 – were quite similar. In both, Nuiqsut whalers used all four strikes during seasons with poor weather, with whales close to Cross Island. In 2007, they had a struck-and-lost, so the average landed whale was larger in 2007 than in 2008. Both seasons were closed after the quota was completed and the harvest considered adequate for community needs, so that an additional fifth strike was not requested. The whalers were ready to go back to Nuiqsut. The 2001 season was quite different. Weather and sea-state conditions were not an issue, but the whalers did not see many whales, and those they saw were quite distant from Cross Island and were difficult to follow and approach. The whalers described them as "skittish" and very shy. 2001 was the third longest season documented by the project (after the 2004 and 2005 seasons – both less successful). The whalers did not leave Cross Island until September 26 (the latest of the 12 documented seasons), landing their third and last whale September 22 and then waiting several days for good weather so they could return to Nuiqsut.

For six of the documented seasons, Nuiqsut whalers landed three or four whales totaling significantly more than 120 linear feet (2002, 2003, 2006, 2010, 2011, and 2012). They landed four whales, completing the quota, in five of those seasons (and requested and used a fifth strike in 2002, since they had a struck-and-lost that year). For 2011, they only landed three whales and used three strikes, but the whales averaged 50+ feet and more than satisfied community needs. The 2002 season was quite similar to 2001, in that whales were relatively distant from Cross Island and difficult to approach, and two of the landed whales sunk and were not recovered until several days later. Only the muktuk was recovered from these two whales. With the struck-and-lost, this was a relatively long season, and the longest of these six seasons. The other five ended shortly after the quota was completed. The 2006 season was also a fairly long season, due to ice conditions in its first half very similar to those of 2005 and some weather days at the end of the season that delayed the departure from Cross Island.

What becomes evident in this context is that the Nuiqsut whalers recognize relatively fine distinctions in what makes some seasons "better" than others. That is, the evaluation of the variability between and among seasons is recognized by Nuiqsut whalers. Thus, the measures discussed below to explain interseasonal viability make sense to the whalers. Some they accept as factors they cannot change but need to adapt to (weather, sea conditions, ice conditions, whale migration), while others (anthropogenic) can potentially be controlled. 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 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 disruption from these sources occur, or mitigation measures fail, so salient to the whalers. The following discussions focus on specific measures of Cross Island behavior, followed by a more general examination of variability in Cross Island whaling.

Timing and Length of Season

This section begins with a general discussion of the timing and the length of the 2001-2012 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 to characterize 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 twelve seasons documented by this project, almost all crews arrived on Cross Island before Labor Day, and the first crew at Cross Island always arrived before Labor Day except for 2001, when it arrived on Labor Day (Table 12). Nor was there a season when all crews traveled to Cross Island together, or even on the same day. For six seasons the first two crews arrived on the same day, and for four seasons (2009-2012) the first three crews arrived on the same day. In most cases, these crews still did not travel together, although they maintained radio contact. 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 was only 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 5.1 days before Labor Day.

On average, the "second whaling crews" left for Cross Island 3.4 days before Labor Day, and "third whaling crews" 2.1 days before Labor Day. This is a dramatic change from the same analysis done for the 2007 "final" report (Galginaitis 2009a), that only considered the 2001-2007 field season. The change may be due more to the relatively late date of Labor Day in 2009-2012 than to any real change in behavior, however. On average, "first arriving crews" were on Cross Island August 29, "second" crews on September 1, and "third" crews on September 2. The behavioral generalization would seem to be that whaling crews try to be at Cross Island on or before September 1, with variation due to the individual characteristics and circumstances of the captains making the decision for each whaling crew. The temperature tends to be lower in September than in August, which is better for maintaining the quality of the butchered products.

Table 12. Timing and duration of Cross Island subsistence whaling seasons, 2001-2012

Measure	Season												
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average
Date Labor Day (LD)	9/3	9/2	9/1	9/6	9/5	9/4	9/3	9/1	9/7	9/6	9/5	9/3	9/3
Date 1st Crews Out (FCO)	9/3	8/30	8/23	8/15	8/30	9/2	8/30	8/29	8/27	8/28	8/29	9/1	8/29
FCO-LD[1]	0	-3	-9	-21	-6	-2	-4	-3	-11	-9	-7	-2	-6.4
Date 2nd Crews Out (SCO)	9/3	9/1	8/29	8/30	9/4	9/2	8/31	9/5	8/27	8/28	8/29	9/1	9/1
SCO-LD[1]	0	-1	-3	-6	-1	-2	-3	4	-11	-9	-7	-2	-3.4
Date 3rd Crews Out (TCO)	9/6	9/5	8/31	9/4	9/4	9/2	9/3	9/5	8/27	8/28	8/29	9/1	9/2
TCO-LD[1]	3	3	-1	-2	-1	-2	0	4	-11	-9	-7	-2	-2.1
Length of Season (Days)	24	23	19	30	27	21	13	14	20	10	12	16	19.1

[1]These are measures relative to Labor Day: "FCO-LD" is the date the first crew arrived on Cross Island in relation to Labor Day. "SCO-LD" is the same measure for the second crew. "TCO-LD" is the same measure for the third crew.

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." In fact, they now almost always go out to Cross Island before Labor Day, unless they encounter mechanical or other equipment problems. 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. Some captains are now of the view that the bowhead whale migration is starting earlier in the fall than before, as an explanation for why a crew will sometimes go out to Cross Island in mid- to late-August. This may also 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 sometime in August. 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 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 of seasons prior to 2000) 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, family responsibilities) 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. Figure 25 may be helpful for the following discussions. The longest season documented by the project had the earliest starting date, August 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 August 23 (the second earliest during the project), with other whaling crews arriving August 29 and August 31. All whaling crews were on hand when what had been poor weather broke on September 1 and conditions were good for whaling. The whalers completed the quota on September 6, and left for Nuiqsut on September 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 (August 29, September 4) two whales were quickly landed (September 5, September 6) but conditions again deteriorated and even when boats could go out few or no whales were seen. A third whale was taken September 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 August 27 to September 3. The duration of these seasons ranged from 10 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.

All recent seasons have been no longer than three weeks (21 days). The four project seasons that were longer were in the first five years of the project (2001-2005). This may be coincidental. However, all seasons after 2006 (2007-2012) except 2009 have been 16 days or less in length, and the 2009 season was extended due to poor whaling conditions and ended after landing only two whales. It appears that Nuiqsut whalers are trying to complete their season within two weeks, if possible. The linear regression of length of season versus year (2001-2012) yields r^2=0.49, and a significant trend towards a shorter Cross Island whaling season. The linear regression of the end date for those same seasons yields r^2=0.41, supporting the same trend. The linear regression of the start of each season by years yields r2=0.02, indicating that there is no trend for a change in the start date of the Cross Island whaling season. Dividing the 12 documented seasons into two groups of six chronological years, the harvest rate for both is surprisingly close – 19 whales landed and 2 struck-and-lost for 2001-2006, and 20 whales landed and 2 struck-and-lost for 2007-2012. However, the average season length for 2001-2006 was 24

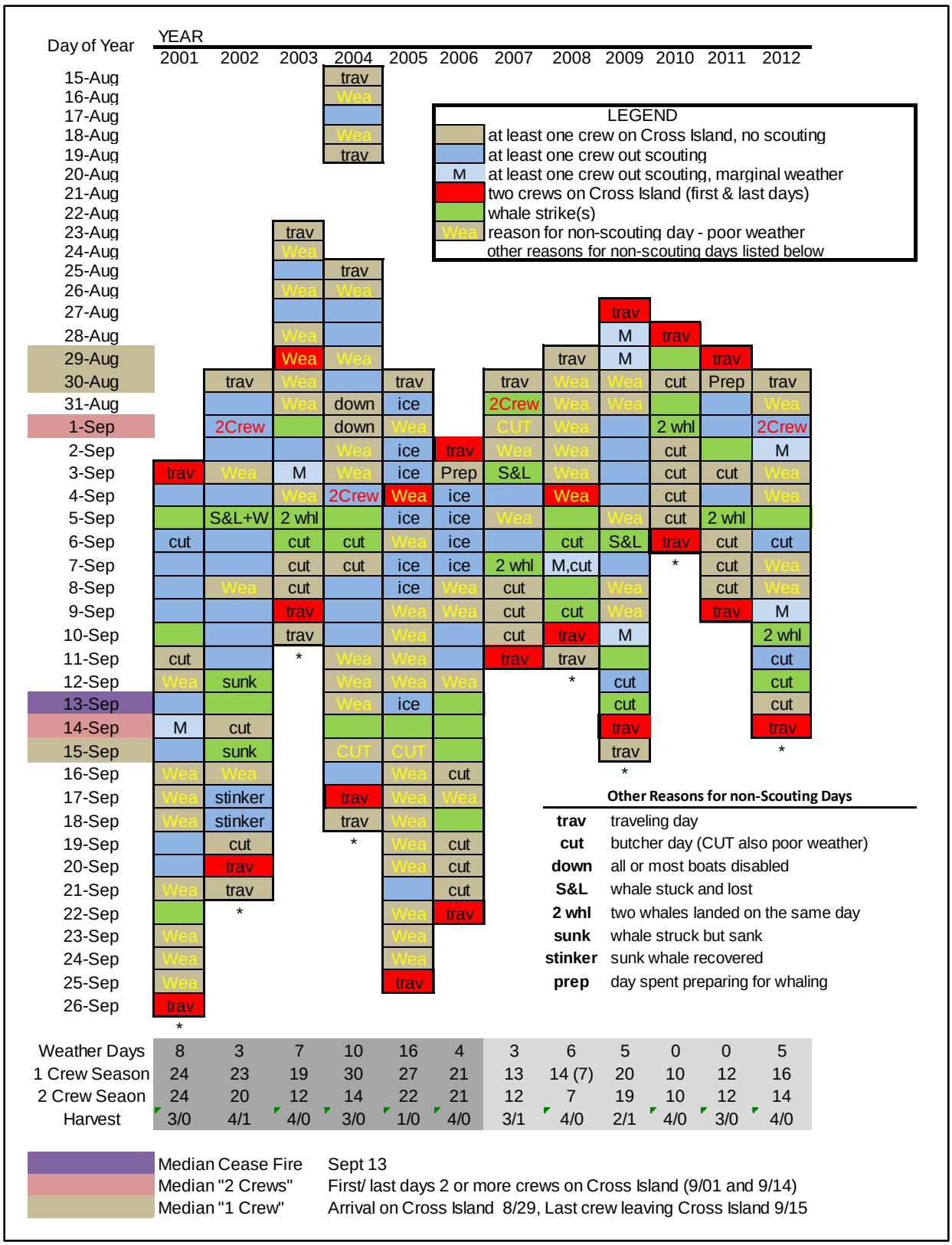

Figure 25. Comparative summary of Cross Island whaling seasons, 2001-2012

days, but only 14.25 days for 2007-2012. The timing for the whaling seasons for the first six years of the project appears to be significantly different from that of the last six years, with similar start dates, but with the seasons for the last six years being shorter and thus ending sooner. It is not clear if this can be attributed to different environmental conditions for the two periods, different thresholds for acceptable whaling conditions during the two periods, different whaling practices, or a combination or interaction of factors.

Changing Whaling Practices – Adaptation to Changing Conditions

Table 13 is essentially the same as Table 2 (above), with the addition dashed horizontal lines separating the three "periods" of Nuiqsut whaling and the addition of the last column relating to whether Nuiqsut whalers conducted their hunt in accordance with the "Old Rules" discussed in the "Overview" description of Nuiqsut whaling. "Y" indicates they did, "N" that they did not, and "NA" that they did not have the opportunity to not comply with the rules (so a compulsory "Y"). Assessments for the 2001-2012 seasons were made primarily on the basis of the dates of landed whales, supplemented by the more detailed information documented for the BOEM Cross Island project. Assessments for earlier seasons were made based on AEWC records of dates whales were landed and sometimes some additional more detailed information. Much more information was available for the 2001-2012 seasons, of course, but reasonable assignments could be made in most cases. The "*" merely indicate that the divergence(s) from the "Old Rules" were verifiable (and 1989 as a special case is discussed below).

Table 9 (above) will also be useful for this discussion. Here, the importance of Table 9 is to summarize the differences among the three time periods. In terms of environmental conditions, 1973-85 was a period of quite a bit of ice and rough weather, whereas 1986-94 had somewhat more variable ice conditions. Both periods had whaling seasons that were disrupted by oil and gas activities. The OWA/CAA was developing during the second of this two periods, and did provide some logistical mitigation/assistance to the whalers, but was not of much help in avoiding conflicts between oil and gas activities and whaling activities during the open water season. It is interesting to note that most of these incidents occurred in "heavy" ice years, when both sorts of activities would have been trying to operate in the same area (since much oil and gas activity was exploratory/seismic). That sort of conflict situation in a year with severe environmental constraints was also the context for the serious disruption event of 2005.

The two periods differed because during the first, Nuiqsut whalers were conducting whaling essentially as an extended camping trip, carrying all their supplies and setting up temporary camp sites, hunting for food along the way, and staying near shore and the barrier islands. This was not dissimilar to what traditional and historic subsistence whaling must have been like in the mid-Beaufort Sea. For the second period, a single logistical base had been established at Cross Island. For the most part, resources at these bases was still minimal, but they provided the advantage of a stable location to store things, and hunting success and efficiency improved during 1986-94. While during 1973-85 Nuiqsut whalers were not committed to an particular area, during 1986-94 they essentially moved whaling operations east to the Cross/Narwhal Islands area. Boats and motors had also improved in that time and the OWA/CAA provided increased logistical support. During 1973-85, most boats were wooden and fairly slow. By 1986-94, most boats were aluminum or fiberglass, and faster even with the same size motor as a

Table 13. Nuiqsut landed whales and whaling behavior

Year	Quota	Whales		Notes	Old Rules
		Landed	S&L		
1973	NA	1	0	Landed near Flaxman Island	NA
1982	1	1	0		NA
1986	2	1	0	First year of Oil/Whalers' Agreement (OWA)	NA
1987	2	1	0		NA
1989	3	2	2	Industry disturbance reported by whalers	Y*
1990	3	0	1	Industry disturbance reported by whalers	NA
1991	3	1	2	Adverse weather and ice conditions	Y
1992	3	2	1		Y
1993	3	3	0	Good whaling conditions	Y
1994	3	0	0	Season canceled due to adverse conditions	NA
1995	4	4	0		Y
1996	4	2	0		Y
1997	4	3	1		Y
1998	4	4	1		N*
1999	4	3	0		Y
2000	4	4	0	Good whaling conditions	N*
2001	4	3	0	"Skittish" whale behavior reported	Y
2002	4	4	1	Similar to 2001	Y
2003	4	4	0	Adverse weather conditions	N*
2004	4	3	0	Adverse weather conditions	N*
2005	4	1	0	Adverse weather & ice conditions, industry disturbance	NA
2006	4	4	0	Adverse ice conditions first half od season	N*
2007	4	3	1	Adverse weather conditions	N*
2008	4	4	0	Adverse weather conditions	N*
2009	4	2	1	Rough sea conditions	N*
2010	4	4	0	Good whaling conditions	N*
2011	4	3	0	Rough sea conditions	N*
2012	4	4	0	Similar to 2011	N*

Note: Years of no harvest and no "struck-and-lost" are not listed (except for 1994). There may have been some whaling effort in those years. "Quota" was imposed in 1978.
Sources: Compiled from AEWC records, NSB Department of Wildlife harvest records, personal communication with Nuiqsut whalers, and field notes and observations from the 2001-20012 Cross Island whaling seasons.

wooden boat. This allowed the whalers to hunt further offshore if they wished, and to more actively chase whales in more open water, rather than wait for them near ice

Thus, probably the most important behavioral change in whaling practices between the two periods was the establishment of a central (although remote from Nuiqsut) logistical base for whaling. There were also some change in the equipment that the whalers used to access the whales (boats and motors – the weapons to kill whales remained the same). Also quite important, and interrelated to the establishment of Cross Island as a logistical base was the establishment of a relationship with the oil and gas industry in order to establish a process to

minimize conflicts between the two very different user groups, and to develop mitigation measures to counteract the inevitable adverse effects of one user group upon the activities of the other. As far as can be determined, all of the whaling seasons for both earlier Nuiqsut whaling periods complied with the "Old Rules." The 1989 season has a "Y*" in its column because Nuiqsut had a quota of three strikes for that year, but used four. They landed a whale September 11, but then had two struck-and-lost whales on September 27. It is not known whether these were sequential (that is, one was struck-and-lost, and the other was struck-and-lost) or if the whalers intentionally tried to land two whales that day. The first case is much more likely. They then requested a fourth strike and landed a second whale on October first. For both periods, Nuiqsut whaling captains generally operated only one boat.

For the 1995-2012 period, ice was much less of a constraining factor and open water whaling predominated. Equipment was much better, logistics and support at Cross Island was much better than previously, and harvest success was vastly greater. Through 1993, most crews whaled with one boat (the apparent standard in other whaling communities), but since at least the 2000 season some Nuiqsut crews have used multiple boats and this is now the Nuiqsut norm. This is one behavioral adaptation to (or a cause of) fewer crews actively whaling than in the past, and facilitates shorter seasons. For the overall period 2001-2012, the average number of whaling boats per crew has been two. For the past three Cross Island whaling seasons, no crew has left Nuiqsut with only one whaling boat (one crew in 2012 had to leave their disabled second boat at Oliktok Point). The total number of boats whaling at Cross Island was stable until the last several years, when it has been higher than in the past (Table 7). The number of people on Cross Island available to whale, and thus available to butcher, is directly related to the number of boats.

Perhaps one of the most important changes in recent years has been behavioral, however. For the 12 documented seasons of the Cross Island project, 2001-2012, only three have fully complied with the "Old Rules" and one of these was 2005, when only one whale was landed and conditions did not allow scouting for whales the next day. The other two seasons were 2001 and 2002, two of the longer seasons (only 2004, when one crew was on Cross Island for 15 days by itself, and 2005, when localized ice prevented access to open water for all but three days, were longer). While weather and the relatively low number of whales seen in 2001 were also factors, it is likely that the enforced non-scouting during butchering may have also been a factor. In 2002, compliance with the rules was not a factor for the length of the season. Whales were again either few or difficult to see, and one whale was struck-and-lost and two others sank when killed and were only recovered as "stinkers." Scouting resumed the day after the struck-and-lost whale and after the first sunk whale.

What is perhaps most interesting is that the year the Nuiqsut whalers used as the example of the "ideal" year that complied with the "Old Rules" perfectly and resulted in the shortest season possible, does not actually fit this description. Written documentation exists in the form of the DCC log for that season (the first season for such logs). The season was very successful, with four whales landed, and generally good conditions – after a period of bad weather just after the first whale was landed. Once this bad weather was over, the other three whales were landed very quickly on successive days (September 7-9). While the whale landed on September 7 was small enough to butcher in one day (27 feet) so that scouting could resume the next day, the one landed September 8 probably was not (43 feet). The third whale was landed September 9, regardless.

The summary description of the 2000 season related to the researcher by several Nuiqsut whalers can be reconciled to some extent with the "facts" contained in the DCC log, but clearly is an idealized recollection of whaling events in 2000. Be that as it may and heeding the advice "When the legend becomes fact, print the legend," (from the classic film *The Man Who Shot Liberty Valance*), the following discussion accepts the "Old Rules" as a normative standard.

There is a distinct difference between 2001-2006 and 2007-2012 in the degree to which the "Old Rules" were apparently modified, evident in Figure 25 above and in the researcher's field notes. For the earlier six years, it appeared that the whalers tried to abide by these normative rules for 2001-2002 seasons. Doing so in **2001** may have been a factor in a long 24 day season that had started relatively late as well (September 3). Only three strikes were used, to land three whales. Too few whales were seen to have many opportunities to strike (evidenced by the nine days when boats scouted for whales but made no strikes – Figure 25). The **2002** season started earlier (August 30) but was again a long season at 23 days, with ten days of scouting with no strikes. All four strikes were used, but two whales sank and were not recovered until three to five days after they sank. This prolonged the 2002 season.

Perhaps as a result of the experience of 2001-2, one captain went to Cross Island August 23 for the start of the **2003** season. The second crew joined him August 29. The weather was generally poor and few whales were being seen. After the first whale was landed, whaling resumed the next day. This whale was fairly small (26 feet) and landed early in the afternoon, and butchered in one day. No strikes were made in two days of scouting, followed by a weather day. The next day another small whale (27 feet) was landed early in the morning and, since whales were still being seen, the captains decided to try to land another. A 42 foot whale was landed 30 minutes later. The 27-footer had been butchered by the next day, and the second was well advanced, and scouting conditions were good on the following day, so several crews went out scouting. They landed the fourth whale (39 feet) and the community's needs were met.

For **2004**, one crew went to Cross Island August 15, but was caught in poor weather and returned to Nuiqsut for August 20-24, and then went back to Cross Island August 25. The 2004 season had nine days of scouting with no strikes. The first landed whale was September 5, early in the morning. As a large whale (46 feet) it was not butchered by the next day, but scouting resumed and a second whale was landed September 6 (33 feet). All crews took the next day to help complete butchering, and then resumed scouting September 8-10, unsuccessfully. This was followed by three weather days, and then the landing of a third whale (32 feet). After this was butchered, the season was ended September 18, as community needs had been met and one crew had been whaling for about a month.

For **2005** (and all seasons after) no crew thought about an early start. The apparent consensus was that the experiment of trying to start the season earlier than September was not fruitful. The first crew went to Cross Island August 30, but found that ice packed on the island's north shore prevented any access to open water seaward of the island. The whalers spent the entire season either shorebound by weather (seven days) or confined to scouting shoreward of the barrier islands (seven scouting days with no strikes). They had one day when they could access open water, and struck and landed a whale September 14. This was followed by another six weather days and another day of fruitless scouting – they could reach open water, but then encountered big waves and swells. The season was ended September 18 due to poor conditions.

The **2006** season started later, September 2, since the whalers knew that the same ice conditions as in 2005 were again in place. They again waited out weather (4 days) and fruitless scouting inside the barrier island (6 days) until they could access open water northeast of the island. As soon as this change took place, they landed three whales on successive days (September 13-15). Butchering was not complete on one before scouting resumed the next day, but after the third whale was landed all crews stayed onshore for two days to help complete butchering. Scouting resumed September 18 and the fourth whale was landed. Weather delayed leaving the island and ending the season until September 22.

The lessons that he Nuiqsut whalers apparently learned from these six seasons were that trying to start the season at Cross Island before the end of August or early September was too big a gamble. Poor weather was likely to prolong the season, especially as few or no whales were seen on scouting trips in August. They also learned that staying on Cross Island past mid-September seemed to invite poor weather that kept them shorebound rather than homeward bound (all six seasons except 2003, which ended September 10 because of three whales landed in two days, September 5-6). As evidenced by their actions the next six seasons, they adapted their whaling behavior so that on days when conditions were good, they would consider landing more than one whale, especially if the first one landed in the day were small. If butchering of a whale was well advanced the day after it was landed, other crews would often resume scouting.

The **2007** season started August 30 and the first whale was landed August 31, late in the day. All crews stayed in the next day to butcher (conditions for scouting were poor in any event). This season had only three or four weather days and two scouting days without strikes. The second strike was used September 3 on a struck-and-lost, followed by the two scouting days with no strikes, separated by a weather day. The last two strikes were used on September 7 to land two whales, neither really very small (37 and 49 feet). Butchering and packing took three days and the season was over September 11. The **2008** season similarly started August 29 for the first crew, but then weather came up and no other crew could reach Cross Island until September 4. Scouting then took place on five successive days, September 5-9, with single whales landed on all days except September 7. They were all 29-35 feet, so even though the first two were struck late in the day and reached Cross Island in the evening, other crews went scouting the day after they were landed. Most crews left Cross Island September 10. The crew that landed the last whale needed another day to complete their butchering and left September 11.

The **2009** season was a frustrating one for the whalers. Most of the crews arrived on Cross Island August 27 and started scouting the next day. For the nine days August 28-September 5 they experienced six scouting days during which they had no chances to strike a whale, seeing very little due to poor sighting conditions. They did see commercial (non-petroleum industry) vessel traffic on a regular basis – more often than noted for any other season – but it was not obvious that this vessel traffic was a cause for the lack of whale sightings. Some whales were seen on the same day as commercial vessels were observed, and on some days neither whales nor vessels were seen. On September 6, a whale was struck-and-lost, followed by another scouting day on September 7 with no strike opportunities. September 8-9 were weather days, and September 12 another fruitless scouting day. The first whale of the season was landed September 11, a departure from the trend of earlier first landings for recent seasons, with only 2005 and 2006 being comparable (when localized ice conditions blocked the whalers' access to

whales). The first landed whale in 2009 was a large (40+) whale, but scouting resumed the next day with no strike opportunities. Some of the boats that went out scouting returned to Cross Island to help with butchering, and on September 13 boats again went scouting and landed the second whale. This was a very small whale. The combination of the relative lack of whales, poor sighting conditions, too many commercial vessel sightings, and social tensions among the crews led to a consensus among the captains that it was pointless to continue the season. The second whale was butchered very quickly and most crews left the next day (September 14). The crew that landed the second whale left September 15.

The **2010** season was the shortest of the 12 documented by the project, and the only one the whalers characterized as having generally favorable conditions. Most crews arrived on Cross Island August 28. They went scouting the next day on August 29 and landed a 51 foot whale. All crews stayed in the next day to help butcher. On August 31, five crews (all crews except the one still butchering their whale) went scouting and landed the second whale. This was also a large whale, at nearly 45 feet. Butchering proceeded relatively rapidly and the next day, September 1, four crews went scouting and landed a small whale (26 feet). Since winds were predicted to increase and last several days, the captains decided to try for another whale. Conditions were good and they were seeing lots of whales. They landed the fourth whale (46 feet) and winds did increase to a peak on September 5, which is when butchering on all the whales was completed. All crews returned to Nuiqsut on September 6.

For the **2011** season, most crews arrived on Cross Island August 29. August 30 was probably suitable for scouting, but the whalers stayed onshore to prepare the equipment for the season. They went scouting August 31 and September 1 and saw few whales, primarily due to difficult sighting conditions. The large swells or standing waves made it very difficult to impossible to see small whales from their small boats, and the only whales seen were large ones. There were no strike opportunities. On September 2 the whalers again went scouting and landed a large whale (52 feet). September 3 was a butcher day for all crews, but on September 4 four crews went scouting, but had no strike opportunities. They saw a few whales. They resumed scouting on September 5 and saw a number of whales. Scouting conditions were better than on previous days. They struck and landed one of the whales and while preparing for the tow, another whale was seen nearby. Several of the boats chased it and eventually struck and landed it. When these two whales reached Cross Island, they were measured as 50 feet and 49 feet. The consensus of the captains, after a bit of discussion, was that three very large whales were enough and the season was closed. It took three days to complete butchering, and all crews returned to Nuiqsut on September 9. The whalers had been concerned about barge sightings early in the season, but once they were seeing (and landing) whales this concern abated. There was also a moratorium on at least some commercial barge traffic during the whaling season.

Conditions for the **2012** season were reasonably good, although four days were lost to weather. The first crew arrived on Cross Island on August 30, but the first day of scouting was September 1, the day the second crew reached Cross Island. There were no strike opportunities. September 2 was the same – scouting with no strike opportunities. September 3-4 were weather days. The first whale was landed September 5 and four crews went scouting the next day, with no strike opportunities. The next two days were weather days, during which the sixth crew arrived on Cross Island. Scouting occurred on four consecutive days September 9-12, with two whales

landed September 9 and the fourth and last whales on September 12. Four crews went scouting on September 11, even though two whales had been landed the day before. Butchering was completed September 13 and all crews left Cross Island September 14. No commercial vessels were noted during the season.

As discussed above, all recent seasons have been no longer than three weeks (21 days), but 2001-2006 differed significantly from 2007-2012 in terms of season length. They also differed significantly in terms of other characteristics (Tables 14 and 15). The 2007-2012 seasons were characterized by more whaling boats on the island, a greater number of people available as a labor force, fewer weather days, fewer days scouting, and more boats on the water for each scouting day than the earlier period (Table 14). The 2007-2012 seasons also, on the average, had shorter scouting trips (both in terms of time and distance), struck whales closer to Cross Island, and expended significantly less on-the-water effort per strike used than the average for the 2001-2006 seasons (Table 15). Thus it is likely that the two periods did differ in the environmental conditions that the whalers experienced – the earlier period was probably somewhat more challenging. However, the whalers' strategy for whaling was also different in the two periods. Referring again to Figure 25, during the six seasons of 2001-2006, Nuiqsut whalers landed two whales on the same day only once, although they then landed another whale the next day to complete that season. They also landed single whales on two successive days in one season and on three successive days in another. During the 2007-2012 seasons, Nuiqsut whalers landed two whales on the same day during four of the six seasons, and whales on successive days three times. For both periods, Nuiqsut whalers showed a willingness to go out scouting the day after landing a whale, but did so more frequently during the 2007-2012 period, and during the earlier period sometimes explicitly reported they were not going out whaling because they needed to whale. The average season length for the two periods is also significantly different, and cannot be accounted for solely on the basis of weather days. How much of the difference is due to environmental factors and how much can be attributed to behavioral differences in whaling strategy cannot be easily determined. While it was a choice for the Nuiqsut whalers to pursue landing multiple whales on the same day more often during 2007-2012 than 2001-2006, there may also have been environmental conditions that made it easier (or more necessary) to do so in the later period than in the earlier one. Bodenhorn (2003) discusses different behaviors but the same general topic – changes in subsistence whaling practices for the fall hunt in response to changing environmental factors, albeit for a somewhat earlier period of time. There is also the difference between short-term variation of environmental conditions and long-term change in climatic regimes, which will not be addressed in this report but has been raised in another forum (Galginaitis 2013c).

Table 14. Average observational measures for two six-year periods

Measure	Average 2001-2006	Average 2007-2012
Whales Landed	3.2	3
Length of Whales Landed, Total	114.8	130.303
Length of Average Whale Landed	37.3	39.2
Active Crews on Cross Isl. (max.)	4.0	5.7
Scouting Boats at Cross Isl. (max.)	8.2	11.7
Cross Island Population	25.4	36.8
Length of Season	24.0	14.2
Crew Days (total for all crews)	77.8	66.2
Length of Season/Crew (days)	19.4	11.6
Weather Days	8.0	3.2
# days scouting	10.8	6.3
# days whales seen	7.7	5.7
Boats scouting/day	4.4	6.5
Boat Crew Size	3.8	3.8

Table 15. Average analytical measures for two six-year periods

Measure	Average 2001-2006	Average 2007-2012
# boat days	46.7	43.333
# boat trips (possible # of GPS tracks)	52.5	53.7
Actual # of GPS tracks collected	46.8	47.5
Length of trip (miles)	58.7	47.5
Duration of trip (hours)	7.4	6.3
Furthest point from Cross Is (miles)	18.0	13.3
Strike distance from Cross Is (miles)	15.8	11.4
Strike Direction from Cross Is (degrees)	60.7	55.5
Total Seasonal Boat Effort (Boat-hr)	389.8	331.2
Boat Hours/Strike	147.8	97.9

Size of Whales Landed Near Cross Island and "Community Need"

The discussion above on the size of whales landed near Cross Island fully incorporated the 2001-2012 data, so it will not be repeated here. The primary purpose of this section is a short discussion of the concept of "community need." Aspects of this discussion appear in various parts of this report, but only in passing. No attempt will be made to be comprehensive in the discussion here either, but a focused exploration of what Nuiqsut whalers mean by "community need" will clarify how that term is used elsewhere in this report.

There are in fact at least two aspects to "community need" when a Nuiqsut whaling captain uses the term, and it is sometimes difficult to determine which is uppermost in his mind, or if the two can really be separated at all. When explaining why he whales, the typical remark is "To feed the community." When the whale is butchered and divided on Cross Island, the uati is reserved for general distribution to the community, mostly at community celebrations at Thanksgiving, Christmas, and Nalukataq (the special celebration held in June by every whaling captain who landed a whale the previous fall). In the literature, the uati is sometimes described as the captain's share, but it can more accurately termed the captain's trust or responsibility, since it is only temporarily in his possession and his duty is to take care of it until he can distribute it to the members of his community (in Nuiqsut and more broadly to relatives and friends outside of Nuiqsut). Most Nuiqsut captains reserve a fourth of the uati for Thanksgiving, a fourth for Christmas, and half for Nalukataq. Since all captains participate in the first two, there is generally a great deal to distribute (usually in Nuiqsut the equivalent of 75 to 100 percent of a whale). In principal, each captain conducts a separate Nalukataq and supplies all of the food (with help from his crew members and relative), so that more needs to be reserved for that occasion. The tavsi, the "belt" of muktuk and meat that separates the uati from the niñiq, is called the captain's share by Nuiqsut whalers, but in fact is also used primarily to "feed the community" at an open house as soon as possible after the whale is landed. In most cases, the tavsi is sent to Nuiqsut from Cross Island (along with the captains flag), and the captain's wife and her helpers prepare the food and serve it to all who come – and all are welcome. The captain does not accompany the tavsi to Nuiqsut, but rather generally sends two crew members.

Thus, the first meaning of "community need" is the amount of whale required to provide enough muktuk, meat, and special parts from the whale to supply the demand at these public celebrations. For present-day Nuiqsut, the captains indicate that this requires four 30-foot whales, or three whales if they are larger – if they average 35 feet or larger. This is the foundation for the "120 linear feet" definition of "community need," and is consistent with the stated "preferred size" whale of 25-35 feet. What is not explicitly stated is that the goal for harvest is a total of four whales averaging 30 feet in length.

The second meaning of "community need" relates to the reputation of the captain, as determined by how he conducts himself when whaling (and success at landing whales is the most important, but not the only, component of whaling conduct) and how well he fulfills his responsibilities (and providing for the community, by distributing subsistence food at public celebrations and as needed on other occasions as well as public service is the most important aspect of this component). The tavsi from almost any size whale can be adequate for the "open house" conducted soon after the landing of the whale, although of course a larger whale provides more, which is then generally saved to be distributed at the other occasions. For Nalukataq, however,

Nuiqsut captains indicate that a 35 foot whale is required, or two smaller whales. This may be one reason why it common for two Nuiqsut captains to cooperate to conduct a joint Nalukataq (and why, in the much larger community of Barrow, even a larger number of captains will cooperate at Nalukataq). Such cooperation also spreads the burden of preparing for Nalukataq, of course, and closely related captains or those who are close friends often choose to hold a joint Nalukataq even if both have landed large whales. Some captains prefer to hold an individual Nalukataq, however, and for them this may be one factor influencing the size of whale they seek to strike. This is another factor to consider in the context of the average size of Nuiqsut's bowhead whale harvest and their stated preference for 25-35 foot whales.

Yet another factor is the size of Nuiqsut as a community – somewhat over 400 at present. The "35-foot whale" guideline clearly relates to size population. The whale landed in 1973 was said to be small, and since it was landed in very shallow water, this was no doubt the case. At the same time, the newspaper account of its landing indicated that it would provide muktuk for the newly settled community of Nuiqsut for "all winter." At the time, Nuiqsut's population was about 100 people (at most) and still living in tents while constructing more permanent housing. The "preferred" whale of 25-35 feet may be one of those conservative societal or cultural norms that changes only slowly in explicitly stated form, even when behavioral patterns are much different (the nuclear family in America as the norm, for instance). Another example from Nuiqsut whaling is the norm of starting the season after Labor Day. That was the case through the 1980s and perhaps into the 1990s (detailed information is difficult to elicit), but was certainly not the case for the 2001-2013 seasons, all but one of which started before Labor Day (and that exception started on Labor Day).

Harvest Location

There is little that can be added to the previous discussion of the location of recent bowhead whale landings near Cross Island from Tables 10 and 11. The whalers find and strike whales were they can find them, and presumably find those closest to Cross Island in any specific season, given the sighting conditions of that season (although this was not the case in 2005, due to the additional restrictions that ice conditions placed on the whalers that year). The only reliable distance information relates to the strike distance from Cross Island, and the average strike distance for the 2001-2006 seasons was greater than for 2007-2012 – 15.8 miles compared to 11.4 miles. The average vector bearing of the strikes made for the two periods was almost the same – 55.1º for 2001-2006 compared to 54.4º for 2007-2012. The difference in the average distance may indicate some difference between the two groups of seasons, but exactly what is not clear. Scouting trips were shorter, both in duration and miles traveled, during the 2007-2012 period, indicating that whales may have been found closer to Cross Island in that period than during 2001-2006. The difference between the averages of the two periods is probably related to a combination of the local whale distribution and sighting conditions, and also how individual whales react after being spotted by a whaling boat and chased. Almost all whales are chased for some period of time before being struck, and thus the strike location is almost never where the whale was initially seen. On rare occasions, a whale will surface right in front of a boat where it can be struck, but not often. A whale can be chased for an hour or more before one of the boats can approach closely enough and in the right position to make a strike.

Crew Size and Other Characteristics of the Cross Island Population

The decline in the number of crews since the mid-1990s has not yet been examined, although a somewhat depressed local economy was probably one factor. The eleven one-boat crews (11 whaling boats) of the mid-1990s are now represented in 2011 and 2012 by four 2-boat crews and two 3-boat crews (six crews, 14 whaling boats). When asked, Nuiqsut whaling captains state that most crews now operate more than one boat, but that usually the second (and third, if a third is used) may not actually be owned by the captain. The person who owns the boat could be a senior crew member (often a formal co-captain) who then operates the boat under the overall authority of the whaling captain for that crew. This pattern has operated since at least 2001. The average number of boats per crew per year from 2001-2012 ranged from 1.6 (2005) to 3 (2002), and the overall average for the period was 2.1. Thus, the number of boats available for whaling since the mid-1990s may have remained relatively constant, even as crews have decreased in number. The dynamics behind this trend remain to be explored, and may be unique to Nuiqsut.

There are some indications that the number of boats, and consequently the size of crews, may be increasing. Table 10 displays the information on the number of crews active on Cross Island, the number of scouting boats at Cross Island, and the overall population on Cross Island during the whaling season. These were all relatively stable through the 2007 season, but then showed a tendency to increase. Part of the population increase was due to the calculation of population as an average rather than the maximum during the season, since during recent seasons almost all crews have been on Cross Island for most or all of the season, which was not true for earlier seasons. There is also interest on Nuiqsut for additional crews to form – but it is an expensive proposition, and such interest has been a constant in Nuiqsut since the start of the project. It should be noted that one requirement for landing several whales within a restricted period of time is a larger labor force to butcher them. The hunting may be the easier and is certainly the more glamorous part of whaling (a common way on Cross Island to indicate that a person or crew does not really like to butcher or may be shirking his butchering duties is to remark, in the understated Iñupiat manner, "They sure do like to hunt whales"). While it is not discussed in this report, there are indications that organizing the butchering of several whales at the same time on Cross Island has not been an altogether smooth process, given the relatively small labor force available. The much larger community of Barrow limits the number of whales landed per day in the fall to three, not because they could not land more, but because they have found that the labor reliably available cannot butcher more than that efficiently. This topic will be covered for Cross Island whaling in a future paper, but the data still needs quite a bit of work. The larger average work force available on Cross Island for the 2009-2012 seasons may be one response to the increased butchering demands of recent Cross Island whaling practices.

Summary

In an earlier "final report" (before field work was extended for five more seasons), based on more limited data (Galginaitis 2009a, summarizing data from the 2001-2007 whaling seasons), the simplistic conclusion was reached that seasons Nuiqsut whalers labeled as "good" were shorter than "less good" seasons. This was based primarily on the basis of efficiency as measured by the level of effort expended per strike used. The argument was that they were efficient because they were short, and they were short because whales were closer than in other seasons, combined with conditions for scouting for whales that, while perhaps not optimal, were

good enough for the whalers to find and strike whales. With the addition of five more years of data (2008-2012), this conclusion is essentially confirmed. While Nuiqsut whalers tend not to explicitly rank seasons, since any season with an adequate harvest is by definition "good," their statements do in fact reveal distinctions that they make among the seasons when three or four whales are landed, on the basis of how well the harvest of that season met community needs. These distinctions can be labeled "surplus" (three or four whales totaling more than 120 linear feet), "adequate" (three or four whales totaling about 120 linear feet), and "thin" (three or four whales totaling less than 120 linear feet). A fourth distinction, "inadequate," represents those seasons when less than three whales are landed, and their total linear length is significantly less than 120 linear feet. These are analytical categories and definitely not terms that the whalers used to describe the seasons.

Tables 16 and 17 display the averages of the measures of Tables 10 and 11 for each of the four categories of seasons, in the same general format. The number of cases for most of the categories is small, so the discussion and conclusions can at best be considered provisional. The categorization of seasons is:

- Surplus: 2002, 2003, 2006, 2010, 2011, 2012
- Adequate: 2001, 2007, 2008
- Thin: 2004
- Inadequate: 2005, 2009

Perhaps surprisingly, the average size of the whales landed for all categories is about the same Table 16). Nuiqsut whalers do not seem to actively select whales by size, and harvest all sizes of whales except the very small and the very large (they do actively avoid striking those size classes of whales). This implies that, in general, they usually encounter the same general size distribution of whales each year (with some exceptional years, of course). For most of the measures, the three categories of "good" seasons are fairly similar. The major exception is

Table 16. Average observational measures, by season category

Measure	Surplus	Adequate	Thin	Inadequate
Whales Landed	3.8	3.3	3	1.5
Length of Whales Landed, Total	147.1	122.3	110.8	55.0
Length of Average Whale Landed	39.1	37.3	36.9	37.5
Active Crews on Cross Isl. (max.)	4.7	5.0	4.0	5.5
Scouting Boats at Cross Isl. (max.)	10.7	9.3	8.0	9.5
Cross Is. Pop.	34.5	25.2	18.9	35.8
Length of Season	16.8	17.0	30.0	23.5
Crew Days (total for all crews)	63.5	62.0	77.0	110.0
Length of Season/Crew (days)[3]	14.4	13.4	19.3	20.1
Weather Days	3.5	6.0	10.0	9.0
# days scouting	8.0	7.3	12.0	10.5
# days whales seen	6.5	6.0	6.0	8.5
Boats scouting/day	6.3	4.3	3.4	5.7
Boat Crew Size	3.7	4.0	3.6	4.0

Table 17. Average analytical measures, by season category

Measure	Surplus	Adequate	Thin	Inadequate
# boat days	45.5	34.0	41.0	62.0
# boat trips (possible # of GPS tracks)	52.7	38.0	46.0	80.5
Actual # of GPS tracks collected	47.0	33.0	44.0	70.5
Length of trip (miles)	53.9	48.7	45.3	61.2
Duration of trip	6.8	6.8	6.9	6.9
Furthest point from Cross Is (miles)	16.4	14.1	12.1	17.5
Strike distance from Cross Is (miles)	12.6	12.7	9.7	19.9
Strike Direction from Cross Is (degrees)	60.0	49.7	36.0	76.0
Total Seasonal Boat Effort (Boat-hr)	346.2	285.1	301.2	546.5
Boat Hours/Strike	86.8	87.2	100.4	296.0

season length. "Surplus" and "Adequate" seasons were about the same average length at somewhat over two weeks. The other two categories were longer, at three to four weeks. Average duration of trip was about the same for all categories at close to seven hours. Average distance traveled per trip was greatest for the "Inadequate" and "Surplus" categories, implying that average speed during these trips was also greater than for the other two categories. The whalers also traveled the farthest away from Cross Island during scouting trips for the "Inadequate" and "Surplus" categories. The level of effort expended per strike was similar for all seasons in which at least three whales were landed, and much larger for "Inadequate" seasons (since fewer strikes were used during those seasons). The confusing tradeoffs among the various measures leads to the conclusion that in most years, the combination of weather, ice, sea state, and distribution and abundance of whales allows the Nuiqsut whalers to land three or four whales within a period of two to three weeks (a "Surplus" or "Adequate" season – nine out of twelve project years, or 75 percent of the time). That is, if whales are close to Cross Island, trips don't need to be as long in terms of time or distance and long periods of good weather are not as critical. If the weather is good, but the whales are relatively far away or few in numbers, more time may have to be spent on the water for a successful harvest. If sighting conditions are poor, few whales will be seen, no matter how many may be present in the area. Short seasons need not represent a season with ideal whaling conditions – only one where conditions combined on at least a few days to produce conditions that allowed the whalers to find and strike whales.

The whalers did not articulate this "explanation" for their relatively consistent success, but they clearly expected to usually have successful seasons, accepting the occasional year where unusually adverse conditions prevented landing three or four whales (such as 2005 and 2009) with "There's always next year." The whalers also actively seek to maximize their chances, through the use of the best and fastest equipment that they can afford, and by changing their hunting strategies and behavior in response to more unpredictable weather, reduced ice presence, and what may be a shortened window of opportunity for them to whale near Cross Island. They have experimented with whaling before the last week in August, with no success, and have also concluded that whaling past mid-September is not productive.

GPS INFORMATION

Surprising as it may be for a project that is heavily dependent on GPS for primary data collection, and GIS to process and create graphic displays using that information, relatively little can be said using only the GPS information. That is, GPS data and GIS have been used as tools to discuss the various topics of interest for the report. No attempt has been made to use GIS as an analytical tool. Partly this is due to the initial design of the project as a low-budget data collection effort. A GIS analyst was never included in the project design. This, in retrospect, may have been an oversight, but one made necessary by the restricted scope of work of the project. Emphasis was placed on the collection of data and the documentation of Cross Island whaling, so the GPS information was processed for that use. Measurements of other environmental variables (weather, ice conditions) were made systematically, but do not have the rigor of the GPS data, and have not been linked to the GPS data. As briefly discussed elsewhere, information on concurrent oil and gas activities is not available in any detailed form, and the same is mostly true for information on commercial vessel traffic in the Beaufort Sea.

It may be useful here to present the aggregated GPS data that is not displayed elsewhere in the report. The harvest site locations has been displayed in Figure 22 (above), in the context of the characteristics of Nuiqsut whaling during different periods of time. The latest version of the comparative GPS track map for all years, coded in color by year, is included below as Figure 26.

The main purpose of this map, which is far too busy to examine in detail, is to illustrate the variability of Nuiqsut scouting behavior form year-to-year, not only in terms of the intensity (number of tracks) per year but also in terms of the distance from Cross Island and the length of trips taken. Also of note is the great deal of overlap of tracks from one year to the next to the NE of Cross Island. As has been discussed above in various parts of the report, 2005 and the first half of the 2006 seasons were characterized by severe localized ice that confined the whalers shoreward of Cross Island, as is evidenced by the green and red tracks on Figure 26. During the other documented whaling seasons, there were very few GPS tracks in the area shoreward of Cross Island, except for trips to West Dock.

Figure 27 displays all documented whale sightings for 2001-2012, color coded by year. The limitations of these data have been discussed above. The major point is again the variability from year-to-year, with whale sightings reflecting the general pattern of scouting for the year. Those years when the whalers were closer to Cross Island display more compact groupings. Some years have more reported sightings than others and, while the numbers are not precise, the relative number of sightings each year is probably fairly representative of differences between years (but this represents whales seen, not necessarily whales present – for some years whales were much more difficult to spot than for others). It should also be noted that, at least for some years, the sightings seem to show the general SE to NW overall orientation to the fall whale migration.

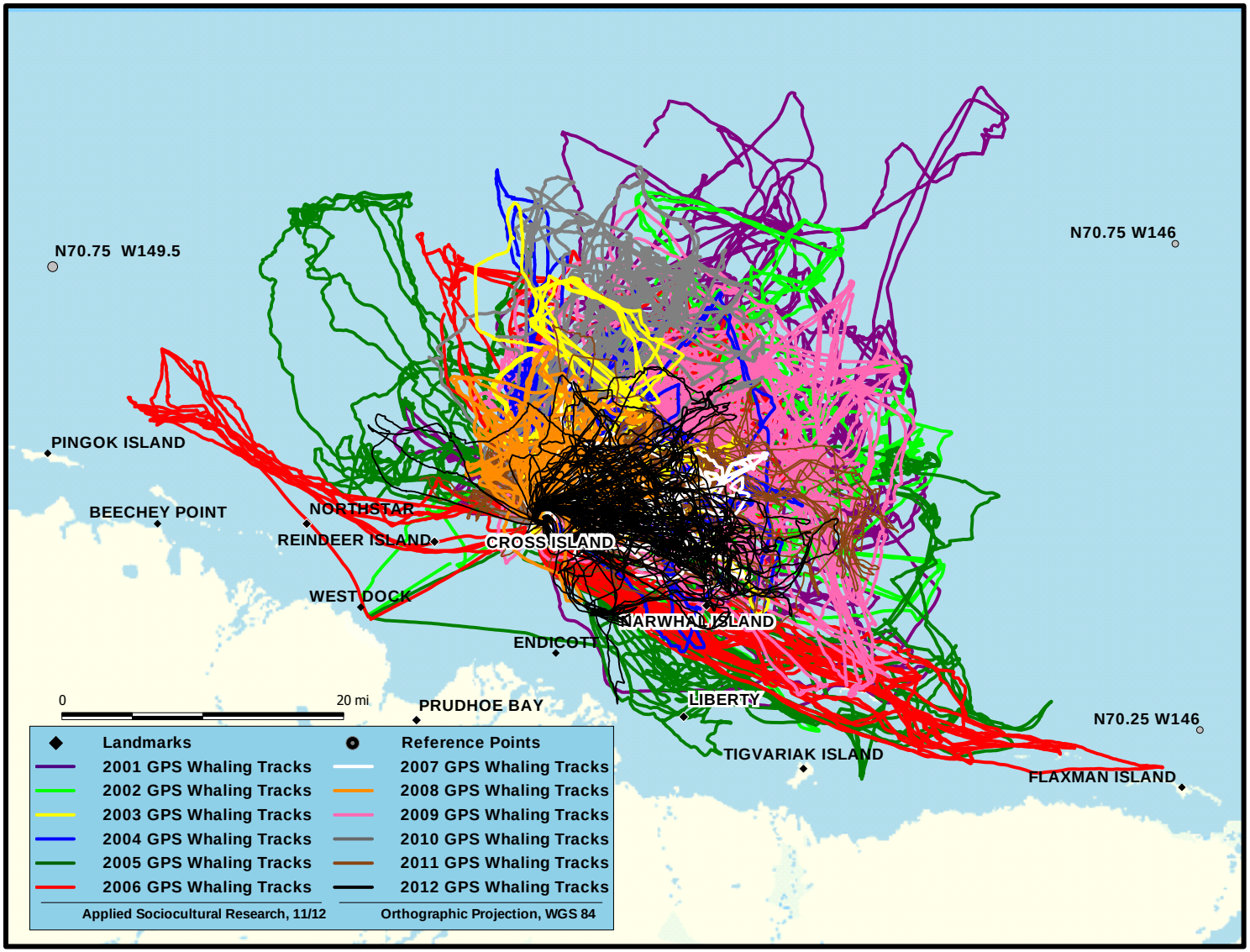

Figure 26. All Cross Island subsistence whaling GPS tracks, 2001-2012

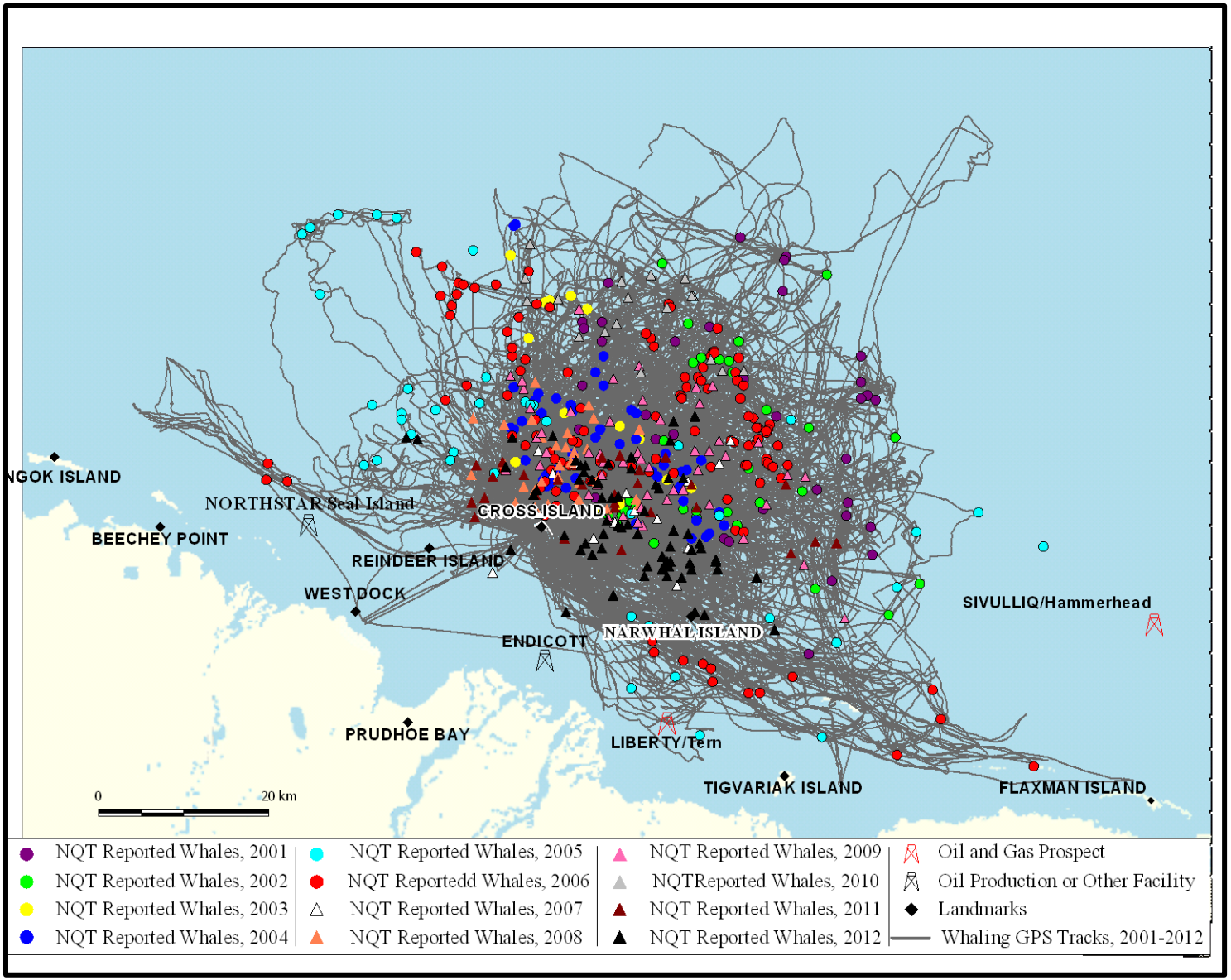

Figure 27. All Cross reported whale sightings, 2001-2012

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 2001-2012. 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 potentially 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. There has been a trend in more recent years for the taking of one or two polar bears "with intent" to be more common. On the other hand, there has been less need to kill nuisance bears, since the whalers have more regularly hired full-time bear hazers to keep bears away from the cabins and butcher site. In any event, the time required to hunt the polar bears taken on Cross Island is minimal, as they are most often targets of opportunity. The time for processing the dead animal is the more significant investment of time.

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 in a harvested seal, however – perhaps three to five over the 12 years described in this report. Many of these trips are as much recreational as they are to shoot "something for the pot." 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 the project. 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 (because it was a sickly animal), 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. As with polar bear, the seal and walrus taken during the Cross Island whaling season require minimal hunting time (and thus time away from whaling). Although the tow of the walrus did occupy two boats for the rest of day after it was taken, it was shot only after the boat crew had determined that striking a whale that day was not likely to happen. Again, the major time element involved is the time required to handle and process the animal after it is dead.

When game birds are present at Cross Island, they will be hunted during periods when no whaling tasks need to be done. Processing and preparation take less time than polar bears, seals, or walrus. During the course of the project, such activity was observed during two or three seasons.

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 at whale camp (on Cross Island or elsewhere), 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 time pressure than did whalers of the past. Whalers with wage employment 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. For the most part, the subsistence food consumed on Cross Island, other than whale, is brought to the island from Nuiqsut, again a departure from the past. 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, by shortening the time required for them to fill their quota (and thus reducing their need for food during whaling), than would be the case in the absence of the CAA. It may also be that the need to fulfill the Nuiqsut quota within a two to three week period, a relatively recent development in Nuiqsut whaling, precludes the opportunity to engage in most other subsistence activities during that time. Specific non-whaling subsistence activities took place during each season as discussed in the annual reports for each season, but at a very low and variable rate. The interested reader is directed to those reports (included as electronic files on the CD-ROM accompanying this report).

ANTHROPOGENIC EFFECTS ON CROSS ISLAND WHALING

This research project was explicitly intended to examine the question of anthropogenic effects on Cross Island subsistence whaling, and particularly the effects of oil and gas exploration. To that end, the project funded the collection of information to describe the whaling activities at Cross Island during the 2001-2012 subsistence whaling seasons. Unfortunately, there has not been a parallel effort to compile information on other anthropogenic activities in the Cross Island region for the same period. The two most obvious categories of such activities are oil and gas activities and commercial vessel traffic. Non-commercial vessel traffic is a third category, and research projects of various sorts (but especially those involving ocean transects and/or noise sources of some sort) constitute a fourth, at least in the minds of the whalers.

OIL AND GAS ACTIVITIES

During the time period of this project, all oil and gas activities were subject to the conditions of the CAA between industry and the whalers. This agreement, in order to prevent industry

activities from adversely affecting subsistence whaling, has the effect of preventing any oil and gas activity in the vicinity of Cross Island unless the whalers on Cross Island explicitly give their consent. There have been instances during the course of this project when industry did ask for permission for specific vessels to transit the Cross Island area. In those instances when the whalers were not whaling, or did not intend to whale in the area that the ship would be transiting, permission was usually granted (only a few instances). In most cases, the whalers did not give their consent (but again, not many cases). Most of these cases were for rather routine missions in support of existing production units in the area (Endicott and Northstar) or for the transport of materials from West Dock to Point Thomson. Routine crew changes for Northstar and the scheduled movements of ACS vessels were noted in the DCC log and caused no disruption to the whaling effort. As noted in the annual reports prepared for this project, vessel and other activities to the west of Cross Island have much less potential to disrupt Cross Island whaling than do similar activities to the east of Cross Island (Galginaitis 2009a; Ahmaogak 2002). Nuiqsut whalers made no reports of the Endicott or Northstar production units directly affecting their whaling activities during 2001-2012. They did have a constant concern that oil spills from either unit could dramatically affect bowhead whales and their whaling activities, but this "worry" factor is present with any sort of offshore oil and gas development, and is why the NSB, AEWC, and NWCA all insist on constant efforts to improve oil spill response under Arctic conditions. Nuiqsut whalers also reported every year of the project that they now avoid scouting for whales in the vicinity of Northstar. During the 2005 whaling season, when ice conditions prevented the whalers from scouting seaward (north) or Cross Island for all but two days, whalers did skirt the Northstar area but consistently radioed to other whalers when they were changing course "because we are getting too close to Northstar" (Galginaitis 2009a). Nuiqsut whalers also report that prior to the development of Northstar that they consistently saw whales feeding near the present location of Northstar, but that this is no longer true.

The assessment of past (prior to 2001) oil and gas activities on Cross Island subsistence whaling cannot be addressed. That adverse effects on whaling occurred in the 1980s and 1990s seems very likely, judging from whaler accounts of the period (many published in BOEM 1997, see also Long 1996), and from the pattern of landed whales during that period compared to afterwards when the CAA made more effective use of time and area closures as a management tool (Lefevre 2013a, b). However, a definitive statement in this regard cannot be made, since independent evidence corroborating the whalers' accounts is not available. The documentary records from that period are inconsistent, and held as proprietary by the petroleum industry. Wainwright (2002) provides abstracted and summary mapped information for the period 1979-1999, but it is not detailed enough for an effects analysis. Only Volume 1 of the study was released to the public. The more detailed maps and notes (Volume 2), the database documentation report (Volume 3), and the database itself were not released, as they contain proprietary information from the MMS (BOEM) Resource Evaluation Vault (Wainwright 2002). Wainwright (2003) indicates that the information for 1979-1989 has significant gaps, but that the information for 1990-1998 is relatively complete. Obtaining access to this data and the effort required to analyze and use it were beyond the scope of this project.

The project did not document any direct adverse effects of oil and gas activities on Cross Island whaling during the 12 years of fieldwork (2001-2012). As noted above, the whalers reported that they avoided scouting for whales in the area of the Northstar production unit, but this did not

significantly affect the conduct or the success of their hunt. During this period the CAA had, for the most part, managed adverse effects associated with oil and gas activities (seismic work, exploratory drilling, associated vessel traffic, air traffic). The only serious adverse effects on the Cross Island subsistence whale hunt documented in this period were related to commercial (but not petroleum industry) vessel traffic in 2005 and 2009. However, the most consistent concern expressed by Nuiqsut whalers during the course of the project was that an oil spill, whether from exploratory or production activities, would have devastating effects upon subsistence resources and the Iñupiat subsistence activities dependent on those resources. A secondary concern, based on the success of the CAA in managing the potential adverse effects of "normal" oil and gas activities (that is, those that were planned under the CAA process) was to extend the CAA to all vessel traffic (as discussed below).

In a later section, a more general discussion of the concerns about oil and gas development expressed by Nuiqsut whalers will demonstrate that the sorts of effects whalers report they experienced in the 1980s and 1990s are still their principal worries about future oil and gas activities. This is not to say that Nuiqsut whalers do not recognize the benefits that oil and gas developments have provided to them (and the North Slope Borough in general). This recognition has been well documented, and a general comparison of measures of well-being and life-satisfaction for the communities of Barrow, Nuiqsut, Wainwright, and Atqasuk indicates that between 1977 and 2003 all measures showed significant improvements (SRB&A 2009). However, they also note a significant decline between 2003 and 2007 in Iñupiat perception of well-being and life-satisfaction (Braund & Associate 2009), which they conclude is due to the increased intensity of oil and gas development on the North Slope and the increased frequency with which oil and gas development has adversely affected Iñupiat activities, and especially subsistence activities (SRB&A 2009). They sum up their report by repeating a quote (SRB&A 2009:173) from the National Research Council Committee on Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (2003):

> The 1983 observation of Kruse and colleagues, that Native Alaskans' "fears that offshore development will inevitably harm subsistence resources are both intense and widespread and themselves constitute an impact of development" [Kruse et al 1983] is still true. The committee was repeatedly told that this is **the** issue for the Iñupiat (emphasis in the original).

COMMERCIAL (NON-PETROLEUM INDUSTRY) VESSEL TRAFFIC

The most consistently voiced concern, and the single most significant direct anthropogenic adverse effect on Cross Island subsistence whaling during the term of the project, was commercial (non-petroleum industry) vessel traffic. During the first four years of the project (2001-2004), there were essentially no reports of sightings of such vessels. No such events or sightings were noted in the DCC logs for those years. The whalers did remark that the skittishness of whales during the 2001 season could have been caused by a number of factors, one of which was vessel and barge traffic. They did not report seeing such traffic, but expressed it as a possible concern. Whales were reported to be less skittish in 2002, and no reports of skittish whales were reported in 2003 or 2004. All of these years resulted in adequate harvests, although 2001 and especially 2004 were in the lower range of adequate harvests and were long seasons with spells of bad weather near their ends.

Since 2005, every season has been marked by whaler concerns with commercial vessel traffic, but relatively few whaler reports of encounters with or sightings of other vessel traffic. The most significant events occurred in 2005 and 2009. The details of these events can be found in Galginaitis (2008, 2009a, 2009b), but will be briefly described here.

In 2005, a tug and barge came out of the fog and interrupted several boats chasing a whale NE of Cross Island. The whale was diverted away and the boats changed the direction of their scouting, not wanting to look in the area just transited by the tug and barge. The whalers managed to strike and land a different whale later in the day, but this was the only good day of scouting for the entire season, and the only whale landed by Nuiqsut whalers in 2005. Ice restricted the whalers to scouting shoreward of Cross Island on all but that one day. Weather prevented any scouting at all on 16 of the 27 days of the season. The same ice and weather probably confined commercial vessels to the same general area as the whalers and since only petroleum industry vessels of companies that sign the CAA are subject to its provisions, conflicts were almost inevitable.

In 2009, ice was not a problem and weather only prevented scouting on five of the season's 20 days – but a few boats went scouting on 3 additional days with only marginal conditions, while most boats stayed on the island. Even on the "good" days, not many whales were seen and were hard to follow due to high swells. The whalers saw commercial vessels on three consecutive scouting days early in the season and on two of these days reported that they had been chasing whales that were then dispersed and diverted by the vessels. On their seventh day of scouting, the whalers made their first strike, but struck-and-lost a whale. They finally landed a large whale, their first for the season, five days later on September 11. On September 12, most crews went scouting to the east of Cross Island and saw few whales. One boat, scouting west of Cross Island, encountered a vessel near the Northstar Hydrophone array (north of Northstar itself). This vessel had notified the DCC of its plans, but the whalers were not aware of them, and reported the encounter. This was an industry ship, and immediately aborted its mission, and the whale boat also changed direction and went east to join the other boats. On September 13, the whalers landed a second, very small whale, and most crews left the island the next day, once all the common butchering was done. The last two crews left September 15. Nuiqsut whalers had landed only two whales, which were not adequate to satisfy the community's needs. However, they had concluded that the presence of commercial vessels, combined with relatively poor weather and marginal spotting conditions, made the probability of landing another whale low.

For the other five seasons, 2007-08 and 2010-12, the Nuiqsut whalers reported sighting commercial vessels in the area only in 2011. These were all quick and short seasons except for 2012, and 2012 was only longer because six of its first ten days were weather days. After that, the quota was completed quickly. In spite of the lack of commercial vessel sightings, the whalers were preoccupied with the possibility of such interference, especially in 2006 and 2007. In these two years they had extensive phone conversations from Cross Island with the AEWC and NSB Planning Department to ensure that no barging activity took place in the Cross Island area while they were whaling. The first half of 2006 was another bad ice year, and whalers feared a repeat of 2005. Once the ice cleared and weather improved, the quota was quickly completed.

Weather was poor in 2007, but the whales were accessible and the quota completed on the few good days. There was a good deal of commercial vessel traffic noted in the DCC log, but most was not in the Cross Island area and was of routine support activity. The few cases where barges requested consent to transit to Cross Island area were handled in accordance with the CAA. The same was true in 2008. In 2008 the whalers were weathered in for six days once they reached Cross Island but landed four whales in five days and had little time to worry about possible commercial vessels. 2009 was problematic, as described above. In 2010 the whalers landed four whales in the first five days of the season, and again had no time to worry about commercial vessels in the area. In 2011 and 2012, poor sighting conditions (high swells) and poorer weather extended the seasons. In 2011 quite a few commercial vessel observations were made near Cross Island, but this appeared to be traffic between West Dock and Badami inside of the barrier islands, and had no direct effect upon the conduct of the whaling season. No commercial vessel sightings were reported in 2012.

As each of these seasons progressed, the whalers were increasingly concerned that no barging activities be allowed, and made phone calls to ensure that the NSB (and the barging companies) knew that the whaling season was still in progress. In 2012, in response to an invitation from the NWCA, the director of BOEM, Tommy Beaudreau, also made a short visit to Cross Island to talk with the whalers and listen to their concerns. The points expressed during this session are summarized in a later section as representative of their concerns about potential effects, and the high level of their anxiety about the effects of continued oil and gas development upon subsistence whaling.

In summary, for at least two of the documented seasons (2005 and 2009), non-petroleum industry commercial vessel activity had adverse effects upon Cross Island subsistence whaling. A precise assessment of this effect is not possible, due to the lack of precision of where the vessels were spotted. It is possible that if commercial coastal vessels were required to have GPS transmitting devices this could be rectified. Although this system has not yet been incorporated into the DCC yet, it would be a mechanism to ensure that the DCC (and the whalers) were aware of the commercial vessels transiting the area, and where they were at any point in time. For 2012, at least one of the major oil companies did have access to the system and on various occasions made the DCC aware of various vessels that could potentially have an effect on whaling activities (Anthony Penino, Exxon Mobil, personal communication 10/16/13 at the AEWC quarterly meeting in Anchorage).

NON-COMMERCIAL (RECREATIONAL) VESSEL TRAFFIC

Not much can be said about this category of potential effects. Little or no information is available on how frequently such vessels transit the Cross Island area. During the course of the project, at least two parties of adventurers have landed on Cross Island. One was a pair of kayakers on their way from the Canada along the coast to Barrow and then south. Another was a party for Greenland trying to transit the Arctic. In addition, at least two sail boats have sailed by Cross Island, one putting into the lagoon and visiting for a short while. The two parties of adventure travelers stayed a bit longer. None had any real effect upon whaling activities, other than to serve as a fresh audience for whaling stories. These incidents have had the effect of a directive from the AEWC not to be so welcoming to such parties, because of the potential for publicity unfavorable to the AEWC and subsistence whaling if such access is given too freely.

RESEARCH ACTIVITIES

Nuiqsut whalers are sometimes wary of "western" scientific research for two reasons. It can produce information (whether valid or not may be inconsequential) that may be detrimental to their interests ("can be used against them" as they commonly express it), and it may be disruptive of their activities. Both of these reasons may have contributed to the approximately 18 months that were required to obtain the consent of the Nuiqsut whalers for this project to start. The whalers did not want any "bad" publicity that animal rights groups could use for their own purposes, and placed certain restrictions on the research. The researcher could not observe the hunt, on the water, by going out in a whaling boat (uncertain in any event, since under the MMPA he could not assist in the active harvest of any marine mammal, which would have been impossible to comply with once out on the water on a whaling trip). The researcher was allowed to photograph anything that happened on Cross Island, and to talk with the whalers about their experiences on the water during the hunt. He could look at, but not reproduce, photos that the whalers took while out on the water. It was fairly obvious that the first field season was a probationary period for the project, to see if the information that was being collected would be useful to the whalers as well as to the sponsor, and especially to ensure that the research products would not harm or cause difficulties for subsistence whaling. The increased participation in the second and following years indicates that the project produced information of use to the whalers (and the NSB and AEWC).

The most common example of the research process producing adverse effects on subsistence hunters is that of wildlife biologists flying in a helicopter doing transects or other observations, disturbing caribou and caribou hunters at the same time. A Cross Island example would be the whalers sensitivity to airplanes flying over or near Cross Island during the whaling season. While this has not been a common occurrence, there were at least three seasons when such a plane was observed. In most cases the whalers did not see identification markers, but in one case they identified it as the polar bear survey plane (from its coloration). On several other occasions the whalers were radioed to ask if the polar bear survey plane could fly in their general area, and in all cases the request was refused. In many of these cases the conditions turned out not to be acceptable for the plane to fly anyway. The BWASP bowhead aerial survey, and its successors, has a policy of not flying survey transects in areas where subsistence whaling is underway in order to avoid affecting the hunt by spooking the whales or affecting the whalers.

At recent Open Water Meetings one of the issues the whalers have raised is the apparent double standard for industrial work that puts noise into the marine environment as opposed to scientific work that also does so. Hunters do not object to the fairly rigorous review that industry plans undergo, but have the perception that research plans are not subject to the same process. They also note that research projects have not been asked to sign the annual CAA, whereas all industry operators with activities planned in the area are expected to do so. This underlines the whaler perception that while the CAA process is very useful, it is also quite limited as long as it includes only the petroleum industry operators, and not other entities with activities in the area that could potentially have adverse effects on whales and/or subsistence whaling.

NUIQSUT WHALERS' GENERAL CONCERNS, AS REPORTED TO BOEM, 2012

No adverse effects on Cross Island whaling were reported during the 2012 season, but the potential for such adverse effects was a constant topic of conversation. This may in part have been due to the much anticipated visit of Tommy Beaudreau (Director of BOEM) to Cross Island, during the 2012 whaling season. This meeting was sought by both Director Beaudreau and the Nuiqsut whalers. The whalers had extended the invitation and Director Beaudreau had accepted. While Shell's planned activities in Camden Bay were clearly the most salient focus for this meeting, other potential challenges for Cross Island whaling were also summarized by the whalers for the Director. The Director was there primarily to listen to these concerns and to learn about the context and constraints of Cross Island whaling. This meeting provided a summary of the most salient concerns of Nuiqsut whalers about the challenges and potential adverse effects they faced. While these included both anthropogenic and non-anthropogenic factors, a brief discussion of this meeting serves as a reasonable summary of the preceding sections. The points are those made by the Nuiqsut whalers or their representatives at the meeting, although they are paraphrased and may not be presented in the words used at the meeting. The Nuiqsut whalers were especially focused on articulating their near-term concerns with the planned drilling activities in Camden Bay.

- Nuiqsut is the only Alaskan community whose whalers have to travel large distances away from the community to whale. This places much more stringent time constraints on the time available to them for whaling, presents them with greater logistical challenges, and imposes greater economic costs on them, then are experienced by the whalers of other Alaskan communities.
- The whalers stated that industry has adversely affected Cross Island whaling in the past, citing deflection of whales from the Hammerhead drill site. In that case, Nuiqsut whalers were forced to go 30 miles offshore to find whales, and subsequent to weather worsening had to cut a whale being towed loose for safety reasons, the first time they had to do so. This account may have conflated experiences of the mid-1980s with those of the 1990s, but clearly makes the point that past drilling in Camden Bay [in the mid-1980s and 1990s] adversely affected Cross Island subsistence whaling.
- Noise in general is a very serious issue, and can greatly affect Cross Island whaling activity. Vessel and barge traffic is increasing every year. In Barrow, when industry was working in their lagoon (Elson Lagoon), whalers reported that seals and other animals were deflected (because of the noise of the activity). The whalers stated that when there is no unusual activity in the Cross Island area they usually see whales and have a successful season, but if there is industrial activity, the whales are absent or have deflected away and their season is either not successful, or they need to expend much more effort to harvest their whales.
- The whalers indicated a need to adopt Norwegian standards of zero discharge of wastes into the ocean, among others. Whales are very sensitive not only to noise, but also to smells, and also to strange visual stimuli.

- The whalers stated that some CAA participants only signed the CAA recently and reluctantly. When these CAA participants started to talk to the whalers, they were described by the whalers as always being very vague as to what they would do for the villages, in terms of protecting both the environment and the ability of the whalers to conduct their subsistence hunt. It was unclear how these CAA participants would ensure that they could mitigate the potential adverse effects of their planned activities upon whales and/or the conduct of the subsistence whale hunt. The whalers stated that "the sea is our garden" and that not only must the health of that garden be protected, but also their continued ability to harvest the bounty form that garden must be ensured.
- A whaler stated that 60 percent of Iñupiat are unemployed and depend on subsistence for much of their food. It is too expensive to buy store food. It can be very dangerous out whaling, as well as difficult and expensive. With no industry activity, Nuiqsut can land their quota in a reasonable period of time, weather and other activity permitting. With industry activity affecting the whales, the season is extended or may even be unsuccessful. Whales may become skittish or be diverted farther offshore by industry activity in the Cross Island area, or in the area to the east of Cross Island, including Camden Bay.
- Camden Bay was reported to be a haven for whales. They go there to feed, and this is also an area where they wait out bad weather before going on with the migration. Nuiqsut whalers have sometimes seen hundreds of whales in Camden Bay. The implicit message was that oil and gas activities in Camden Bay would be quite disruptive for the whales and as a result also for the Cross Island whalers.
- A spokesman for the Nuiqsut whalers present at the meeting (a whaling captain from Barrow) stated that the Nuiqsut whalers knew that Shell's prospect in Camden Bay had a good chance of proving out and being produced, and would listen to Shell's proposals on how to produce the oil while also protecting the Cross Island subsistence whale hunt. However, the Nuiqsut whalers also have many concerns about possible adverse effects on subsistence whaling from the proposed oil development ion Camden Bay. Nuiqsut whalers also have some ideas on some mitigation measures that could alleviate or reduce many of these potential concerns and adverse effects. The whalers noted that the CAA can be a useful part of this process, but that it can be too easily circumvented. There is thus a need for a more formal set of mandatory guidelines, or the CAA itself needs to be formally required as part of the regulatory process. The whalers present agreed with this statement but made no substantive addition to it.
- The same spokesman stated that a deferral area in the Cross Island area from future federal lease sales to protect Nuiqsut/Cross Island whaling is seen as a fundamental need by Nuiqsut whalers. He also noted that there is by no means agreement about the nature or size of such a deferral by all stakeholders, or even the need for such a permanent area deferral (by industry and/or regulators was implied).

- The whalers stated their firm conviction that they have been successful in finding whales this year (2012) because Shell was **not** currently conducting activities in Camden Bay. With industry activity in Camden Bay, they thought that the whale migration would be deflected farther offshore. They noted that whales are also "spooked" and made skittish by industrial activities and, even if not physically displaced, are behaviorally more difficult to approach and act more unpredictably.
- Even in the presence of the Director of BOEM, the whalers made no comments on adverse effects form existing oil production units in the area (Endicott and Northstar). One conclusion of this report is that Northstar, located well to the west of Cross Island, has had no direct effect on Cross Island whaling for the 2001-2012 whaling seasons. Nuiqsut whalers avoid scouting for whales in the area of Northstar, but this has no significant effect on the conduct or success of their hunt during this period. The whalers do state that one of the reasons they made Cross Island their logistical base is that it is east of the development of Seal Island, the precursor to Northstar.
- Underlying all comments was the general whaler position that the oil and gas industry had no reliable and proven way to clean up an oil spill under Arctic conditions.

A Cross Island Lease Sale Deferral Area as a Management/Mitigation Measure

The collection of information on mitigation measures in general, and a lease sale deferral in the Cross Island area in particular, was not included in the scope of work. However, the work products of this project have some obvious applicability to the consideration and design of such a deferral area. The information presented here represents the author's best attempt to present this information in a comprehensible form. It does not represent the view of the Nuiqsut whalers or of any other party, as those parties can (and must) speak for themselves.

The effectiveness of time and area closures to commercial vessel traffic as part of the CAA for managing potential conflicts between industry and the whalers (Lefevre 2013a) has been discussed several time above. While the Nuiqsut whalers have expressed their appreciation for this mechanism and the overall CAA process as discussed above, they also believe that it has some inherent weaknesses (Aiken 2011). When a conflict does arise, there is no swift and direct way to resolve the situation if the parties do not agree on the basic description of the conflict. The CCA only deals with potential conflicts between the oil and gas industry and the whalers. It does not aid in avoiding conflicts with other vessels operating in the area, or resolving the conflicts that arise with those vessels (as in 2005 and 2009). The CAA is also a mechanism for dealing with temporary or transient activities, but not year-round production operations. The primary management tool the CAA uses is a robust communications system combined with time and area closures for oil and gas activities. Time and area closures do not work for year-round activities, unless the "time" element is also year-round. In such a case, the tool can more properly be termed an area deferral.

As discussed in the above section, Nuiqsut whalers consider an area deferral for the Cross Island essential, but also recognize that there is no agreement among the various stakeholders on the various elements that would constitute such a deferral. The information developed for this

project can address some of these elements, but not all. This section will list as many of the logical elements of a deferral area as occur to the author, but will not claim to be comprehensive in this regard. The discussion will present project information pertinent to each element, or state that the project has no information applicable to that element.

Necessity for a Cross Island Lease Sale Deferral

This project was not designed to develop information relevant to whether a deferral area is necessary to manage or mitigate the potential effects of a year-round production unit in the Cross Island area. The options would seem to be either area exclusions on production units, or area unit-specific stipulations. Such stipulations would need to address at least:

- the design of production units (artificial islands, structures)
- what production activities would be permitted and at what times (production year-round or shutdowns, "warm" versus "cold" shutdowns, frequency of crew changes and other logistical vessel and air traffic)
- monitoring programs to document adverse effects as they occur (or the absence of such effects)
- potential cumulative effects (number of offshore exploration/production units, location and spacing of exploration/production units, effect thresholds, additive vs. multiplicative or greater effects of each additional exploration/production unit

In their public testimony, Nuiqsut whalers have expressed their dissatisfaction with specific lease stipulations in the past and a preference for area deferrals. This project has not produced information to choose between those options or to evaluate the relative effectiveness of either in preventing adverse effects on Cross Island subsistence whaling.

However, it is only common sense to give great consideration to the whalers' concerns about the severity of possible adverse effects from oil and gas activities, based on their experiences in the 1980s and 1990s. Their testimony speaks to the greater sense of security and trust they would have in a deferral management regime as opposed to more of a individualistic unit-specific stipulation system. The more general and universal the unit-specific stipulations can be made, the more closely they would probably be perceived as "deferral-like" or at least as defining a special use area. The Nuiqsut whalers seem to desire an overall and general management arrangement that can address (or protect against) cumulative development and potential impacts, rather than one that focusses more on individual development units and that could fail to capture the potential cumulative effects.

Time Element of a Cross Island Lease Sale Deferral Area

A lease sale deferral area could be either permanent, for a given period of time, or for a specific lease sale. Clearly, the longer the time period for an area deferral, the greater security there would be for the Nuiqsut whalers, reducing their general fear that offshore oil development will inevitably adversely affect subsistence resources. This would be at the cost of allowing little or no flexibility for BOEM to manage the resource, even if information changes or new technologies and methods are developed. This sort of tradeoff is one that can only be evaluated

at the management level and vetted through the public decision making process. This project developed no information pertinent to that process.

Area and Size of a Cross Island Lease Sale Deferral Area

The historical and GIS information developed for this project address this component of a potential Cross Island lease sale deferral area directly. Figures 22 and 23 display the contemporary (1973-2012) and project documented (2001-2012) harvest locations for all whales landed by Nuiqsut residents near Cross Island. These landings are displayed relative to the aggregated documented GPS tracks for the 2001-2012 Cross Island whaling seasons. This will be the basic data used to ground the discussion in this section. Historical landings from the first half of the twentieth century are not relevant to this discussion.

All but the first two of Nuiqsut's landed whales fall within the aggregated GPS tracks documented for the 2001-2012 Cross Island whaling seasons. The first two whales, landed well to the east of this area, were taken before Nuiqsut whalers settled on Cross Island as a permanent logistical whaling base. As such, they represent an historical use of the marine environment east of this area for whaling, and an area known to be frequented by whales, but not one currently actively scouted for whales. This is not to imply that Nuiqsut whalers would not scout for whales in this area if whales were not found within the documented use area for 2001-2012, but this would be unlikely due to the difficulty of towing a whale from that distance back to Cross Island. Assuming that Nuiqsut whalers maintain Cross Island as their logistical base, the use area for 2001-2012 can be taken to represent the area that they currently scout for whales on a regular basis.

However, this documented "active scouting area" is not the total area that would be considered for inclusion in a deferral area. Any deferral area should be set a distance beyond (father from Cross Island) than the extent of the "active scouting area." Whales are known to be quite sensitive to disturbances of various kinds, with sound being the most commonly cited. The distance at which whales react to sound, the threshold level at which they react, and how long it takes for them to recover, are all unsettled questions. Nuiqsut whalers also report that whales can be disturbed by strange or different visual stimuli as well as by different scents. That is one reason the whalers generally have boats with white-colored hulls and wear white outer garments while out on the water. Any lease sale deferral area boundary should probably be set at the greatest distance for the most sensitive sense. In most cases, this would probably be sound.

Any deferral area should also be asymmetrical in relation to Cross Island. Distances to the north and east should be greater than those to the south and west, reflecting where Nuiqsut whalers land most of their whales and most often scout for whales. Currently federally leased areas should probably not be included in any deferral area, so the southern boundary would run between Narwhal Island and the Liberty Unit, Endicott and Cross Island, and Reindeer Island and West Dock/Northstar. Any potential deferral area should probably not include the area traversed by the Cross Island GPS tracks to the west in the area of the past Harvard prospect. These tracks were made during the 2006 season when the whalers were confined shoreward of Cross Island by local ice conditions and are a very low probability area for finding whales. The western boundary of a potential deferral area would probably not need to be much further west than a point north of the Northstar unit. However, the northern boundary of a potential deferral

area should probably extend north of the tracks to the NE of the "Harvard" tracks, as well as the main body of documented tracks. How far north depends on the threshold values for the level of sound that whales react to, and the distance at which they show that reactive response. The boundary distance to the NE of Cross Island for a deferral area should also, at a minimum, be set at the threshold limits at which whales react to sound.

To the east and SE these boundaries may become problematic, in terms of how close to the Sivulliq prospect and Flaxman Island the boundaries are proposed. The normal migration route for bowhead whales lies in this area, so that the distance within which whales "recover" from exposure to sound at various levels also becomes important. That is, any proposed deferral area must extend far enough to the east and SE so that a whale exposed to the sounds of oil and gas activities outside of the deferral area and diverted offshore in response to that noise has the time and distance to recover and resume its normal migration path, and thus be available to the Nuiqsut whalers at Cross Island. Where this boundary would be is also uncertain at present. It would also depend on seasonal mitigation measures undertaken to reduce noise and other potential disturbances from oil and gas activities outside of the deferral area. It can be assumed that any effective lease sale deferral area would extend well to the east and SE of the documented 2001-2012 "active scouting area" and may require additional lease stipulations on lease sales to the east of the lease sale deferral area.

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APPENDIX A
SUMMARY DESCRIPTIONS OF WHALING SEASONS, 2001-2012

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INTRODUCTION

The next twelve figures at the end of this appendix are graphical summaries of key characteristics for each of the Cross Island subsistence whaling seasons documented by this report, 2001-2012. Each figure presents the information for one season. Since the figures are all landscape in orientation and would disrupt the text if interspersed with the text, they are collected at the end of the appendix.

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:

- Wind speed from the Deadhorse weather station (average hourly values) – in blue
- Wind speed from the Cross Island weather station (readings every 4 minutes) – in teal
- Barometric pressure from the Deadhorse weather station – in black
- Barometric pressure from the Cross Island weather station – in light purple
- 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.
- 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.

2001. In 2001 (Figure A1), 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 (24 days compared to about 19), 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.

2002. In 2002 (Figure A2) 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 Iñupiat), 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 (23 days compared to the average of about 19) than the average for the twelve 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 in 2002 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 scouting days without seeing any whales (six), along with the 2004 season. The other seasons with comparable numbers of scouting days without a strike (an indicator that not many whales were seen and/or difficult to approach) were 2001, 2004, 2005, 2006, and 2009. These are all seasons with "scouting days" in the double digits, an indication of adverse conditions. The quota was not completed for the 20005 and 2009 seasons.

2003. The 2003 season (Figure A3) was both an average and a median season in terms of length, 19 days (2009, a 20-day season, was the other median season). It was characterized by the whalers as one of poor weather, with whales "close" to Cross Island. The quota was completed using four strikes. 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 crew 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.

2004. The 2004 season (Figure A4) was the longest season for the twelve discussed in this report, but primarily because one whaling crew went out to Cross Island on August 15 and 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 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. The five days they spent in Nuiqsut were not counted as part of the whaling season, as no crew was at Cross Island during that time. 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 already landed a whale, but 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 having decided not to hunt anymore that season while the crew that had landed 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 (second highest of the 12 seasons, and comparable to the four seasons with similarly high numbers – 2005, 2001, and 2003). No scouting at all could take place on weather days. 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.

2005. The 2005 season (Figure A5) 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.

This 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" (how at least one whaler expressed it) 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.

2006. The 2006 season (Figure A6) 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 from September 6 through September 12 all whaling crews went scouting the same six of the nine days, with winds generally below 10 mph for those six days (1 day of 10-15 mph). There were three 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.

2007. The 2007 season (Figure A7) 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 one of the shortest season, in terms of days, of the seven documented for this report (13 days, with only 2010 and 2011 as shorter at 10 and 12 days respectively; 2008 was also short at 14 days for 1 crew, but only 7 days for all other crews). The key characteristic of the season seemed to be that whales could be found close to Cross Island and that there were local areas of open water 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 August 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 September 3 whale was struck-and-lost. 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. The fact that community needs had been met and all four strikes used, combined with the overall poor weather for the season, probably were the factors influencing this decision.

In spite of the poor weather, 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.

2008. Figure A8 summarizes the 2008 subsistence whaling season by displaying barometric pressure, wind speed, the periods when whalers were out scouting for whales, and when whale

strikes occurred. Since the weather station on Cross Island only operated for part of the whaling season (one crew went out about a week before the other crews), barometric pressure and wind speed for both the Cross Island weather station and the weather station at Deadhorse are displayed. The Deadhorse measurements are reasonable, although not perfect, proxies for the Cross Island readings, as Figure A8 demonstrates, so this allows some level of documentation for the weather for the entire season. Periods when boats were out scouting are plotted at the average wind speed measured during the period of time that they were on-the-water (Cross Island measurements when available, otherwise Deadhorse measurements). Similarly, whale strikes were plotted at the wind speed measured at the time recorded for the strike.

Figure A8 shows that the 2008 season was one of relatively good conditions, although one crew that went out before the other crews was stuck on Cross Island for a week of high winds. High winds were still experienced after this, but were not as steady. Periods of shifting (and lower) winds were important for whalers in 2008. Nuiqsut whalers rely much more on their direct observations of the wind and their experience as to what the future wind conditions will likely be. Nuiqsut whalers do not observe barometric pressure directly – or, at least did not do so until the start of this research and the appearance of a weather station on Cross Island. If the barometric pressure trend is available, whalers will take it into account when deciding whether to scout for whales or not (although some may now be placing more faith in it as an indicator than is prudent). Since it is at best a rough predictive tool, however, and whalers know from experience that a (relatively brief – up to several hours) period of good scouting conditions can occur when the wind shifts directions, whalers will sometimes go out scouting even when the barometric pressure is falling. Whalers prefer days with no wind, though winds up to 5 mph, or even 10 mph, are generally acceptable. Scouting can occur even with higher winds, given the right circumstances (ice cover, whales close to Cross Island). The following discussion will show that scouting activities correspond with periods of lower wind speeds. It should be noted that conditions on Cross Island are not necessarily the same as experienced when scouting for whales, but the general trends are often the same (complete weather file in electronic appendix). It should be noted that for 2008, weather conditions were a major factor for the whalers.

As is quite clear from Figure A8, the first crew traveled to Cross Island in good conditions (August 29, with relatively low wind) but once on Cross Island experienced a week of high winds that prevented any scouting activities. Other crews were also prevented from traveling to Cross Island during this period. On September 4 the crew on Cross Island tried to go out scouting, but due to high seas (due to wind and large swells) they only stayed out 48 minutes and probably did not leave the relative shelter of the Cross Island lagoon. Conditions on September 4 did allow two crews with relatively large boats with deep "V" hulls to travel from Nuiqsut to Cross Island, although one stopped at West Dock and did not reach Cross Island until September 5. Another crew delayed leaving for Cross Island until September 5, as they had smaller boats and wanted to wait for better conditions. The last two crews traveled to Cross Island in 6/06, partly due to waiting for conditions, but also because they needed some additional time to get ready for whaling.

During the period of time for which weather measurements are available, scouting occurred on September 6-7. The weather station was set up early on September 6 (12:30 in the morning), a scouting day, but the weather measurements indicate that the barometric pressure was at a high and would do nothing but decline until the end of the season (Figure A8). Wind speed varied

throughout the season, but for the period of time when the weather station was set up was mostly between 5-15 mph, with some higher gusts on September 7 and lower speeds briefly on September 6 and for longer periods of time on September 8-10. Note that most crews took advantage of the low wind speeds on September 10 to leave Cross Island for Nuiqsut. The only day when the whalers went scouting but did not land a whale (September 7) was the day when wind speed did not go below 6 mph and went above 15 mph, and was the day when Nuiqsut whalers reported the most difficulty seeing whales. It is likely that the wind speed on Cross Island (and experienced by the whalers when out scouting) on 6/05 was less than documented by the Deadhorse weather station, given that a whale was landed that day, Nuiqsut whalers prefer not to scout for whales when the wind speed is over 15 mph. Also, for that part of the season documented by both the Cross Island and Deadhorse weather stations, the only period with a significant difference in wind speed for the two was immediately after this, on 6/06, when the Cross Island weather station had just been set up.

Scouting conditions were challenging throughout the whaling season, although not as bad as the first week of the first crew, and whalers went out scouting whenever winds and sea conditions allowed them to do so. The lack of ice cover exacerbated the adverse effects of the nearly constant wind, and it is likely that the relative closeness of whales to Cross Island was a major factor in the ability of Nuiqsut whalers to see, follow, and land their full quota in 2008. The whalers indicated that they could not spot or follow whales beyond eight miles from Cross Island due to the rough seas, although they knew whales were in that area because they followed some there before losing track of them. The whalers also indicated that the sea conditions in those areas were dangerous, if not for travel, for whaling and especially for towing a whale.

2009. Figure A9 summarizes daily boat activities for the 2009 Cross Island whaling season with basic weather conditions (wind speed, barometric pressure). Five crews left for Cross Island on August 27 in order to get things ready for whaling and to build or repair their cabins. Two crews were relatively newly formed and had "borrowed" cabins the previous year, and wanted to construct cabins of their own. The cabins for three other crews (one not whaling in 2009) had been damaged by polar bears since the 2008 season, and needed to be cleaned and repaired. Other structures that had not been recently used on the island had also been damaged. The sixth crew traveled from Nuiqsut to Cross Island on August 28. Two boats went scouting on August 28, but one was out for only 12 minutes, to check a potential sighting seen from the island (it was negative). Winds were 5 to 17 mph, so conditions, while not optimal, were at least marginally acceptable. The other boat remained out about 4 hours 11 minutes and reported no whale sightings. Winds were about the same on August 29 and three crews (four boats) went scouting, with trips of 3.5 to almost 11 hours, and reported a total of two whale sightings. The other three crews remained on shore. Wind speeds on August 30–31 prevented anyone from whaling. Although wind speed dropped as low as 5 mph on August 30, it had peaked at 35 mph and sea states were too rough. On August 31 wind speed peaked at nearly 40 mph.

Conditions on September 1–4 were more suitable for scouting for whales, with wind speed generally less than 10 mph. (Although it increased to over 35 mph at midnight on September 3–4, it decreased to less than 5 mph late in the afternoon.) Of the 11 whaling boats on Cross Island, eight went scouting during all four days. Of those that did not, one was disabled, one went out the first three days (conditions on September 4 were marginal), and the third went out two days. These were the days when the most whale sightings were reported (36 of 53 total), and these four

days (mostly September 1–3) accounted for 64 percent of all the whale sightings reported for the 2009 season (but see the "Distribution of Whales" discussion below). The longest trip times were over 11 hours on 1 September and over 15 hours on September 2, but only 5.5 hours on September 3 and 4 hours on September 4. Winds on September 5 were generally over 20 mph and no boats went out scouting.

Winds moderated on September 6 and 10 boats (all but the disabled boat) went scouting and spent from 5 to 17.5 hours on the water. They reported a total of 5 whale sightings, and a whale was struck late in the day. It was left once it became too dark to safely continue to pursue it. Its position was marked on several of the whalers' GPS units. Conditions on September 7 were more marginal, with wind speeds averaging over 10 mph, but nine boats went out scouting. They first looked for the whale struck the day before, but only found an oil slick in the area where they had left it. They continued scouting and most boats spent from 6 to 8 hours on the water. Two whale sightings were reported. Winds speeds were very high on September 8–10, peaking at almost 45 mph at midnight on September 8–9. One boat went scouting on September 10, once the wind speed was below 5 mph, but only stayed out 2.5 hours and near the island. That crew did not report any whale sightings.

Ten boats went scouting on September11, with the wind speed was less than 5 mph. The wind speed soon increased, but a whale was seen, followed, struck and landed about 2 hours after the first boat had left Cross Island that morning. Because the whale was large (49 ft) and seas were rough, all boats were needed to help with the tow. However, conditions were too harsh for the smaller boats to do so safely so instead of helping with the tow they returned to Cross Island to make preparations to haul the whale onshore. The tow required about 6 to 6.5 hours and reached Cross Island in mid-afternoon.

Butchering progressed to a stage where eight boats—all but those from the crew that landed the whale and the disabled boat from another crew—could go out scouting on September 12 and 13. Conditions on those days were reasonably good for scouting, with wind speeds generally less than 5 mph. Few whales were seen, perhaps four each day. A whale was struck and landed on September 13. Since this was a small whale, three boats towed it to Cross Island while the other boats stayed out to look for another whale. Although several crews may have had potential opportunities to make a strike, no other whale was struck. Once all the boats returned to Cross Island the captains talked with each other and decided to call a "cease fire" and end their season. Conditions were such (not seeing many whales, whales fairly skittish) that the crews did not want to risk being stuck on Cross Island by an extended period of bad weather. Four crews that had completed their butchering and packing tasks left on September 14. The last two crews left on September 15. One was the crew who landed the whale on September 13 and so had more butchering chores than did the other crews. The other was the crew with the disabled boat, which they fixed either late September 14 or early September 15, in time to go back to Nuiqsut without being towed.

Data from the project's weather station at Cross Island provided information on the weather conditions from when it began to receive wind speed readings up at 05:39 on August 28 through 10:54 on September 14. During this period, crews went out scouting for whales on 12 days, as described above. Wind speeds recorded at Cross Island corresponded well with those recorded at Prudhoe Bay for this period (Figure A9). Although the magnitudes may have varied slightly

between the two locations, the overall patterns were the same — winds increased and decreased at the same times. It is clear that whalers go out scouting when wind speeds tend to be lower (5 mph and that the exceptions are primarily due to increases in wind speed when the whalers are already out on the water (September 3, September 7, and especially September 11). Whales also tend to be struck when wind speed is lower (September 6 and September 13). Whalers remember that the wind came up on September 11 after the whale was struck, so it is possible that the wind speed at Cross Island increased sooner than it did out on the water where the whalers were. In any case, the whale landed on September 11 was seen and approached when wind speeds were lower.

At least one crew was on Cross Island for parts of August 27 through September 15, a total of 20 days. There were several periods of high winds when conditions were not suitable for scouting for whales, on August 30–31, September 5, and September 8–10 (although one boat tried to scout on September 10). This was a total of 5 or 6 weather days. Three days were devoted to travel or other chores. Scouting occurred on 12 days, but one should probably be considered a "weather" day. The season was 20 days total, with 11 scouting days, 6 weather days, and 3 days for travel and other chores.

2010. Six crews whaled from Cross Island in 2010. All had whaled at Cross Island previously. No crew whaled with only one boat, a large change from past years. Four crews whaled with two boats, and two crews whaled with three boats. One of the "3-boat" crews also used a fourth boat for logistical support. The other "3-boat" crew sent one boat back to Nuiqsut early, but only after all four whales had been landed. As in previous years, the start of the Cross Island whaling season depended primarily on weather conditions, reports of whale sightings near Cross Island, and the readiness of the whaling boats. The whalers perhaps started the season earlier rather than later because of recent experiences with poorer weather late in September. The whalers used their full quota, landing four whales. Figure A10 displays the 2010 whaling season characteristics graphically with basic weather conditions (wind speed, barometric pressure).

As in previous years, the start of the Cross Island whaling season in 2010 depended primarily on weather conditions, reports of whale sightings near Cross Island, and the readiness of the whaling boats and crews. Most captains had initially planned to leave for Cross Island sometime during the weekend before Labor Day. As it turned out, since Labor Day was relatively "late" in 2010 (September 6) and whales were already being sighted on their migration, all crews left for Cross Island about a week before Labor Day. Three crews traveled to Cross Island on August 28, one on August 29, and two on August 30. Wind speed was 5 mph or less for most of this period. The whalers completed landing their quota of four boating whales on September 1 and the last crews left Cross Island on September 6.

On ***August 29***, the three crews that had arrived on Cross Island the previous day went scouting for whales with seven boats, and landed a whale. The fourth crew arrived at Cross Island in time to assist with the last stages of the tow. Floating ice was encountered until about 12.5 miles from Cross Island, and was especially thick within 5 or 6 miles of Cross Island. Beyond about 12.5 miles the water was mostly open water. The only whale seen on August 29 was in open water about 18.1 miles NNE of Cross Island. All boats scouted to the NNE of Cross Island, but did not closely coordinate their movements until the initial sighting of the whale. From that point on all boats were involved in the chase and landing of this whale. The whale was struck about 19.7

miles from Cross Island and killed about 18.3 miles from Cross Island. The tow back to Cross Island took about 7.5 hours, primarily due to the delays involved in finding a route back to Cross Island through the floating ice. The tow did not arrive at Cross Island until about 23:00, so the whale was left in the water until the next morning. Several whalers reported smelling, but not seeing, whales within the thicker pack ice about 5 or 6 miles from Cross Island. Several whalers also reported some possible sightings of whale blows in the distance during the day, but were not sure enough of them to report them as sightings. The general consensus was that the floating ice made it difficult to spot whales, and that whaling effort on following days would concentrate on the area of more open water beyond the floating pack ice. Crews reported seeing seals in proximity to the ice, but did not specify sighting locations.

On ***August 30***, no scouting took place, although conditions were generally favorable. The whale landed August 29 was large, and on August 30 all hands were needed for butchering.

On ***August 31***, five crews with 11 boats went scouting for whales, and landed the second whale of the season. Crews left primarily toward the N and NNE of Cross Island, and saw perhaps five whales (and lost track of them) before spotting and landing a different whale. Floating ice was again encountered until about 12 miles from Cross Island, and weather conditions continued to be favorable. The boat that first spotted the whale that was eventually landed also reported seeing three other blows in the distance. Until this whale was spotted about 09:37, no boat had been able to follow a whale for any significant period of time. Once this whale was spotted, eight of the boats coordinated to chase it. One crew (two boats) was independently scouting for other whales NE of Cross Island, and those two boats were joined by a boat from another crew that left Cross Island after the other boats. The crews of these three boats spotted and started chasing a whale independently of the other group. However, once a boat in the larger group struck the whale they were chasing, these three boats broke off their chase and joined the other eight boats. The whale was struck about 13.1 miles from Cross Island and killed about 13.3 miles from Cross Island. The tow took about four hours, again primarily due to the need to find passage through the floating ice pack. The whale arrived at Cross Island about 17:19 and butchering progressed to the point where the carcass was opened before crews quit for the night. A total of perhaps seven to nine different whales were seen during the day, including three or four observed as blows in the distance. All whales observed were seen in open water at distances of 16 to 21 miles from Cross Island, in the northeast quadrant from Cross Island. Seals were also seen in proximity to the ice, but no specific sighting locations were noted.

On ***September 1***, four crews with nine boats scouted for whales, since butchering on the two landed whales was well advanced. Whaling conditions continued to be good and the whalers landed the last two whales of their quota. The first whale was small and winds were expected to increase the next day, so the captains decided to try for another whale that same day. Winds did subsequently increase to a peak on September 5, decreasing on September 6 to levels that allowed the whalers to return to Nuiqsut. One boat experienced mechanical problems on September 1 and returned to the island early in the day, but was repaired and able to assist with the tow on the second whale landed. Floating ice was again encountered, but may not have extended as far from Cross Island (perhaps 6 to 8 miles rather than 12 as on the previous day). A total of seven whale sighting locations were documented, but it is possible (as for August 31)

that more whales were observed than were reported. On the other hand, at least two crews reported seeing floating logs that could easily be mistaken for whales.

On the morning of September 1, all boats left the island between 08:30 and 09:30 and went NNE, towards where they had seen whales before. Whale sightings were reported from about 14 to 21 miles from Cross Island, mostly in open water, with the qualification that there were also whales (especially the smaller ones) nearer the ice edge and perhaps within the floating ice pack. These whales were not enumerated or located more precisely, as this was more a general characterization of the season than a specific statement about this one day. Once the first whale was spotted, shortly before 10:00 about 14 miles NNE of Cross Island, all boats coordinated to chase the whale seen. Even though all boats were in the same general area, more than one whale may have been pursued (by different boats) at the same time. No whale was pursued for very long or seen more than two or three times until a whale was sighted about 12:21, about 21 miles NE of Cross Island. Whalers had reached this location by chasing (and losing) whales earlier in the day, but then coming across this whale. The 12:21 whale may have been spotted earlier, but 12:21 was the time when all boats were informed of its location and changed direction to assist with the chase. This small whale was struck about 12:29.

Once this whale was killed, about 21 miles NE of Cross Island, four boats (from two crews) tied on for the tow and four boats (from three crews) continued to scout for whales, primarily in the area to the south and east of where this whale had been secured. This scouting area was probably also selected (in part) so that these boats could assist with the tow if required. The latter four boats left this area at high speed about 14:20 and traveled to the SSW, towards a whale one of them had sighted about 14.4 miles NE of Cross Island (and 3 to 4 miles SSW of where the boats were at that time). This whale was struck about 14:43 and was secured about 12 miles NNE of Cross Island. The tow for the first whale lasted about 3.5 hours while that for the second was 5 to 6 hours. The tow for the second and larger whale went no faster than 4 mph while that of the smaller whale could go 7 to 8 mph at times.

All crews spent ***September 2-5*** butchering and packing. Wind speed started to increase September 2. and reached a peak of 30 mph on September 5. It is likely that, if the fourth whale had not been landed on September 1, no further scouting would have taken place until September 6. Most packing had been completed by the end of September 5, and demobilization was scheduled for September 6. One crew that had not landed a whale left Cross Island on September 5. The other five crews left Cross Island on September 6.

Data from the project's weather station at Cross Island provided information on the weather conditions from when it began to receive wind speed readings from 9:18 pm on August 28 through 4:49 pm on September 5. During this period, crews went out scouting for whales on 3 days, as described above. Wind speed trends recorded at Cross Island corresponded well with those recorded at Prudhoe Bay for this period (Figure A10), although magnitudes tended to peak higher at Deadhorse than at Cross Island. That is, although the magnitudes may have varied between the two locations, the overall patterns were the same — winds increased and decreased at the same times. It is clear that whalers go out scouting when wind speeds tend to be lower (5 mph or so) and that the exceptions are primarily due to increases in wind speed when the whalers are already out on the water (uncommon for the 2010 season, and mainly on September 1). Whales also tend to be struck when wind speed is lower.

At least one crew was on Cross Island for parts of August 28 through September 6, a total of 10 days. The only period of high winds when conditions were not suitable for scouting for whales occurred after the quota had been completed, September 2-5. During this period the whalers completed the butchering of the whales landed August 29, August 31, and September 1. Thus, no days were lost to poor weather. Two days were devoted to travel or other chores. Scouting occurred on 3 days. One crew left Cross Island for Nuiqsut on September 5, and the rest on September 6, as soon after completing butchering as they could. The season lasted 10 days total (the shortest documented for the project), with 3 scouting days, 5 butchering days, and 2 days for travel. The average length of trip and average duration of trip measures for 2010 were the highest for the 12 documented years, but primarily because there was no poor weather to shorten trips, and whales were landed on all three scouting days, so that most trips included the tow time. The average "furthest point from Cross Island" and the average "strike distance" were also at the higher end of the range for the 12 years, probably related to the band of floating ice encountered to about 12 miles from Cross Island. Most whales were encountered in the open water beyond the floating ice, and the ice also made towing whales more challenging.

2011. Figure A11 summarizes daily boat activities for the 2011 Cross Island whaling season graphically with basic weather conditions (wind speed, barometric pressure). Five crews whaled from Cross Island in 2011. All had whaled at Cross Island previously. No crew whaled with only one boat, a large change from past years. Four crews whaled with two boats, and one crew whaled with three boats. One of the "2-boat" crews also used a third boat for logistical support. As in previous years, the start of the Cross Island whaling season depended primarily on weather conditions, reports of whale sightings near Cross Island, and the readiness of the whaling boats. The whalers state that they prefer to start the season early rather than late because of recent experiences with poorer weather late in September, and 2011was typical for the 12 seasons documented for this project.

The first three crews arrived on Cross Island29 August, and all crews left Cross Island September 9. The whalers used only three of their four strike quota, landing three large whales. Data from the project's weather station at Cross Island provided information on the weather conditions from when it began to receive wind speed readings from 12:10 pm on August 30 (8:45 am for some readings) through 12:20 am on September 9. During this period, crews went out scouting for whales on 5 days, as described above. Wind speed trends recorded at Cross Island corresponded well with those recorded at Prudhoe Bay for this period in terms of trends (peak and minimum wind speed), but for some periods, and especially after September 5, Deadhorse win speeds tended to be significantly higher than those at Cross Island (Figure A11).That is, although the magnitudes may have varied between the two locations, the overall patterns were the same — winds increased and decreased at the same times. It is clear that whalers go out scouting when wind speeds tend to be lower (5 mph or so) and that the exceptions are primarily due to increases in wind speed when the whalers are already out on the water (uncommon for the 2011 season, and probably most significant on August 31 and September 4. Whales also tend to be struck when wind speed is lower.

Sighting conditions were very difficult, due to large swells or standing waves, and the whalers saw relatively few whales, and those they saw were primarily large whales. They were of the opinion that there were whales of all sizes present, but that the conditions essentially masked the

smaller whales – they were more difficult to see amid the large swells from the small whaling boats. The larger whales took longer to surface and dive, and had larger blows, and so could be seen (and followed) more easily. Because of the relatively few whales seen, the whalers tried to approach and strike any whale that was not clearly too large, and so were able to land three large whales in a short period of time. These whales were so large, averaging over 50 feet in length, that the whalers chose not to use their fourth strike.

At least one crew was on Cross Island for parts of August 29 through September 9, a total of 12 days. The only period of high winds when conditions were not suitable for scouting for whales was on September 6, after the whalers had closed their season by landing three large whales. During this period the whalers continued butchering of the whales landed September 2 and September 5. Thus, no days were lost to poor weather. Two days were devoted to travel or other chores. Scouting occurred on five days. All crews left Cross Island for Nuiqsut on September 9. The season lasted 12 days total (the second shortest for the project), with 1 preparation day on Cross Island before going scouting, 5 scouting days, 4 butchering days, and 2 days for travel. In addition, two crews had an extra travel day, as they required two days to travel from Nuiqsut to Cross Island. They had to overnight in Deadhorse due to high sea conditions between West Dock and Cross Island. (A third crew required three days to reach Cross Island, but left Nuiqsut the same day as the first crews and so fell within the total 12-day season.)

2012. Weather conditions, time spent out boating (which includes all time spent out on the water from the first boat leaving Cross Island until the last boat returning), and times and dates of strikes for the 2012 Cross Island whaling season are graphically summarized in Figure A12. At the Nuiqsut Whaling Captains Association (NWCA) meeting prior to the 2012 whaling season (August 21), the "open fire" date for the whaling season was set at September 1 and all crews stated that they hoped to travel to Cross Island no later than Labor Day (September 3 and probably no sooner than August 30. As it turned out, one crew left for Cross Island on August 30 and three others on September 1. The fifth crew left for Cross Island on September 2. The sixth (and final) crew left Nuiqsut for Cross Island on September 5. All crews reached Cross Island the same day they left Nuiqsut, which is the typical case but in contrast to the 2011 season when weather required several crews to overnight at West Dock.

The 2012 Cross Island whaling season extended over 16 days (August 30-September 14), with an "open fire" period of 12 days (September 1-12). Scouting occurred on eight days. Two days were devoted to travel, one day to butchering (butchering also took place on some weather and scouting days), and four days were "lost" to weather. One day was spent in preparing for the season while on Cross Island. In principle, the crew that arrived at Cross Island on August 30 could have gone scouting on August 31. That would have been consistent with past Cross Island practice in which crews generally go out scouting as soon as they can after arriving at the island. Conditions on August 31 appear to have been favorable for scouting, but this crew stayed on Cross Island. Whether this was due to the "open fire" date of September 1 or the need to set up and check the equipment needed for the season (e.g., unload gear, set up the cabin, load bombs, check the generator and winch) is uncertain.

The first crew at Cross Island did go scouting, with two boats, on September 1 and saw two whales. Conditions were quite poor for scouting. They had seen a whale from the island the day before, to the north, and they went towards that location on September 1to look, but it was too

choppy to go very far north. One member of the crew saw a whale to the south, so they headed that way. This whale was not seen again, and it was just as choppy to the south, so they returned to the island. On September 2, although four crews were by then on the island, only two crews went out scouting, with only two boats – their two biggest boats. The other two crews deemed conditions too rough to go out. No whales were seen and the trips were of short duration and close to Cross Island. If they had seen whales, the other crews might have joined them.

Weather prevented any scouting on September 3-4. Five crews (ten boats) scouted on September 5 and most boat crews saw signs of whales, and perhaps six whales were seen long enough to chase. One whale was struck and landed. Conditions were still fairly rough, with waves and swells estimated at 6 feet (1.8 m) in the morning, calming to about 4 feet in the afternoon. The wind speed diminished greatly in the afternoon. At least one crew had equipment failure (broken harpoon) due to the conditions. Four crews (six boats) scouted for whales on September 6 and reported eight whale sightings, as well as numerous more distant blows, but were not able to chase whales. Conditions deteriorated as the day went on, with the wind increasing greatly. The fact that a whale had been landed the day before may have prompted the whalers to return to the island to help butcher, once it became clear that no one would make a quick strike. Weather prevented any scouting on September 7-8.

Six crews (nine boats) scouted on September 9, going out in marginal conditions, although winds were diminishing. Crews went scouting only after Sunday services (the longest and best attended service in recent memory) and only after conditions had improved enough, at least in the perception of one crew, to warrant going to look for whales. Once the first crew went out scouting, the others soon followed. They went to where they had seen whales on previous days. Six whale sightings were reported, mostly in the area north of Narwhal Island, but no large number of blows. Two crews had equipment failures related to the rough conditions. Scouting conditions were much better on September 10, and six crews (11 boats) scouted for whales. Seven whale sightings were reported, as well as numerous more distant blows, and two whales were struck and landed. The whalers made a conscious decision to try for a second whale once the first was landed, since conditions before September 10 had been so marginal for whaling, and future conditions were uncertain. On September 11, scouting conditions had indeed worsened, with increasing winds and sea state. Four crews (six boats) scouted on September 11, in marginal conditions, and reported seeing about 11 whales, but were not able to make any strikes. Also, because two whales had been landed the day before, some boats returned to Cross Island in the early afternoon to help with butchering. Four boats stayed out until the evening, however. It is possible that some of the reported sightings on September 11 were "false positives".

On September 12, conditions had greatly improved and four crews (seven boats) scouted for whales. Only six to eight specific whale sightings were reported, but all boats saw many whales, and there were many admonitions from senior whalers to concentrate and focus on following one whale, rather than to be distracted by the whale that just came up, even if the latest sighting were closer. The fourth whale, completing the Nuiqsut quota, was struck and landed early in the morning. The captains reached a consensus not to seek a fifth strike, and a "cease fire" for Cross Island whaling was declared. Butchering of this whale was well advanced by the end of the day, and four crews left Cross Island for Nuiqsut on September 13 The crew that landed the last

whale and a crew that had landed two whales stayed another day and left on September 14. All crews made the return trip in one day.

Whales were seen on all but one scouting day, and on all days when scouting conditions were better than "poor" or "marginal". The whalers did not report encountering ice. Sighting conditions were similar to those of 2011, although not as extreme. Waves and swells made it difficult to see whales on most days. Although blows could be seen, finding and following these whales was often difficult. Many blows were too far away and conditions too rough for them to be pursued. As in 2011, floating logs were easily mistaken for whales, and certain wave conditions also were mistaken for whale sightings. Those whales seen were, in general, relatively close to Cross Island (within 10 mi), with a few to 20 mi. The four strikes were made an average of 10.2 miles ESE (100º) of Cross Island.

More missed strikes (the darting gun and harpoon not hitting the whale) were reported during the 2012 season than in any previous season. The whalers attributed this to a combination of the rough conditions and the relative inexperience of some harpooners (many crews had "rookie" or inexperienced harpooners). More harpoons were broken in 2012 than in any previous year as well. In all cases they were broken due to sudden movements of the boat due to rough sea conditions that caused the harpoon to bang sharply against the boat when the harpooner could not keep it steady. This was again attributed to a combination of rough conditions and inexperience.

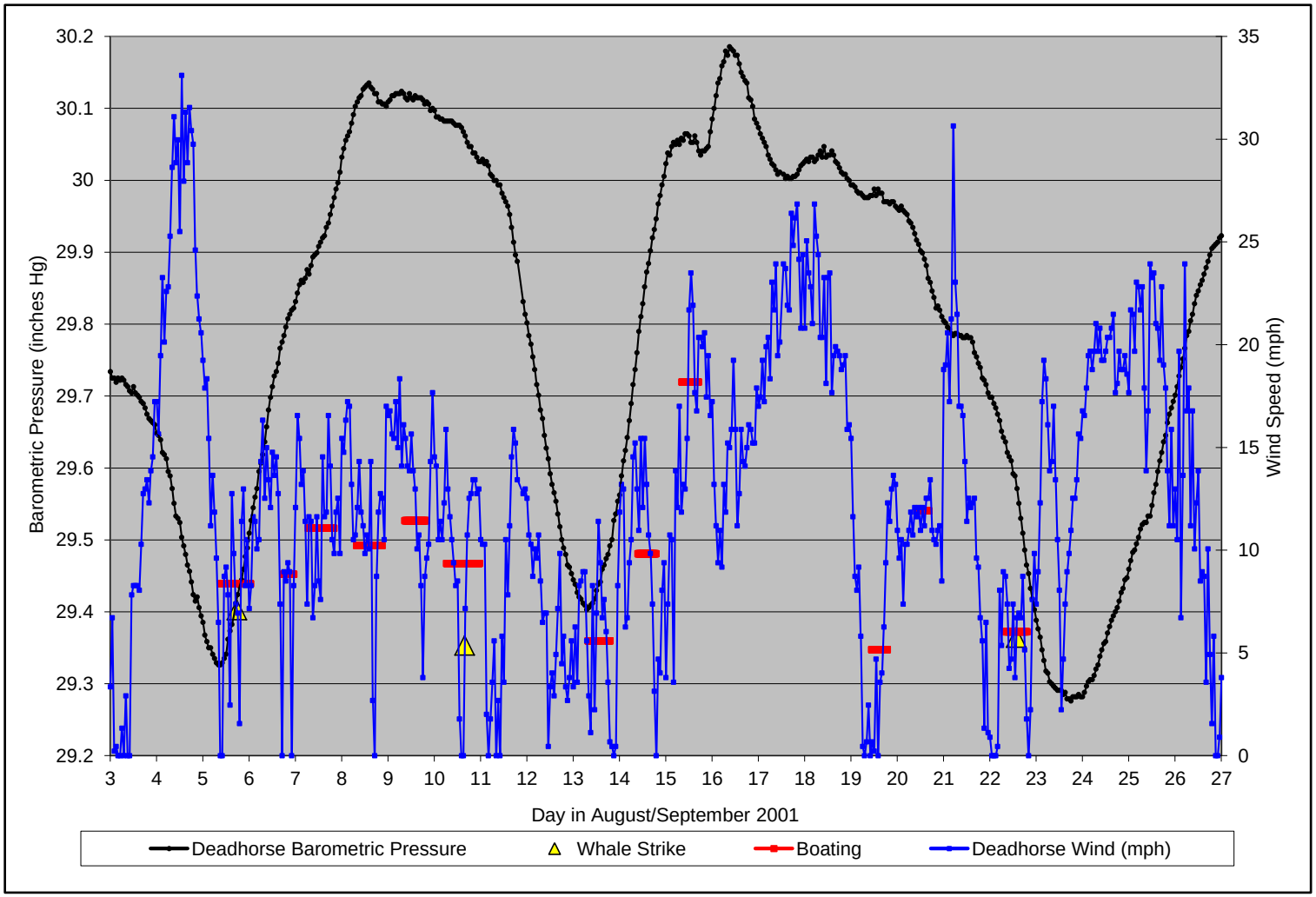

Figure A1. Graphical summary of the 2001 Cross Island subsistence whaling season

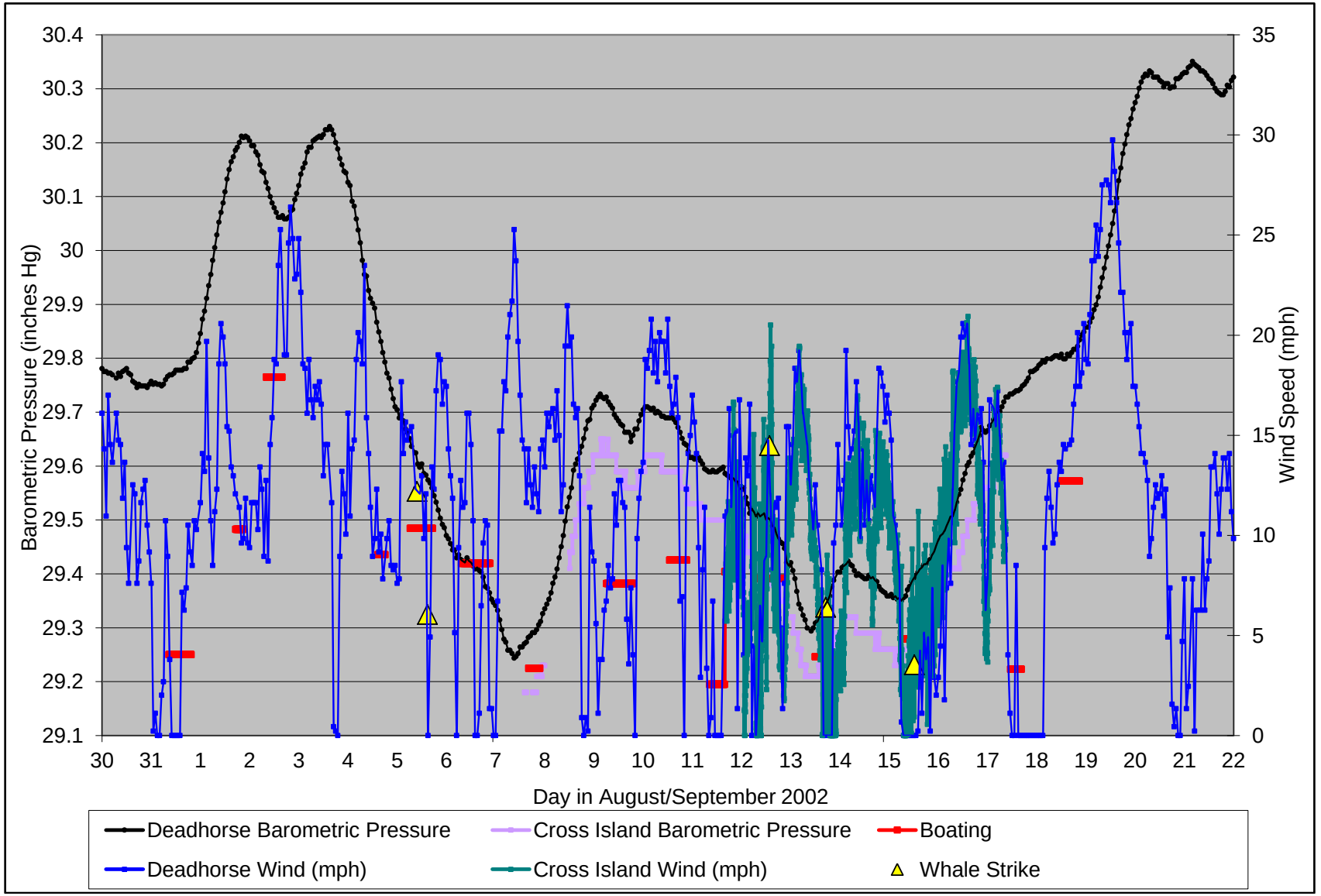

Figure A2. Graphical summary of the 2002 Cross Island subsistence whaling season

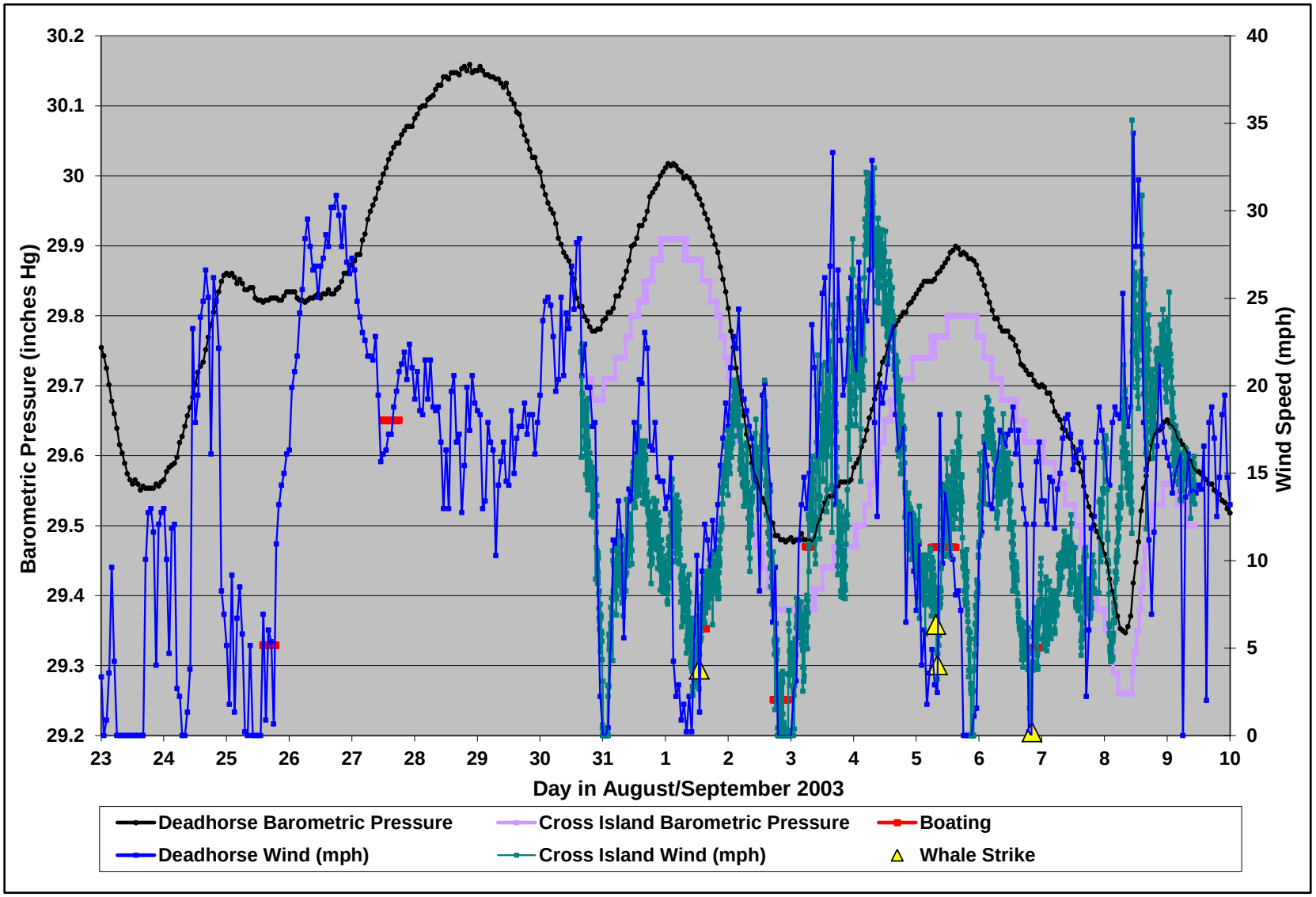

Figure A3. Graphical summary of the 2003 Cross Island subsistence whaling season

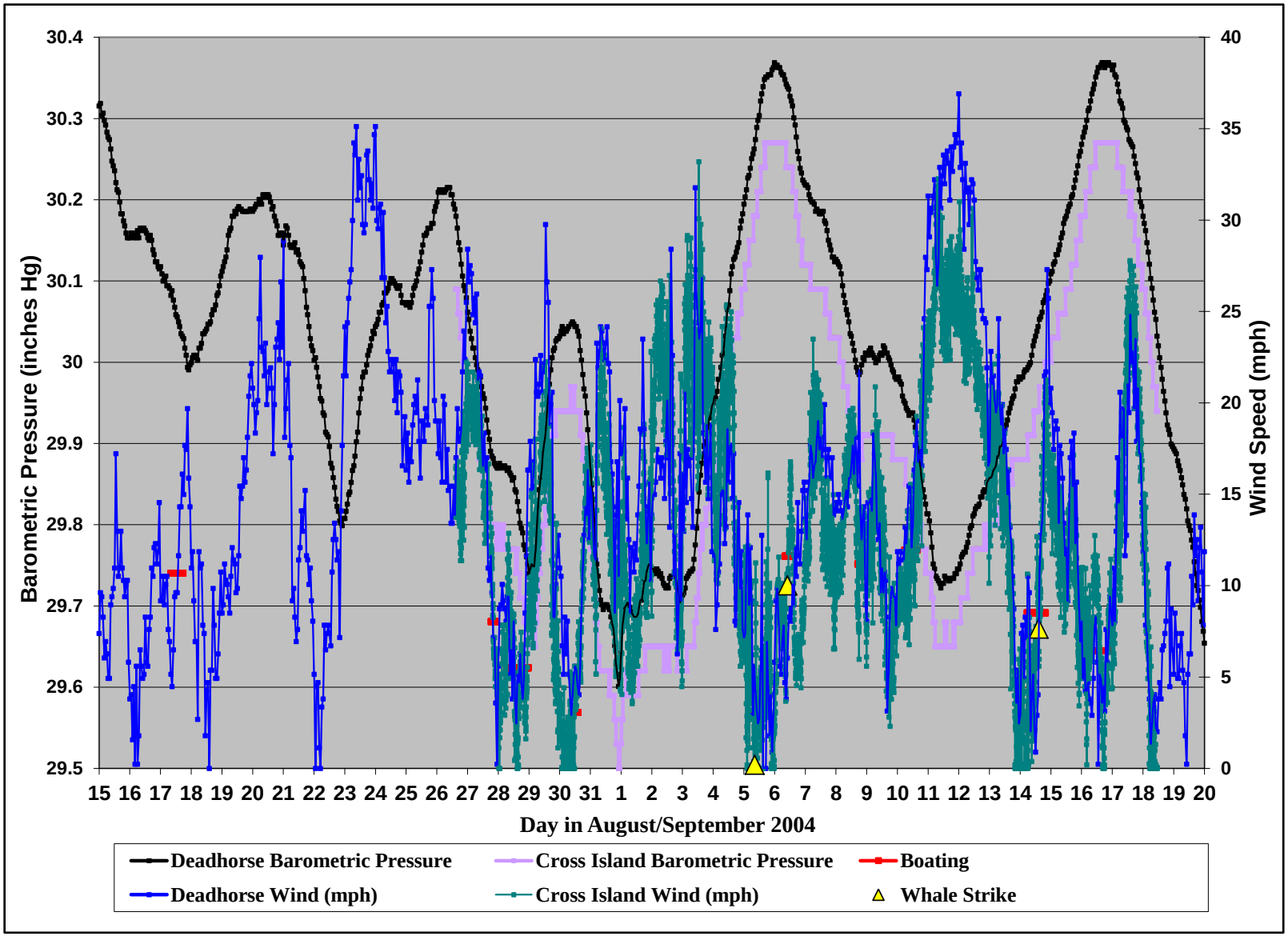

Figure A4. Graphical summary of the 2004 Cross Island subsistence whaling season

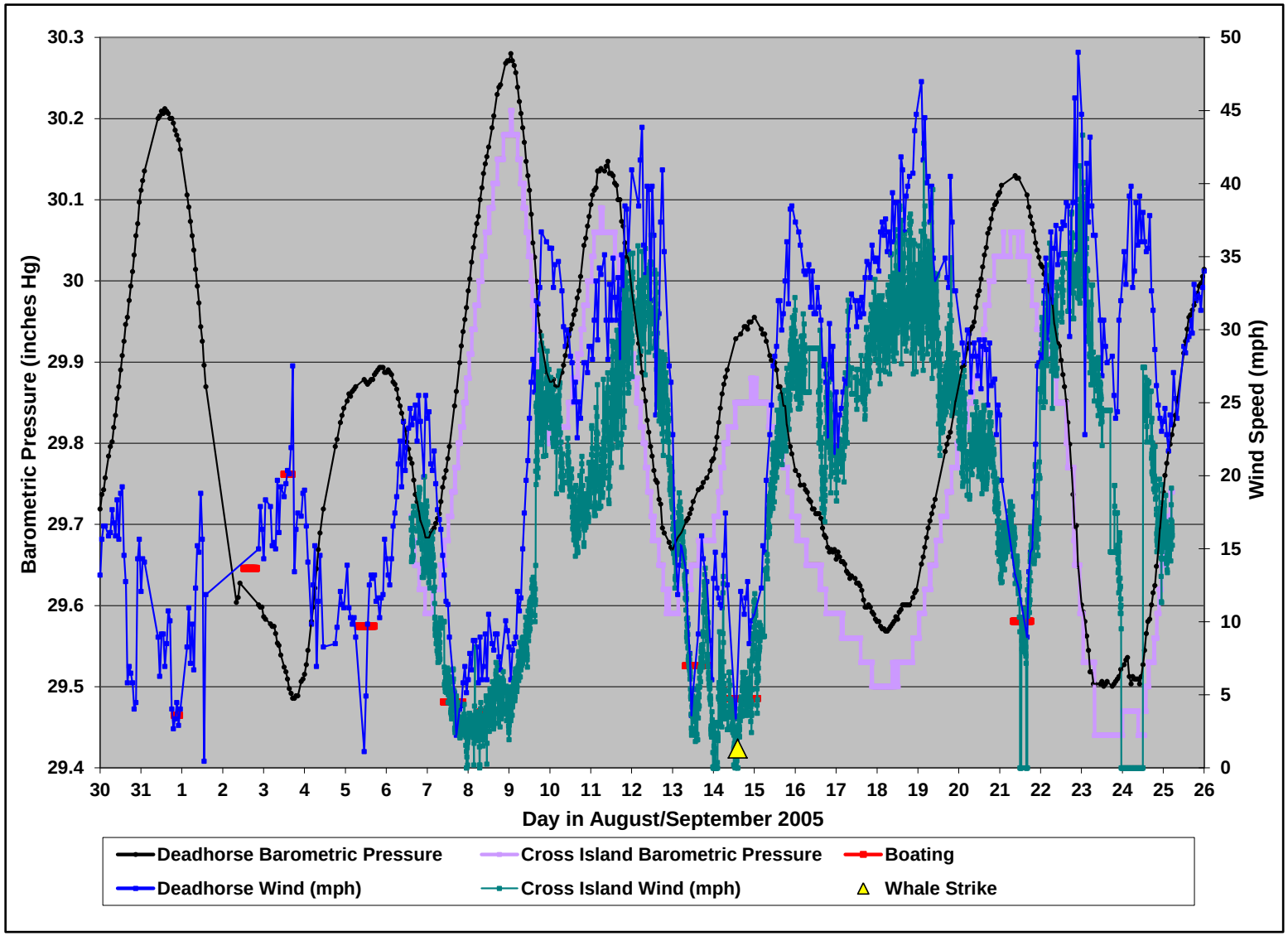

Figure A5. Graphical summary of the 2005 Cross Island subsistence whaling season

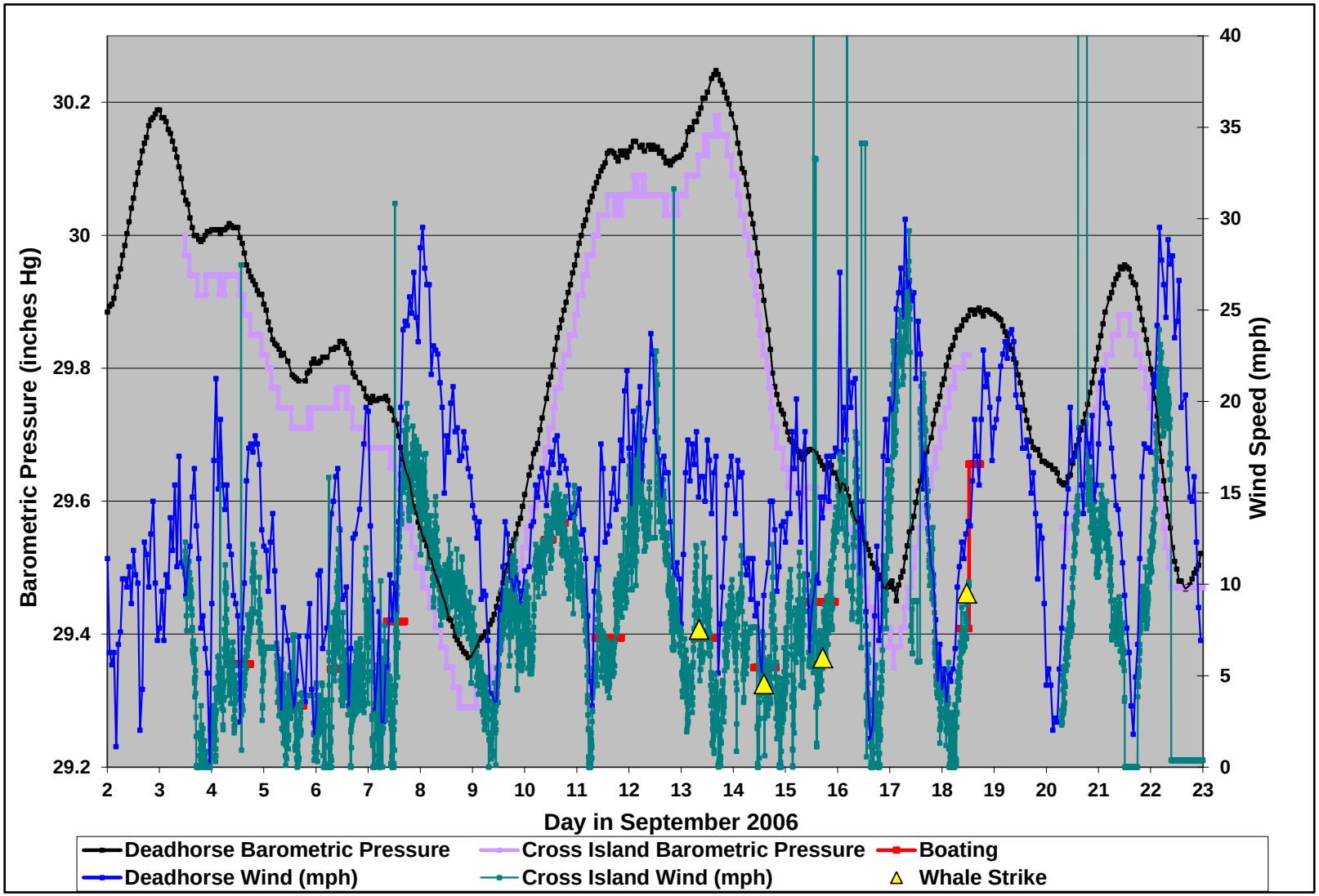

Figure A6. Graphical summary of the 2006 Cross Island subsistence whaling season

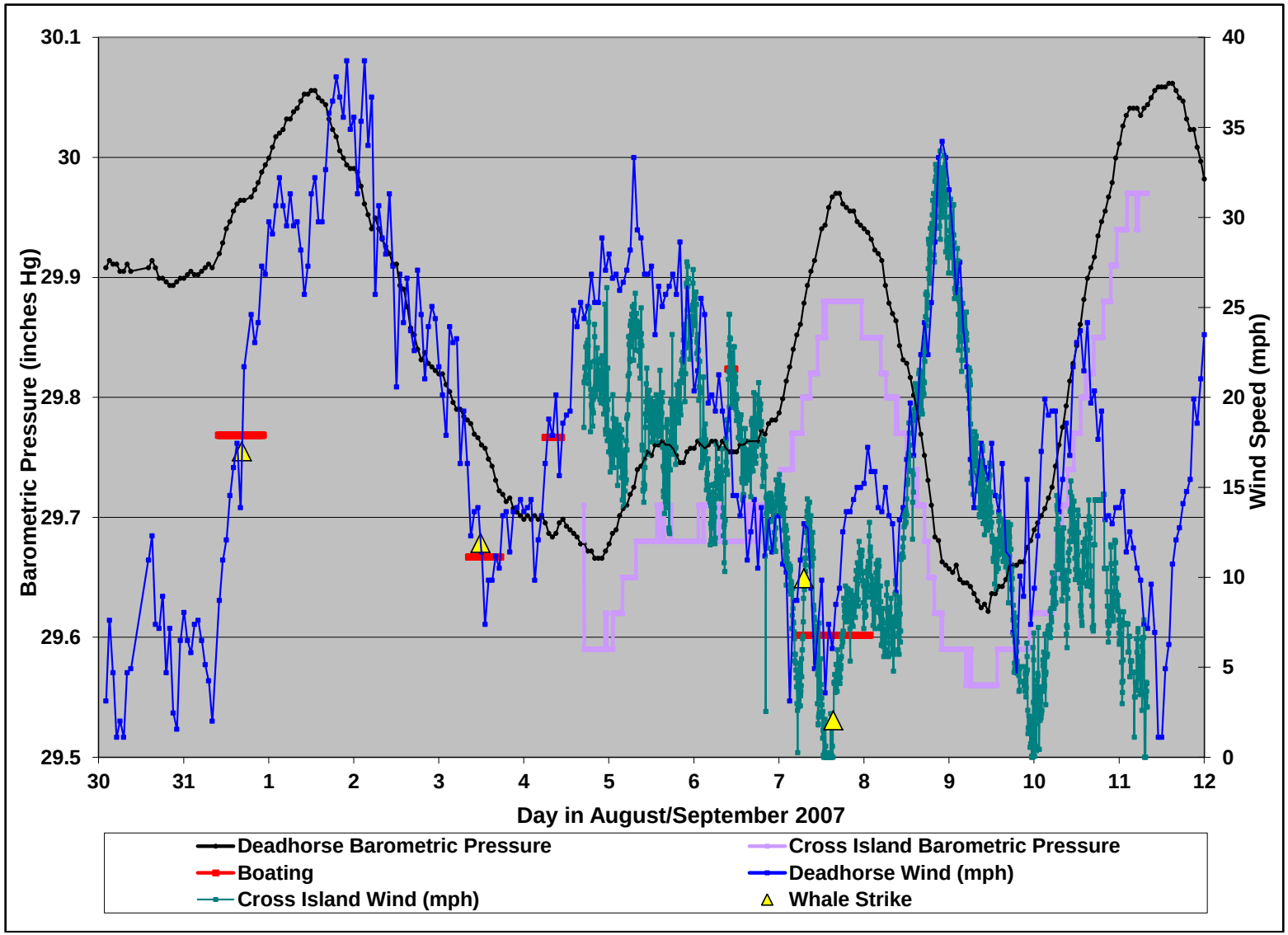

Figure A7. Graphical summary of the 2007 Cross Island subsistence whaling season

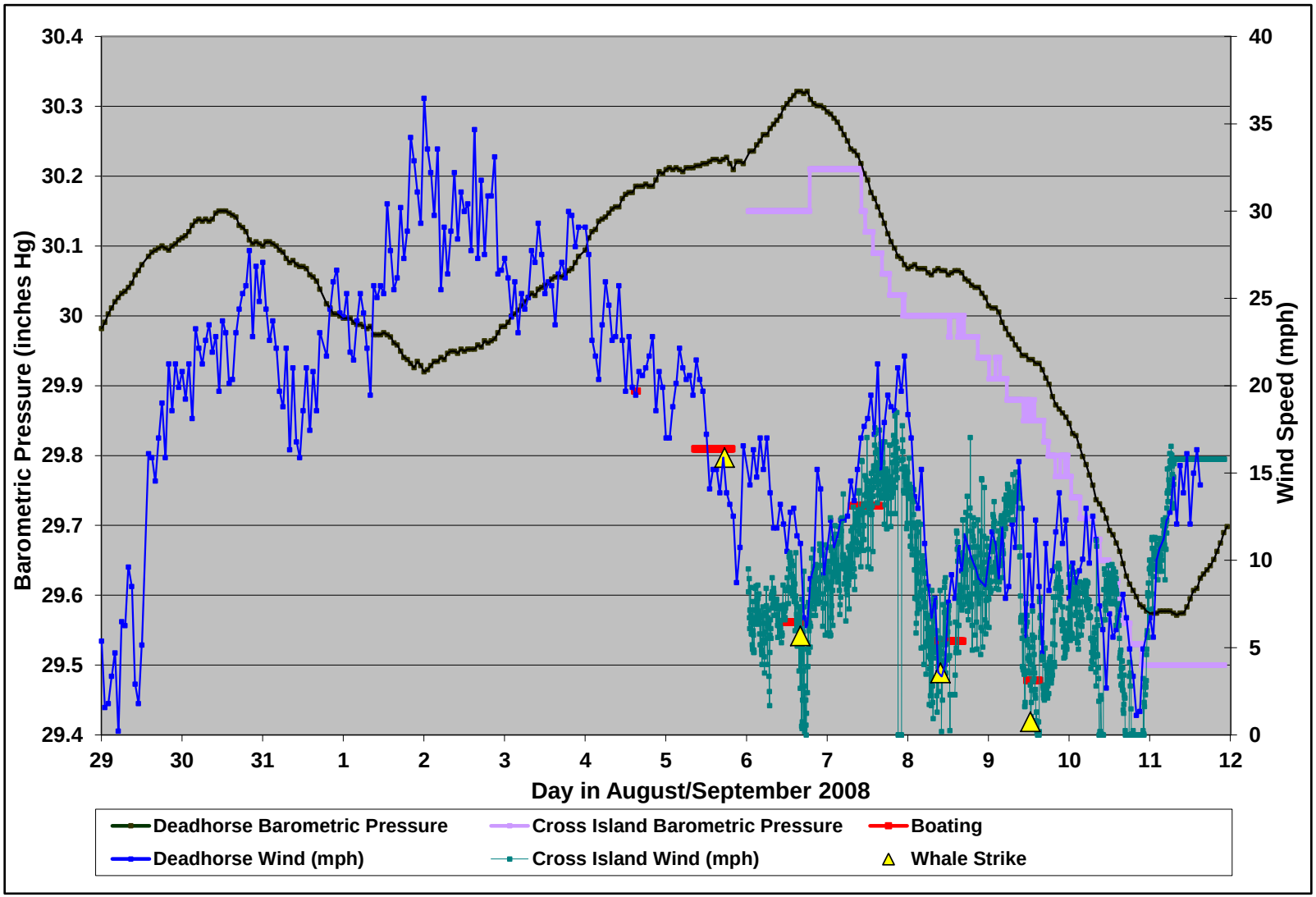

Figure A8. Graphical summary of the 2008 Cross Island subsistence whaling season

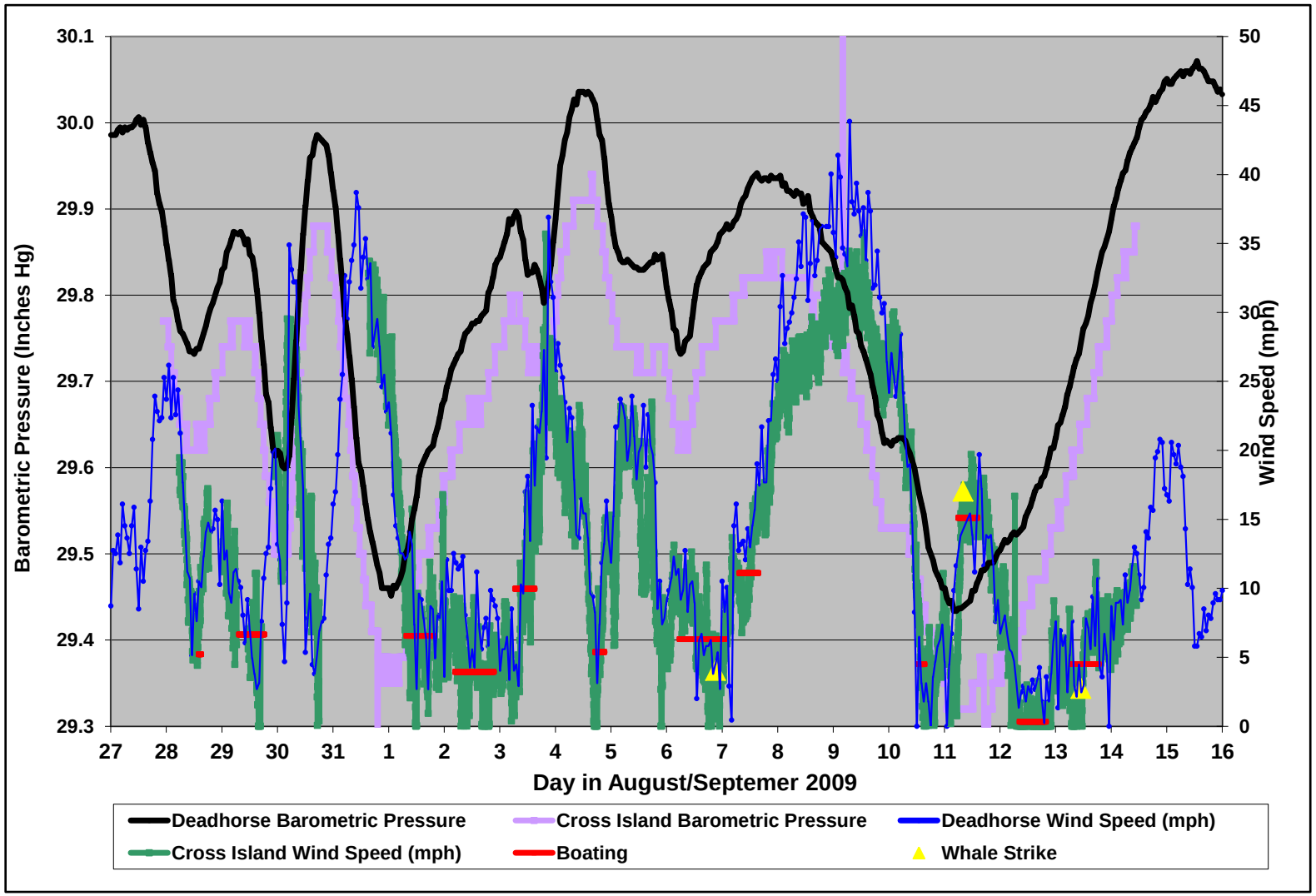

Figure A9. Graphical summary of the 2009 Cross Island subsistence whaling season

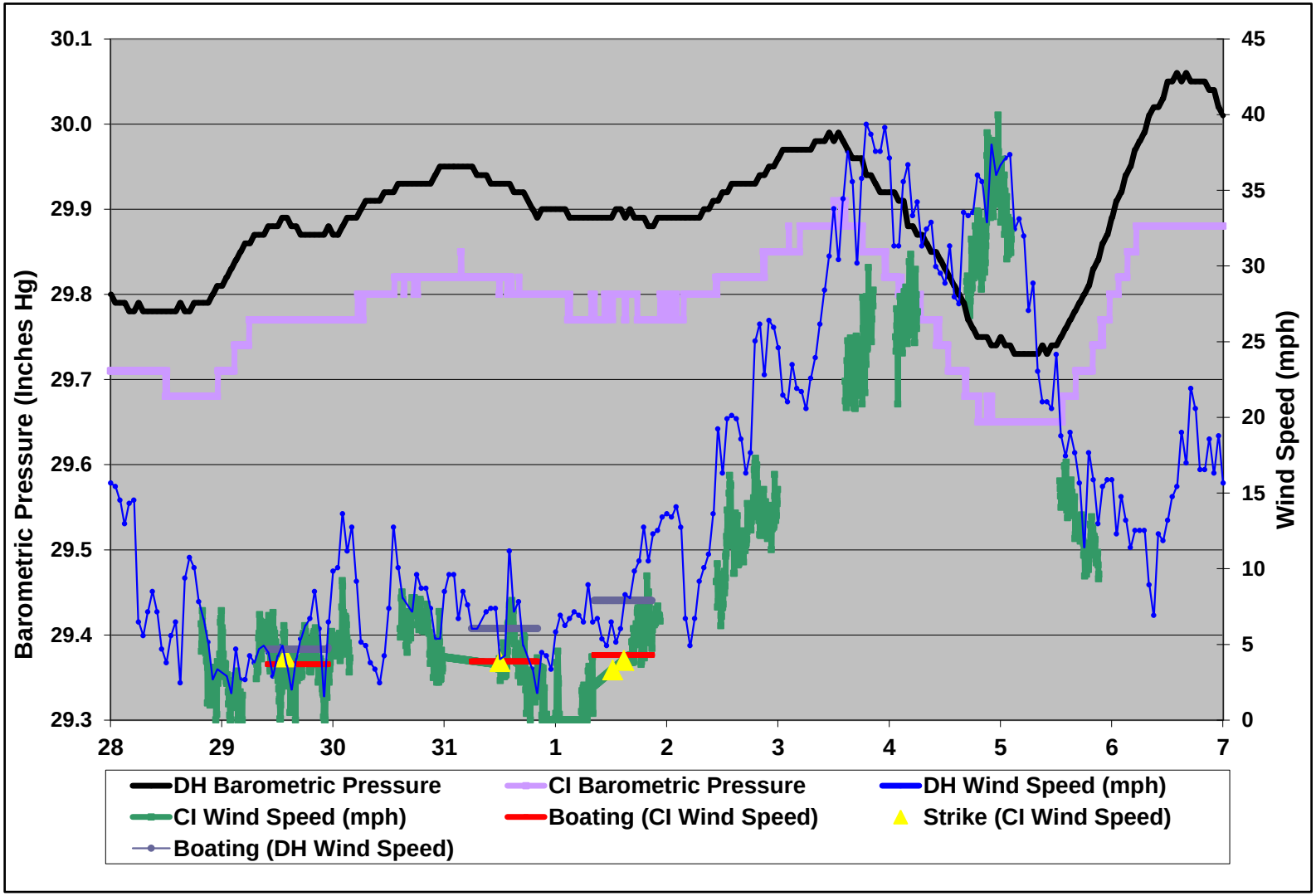

Figure A10. Graphical summary of the 2010 Cross Island subsistence whaling season

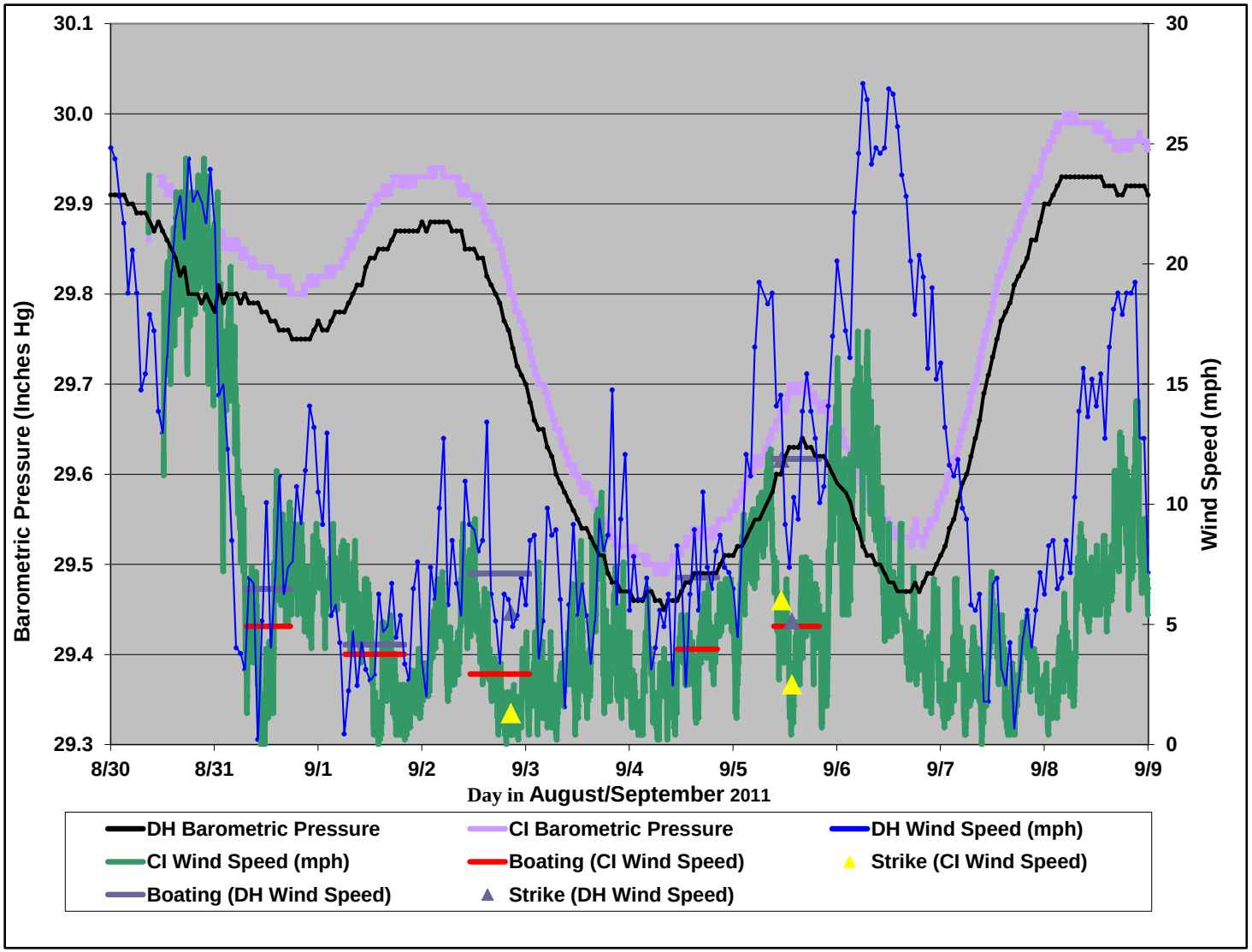

Figure A11. Graphical summary of the 2011 Cross Island subsistence whaling season

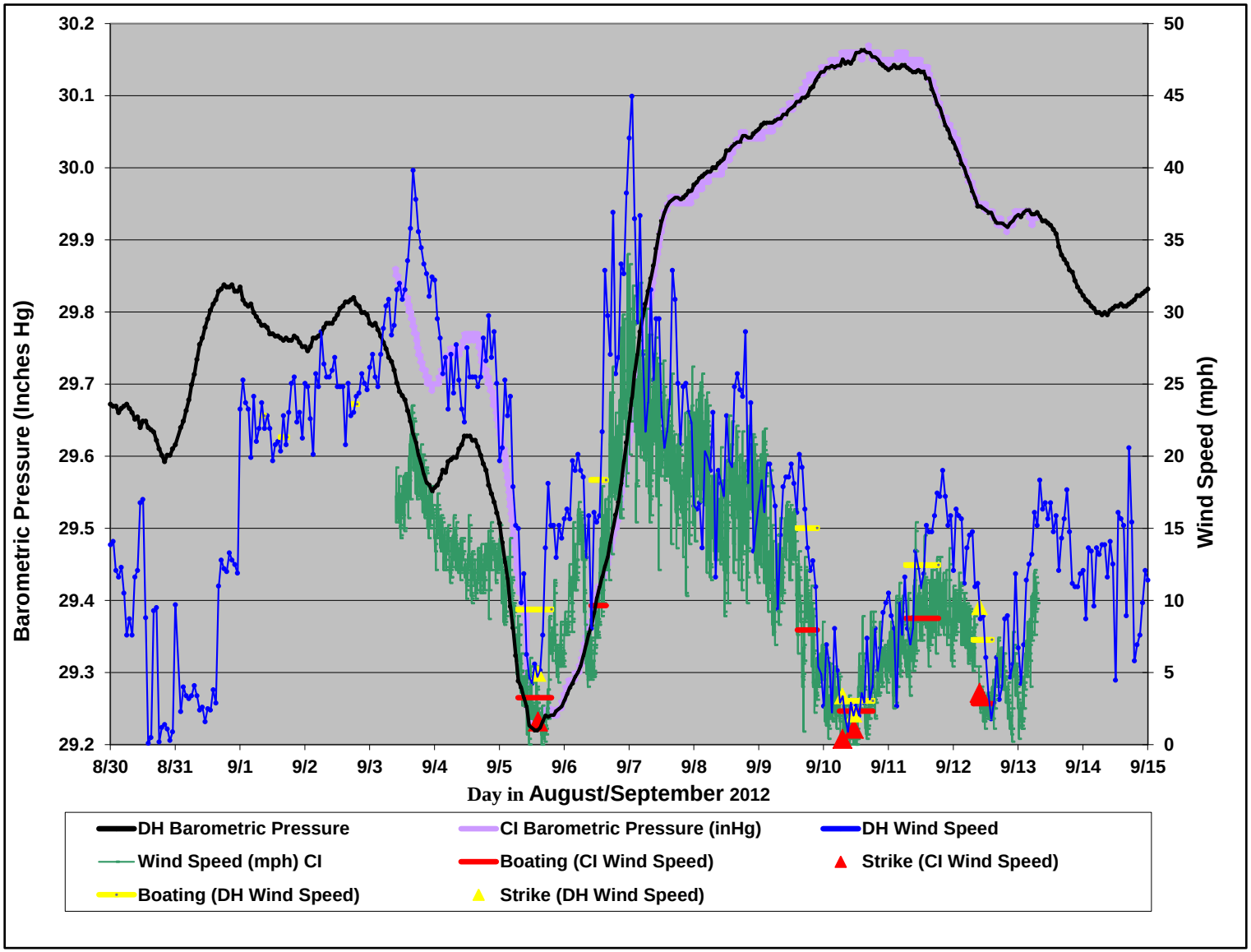

Figure A12. Graphical summary of the 2012 Cross Island subsistence whaling season

APPENDIX B
MONITORING INDICATOR MATRIX FOR DECISION MAKING

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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. BOEM requires that this matrix be reproduced in the final report for each task of the ANIMIDA and cANIMIDA projects. A short discussion of this matrix is useful for the Cross Island Subsistence Whaling Documentation and Monitoring task, since it continued as the central guide for data collection for the stand-alone Cross Island project after the termination of the cANIMIDA project. The central or key hypotheses were not testable from the data collected, since only data related to variability in Cross Island subsistence whaling was collected, and systematic information on non-whaling factors potentially affecting Cross Island subsistence whaling is not currently available (oil and gas activity information is for the most part confidential, and vessel traffic information has not been collected and compiled in any systematic way.

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 (2001-2012). 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 whalers attributed the lack of effects primarily to Northstar being located 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 – although this could be a possible impact in years when access to the area Northeast of Cross Island is restricted by ice or other conditions.

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 2001-2012. Another important factor is the 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 crews over the seven years discussed in this report, it became clear that most crews and captains displayed the same characteristics from one year to another, and that they sometimes differed markedly in these 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 2001-2012, 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.

Table B1. 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 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 changed by offshore oil developments at Northstar and/or Liberty. H2: General subsistence activities on and near Cross Island are not significantly changed by oil and gas activities associated with Northstar and/or Liberty.	Systematic retrospective (2000, prior years as possible) and observational/interview data collection (2001-2012) on: (a) number of whales taken, (b) GPS location of whale strikes (direction and distance from Cross Island), (c) number of crews, composition of crews, total number of crew, (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 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.

Table B2. 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 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 changed by offshore oil developments at Northstar and/or Liberty. H2: General subsistence activities on and near Cross Island are not significantly 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 (2001-2012) on: (a) number of whales taken, (b) GPS location of whale strikes (direction and distance from Cross Island), (c) number of crews, composition of crews, total number of crew, (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 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.

APPENDIX C
FIELD MANUAL

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OBJECTIVES AND INTRODUCTION

The Bureau of Ocean Energy management (BOEM) has funded the several phases of the Cross Island Documentation Project for one primary purpose – the collection of information to examine whether oil and gas activities have affected or are affecting whaling or other subsistence activities on or near Cross Island. This requires the documentation of whaling and other subsistence activities in terms of measures for which change over time can be demonstrated (or not), and for which correlation with hypothesized associated factors (for example, oil and gas activities, other human non-subsistence activities, weather, ice conditions) can be tested. This approach has been summarized on the "Monitoring Indicator Matrix for Decision Making" submitted with proposals for the early phases of this project (Appendix B of this report). This manual in essence shows how to collect the information (measures) related to subsistence whaling as conducted from Cross Island necessary to examine this question. These measures fall into two main categories – behavioral aspects of Cross Island whaling and the physical conditions under which that whaling takes place (both to be explicated below). The collection of measures of oil and gas activities, commercial and recreational vessel traffic, or other human non-subsistence activities will not be described in this manual, as collection of this information was excluded from the BOEM project because of financial constraints and confidentiality concerns.

An important accompanying (although not fully explicit or as yet not achieved) goal is to fully engage the participation of Nuiqsut whalers in all aspects of the research, with the ultimate result that local Nuiqsut residents become responsible for most or all of the aspects of this monitoring task. To this end, the development of a set of relatively simple, explicit, and transparent methods for data collection and processing is required. This manual is intended to enable the whalers (or some other interested party) to continue the collection of these data.

FRAMEWORK OF THE SCIENTIFIC APPROACH

The observations to be made and information to be reported (see below) are all intended to help address the fundamental issue to be tested, whether Northstar (and Liberty and/or additional units) development and production have any effect upon the whaling activities of the residents of Nuiqsut. The overall scientific approach must be quite straightforward and simple, given the financial constraints and the potential logistical complications of the project, as well as the desire for local participants to eventually assume responsibility for collection of the information for the project. The scope of work for the original project required an explicit discussion of how the results can be used to detect changes or impacts from oil development on subsistence whaling and other subsistence activities, with specific hypotheses that can be tested from these results. For purposes of this proposal and later analysis, hypotheses for potential testing will be stated in the "null hypothesis" format. Although this format has proven to be confusing to the local participants in the project, it is retained used here to remind proposal evaluators that the variables proposed for the examination of the change in subsistence activities over time must be measurable and related to specific, testable, hypotheses. Public presentations of

ANIMIDA/cANIMIDA results have been less scientifically rigid in the discussion of testable hypotheses in the interest of better communication with the general public.

The overall general monitoring hypotheses is that there is no year-to-year variability in Cross Island whaling activity. Study results clearly demonstrate that this hypothesis is false, so the question moves to explaining the causes of this variability. Weather (especially wind speed) and ice conditions have been shown to be significant factors, and commercial vessel traffic is at least implicated as a possible factor. Testing whether oil and gas exploration and production affects Cross Island whaling has proven more difficult. Little data collected for 2001-2012 can be applied to disprove the null hypothesis. The only oil production near Cross Island during the period of the ANIMIDA/cANIMIDA projects was Northstar (and of course the Prudhoe Bay onshore complex). While there may be a slight deflection of the overall whale migration by Northstar-related activities (Richardson 2006) and Nuiqsut whalers prefer to avoid whaling in the area of Northstar, there have been no extraordinary whaler-industry interactions during the period of data collection. That is, for 2001-2012, oil and gas activities have had little or no direct significance for Cross Island whaling (but may have in earlier years). The existence of the Conflict Avoidance Agreement (CAA) on some level works against disproving the null hypothesis, as it seeks to prevent extraordinary and disruptive whaler-industry interactions, and for the most part has done so. The CAA also provides logistic support for Cross Island subsistence whaling as mitigation measures for the potential adverse effects of oil and gas activities. Monitoring Cross Island whaling in the presence of the CAA is still justified for a number of reasons. First, the lack of data to disprove the null hypothesis (a "negative" result) can be considered a desirable and worthwhile result. Iñupiat whalers are very distrustful of offshore oil activity, and are fully aware that one cannot prove a negative, and would probably regard the suspension of monitoring with extreme suspicion. Second, should an extraordinary and disruptive whaler-industry interaction occur (an oil spill, for instance, or vessel interference), careful documentation of the incident should prove valuable to all concerned. For long-term monitoring to continue, the transfer of at least data collection responsibilities to local entities would be appropriate and perhaps more efficient in terms of budget than the 201-2012 BOEM project.

Measures of two sorts of variables are required to test such the hypothesis that oil and gas activities do not affect Cross Island whaling. The first are measures to demonstrate change (or no change) in the behavior or the success of Nuiqsut whalers. These measures, describing current Cross Island whaling and changes in that activity through time, define the focus of this effort. The second class of variables consists of measures of oil and gas activities at Northstar, as well as measures of other human activities potentially affecting Cross Island whaling. This second class of measures is not part of this research effort. Thus, additional effort to compile and/or collect information on the second sort of variable will be required to actually test such hypotheses. That is, this effort will collect information that demonstrates whether changes or variation in Cross Island whaling have occurred. It is not likely to be able to correlate any such changes with other factors such as oil and gas activities; other than for extraordinary and disruptive whaler-industry interactions actually documented by the research itself.

Be that as it may, more specific hypotheses incorporating measurable variables useful for describing potential change in Cross Island whaling are required to guide the collection of useful information for this project. These specific hypotheses in essence define the measures and observations of primary interest, for which methods of systematic collection and recording must then be developed so that local participants can eventually assume responsibility for the project. Examples of such hypotheses to be carried forward:

- The number of whales taken by whalers each season near Cross Island will not vary over time;
- The distance from Cross Island where whalers strike whales will not vary over time;
- The distance traveled per day per boat actively scouting for whales near Cross Island will not vary from year-to-year;
- The number of whales seen by Nuiqsut whalers while scouting will not change over time;
- The number of boats whaling on Cross Island will not change over time;
- The number of people whaling from Cross Island will not change from over time;
- The average number of people crewing a whaling boat will not change over time;
- The number of days per season that boats actively scout for whales will not change over time;
- Catch per Unit Effort (CPUE) will not change from season to season.
- The number of whales struck-and-lost (not landed) will not change over time;
- The number of bombs required to kill a whale will not change over time.

Other hypotheses can of course be developed as the research progresses and data accumulates.

GENERAL DISCUSSION OF METHODS

Methods for data collection are discussed in this section, but are relatively straightforward, and implement the analytical framework discussed above, and have been described in all past project reports. The development of local expertise is much more complicated, and has also been discussed in those reports. The discussion below summarizes methods, with some slight differences from the earlier years of the project.

Data Collection Overview

Observational data on the variables of interest were initially systematically recorded on the Daily Boat Report Form (DBRF – example Table C1) developed for the first phase of the project, with one form for each boat being used for whaling. This form combined both general information, common to all boats for that day (weather, ice conditions, sea state – although different boats could encounter somewhat different conditions) as well as the measures related to each boat's specific activities for that day. It became evident that the duplication between the forms for each boat (especially for the multiple boats of the same crew) made this unwieldy. In most cases the information has been collected in field notes during post-whaling trip interviews while downloading and reviewing GPS tracks, and only later transferred to the DBRFS. That is, little information has been recorded directly onto the DBRFs. It has generally been easier for the field

Table C1. Example Daily Boat Report Form (old version)

Cross Island Whaling 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 “l” 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)	
percent Ice Coverage:	0	Ice Type:		Other Notes:	Wind for most/all whaling <5 mph
Wave Height:	small	Other notes on sea conditions:		“calm” with 4-foot rollers (swells)	

Other pertinent notes:	The best day for scouting for whales of the season, worse conditions predicted for the next day. This was the main reason the captains decided to try to land two whales (and did). Wind shifted around the compass.

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?

researcher to record observations and whaler reports in a field notebook, and to later transfer them to the appropriate BRF. In addition, because of the increase in multiple-boat crews on Cross Island and the common practice of the boats from the same crew generally closely cooperating together, the practice of using individual DBRFs for each boat was discontinued in favor of Daily Crew Report Forms (DCRF – essentially the same form with all boats from the same crew on the same form – no longer a one-page form). These forms summarized the activities of all boats from the same crew – but GPS tracks were downloaded from all boats (when available) and interviews with crewmembers from all boats were sought (but not always obtained). Inclusion of the DBRFs, and later the DCRFs, in the annual reports was also discontinued in favor of better summary data forms, generally in Excel spreadsheet form – the Boat Trip Form (BTF), the Weather Data File (WDF), and the Crew Detailed Information File (CDIF) – and a summary daily narrative of whaling activity. Formally, most of this information was also then assembled on a Daily Whaling Activity Form (DWAF – Table C2). All but the CDIF were included in reports to BOEM. Only summary aspects of the CDIF were shared with BOEM, in deference to confidentiality concerns. Information on boats not engaged in whaling activities for a given day was summarized on a separate form for each day (example Table C3).

Great emphasis is placed on quantified measures. One key source of quantified measures are the automatic (but fallible) electronic devices, foremost of which are the Garmin GPS units supplied to each whaling boat. Most Nuiqsut whalers have made a good faith effort to record a track of their travel path while out scouting for whales, and some have also marked significant points such as whale sightings, "blows," strikes, and so on. These points and tracks are the basis for such measures as locations and distances of sightings and strikes, length and duration of daily whale scouting trips, minimum number of whales seen, and the time of day associated with each recorded observation. Tracks and waypoints are downloaded from those boats that go out whaling on a daily basis. Basic local weather conditions (temperature, wind speed, wind direction, relative humidity, barometric pressure) have been collected for most of the past whaling seasons on Cross Island documented by this project with a weather station and an automatic data logger. The data logger must be downloaded at least every three days. Whaler observations of the weather, ice conditions, and sea states encountered were also elicited and recorded.

A second key component for recording systematic quantified measures is a resident researcher on Cross Island. There are two aspects to the researcher's role. The first ensures the collection and integrity of the "automatic" information (often by filling in gaps or eliminating ambiguities), while the second supplements or augments or elicits more detailed information explaining the "automatic" information. GPS units rely on human operators, who must be reminded to take them in the boat, to turn them on, and to maintain the proper settings. The GPS information is seldom "clean" in the sense that it is downloaded as a file ready for use. Extraneous tracks and waypoints (constant reference points or from previous days) must be excised. Not all whales sighted are marked with a waypoint, for various reasons, and the researcher needs to document these unmarked sightings by reviewing the GPS tracks obtained with the appropriate captain/crewmember in a timely manner. Often a good positional location can be assigned, with the help of the GPS track and a whaler's recollection while looking at the track. The weather

Table C2. Example Daily Boat Report Form for "active" boats

Daily Report Form, Cross Island Subsistence Whaling Documentation, 2 September 2011

"Active" Boats Summary

Date	Crew	Boat	Track #	Crew #	Time out	Time in	TOT min	HOURS	MIN	RT	F_PT	Track?
9/2/2011	BO	BO1	BO1_090211	4	12:50	20:15	445	7	25	69.5	24.9	yes
9/2/2011	BO	BO2	BO2_090211	4	12:47	20:13	446	7	26	75.9	25.3	yes
9/2/2011	IAN	IAN1	IAN1_090211	5	15:36	22:45	429	7	9	69.9	20.9	yes
9/2/2011	IAN	IAN2	IAN2_090211a	3	13:19	20:26	427	7	7	70.1	23.3	yes
9/2/2011	IAN	IAN2	IAN2_090211b	3	21:31	24:48	197	3	17	19.3	7.5	yes
9/2/2011	IP	IP1	IP1_090211	3	12:17	24:52	755	12	35	87.4	23.9	yes
9/2/2011	IP	IP2	IP2_090211	3	12:20	24:49	749	12	29	102.0	24.0	yes
9/2/2011	IP	IP3	IP3_090211	2	12:13	22:11	598	9	58	104.0	23.7	yes
9/2/2011	NUK	NUK1	NUK1_090211	4	12:43	22:46	603	10	3	50.5	9.2	yes
9/2/2011	NUK	NUK2	NUK2_090211a	4	11:08	19:56	LOGISTICAL TRIP TO WEST DOCK					no
9/2/2011	NUK	NUK2	NUK2_090211b	4	20:50	24:50	240	4	0	20.6	7.6	yes
9/2/2011	TAL	TAL1	TAL1_090211	5	15:44	24:56	552	9	12	71.5	20.9	yes
9/2/2011	TAL	TAL2	TAL2_090211	3	15:45	24:49	544	9	4	68.0	20.9	yes

"Inactive" Boats

Date	Crew	Boat	Notes
None			

Strikes Used

Date	Time Struck	Length	Sex	Whale ID	Miles from Cross Island	Bearing from Cross Island	Notes
02 Sept.	20:35	52'1"	F	11N1[2]	7.9	63° true	Taalak, landed

Waypoints

Date	Crew	Waypoint	Lat/Long	Time	Notes	Type
9/2/2011	BO1	BO1_090211a	N70 28.617 W147 06.092	15:14	Where BO1 slowed looking for a whale	C
9/2/2011	BO2	bo2_090211a	N70 28.452 W147 05.942	15:14	BO2 reported position next to mother and calf pair	W
9/2/2011	BO2	BO2_090211b	N70 28.196 W147 05.307	15:21	Marked point for mother and calf pair	C
9/2/2011	GEN	GEN_090211a	N70 28.356 W147 07.235	14:41	"Cluster" of whales, general area	C
9/2/2011	GEN	GEN_090211b	N70 27.649 W147 03.314	16:12	General location where boats slowed after the 16:07 whale sighting (not localized)	C
9/2/2011	GEN	GEN_090211c	N70 28.759 W147 00.119	17:17	General area where boats slowed, one boat reported sighting a log, but no further whale sightings	C
9/2/2011	GEN	GEN_090211d	N70 31.650 W147 18.574	18:54	General area where most boats gave up looking for the whales they had been seeing. Most headed in the direction of CI with a few taking less direct routes.	C
9/2/2011	IAN1	ian1_090211a	N70 27.412 W147 56.717	15:48	IAN1 boat position when barge sighted	Tr
9/2/2011	IAN1	ian1_090211b	N70 25.585 W148 01.563	15:48	Estimated position of barge that was sighted	B
9/2/2011	IAN1	IAN1_090211c	N70 30.338 W147 16.377	17:51	IAN1 recorded coordinates when some other boat respots whale in front of his boat. These are clearly coodinates for a later position (Com Center recorded the time of the observation, and filled in the coordinates later, when they were given)	C
9/2/2011	IAN1	IAN1_090211d	N70 30.329 W147 16.425	17:57	IAN1 reported position when he respots whale	C
9/2/2011	IAN1	ian1_090211e	N70 33.218 W147 42.940	21:01	Use of superbomb (6th or 7th bomb used)	C
9/2/2011	IAN2	IAN1_090211f	N70 33.184 W147 42.930	21:23	Marked point for location of dead whale	K
9/2/2011	IAN2	IAN2_090211a	N70 26.019 W147 04.039	15:38	Marked coordinates, significance not known	Tr
9/2/2011	IAN2	IAN2_090211b	N70 26.282 W147 03.000	0:00	Position of IP3 @ 15:42, why marked unknown	Tr
9/2/2011	IP1	ip1_090211a	N70 26.216 W147 14.244	14:49	Likely sighting or response to sighting	C
9/2/2011	IP2	ip2_090211a	N70 30.380 W147 36.909	12:52	Radio report of whale sighting (likely seen earlier)	W
9/2/2011	IP2	ip2_090211a'	N70 30.415 W147 40.814	12:48	Likely 1st sighting of ip2_090211a whale	C
9/2/2011	IP2	ip2_090211b	N70 24.318 W147 08.609	14:49	Likely sighting or response to sighting	C
9/2/2011	IP2	ip2_090211c	N70 32.007 W147 11.348	17:34	Sighting of "whale that does not blow"	W
9/2/2011	IP2	IP2_090211d	N70 30.909 W147 12.804	17:38	Report of coordinates for 17:34 whale	C

9/2/2011	IP3	IP3_090211a	N70 28.243 W147 01.999	16:29	Marked sighting of a blow and all boats went N	W
9/2/2011	NUK1	nuk1_090211a	N70 27.673 W147 10.659	14:41	Com Center recorded report of a whale	W
9/2/2011	NUK1	NUK1_090211b	N70 30.001 W147 14.845	17:57	Marked point for the mother and calf pair (must be coordinates from another boat)	C
9/2/2011	TAL1	tal1_090211a	N70 32.607 W147 40.292	20:35	Possible strike location (judged more probable)	S
9/2/2011	TAL1	tal1_090211a'	N70 32.800 W147 41.248	20:41	Alternate possible strike location	S
9/2/2011	TAL1	TAL1_090211b	N70 33.196 W147 42.956	21:20	Marked position for dead whale	K
9/2/2011	TAL1	TAL1_090211c	N70 33.186 W147 42.945	21:24	Marked position for dead whale, prayer	K
9/2/2011	TAL1	tal1_090211d	N70 33.009 W147 43.429	22:22	Start of tow	Tow
9/2/2011	TAL2	tal2_090211a	N70 29.927 W147 15.997	18:10	Resighting of a whale	C
9/2/2011	TAL2	tal2_090211b	N70 29.863 W147 15.109	18:11	Confirm that resighting is the mother and calf pair	C
9/2/2011	TAL2	tal2_090211c	N70 31.104 W147 42.247	20:15	Resighting of one of the whales	C
9/2/2011	TAL2	TAL2_090211d	N70 32.822 W147 41.138	20:51	Marked position of TAL2 @ 20:41, but marked @ 20:51 - strike event?	C

Narrative Description

The morning started very foggy and all crews waited until the fog lifted (shortly before noon) to go out scouting. BP was steady and then decreasing, with wind speed 0–10 mph (up to 14 mph at Deadhorse). Wind speed decreased late in the day, and a whale was struck. Boats were returning to Cross Island for the day (and some had already reached Cross Island) when this whale was spotted. Most whalers believed it was a whale seen earlier in the day. NUK2 made a trip to West Dock, and did not return to Cross Island until 19:56, but did participate in the tow.

Seven whaling boats from four crews left Cross Island to go scouting between 12:17 and 13:19 (IP1-3, NUK1, BO1-2, IAN2). Three other boats from two crews (one with a boat already out scouting) left Cross Island between 15:36 and 15:45 (IAN1, TAL1-2). Conditions for sighting whales were probably somewhat better than on previous days, but were still not optimal. Although the smaller boats were able to go scouting, there were still several "false alarms" noted, and swells still presented a challenge. Crews were able to spot, follow, and recognize whales when they resighted them. However, they lost track of all whales seen until, after all boats were on their way back to Cross Island (or had already returned to Cross Island), the Taalak crew spotted a whale, struck it and landed it late in the day. The whalers reported that it was one of the whales that had been seen and chased earlier in the day, as it was quite tired when the Taalak crew went after it. The six boats that participated in the tow (IAN2, IP1-2, NUK2, TAL1-2) returned to Cross Island after midnight, around 00:49 ("24:49" in the Table). The five boats that did not participate in the tow returned to Cross Island between 20:13 and 22:46. About five whales were seen during the day, including a mother and calf pair seen in different places by different boats (GEN_090211a, bo1_090211a, bo2_090211a, BO2_090211b, tal2_090211a&b, NUK1_090211b). Most of these whales were seen more than once, and by different crews in different locations. The farthest any boat went from Cross Island was 25.3 miles. Boats went farther E (25 miles) than N (7 miles) or south (9 miles). No boat scouted west of Cross Island on 2 Sept. All whales reported were seen within a rectangle extending 3 miles north, 22 miles east, and 7 miles south of Cross Island.

All boats scouted primarily east of Cross Island. The first whale was spotted fairly close to Cross Island (ip2_090211a and ip2_090211a', about 8.5 miles away at about 12:50), but was not resighted, or at least was not followed for very long before it was lost. All boats continued to scout to the east (with some boats just leaving Cross Island taking a jog to the south on their way east). A loose grouping of four whales was seen about 14:41 (GEN_090211a, nuk1_090211a, ip2_090211b - the proximity of the whales to each other was not clear, other than that there was a mother and calf pair). All of the boats scouting to the east at that time (IP1-3, BO1-2, NUK1, IAN2) then scouted south of the mother and calf pair for other whales. IAN1, shortly after leaving Cross Island, reported seeing a barge about 15:48 (ian1_090211a,b). About 16:06/16:07, one of the boats (unidentified) saw a whale to the north ("came up 4 times, no blow") and all boats accelerated to the north and subsequently slowed in the same general area (GEN_090211b, IP3_090211a). They saw no further evidence of the whale, however, and by 17:17 all boats generally headed north and northwest (GEN_090211c). About 17:34 IP2 reported (ip2_090211c,d) that they had seen "the whale that does not blow" (a whale they had seen before) behind them. At 17:51 someone reported that the whale is in front of IAN1 and IAN1 marked this point and a subsequent resighting (IAN1_090211c,d). The boats eventually lost track of this whale as well. Thus there were several whales that were chased by different boats (including the mother and calf, which was not chased but merely observed).

From this point (about 18:54, GEN_090211d) most boats proceeded in a general direction back to Cross Island, still scouting but at generally higher speeds. The NUK1 boat had left the other boats to scout south at 17:18 or so, on a "false alarm" sighting. After investigating this they eventually rejoined the other boats. The IP2 and I(tal2_090211c). TAL1, TAL2, IAN1, IP1, IP2, IP3, and NUK1 all accelerated for Cross Island between 20:01 and 20:06, and so were in the vicinity of TAL2 when it saw something and radically changed its direction of travel, to the north. The strike for this whale was reported at 20:35 (possibly 20:41 – the most probable strike location is judged to be tal1_090211a, with alternatives tal1_090211a' and TAL2_090211d). Specific locations for chase events were not well documented. The BO boats had already reached CI and so did not participate in the chase. IAN2 and NUK2 had also returned to CI. The other boats diverted to this whale (but IP2 and IP3 were far to the south). TAL1 ended up with the strike opportunity. The first bomb may not have exploded, and the float apparently came off. A second darting gun shot missed the whale. Between 9 and 11 bombs were used on the whale, including a superbomb that was said to have effectively stopped the whale (and was the 6th or 7th bomb used, ian1_090211e). The time of death was between 21:19 and 21:23 (IAN1_090211f, TAL1_090211b, TAL1_090211c). The tow started about 22:22 from a location 7.1 miles northeast of Cross Island (tal1_090211d). Boats that helped tow were IAN2, IP1, IP2, NUK2, TAL1, and TAL2. IAN2 had gone out again to help with the tow, as had NUK2 when it returned from West Dock. The BO boats did not go out again, once they had reached Cross Island, and NUK1 and IAN1

had either mechanical problems or other reasons not to tow. The tow reached Cross Island very early in the morning of 3 September, and the decision was made to leave the whale in the water until the morning. Butchering at night at Cross Island is difficult, especially with a large whale, and the experience of the whalers is that spoilage is minimal if the whale is kept in the water overnight – while butchering at night with tired crews is most often inefficient and counterproductive.
While not evident in terms of gross effects upon the events of the day, "barge issues" were quite salient to the whalers. The day started with some of the whalers discussing the barge "incident" of the previous day with the Com Center as soon as they woke up, trying to find out who was responsible for the vessel and what it was doing. This resulted in a 10:48 announcement from Cross Island that all barge activity (including that to Badami) was stopped until the subsistence whaling season was closed. About 14:05 Cruise Marine requested permission to "cross over Cross Island" [apparently on the way to Badami] and was answered about 14:48 by a statement from the Nuiqsut AEWC Commissioner that there "will be no barging to Badami until Nuiqsut whalers has[*sic*] met their quota" (as recorded in the Deadhorse Com Center logbook). Soon after IAN1 left Cross Island to go scouting, they reported seeing a couple of barges in front of them (15:49), but were too far away to identify them. The barges were SW of Cross Island. After the boats had returned to Cross Island, those that had been scouting north of Pole Island reported that they had also seen a barge (but no whales) north of Pole Island (perhaps about 15:38 or 15:43 – the time when some otherwise unexplained points-of-interest were entered into the GPS data logger by crews on the water. These boats report turning away from the barges, and were soon called away to a whale sighting by IAN1 (16:05 or so) to the north. P3 boats also left the other boats to scout south, but much later at about 19:22. No additional whale sightings were reported before the time that all boats decided to head into Cross Island at high speed. The BO boats did so about 19:40, and IAN2 about 19:46, and all three got back to Cross Island before TAL2 spotted something about 20:14

station data logger must be downloaded regularly, and checked to be sure that it and the weather station are operating correctly.

Gaps in the GPS track itself can often also be filled in, at least in an approximate way, through an interview while initially downloading the track information. Lastly, each GPS track must be assigned to the correct boat and saved in a systematically labeled file. The researcher must also check, process, and save the weather information from the data logger on a regular basis, to ensure that it is functioning properly. The researcher must also record personal (and general) weather observations, to supplement those of the weather station. This also serves as insurance against the failure of the weather station or the data logger (for a similar reason, the researcher will note the time when boats leave to scout for whales and the time they return). The researcher will also record measures that GPS units or the weather station do not. This includes such quantified measures as which boats go out whaling, how many crew members go in each boat, what "non-whaling" vessels arrive at Cross Island and with how many people, what activities people and boats engage in other than whaling, and boat characteristics (length, motor horsepower, material). Other information to be collected in field notebooks includes such non-quantified information as narrative descriptions of daily scouting trips; whalers' observations on ice conditions, weather, and whale behavior; non-whaling activities on Cross Island; and many other contextual behaviors. The field notebook will resemble, in essence, a journal covering the period of the Cross Island whaling season.

TableC3. Example Daily Boat Report Form for "inactive" boats

"Active" Boats Summary, 3 September 2011												
Date	Crew	Boat	Track #	Crew #	Time out	Time in	TOT min	HOURS	MIN	RT	F_PT	Track?
NONE												

"Inactive" Boats			
Date	Crew	Boat	Notes
9/03/11	BO	BO1	Stayed in to butcher
9/03/11	BO	BO2	Stayed in to butcher
9/03/11	IAN	IAN1	Stayed in to butcher
9/03/11	IAN	IAN2	Stayed in to butcher
9/03/11	IP	IP1	Stayed in to butcher
9/03/11	IP	IP2	Stayed in to butcher
9/03/11	IP	IP3	Stayed in to butcher
9/03/11	NUK	NUK1	Stayed in to butcher
9/03/11	NUK	NUK2	Stayed in to butcher
9/03/11	TAL	TAL1	Stayed in to butcher
9/03/11	TAL	TAL2	Stayed in to butcher

Waypoints

Date	Crew	Waypoint	Lat/Long	Time	Notes	Type
NONE						

Narrative Description

The morning was again very foggy, and winds were higher than on 2 Sept. BP was falling sharply, with wind speed 1–11 mph (up to 15 mph at Deadhorse). Conditions may have been acceptable for scouting, but all hands were required for butchering. Since the towed whale had arrived at Cross Island early in the morning, it had been left in the water and butchering was delayed until the sun came up. The limited spot lights available at Cross Island are not really adequate to butcher at night unless absolutely necessary. Nuiqsut whalers have found that whales can usually be left in the water overnight without a great deal of spoilage. If the whale is taken out of the water and not butchered right away, however, there is a great deal of spoilage. Thus, the choice was between leaving the whale in the water and delaying the start of butchering until after all the crews had rested; or of hauling the whale out of the water and butchering to at least the point where the internal organs of the whale were removed, in the dark with limited artificial lights, with crews already tired from a full day of hunting.

Since the whale was quite large (length 52'1" or 15.9 m), it required longer than usual to haul up on the beach. It was a female with a 5" (13 cm) fetus. All crews participated in the butchering, but butchering proceeded somewhat more slowly than would normally be expected. Butchering did proceed far enough for the Taalak crew to send the *tavsi* (captain's belt, used by Nuiqsut whalers to "feed the village" as soon as possible after a whale is landed) to West Dock to be sent to Nuiqsut by plane (under the provisions of the CAA, the *tavsi* from the first whale taken is flown to Nuiqsut). A polar bear was also harvested and processed (skinned and some meat taken) on 3 Sept.

Whalers were again concerned with barge issues. A request was made (about 08:45) for the whalers to allow a Crowley barge to go by, and the whaling captains discussed whether this would be acceptable or not. The resolution (their final decision) was not clear and is not recorded in the Deadhorse Com Center logbook, but at least one captain argued that even though it was foggy, and they had a large whale to butcher, if it cleared up they might want to allow at least a few boats to go out scouting. The researcher's notes indicate that he thought that the whalers told the barge not to proceed.

Data Collection, GPS Units

Every crew should have a suitable GPS unit for every boat that is expected to go scouting for whales. A "suitable" GPS unit is one that is the same for all boats (or at least the same brand), so that the same software can be used to download and display the information. While in principle different brands can be accommodated, this complicates the data synthesis and analysis. The BOEM project decided to use Garmin GPS units since the Garmin MapSource software was easy to use for downloading and rapidly displaying the GPS information. Many Nuiqsut whalers already had GPS units, a majority of which were Garmins. Over the years of the project a number of different models have been distributed – the GPS12, the GPS III, the GPS V, the eTrex, the GPS 60, and the GPS72/76 families of units. Those with larger track memories (such as the eTrex Legend HCx or the GPS76Cx, with memory card slots) should be preferred to those with smaller track memories. Other things being equal, units that can be downloaded via a USB connection are preferable to those with only a serial connection. The whalers have shown a preference for the GPS76 family of units, since they float when dropped in the water (whereas the others sink).

The GPS unit must be set up correctly and consistently with those of the other crews, in order to ensure that the data is collected and is comparable to that of the other crews. The important settings to be concerned about, and that need to be consistent from one unit to the next, are:

- "Tracking" should to set to "Wrap"
- "Map Datum" should be set to "WGS 84"
- "Heading" or "North Reference" should be set to "True"
- "Distance/Speed" should be set to "Statute"
- "Position Format" should be the same on all units, and preferably "hddd.ddddd"
- "Interface" (if changeable) should be "Garmin"
- "Time Zone" should be "US-Alaska" so that the time offset is –09 hours 00 minutes
- "External Power Lost" should be set to "Stay On" (usually in system setup)
- For those units with memory cards, "Log Track To Data Card" should be on (checked) – in Track Setup

Most other settings can differ, according to their preference of the GPS users. For instance, some users prefer that the map page always be displayed with North in the "up" direction, while others may prefer that the direction they are going (the track) be displayed in the "up" direction. Screen intensity, color (on some models), power settings, and many other settings likewise have a number of options.

The details for how to set up each GPS unit will not be included here – refer to the specific manual for the particular GPS unit being used.

In addition, each boat should have the appropriate marine mount for the GPS unit, so that it is visible to the boat operator, is held securely in a position that allows it to receive strong and steady signals from the available satellites, and will not be in the way of whaling activities. Each

unit should generally be accompanied with an external power cord that plugs into the unit and a "cigarette lighter" power receptacle on the boat, a data transfer cable (usually USB for current GPS units), a write-in-the-rain waterproof notebook and pencil so that observations can be written down, and a case of some sort to contain all of these things.

The primary or main procedure to download the track and waypoint information from a GPS unit is generally the same for all units. It is usually fastest if the computer is already on or is turned on before visiting the crews. Connect the GPS unit to the computer with the appropriate cord (serial or USB). Start the MapSource program and turn on the GPS unit. Click on the "Transfer" pull-down menu and then click on "Receive From Device." The program should automatically find the GPS unit and display the items that can be downloaded (if a driver installation wizard pops up, simply follow the prompts and it will automatically find the needed driver). In most cases, only "Tracks" and "Waypoints" are of interest, so uncheck "Maps" and "Routes" unless you are sure you want them. Click "Receive" and the data will be transferred to MapSource and displayed on the computer screen. Be sure to save the download from each different GPS to a separate and unique file each day. The easiest way to ensure that you do not write one file over another is to give each a different and systematic name based on the crew, boat, and date. For instance, if downloading tracks and waypoints from the Nukapigak number two boat on September 11, 2008 the file would be named NUK2_091108-raw (or EMN2_091108-raw, since "EMN" is the abbreviation the captain uses for his crew) and MapSource would add the extension ".gdb". The addition of "-raw" to the end of the file name marks the file as not yet processed. It is important to maintain a backup copy of all raw data files, in case it is later necessary to check the original data. In those cases where more than one GPS unit is downloaded from the same boat or trip, an extra identifier should be added to the file name in order to identify the GPS unit, in order to make the file name unique. Before downloading the next GPS unit, be sure to open a "new" file or you will add the tracks and waypoints from the second unit to those of the first.

When the GPS track file is reviewed with the whalers whose trip it represents, points can be added where they indicate sightings of whales or other significant events or conditions. The easiest way to add a waypoint is to place the cursor where the point is to be added (zooming in with the dropdown menu of the "view" area of the toolbar if necessary to properly place the point) and to right-click the mouse. Select "New Waypoint" and the "Waypoint Properties" dialogue box will appear with the "name" block highlighted. Type in an appropriate name (using the crew, boat, and date identifiers of the track involved, with some addition about what the point represents – for example "BO1_090507-whale1" for the first whale seen by the Oyagak1 boat on 9/05/07. Be sure to also take notes in a field notebook about the name of each point and what it represents. Do the same for all added points, as well as for points that the crew marked while out on the water. Each point name will need to be unique. Also take notes, in as much detail as is feasible, on the whalers' accounts of their trips (why they headed out the way they did, conditions they encountered, what they saw, and so on). In many cases the accounts will only be partial or incomplete, but try to fill in missing information if you can by asking questions. However, also be aware that in most cases the time available to collect this information will be limited to what the whalers are willing to spend talking with you, and that this information needs

to be collected from all boats that went scouting on any given day. Time management – both yours as a researcher and the whalers' to accomplish all that they need to do to land and process whales – is a vitally important aspect of the data collection task.

It is best to have a separate directory for all MapSource GPS files for each whaling season, to make it easier to find them. Setting up separate subdirectories for each crew, or even each boat, may make it less likely to accidently overwrite one file with another, but also creates a more complicated file structure and a greater need to be precise in creating and saving files. It also makes it more difficult to manipulate and compare files with each other. The Cross Island project as it operated 2001-2012 simply used one directory for all unprocessed ("raw" files as downloaded from each GPS unit) GPS track data files for each season (labeled something like "GPS Tracks_2001-RAW" – changing the year as appropriate for each season. There should also be a separate directory for processed or "cleaned" MapSource GPS files, since in most cases the tracks as they come from the GPS unit are not in a final form for GIS work (labeled similarly to the other, such as "GPS Tracks_2001-Processed"). The convention for the Cross Island project for the 2001-2012 seasons was to change the name of a track file when it was processed by simply removing the "-raw" part of the name of the unprocessed file and placing it in the "Processed" file directory for the appropriate season (how to actually process these files is discussed further below). The first step in processing tracks is to delete all tracks for days other than the one of interest, and to combine all fragments (as far as possible) into one continuous track for each trip taken during that day. Most boats will make only one trip on a given day, but some will make two or three, depending on circumstances. Multiple tacks or fragments that cannot be joined should have a lowercase letter added to their labels or names.

Identifiers should be used to systematically label all tracks and points associated with each crew that whales from Cross Island. As new crews are formed, each would be designated by a unique identifier. Those used for crews that have whaled from Cross Island during the life of the project were:

- Ahkiviana UA, AA
- Aqarguin AIN
- Ipalook IP
- Napageak NAP, TN
- Nukapigak NUK, EMN
- Oyagak BO
- Kittick PK
- Taalak TAL

Downloading the information from the memory card of the GPS unit is somewhat less intuitive, and if the GPS unit is downloaded regularly on a daily basis will not need to be done often. The primary reason to do so is if tracks have not been downloaded for some time, so that some of the older tracks may have been "lost" by being overwritten by newer tracks in the GPS unit's "track memory." The memory card has a much greater storage capacity than the "track memory" and

so retains old tracks far longer before they are overwritten. The process to download the memory card information is as follows ("Interface" part of manual):

1. Connect the GPS unit to a computer via a USB cord (both computer and GPS unit turned on)
2. Page to "Main" Menu on GPS unit, select "Setup" with cursor, click "Enter"
3. On "Setup" Menu select "Interface" with cursor, click enter
4. Select "USB Mass Storage" with cursor, click "Enter"
5. The memory card in the GPS unit will appear as a removable drive on the computer. Daily track files will appear in the root or main directory of this drive, with the date of each file as its name.
6. Using a file management program (commonly "Windows Explorer" when using a "Windows" operating system) copy the appropriate "*.gpx" files into a separate directory for each boat. Since the GPS unit makes a single file for each day on the memory card, and each filename is simply the date the file represents, files from different units (used by other boats) would overwrite each other if copied to the same directory. Unlike files saved from "MapSource" it is not possible to rename these files until they are copied to the computer, so it is simpler to have a separate directory for each boat. If each GPS unit is downloaded on a regular basis using the primary or main method, it will not be necessary to download from the memory card – the memory card's main function is as a backup in case the GPS unit cannot be downloaded for an extended period of time. One disadvantage of using files downloaded from the memory card is that they save only track information. Point information can only be downloaded from the GPS unit by the primary or main method (but point information is not overwritten in the same way as is transient track information – "saved" tracks are of course never overwritten).
7. To "break" the connection to the computer and return the GPS unit to normal operation, press the "power" button briefly. Holding the "power" button longer will turn the GPS unit off.

Data Collection, LaCrosse Weather Station

Almost any weather station will serve to collect and record the basic weather measurements – barometric pressure, wind speed and direction, and temperature. Most will also collect relative humidity and perhaps some other measures. The Cross Island project decided on LaCrosse weather stations as relatively inexpensive units that were dependable, relatively easy to setup and operate, relatively precise, and fairly dependable. More expensive weather stations tend to be more precise, but can be more complicated to in terms of setup and operation. The weather station chosen should have a data logger (either as a separate unit or built into the panel unit), and the software to download and display the information recorded, usually supplied with the unit. It is preferable for the data logger to have a larger, rather than a smaller, memory. For most weather stations, the interval between each saved measurement can be changed. For the Cross Island project, this was typically set at either 5 or 6 minutes. This was to facilitate comparison with the official weather station maintained at Deadhorse, which has historical weather information available with time intervals of 6 minutes and 1 hour. It also extended the time period for which the data logger could record measurements, compared to shorter time

intervals. Still, the data logger should be downloaded relatively frequently, in order to check that the system is operating properly

The weather station setup is reasonably simple – refer to the manual for the specific weather station deployed (most used for the 2001-2012 field seasons are no longer available). You can tell if all sensors are within the range of the base display unit if readings for all of them are displayed (usually one-by-one during the test phase, and all together after the test phase). You will need to test the data logger soon after you deploy it to ensure that it is also picking up the sensors. Most data loggers are now built-in to the weather station base units, although some may still be separate units (again, see the manual for the specific weather station deployed). Download the data logger as instructed by the manual. Start the "PC Weather Station" or other software program supplied with the weather station (or a third-party program, if preferred). If there is more than one weather station for which you are collecting information, be sure that you are downloading the information to the proper file. Click on the "File" pull-down menu and then click on "Weather data file" and then "Select". Choose the appropriate file for the weather station you are working with. If it is the first download of the season for the weather station in question, assign a unique name to the file based on its location (crew cabin) and year, preceded by "WS" (for instance, "WS_AIN2008"). Keep the weather station file(s) in a separate directory. There may be a program default directory, and if so, change it to a standard "PC Weather Station" directory. You can check to see that the information has properly saved by using the weather station program to see if it displays data up to the time you performed the download or not.

To download historical weather information from Deadhorse to compare with that collected from a Cross Island weather station, first access the webpage http://www.ndbc.noaa.gov/station_page.php?station=PRDA2. This is the "Station Page" and displays current conditions and, at the bottom, links describing the measurements reported, real time data for the last 45 days, and historical data for past years. If the download is taking place soon after the Cross Island season in question, the link for the last 45 days may be applicable. In most cases, the historical data link will be used. Clicking on the historical data link will take you to a page with links to the most recent years (as of April 2013, 2005-2012) and a link to "other available historical data." Since the Cross Island documentation project has archived the Deadhorse weather measurements for 2001-2012, it is most likely that only the most recent year's weather data will need to be downloaded.

There are two ways to download the information desired. That used by the Cross Island documentation project has the advantages that it does not require the use of compression/decompression software, allows for the selection of a date range of data (not the whole year), and allows for the selection of units for the measurements. On the "Station Page" click on the link for "Other Available Historical Data" (http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=9497645&type=Meteorological). This will take you to a page displaying several graphics for current weather information and a limited number of choices at the bottom of the page for the date range of data to be displayed and the units of measurement to be used for that data. Set the year first, which will also set the month(s),

and then the date. There is a limit of 31 days for "6 minute interval" data and 1 year for "hourly interval" data. Set the interval for "hourly" of "6 minute" and data units to "Fahrenheit-knots" or "Celsius-m/sec". The Cross Island documentation project used "Fahrenheit-knots" since these were more familiar units to the whalers (and the Cross Island weather station actually displayed mph rather than knots, so a conversion of knots to mph or vice versa was required for comparison). Most importantly, select "Local" time rather than "GMT" since the Cross Island weather station will be recording measurements in local time. Otherwise, a conversion of "GMT" time to "local Cross Island" time will be required for comparison.

For the other download method, from the "Station Page" click on the year for which the data is desired (2012 for this example). This will take you to a "Download" page with two options. In most cases, it will be easiest to download using "method two" rather than "method one". Both methods download data in a "text file" format (*.txt), which is easily imported into a spreadsheet program for manipulation, analysis, and the construction of graphics. Click on the "method two" link (prda2h2012.txt in the case of 2012). The data for the entire year will appear on your screen. You can either save the entire file or, with the mouse and cursor, select a portion of the data to copy, select "Edit" from the browser menu and then click on "Copy". You can then paste the data into the program of your choice (most usefully a spreadsheet program). Note that for this download method, there is no choice of units – time is GST (GMT), wind speed is in m/sec, and temperature in Celsius. Conversions will be required for comparison with Cross Island weather station measurements.

Common conversion factors that may be needed:

- GST (GMT) time top Cross Island local time: for Alaska Daylight Savings Time, Cross Island local time = GMT minus eight hours; for Alaska Standard time, Cross Island local time = GMT minus nine hours
- Cross Island local time to GST (GMT): for Alaska Daylight Savings Time, GMT = local Cross Island time plus eight hours; for Alaska Standard time, GMT = local Cross Island time plus nine hours
- Knots to miles per hour (mph): 1 knot = 1.15078 mph
- mph to knots: 1 mph = 0.868976 knots
- meters/second (m/sec) to mph: 1 m/sec = 2.23694 mph
- mph to m/sec: 1 mph = 0.44704 m/sec
- kilometers (km) to miles: 1 km = 0.621371 miles
- miles to km: 1 mile = 1.60934 km
- Celsius to Fahrenheit: (°C x 9/5) + 32 = °F
- Fahrenheit to Celsius: (°F – 32) x 5/9) = °C

Data Collection, Systematic Observations

It is advisable that the field worker systematically records as much information as possible in the normal course of his or her day. This would include such things as when boats leave and arrive back at Cross Island, how many people are in each boat, and any information related to whaling

heard over the radio. While much of this information may be recorded in the Whale Communication Center log or be obtainable from the whalers during conversations, the Com Center log is often incomplete in this regard (and sometimes inaccurate), and whalers are not always communicative, or time for conversation may be limited. It is also advisable to record weather readings several times a day, as a precaution in case either the data logger or the weather station malfunctions in a way that is not obvious until too late to deal with.

When downloading GPS units, it is often possible to talk to the crew right away while displaying the tracks and points to them in MapSource. You can them ask them for a general description of the trip and ask them about any significant events or conditions (whale sightings, strikes, sightings of other animals, ice cover, sea state, and so on). Often, crew members will locate points on the track that they did not mark on the water. These will be only approximate in terms of location, but can often be refined later by using the Communication Center log and other information. This is also a good time to ask about observations of whale behavior, location of currents, and other topics of interest. The general guide for topics to collect information about are the items on the DBRF (see example Tables C1 and C2) – but of especial interest are events "out of the ordinary" that affected the trip and/or whaling.

Field notes can be kept in physical notebooks, in electronic computer files, or both. Since computers can fail, it is wise to have at least outline notes in physical form, and to backup computer file to a thumbdrive (or two) on a regular basis.

Data Collection, Photographic

A limited number of pictures to document each whaling season have been made available to the sponsor, subject to approval by the Nuiqsut whalers, and subject to use restrictions that Nuiqsut whalers place upon them. Photographs are often useful to document observations when it is inconvenient or impossible to make detailed notes. Before each field season, whoever collects the data should revisit the issue of photography with the whalers – how many photos, and of what subjects, it would be appropriate to take. For the Cross Island project, the researcher was allowed to take many photos, with the qualification that they all be made available to the whalers but only a limited number used in the report to the sponsor and made available to the sponsor. Such extensive photography was not in the scope of work for the BOEM project and so was not included in the budget for that project.

DATA PROCESSING AND DATA MANAGEMENT

GPS data will be downloaded to a laptop computer from the units carried by the whaling boats as soon as is practicable when they return to Cross Island. Since some whalers have GPS units of their own, several types of GPS-computer interface cords will be available, but the two used most often will be those for the Garmin units provided by the project. Some of these units take a serial cord with a circular plug for the GPS unit, and others take a standard USB cord with a "mini" USB connection for the GPS unit. Garmin Etrex units commonly provided to the whalers by the NSB or the oil companies require a different serial cord, with a flat connection for the GPS unit. Tracks and waypoints will be examined with the whaling crews so that they can be

documented as fully as possible, ambiguities clarified, and gaps filled. All raw data files will be preserved and archived in a separate directory. Another directory will contained "processed" files, form which extraneous tracks and waypoints have been deleted, so that a "clean" file with only tracks and waypoints related to a single boat for a single day is created for each boat that goes out whaling on any given day. If a boat's daily trip tracks are "chopped up" due to lose of signal, the unit's being turned on and off, or for other reasons, the tracks should be joined to make a single trip track, to the extent this is possible. MapSource has a function to perform this task, but care must be exercised to ensure that the end of one track segment is joined to the beginning of the next. Waypoints will be renamed with labels coded for date and boat. These files will be stored in a separate directory from the archived "raw" GPS data.

Some GIS programs will have the ability to import Garmin GPS files directly, while for others (such as "Manifold", the GIS program used by the Cross Island documentation program), the Garmin GPS files will need to be converted into an intermediary format. The GPS utility program "GPS Utility" was used for this function, with the "MIF" format as the intermediary. The "GPS Utility" (and the add-on utilities making the batch processing of files possible) documentation describes the process. Most GIS programs will be able to then export any required files in the formats required for other end users ("Shape", "EØØ", or other file formats). Depending on the GIS program used, metadata may or may not be easily included in these exported files. Important metadata should be supplied in spreadsheet form (boat trip form, waypoint form) that can easily be linked to exported GIS files.

Daily boat report forms be will completed for each boat on a daily basis – preferably in electronic form, but in physical form if more practicable. Information for these forms will be derived from the GPS data, researcher/field assistant observations, and interviews with whalers about their whaling trips and observations. Weather observations (temperature, relative humidity, wind speed, wind direction, barometric pressure) will be recorded from a weather station by a data logger that will be down loaded to a laptop computer on a daily basis. This data file will be stored and transmitted to the sponsor in Excel format as well as text delimited format, so that it is readable to other programs.

The field researcher (Galginaitis and/or the field assistant) will be responsible for storing all project information on a laptop computer for the 2008-2012 field seasons, and transforming it into formats for submission to BOEM, and incorporation into annual reports and the final summary report. This first level of data abstraction and compilation is discussed in more detail in terms of data management below.

Primary Data Abstraction and Compilation

For the BOEM sponsored project, it has been useful to use Excel spreadsheets to abstract and organize the primary data and in some cases to construct graphic representations of that data. The following sections each discuss one sort of Excel file used by the BOEM sponsored project and the data which it contains. These will likely be useful for data collection and analysis for future field seasons as well, although they should of course be modified or replaced by better tools as future research and whaler needs dictate. Examples of these types of files are included

on the CD-ROM for the 2013 final BOEM project report for the 2001-2012 field seasons, in a directory named "Summary Data Examples". The 2010 season is used for most of these example, since there were only three scouting days for that season, so that most tables were smaller that year.

Waypoint Summary file

This is the simplest of the summary data forms/files, as it is a single-worksheet Excel workbook, set up as in Table C4 (see example file "2010_Waypoints.xls" in the "Field Manual Example Files" directory on the accompanying CD-ROM). The points are abstracted from several possible sources. Points marked by the whalers on the water will be downloaded from the handheld GPS devices along with the tracks. When examining the tracks with members of the whaling crew, they may identify the location of other whale sightings or other events that they did not mark while out on the water. In addition, there may have been radio reports of sightings or other events that were not marked on the GPS, but were noted (with a time reference) by the researcher listening to the radio or logged into the DCC log by time, and identified as to the source of the report (by boat), These can then be matched to the GPS track for the appropriate boat by the time stamp and located and plotted on the MapSource track. Once all the points for a single day associated with a single boat's track for that day are identified, they can be entered into MapSource and placed on that track, and entered on the form. The first two columns of the form are for the date of the point and the crew reporting the point. The third column is the label or name for the waypoint and is composed of several elements. The first is the crew identifier and the identifier for the boat of that crew reporting the point, followed by an underscore. This is followed by the date of the report and a lowercase letter indicating the sequence I which the points were reported ("a" for the first point reported by that boat for that day, "b" for the second, and so on). The position or lat/long of the point are taken from the MapSource GPS file. The next column is the time of the event that the point represent. This may not always be available. For points marked on the water, the GPS track will have a timestamp for the point. For points plotted on the track by the approximate time of the report heard on the radio or in the DCC log, the approximate time will be entered. For points located on the tack by crew members in a general way, while looking at the tracks after returning to Cross Island, it may be possible to enter an approximate time (based on the GPS track timestamp), but in many cases this will not be possible. The "Notes" column is to indicate what the crew members tell you that the point represents – a whale sighting, environmental conditions, meeting up with another boat, a reference location, and so on. The last column is simply a general classification of the sort of information that the point represents.

It is generally easiest to enter all the points into the MapSource file, while talking with the crew members for that track and those points, with temporary names to help you remember what the points represent, while you also make notes about the names of the points and what they represent. Preserve this original MapSource file in an archive and copy it to a working directory, where you can change all the point names to the standard format described above. Once that it done, you can display all the waypoints in the file and block "copy and paste" them into an Excel worksheet, which will save the chore of entering the name and lat/long information individually

by hand. If all Points for all boats for all days for a single season are aggregated into one file, this can be done in one step for all points – but it may be advisable to do this on a daily basis I order to keep current. In any event, the "paste" will not result in a finished file, but will be easy to clean up, after which the other information can be entered.

Table C4: Example season point summary form (2010)

Date	Crew	Waypoint	Lat/Long	Time	Notes	Type
29-Aug	Aqarguin	ian1_082910a	N70.53078 W148.12456	1020	Traveled through ice to this point, then had open lead to the NE (but with ice on both sides)	Track
29-Aug	Aqarguin	ian1_082910b	N70.57292 W147.82274	1144	IAN1 met up with NAP1	Track
29-Aug	Aqarguin	ian1_082910c	N70.58682 W147.84937	1153	Open water	Track
29-Aug	Aqarguin	ian2_082910a	N70.53106 W148.15980	1024	Traveled through ice to this point, then had open lead to the NE (but with ice on both sides)	Track
29-Aug	Ipalook	ip1_082910a	N70.54408 W148.09290	1028	Met/coordinated with IP3, IAN1 and IAN2 as well	Track
29-Aug	Ipalook	ip1_082910b	N70.64335 W147.61312	1240	IP1 location at time IP2 first saw whale	Chase
29-Aug	Ipalook	ip1_082910c	N70.73485 W147.69256	1505	IP1 location at time of announced death of whale	Kill
29-Aug	Ipalook	IP1_082910d	N70.73989 W147.67740	1540	IP1 location at time of start of tow	Tow
29-Aug	Ipalook	ip2_082910a	N70.72200 W147.55919	1240	Estimated position of IP2 whale sighting	Whale
29-Aug	Ipalook	ip2_082910b	N70.74333 W147.58972	1258	Estimated location of resighting of IP2 whale - boats together	Chase
29-Aug	Ipalook	ip2_082910c	N70.74446 W147.63480	1344	Estimated strike location	Strike
29-Aug	Ipalook	ip2_082910d	N70.73671 W147.68880	1509	Probable tow event	Tow
31-Aug	Oyagak	bo1_083110a	N70.65585 W147.38652	1122	Spot a Whale	Whale
31-Aug	Oyagak	bo1_083110b	N70.65567 W147.31922	1144	Spot a second whale, the one they chased	Whale
31-Aug	Oyagak	bo1_083110c	N70.65499 W147.29667	1153	Attempted strike, but missed	Chase
31-Aug	Oyagak	bo1_083110d	N70.62448 W147.51660	1228	Left area to chase whale or to assist with NAP whale	Track
31-Aug	Oyagak	BO2_083110a	N70.76865 W147.71999	916	Unknown	Unknown
31-Aug	Oyagak	bo2_083110b	N70.66674 W147.42165	1122	Spotted two whales	Whale
31-Aug	Oyagak	BO2_083110c	N70.65023 W147.36246	1136		Unknown
31-Aug	Oyagak	BO2_083110d	N70.77223 W147.01419	155	Unknown - point not on any track - coord entered by BO2	Unknown

31-Aug	Oyagak	BO2_083110e	N70.67219 W147.30377	1211	Whale spotted again	Chase
31-Aug	Oyagak	BO2_083110f	N70.70179 W147.78793	1252?	Unknown - head south for other boats - entered by BO2	Unknown
31-Aug	Oyagak	BO2_083110g	N70.67303 W147.80590		Unknown - probably coordinate from another boat	Unknown
31-Aug	Aqarguin	IAN1_083110a	N70.75774 W148.02319	808	Probable IAN1 sighting of whale reported by NAP1	Chase
31-Aug	Aqarguin	IAN1_083110b	N70.73246 W147.90897	1021	Small whale sighted	Whale
31-Aug	Aqarguin	IAN1_083110c	N70.72461 W147.70973	1120	Big floating ice	Track
31-Aug	Aqarguin	IAN1_083110d	N70.67322 W147.80257	1239	Marked kill location for NAP whale	Kill
31-Aug	Aqarguin	IAN1_083110e	N70.63977 W147.80903	129	Point marked for the tow to head for (IAN1 scouting a route through the ice for the tow)	Tow
31-Aug	Aqarguin	IAN2_083110a	N70.76195 W148.02195	808	Probable IAN2 sighting of whale reported by NAP1	Chase
31-Aug	Aqarguin	IAN2_083110b	N70.79108 W147.99607	832	Whale spotted	Whale
31-Aug	Napageak	NAP1_083110a	N70.73003 W148.00649	751	Whale sighting report	Whale
31-Aug	Napageak	NAP1_083110b	N70.75349 W148.01250	802	Spot a whale, 16 miles from Cross Island	Whale
31-Aug	Napageak	NAP1_083110c	N70.75682 W147.61096	1110	Spot a whale, 21 miles from Cross Island	Whale
31-Aug	Napageak	nap1_083110d	N70.66845 W147.78493	1159	Boat position at time of estimated NAP1 strike	Strike
31-Aug	Napageak	nap1_083110e	N70.67327 W147.80266	1241	Estimated kill location for NAP whale (based on NAP radio announcement)	Kill
31-Aug	Napageak	nap1_083110f	N70.67288 W147.79978	122	Estimated start of tow	Tow
31-Aug	Napageak	NAP2_083110a	N70.66781 W147.78424	1223	Unknown - coordinates for strike? - marked afterwards	Unknown
31-Aug	Nukapigak	NUK1_083110a	N70.73425 W147.47725	937	Report seeing three blows (to the east)	Whale
31-Aug	Nukapigak	NUK1_083110b	N70.73420 W147.48291	937	Also saw a single whale to the west (eventually struck by NAP1)	Whale
31-Aug	Nukapigak	NUK1_083110c	N70.74961 W147.75027	1110	Resighting of NAP whale	Chase
31-Aug	Nukapigak	NUK1_083110d	N70.66785 W147.78512	1159	Report of NAP1 strike (by NUK1 boat)	Strike
31-Aug	Nukapigak	NUK3_083110a	N70.79194 W148.00100	934	Coordinates reported for IAN2 boat - reason unknown	Unknown

1-Sep	Oyagak	BO1_090110a	N70.70499 W147.72518	959	Whale sighting	Whale
1-Sep	Oyagak	BO1_090110b	N70.70504 W147.72492	959	Duplicate of point a?	Duplicate
1-Sep	Oyagak	BO1_090110c	N70.70458 W147.72278	1000	Duplicate of point a?	Duplicate
1-Sep	Oyagak	bo1_090110d	N70.71497 W147.74778	1010	Resighting of whale	Chase
1-Sep	Oyagak	BO1_090110e	N70.71679 W147.75979	1016	Resighting of whale	Chase
1-Sep	Oyagak	BO1_090110f	N70.71684 W147.75998	1016	Duplicate of point e	Duplicate
1-Sep	Oyagak	BO1_090110g	N70.73378 W147.68450	1120	Whale sighting	Whale
1-Sep	Oyagak	BO1_090110h	N70.75283 W147.50388	1221	Coordinates for NUK whale sighting	Whale
1-Sep	Oyagak	bo1_090110i	N70.64681 W147.74718	1443	BO whale strike, estimated position	Strike
1-Sep	Oyagak	BO1_090110j	N70.64876 W147.80215	1614	Unknown - may be kill site of whale	Unknown
1-Sep	Oyagak	bo1_090110k	N70.64685 W147.80538	1655	Estimated start of tow	Tow
1-Sep	Oyagak	BO1_090110l	N70.50733 W147.98460	1719	Unknown, not on track (entered coordinates)	Unknown
1-Sep	Oyagak	BO2_090110a	N70.69164 W147.84172	1010	Small whale sighting	Whale
1-Sep	Oyagak	BO2_090110b	N70.75395 W147.51050	1232	Coordinates given for NUK whale as dead	Kill
1-Sep	Oyagak	BO2_090110c	N70.75259 W147.50705	1253?	Unknown - duplicate of NUK kill site?	Duplicate
1-Sep	Aqarguin	ian1_090110a	N70.65089 W147.66593	1429	IAN1 leaves tow of NUK whale to chase whale	Chase
1-Sep	Aqarguin	IAN2_090110a	N70.69755 W147.75948	952	Whale sighting	Whale
1-Sep	Aqarguin	IAN2_090110b	N70.64431 W147.69006	1425	Resighting of whale?	Chase
1-Sep	Aqarguin	IAN2_090110c	N70.64879 W147.80048	1552	Coordinates of BO whale kill site	Kill
1-Sep	Nukapigak	nuk1_090110a	N70.75495 W147.50674	1259	Estimated start of NUK whale tow	Tow
1-Sep	Nukapigak	NUK2_090110a	N70.75448 W147.50964	1219	Strike coordinates for NUK whale	Strike
1-Sep	Nukapigak	NUK3_090110a	N70.74806 W147.50892	1305?	Unknown (MOB)	Unknown
1-Sep	Taalak	TAL1_090110a	N70.52142 W147.80542	1509	Unknown (MOB)	Unknown
1-Sep	Taalak	TAL2_090110a	N70.75120 W147.70432	1025	Coordinates for whale sighting	Whale
1-Sep	Taalak	tal2_090110b	N70.65441 W147.64707	1423	Whale seen from NUK tow	Whale
1-Sep	Taalak	tal2_090110c	N70.64681 W147.74694	1442	TAL2 attempted strike (estimated position based on time of report- coordinates given not consistent with time or track properties)	Chase
1-Sep	Taalak	TAL2_090110d	N70.64785 W147.79883	1518	Coordinates for BO whale kill site (received from IAN2)	Kill

Boat Trip File/Form

The boat trip form/file is essentially an inventory of the GPS tracks collected and some preliminary processing of track characteristics (Table C5, see file "2010_Boat_Trips.xls" in the "Field Manual Example Files" directory on the accompanying CD-ROM). As such, it is also a fairly straightforward form. The information may seem redundant, but this serves as a series of internal checks. The first several columns are for the date of the GPS track, the crew that made the trip, and the boat from that crew that made the trip. The fourth column is the assigned track label, and takes the form of "boat identifier" underscore" date of track". In the case where a boat makes more than one trip on the same day, a lowercase letter should be added at the end indicating the sequence of the track in the day ("a" for the first, "b" for the second, and so on). This is also necessary when the track is fragmentary and cannot be easily joined together.

The number of crew members in the boat is information that must be obtained from the crew itself or from observation when the crew leaves. Time in and out can be from observation, but will also be available from the GPS track information, if the track is complete. It may be necessary to delete some track information to obtain this information, if the GPS was turned on before the trip actually started or was left on after the boat came back. Sometimes a GPS will be turned on "late" or turned off "early", in which case some approximations will need to be made. Times should be recorded using the military 24-hour convention, to make later computations easier. "Crew size" and the time indicators can also usually be recovered from the DCC log entries, although this is not always the case, and time information is sometimes several minutes off (for various reasons, one of which is that the whalers do not always immediately radio the DCC when they leave or arrive back at the island). That is, GPS unit times are usually more reliable than are DCC log or clock times – but it can be difficult to calibrate one to the other.

"Notes" on the form is to remind the researcher to indicate if there was anything different about the track. Usually this space is reserved for notes that the trip may have been for the tow only (no scouting) , non-whaling activities, or that some assumption about a missing part of the track has been made and included in the other entries.

The "TOT_min" column is the total time of the trip in minutes and is derived from the start and finish times. Usually it is easier to fill in the "HOURS" and "MIN" columns and then compute the minutes. It is not necessary to have a complete GPS track to derive these measures. The "RT" (roundtrip in miles) and "F_PT" are dependent on a complete (or mostly complete) GPS track, as they are direct measurements made on the track. MapSource actually provides the roundtrip distance of a track, although if the track is incomplete some estimates will need to be

made. The furthest point form Cross Island measurement must be made using the "distance" tool, but is a simple task. This will also indicate the bearing from Cross Island of the point.

The last column is a simple yes or no entry on whether a GPS track was collected for that trip or not. This is a handy reminder of tracks that may still need to be collected, as well as a running indicator of the percentage of scouting trips that have been documented.

Table C5: Example summary Boat Trip Form (2010)

Date (2010)	Crew	Boat	Track #	Crew #	Time out	Time in	Notes	TOT_min	HOURS	MIN	RT	F_PT	Track?
08/29/10	IAN	IAN1	IAN1_082910	4	10:01:00	22:55:00		774	12	54	65.5	20.5	Y
08/29/10	IAN	IAN2	IAN2_082910	4	10:05:00	22:09:00	In ?	724	12	4	66.0	20.6	Y
08/29/10	IP	IP1	IP1_082910	3	10:08:00	22:56:00		768	12	48	68.4	20.5	Y
08/29/10	IP	IP2	IP2_082910	3	10:05:00	22:56:00		771	12	51			N
08/29/10	IP	IP3	IP3_082910	3	10:03:00	22:56:00		773	12	53	63.0	20.3	Y
08/29/10	NAP	NAP1	NAP1_082910	5	9:57:00	22:56:00		779	12	59	75.8	20.5	Y
08/29/10	NAP	NAP2	NAP2_082910	3	9:59:00	20:30:00		631	10	31	87.3	20.5	Y
08/29/10	NUK	NUK1	NUK1_082910	2	20:11:00	22:37:00	Tow Only	146	2	26			N
08/29/10	NUK	NUK3	NUK3_082910	3	20:30:00	22:08:00	Tow Only	98	1	38	13.5	4.6	Y
08/31/10	BO	BO1	BO1_083110	3	6:52:00	16:41:00		589	9	49	87.4	20.8	Y
08/31/10	BO	BO2	BO2_083110	3	6:58:00	16:42:00		584	9	44	83.0	20.3	Y
08/31/10	IAN	IAN1	IAN1_083110	4	6:40:00	16:38:00		598	9	58	85.5	22.7	Y
08/31/10	IAN	IAN2	IAN2_083110	4	6:34:00	17:18:00		644	10	44	88.5	24.3	Y
08/31/10	NAP	NAP1	NAP1_083110	3	5:54:00	17:18:00		684	11	24	81.2	23.4	Y
08/31/10	NAP	NAP2	NAP_083110	3	6:00:00	6:13:00		13	0	13	3.8	1.2	Y
08/31/10	NUK	NUK1	NUK1_083110	3	7:01:00	17:18:00		617	10	17	81.8	21.9	Y
08/31/10	NUK	NUK2	NUK1_083110	3	7:13:00	17:18:00		605	10	5			N
08/31/10	NUK	NUK3	NUK1_083110	3	7:13:00	17:18:00		605	10	5	94.3	25.5	Y
08/31/10	TAL	TAL1	TAL1_083110	5	9:40:00	15:58:00		378	6	18	54.1	18.5	Y
08/31/10	TAL	TAL2	TAL2_083110	5	9:19:00	15:54:00		395	6	35	56.4	16.4	Y
09/01/10	BO	BO1	BO1_090110	4	8:31:00	20:45:00		734	12	14	83.2	21.4	Y
09/01/10	BO	BO2	BO2_090110	3	8:53:00	20:34:00		701	11	41	93.9	21.2	Y
09/01/10	IAN	IAN1	IAN1_090110	4	8:20:00	18:29:00	out ?	609	10	9	87.0	21.3	Y
09/01/10	IAN	IAN2	IAN2_090110	3	8:29:00	20:45:00	tow assumed	736	12	16	82.2	23.0	Y
09/01/10	NUK	NUK1	NUK1_090110	3	8:52:00	18:29:00		577	9	37	84.0	21.8	Y
09/01/10	NUK	NUK2	NUK2_090110	2	8:57:00	18:29:00	tow assumed	572	9	32			N
09/01/10	NUK	NUK3	NUK3_090110	2	8:53:00	18:29:00	tow assumed	576	9	36	98.2	22.0	Y
09/01/10	TAL	TAL1	TAL1_090110a	5	9:15:00	10:10:00	Abort	55	0	55	8.3	2.0	Y
09/01/10	TAL	TAL1	TAL1_090110c	4	14:50:00	20:53:00	Tow only	363	6	3	40.0	11.7	Y
09/01/10	TAL	TAL2	TAL2_090110	5	9:23:00	20:42:00		657	10	57	76.4	21.2	Y

Cross Island Population file

Two example files are on the CD-ROM for this information – the file with simple aggregated population data as sent to the sponsor, and an empty workbook with four worksheets that was completed in the field as a data organizational tool. Because of confidentiality concerns, this data was not shared with the sponsor.

The file "CI_POP20XX.xls" includes two worksheets. One contains the data on how many people were on Cross Island each day, how many boats were on the island, how many crews were on the island, how many boats went out scouting, and how many people went out scouting. The other worksheet is a graph plotting the total Cross Island population, the boats out scouting, and the number of people out scouting by day. Using this as a template, similar graphs can be made for future whaling season.

The file "EXAMPLE_CI_POP_20XX.xls" is a four worksheet workbook that is somewhat more complicated and is the basis for the aggregated data in "CI_POP2010". For the "Boat Summary" worksheet, one simply enters a notation of any activity for the boat and the crew number (if the boat went out scouting and nothing if not), and totals the columns for the boats out scouting. The number of boats on the island need to be physically (or mentally) counted. The "Crew List" worksheet is simply a listing of the members of crew. This can be my name or by assigned code, and is the basis for the "Active Whaling" and "Cross Island Population" worksheets. For those sheets, a "1" is entered in the cell for any day for which that person went out whaling for "Active Whaling" or was on Cross Island for "Cross Island Population". The totals for each column are then totaled automatically by a formula. This example worksheet includes real data for one of the study years, but it has been somewhat jumbled so that individual identities are somewhat protected. The same coded letter is not consistently applied to the same crew. How to complete the characteristics of the boats used should be self-evident, so that information was deleted from the file. The other files are clearly from 2010, and could not really be coded and still be useful as templates or examples.

Weather file and Season Summary Charts

The weather file workbook, with six worksheets, is the most complex of the files and the graphic produced from it the most complicated. The Cross Island weather information is as downloaded from the weather station installed seasonally for the project and transformed into an Excel spreadsheet. Care must be taken when examining the resulting data to ensure that "missing" records are accounted for. "Missing" records (a sampling time for which the panel did not receive a reading from the instruments) was not unusual for the BOEM project season, but was usually represented by "0" readings or by a simple repeat of the reading for the previous sampling time. The Deadhorse weather station readings, on the other hand, simply dropped the "missing" observations, so to match up the times of observations for the two stations, it is necessary to examine the time sequence of the Deadhorse readings to ensure that it is continuous and, when it is not, to add in the appropriate sampling times with placeholder readings of "0" (the "Weather Data-CI and Deadhorse" worksheet). Since the Cross Island weather station samples every five minutes and the Deadhorse station every six minutes, it was easier simply to

use the hourly Deadhorse information, rather than downloading the six-minute information and extracting the hourly and half-hourly information that would match up with the Cross Island readings. Care must also be taken to adjust the Deadhorse readings to local time. Once the readings from the two sources are matched, the appropriate hourly data is extracted to the "Data for Chart" worksheet. Additional columns are included on this worksheet for "Boating Wind speed" (wind speed while at least one boat is out scouting for whales) for both weather stations and "Strike Wind speed" (wind speed when a strike occurred) for the Cross Island weather station only. For strikes, this wind speed reading was taken as the closest reported value to the time of the strike. The "Boating Wind speed" was computed as the average of all the reported wind speed values for the period during which at least one whaling boat was out scouting, chasing, or towing a whale. The averages for the Cross Island and the Deadhorse weather station often differed significantly. The average was graphed so that it would display in relation to the varying reported wind speeds from the two weather stations.

The chart is then generated from the data entered into the "data for Chart" worksheet. When using this worksheets as templates, care must be taken to enter the data in the proper form and location, and to change the data ranges as needed, since the timing of each whaling season is different. The "Wind Direction" data worksheet and chart worksheet are similarly related. Similar wind direction charts can be generated from future data using them as templates.

SUMMARY

This brief field manual should enable interested parties to collect similar data to that of the BOEM 2001-2012 Cross Island Documentation Project. Procedures to collect and archive the primary GPS data have been described. Supplementary observational data have been outlined, and the usefulness of the DCC log as a crosscheck and/or supplement to both GPS and observational information has been stressed. Some reasonably simple Excel spreadsheets have been described and provided as templates for the compilation and primary analysis of the data.

Past CD-ROM Sleeve Here

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 the 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 communities.

The Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.