OCS Study
BOEM 2014-018

Distribution and Relative Abundance of Marine Mammals in the Northeastern Chukchi and Western Beaufort Seas, 2013 Annual Report

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Final Report

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DISCLAIMER

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ABSTRACT

This report describes field activities and data analyses for the Aerial Surveys of Arctic Marine Mammals (ASAMM) project conducted during summer and fall (1 July – 28 October) 2013. Surveys were based in Barrow and Deadhorse, Alaska, and targeted the northeastern Chukchi and western Beaufort seas, between 68°N and 72°N, 140°W and 169°W.

Sea ice cover in the study area in 2013 was generally light when compared with historical (pre-2007) sea ice cover. Sea ice remained in much of the Chukchi Sea study area in early July, with shorefast ice present from Point Barrow to Cape Lisburne. By mid-July, sea ice in the Chukchi Sea had receded to the northernmost survey blocks and the majority of the nearshore areas in the western Alaskan Beaufort Sea had ~1% sea ice, although ~30-100% sea ice cover between Harrison Bay and Point Barrow. Remnant sea ice persisted in the northeastern Chukchi Sea study area through mid-September, but the western Beaufort Sea study area was ice-free by late August. By 23 September the entire study area was almost completely ice-free and remained open until new ice started forming in late October when the 2013 field season ended.

A total of 90 survey flights were conducted. Two aerial survey teams conducted surveys from July through September and one aerial survey team conducted surveys from 20-28 October. There was no survey effort from 1-19 October due to the partial government shutdown; that was the first time in >30 years that surveys were not conducted in early October. Total combined flight time was 403 hours, including 183 hours of transect survey effort. Over 104,000 km were flown, with 40,026 km of effort on transect. Surveys were conducted in the western Beaufort Sea in summer (mid-July through August) for the second consecutive year.

There were 2,588 sightings of 37,938 marine mammals observed during all (transect, search and circling) survey modes, including:

- 424 sightings of 743 bowhead whales (*Balaena mysticetus*),
- 174 sightings of 281 gray whales (*Eschrichtius robustus*),
- 2 sightings of 4 humpback whales (*Megaptera novaeangliae*),
- 3 sightings of 3 fin whales (*Balaenoptera physalus*),
- 5 sightings of 5 minke whales (*Balaenoptera acutorostrata*),
- 446 sightings of 1,601 belugas (*Delphinapterus leucas*),
- 46 sightings of 47 unidentified cetaceans,
- 370 sightings of 33,392 Pacific walruses (*Odobenus rosmarus divergens),*
- 79 sightings of 82 bearded seals (*Erignathus barbatus*),
- 5 sightings of 5 ringed seals (*Pusa hispida*),
- 1,015 sightings of 1,733 unidentified pinnipeds, and
- 19 sightings of 42 polar bears (*Ursus maritimus*).

Bowhead whales were seen in all months of the study period. Distribution in the western Beaufort Sea (140°W to 157°W) was primarily on the outer continental shelf (51-200 m depth) in July, on the outer and inner continental shelf (0-200 m depth) in August, and on the inner continental shelf (≤50 m depth) in September. Sighting rate (whales per transect km) by depth zone between 140°W and 154°W in the western Beaufort Sea was highest in the 51-200 m zone

in July, the ≤20 m zone in August, and the 21-50 m zone in September. Sighting rate by depth zone in the Barrow Canyon area (154°W to 157°W) was highest in the 51-200 m zone in August and October, and the ≤20 m zone in September. In the northeastern Chukchi Sea, bowhead whales were scattered in July and August; the majority of sightings occurred in September west of Barrow between 71°N and 72°N, in the 51-200 m North depth zone. The survey block with the highest overall bowhead whale sighting rate in July was block 7. Block 4 had the highest overall sighting rate in August and September. The few bowhead whales seen during the limited survey effort in late October were in block 12, located at the margin of the northeastern Chukchi and western Beaufort seas. The northeastern Chukchi Sea survey block with the highest overall sighting rate was block 15. Bowhead whales sighted in July 2013 were significantly farther from shore and in deeper water than bowhead whales sighted in August 2013; similar differences were observed in 2012. Compared to previous years with light sea ice cover (i.e., 1989, 1990, 1993-2012), bowhead whale sightings (not normalized by survey effort) in the western Beaufort Sea in fall 2013 were significantly farther from shore and in deeper water in the West Region (148°W-156°W); no significant difference was noted in distance from shore or water depth at sighting locations in the East Region (140°W-148°W). Spatial models of bowhead whale relative abundance (accounting for heterogeneous survey effort) in the western Beaufort Sea were created to examine high-use areas (HUAs) during the fall (September-October) of 2013 and during July through October (each month separately) for the 14-year period from 2000 to 2013. The spatial model for 2013 suggested that the median distribution of bowhead whales during the fall was located slightly farther from shore in the West Region than the East Region. Furthermore, the spatial model for 2000 to 2013 suggested that the bowhead whale HUA was located farthest from shore in July compared to August, September, and October. Finally, comparison of the predictions from the two spatial models suggested that bowhead whale HUAs were located slightly farther offshore in both the East and West regions in 2013 compared to the most recent 14-year time series. Sixty-six bowhead whale calves were seen in 2013, including twenty-nine calves seen during July and August in the western Beaufort Sea. The fall bowhead whale calf ratio (number of calves/number of total whales) was higher than any calf ratio previously reported from these surveys. Feeding and milling were noted for bowhead whales in several locations from July through September, including east and southeast of Point Barrow; large feeding aggregations (>30 whales) were seen in Camden Bay on one day in August and north of Smith Bay on one day in September.

Gray whales were seen in all months of the study period in the northeastern Chukchi Sea and westernmost Alaskan Beaufort Sea (just east of Point Barrow), although sightings were fewer than in 2011 and 2012. Gray whale aggregations were observed within ~50 km of the Alaskan coastline between Point Barrow and Icy Cape, and lower sighting densities were found south and west of Point Hope and >200 km offshore of Icy Cape. A few gray whales were seen near the southern extreme of Hanna Shoal. Sighting rate by depth zone was highest in the ≤35 m zone in the northeastern Chukchi Sea; highest sighting rate per month occurred in July and decreased sharply in August and September. Most gray whales (68%) were feeding. Fifty-seven gray whale calves were seen, although some calf sightings may have been repeat sightings.

Additional noteworthy results from the 2013 ASAMM field effort included:

- Humpback whales (two sightings of four whales) were sighted in the northeastern Chukchi Sea.

- Fin whales (three sightings of three whales) were sighted in the northeastern Chukchi Sea.
- Minke whales (five sightings of five whales) were sighted in the northeastern Chukchi Sea.
- Beluga distribution in the western Beaufort Sea in summer and fall was centered over the continental slope and Barrow Canyon, with few sightings nearshore. Beluga sightings were scattered in the northeastern Chukchi Sea in all months. One large group (400 whales) was seen near Kasegaluk Lagoon in July.
- Walruses were observed in the water and hauled out on ice, particularly near Hanna Shoal. One walrus haulout on land was observed near Point Lay in mid-September, with an estimated maximum group size of 10,000 animals.

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Abbreviations and Acronyms

ADFG	Alaska Department of Fish and Game
AFSC	Alaska Fisheries Science Center
ARBO	Arctic Region Biological Opinion
ASAMM	Aerial Surveys of Arctic Marine Mammals
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOWFEST	Bowhead Whale Feeding Ecology Study
BSPA	Beaufort Sea Planning Area
BWASP	Bowhead Whale Aerial Survey Project
CI	confidence interval
COMIDA	Chukchi Offshore Monitoring in Drilling Area
CSPA	Chukchi Sea Planning Area
e.g.	for example
ENVISAT	Environmental Satellite
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FR	Federal Register
GAM	Generalized Additive Model

GIS	Geographic Information System
GPS	Global Positioning System
GRS	Geodetic Reference System
hr	hour
HUA	High Use Area
i.e.	that is
IBCAO	International Bathymetric Chart of the Arctic Ocean
km	kilometer
m	meter
Max	maximum
Min	minimum
MIZOPEX	Marginal Ice Zone Observations and Processes Experiment
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MODIS	Moderate Resolution Imaging Spectroradiometer
n	sample size
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
nm	nautical mile
NMFS	National Marine Fisheries Service
NMML	National Marine Mammal Laboratory
NSB	North Slope Borough
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
P	probability
PMEL	Pacific Marine Environmental Laboratory
s	second
SD	standard deviation
Tr	transect
TrSi	transect sightings
UAF	University of Alaska Fairbanks
UAS	unmanned aerial system
UAV	unmanned aerial vehicle
USB	universal serial bus
USC	U.S. Code
USCG	U.S. Coast Guard
USDOC	U.S. Department of Commerce
USDOD	U.S. Department of Defense
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WHOI	Woods Hole Oceanographic Institute
WPUE	whales per unit effort (index of relative abundance or occurrence)

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INTRODUCTION

In 1953, the Outer Continental Shelf Lands Act (OCSLA) (43 USC 1331-1356) charged the U.S. Secretary of the Interior with the responsibility of administering minerals exploration within and development of the Outer Continental Shelf (OCS). The Act empowered the Secretary to formulate regulations so that its provisions could be met. The OCSLA Amendments of 1978 (43 USC 1802) established a policy for the management of oil and natural gas in the OCS and for protection of the marine and coastal environments. The amended OCSLA states that the Secretary of the Interior shall conduct studies in areas or regions of sales to ascertain the "environmental impacts on the marine and coastal environments of the Outer Continental Shelf and the coastal areas which may be affected by oil and gas development" (43 USC 1346).

Subsequent to the passage of the OCSLA, the Secretary of the Interior designated the Bureau of Land Management (BLM), U.S. Department of the Interior (USDOI), as the administrative agency responsible for leasing submerged federal lands, and the Conservation Division of the U.S. Geological Survey (USGS) for classifying and evaluating submerged federal lands and regulating exploration and production. In 1982, the U.S. Minerals Management Service (MMS) assumed these responsibilities. The MMS was renamed the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) in 2010. In 2011, the Bureau of Ocean Energy Management (BOEM) assumed responsibilities for administering environmentally and economically responsible development of offshore resources.

To provide information used in Environmental Impact Statements and Environmental Assessments under the National Environmental Policy Act (NEPA) of 1969 (42 USC 4321-4347), and to assure protection of marine mammals under the Marine Mammal Protection Act (MMPA) of 1972 (16 USC 1361-1407) and the Endangered Species Act (ESA) of 1973 (16 USC 1531-1543), the BLM (and, later, MMS) funded numerous studies involving acquisition and analysis of marine mammal and other environmental data.

In June 1978, the BLM entered into an Endangered Species Act Section 7 consultation with the National Marine Fisheries Service (NMFS). The purpose of the consultation was to determine the likely effects of the proposed Beaufort Sea Oil and Gas Lease Sale on endangered bowhead (*Balaena mysticetus*) and gray whales (*Eschrichtius robustus*). NMFS determined that insufficient information existed to conclude whether the proposed Beaufort Sea sale was likely to jeopardize the continued existence of bowhead and gray whales. In August 1978, NMFS recommended studies to the BLM that would fill the information needs identified during the Section 7 consultation. Subsequent Biological Opinions for leasing and exploration in the Beaufort Sea (Sales 71, 87, and 97) and the 1988 Arctic Region Biological Opinion (ARBO) used for Beaufort and Chukchi sea sales (Sales 124, 126, 144, and 170) recommended continuing studies of whale distribution and OCS-industry effects on bowhead whales (USDOC, NOAA, NMFS 1982, 1983, 1987, and 1988), in addition to monitoring bowhead whale presence during periods when geophysical exploration and drilling were occurring. The 2006 and 2008 ARBO issued by NMFS for leasing and exploration in the U.S. Beaufort and Chukchi seas, Alaska, and authorizations of small takes under the Marine Mammal Protection Act (USDOC, NOAA, NMFS 2008) recommended the following conservation recommendations:

> MMS and NMFS should continue research to update environmental inventories of marine mammals for the Chukchi Sea. Marine mammal surveys should be continued. MMS should consider a comprehensive program for this purpose which employs aerial and ship based efforts as well as the use of passive acoustics. In particular, the current BWASP [Bowhead Whale Aerial Survey Project] program should be expanded to include Block 13. MMS should particularly engage in research to describe bowhead whale behavior, movements and distribution, and important habitats in these waters. Efforts should be made to obtain photographs of humpback whales within the area for photo-identification…
>
> MMS should continue research to describe the impact of exploration activities on the migrational movements and feeding behavior of the bowhead whale. Specific plans should be developed and implemented to monitor the cumulative effects of exploration, development, and production on the bowhead whale. These research designs and results should be reviewed annually to ensure that the information collected is addressing the concerns of NMFS and the affected Native communities.

The current ARBO, issued by NMFS in 2013 for oil and gas leasing and exploration activities in the U.S. Beaufort and Chukchi Seas, Alaska (USDOC, NOAA, NMFS 2013) includes the following conservation recommendations:

> Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).
>
> 9. Under the BOEM Environmental Studies Program, consider studies to monitor abundance, trends, habitat use, and productivity of listed species to assist with understanding potential effects of human activities on populations;
>
> 10. Under the BOEM Environmental Studies Program, consider specifically [studies] designed to assess abundance, population trends, habitat use, and productivity of ringed and bearded seal populations that may be affected by oil and gas development.

Following several years when drilling was limited to the period 1 November through 31 March (USDOI, MMS 1979), variable two-month seasonal drilling restrictions on fall exploratory activity in the joint Federal/State Beaufort Sea sale area were implemented in May 1982. The MMS (Alaska OCS Region) adopted an endangered whale monitoring plan that required aerial surveys. The Diapir Field Sale 87 Notice of Sale (1984) stated that "Bowhead whales will be monitored by the Government, the lessee, or both to determine their locations relative to operational sites as they migrate through or adjacent to the sale area" (USDOI, MMS 1984). Subsequent lease sales in the Beaufort Sea Planning Area (BSPA) (Sales 97, 124, 144, 170, 186, 195, and 202) and Lease Sale 193 in the Chukchi Sea Planning Area (CSPA) did not include a seasonal drilling restriction, but the Notice of Sale for each contained an Information to Lessees clause stating that the "MMS intends to continue its area wide endangered whale monitoring program in the Beaufort Sea during exploration activities" (USDOI, MMS 1988, 1991, 1996, and

1998). Information gathered during the monitoring program was used to help determine the extent, if any, of adverse effects on the species.
From 1979 to 1987, the BLM and then the MMS funded annual monitoring of endangered whales via aerial surveys in arctic waters under Interagency Agreements with the Naval Ocean Systems Center and through subcontracts to SEACO, Inc. (Ljungblad et al. 1987). The MMS used agency personnel to perform fieldwork and reporting activities for surveys conducted in the western Beaufort Sea on an annual basis from 1987 to 2006 (referred to as the Bowhead Whale Aerial Survey Project, BWASP) (Treacy 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 2000, 2002a, 2002b; Monnett and Treacy 2005; and USDOI, MMS 2008). In 2007, an Interagency Agreement between the MMS (U.S. Department of the Interior) and NMFS (specifically, the Alaska Fisheries Science Center [AFSC], U.S. Department of Commerce) was established to authorize the National Marine Mammal Laboratory (NMML, a division of AFSC) to conduct BWASP surveys and assume partial responsibility for the management of the project. In 2008, NMML adopted full responsibility for all aspects of the BWASP surveys and related tasks, with continued funding and co-management by the MMS (now BOEM) (Clarke et al. 2011a, 2011b, 2011c).

The Chukchi Offshore Monitoring in Drilling Area (COMIDA) marine mammal aerial survey component was initiated in 2008, via an Interagency Agreement between the MMS and AFSC. These surveys were a continuation of aerial surveys that were conducted by MMS-sponsored contractors from 1982-1991 (Ljungblad et al. 1987; Moore and Clarke 1992) and used similar methodology. The goal of the COMIDA aerial surveys was to investigate the distribution and relative abundance of marine mammals in the CSPA during the open water (ice-free) months of June-October, when various species undertake seasonal migrations through the area. The COMIDA study area encompassed the northeastern Chukchi Sea from the shore seaward, 68°N to 72°N and 157°W to 169°W, and overlaid Lease Sale 193 (offered in February 2008) (Clarke et al. 2011d).

In 2011, an Interagency Agreement between the BOEM and AFSC was established to authorize NMML to continue the BWASP and COMIDA studies under the auspices of a single study, Aerial Surveys of Arctic Marine Mammals (ASAMM). The goal of the ASAMM study is to document the distribution and relative abundance of bowhead, right, fin and gray whales and other marine mammals in areas of potential seismic surveying, drilling, construction, and production activities in the western Beaufort and northeastern Chukchi seas (Clarke et al. 2012, 2013a). Data from the project shall be used to relate variation in marine mammal distribution or relative abundance to other variables, such as physical oceanographic conditions, indices of potential prey density, and anthropogenic activities, if information on these variables is available.

The objectives of the ASAMM study are to:

1) Describe the annual migration of bowhead whales across the Alaskan Arctic, significant inter-year differences, and long-term trends in the spatial distribution and timing (duration and start date) of the migration.

2) Document relative abundance, spatial and temporal distribution, and behavior (including calving/pupping, feeding, hauling out) of marine mammals (cetaceans, ice seals, walruses, and polar bears) in the Alaskan Arctic.

3) Provide near real-time data and maps to BOEM and NMFS on marine mammals in the Alaskan Arctic, with specific interest in endangered species, such as bowhead whales.

4) Provide an objective wide-area context for understanding marine mammal ecology in the Alaskan Arctic, to help inform management decisions and interpret results of other small-scale studies.

5) Provide, when requested by BOEM's Representative, limited integrative products such as graphics of summarized observations for use by BOEM analysts in NEPA and ESA analyses and documentation.

6) Provide timely information on environmental conditions, including ice conditions, to organizations (e.g., National Ice Center, Alaska Eskimo Whaling Commission, BOEM) as directed by BOEM's Representative.

METHODS AND MATERIALS

Study Area

The study area encompasses the western Beaufort and northeastern Chukchi seas (Figure 1). Survey blocks overlay Beaufort Sea and Chukchi Sea oil and gas lease sale areas offshore of Alaska. The study area partially overlaps the CSPA and BSPA but does not completely encompass either. The present study includes survey blocks 1 through 22 between 140°W and 169°W, and between 68°N and 72°N, and encompasses approximately 230,000 km^2. Survey blocks 1 through 12 (140°W to 157°W) comprise the western Beaufort Sea (formerly BWASP) study area, while survey blocks 13 through 22 (157°W to 169°W) comprise the northeastern Chukchi Sea (formerly COMIDA) study area.

The Chukchi Sea is largely ice-covered from late fall through winter. In spring, open water leads begin to develop, as ambient temperatures increase and warmer water flows northward from the Pacific Ocean through the Bering Sea and Bering Strait. The most nutrient rich waters flow in the Siberian Coastal Current, west of the ASAMM study area. Two less productive water masses, the Alaska Coastal Water and Bering Shelf Water, are found in the northeastern Chukchi Sea (Figure 2). Current flow may be with or opposite that of predominant winds.

In the Beaufort Sea, the Beaufort Gyre moves surface waters clockwise in the offshore regions. Underlying the gyre is the eastward-flowing Beaufort Undercurrent, which flows subsurface in areas where bathymetry is 51 to 2,000 m and undergoes frequent current reversals to the west (Aagaard 1984). In the nearshore shallow waters of the Beaufort inner shelf (≤50 m depth), currents tend to follow local wind patterns. In winter, currents are not substantial, even when winds are strong. In summer, currents are much stronger and may flow either east or west, depending on prevailing winds. Based on analysis of modeled sea level and ice motion, wind-driven motion in the Arctic was found to alternate between anticyclonic and cyclonic circulation, with each regime persisting from five to seven years (Proshutinsky and Johnson 1997; Johnson et al. 1999).

Shorefast ice forms during the fall and may eventually extend up to 50 km offshore by the end of winter (Norton and Weller 1984). The pack ice, which may include multiyear ice averaging 4 m in thickness with pressure ridges up to 50 m thick (Norton and Weller 1984), becomes contiguous with new and shorefast ice in late fall. From late November to mid-May, the Beaufort Sea normally remains almost completely covered by ice. In spring, a recurring lead forms just seaward of the stable shorefast ice, followed by decreasing ice concentrations (LaBelle et al. 1983) and large areas of open water in summer. In recent years, the minimum area of the summer ice pack has been shrinking, setting records for new minima in several years, including 2007-2012 (National Snow and Ice Data Center 2007, 2008, 2009, 2010, 2011, 2012). Arctic summer sea ice extent continued to decline in 2013 (National Snow and Ice Data Center 2013). Since 2007, the open water season has lengthened and the southern edge of the ice pack has been farther from Alaskan coastlines during annual sea ice minima. The decrease in sea ice extent has been correlated with an increase in Arctic Ocean cloud cover (Eastman and Warren 2010).

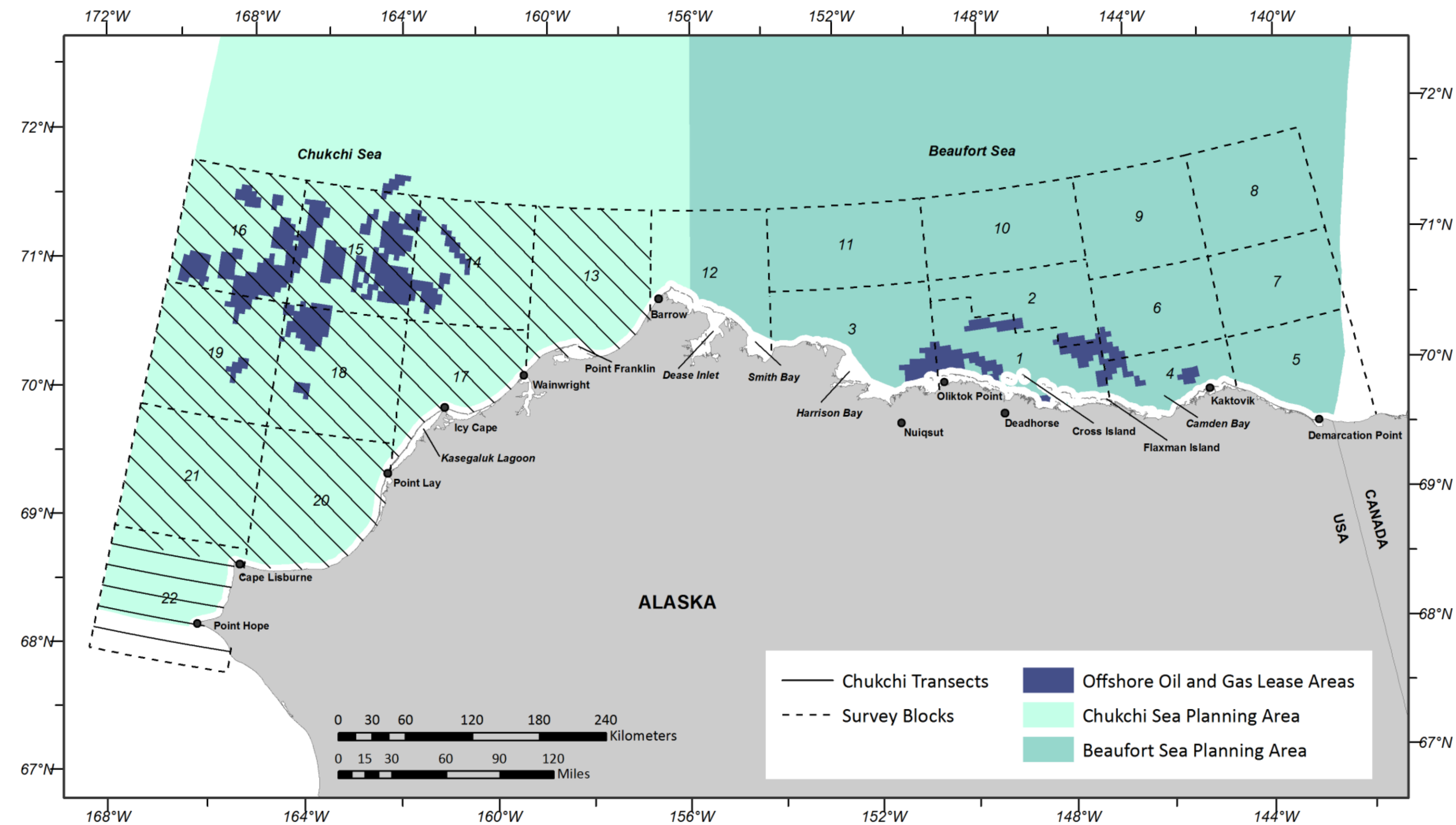


Figure 1. ASAMM study area showing survey blocks, 2013 Chukchi Sea transect lines, Chukchi Sea Planning Area, Beaufort Sea Planning Area, and current lease areas. Transect lines in the Beaufort Sea are generated daily and, therefore, not shown.

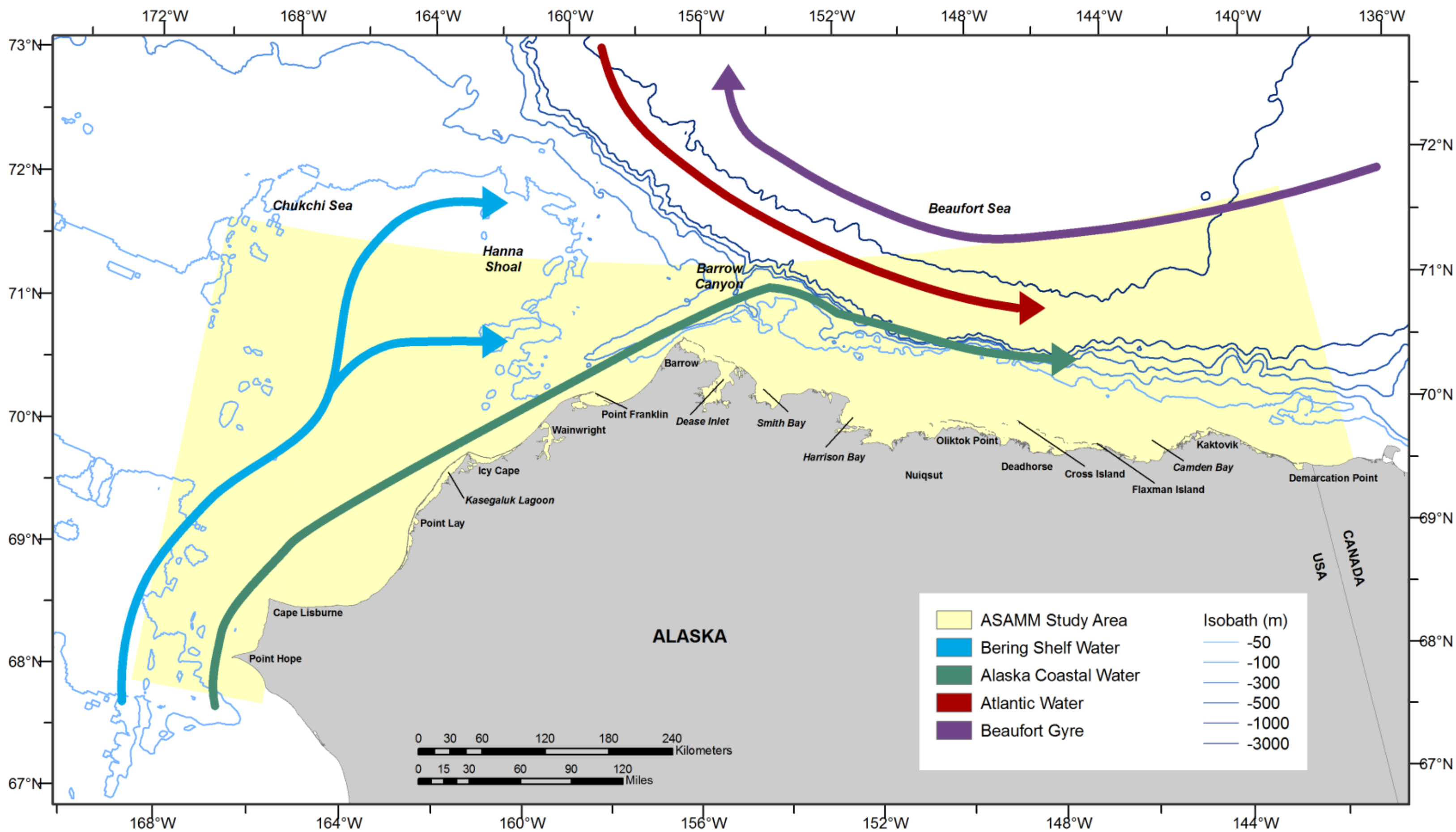


Figure 2. Northeastern Chukchi Sea and western Beaufort Sea major currents and isobaths.

Local weather patterns affect the frequency and efficacy of all marine aerial surveys. The ASAMM study area is in the Arctic climate zone, with mean air temperatures at western Beaufort Sea coastal locations ranging from -0.9°C to -0.1°C during September and from -9.7°C to -8.5°C during October (Brower et al. 1988). Mean annual air temperatures measured at Barrow, Alaska, from 1972 to 2007 increased by 2.9°C, likely due to circulation changes (increased warm air advection from southern latitudes) or increased infrared back-radiation due to increased cloudiness, water vapor or carbon dioxide (Wendler et al. 2009, 2011). The heaviest precipitation (snow and rain) occurs in September and October (Brower et al. 1988), but the total annual precipitation in the Alaskan Arctic has decreased since the late 1940s (Stafford et al. 2000). Mean wind speed at Barrow and Barter Island, Alaska, is from 5-6 m/s during September and 5-7 m/s during October (Brower et al. 1988). Wind speeds in September and October are generally higher than during other times of the year, perhaps because the open water and cooling land mass increase thermal instability (Wendler et al. 2009). Wind direction is predominantly easterly, driving the Beaufort Gyre, but winds occasionally reverse and shift to being westerly. The occurrence of storms during which at least one hourly reading of wind speed was >15 m/s (approximately Beaufort wind force 7) also increased from 1972 to 2007 (Wendler et al. 2009). Mean annual wind speed recorded at Barrow from 1972-2007 was 5.6 m/s (Wendler et al. 2009).

Sea state also affects visibility during aerial surveys. Surface waters in the Beaufort and Chukchi seas are influenced primarily by wind. Ocean waves are generally from the north or east during September and October. Prior to 1997, significant wave heights were reduced by a factor of four from heights that would otherwise be expected during the open water season because pack ice limited fetch. Since 1997, large expanses of open water have been present during some or all of the field season. Corresponding wave heights have been considerably higher during periods of strong wind, obscuring visibility of marine mammals due to wave height, whitecaps and/or spray.

Equipment

Surveys were flown in Aero Commander 690A twin turbine aircraft, provided by Clearwater Air, Inc. Observers and pilots were linked with a common communication system. The maximum time aloft in the Aero Commander was approximately 5.5 hours, including fuel reserve. Onboard safety equipment included an impact-triggered emergency locator transmitter installed in the aircraft, an 8-person search and rescue life raft equipped with an emergency survival kit, a portable personal locator beacon, portable marine and aviation band transceivers, and orange immersion suits. All personnel participating in the surveys underwent safety trainings, were thoroughly briefed on aircraft operations, and participated in aircraft egress drills. All personnel wore either flight or dry suits and were outfitted with Switliks or other personal floatation devices containing emergency equipment.

Aircraft were equipped with bubble windows that afforded primary observers a complete view of the trackline. The pilot and copilot had good forward and side viewing. Each observer was issued a hand-held clinometer for measuring the angle of declination to sighting locations. A laptop computing system was used aboard each aircraft to display, store and analyze flight and observational data. The computer system was connected to a Garmin Global Positioning System

(GPS) with an external antenna, independent of the aircraft GPS. Latitude, longitude, and aircraft altitude from the GPS were transmitted to the computer through a USB connection. Specialized software developed for ASAMM was used to help prompt data recording. A custom mapping component of the software permitted the data recorder to view sightings along the aircraft's trackline in real time. Data were continually backed up to an onboard external hard drive throughout each flight.

The USDOI, Bureau of Land Management, Alaska Interagency Coordination Center, South Zone Dispatch, used Automated Flight-Following for real-time satellite-tracking of project aircraft. Dispatch personnel monitored current flight status via maps, and hourly updates were communicated from the aircraft to Dispatch via Iridium satellite phones. In addition to these flight-following protocols, onboard transponders were set at discrete identification codes for radar tracking by air-traffic-control personnel. Detailed communication protocols were developed to coordinate ASAMM "manned" surveys with several unmanned aerial vehicle (UAV) operations that were conducted in overlapping airspace in 2013. Communication protocols are currently the only means available to deconflict airspace between UAVs and manned aircraft.

Survey methods, equipment, and standard procedures have been developed and refined over the duration of the ASAMM project and precursor studies (1979-2012). Additional details of onboard equipment, data collection, and post-field analyses are described in detail elsewhere (e.g., Monnett and Treacy 2005; USDOI, MMS 2008; Clarke et al. 2011a, 2012, 2013a).

Aerial Survey Design

Aerial surveys were based out of Barrow, Alaska, to target the northeastern Chukchi Sea study area, and out of Deadhorse, Alaska, to target the western Beaufort Sea study area. The field schedule was designed to maximize survey effort during the open water time period in the northeastern Chukchi Sea and monitor the progress of the bowhead whale migration across the western Beaufort Sea.

Transects in both study areas were perpendicular to the coastline to cross major bathymetric features, such as Barrow Canyon, Hanna Shoal and the Beaufort Sea shelf and slope, and bowhead whale and beluga migration paths. Survey design differed slightly between the two study areas.

In the Beaufort Sea (140°W to 157°W), survey design focused on survey blocks to maintain consistency to the flight planning protocol established in the Beaufort Sea component of ASAMM in the 1980s. Sets of unique transects were computer-generated prior to each flight for each survey block or set of two survey blocks (for blocks oriented together on a north-south axis). Transects were derived by dividing each survey block into sections 30 minutes of longitude across. One of the minute marks along the northern edge of each section was selected at random and then connected by a straight line to a similarly selected endpoint along the southern edge of the same section. This procedure was followed for all sections of the survey block, resulting in a series of transect lines. The transect lines were then alternately connected at their northernmost or southernmost ends to produce one continuous flight path within each survey block. Transects changed each time a survey block was surveyed, so that unique parts of the survey block were covered on each flight. Allocations of survey effort in the Beaufort Sea favored coverage of inshore survey blocks 1 through 7, 11 and 12 because bowhead whales were rarely sighted north of these blocks in three decades of previous aerial surveys, and this pattern has been confirmed by satellite tag data (Quakenbush et al. 2010b). The purpose of these survey-effort allocations was to increase the sample size of bowhead whale sightings within high-use areas (HUA), thus increasing the power of statistical analyses within inshore blocks.

In the northeastern Chukchi Sea (157°W to 169°W), thirty-two transects were generated once at the beginning of the field season and then flown for the duration of the field season (Figure 1). Transects were parallel to each other and spaced 19 km apart to be consistent with the mean distance that transects were generally spaced in the Beaufort Sea study area. The coastal endpoints for the set of Chukchi Sea transects are randomly shifted each year, while maintaining a consistent orientation to the coast. This survey design allows examination of differences in marine mammal distribution and relative density at each unique transect over the course of a field season, and theoretically generates uniform coverage throughout the northeastern Chukchi Sea study area when multiple years of effort are pooled. The survey design also included a coastal transect located one km offshore between Point Barrow and Point Hope, Alaska. The coastal transect allowed better documentation of nearshore habitat, including pinniped haulouts along the coastline.

The selection of transects or survey blocks to be flown on a given day was nonrandom, based on reported or observed weather conditions over the study area, avoidance of recently surveyed areas, and the need to deconflict airspace with UAV and other aerial operations. Weather permitting, the project attempted to distribute effort fairly evenly across the entire study area, with the exception of the northeasternmost Beaufort Sea survey blocks (blocks 8, 9, and 10), as noted above, and the southern Chukchi Sea survey blocks (blocks 20, 21, and 22) because they are south of Sale 193 lease areas.

Survey Flight Procedures

During a typical flight, a search or deadhead leg was flown to the targeted survey block or transect line. A series of transect lines were then flown, followed by a search or deadhead leg back to the base of operations. Survey speed was generally 213 km/hr. Survey effort over land or in areas with zero visibility was designated as deadhead and not incorporated into further analyses. Data were not collected during deadhead segments. Transects were joined together by short search or deadhead legs. Surveys were generally flown at a target altitude of 365 m in the northeastern Chukchi Sea and 458 m in the Beaufort Sea, but could be flown as low as 305 m in either area. Higher altitudes were maintained to maximize visibility and minimize potential disturbance to marine mammals in favorable weather. When cloud ceilings were less than 305 m or the wind force was above Beaufort 5, survey flights were redirected to survey blocks or transects with better conditions. Survey flights were aborted when conditions consistently did not meet minimum altitude (305 m) or wind force (Beaufort 5) requirements.

Primary observers (two total) were stationed on each side of the aircraft at bubble windows that permitted an unobstructed field of vision from the trackline directly below the aircraft to the horizon. The data recorder was primarily responsible for data entry but also functioned as a secondary observer. Sightings from primary observers during transect effort were recorded as on-effort; sightings by the data recorder, pilots, or occasional fourth observer during transect effort were considered off-effort.

When cetaceans were encountered, the aircraft usually diverted from the trackline for brief (<10 minute) periods and circled the whales to verify species, observe behavior, obtain better estimates of group size, and determine whether calves were present. Any new sightings of whales made while circling were recorded as sightings "on circling". Sightings made off transect and not while circling were recorded as sightings "on search". All search and circling sightings were considered off-effort.

Data Entry

Identical protocols were used to collect data in the two study areas. Customized, menu-driven data entry software was used to record all data in database format (Microsoft Access). Time and location data (date, time, latitude, longitude, altitude, and aircraft heading) and environmental conditions (sky conditions, visibility [km] and visual impediments, percent sea ice cover, ice type, and Beaufort wind force) were recorded at sightings, during transitions in flight type (transect, search, or circling), when environmental conditions changed, or otherwise at intervals of 5 minutes (in time). Wind force was recorded according to the Beaufort scale outlined in *Piloting, Seamanship, and Small Boat Handling* (Chapman 1971). Ice type was identified using terminology presented in Naval Hydrographic Office Publication Number 609 (USDOD, Navy, Naval Hydrographic Office 1956). Average sea ice cover within the field of view from the aircraft was estimated as a single percentage, regardless of ice type.

All marine mammal sightings were recorded. Common and scientific names used for marine mammals in this report are taken from Rice (1998). The suite of data recorded for cetacean, walrus, and polar bear sightings included time, location, environmental conditions, survey mode, species, total number (low, high, and best estimates of group size were recorded as necessary), observer, swim direction (degrees True; cetaceans only), clinometer angle, number of calves, behavior, sighting cue, habitat, swim speed, whether it was a repeat sighting, and response to the aircraft. Reduced data subsets were sometimes recorded for other marine mammals to expedite data entry, but always included time, location, environmental conditions, survey mode, species, total number, and response to aircraft. Marine mammal observers and flight crew watched for and recorded sudden overt changes (e.g., an abrupt dive, course diversion, or cessation of initial observed behavior) in marine mammal behavior that might be indicative of a response to the survey aircraft.

The behavior, swim speed, and swim direction of observed whales represented what the group was doing at the time it was first sighted. Behaviors were entered into 1 of 14 categories (Table 1). Swimming speed was subjectively recorded as a categorical variable (i.e., still, 0 km/hr; slow, 0-2 km/hr; medium, 2-4 km/hr; or fast, > 4 km/hr). Swim direction was recorded relative to the aircraft's heading, and then converted to actual swim direction via a module incorporated into the data collection software.

Time and location only (date, time, latitude, longitude, and altitude) were automatically recorded from the GPS feed every 30 seconds (in time) to provide a detailed record of the flight track.

General Data Analyses

Preliminary data analysis was performed in the field after each flight by a customized computer program that provided daily summaries of marine mammal sightings and effort (time and distance on transect, search, circling, and deadhead). The program also provided options for editing the data file and plotting the paths of one or more flights by Beaufort wind force. An additional customized computer program was used for post-season analysis and production of figures and tables. Maps were prepared using ArcGIS 10.1 (Environmental Systems Resource Institute [ESRI, 2012], Redlands, CA) based on Universal Transverse Mercator Zone 5 (central meridian = -154.000000°, latitude of origin = 70.000000°, false easting = 500000.000000, false northing = 0.000000, spheroid = GRS 80, scale factor = 0.999600). The Alaskan coastline was adopted from the World Vector Shoreline produced by the U.S. Defense Mapping Agency, now called the National Imagery and Mapping Agency.

Data from the western Beaufort Sea and northeastern Chukchi Sea study areas were combined into one large dataset for editing and archiving, and were parsed into smaller subsets for various analyses of sighting rates, relative abundance, swimming direction, and HUAs. Survey effort and observed bowhead whale and gray whale distributions were plotted semimonthly over the study area. Beluga and walrus distributions were plotted monthly. Humpback whale, fin whale, minke whale, unidentified cetacean, pinniped and polar bear distributions were plotted annually (July to October). All sightings were shown on most distribution maps regardless of survey mode (e.g., transect, search, or circling) being conducted, observer type (primary or secondary), or the prevailing environmental conditions (wind force, sea ice cover, etc.) when the sightings were made. As with previous reports in this series (e.g., Monnett and Treacy 2005; USDOI, MMS 2008; Clarke et al. 2012, 2013a), same-day repeat sightings or sightings of dead marine mammals were not included in summary analyses or maps. Where tables and figures exclude certain data, such exclusions are indicated in the captions. Because feeding is likely underreported or recorded as milling, figures showing cetacean feeding occurrence include all sightings reported as feeding and milling, regardless of survey mode, observer type or prevailing environmental conditions.

The water depth at each bowhead whale sighting in the ASAMM database was derived from the International Bathymetric Chart of the Arctic Ocean (IBCAO) Version 3.0 (Jakobsson et al. 2013), which had a pixel resolution of 500 m. The shoreline used to calculate a sighting's distance from shore was 'normalized' from the actual shoreline to provide a standardization of distance-from-shore measurements regardless of the mapping software being used to depict the distribution data (Figure 3). The normalized shoreline was re-defined in 2011 to better represent the actual coastline of Alaska from 140°W (the easternmost part of the ASAMM study area) to

Table 1. ASAMM operational definitions of observed whale behaviors.

Behavior	Definition
Breaching	Whale(s) launching upwards such that half to nearly all of the body is above the surface before falling back into the water, usually on its side, creating an obvious splash.
Diving	Whale(s) changing swim direction or body orientation relative to the water surface, resulting in submergence; may or may not include lifting the tail out of the water.
Feeding	Whale(s) diving repeatedly in a fixed area, sometimes with mud streaming from the mouth and/or defecation observed upon surfacing. Feeding behavior is further indicated by synchronous diving and surfacing or echelon-formations at the surface with swaths of clearer water behind the whale(s), or by surface swimming with mouth agape.
Flipper-Slapping	Whale(s) floating on side, striking the water surface with pectoral flipper one or many times; usually seen within groups or when the slapping whale is touching another whale.
Log-Playing	Whale(s) milling or thrashing in association with a floating log.
Mating	Ventral-ventral orientation of two whales, often with one or more other whales present to stabilize the mating pair. Mating is often seen within a group of milling whales. Pairs may appear to hold each other with their pectoral flippers and may entwine their tails.
Milling	Whales moving slowly at the surface in close proximity (within 100 m) to other whales, often with varying headings. Also one whale slowly changing its heading.
Resting	Whale(s) floating at the surface with head, or head and back exposed, showing no movement; more commonly observed in heavy ice conditions than in open water.
Rolling	Whale(s) rotating on the longitudinal axis, sometimes associated with mating.
Spy-Hopping	Whale(s) extending head vertically out of the water such that up to one-third of the body, including the eye, is above the surface.

Swimming	Whale(s) proceeding forward through the water propelled by tail.
Tail-Slapping	Whale(s) floating horizontally or head-downward in the water, waving tail back and forth above the water and striking the water surface; usually seen in group situations.
Thrashing	Whale(s) exhibiting rapid flexure or gyration in the water.
Underwater-Blowing	Whale(s) exhaling while submerged, thus creating a visible bubble.

68°N (the southernmost part of the study area), and to improve approximation of bays and barrier islands. The projection used for the normalized shoreline analysis was North American Equidistant Conic, appropriate for distance measurements, with custom projection parameters (central meridian = -154.5°, latitude of origin = 70.5°, standard parallels = 60.5°, 80.5°).

Mean vector headings and circular standard deviations for headings of swimming cetaceans were determined using Oriana statistical software (Rayleigh Test; KCS 2012) for two subareas (Beaufort Sea subarea 140°W-154°W; Chukchi Sea subarea 154°W-169°W). The 154°W demarcation between subareas for swim direction most closely approximates the natural break between the Beaufort and Chukchi basins.

Environmental information, including wind speed and direction, cloud ceiling, visibility, temperature, dew point, sea ice cover, and sea surface temperature, was collected from National Weather Service web sites and other weather and climate-related web pages for the duration of the field season. Data were collected and stored electronically for specific locations along the northern coast of Alaska (e.g., Point Hope, Cape Lisburne, Point Lay, Wainwright, Barrow, Alpine, Kuparak, the weather station at West Dock, Deadhorse, and Barter Island) and for the broader Chukchi and Beaufort sea regions.

Sea ice information was obtained from the U.S. National Ice Center (2013), where it was available as charts or shapefiles. Sea ice analyses by the National Ice Center used data from several sources including ENVISAT imagery and MODIS to show sea ice concentration. Shapefiles for the Beaufort and Chukchi seas were combined to produce biweekly sea ice concentration maps, included in Appendix A.

Data analyses and figures made prior to 2012 using on-effort data included all on-transect sightings regardless of observer type (e.g., Clarke et al. 2012). Data denoting primary observers were collected starting in 1989, and the ASAMM historical database was amended in 2012 to include a field specifically denoting whether a sighting was made by a primary or secondary observer. Consequently, in 2013, sightings made by only primary observers were included in most analyses that used on-effort sightings, including sighting rate and central tendency analyses.

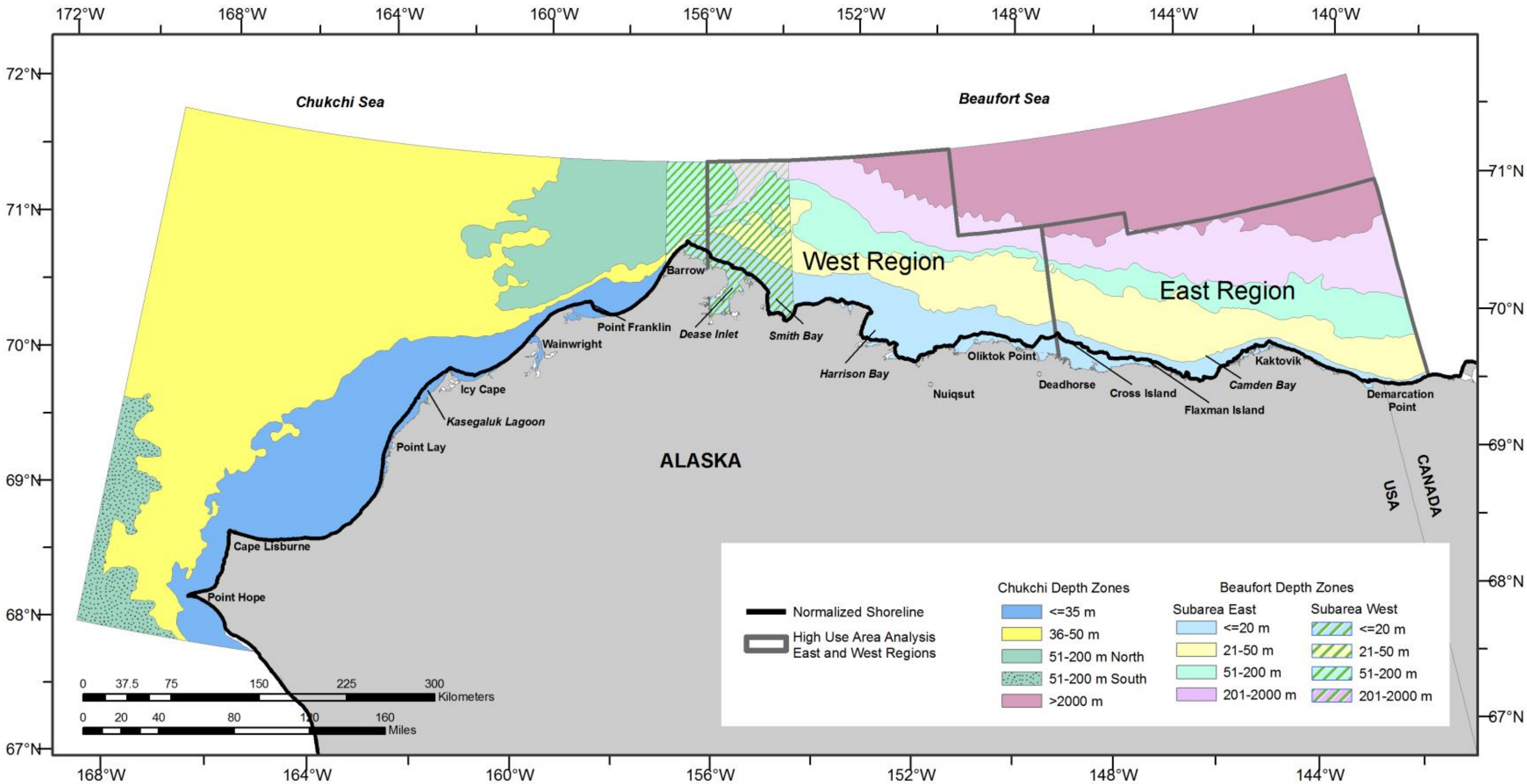


Figure 3. East and West regions and normalized shoreline used in ASAMM bowhead whale high-use area (HUA) analysis, and depth zone subareas used for sighting rate analyses.

Sighting Rate and Relative Abundance Analyses

Sighting rates (number of whales per unit [km] effort, or WPUE) quantify relative abundance by accounting for heterogeneity in survey effort and group size across the study area. Sighting rates were derived for three different spatial scales, each limited to transect effort and whales observed on-effort (i.e., on transect, primary observers only). To calculate monthly and annual sighting rate per survey block for bowhead whales and gray whales, the number of whales was divided by effort (km) per survey block. Although survey blocks are arbitrary geographic areas, they provide a basis for inter-annual cross-comparisons. Effort over land, between barrier islands and the mainland, and north of the study area (north of 72°N) was not included in the survey block sighting rate analysis. To calculate monthly and annual sighting rate per depth zone for bowhead whales, gray whales and belugas, the number of whales was divided by effort (km) per depth zone. Depth zone analysis in the western Beaufort Sea study area was computed for two subareas (Figure 3). One subarea spanned 154°W to 157°W, and included Barrow Canyon and its surrounding area, which has noticeably different bathymetry than the rest of the Beaufort Sea study area. The other subarea for the western Beaufort Sea depth zone analysis spanned 140°W to 154°W, an area incorporating a well-defined continental shelf and slope. Beaufort Sea subareas used depth zones of ≤20 m, 21-50 m, 51-200 m, 201-2,000 m and >2,000 m. Depth zone analysis in the northeastern Chukchi Sea used slightly different depth zones to better reflect the bathymetric features of the area (≤35 m, 36-50 m, and 51-200 m); the 51-200 m depth zone was divided into North and South segments because they are separated by a large expanse of shallower depths (Figure 3). Sighting rate analyses for survey blocks and depth zones used an Equidistant Conic projection (False_Easting: 0.0; False_Northing: 0.0; Central_Meridian: -154.5°; Standard_Parallel_1: 60.5°; Standard_Parallel_2: 80.5°; Latitude_Of_Origin: 70.5°; Linear Unit: Meter [1.0]). Finally, sighting rate was calculated for fine-scale (5 minutes latitude by 15 minutes longitude) areas, using a grid consisting of approximately equilateral grid cells (roughly 5 km x 5 km) superimposed across the study area. Seasonal (summer and fall) sighting rates were calculated for bowhead whales and annual sighting rates were calculated for gray whales and belugas for each grid cell. An index of relative abundance of bowhead whale and gray whale feeding and milling behaviors, quantified as WPUE, was also calculated for the fine-scale grid. The fine-scale grid analysis included effort and whales observed within barrier islands and north of 72°N. Sighting rates were not corrected for availability or perception bias (Buckland 2001).

Analysis of Bowhead Whale High Use Areas (HUA) in the Beaufort Sea

There is no evidence to suggest that bowhead whales remain in the Beaufort Sea throughout winter; at some point, bowhead whales observed in the Beaufort Sea in summer and fall migrate through the Chukchi Sea to return to wintering areas in the Bering Sea. It was thought that most bowhead whales summered in the Canadian Beaufort Sea then actively migrated westward through the western Beaufort Sea in fall, and previous central tendency analyses (e.g., Treacy 2002a; Monnett and Treacy 2005; Clarke et al. 2011b, 2012) have defined results as "migratory corridors". However, results of satellite tagging studies have shown that some bowhead whales crisscross the western Beaufort Sea during summer (Quakenbush et al. 2010b). Furthermore, large dynamic groups of bowhead whales have been documented feeding in the western Alaskan

Beaufort Sea as early as July and continuing into October. There is no reliable way, via data collected during aerial surveys, to differentiate between whales that were actively undergoing a directed, unidirectional, east-west fall migration and whales that were crisscrossing the western Beaufort Sea prior to undergoing directed migration. To acknowledge that some bowhead whales observed in the western Beaufort Sea in summer and fall might not be actively migrating, we use the term "high-use area" instead of "migratory corridor" for this report. High use areas (HUA), in this context, describe areas in the western Beaufort Sea where bowhead whales are expected to occur in greatest densities, based on data collected during ASAMM surveys. HUAs could be considered one component used to interpret the relative biological importance of certain areas within the western Beaufort Sea based on the numbers of whales expected to be present in a given area during a particular month or season. HUAs were not defined based on specific activity states (e.g., migrating or feeding).

Two analyses of bowhead whale HUAs (previously referred to as "migratory corridors") in the western Beaufort Sea were undertaken.

Bowhead Whale Central Tendency – Analysis 1

One analysis was similar to that conducted for previous BWASP annual reports, in which the bowhead whale HUA was examined using the mean and median distance from shore of, and the median depth at, whale sightings on transect by primary observers (Houghton et al. 1984). Treacy (1998) found that median and mean bowhead whale distance from shore values were only slightly different. Further comparisons of subsets of data were based on statistical analyses of median distance from shore and depth at sighting, via the nonparametric Mann-Whitney *U*-test. The nonparametric test was used for these data because distributions generally did not fit assumptions necessary to use the two-sample *t*-test. The variances were not equal between subsets of data for both depth and distance from shore; in addition, the depth data were considerably skewed and the distance from shore data were slightly skewed, so neither distribution strictly met the assumption of normality. When assumptions of the *t*-test are seriously violated, the Mann-Whitney *U*-test may be more powerful than the two-sample *t*-test (Hodges and Lehmann 1956; Zar 1984). Statistical tests were undertaken using *Statistica*™ StatSoft Version 10.0 and ArcGIS Version 10.1. Median distance from shore and depths for bowhead whale sightings in fall 2013, a year with light sea ice cover, were compared with analogous values for combined data from previous years having light sea ice cover (i.e., 1989, 1990, 1993-2012). Median distance from shore and depths at bowhead whale sightings in summer (July-August) 2013 were compared to bowhead whale sightings in summer (July-August) 2012 and fall (September-October) 2013.

All bowhead whale sightings made while on-effort (primary observers only), regardless of distance from the transect line, were included in this analysis. Neither group size nor survey effort (km) was taken into account. Distance from shore and water depth at bowhead whale sightings were analyzed for two regions (Figure 3), the boundaries of which correspond roughly to oceanographic patterns and the offshore extent of sampling, described in more detail below. The delineation between East and West regions for this analysis occurs at 148°W, based upon association with the general distribution patterns of water masses. Oceanographic patterns common to waters off northern Alaska are reviewed in Moore and DeMaster (1997). In brief, cold saline Bering Sea Water and warm fresh Alaska Coastal Water enter the western Beaufort Sea through Barrow Canyon. Both water masses are identifiable on the outer shelf (seaward of 50 m) as the eastward flowing Beaufort Undercurrent (Aagaard 1984). Bering Sea Water has been traced at least as far east as Barter Island (~143°W), but the Alaska Coastal Water mixes with ambient surface waters as it moves eastward and is not clearly identifiable east of Prudhoe Bay (~147°W-148°W).

The northern extent of each region is based upon survey effort. The East Region extends from 140°W to 148°W and northward from the shore to 71°10'N, except between 146°W and 148°W where the region extends to 71°20'N. The eastern boundary (140°W) is the easternmost longitude of the survey blocks. The northern boundary for this region corresponds with the boundaries of survey blocks 2, 6, and 7 (Figure 1), blocks with sufficient survey effort to support analyses (Treacy 1998). The West Region extends from 148°W to 156°W and northward from shore to 72°N, except between 148°W and 150°W where the region extends to 71°20'N due to the layout of block 2. The northern boundary for this region corresponds with the boundaries of survey blocks 2, 11, and 12 (Figure 1). The western cutoff at 156°W limits the analysis to bowhead whales seen in the western Beaufort Sea and minimizes the influence of Barrow Canyon on bowhead whale depth distribution.

Two subsets of data from fall 2013 were analyzed and are described below:

- All bowhead whale sightings by primary observers on-effort, regardless of behavior recorded. The analysis of this subset assumed that observed bowhead whale behavior did not affect overall whale distribution related to the HUA.
- All bowhead whale sightings by primary observers on-effort, excluding whales that were observed feeding, milling, or resting. This subset of data was analyzed separately to examine whether bowhead whale distribution was a function of observed behavior.

One caveat to this analysis is that analyzing bowhead whale HUAs based only on number of sightings may be biased because survey effort was often variable both within and across years and because sightings of a single animal were weighted equally to sightings of several animals. Therefore, there may have been more sightings in areas with greater transect effort and fewer sightings in areas with less transect effort, even if the density of individuals in the two areas was the same.

Bowhead Whale Central Tendency – Analysis 2

The second method for investigating the central tendency of the fall bowhead whale distribution in the Alaskan Beaufort Sea in 2013 involved a three-step process: 1) constructing spatial models of bowhead whale relative abundance (encounter rate) based on bowhead whale sightings from 2013; 2) applying the spatial relative abundance model to predict the expected number of bowhead whales in every cell of a grid overlying the study area; and 3) using the predicted number of bowhead whales in each cell to compute the median distance from shore of the whales sighted in 2013. As in the central tendency analysis described above, this analysis was based on transect bowhead whale sightings made by primary observers in September and October, 2013; this analysis did not account for availability or perception bias. Estimates of median distance from shore were calculated for the East and West regions individually. The analysis was conducted in R version 2.15.2 (R Core Team 2013) using packages *sp* (Pebesma and Bivand 2005; Bivand et al. 2008), *maptools* (Lewin-Koh et al. 2013), *raster* (Hijmans and van Etten 2013), *rgeos* (Bivand and Rundel 2013), *rgdal* (Keitt et al. 2013), and *mgcv* (Wood 2006).

To begin, the western Beaufort Sea study area was partitioned into a 5 km x 5 km grid, which was chosen as a compromise between having adequate survey effort and sightings in each grid cell in order to construct models, versus maximizing the resolution of the distance from shore data. All geospatial data were projected into an Equidistant Conic projection with the following parameterization: first standard parallel 69.5°N; second standard parallel 71.5°N; latitude of origin 70.5°N; central meridian 148.0°W; false easting 0.0; and false northing 0.0. Data extracted for each grid cell included the total number of whales sighted, the projected x and y coordinates of the midpoint of each grid cell, and the shortest distance from that midpoint to the normalized shoreline. Bowhead whale relative abundance was modeled as a generalized additive model (GAM), parameterized by a negative binomial distribution with a natural logarithmic link function. Quasi-Poisson and Tweedie (Tweedie 1984; Dunn and Smith 2005) models were also considered, but examination of model residuals (Ver Hoef and Boveng 2007) suggested that the negative binomial distribution provided a better fit to the data. The model formula can be represented as

$$ln(E(W_i)) = ln(\mu_i) = \alpha + s(X_i, Y_i) + offset(ln(L_i))$$

where

W_i: random variable for the number of individual bowhead whales in grid cell i, with W_i referring to the associated observations and $E(W_i)$ the expected value (mean) of W_i

μ_i: number of individual bowhead whales expected to be observed in grid cell i

α : intercept

X_i: projected (equidistant conic) longitude of the midpoint of grid cell i

Y_i: projected (equidistant conic) latitude of the midpoint of grid cell i

$s( )$: smooth function (Wood et al. 2006) of location covariates used to describe bowhead whale relative abundance; this function is parameterized in the model-fitting process

L_i : length (km) of transect effort in grid cell i, which was incorporated into the model as a constant (an “offset”) in order to account for spatially heterogeneous survey effort throughout the study area.

The median distance from shore of the fall distribution of bowhead whales was estimated using the spatial model to predict the number of individuals likely to be observed in each grid cell after a uniform amount of transect effort (a constant L_i for all i) was covered throughout the portion of the study area contained within the East and West regions. The magnitude of L_i used in the predictions did not affect the resulting median statistic as long as L_i was constant across all cells, thereby eliminating apparent variability in bowhead whale distribution due only to spatial heterogeneity in survey effort. Grid cells were ordered by distance from shore, from closest to farthest, and then the associated predicted number of individuals per cell was cumulated, beginning with the closest grid cell and ending with the farthest. The median distance from shore was calculated as the distance corresponding to the midpoint of the grid cell for which one-half of the total predicted number of individuals was assigned to cells located closer to shore and one-half assigned to cells located farther from shore.

This method of estimating the median distance from shore was also applied to ASAMM bowhead whale data from 2000-2013 combined. The analysis for the pooled years used the same data filtering criteria as described above (all transect bowhead whale sightings made by primary observers) and did not account for availability or perception bias. It included data from July – October, and varying-coefficient generalized additive models (Wood 2006) were used to examine the spatial distribution of bowhead whale relative abundance by month. In essence, the varying-coefficient model structure enables estimation of a separate smooth function for each month, allowing both the location and intensity of areas with high or low relative abundance to vary by month. Median distances from shore for the 14-year time period were calculated for the East and West regions separately.

The median can also be referred to as the 50th percentile or quantile. An additional analysis was undertaken to define the location of bowhead whale HUAs in 2013 alone and in 2000-2013 (all years pooled) based on the locations of the 30th, 40th, 50th, 60th, and 70th percentiles of predicted bowhead whale relative abundance for each column of 5 km x 5 km grid cells in the East and West regions. For example, in this analysis the location of the 30th percentile in a specific column of cells refers to the location where 30% of the predicted number of bowhead whales would be closer to shore and 70% would be farther offshore. Due to the granularity of the spatial grid used for this analysis, adjacent percentiles may overlap in a single grid cell in locations where the predicted distribution of bowhead whales changes rapidly with distance from shore. The midpoints of all cells corresponding to the 30th percentile were connected across the entire region to define a linear boundary across the western Beaufort Sea corresponding to the 30th percentile of bowhead whale HUAs, and similarly for the 40th, 50th, 60th, and 70th percentiles.

RESULTS

Environmental Conditions

In 2013, sea ice cover in the area surveyed was generally light. When surveys commenced in the northeastern Chukchi Sea in early July, sea ice remained in most of the study area, with shorefast ice present from Point Barrow to Cape Lisburne (Appendix A, Figure A-1). By mid-July, sea ice in the Chukchi Sea had receded to the northernmost survey blocks. Much of the nearshore area in the western Alaskan Beaufort Sea had ~1% sea ice, although ~30-100% sea ice cover remained between Harrison Bay and Point Barrow (Figure A-2). While ice was largely absent from the western Beaufort Sea study area by late August (Figure A-5), it remained in the northeastern Chukchi Sea study area through mid-September (Figure A-6). By 23 September, the entire study area was almost completely ice-free (Figure A-7). New ice was forming in shallow nearshore areas of the Chukchi Sea and most of the western Beaufort Sea in late October when the 2013 field season ended (Figure A-9).

Arctic sea ice extent reached the seasonal minimum on 13 September 2013, and sea ice fell to the sixth lowest extent since satellite data were first recorded in 1979 (National Snow and Ice Data Center 2013). Summer conditions in the Arctic in 2013 were cooler and stormier than recent years, which helped to retain more sea ice than in 2012. To examine interannual variability in bowhead whale and other marine mammal distributions and relative abundance, 2013 data were compared to data from previous years with light sea ice cover.

Survey Effort

The ASAMM field season commenced 1 July 2013 and ended 31 October 2013; survey flights were conducted from 2 July to 28 October (Table 2), corresponding to the summer and fall months when open-water anthropogenic activities occur. ASAMM surveys were not conducted from 1 to19 October 2013 due to the partial government shut down. Surveys were conducted from one aircraft based in Barrow from 2 July to 30 September, primarily targeting the northeastern Chukchi Sea, and from one aircraft based in Deadhorse from 19 July to 30 September and 19 to 30 October, primarily targeting the western Beaufort Sea. There were 90 survey flights, of which 21 were in July, 31 in August, 31 in September, and 7 in late October. Surveys originating on the aircraft based in Barrow (and in Deadhorse in late October) were numbered sequentially starting with 201; surveys originating on the aircraft based in Deadhorse from July through September were numbered sequentially starting with 1. On 17 occasions, two flights in one day were completed by the same survey team to take advantage of favorable survey conditions. Surveys were conducted simultaneously by both survey teams on 21 days. Surveys were conducted on 67% of the days in the field season (69 out of 103 possible days). Surveys were not conducted on 33% of the days in the field season (34 out of 103 possible days) due to weather alone (32 days) or weather combined with aircraft inspections or other equipment issues (2 days).

Table 2. ASAMM aerial survey flight effort in chronological order, 2 July – 28 October 2013, by survey flight and semimonthly time period. No surveys occurred from 1 to 19 October due to the partial government shutdown. Semimonthly totals may not exactly match the sum for the time period due to rounding error.

Day	Flight No	Transect (km)	Circling (km)	Search (km)	Deadhead (km)	Total (km)	Transect (hr)	Total (hr)
2 Jul	201	523	41	80	280	923	2.3	3.8
4 Jul	202	574	34	172	216	996	2.7	4.3
6 Jul	203	306	24	174	552	1,056	1.4	4.5
7 Jul	204	634	93	2	596	1,325	2.8	5.1
10 Jul	205	733	57	85	145	1,020	3.4	4.7
11 Jul	206	454	58	243	227	981	2.0	4.2
12 Jul	207	334	79	81	1,091	1,585	1.5	5.5
14 Jul	208	249	0	1	997	1,247	1.1	4.2
15 Jul	209	161	0	1	173	334	0.7	1.3
19 Jul	1	583	187	17	439	1,227	2.7	5.2
20 Jul	2	302	0	120	400	823	1.4	3.1
20 Jul	210	127	58	3	453	640	0.6	2.4
21 Jul	3	635	44	39	186	904	2.9	4.0
21 Jul	211	318	111	95	690	1,214	1.5	5.0
22 Jul	4	1,145	143	56	971	2,315	5.2	9.0
23 Jul	212	21	0	0	164	185	0.1	0.7
24 Jul	5	9	0	23	507	539	0.0	1.6
25 Jul	213	511	47	109	206	873	2.4	4.2
26 Jul	6	541	42	18	831	1,431	2.5	5.3
28 Jul	7	438	33	56	187	714	2.0	3.1
30 Jul	8	457	26	67	166	715	2.1	3.2
1 Aug	214	831	253	70	926	2,080	3.6	8.0
2 Aug	215	59	0	1	320	380	0.3	1.4
4 Aug	9	526	141	79	482	1,226	2.4	4.7
5 Aug	10	474	177	5	670	1,325	2.2	5.1
5 Aug	216	53	7	72	980	1,112	0.3	3.6
7 Aug	11	481	128	46	401	1,056	2.1	4.3
7 Aug	217	655	67	2	252	976	3.2	4.6
11 Aug	12	977	68	76	1,139	2,260	4.3	8.4
11 Aug	218	440	53	182	57	732	2.2	3.7
13 Aug	219	615	116	118	987	1,836	2.9	6.9
16 Aug	13	109	0	72	430	611	0.5	2.0
17 Aug	14	27	0	190	611	828	0.1	2.7
18 Aug	220	91	0	42	795	929	0.4	3.3
19 Aug	221	47	0	1	164	213	0.2	1.0
20 Aug	15	1,326	142	108	593	2,169	5.8	9.2

Day	Flight No	Transect (km)	Circling (km)	Search (km)	Deadhead (km)	Total (km)	Transect (hr)	Total (hr)
20 Aug	222	1,091	25	19	694	1,828	5.2	7.7
21 Aug	16	29	0	1	594	624	0.1	1.8
21 Aug	223	485	8	6	494	993	2.3	4.1
23 Aug	17	345	215	62	643	1,265	1.5	4.8
23 Aug	224	132	0	89	836	1,057	0.6	3.6
24 Aug	18	340	229	10	558	1,138	1.5	4.6
24 Aug	225	471	0	83	1,480	2,033	2.2	7.1
25 Aug	19	127	0	6	596	728	0.5	2.3
25 Aug	226	147	0	146	414	707	0.8	3.0
26 Aug	20	555	58	20	528	1,161	2.5	4.3
27 Aug	227	714	58	2	412	1,185	3.4	5.0
28 Aug	21	332	28	21	811	1,191	1.5	4.1
29 Aug	228	1,083	88	2	986	2,159	5.3	9.0
30 Aug	22	864	259	125	897	2,146	3.8	8.3
30 Aug	229	564	8	1	732	1,306	2.7	5.0
31 Aug	230	365	0	69	836	1,269	1.8	4.7
1 Sep	23	189	91	10	557	846	0.8	3.0
1 Sep	231	280	14	3	727	1,024	1.3	3.6
4 Sep	232	0	0	0	528	528	0.0	1.6
6 Sep	24	399	269	77	444	1,189	1.7	5.1
6 Sep	233	532	23	52	520	1,128	2.7	4.6
7 Sep	234	161	0	1	626	788	0.8	2.6
10 Sep	25	0	0	0	565	565	0.0	1.5
11 Sep	26	298	41	53	464	855	1.3	3.1
11 Sep	235	631	155	2	332	1,121	2.9	4.9
12 Sep	236	487	76	34	789	1,385	2.4	5.3
13 Sep	27	419	168	62	755	1,403	1.8	5.1
14 Sep	237	284	28	32	762	1,107	1.3	4.0
15 Sep	28	532	52	242	654	1,479	2.2	5.4
15 Sep	238	647	0	2	445	1,095	3.1	4.5
16 Sep	29	174	0	68	767	1,008	0.8	3.6
17 Sep	30	22	4	338	253	617	0.1	2.1
19 Sep	239	569	7	31	512	1,119	3.0	4.7
22 Sep	31	706	73	93	387	1,259	3.0	5.0
22 Sep	240	583	15	173	426	1,195	2.7	5.1
23 Sep	32	655	106	63	679	1,502	2.8	5.6
23 Sep	241	515	0	51	708	1,273	2.5	4.9
24 Sep	242	94	0	10	278	381	0.5	1.5
25 Sep	33	743	0	27	577	1,347	3.1	4.9
25 Sep	243	595	131	81	391	1,199	2.8	5.2
26 Sep	244	534	51	118	234	936	2.6	4.3

Day	Flight No	Transect (km)	Circling (km)	Search (km)	Deadhead (km)	Total (km)	Transect (hr)	Total (hr)
27 Sep	34	215	15	64	772	1,066	0.9	3.7
27 Sep	245	601	0	15	1,358	1,975	2.9	7.1
29 Sep	35	481	177	42	811	1,511	2.0	5.5
29 Sep	246	1,129	103	97	550	1,880	5.5	8.4
30 Sep	36	0	0	0	667	667	0.0	1.9
30 Sep	247	1,151	74	2	1,118	2,345	5.5	9.4
20 Oct	248	437	9	156	586	1,188	2.0	4.8
21 Oct	249	0	0	0	669	669	0.0	1.9
22 Oct	250	454	0	148	536	1,138	2.1	4.6
24 Oct	251	945	0	10	1,166	2,121	4.4	8.0
26 Oct	252	554	259	32	618	1,463	2.6	6.1
27 Oct	253	19	0	1	1,014	1,033	0.1	3.0
28 Oct	254	581	0	101	768	1,450	2.6	5.3
				Semimonthly Effort Summary				
1-15 Jul		3,968	386	839	4,277	9,467	17.9	37.6
16-31 Jul		5,087	691	603	5,200	11,580	23.1	46.7
1-15 Aug		5,111	1,010	651	6,214	12,983	23.3	50.6
16-31 Aug		9,244	1,118	1,075	14,104	25,540	42.6	97.4
1-15 Sep		4,859	917	570	8,168	14,513	22.2	54.3
16-30 Sep		8,767	756	1,273	10,488	21,280	40.5	82.6
20-28 Oct		2,990	268	448	5,357	9,062	13.6	33.7
Total		**40,026**	**5,146**	**5,459**	**53,808**	**104,425**	**183.2**	**402.9**

Over 104,000 km were flown during 402.9 hours (Figure 4). A total of 40,026 km of effort on transect was flown during 183.2 hours (Figure 5). Transect effort constituted 38% of the total kilometers flown and 45% of the total flight hours. Forty-one percent of total survey effort was flown on deadhead (non-usable flight time), flown at faster speeds (usually >330 km/h) during transits to and from transects when the observers were not actively searching for marine mammals. Deadhead was also recorded during several flights when local weather conditions were not conducive to collecting data; eight flights were entirely or almost entirely on deadhead due to prevailing poor weather conditions. During an average survey day, an aerial survey team covered 1,159 km, ranging from 185 km to 2,345 km. The longer distances required two flights per day.

Survey effort (transect, search, and circling) is summarized semimonthly in Figure 6. In the northeastern Chukchi Sea, transects near active Chukchi Sea lease areas were targeted more often than areas without active lease areas (e.g., survey blocks 20-22). Coverage in early July focused on the northeastern Chukchi Sea. From mid-July through the end of September, survey coverage was balanced between the northeastern Chukchi Sea and the western Beaufort Sea. Systematic broad-scale coverage of the western Beaufort Sea in summer (mid-July through August) was conducted for the second consecutive year based in part on information about bowhead whale movements obtained via satellite tracking (e.g., Quakenbush et al. 2010a, 2010b), from a single ASAMM flight in July 2011 (Christman et al. 2013), and from several surveys conducted by ASAMM in 2012 (Clarke et al. 2013a) that indicated bowhead whales might be regularly present in this area in July. Survey coverage in the ASAMM study area was well distributed throughout July, August and September. In October, survey coverage was limited to 20-28 October, and focused primarily on the western Beaufort Sea because conditions in the northeastern Chukchi Sea were rarely favorable for conducting surveys. The last survey was conducted on 28 October. Survey coverage was greatest in survey blocks 13, 17, and 20 in the Chukchi Sea and survey blocks 1, 3, and 12 in the Beaufort Sea. Surveys in blocks 8 and 9 were not attempted in 2013 because conditions were not favorable for surveying offshore (e.g., strong winds and low visibility). One survey was conducted in early September north of the ASAMM study area to assess walrus use of sea ice habitats on a day when strong winds throughout the ASAMM study area precluded survey flights elsewhere. Flight lines, associated sea states, and sightings on individual flights are shown in Appendix B.

Poor weather impacted survey effort in 2013. While there were relatively few extended periods of time when weather prevented surveys from being conducted, fog and low ceilings did limit survey efforts in late July in the northeastern Chukchi Sea and in early August in the entire ASAMM study area. In late July, only four surveys were attempted by the team based in Barrow because conditions in Barrow were too poor to launch. In early August, there was a ten-day period when surveys were conducted on only three days. The greatest impact on 2013 survey effort, however, was due to the partial government shutdown from 1-17 October which ensured that, for the first time in >30 years, there were no broad scale aerial surveys for marine mammals conducted in the Alaskan Arctic during a critical period in the migration of arctic marine mammals.

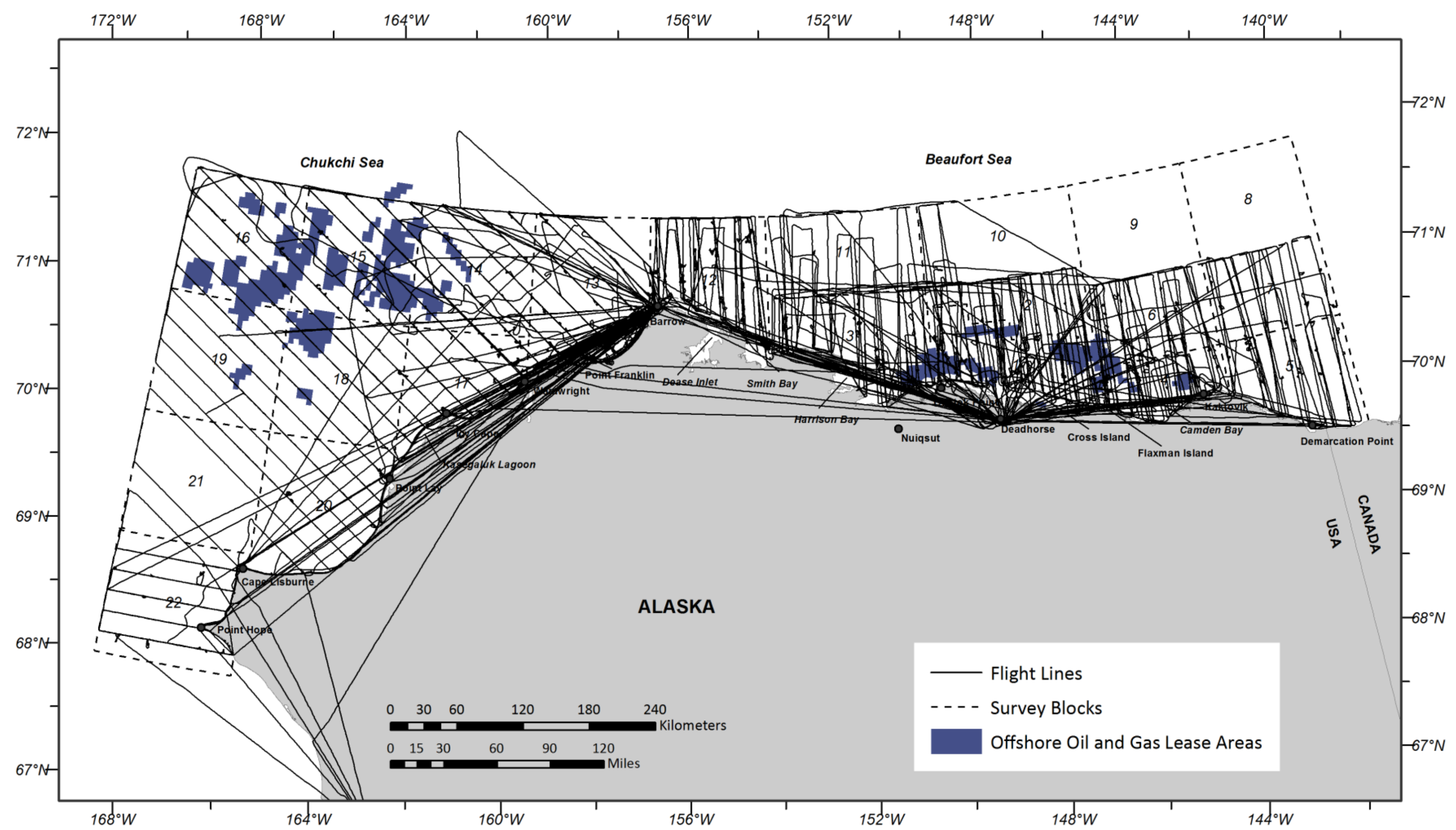


Figure 4. ASAMM 2013 combined flight tracks, all flight types (transect, search, circling and deadhead).

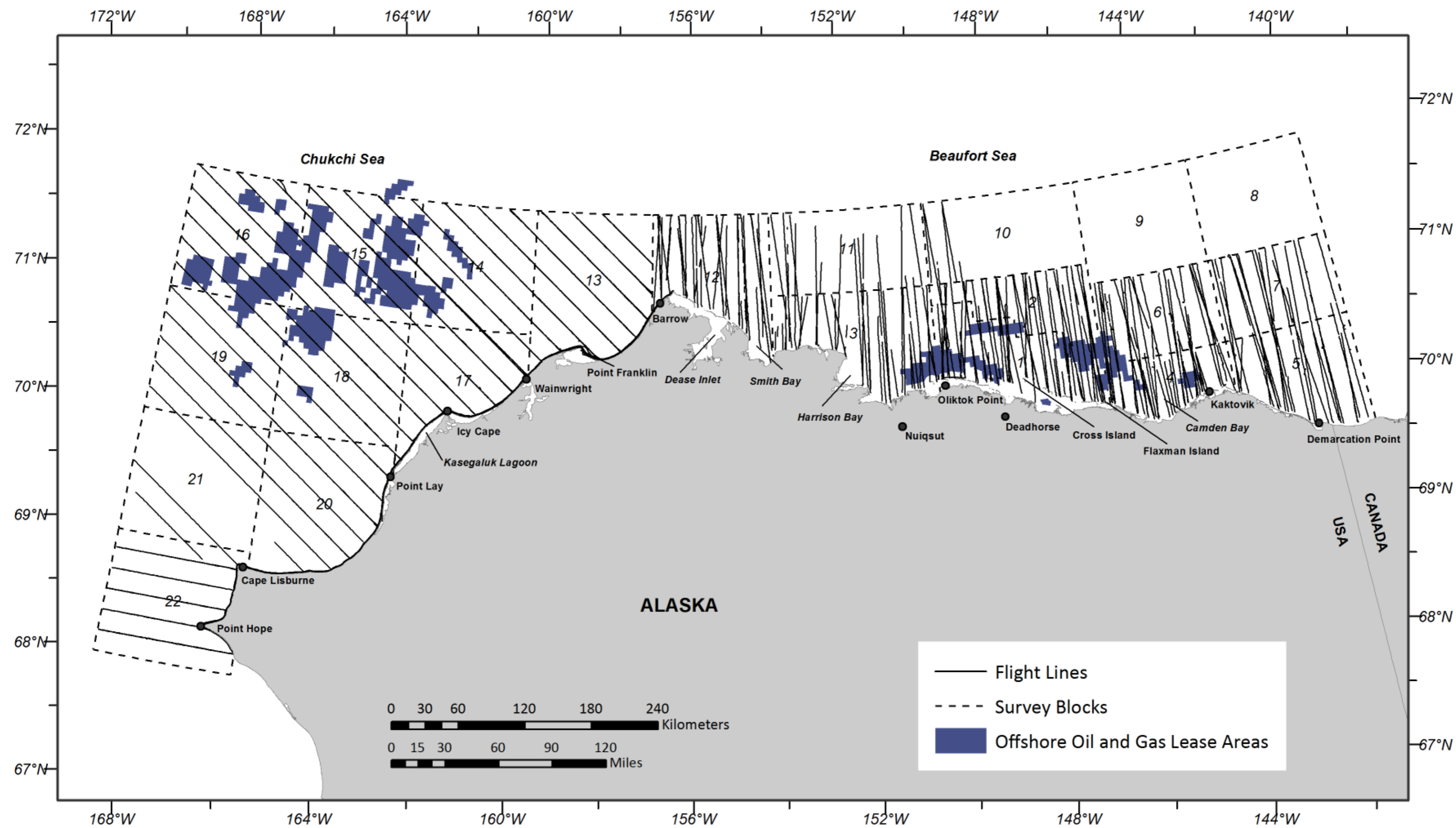


Figure 5. ASAMM 2013 combined flight tracks, transect effort only. No transects were flown north of 72°N.

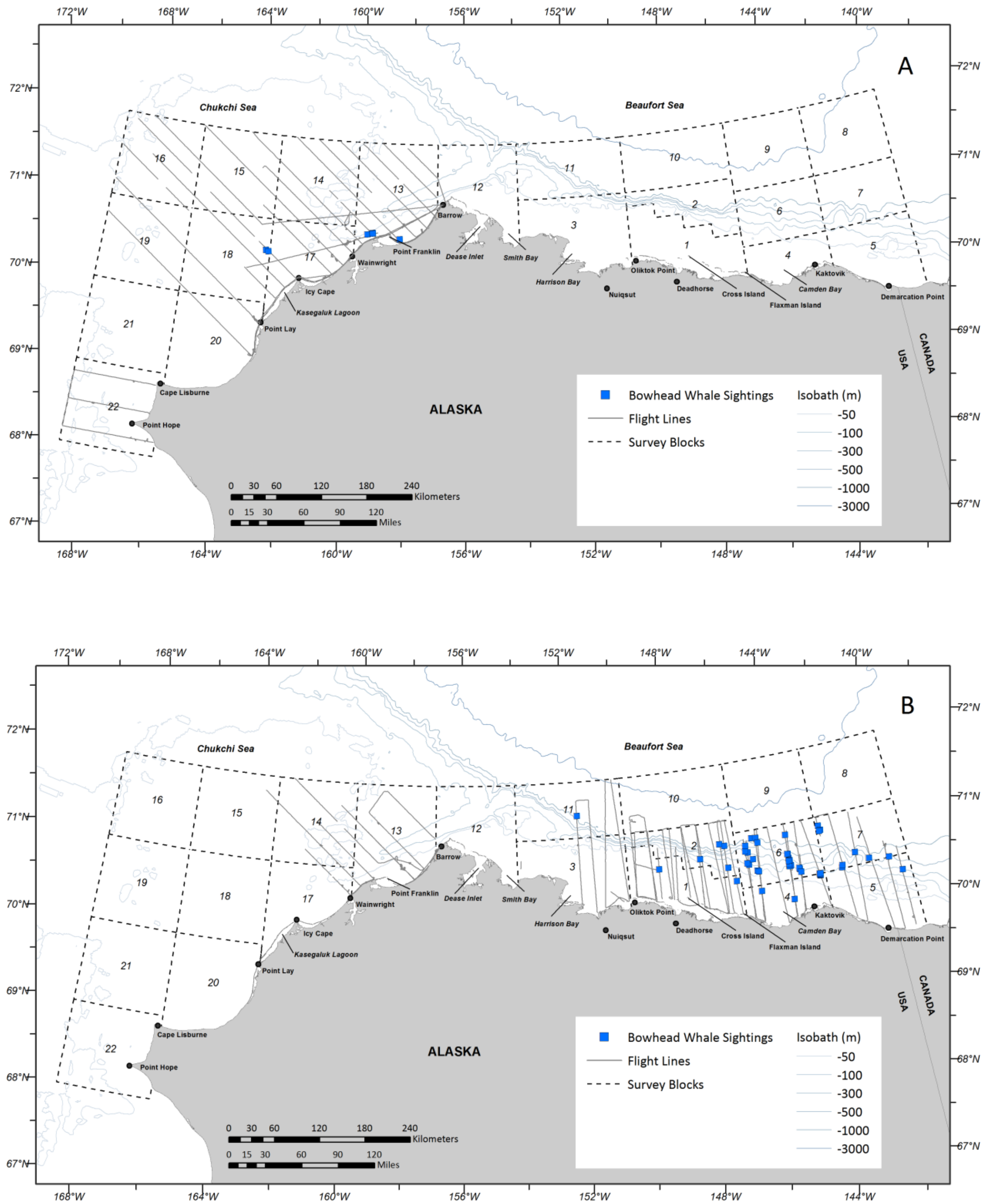


Figure 6. ASAMM 2013 semimonthly bowhead whale sightings, with transect, search and circling survey effort. Deadhead flight tracks are not shown. A: 2-15 July; B: 16-31 July.

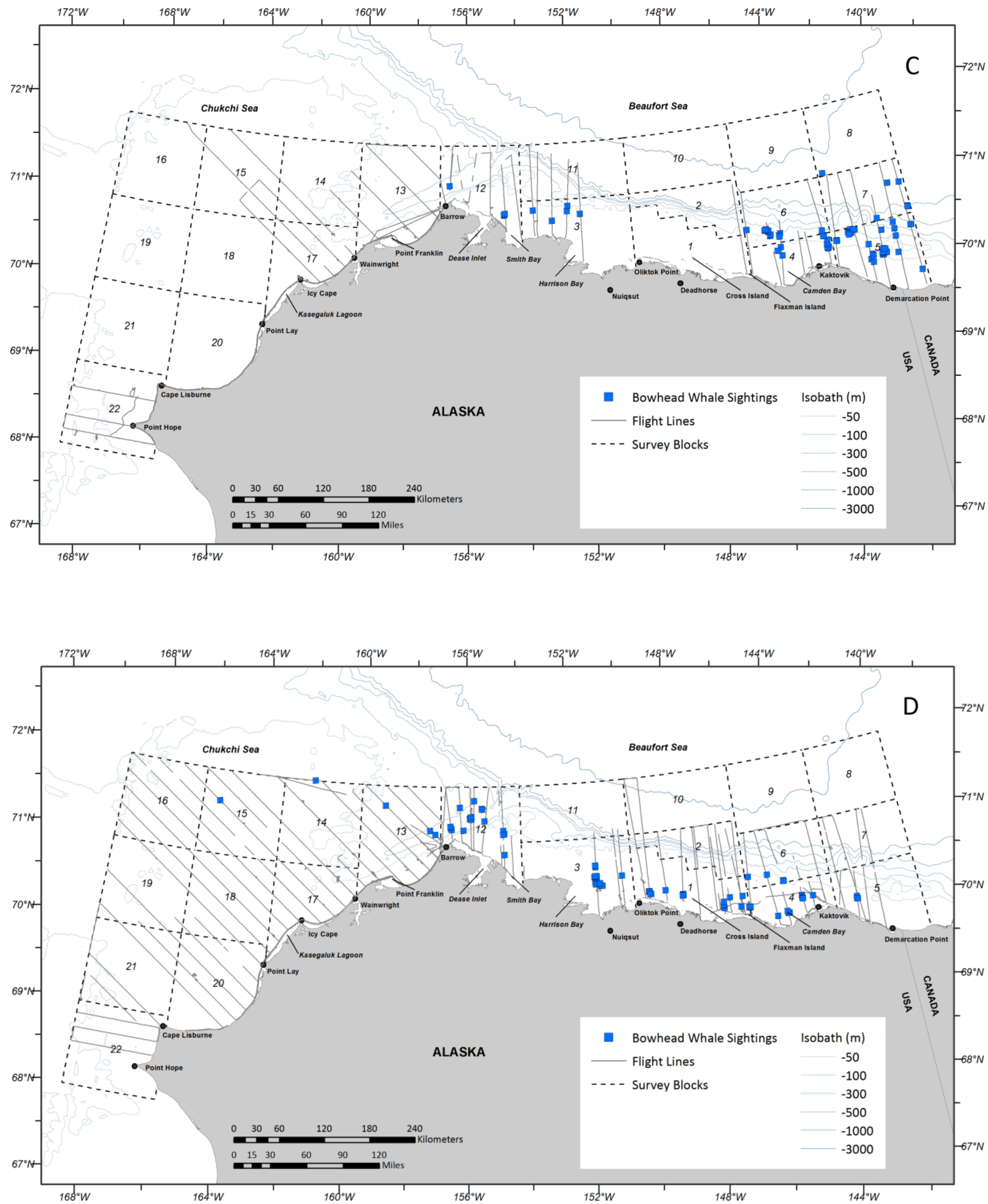
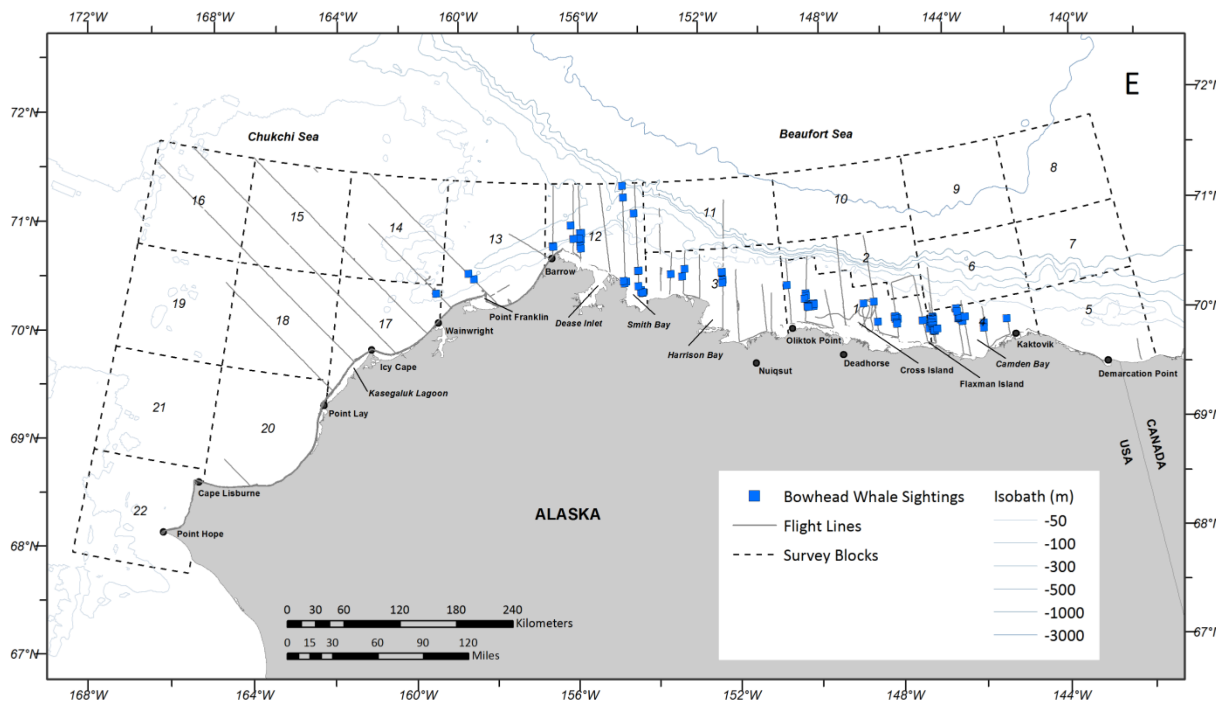


Figure 6 (cont). ASAMM 2013 semimonthly bowhead whale sightings, with transect, search and circling effort. Deadhead flight tracks are not shown. C: 1-15 August; D: 16-31 August.



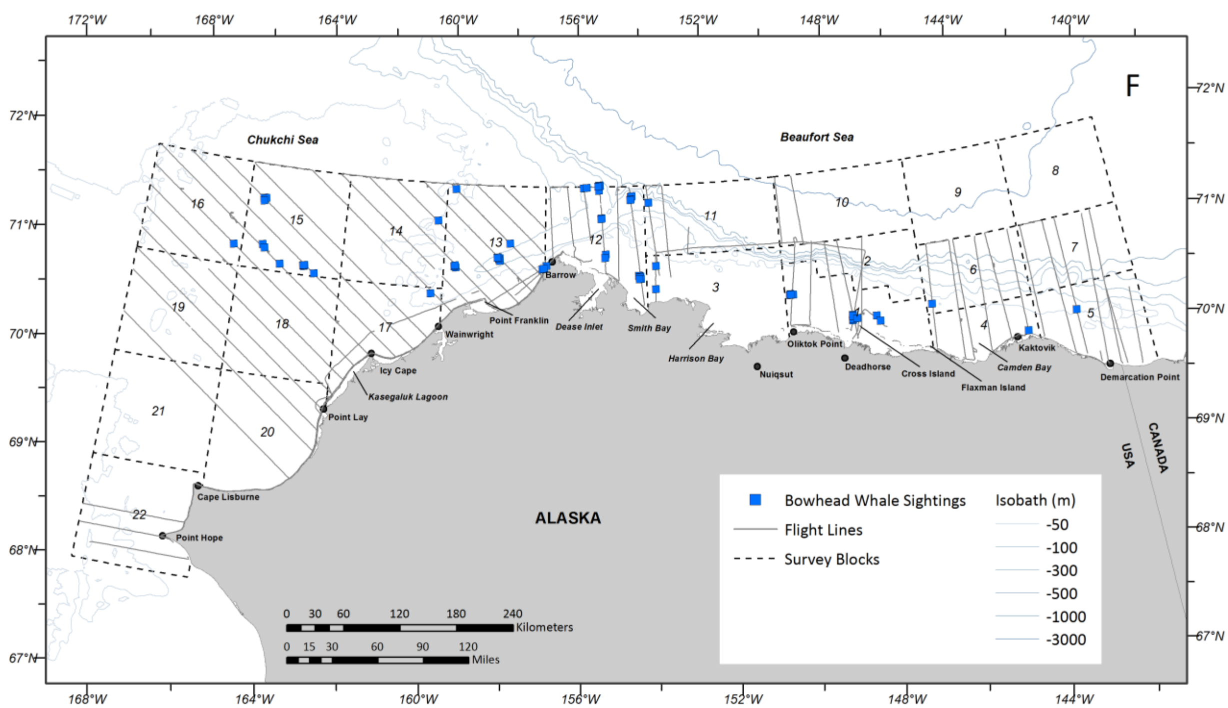


Figure 6 (cont). ASAMM 2013 semimonthly bowhead whale sightings, with transect, search and circling effort. Deadhead flight tracks are not shown. E: 1-15 September; F: 16-30 September.

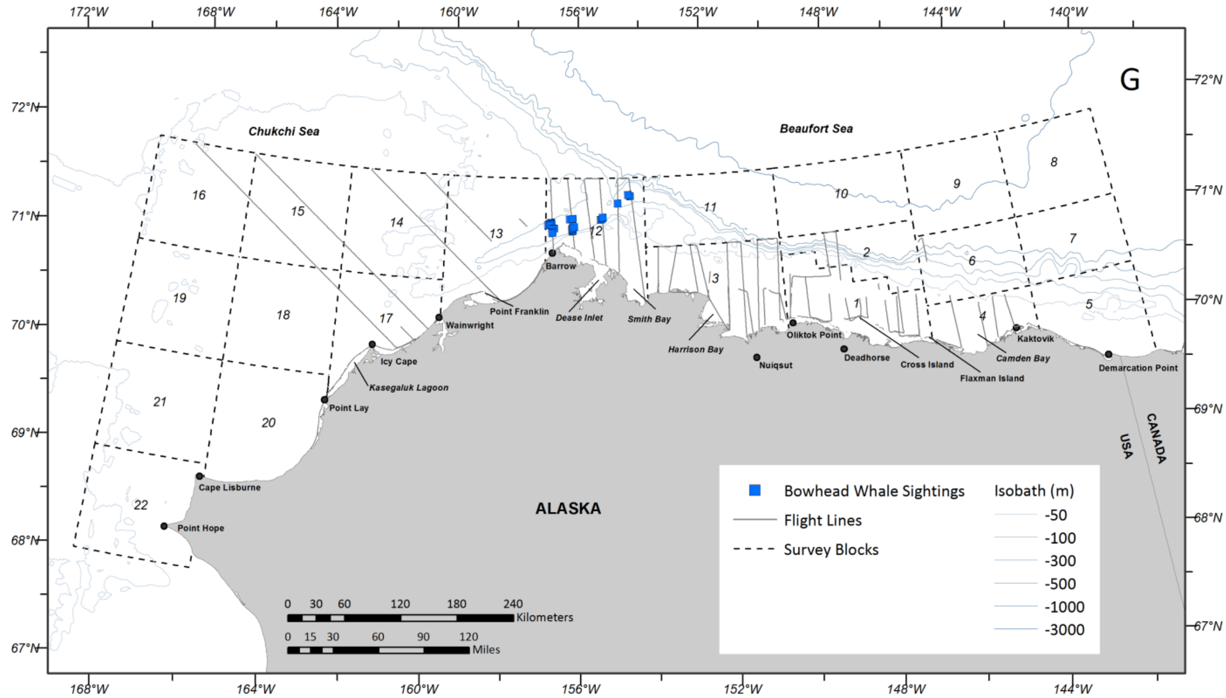


Figure 6 (cont). ASAMM 2013 semimonthly bowhead whale sightings, with transect, search and circling effort. Deadhead flight tracks are not shown. G: 20-28 October.

Cetaceans

Bowhead Whales

BOWHEAD WHALE SIGHTING SUMMARY

During 2013 ASAMM surveys, 424 sightings of 743 bowhead whales (*Balaena mysticetus*) were observed during transect, search and circling survey modes (Table 3). This is higher than the number of bowhead whales usually observed in a single year during ASAMM surveys (e.g., Clarke et al. 2012, 2013a), although more bowhead whales have been observed in a few years (1997, 1998; Treacy 1998, 2000). The high number of bowhead whale sightings was due, in part, to surveys conducted in the western Beaufort Sea in late July and August, during which 384 bowhead whales were seen. Bowhead whales were seen in every month except October in the northeastern Chukchi Sea and from July through October in the western Beaufort Sea (Figure 7).

Sightings in the Chukchi Sea were mostly west of Barrow between 71°N and 72°N. In early July, bowhead whales were seen scattered nearshore in the vicinity of Point Franklin and northwest of Icy Cape (Figure 6). In August, bowhead whales were seen scattered in the northernmost part (71.5°N to 72°N) of the study area. In September, distribution in the Chukchi Sea was mostly west of Barrow (71°N to 72°N). Bowhead whales were not seen south of

Table 3. Summary of ASAMM marine mammal sightings (number of sightings/number of individuals) during all survey modes (transect, search and circling) in chronological order, 2 July-28 October 2013, by survey flight and semimonthly time period. Excludes dead and repeat sightings.

Day	Flight No.	Bowhead Whale	Gray Whale	Humpback Whale	Fin Whale	Minke Whale	Beluga	Unidentified Cetacean*	Walrus	Bearded Seal	Ringed Seal	Unidentified Pinniped**	Polar Bear
2 Jul	201	0	0	0	0	0	1/3	0	8/752	0	0	4/4	0
4 Jul	202	0	3/4	0	0	1/1	3/14	1/1	12/596	2/2	0	8/18	0
6 Jul	203	5/6	13/22	0	0	0	1/2	0	3/21	2/3	0	2/2	0
7 Jul	204	0	1/6	0	0	2/2	4/403	0	11/241	2/2	0	5/6	0
10 Jul	205	1/1	5/5	0	0	0	0	0	10/19	7/7	0	4/25	0
11 Jul	206	0	5/10	0	0	0	1/1	0	3/4	0	0	6/6	0
12 Jul	207	0	6/13	0	1/1	0	0	0	0	0	0	38/46	0
14 Jul	208	0	0	0	0	0	0	0	0	3/4	0	13/18	0
15 Jul	209	0	0	0	0	0	0	0	0	0	0	4/6	0
19 Jul	1	33/74	0	0	0	0	48/124	2/2	0	4/4	0	18/19	0
20 Jul	2	0	0	0	0	0	1/1	0	0	0	0	1/1	0
20 Jul	210	0	2/4	0	0	0	0	0	1/150	0	0	0	0
21 Jul	3	3/5	0	0	0	0	2/3	0	0	0	0	4/4	0
21 Jul	211	0	30/56	0	0	0	1/1	2/2	7/624	0	0	6/8	0
22 Jul	4	10/19	0	0	0	0	61/117	3/3	0	4/4	0	14/14	0
23 Jul	212	0	0	0	0	0	0	0	0	0	0	0	0
24 Jul	5	0	0	0	0	0	0	0	0	0	0	0	0
25 Jul	213	0	6/8	0	0	0	0	1/1	32/1,168	2/2	0	8/8	0
26 Jul	6	4/5	0	0	0	0	13/22	0	0	0	0	11/14	0
28 Jul	7	1/1	0	0	0	0	3/6	0	0	1/1	0	15/16	0
30 Jul	8	2/3	0	0	0	0	22/43	0	0	4/4	0	8/8	0
1 Aug	214	0	4/6	0	1/1	0	0	3/3	1/1	0	0	25/30	0
2 Aug	215	0	0	0	0	0	0	0	1/1	0	0	0	0
4 Aug	9	27/38	0	0	0	0	25/65	1/1	0	4/4	0	28/35	2/2
5 Aug	10	25/40	0	0	0	0	41/111	2/2	0	1/1	0	17/20	0
5 Aug	216	0	0	0	0	0	0	0	0	0	0	0	0
7 Aug	11	17/21	0	0	0	0	9/39	0	0	0	0	0	0

Day	Flight No.	Bowhead Whale	Gray Whale	Humpback Whale	Fin Whale	Minke Whale	Beluga	Unidentified Cetacean*	Walrus	Bearded Seal	Ringed Seal	Unidentified Pinniped**	Polar Bear
7 Aug	217	0	6/10	0	0	0	2/2	0	4/245	0	0	5/5	0
11 Aug	12	9/11	1/1	0	0	0	19/54	0	4/11	6/7	0	110/191	2/3
11 Aug	218	0	13/24	0	0	0	0	0	3/23	1/1	0	15/20	0
13 Aug	219	0	15/19	0	0	2/2	1/2	1/1	4/10	0	0	12/14	0
16 Aug	13	0	0	0	0	0	0	0	0	0	0	0	0
17 Aug	14	1/1	0	0	0	0	1/2	0	0	2/2	0	26/99	0
18 Aug	220	0	4/4	0	0	0	3/24	1/1	0	0	0	0	0
19 Aug	221	0	0	0	0	0	0	0	0	0	0	0	0
20 Aug	15	34/95	0	0	0	0	6/7	1/1	0	3/3	0	3/4	1/1
20 Aug	222	2/2	12/20	0	0	0	1/3	0	0	1/1	0	16/29	0
21 Aug	16	0	0	0	0	0	0	0	0	0	0	0	0
21 Aug	223	0	0	0	0	0	0	0	11/405	1/1	0	3/3	0
23 Aug	17	11/12	6/8	0	0	0	4/11	2/2	0	4/4	0	26/44	0
23 Aug	224	0	0	0	0	0	0	0	1/1	3/3	0	18/59	0
24 Aug	18	16/26	0	0	0	0	6/14	3/3	0	0	0	6/6	0
24 Aug	225	0	0	0	0	0	0	0	0	0	0	3/3	0
25 Aug	19	1/1	0	0	0	0	0	0	0	0	0	1/1	0
25 Aug	226	0	4/7	0	0	0	0	0	4/5	0	0	0	0
26 Aug	20	2/4	0	0	0	0	25/97	0	0	0	3/3	13/13	1/1
27 Aug	227	0	2/2	2/4	1/1	0	2/2	1/1	2/3	4/4	0	62/98	0
28 Aug	21	2/2	0	0	0	0	0	0	0	1/1	1/1	12/22	0
29 Aug	228	1/1	5/5	0	0	0	0	1/1	15/392	3/3	0	59/74	0
30 Aug	22	12/26	6/12	0	0	0	2/2	1/2	33/4,870	1/1	1/1	99/298	0
30 Aug	229	0	0	0	0	0	0	0	1/3	0	0	22/28	0
31 Aug	230	0	0	0	0	0	0	0	0	1/1	0	21/73	0
1 Sep	23	4/6	0	0	0	0	8/16	1/1	0	0	0	12/83	1/1
1 Sep	231	0	0	0	0	0	0	0	0	0	0	1/1	0
4 Sep	232	0	0	0	0	0	0	0	0	0	0	0	0
6 Sep	24	38/59	0	0	0	0	0	2/2	0	0	0	0	0
6 Sep	233	0	1/1	0	0	0	0	0	0	0	0	22/22	0
7 Sep	234	0	0	0	0	0	0	0	0	0	0	1/1	0

Day	Flight No.	Bowhead Whale	Gray Whale	Humpback Whale	Fin Whale	Minke Whale	Beluga	Unidentified Cetacean*	Walrus	Bearded Seal	Ringed Seal	Unidentified Pinniped**	Polar Bear
10 Sep	25	0	0	0	0	0	0	0	0	0	0	0	0
11 Sep	26	3/3	0	0	0	0	0	1/1	0	0	0	0	1/1
11 Sep	235	3/3	5/13	0	0	0	0	3/3	0	0	0	1/1	1/1
12 Sep	236	0	4/6	0	0	0	0	1/1	12/3,027	2/2	0	21/22	2/4
13 Sep	27	27/47	0	0	0	0	0	0	0	1/1	0	5/5	0
14 Sep	237	0	0	0	0	0	0	0	1/3,000	0	0	0	0
15 Sep	28	28/69	0	0	0	0	6/8	0	0	1/1	0	2/2	0
15 Sep	238	0	0	0	0	0	0	0	2/3	0	0	0	0
16 Sep	29	2/2	0	0	0	0	0	0	0	1/1	0	0	1/1
17 Sep	30	2/2	0	0	0	0	0	0	0	0	0	1/1	0
19 Sep	239	0	0	0	0	0	0	0	5/8	0	0	1/1	0
22 Sep	31	2/2	0	0	0	0	1/1	2/2	0	2/2	0	7/7	3/11
22 Sep	240	0	0	0	0	0	0	0	39/6,625	0	0	21/27	0
23 Sep	32	9/9	0	0	0	0	16/19	3/3	0	0	0	2/2	1/3
23 Sep	241	1/1	2/2	0	0	0	0	0	4/13	0	0	14/14	0
24 Sep	242	0	0	0	0	0	0	0	0	0	0	0	0
25 Sep	33	1/2	0	0	0	0	11/12	0	0	1/1	0	5/5	1/1
25 Sep	243	8/14	1/1	0	0	0	0	3/3	9/15	0	0	10/11	0
26 Sep	244	2/2	1/1	0	0	0	0	0	33/638	0	0	15/15	0
27 Sep	34	8/10	0	0	0	0	2/4	1/1	0	0	0	0	0
27 Sep	245	0	0	0	0	0	0	0	61/10,446	0	0	2/2	0
29 Sep	35	19/34	0	0	0	0	46/190	0	0	1/1	0	8/8	0
29 Sep	246	13/35	10/10	0	0	0	0	1/1	14/20	0	0	51/55	0
30 Sep	36	0	0	0	0	0	0	0	0	0	0	0	0
30 Sep	247	7/12	0	0	0	0	13/107	0	19/52	0	0	36/48	0
20 Oct	248	0	0	0	0	0	8/22	1/1	0	0	0	0	1/8
21 Oct	249	0	0	0	0	0	0	0	0	0	0	0	0
22 Oct	250	0	0	0	0	0	0	0	0	1/1	0	4/6	1/4
24 Oct	251	0	0	0	0	0	6/20	0	0	0	0	0	0
26 Oct	252	28/37	1/1	0	0	0	18/24	1/1	0	2/2	0	0	0
27 Oct	253	0	0	0	0	0	0	0	0	0	0	0	0

Day	Flight No.	Bowhead Whale	Gray Whale	Humpback Whale	Fin Whale	Minke Whale	Beluga	Unidentified Cetacean*	Walrus	Bearded Seal	Ringed Seal	Unidentified Pinniped**	Polar Bear
28 Oct	254	0	0	0	0	0	3/3	0	0	0	0	2/2	0
						Semimonthly Summary							
1-15 Jul		6/7	33/60	0	1/1	3/3	10/423	1/1	47/1,633	16/18	0	84/131	0
16-31 Jul		53/107	38/68	0	0	0	151/317	8/8	40/1,942	15/15	0	85/92	0
1-15 Aug		78/110	39/60	0	1/1	2/2	97/273	7/7	17/291	12/13	0	212/315	4/5
16-31 Aug		82/170	39/58	2/4	1/1	0	50/162	10/11	67/5,679	24/24	5/5	390/854	2/2
1-15 Sep		103/187	10/20	0	0	0	14/24	8/8	15/6,030	4/4	0	65/137	5/7
16-30 Sep		74/125	14/14	0	0	0	89/333	10/10	184/17,817	5/5	0	173/196	6/16
20-28 Oct		28/37	1/1	0	0	0	35/69	2/2	0	3/3	0	6/8	2/12
TOTAL		424/743	174/281	2/4	3/3	5/5	446/1,601	46/47	370/33,392	79/82	5/5	1,015/1,733	19/42

*Includes sightings designated as "unidentified cetacean" and "small unidentified cetacean".

**Includes sightings designated as "unidentified pinniped" and "small unidentified pinniped".

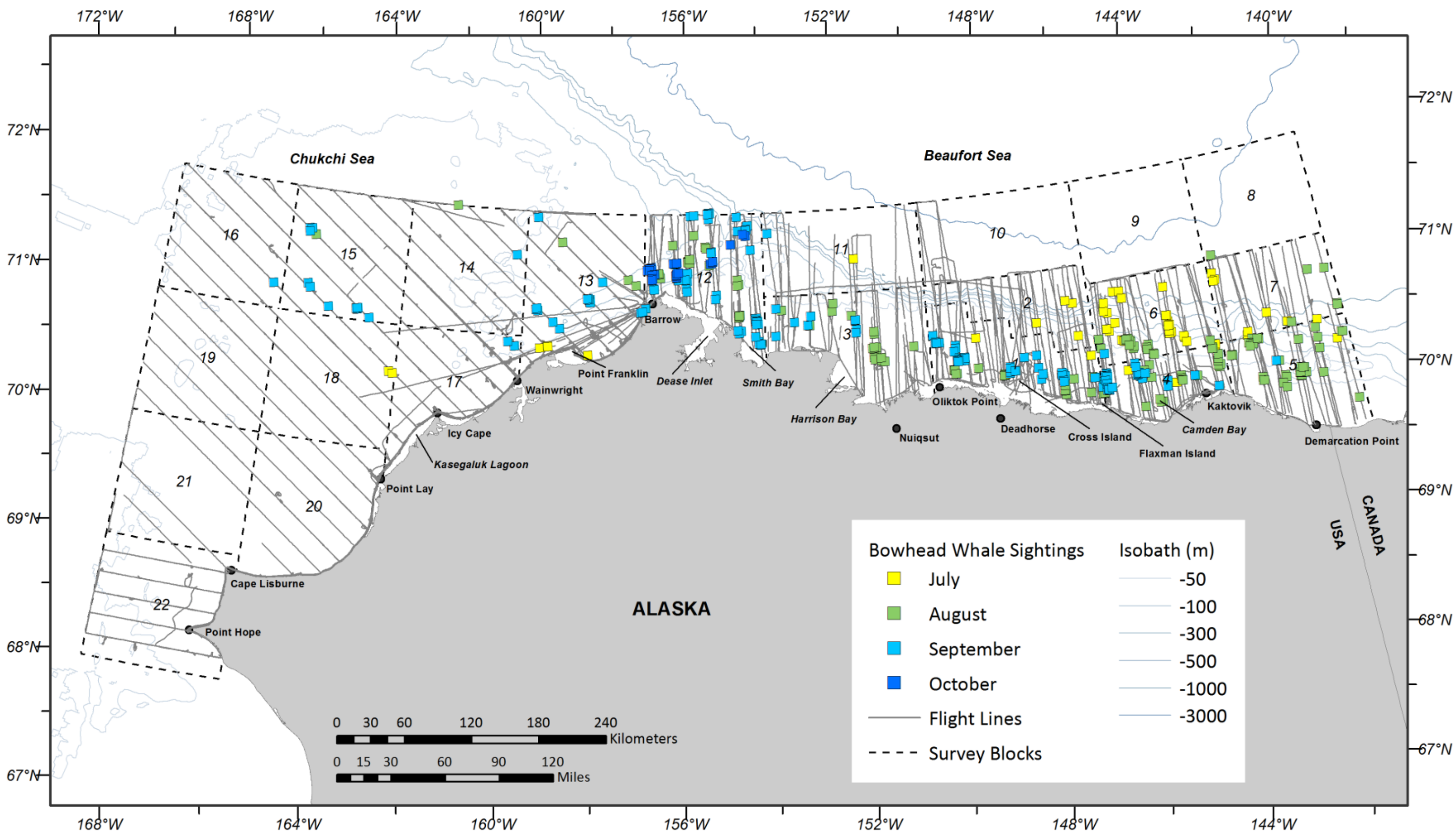


Figure 7. ASAMM 2013 bowhead whale sightings plotted by month, with transect, search and circling effort. Deadhead flight tracks are not shown.

70.5°N. The greatest number of bowhead whales were seen in block 13 (n=46). Relatively few whales were seen in block 14 where the greatest numbers of bowhead whales were seen in 2012. Bowhead whale sightings in the northeastern Chukchi Sea in September 2013 reinforce previous observations from aerial surveys, satellite tracking (Quakenbush et al. 2010a), and acoustics (Delarue et al. 2011), describing a migration path that spreads across the CSPA. Bowhead whales were last observed in the northeastern Chukchi Sea on 30 September when 12 whales were seen approximately 250 to 400 km west-northwest of Barrow. The lack of bowhead whale sightings in the northeastern Chukchi Sea in October was likely due to lack of survey effort due to the government shutdown (1-17 October) and poor weather conditions (19-30 October) (Figure 6). Several bowhead whales were observed in the northeastern Chukchi Sea in October 2013 during vessel surveys conducted by the oil industry (L. Aerts, LAMA Ecological, pers comm. to J. Clarke, 10 February 2014).

In the western Beaufort Sea, bowhead whales were seen on the outer continental shelf (51-200 m) in late July (Figure 8B), with the highest number of whales seen (during transect, search and circling modes) in block 6 (n=62). Bowhead whales in August were observed across the western Beaufort Sea in both outer and inner shelf waters, with the highest number of whales seen (during transect, search and circling modes) in blocks 4 (n=73) and 5 (n=54); several bowhead whales were also seen in block 12, mainly near Barrow Canyon. The highest numbers of whales per survey block in summer (July-August; during transect, search and circling modes) were in blocks 4 (n=90) and 6 (n=89). Distribution in September was primarily on the inner shelf (36-50 m) from approximately 143°W to 157°W (Figure 7), with several whales observed offshore near Barrow Canyon; few bowhead whales were seen east of 143°W. During the limited survey effort in late October, bowhead whales were observed on only one day and all were in block 12 near Barrow Canyon. The highest numbers of whales per survey block in fall (September-October; during transect, search and circling modes) were in blocks 12 (n=149; includes 8 whales at the northern boundary of the block at 72°N) and 1 (n=65). Bowhead whales were seen in shallow (≤20 m) nearshore waters between 143°W and 156°W in August and September, including areas north of Camden Bay, Prudhoe Bay, Harrison Bay and Smith Bay. Bowhead whales were not seen inside barrier islands. Bowhead whales were last observed in the western Beaufort Sea on 26 October during a survey of block 12, when 37 whales were seen.

The lack of bowhead whale observations during the limited surveys conducted in late October (Figure 6) may be an indication that the majority of whales had migrated through this area in early to mid-October when aerial survey teams were not in the field due to the partial government shutdown.

Although surveys had been previously conducted in summer in the western Beaufort Sea (Ljungblad et al. 1987; Christman et al. 2013), survey coverage was sporadic and inconsistent prior to 2012 (Clarke et al. 2013a). Survey coverage in 2012 and 2013 was temporally and geographically similar (Figure 8); therefore comparisons of summer bowhead whale distribution and other parameters are limited to those years. Bowhead whale distributions in the western Beaufort Sea (all sightings regardless of effort mode or observer type) in July 2012 and 2013 were similar, with the majority of sightings east of 148°W and on the outer shelf (51-200 m), although total whales sighted was far greater in 2013 (n=31 in 2012; n=107 in 2013). In August

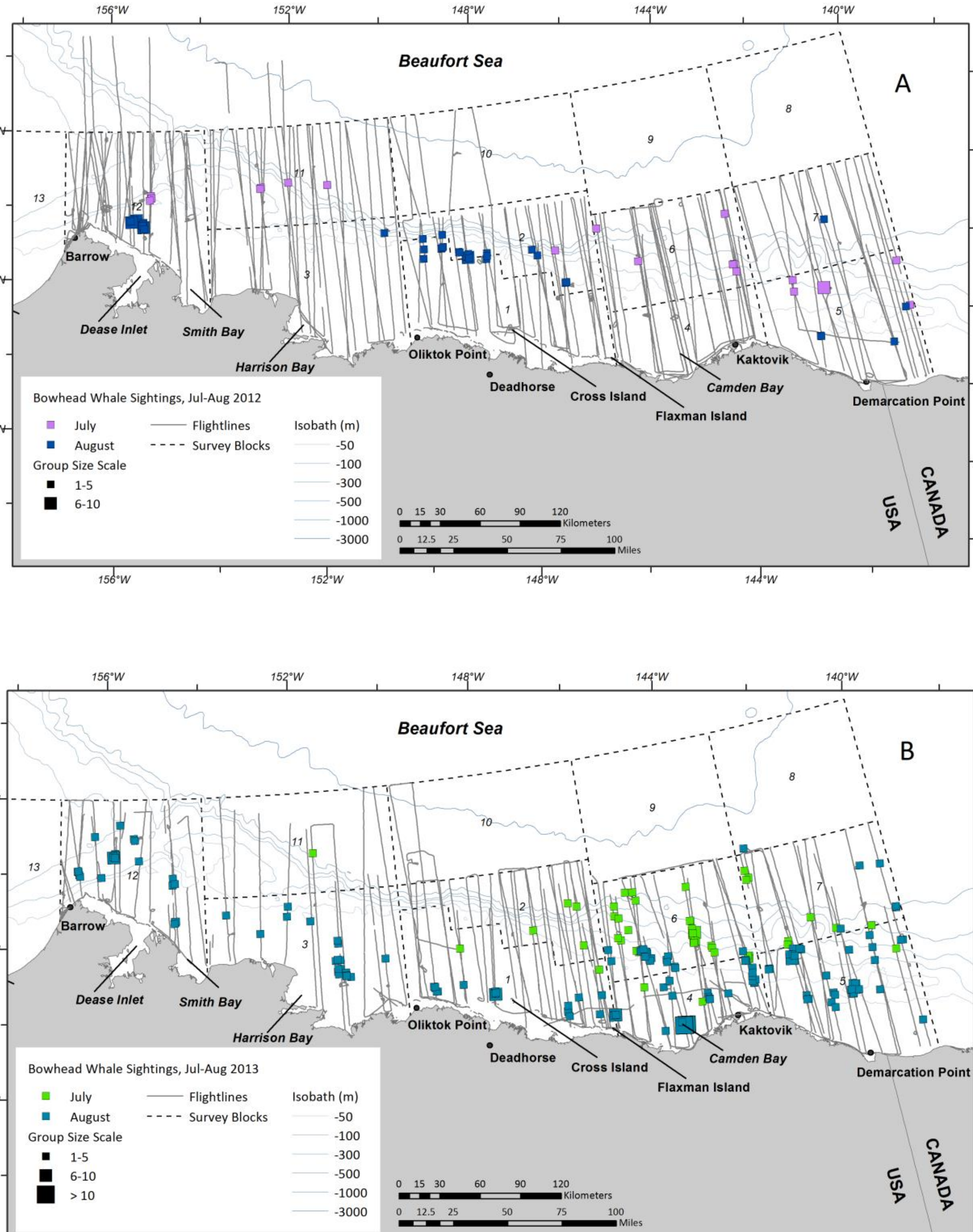


Figure 8. ASAMM bowhead whale sightings in the western Beaufort Sea, July and August, 2012 (A) and 2013 (B), with transect, search and circling effort. Deadhead flight tracks are not shown.

2012, bowhead whale distribution remained offshore, with sightings in the central Alaskan Beaufort Sea near the 50-m depth contour; however, bowhead whales in the western Alaskan Beaufort Sea were also seen nearshore east of Point Barrow (Figure 8A). In August 2013, bowhead whale distribution was primarily on the inner shelf (≤ 50 m), with several whales observed in depths ≤ 20 m (Figure 8B).

BOWHEAD WHALE SIGHTING RATES

In summer and fall 2013, bowhead whales were seen on transect throughout the longitudinal extent of the study area from 140°W to 169°W. There were 215 sightings of 368 bowhead whales on transect by primary observers, ranging from 1 whale per sighting (n=133) to 20 whales per sighting (n=1). The highest number of sightings on transect was in block 12 (49 sightings), followed by block 4 (35 sightings). The largest group of bowhead whales on transect (20 animals) was observed on 20 August in block 4. Highest fine-scale sighting rates (WPUE, 5 km grid) for summer (July-August) and fall (September-October) were scattered across the study area (Figure 9), although there were notable differences between the seasons. In summer, highest fine-scale sighting rates were offshore east of 143°W (blocks 5 and 7), nearshore in Camden Bay (block 4), west of Deadhorse (block 1) and near Barrow Canyon (block 12) (Figure 9). In fall, nearly all populated fine-scale cells were closer to shore, within the 50 m isobath in the western Beaufort Sea, except near Barrow Canyon, and they were scattered across the northeastern Chukchi Sea west and northwest of Barrow. Areas of highest fine-scale sighting rates in fall were north of Harrison Bay (block 3), nearshore northwest of Smith Bay (block 12), ~50 km west of Barrow (block 13), and ~300 km west of Barrow (blocks 15). As with all other data subsets for fall 2013, the fine-scale sighting rate analysis is largely indicative of September only, as few flights were conducted in October due to the partial government shutdown.

For all months combined, the highest sighting rates per survey block were in block 4 (0.052 WPUE), block 6 (0.028 WPUE) and block 12 (0.027 WPUE), with an overall sighting rate of 0.010 WPUE (Table 4). The combined sighting rates for summer months (July-August) were highest in block 4 (0.067 WPUE), block 6 (0.039 WPUE) and block 12 (0.025 WPUE), although sighting rates for combined summer months are misleading. Sighting rates in July were 3-4 times higher in blocks 6 (0.045 WPUE) and 7 (0.051 WPUE) than in any other block, while sighting rates in August were more than three times higher in block 4 (0.112 WPUE) compared to any other block, illustrating the distribution shift from offshore blocks to nearshore blocks from July to August. Sighting rates in summer were relatively low in all Chukchi Sea blocks.

The combined sighting rates for fall months (September-October) were highest in block 4 (0.030 WPUE), block 12 (0.029 WPUE) and block 1 (0.019 WPUE); overall sighting rate in fall for all blocks combined was 0.008 WPUE. The combined sighting rate for fall months for the western Beaufort Sea only was 0.014 WPUE, which is higher than that observed in 2008, and 2010-2012, but lower than that observed in 2006-2007 and 2009 (Clarke et al. 2011a, 2011b, 2011c, 2012, 2013a). The survey block sighting rate analyses for previous years with light sea ice cover in the 1980s and 1990s (e.g., Ljungblad et al. 1987; Treacy 1988, 1990, 1991, 1994, 1995, 1996, 1997, 1998) analyzed the total number of bowhead whales/survey hour flown, and did not remove unsurveyable time periods (due to lack of suitable visibility), time spent surveying inside the barrier islands and north of 72°N, or sightings from secondary observers, so it is difficult to

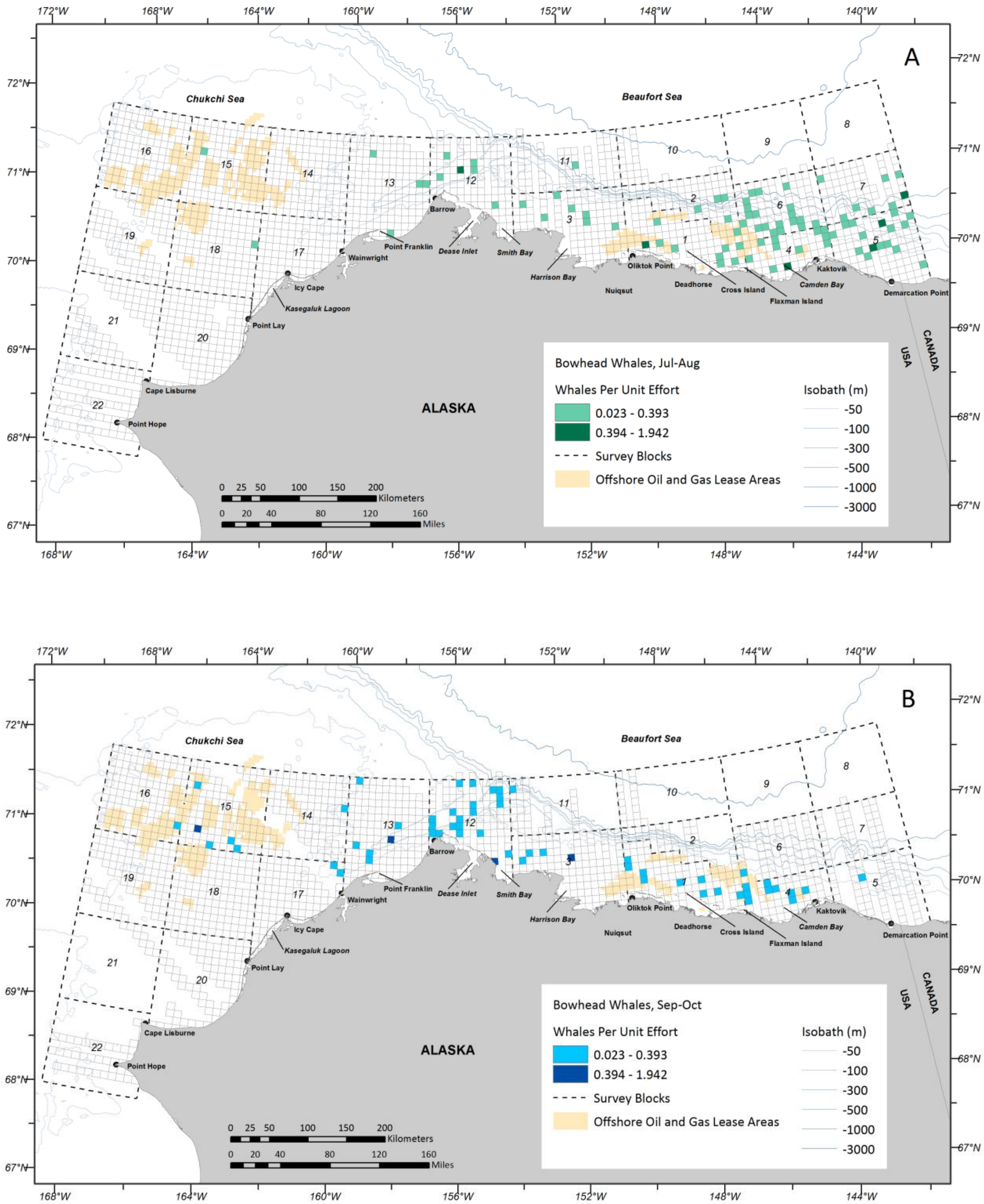


Figure 9. ASAMM 2013 bowhead whale sighting rates (WPUE, transect sightings from primary observers only), (A) summer (July-August); and (B) fall (September-October). Empty grid cells indicate sighting rates of zero. Transect survey effort was not conducted in areas without grid cells.

Table 4. ASAMM 2013 transect (Tr) effort (km), bowhead whale transect sightings (primary observers only) and bowhead whale sighting rate (WPUE = bowhead whales per transect km surveyed) per survey block per month. NA – surveys were not conducted. Minor discrepancies within the table are due to rounding error.

	JUL				AUG				SUMMER			
Block	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**
1	976	2	3	0.0031	606	14	18	0.0297	1,582	16	21	0.0133
2	687	4	6	0.0087	640	0	0	0.0000	1,327	4	6	0.0045
3	372	0	0	0.0000	578	7	8	0.0138	950	7	8	0.0084
4	460	4	7	0.0152	525	17	59	0.1123	986	21	66	0.0670
5	414	1	2	0.0048	856	20	24	0.0280	1,270	21	26	0.0205
6	661	17	30	0.0454	513	10	16	0.0312	1,174	27	46	0.0392
7	253	6	13	0.0514	689	4	9	0.0131	942	10	22	0.0234
8	2	0	0	0.0000	0	0	0	NA	2	0	0	0.0000
9	0	0	0	0.0000	1	0	0	0.0000	1	0	0	0.0000
10	36	0	0	0.0000	147	0	0	0.0000	183	0	0	0.0000
11	244	1	1	0.0041	326	0	0	0.0000	570	1	1	0.0018
12	20	0	0	0.0000	1,117	14	28	0.0251	1,137	14	28	0.0246
13	1,489	1	1	0.0007	1,786	3	3	0.0017	3,275	4	4	0.0012
14	858	0	0	0.0000	572	0	0	0.0000	1,430	0	0	0.0000
15	419	0	0	0.0000	851	1	1	0.0012	1,270	1	1	0.0008
16	395	0	0	0.0000	608	0	0	0.0000	1,003	0	0	0.0000
17	586	0	0	0.0000	1,184	0	0	0.0000	1,770	0	0	0.0000
18	335	1	1	0.0030	661	0	0	0.0000	995	1	1	0.0010
19	234	0	0	0.0000	330	0	0	0.0000	564	0	0	0.0000
20	228	0	0	0.0000	1,023	0	0	0.0000	1,251	0	0	0.0000
21	0	0	0	NA	360	0	0	0.0000	360	0	0	0.0000
22	329	0	0	0.0000	857	0	0	0.0000	1,186	0	0	0.0000
Total*	**8,997**	**37**	**64**	**0.0071**	**14,230**	**90**	**166**	**0.0117**	**23,228**	**127**	**230**	**0.0099**

NA Block	SEP Tr Km	Tr Sightings	Tr Whales	WPUE	OCT Tr Km	Tr Sightings	Tr Whales	WPUE	FALL Tr Km	Tr Sightings	Tr Whales	WPUE
1	689	11	21	0.0305	433	0	0	0.0000	1,121	11	21	0.0187
2	293	0	0	0.0000	76	0	0	0.0000	369	0	0	0.0000
3	467	7	7	0.0150	750	0	0	0.0000	1,217	7	7	0.0058
4	498	14	20	0.0401	174	0	0	0.0000	673	14	20	0.0297
5	569	1	2	0.0035	0	0	0	NA	569	1	2	0.0035
6	493	1	1	0.0020	29	0	0	0.0000	522	1	1	0.0019
7	367	0	0	0.0000	0	0	0	NA	367	0	0	0.0000
8	0	0	0	NA	0	0	0	NA	0	0	0	NA
9	0	0	0	NA	0	0	0	NA	0	0	0	NA
10	145	0	0	0.0000	0	0	0	NA	145	0	0	0.0000
11	261	1	1	0.0038	0	0	0	0.0000	261	1	1	0.0038
12	1,122	22	33	0.0294	557	13	15	0.0269	1,680	35	48	0.0286
13	1,503	8	19	0.0126	212	0	0	0.0000	1,715	8	19	0.0111
14	757	1	1	0.0013	188	0	0	0.0000	945	1	1	0.0011
15	781	6	14	0.0179	235	0	0	0.0000	1,017	6	14	0.0138
16	811	1	1	0.0012	79	0	0	0.0000	890	1	1	0.0011
17	1,295	2	3	0.0023	208	0	0	0.0000	1,503	2	3	0.0020
18	924	0	0	0.0000	29	0	0	0.0000	953	0	0	0.0000
19	491	0	0	0.0000	0	0	0	NA	491	0	0	0.0000
20	1,443	0	0	0.0000	0	0	0	NA	1,443	0	0	0.0000
21	63	0	0	0.0000	0	0	0	NA	63	0	0	0.0000
22	514	0	0	0.0000	0	0	0	NA	514	0	0	0.0000
Total*	**13,487**	**75**	**123**	**0.0091**	**2,971**	**13**	**15**	**0.0050**	**16,458**	**88**	**138**	**0.0084**

* Total transect effort (Tr km) may differ from values in Tables 2 and 5 because effort between barrier islands and the mainland was not included in the sighting rate per survey block analysis.

compare 2013 sighting rates with existing analyses of sighting rates from two decades ago. However, one pattern that appears to be consistent across all light ice years is that the highest sighting rates per year during fall in western Beaufort Sea are found in coastal survey blocks (1, 3, 4, 5, and 12), and are usually correlated with large groups of bowhead whales in feeding or milling aggregations.

Monthly sighting rates per survey block in the western Beaufort Sea in September 2013 were higher than monthly sighting rate per block for September 1989-2012 combined, with few exceptions (Figure 10). Note that monthly sighting rates per survey block in the western Beaufort Sea in October 2013 were not directly comparable to previous years because surveys in October 2013 were limited to the last third of the month.

In the Chukchi Sea in fall, the highest sighting rate was 0.014 WPUE in block 15, which was lower than the highest sighting rate per survey block observed in fall 2012 (block 14, 0.033 WPUE) (Clarke et al. 2013a) but higher than the sighting rate in any Chukchi Sea block in 2008, 2009, 2010 or 2011 (Clarke et al. 2011d, 2012). The highest sighting rate in the Chukchi Sea in fall 2008, 2009, 2010 or 2011 was in block 13 (Clarke et al. 2011d, 2012).

For summer months, the highest sighting rates per depth zone (Table 5) were in the:

- ≤20 m depth zone (0.046 WPUE) in the central-eastern (140°W-154°W) Alaskan Beaufort Sea subarea, influenced by sightings in nearshore Camden Bay in August; sighting rates in July alone were highest in the 51-200 m depth zone (0.037 WPUE);
- 51-200 m depth zone (0.042 WPUE) in the western (154°W-157°W) Alaskan Beaufort Sea subarea; and
- 51-200 m North depth zone (0.001 WPUE) in the northeastern Chukchi Sea subarea (157°W-169°W), influenced by sightings near Barrow Canyon.

The shift from highest sighting rates in offshore, deeper water (51-200 m) in July to shallower water (21-50 m) in August in the central-eastern (140°W-154°W) Alaskan Beaufort Sea was noted in 2012 (Clarke et al. 2013a), although it was more pronounced in 2013 (shift occurred from 51-200 m to ≤20 m).

For fall months, the highest sighting rates per depth zone (Table 5) were in the:

- 21-50 m depth zone (0.018 WPUE) in the central-eastern (140°W-154°W) Alaskan Beaufort Sea subarea;
- ≤20 m depth zone (0.038 WPUE) and 51-200 m depth zone (0.038 WPUE) in the western (154°W-157°W) Alaskan Beaufort Sea subarea; and
- 51-200 m North depth zone (0.019 WPUE) in the northeastern Chukchi Sea subarea (157°W-169°W), influenced by sightings near Barrow Canyon.

Depth zone preferences in fall were similar to past years, with the exception of the western Alaskan Beaufort Sea (154°-157°W). In most years, particularly those in which large groups of feeding whales were observed, the highest sighting rate was in the ≤20 m depth zone. The high sighting rate in the 51-200 m depth zone in 2013 reflected bowhead whales seen near Barrow Canyon in September and late October. Note that during the limited survey period in October 2013 (20-28 October), bowhead whales were seen only in the vicinity of Barrow Canyon in the western Alaskan Beaufort Sea.

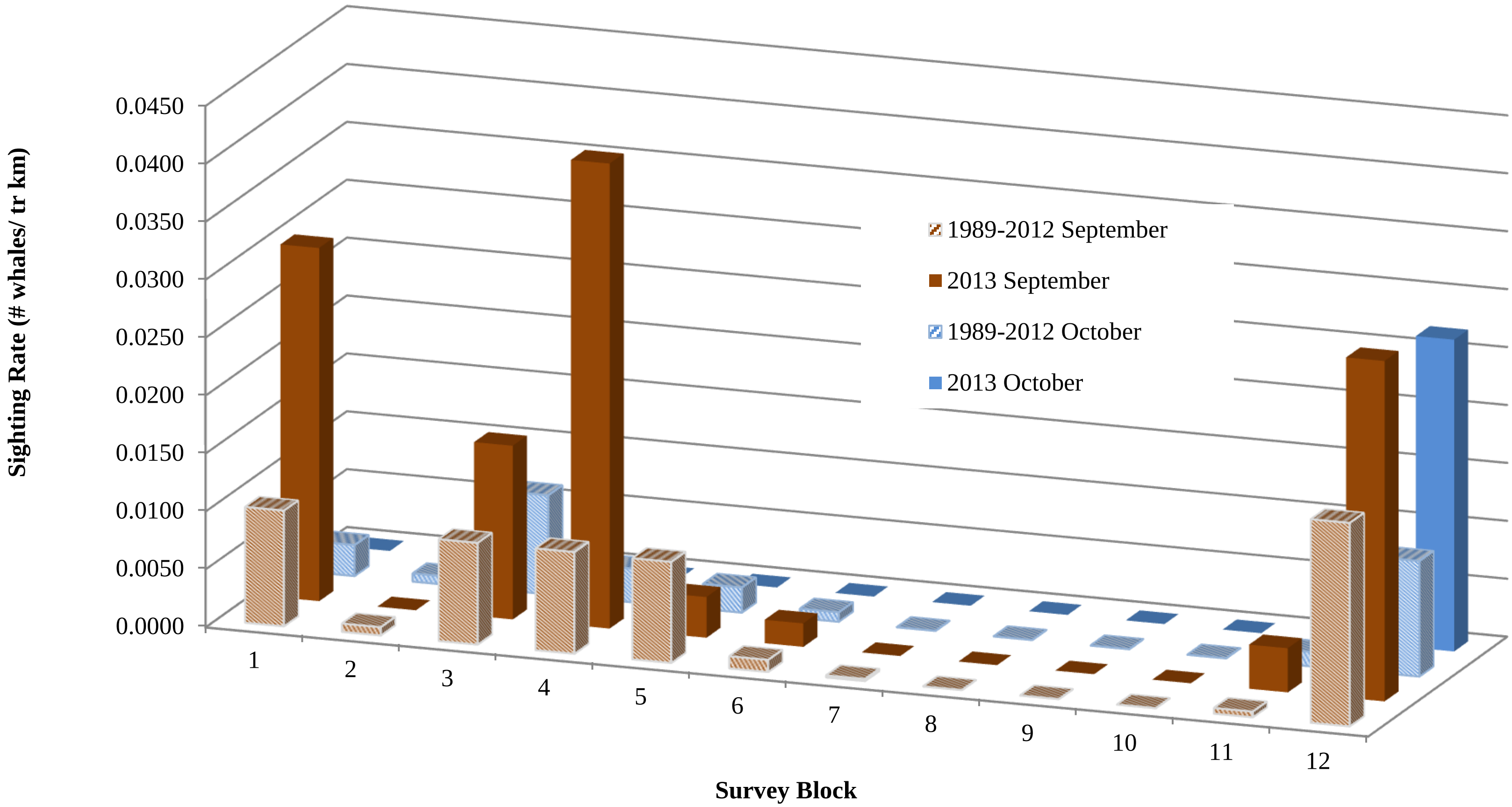


Figure 10. ASAMM September and October sighting rates (WPUE) of bowhead whales on transect (made by primary observers only) in the western Beaufort Sea per survey block, 1989-2012 and 2013.

Table 5. ASAMM 2013 transect (Tr) effort (km), bowhead whale transect sightings (primary observers only) and bowhead whale sighting rate (WPUE = bowhead whales per transect km surveyed) per depth zone per month. NA – surveys were not conducted. Minor discrepancies within the table are due to rounding error.

	JUL				AUG				SUMMER			
Depth Zone	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**
157W-169W												
≤35 m	1,237	1	1	0.0008	2,696	1	1	0.0004	3,933	2	2	0.0005
36-50 m	2,435	1	1	0.0004	4,041	0	0	0.0000	6,476	1	1	0.0002
51-200 m N	1,104	0	0	0.0000	1,080	3	3	0.0028	2,184	3	3	0.0014
51-200 m S	96	0	0	0.0000	239	0	0	0.0000	336	0	0	0.0000
154W-157W												
≤20 m	12	0	0	0.0000	266	2	3	0.0113	277	2	3	0.0108
21-50 m	9	0	0	0.0000	191	0	0	0.0000	200	0	0	0.0000
51-200 m	0	0	0	NA	546	11	23	0.0421	546	11	23	0.0421
201-2,000 m	0	0	0	NA	114	1	2	0.0175	114	1	2	0.0175
140W-154W												
≤20 m	506	0	0	0.0000	560	14	49	0.0875	1,066	14	49	0.0460
21-50 m	1,574	4	6	0.0038	1,630	33	47	0.0288	3,204	37	53	0.0165
51-200 m	618	12	23	0.0372	994	18	25	0.0252	1,611	30	48	0.0298
201-2,000 m	1,068	19	33	0.0309	1,222	6	11	0.0090	2,290	25	44	0.0192
>2,000 m	341	0	0	0.0000	490	1	2	0.0041	830	1	2	0.0024
Total*	9,000	37	64	0.0071	14,067	90	166	0.0118	23,067	127	230	0.0100

Depth Zone	SEP Tr Km	Tr Sightings	Tr Whales	WPUE	OCT Tr Km	Tr Sightings	Tr Whales	WPUE	FALL Tr Km	Tr Sightings	Tr Whales	WPUE
157W-169W												
≤35 m	3,058	0	0	0.0000	197	0	0	0.0000	3,255	0	0	0.0000
36-50 m	4,057	9	17	0.0042	632	0	0	0.0000	4,689	9	17	0.0036
51-200 m N	965	9	21	0.0218	132	0	0	0.0000	1,096	9	21	0.0192
51-200 m S	95	0	0	0.0000	0	0	0	NA	95	0	0	0.0000
154W-157W												
≤20 m	215	8	13	0.0606	124	0	0	0.0000	339	8	13	0.0383
21-50 m	263	2	2	0.0076	119	0	0	0.0000	381	2	2	0.0052
51-200 m	531	10	15	0.0283	257	13	15	0.0583	788	23	30	0.0381
201-2,000 m	114	2	3	0.0263	57	0	0	0.0000	171	2	3	0.0175
140W-154W												
≤20 m	585	7	10	0.0171	623	0	0	0.0000	1,208	7	10	0.0083
21-50 m	1,478	26	39	0.0264	686	0	0	0.0000	2,164	26	39	0.0180
51-200 m	673	2	3	0.0045	76	0	0	0.0000	749	2	3	0.0040
201-2,000 m	743	0	0	0.0000	78	0	0	0.0000	821	0	0	0.0000
>2,000 m	311	0	0	0.0000	0	0	0	NA	311	0	0	0.0000
Total*	13,088	75	123	0.0094	2,981	13	15	0.0050	16,068	88	138	0.0086

* Total transect effort (Tr km) may differ from values in Tables 2 and 4 because effort between barrier islands and the mainland was included in the sighting rate per depth zone analysis.

BOWHEAD WHALE HABITAT ASSOCIATIONS

Biweekly sea ice cover maps for the western Beaufort Sea during 2013 are included in Appendix A. Most bowhead whales (86%, n=642) were observed in 0% sea ice cover (Table 6). Eighty-five bowhead whales (11%) were sighted in 1-20% sea ice cover. Sixteen bowhead whales (2%) were sighted in 21-60% sea ice cover, either in July and early August when sea ice remained in some of the study area, or in late October when new ice was forming in shallow nearshore areas.

BOWHEAD WHALE BEHAVIORS

Behaviors of bowhead whales observed during all survey modes (i.e., transect, search and circling) and by primary and secondary observers in 2013 are summarized in Table 7. The behavior most often recorded was swimming (48%, n=355). Feeding behavior was likely underreported due to the difficulty of identifying this behavior for animals that may feed on benthic or mid-water prey; milling was often recorded in situations where obvious evidence of feeding was not directly observed but was suspected. Milling and feeding were recorded for 194 whales (26%), resting was recorded for 123 whales (17%), and diving was recorded for 24 whales (3%). Twenty-four whales were recorded exhibiting display behaviors, including breaching (7 whales), tail slapping (6 whales), log playing (5 whales), rolling (3 whales) and thrashing (3 whales). Two of the whales observed playing with logs were calves. Twelve bowhead whales (2% of all bowhead whales sighted) appeared to respond to the survey aircraft. Reactions included diving (9 whales) and slowing sinking under the surface (3 whales).

Bowhead whale swim direction was not clustered around any heading in summer or fall. In the western Beaufort Sea in July and August, the mean vector swim direction was 334°T, but headings were scattered in all directions ($n = 47$ observations, Rayleigh $Z = 0.585$, $P = 0.560$). In September and October, the mean vector swim direction in the western Beaufort Sea was 277°T but was not significantly clustered ($n = 18$ observations, Rayleigh $Z = 1.775$, $P = 0.171$). Mean vector swim direction in the Chukchi Sea in September and October was 336°T but was not significantly clustered ($n = 23$ observations, Rayleigh $Z = 1.639$, $P = 0.195$). There were too few observations to test for mean swim direction in July and August in the Chukchi Sea.

Bowhead Whale Calves

Out of the 743 bowhead whales sighted, 66 were identified as calves (Figure 11). Calves were seen from mid-July through late October, distributed from 140°W to 166°W. Most calves (92%) were seen in the western Beaufort Sea. Calves were observed with adult bowhead whales that were feeding, milling, resting and swimming. Two calves were observed playing with logs, one in close association with an adult (Appendix B, Flight 10) and one alone (Appendix B, Flight 27). Two calves were sighted in close association with a single adult (Appendix B, Flight 252); no additional adult surfaced during the approximately seven minutes of observation. Ten calves were initially seen without an adult nearby; on 5 of those occasions no adult ever surfaced near the calf despite prolonged (>10 minutes) circling. Most calves (64%) were sighted after circling was initiated and likely would not have been observed if circling had not commenced.

Table 6. ASAMM 2013 semimonthly summary of bowhead whales (number of sightings/number of individuals) observed during all survey modes (transect, search and circling), by percent sea ice cover at sighting location. Excludes dead and repeat sightings.

Percent Sea Ice Cover	1-15 Jul	16-31 Jul	1-15 Aug	16-31 Aug	1-15 Sep	16-30 Sep	20-28 Oct	Total
0	2/2	21/41	58/83	80/168	103/187	74/125	27/36	365/642
1-5	0	18/44	18/24	0	0	0	0	36/68
6-10	0	2/3	1/2	0	0	0	0	3/5
11-20	0	6/10	0	1/1	0	0	1/1	8/12
21-30	0	0	1/1	0	0	0	0	1/1
31-40	3/4	2/2	0	1/1	0	0	0	6/7
41-50	0	2/4	0	0	0	0	0	2/4
51-60	1/1	2/3	0	0	0	0	0	3/4
TOTAL	6/7	53/107	78/110	82/170	103/187	74/125	28/37	424/743

Table 7. ASAMM 2013 semimonthly summary of bowhead whales (number of sightings/number of individuals) observed during all survey modes (transect, search and circling), by behavioral category. Excludes dead and repeat sightings.

Behavior	1-15 Jul	16-31 Jul	1-15 Aug	16-31 Aug	1-15 Sep	16-30 Sep	20-28 Oct	Total
Breach	0	2/5	1/1	0	1/1	0	0	4/7
Dive	1/1	0	1/1	6/8	9/11	1/2	1/1	19/24
Feed	0	4/10	0	4/42	6/44	1/1	0	15/97
Log play	0	0	2/3	1/1	1/1	0	0	4/5
Mill	0	4/16	5/10	21/50	3/9	6/12	0	39/97
Rest	0	10/17	7/9	18/25	43/65	3/7	0	81/123
Roll	0	0	0	0	2/3	0	0	2/3
Swim	5/6	30/54	52/70	29/38	37/50	62/101	27/36	242/355
Tail slap	0	1/2	1/1	1/3	0	0	0	3/6
Thrash	0	0	0	0	1/3	0	0	1/3
Unknown	0	2/3	9/15	2/3	0	1/2	0	14/23
TOTAL	6/7	53/107	78/110	82/170	103/187	74/125	28/37	424/743

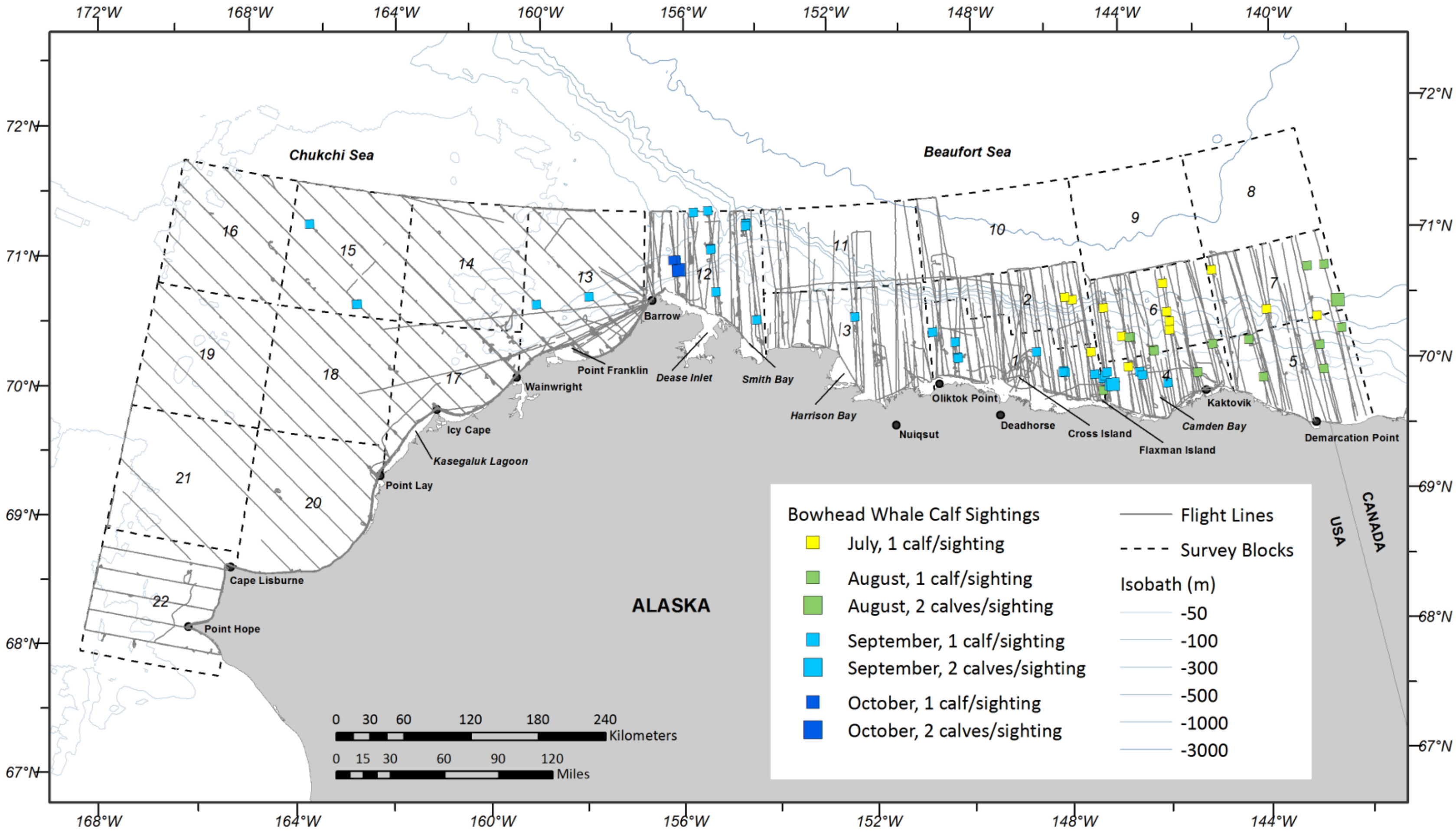


Figure 11. ASAMM 2013 bowhead whale calf sightings plotted by month, with transect, search and circling effort. Deadhead flight tracks are not shown.

Twenty-nine of the bowhead whale calves (44%) were sighted during summer months in the western Beaufort Sea, distributed primarily between 140°W and 147°W, offshore over the slope in July and more broadly distributed in nearshore and offshore waters in August. The summer calf ratio (number of calves/number of total whales) was 0.074, lower than the ratio observed in summer 2012 (0.093) (Clarke et al. 2013a).

Thirty-seven of the bowhead whale calves (56%) were sighted during fall months, distributed from 144°W to 166°W primarily on the shelf or offshore near Barrow Canyon in the western Beaufort Sea. The calf ratio during fall was 0.106, which is higher than any calf ratio previously recorded for any single year from 1982-2012 (0.022 to 0.058; Clarke et al. 2012, 2013a).

Western Beaufort Sea Bowhead Whale Feeding Areas

Bowhead whale feeding behavior, which includes sightings reported as milling, was observed in summer and fall 2013. During summer months (July-August), feeding behavior was documented on seven days in the eastern Alaskan Beaufort Sea (140°W to 149°W), at depths ranging from <20 m to >850 m (4-108 km from shore), and on two days in the westernmost Alaskan Beaufort Sea (154°W to 157°W) at depths ranging from 29 m to >210 m (16-39 km from shore) (Figure 12A). In fall (September), feeding behavior was observed on one day in the central Alaskan Beaufort Sea (145°W to 148°W) and three days in the westernmost Alaskan Beaufort Sea (Figure 12B). Most feeding whales observed in September were within the 20 m isobath, but several small feeding groups were in deeper water at the northern edge of Barrow Canyon. Feeding behavior was not observed in October 2013. Sighting rates for feeding and milling bowhead whales observed on transect in summer and fall are shown in Figure 13.

In 2013, surveys were conducted in block 12, a well-documented bowhead whale feeding area (Moore and Reeves 1993; Mocklin et al. 2011) on seven occasions and bowhead whales were seen during each of those surveys (Figure 14). Surveys in block 12 were not pre-planned based on wind conditions, but overall weather conditions did impact when the area was surveyed due to the cloud ceilings and sea states required to conduct a survey flight and collect reliable data. In other words, surveys were not preferentially conducted on days on which there was a high likelihood of seeing bowhead whales based on recent wind conditions, because that could introduce bias into the data. Weather was not suitable for surveying block 12 in the first half of September so there was a two-week gap in coverage of this area. Surveys in block 12 were conducted on seven days:

- 11 August: Six bowhead whales were seen north of Point Barrow during fairly good survey conditions (Beaufort 0-4, 0-10 km visibility with some fog and glare). Sea ice cover in the area surveyed was 0-40% broken floe. None of the bowhead whales exhibited feeding or milling behavior.
- 23 August: Twelve bowhead whales were seen near Barrow Canyon and north of Smith Bay during fair survey conditions (Beaufort 2-3, 0-10 km visibility with snow showers, fog and glare). There was no sea ice cover in the area surveyed. Four bowhead whales exhibited feeding or milling behavior.

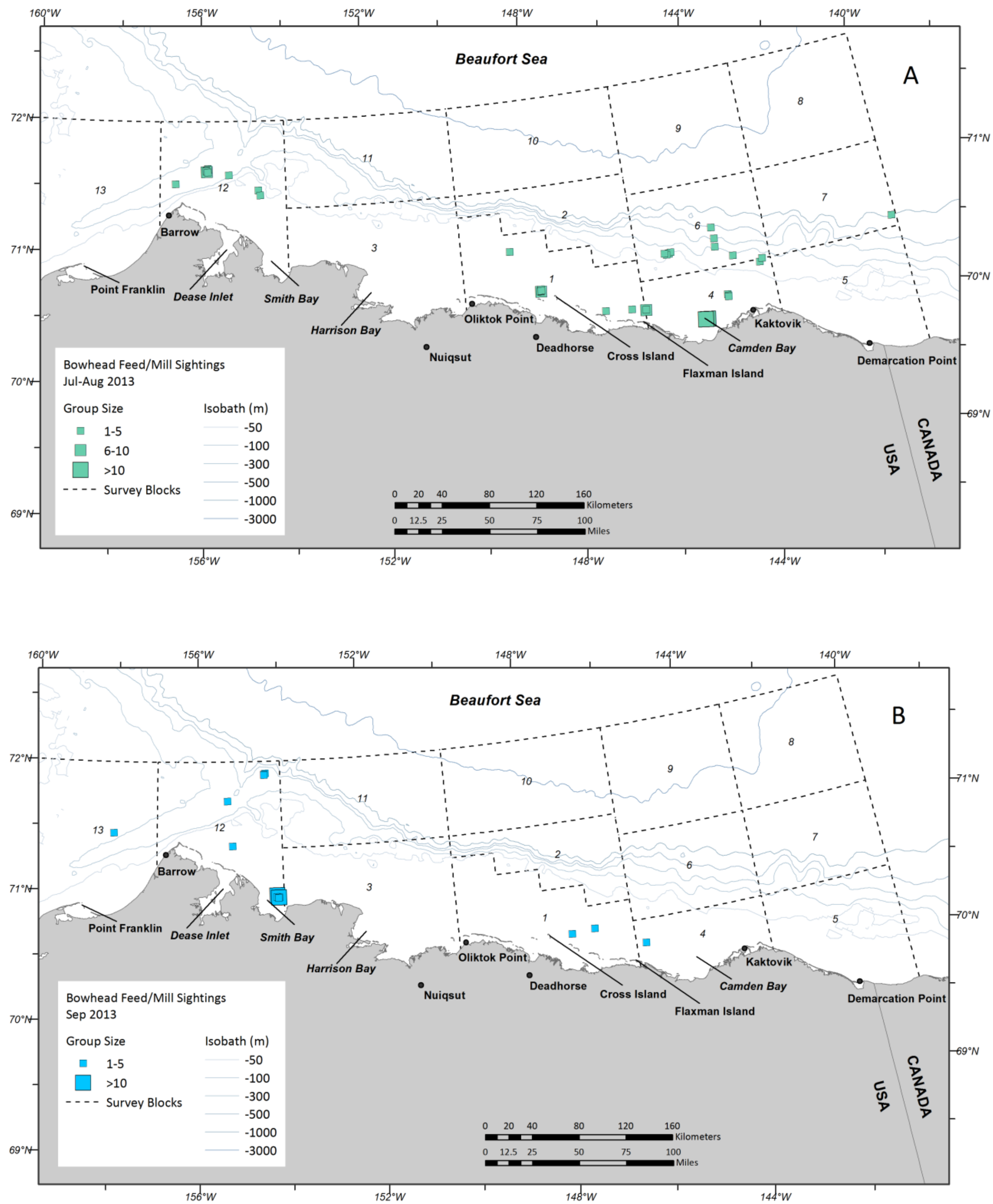
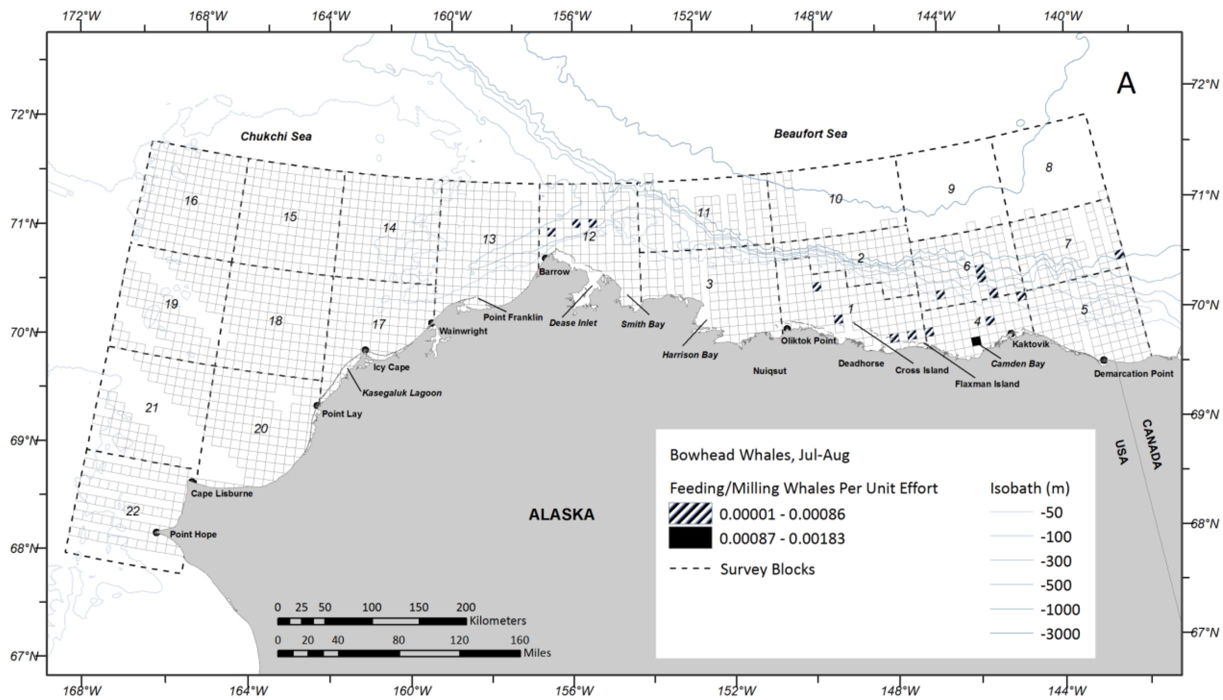


Figure 12. ASAMM 2013 bowhead whale feeding and milling sightings, all survey modes (transect, search, and circling), summer (July-August) (A) and fall (September) (B) 2013. There were no feeding or milling sightings in October.



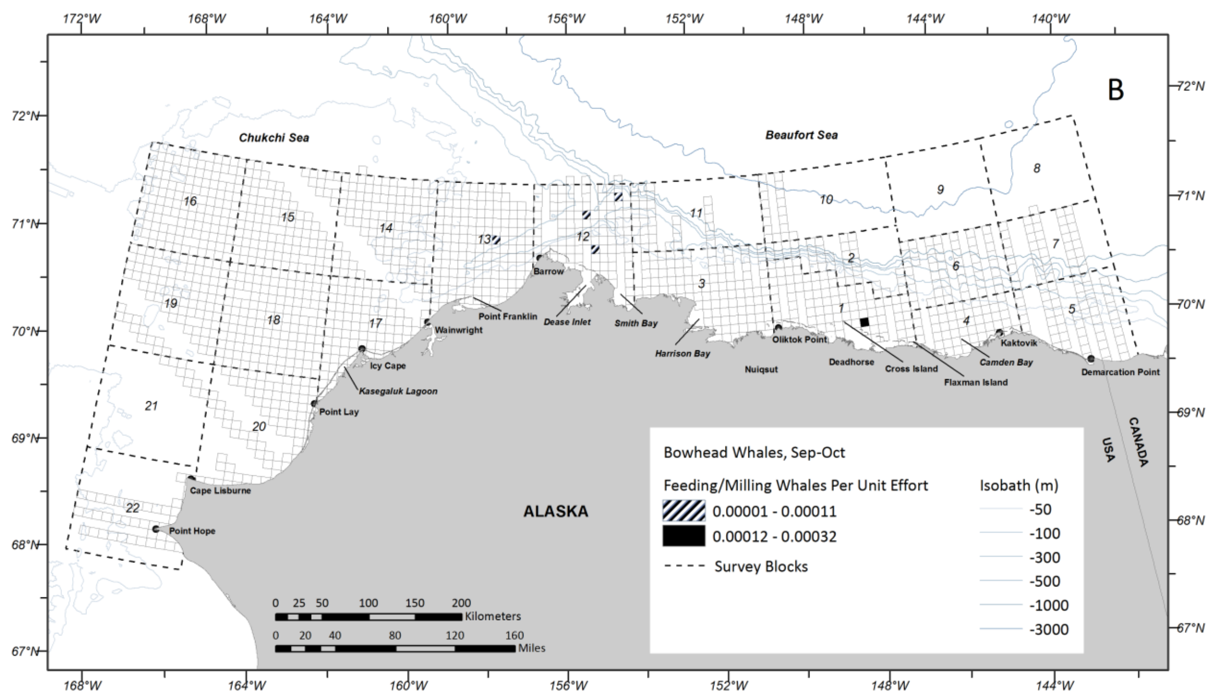


Figure 13. ASAMM 2013 feeding and milling bowhead whale sighting rates (WPUE, transect sightings from primary observers only), summer (July-August) (A) and fall (September) (B). Empty grid cells indicate sighting rates of zero. Transect survey effort was not conducted in areas without grid cells.

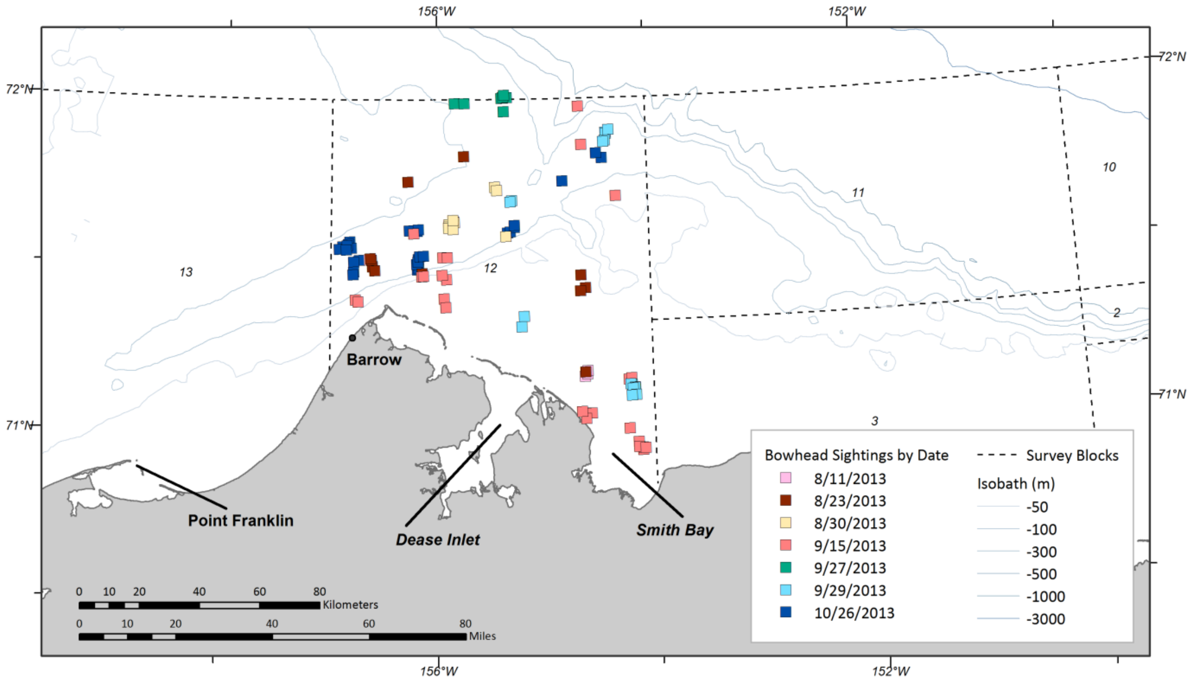


Figure 14. ASAMM 2013 bowhead whale sightings in block 12, all survey modes (transect, search, and circling).

- 30 August: Twenty-four bowhead whales were observed near Barrow Canyon during marginal survey conditions (Beaufort 6, 5-10 km visibility). There was no sea ice in block 12. Twenty bowhead whales exhibited feeding or milling behavior.
- 15 September: Sixty-eight bowhead whales were seen near Barrow Canyon and near-shore north of Smith Bay during a survey in fair conditions (Beaufort 3-6, 0-10 km visibility with low ceilings and precipitation). There was no sea ice in the area surveyed. Forty-four bowhead whales exhibited feeding or milling behavior, including groups of 17 and 20 in shallow (<20 m depth) water near Smith Bay.
- 27 September: Ten bowhead whales were observed near Barrow Canyon, including along the northernmost edge of the survey block. Survey conditions were fair (Beaufort 3-6, 0-10 km visibility with low ceilings and precipitation). There was no sea ice in the area surveyed. Two of the whales were reported milling or feeding.
- 29 September: Thirty-three bowhead whales were seen near Barrow Canyon and near-shore north of Smith Bay during a survey in fair conditions (Beaufort 2-5, 0-10 km visibility with low ceilings, glare, fog, and precipitation). Sea ice was absent from the area. Ten whales exhibited feeding or milling behavior.
- 26 October: Thirty-seven bowhead whales were observed near Barrow Canyon during fair survey conditions (Beaufort 0-5, 0-10 km visibility with glare, fog, precipitation and low ceilings). Sea ice cover in the area surveyed was 0-100% new or shorefast ice. All of the whales were swimming.

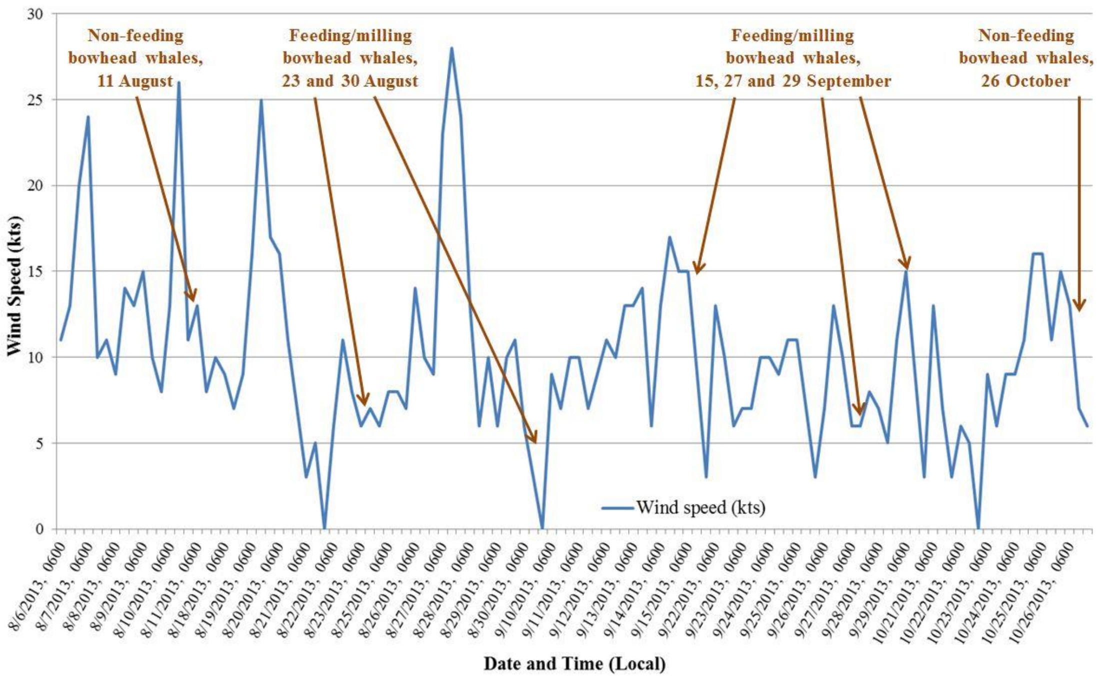


Figure 15. ASAMM bowhead whale occurrence in block 12 (all survey modes), and wind speeds measured at Barrow, Alaska, July to October 2013.

Information on wind speed, wind direction, and other environmental variables, was collected three times per day for Barrow from the National Weather Service Unit (USDOC, NOAA, NWS, Alaska Aviation Weather Unit, 2013), and plotted for the several days immediately preceding ASAMM surveys in block 12 (Figure 15). During two of the days on which feeding or milling whales were seen (23 and 30 August), winds were stronger in the days prior to the observations and had calmed by the time the survey was conducted, which are the conditions under which feeding would be expected (Okkonen et al. 2011). Interestingly, winds were not noticeably high preceding three of the days on which bowhead whales were seen feeding or milling (15, 27 and 29 September). On one of the days when whales were not observed feeding or milling (11 August), winds remained relatively high at the time of the survey and up to 40% sea ice remained in the area, which may have impacted the movement of krill. In late October, non-feeding bowhead whales were seen in the area (26 October) when wind conditions did not appear to favor feeding opportunities.

BOWHEAD WHALE CENTRAL TENDENCY – ANALYSIS 1

Distribution of Bowhead Whales, Summer 2013, Relative to Summer Bowhead Whale Distribution in Previous Years with Light Sea Ice Cover

Bowhead whale distribution in the western Beaufort Sea in summer (June-August) 2013, based on transect sightings from primary and secondary observers, did not appear different from the distribution of transect sightings observed in previous years having light sea ice cover (i.e., 1982, 1986, 1987, 1989, 1990, 1993-2012) (Figure 16).

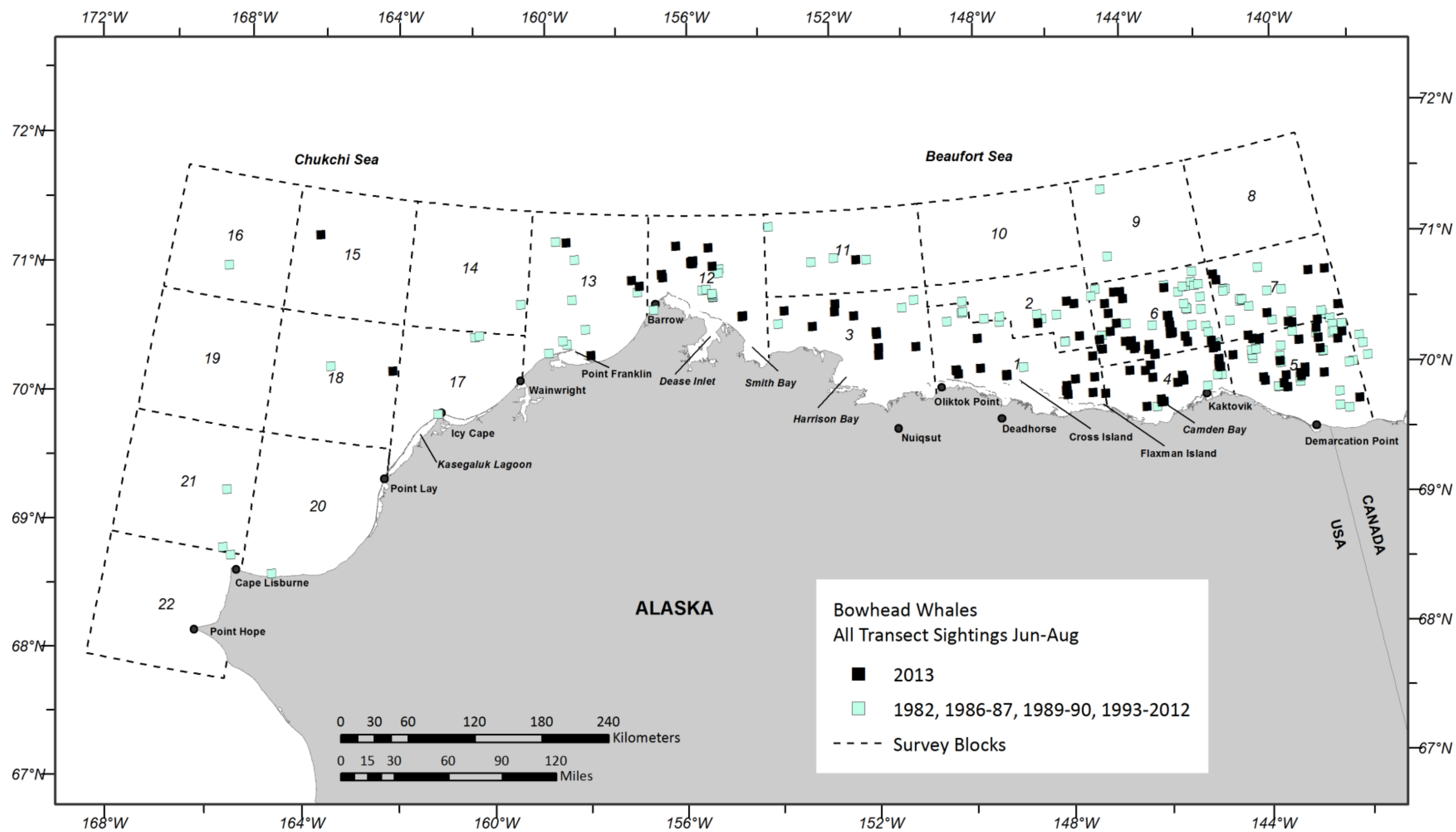


Figure 16. ASAMM bowhead whale sightings on transect, June-August, in years with light sea ice cover: 1982, 1986-87, 1989-90, 1993-2012, and 2013. Includes all sightings on transect, from primary and secondary observers.

In the East Region, mean depth at bowhead whale sightings made on transect by primary observers in July-August 2013 was 293 m (SD = 54.8 m, range 12-2,266 m) and median depth was 53 m (Table 8). In the West Region, mean depth was 108 m (SD = 40.6 m, range 12-1,052 m) and median depth was 27 m.

In the East Region, mean and median distances to the normalized shoreline of bowhead whale sightings made on transect by primary observers in July-August 2013 were 50.8 km (SD = 3.0 km) and 52.1 km, respectively (Table 8). In the West Region, mean and median distances to the normalized shoreline were 28.6 km (SD = 3.6 km) and 33.3 km, respectively.

To evaluate whether significant displacements occurred in the western Beaufort Sea bowhead whale HUAs during summer 2013 compared to previous years with light sea ice cover, estimates of median depth at sightings and distance of sightings from the normalized shoreline were compared with pooled data from previous years. Survey effort during summer in the western Beaufort Sea prior to 2012 was sporadic and inconsistent, so testing for differences was limited to summer 2012 and 2013. In 2012, median water depth at bowhead whale sightings made on transect by primary observers was 114 m in the East Region and 42 m in the West Region; the median distance from shore was 56.2 km in the East Region and 51.4 km in the West Region.

In summer (July-August) in the East Region, a Mann-Whitney *U*-test of significant difference of medians indicated there was no significant difference in median distance from shore of bowhead whale sightings between 2013 (52.1 km) and 2012 (56.2 km), nor was there any significant difference in depth at bowhead whale sightings between 2013 (53 m) and 2012 (114 m) (Table 8). In the West Region, bowhead whales sighted on transect by primary observers were significantly closer to shore in 2013 (median distance 33.3 km vs. 51.4 km, $Z = 2.218$, $P = 0.0266$) than in 2012, although median depth was not significantly different between the two years.

The apparent shift in bowhead whale distribution in summer appears to be between months, not years. In both 2012 and 2013, a Mann-Whitney *U*-test of significant difference of medians indicated that bowhead whales were significantly farther from shore and in deeper water in July compared to August. In 2012, the median depth in July was 200 m compared to 45 m in August ($Z = -3.982$, $P < 0.0001$) and the median distance from shore was 61.5 km in July compared to 48.0 km in August ($Z = -2.415$, $P = 0.0157$). In 2013, the median depth in July was 237 m compared to 47 m in August ($Z = -5.569$, $P < 0.0001$) and the median distance from shore was 67.3 km in July compared to 33.8 km in August ($Z = -5.854$, $P < 0.0001$).

Distribution of Bowhead Whales During Summer and Fall Months, 2013

Summary statistics for bowhead whale data from the western Beaufort Sea in July-August 2013 were compared to values for September-October 2013 (Table 8). In the East Region, bowhead whales sighted on transect in summer were in significantly deeper water (median depth 53 m vs. 35.5 m, $Z = 4.350$, $P < 0.0001$) and significantly farther from shore (median distance 52.1 km vs. 24.7 km, $Z = 3.671$, $P = 0.0002$) than bowheads sighted on transect in fall. Median depth and

Table 8. ASAMM central tendency statistics for depth (m) and distance from shore (km) at bowhead whale transect sightings, by season and region in the western Beaufort Sea, 2012-2013. TrSi = number of transect sightings made by primary observers

2012-2013 Summer, by Region			DEPTH (M)				DISTANCE FROM SHORE (KM)			
Year/Season	Region	TrSi	Median	Mean	SD	Min-Max	Median	Mean	SD	Min-Max
2013 Summer	East	91	53	293	522.77	12-2,266	52.1	50.8	29.05	4-134
2012 Summer	East	20	114	389	597.68	39-1,986	56.2	58.9	22.67	22-101
2013 Summer	West	26	26.5	108	207.01	12-1,052	33.3	28.6	18.09	5-85
2012 Sumner	West	19	42	77	147.52	18-663	51.4	43.3	24.95	15.-82
2012-2013 Summer, by Month			DEPTH (M)				DISTANCE FROM SHORE (KM)			
Year/Season	Month	TrSi	Median	Mean	SD	Min-Max	Median	Mean	SD	Min-Max
2013 Summer	Jul	35	237	531	617.82	33-1,985	67.3	67.8	21.42	20-102
2013 Summer	Aug	82	47	133	342.33	12-2,266	33.8	36.5	25.96	4-134
2012 Summer	Jul	14	200	426	532.58	49-1,682	61.5	66.4	18.84	40-94
2012 Summer	Aug	25	45	132	390.65	18-1,986	48.0	42.9	23.94	15-101
2013 Season, By Region			DEPTH (M)				DISTANCE FROM SHORE (KM)			
Season	Region	TrSi	Median	Mean	SD	Min-Max	Median	Mean	SD	Min-Max
Summer	East	91	53	293	522.77	12-2,266	52.1	50.8	29.05	4-134
Fall	East	20	35.5	36	6.68	24-54	24.7	25.9	10.83	9-45
Summer	West	26	26.5	108	207.01	12-1,052	33.3	28.6	18.09	5-85
Fall	West	37	26	72	75.52	6-258	27.7	37.6	25.82	3-87

distance from shore for bowhead whale sightings on transect in the West Region were not significantly different between summer (depth = 26.5 m, distance from shore = 33.3 km) and fall (depth = 26 m, distance from shore = 27.7 km).

Distribution of Bowhead Whales, Fall 2013, Relative to Bowhead Whale Distribution in Previous Years with Light Sea Ice Cover

Summary statistics for bowhead whale data from the western Beaufort Sea in September-October 1989-2013 are shown in Table 9. Summary statistics results are from sightings made by primary observers only; primary observers were not identified for the earliest years of the ASAMM project (1982-1988). Limiting sightings for this analysis to only primary observers resulted in the exclusion of >800 sightings, but the tighter data constraints result in a more robust analysis.

In the East Region, mean depth at *all* bowhead whale sightings made on transect by primary observers in September-October 2013 was 36 m (SD = 6.7 m, range 24-54 m) and median depth was 35.5 m (Table 9). In the West Region, mean depth was 72 m (SD = 75.5 m, range 6-258 m) and median depth was 26 m. Mean and median depth of *migrating* bowhead whales (i.e., excluding sightings of feeding, milling, or resting whales) on transect were 39 m (SD = 6.8 m, range 29-54 m) and 38 m, respectively, in the East Region. Mean and median depth of *migrating* bowhead whales on transect in the West Region were 64 m (SD = 66.7 m, range 6-216 m) and 24 m, respectively. A Mann-Whitney *U*-test of significant difference of medians indicated no difference between median depths of *all* sightings versus only those sightings considered *migrating* in the East (Z = -1.166, P = 0.2437) or West (Z = 0.498, P = 0.6185) regions.

In the East Region, mean and median distances to the normalized shoreline of *all* bowhead whale sightings made on transect by primary observers in September-October 2013 were 25.9 km (SD=10.8 km) and 24.7 km, respectively (Table 9). In the West Region, mean and median distances to the normalized shoreline were 37.6 km (SD=25.8 km) and 27.7 km, respectively. Mean and median distance of locations of *migrating* bowhead whale sightings on transect were 28.7 km (SD = 10.9 km) and 26.6 km in the East Region, respectively, and 36.1 km (SD = 25.6 km) and 26.9 km, respectively, in the West Region. A Mann-Whitney *U*-test of significant difference between medians indicated no difference between median distances of all sightings versus only those sightings considered *migrating* in the East (Z = -0.638, P = 0.5235) or West (Z = 0.246, P = 0.8058) regions.

Based on the lack of significant difference between *all* bowhead whale sightings in 2013 and *migrating* whales, additional analyses of fall bowhead whale HUAs incorporated *all* sightings and were not limited to only those animals considered actively *migrating*.

Bowhead whale distribution in the western Beaufort Sea in September-October 2013 using sightings made on transect by both primary and secondary observers did not appear to differ from the distribution of transect-only sightings observed in previous years having light sea ice cover (i.e., 1982, 1986, 1987, 1989, 1990, 1993-2012) (Figure 17). With the exception of sightings in the offshore areas of Barrow Canyon (northern block 12) and sightings offshore in the Chukchi Sea (blocks 15 and 16), bowhead whale transect sightings in 2013 overlay those from 1982-2012.

Table 9. ASAMM central tendency statistics for distance from shore (km) and depth (m) at bowhead whale transect sightings (September-October), by year and region in the western Beaufort Sea, 1989-2013. TrSi = number of transect sightings made by primary observers

			DEPTH (M)				DISTANCE FROM SHORE (KM)			
Year	Region	TrSi	Median	Mean	SD	Min-Max	Median	Mean	SD	Min-Max
1989	East	1	48	48			43.8	43.8		
	West	6	16	16	6.4	7-24	17.7	18.6	13.6	4-35
1990	East	35	45	45	9.8	25-72	32.2	30.8	11.1	11-53
	West	6	32.5	33	11.6	20-50	30.8	34.2	11.7	24-54
1991	East	6	119.5	120	71.8	44-228	60.3	55.6	14.7	36-72
	West	1	383	383			72.8	72.8		
1992	East	6	47.5	48	7.7	40-59	28.9	30.7	5.6	24-40
	West	6	57	66	20.4	52-106	53.1	52.5	6.7	43-63
1993	East	35	40	57	96.7	11-610	25.5	25.8	11.8	6-64
	West	23	20	22	8.9	12-49	24.3	25.6	11.9	11-61
1994	East	17	45	46	9.1	33-64	27.9	33.1	16.7	11-66
	West	2	12.5	12.5	0.7	12-13	15.0	15.0	6.0	11-19
1995	East	57	43	54	76.1	13-604	27.2	29.8	16.0	3-97
	West	22	30	89	272.5	6-1,308	33.9	35.7	18.9	10-102
1996	East	6	40	41	4.4	34-46	27.7	26.5	6.4	19-33
	West	4	33.5	31	7.6	20-37	37.6	33.5	9.3	20-39
1997	East	15	21	21	7.1	13-33	7.7	9.7	6.7	4-24
	West	65	19	25	19.2	5-100	21.9	24.8	11.0	7-52
1998	East	70	31.5	32.8	10.7	13-56	17.0	19.5	11.4	2-49
	West	71	16	48	235.4	7-2,001	17.1	22.7	18.0	3-118
1999	East	58	50	49	14.3	7-83	34.4	33.3	12.3	4-57
	West	43	29	41	41.9	10-211	29.6	31.9	16.8	6-73
2000	East	19	39	46	18.0	28-101	31.7	31.8	11.1	14-55
	West	15	11	24	42.0	5-173	7.7	15.8	19.0	1-73

			DEPTH (M)				DISTANCE FROM SHORE (KM)			
Year	Region	TrSi	Median	Mean	SD	Min-Max	Median	Mean	SD	Min-Max
2001	East	13	46	44	9.1	28-53	31.8	27.9	10.7	12-41
	West	2	42	42	43.8	11-73	29.6	39.6	43.5	9-70
2002	East	9	25	25	14.3	3-48	8.5	15.1	18.2	0-58
	West	20	24.5	30	20.6	11-88	31.2	33.9	12.6	9-56
2003	East	17	36	35	16.0	12-72	28.4	24.4	16.6	3-46
	West	29	20	50	67.3	12-310	27.2	28.9	15.7	2-72
2004	East	53	40	44	42.5	7-337	21.5	23.4	12.0	5-71
	West	47	24	34	36.5	5-206	22.7	23.6	10.6	5-65
2005	East	16	40.5	39	13.0	13-61	21.5	23.0	13.0	5-40
	West	17	33	60	66.3	12-227	37.3	34.6	16.0	6-55
2006	East	29	44	215	524.2	9-1,966	28.0	34.7	22.5	2-89
	West	28	37.5	45	36.2	4-175	37.0	35.7	18.9	1-67
2007	East	46	33.5	43	50.3	17-362	20.7	22.9	13.6	5-69
	West	6	23	24	8.6	13-36	24.0	25.2	6.2	18-33
2008	East	24	32	32	6.0	20-43	18.6	20.5	9.6	7-36
	West	32	16.5	18	6.4	7-40	18.1	19.1	10.2	4-52
2009	East	9	21	29	19.4	11-55	6.3	19.9	22.4	3-58
	West	42	17	30	43.6	8-239	16.7	21.7	16.1	4-81
2010	East	43	30	30	11.1	13-49	11.9	14.2	7.7	3-29
	West	25	20	32	34.2	10-189	20.6	26.3	14.8	3-76
2011	East	12	27	31	8.9	22-50	10.7	13.7	6.8	7-27
	West	28	20	26	23.1	15-141	25.5	26.8	10.4	16-64
2012	East	25	35	51	48.8	11-213	24.9	28.5	19.8	6-76
	West	58	29	51	92.5	11-648	31.0	36.4	18.9	8-76
2013	East	20	35.5	36	6.7	24-54	24.7	25.9	10.8	9-45
	West	37	26	72	75.5	6-258	27.7	37.6	25.8	3-87

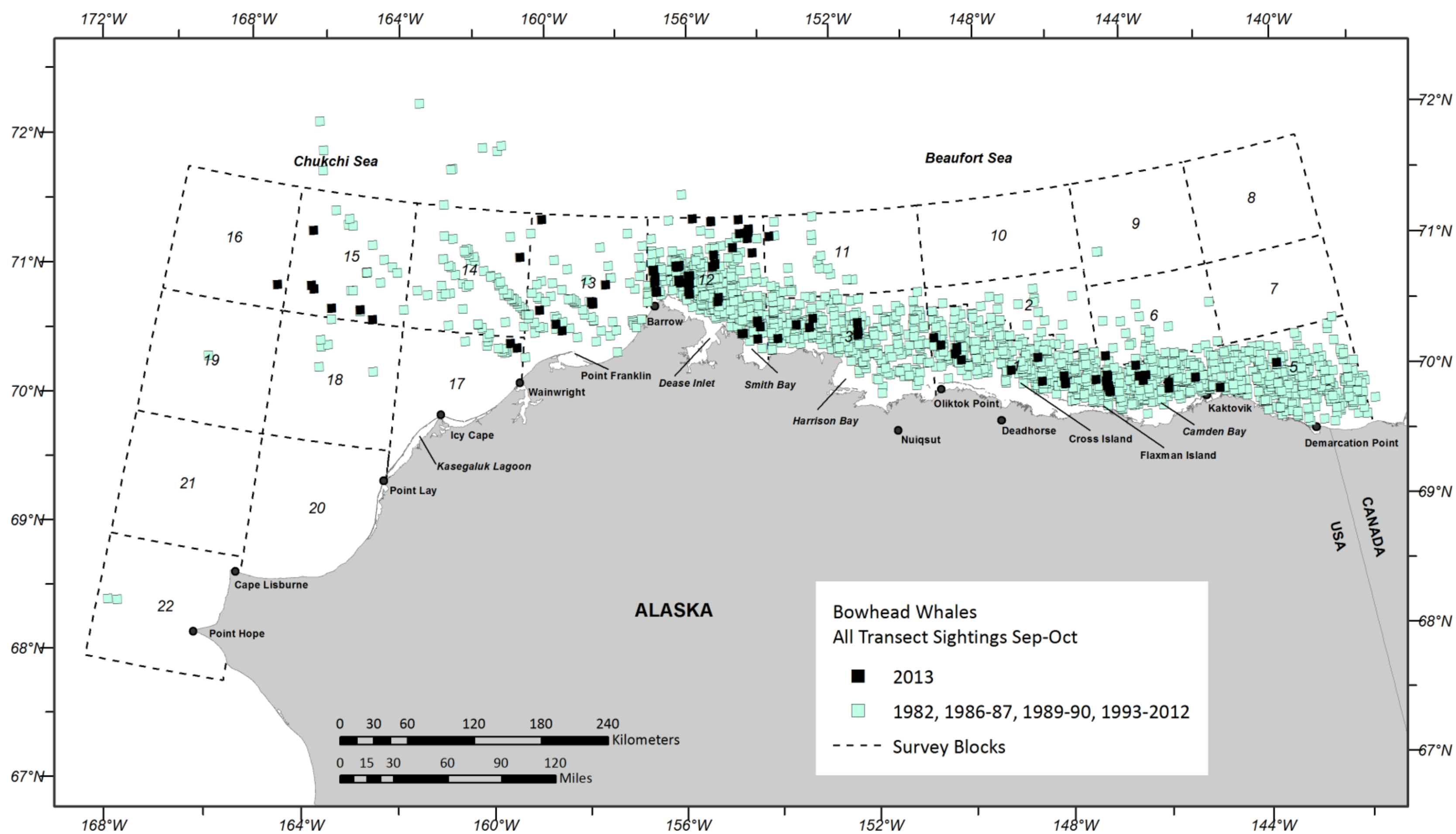


Figure 17. ASAMM bowhead whale sightings on transect, September-October, in years with light sea ice cover: 1982, 1986-87, 1989-90, 1993-2012, and 2013. Includes all sightings on transect made by primary and secondary observers.

To evaluate whether significant displacements occurred in the western Beaufort Sea bowhead whale HUAs during fall 2013 compared to previous years with light sea ice cover, estimates of median depth at sighting and distance of sightings from the normalized shoreline were compared with pooled data from previous years. During previous years with light sea ice cover, median water depth at bowhead whale sightings on transect by primary observers was 39 m in the East Region and 21 m in the West Region; the median distance from shore was 23.6 km in the East Region and 23.9 km in the West Region.

In fall (September-October) in the East Region, there was no significant difference in depth at bowhead whale sightings between 2013 (35.5 m) and previous years with light sea ice cover (39 m) nor was there any significant difference in median distance from shore of bowhead whale sightings between 2013 (24.7 km) and previous years with light sea ice cover (23.6 km). In the West Region, bowhead whales sighted on transect by primary observers were in significantly deeper water in fall 2013 (median depth 26 m vs. 21 m, $Z = -2.239$, $P = 0.0251$) and significantly farther from shore in 2013 (median distance 27.7 km vs. 23.9 km, $Z = -1.960$, $P = 0.02$) than in previous years with light sea ice cover.

BOWHEAD WHALE CENTRAL TENDENCY – ANALYSIS 2

The 2013 spatial relative abundance model (GAM) for fall (September-October) incorporated 70 bowhead whale sightings of 100 total individuals. Relative abundance predictions resulting from the GAM applied to the 2013 survey data for the western Beaufort Sea are shown in Figure 18; the highest predicted relative abundances were located over Barrow Canyon, east of Point Barrow (north of Dease Inlet and Smith Bay), north of Oliktok Point (approximately 40 km offshore), along a band located approximately 30–50 km offshore between Flaxman Island and Kaktovik, and approximately 75 km north of Demarcation Point (~142°W).

The 2000-2013 model (July to October) incorporated 946 bowhead whale sightings of 1,757 individuals. In July there were 50 bowhead whale sightings (90 individuals) (Figure 19A), all of which were from 2012 and 2013. The majority of the July sightings were located in the eastern half of the study area. Limited sample size in the western half of the study area provided minimal information for the spatial model in July (Figure 19A). The spatial model predicted that bowhead whale HUAs were located farthest offshore in July, with relatively high relative abundances located approximately 80 km northeast of Kaktovik, centered on 142°W (Figure 19A). There were a total of 119 bowhead whale sightings (218 individuals) in August (Figure 19B), most of which were from 2012 and 2013. The spatial model predicted that bowhead whale HUAs were located relatively close to shore from Dease Inlet to Cape Halkett, and just outside the barrier islands from Oliktok Point to Flaxman Island (Figure 19B). The high relative abundance predictions inside Camden Bay (Figure 19B) were heavily influenced by two sightings of large groups (14 and 20 animals) made on 20 August 2013. In contrast to the predictions from July, September, and October, the August predictions showed relatively high relative abundances extending up to 100 km offshore near the eastern boundary of the study area (~140°W). The model incorporated 574 bowhead whale sightings (1083 individuals) in September (Figure 19C) and 203 sightings (366 individuals) in October (Figure 19D). The spatial model predicted similar distributions for September and October. In the fall months, bowhead whale HUAs were located relatively close to shore from Dease Inlet to Cape Halkett,

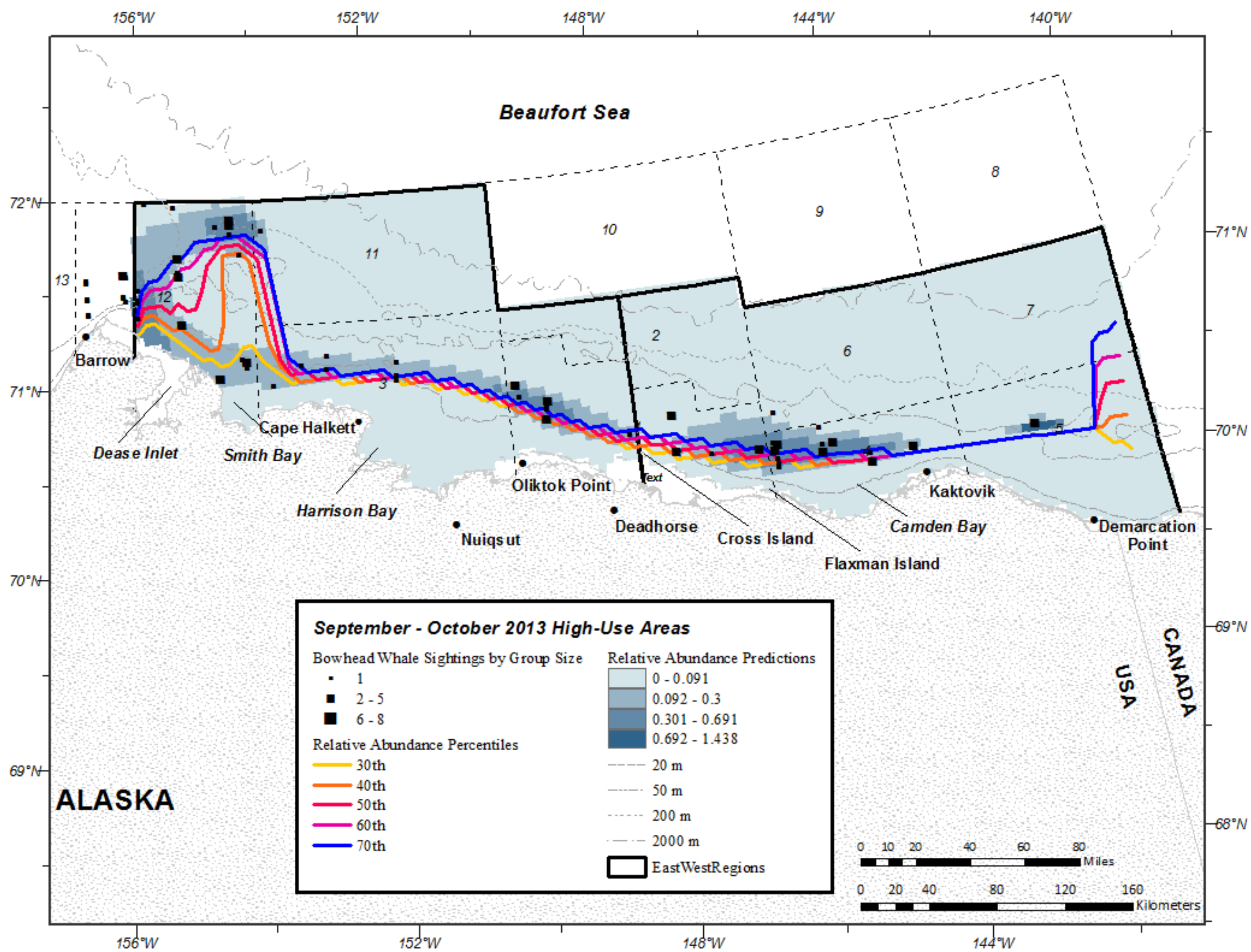


Figure 18. ASAMM observed 2013 bowhead whale transect sightings (primary observers only) by group size and predicted relative abundance of bowhead whales in the western Beaufort Sea in September and October, based on the spatial relative abundance model that accounted for effort by assuming a uniform 5 km of transect effort in every cell. Predictions are not corrected for perception or availability bias. The bowhead whale High-Use Area is represented by distribution percentiles (30th, 40th, 50th, 60th, and 70th), which represent the offshore extent of 30%, 40%, 50%, 60%, and 70% of the predicted number of bowhead whales from the spatial model.

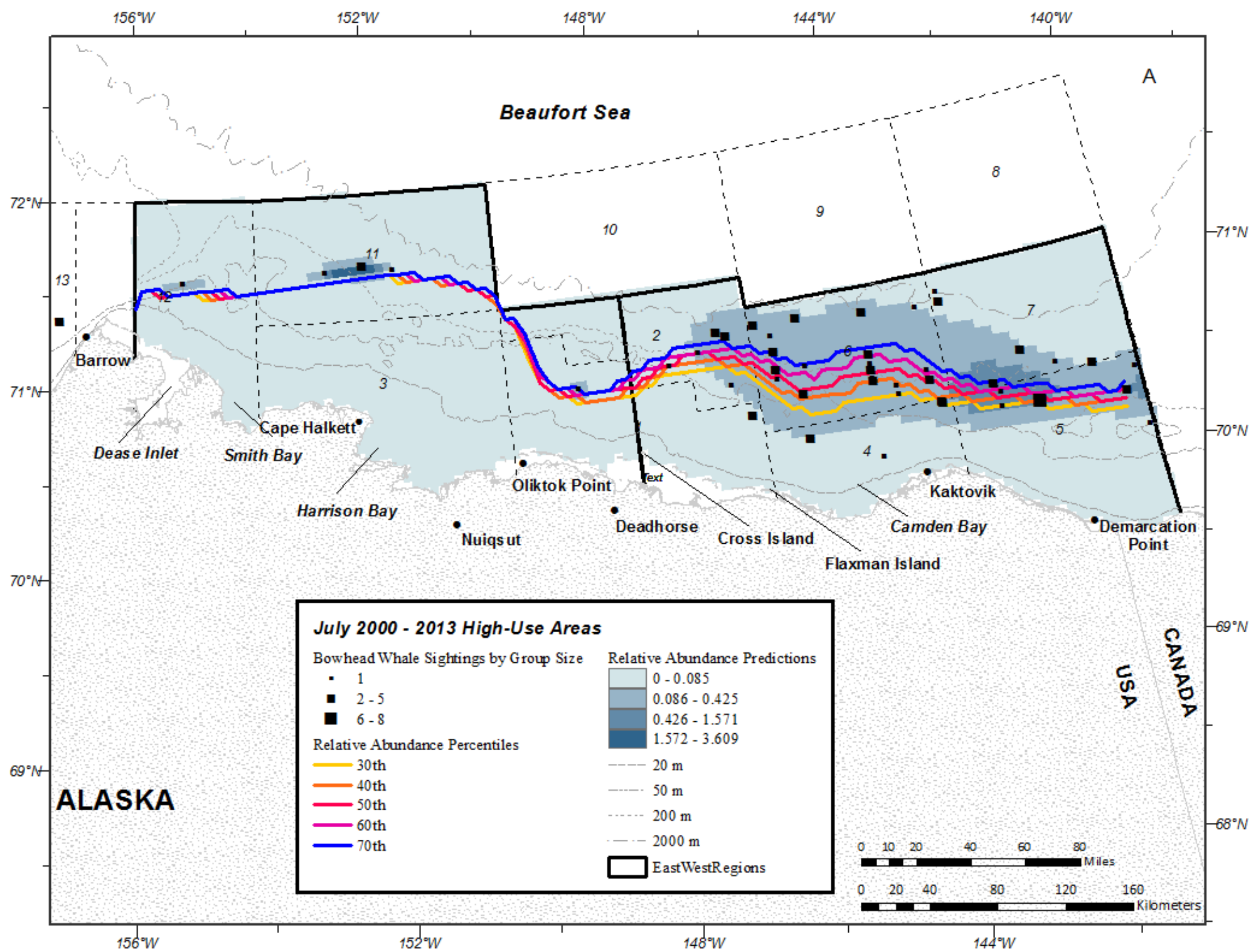


Figure 19. ASAMM observed 2000-2013 bowhead whale transect sightings (primary observers only) by group size and predicted relative abundance of bowhead whales in the western Beaufort Sea in July (A), based on the relative abundance rate model that accounted for effort by assuming a uniform 5 km of transect effort in every cell. Predictions are not corrected for perception or availability bias. The bowhead whale High-Use Area is represented by distribution percentiles (30th, 40th, 50th, 60th, and 70th), which represent the offshore extent of 30%, 40%, 50%, 60%, and 70% of the predicted number of bowhead whales from the spatial model.

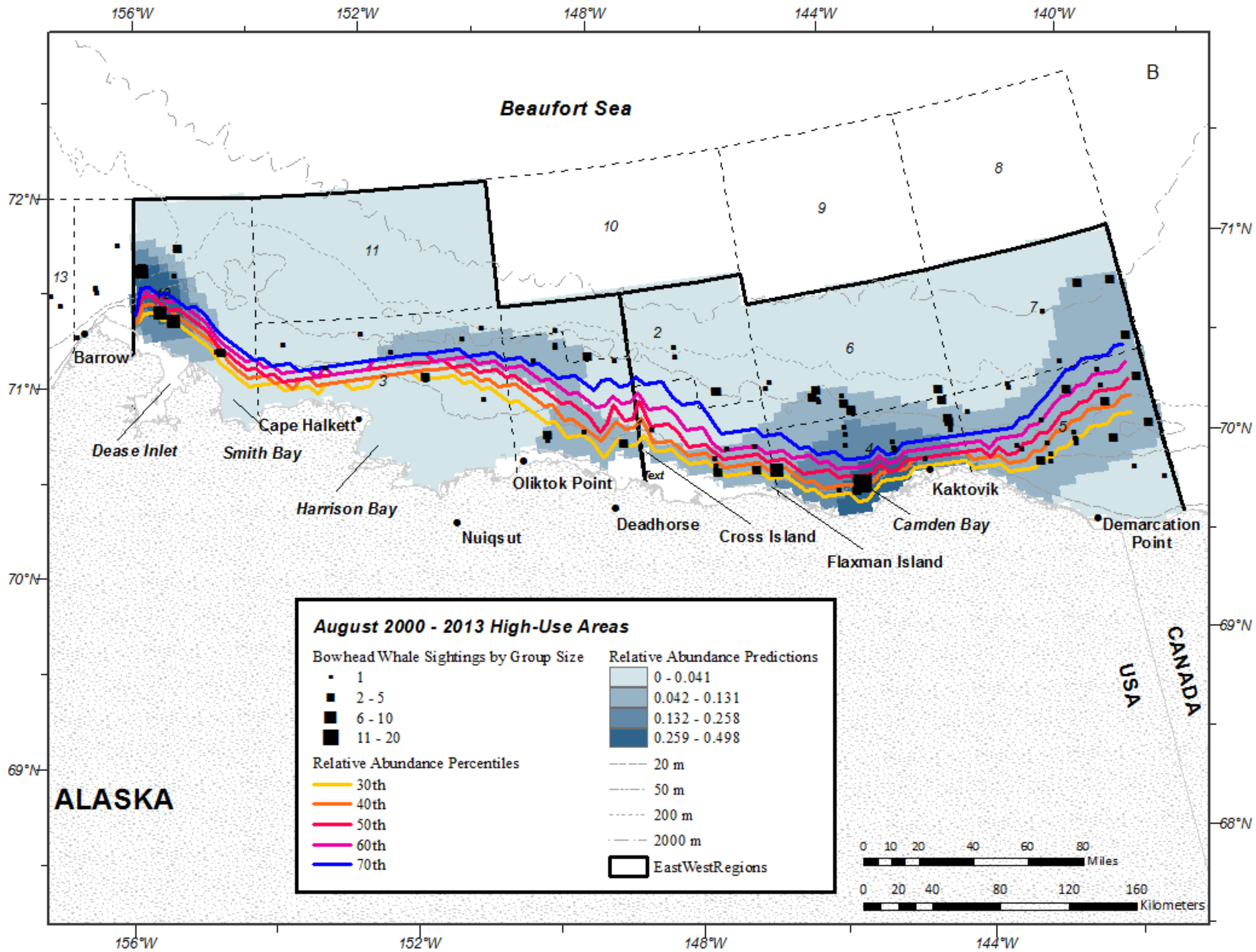


Figure 19 (cont). ASAMM observed 2000-2013 bowhead whale transect sightings (primary observers only) by group size and predicted relative abundance of bowhead whales in the western Beaufort Sea in August (B), based on the relative abundance rate model that accounted for effort by assuming a uniform 5 km of transect effort in every cell. Predictions are not corrected for perception or availability bias. The bowhead whale High-Use Area is represented by distribution percentiles (30th, 40th, 50th, 60th, and 70th), which represent the offshore extent of 30%, 40%, 50%, 60%, and 70% of the predicted number of bowhead whales from the spatial model.

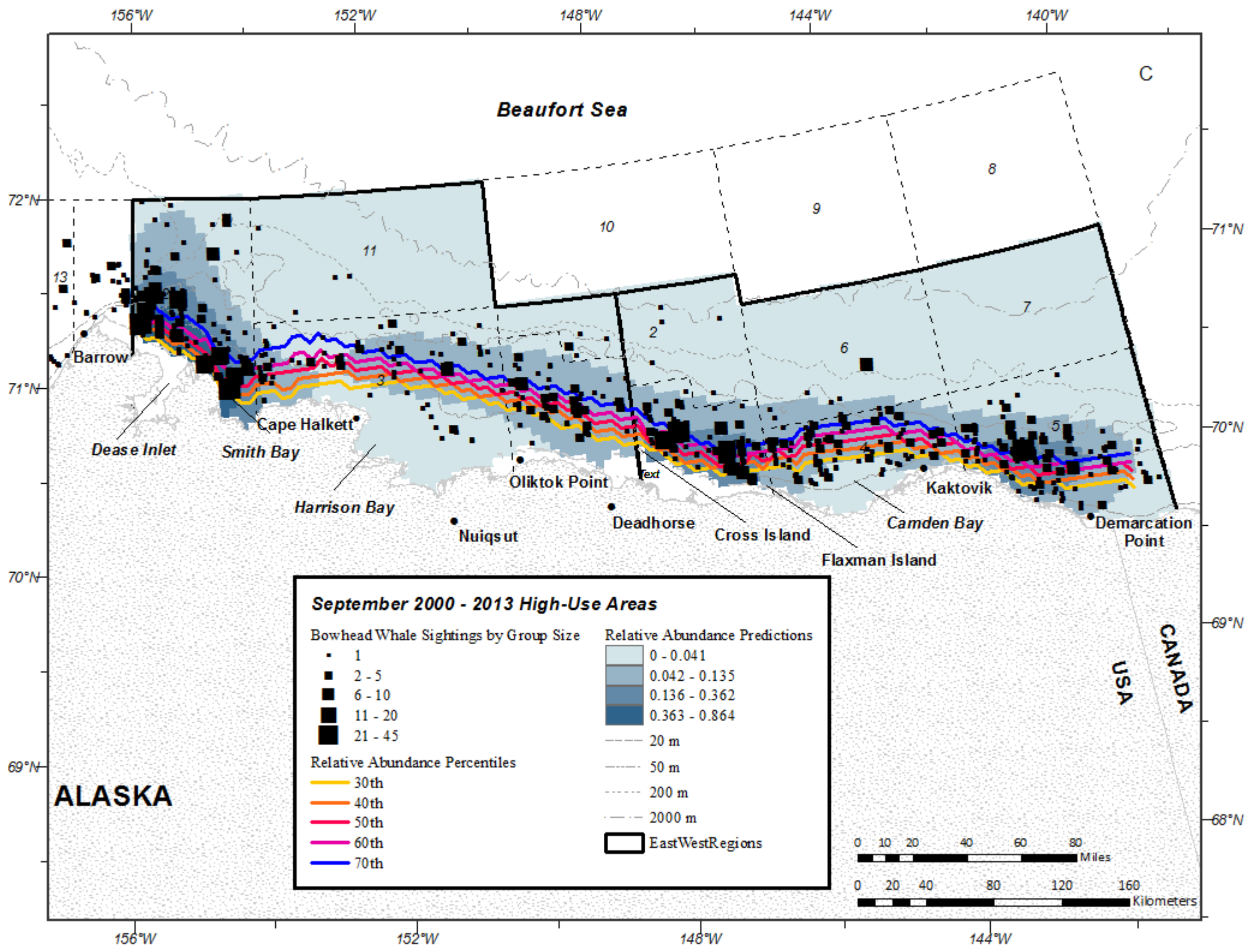


Figure 19 (cont). ASAMM observed 2000-2013 bowhead whale transect sightings (primary observers only) by group size and predicted relative abundance of bowhead whales in the western Beaufort Sea in September (C), based on the relative abundance rate model that accounted for effort by assuming a uniform 5 km of transect effort in every cell. Predictions are not corrected for perception or availability bias. The bowhead whale High-Use Area is represented by distribution percentiles (30th, 40th, 50th, 60th, and 70th), which represent the offshore extent of 30%, 40%, 50%, 60%, and 70% of the predicted number of bowhead whales from the spatial model.

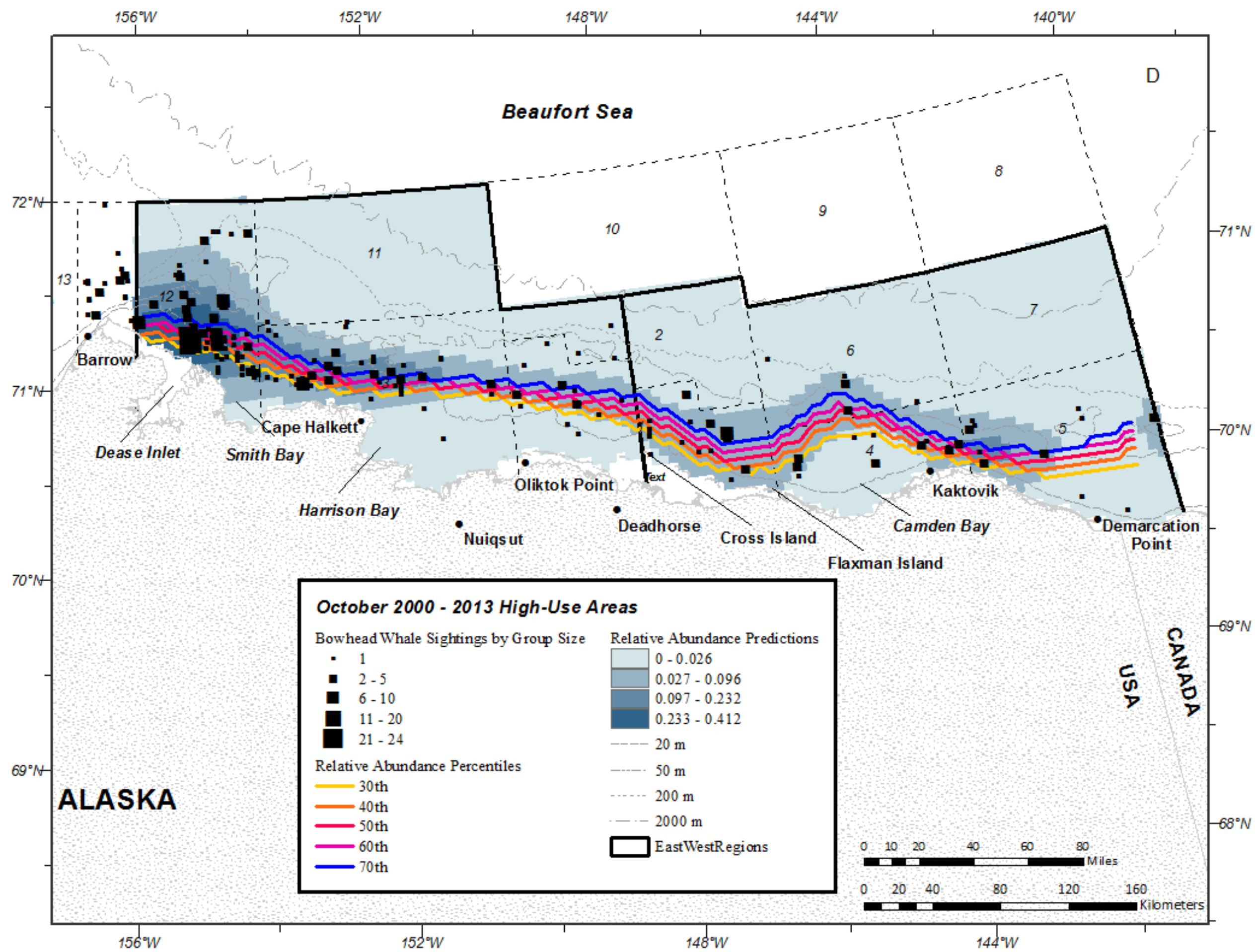


Figure 19 (cont). ASAMM observed 2000-2013 bowhead whale transect sightings (primary observers only) by group size and predicted relative abundance of bowhead whales in the western Beaufort Sea in October (D), based on the relative abundance rate model that accounted for effort by assuming a uniform 5 km of transect effort in every cell. Predictions are not corrected for perception or availability bias. The bowhead whale High-Use Area is represented by distribution percentiles (30th, 40th, 50th, 60th, and 70th), which represent the offshore extent of 30%, 40%, 50%, 60%, and 70% of the predicted number of bowhead whales from the spatial model.

Table 10. Percentiles of bowhead whale predicted distribution from the spatial model for the West and East regions of the ASAMM study area. For 2013, the predictions correspond to September and October combined. Monthly predictions are provided for 2000-2013.

	WEST REGION					EAST REGION				
	2013	2000-2013				2013	2000-2013			
Percentile	Sep-Oct	Jul	Aug	Sep	Oct	Sep-Oct	Jul	Aug	Sep	Oct
30th	20.1	75.7	19.0	9.6	15.6	21.9	52.7	15.4	12.7	16.6
40th	24.5	77.1	23.7	14.2	19.5	24.5	57.7	21.4	16.8	20.8
50th	29.1	78.3	28.0	19.1	23.5	27.4	63.2	28.8	21.1	25.8
60th	34.6	79.2	32.5	25.4	27.7	30.4	68.4	37.5	25.7	30.6
70th	44.8	80.2	37.5	33.2	32.9	32.9	74.3	49.4	30.6	37.4

and just outside the barrier islands from Cross Island to Flaxman Island (Figures 19C and D). Furthermore, the model predicted relatively high relative abundances in the Barrow Canyon area and the relatively low relative abundances in Harrison and Camden bays (Figures 19C and D).

The estimated median distance from shore statistics for 2013 derived using the spatial model were 27.4 km for the East Region and 29.1 km for the West Region (Table 10). Compared to results from the analysis of bowhead whale sightings that were unadjusted for transect effort or group size (median values of 24.7 km in the East and 27.7 km in the West, summarized in BOWHEAD WHALE CENTRAL TENDENCY – ANALYSIS 1), the model-derived results placed the median of the bowhead whale distribution slightly farther offshore in both the East and West regions. The interaction of two factors likely contributed to these differences. First, the spatial model had a 5-km resolution; therefore, the model could not identify differences in distance from shore that are smaller than 5 km. Second, due to logistical and weather constraints, there was greater survey effort in the nearshore areas of the western Beaufort Sea study area compared to the offshore areas. Because the spatial model weighted the observed number of individuals by the inverse of the survey effort in the associated grid cell, each sighting in a grid cell having relatively little survey effort counted for more in the model-derived median statistics.

The estimated median distance from shore statistics for the East Region in 2000-2013 derived using the spatial model decreased from 63.2 km in July to 28.8 km in August, 21.1 km in September, and 25.8 km in October (Table 10). In the West Region, the 2000-2013 model predicted that the median distance from shore decreased from 78.3 km in July to 28.0 km in August, 19.1 km in September, and 23.5 km in October (Table 10). These results suggest that the bowhead whale HUAs were located slightly farther offshore in both regions in 2013 compared to the 14-year time series from 2000 to 2013.

Gray Whales

Gray Whale Sighting Summary

During 2013 ASAMM surveys, 174 sightings of 281 gray whales (*Eschrichtius robustus*) were observed during all survey modes (transect, search and circling) in the study area (Table 3). This is far fewer than the total observed in 2012, when there was more survey effort in early July (Clarke et al. 2013a), and similar to the total observed in 2011. Gray whales were seen in July, August, and September in the northeastern Chukchi Sea (Figure 20); they were also seen east of Point Barrow in August and October. Gray whales were seen primarily nearshore (<50 km) between Point Barrow and Icy Cape, and up to 77 km offshore between Point Franklin and Icy Cape. There were scattered sightings offshore (~75 km) west of Point Hope, nearshore north of Cape Lisburne and south of Point Hope, and one sighting >220 km offshore west of Barrow. Some gray whales appeared to be distributed farther offshore between Point Franklin and Icy Cape in late summer and early fall; few gray whales were seen near Hanna Shoal and offshore west of Point Hope. Observed gray whale distribution was undoubtedly affected by the lack of surveys in early October 2013 due to the partial government shutdown. Locations of gray whale sightings are shown in semimonthly periods in Figure 21.

Gray whale distribution in 2013 (all sightings regardless of survey mode or observer type) was generally similar to that documented in previous years with light sea ice cover, with a few exceptions.

- Gray whales continued to be mostly absent from Hanna Shoal in all months in 2013, as has been documented since 2008 (Clarke et al. 2012, 2013a). Two sightings in September 2013 were near the southern edge of Hanna Shoal. Gray whales were frequently observed feeding near Hanna Shoal in the 1980s and early 1990s (Moore 2000).
- Gray whales were observed south of Point Hope in July 2013. While gray whales were often seen in this area in the late 1980s, early 1990s (Moore 2000), 2011 and 2012 (Clarke et al. 2012, 2013a), they were not observed there in 2008-2010 (Clarke et al. 2011d).
- Gray whales were seen offshore west of Point Hope in 2013, which is similar to 2008-2010 when gray whales were seen in that area nearly every month surveys were conducted; gray whales were not seen offshore of Point Hope in 2012 and were rarely seen there in 2011.
- Gray whales were observed 50-75 km offshore between Point Franklin and Icy Cape (southeast corner of block 14 and northeasternmost corner of block 17) in 2013 in an area where few gray whales were seen in 2008-2010, but where several were seen in 2011 and 2012 (Clarke et al. 2012, 2013a).
- Gray whales were observed east of Point Barrow in August and October, though not as frequently or as widespread as in 2012.

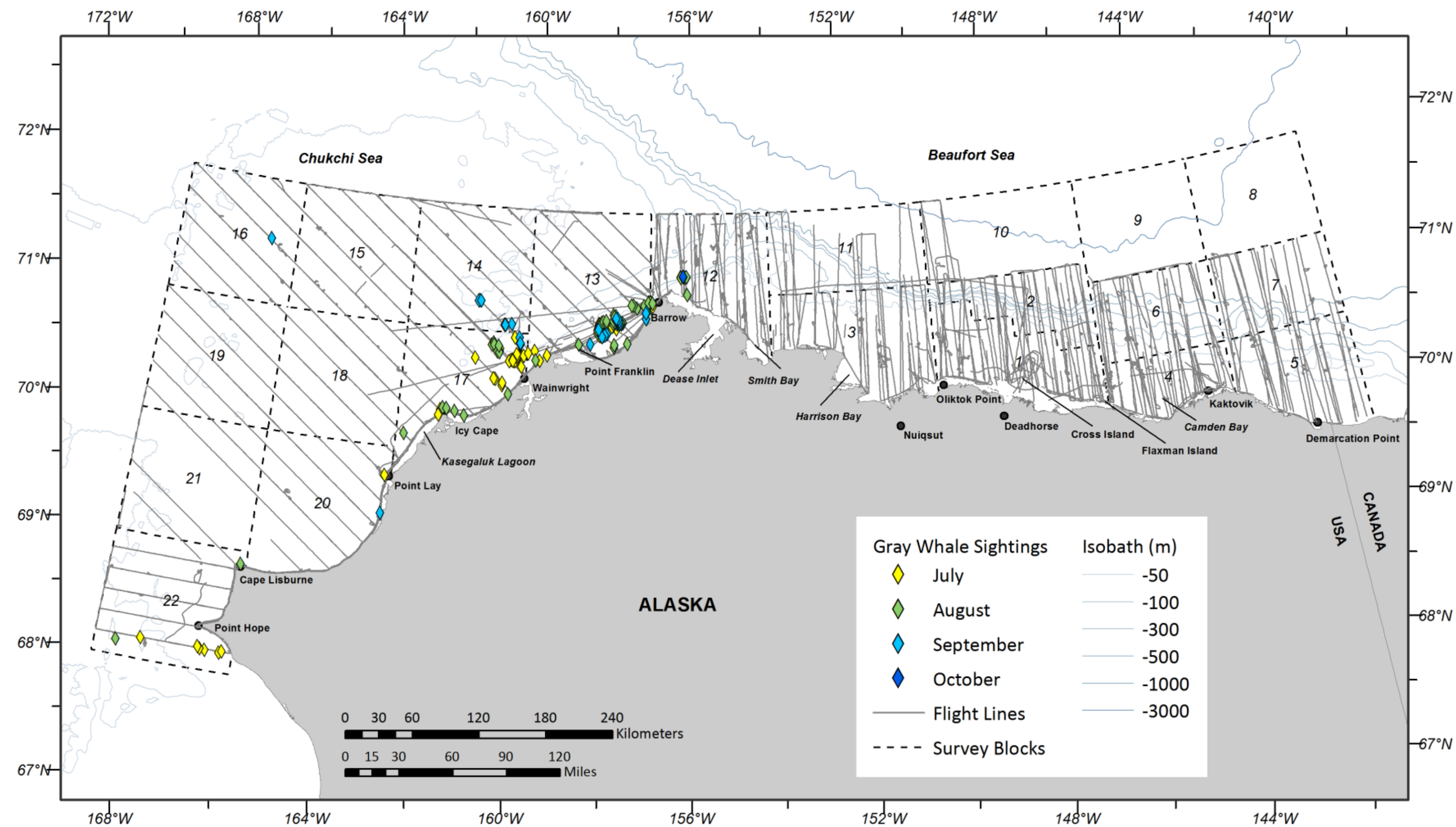
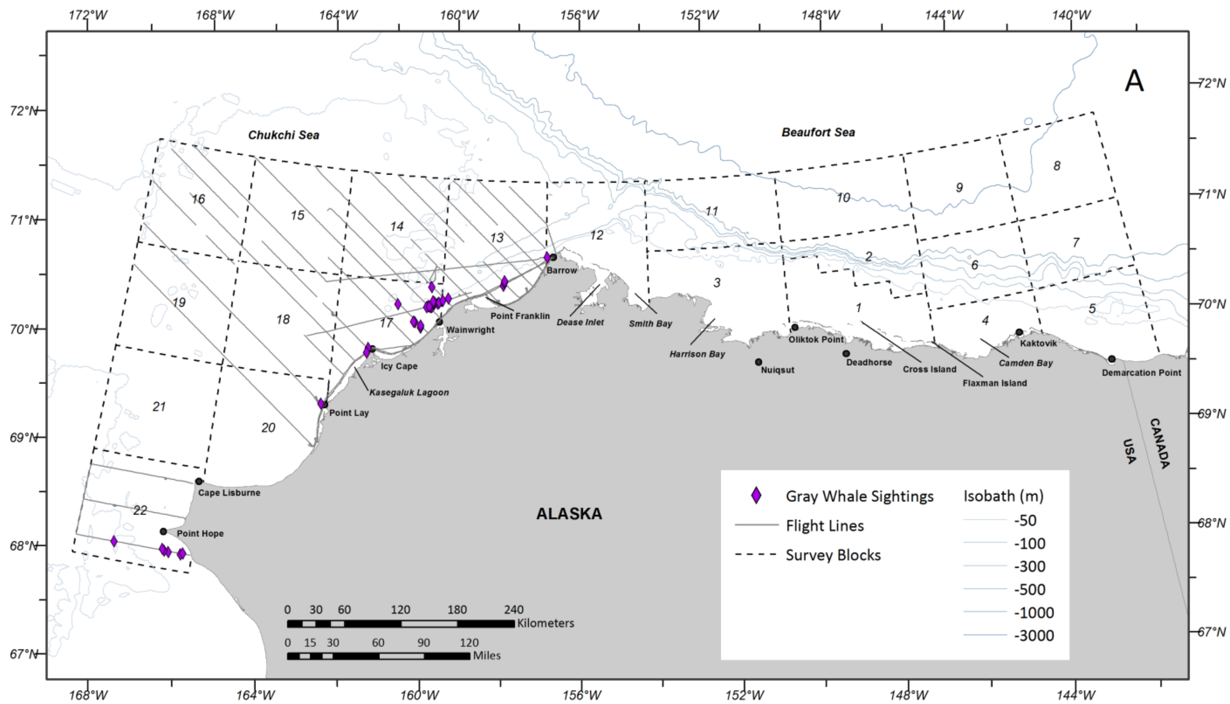


Figure 20. ASAMM 2013 gray whale sightings plotted by month, with transect, search and circling effort. Deadhead flight tracks are not shown.



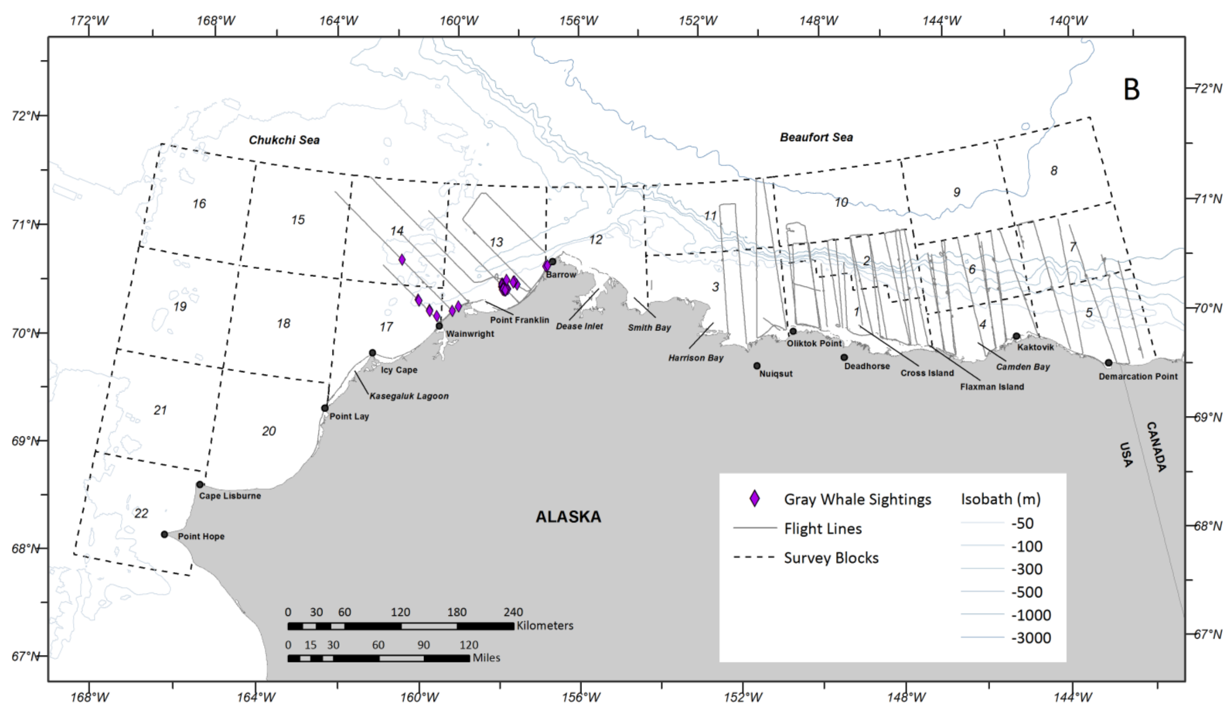
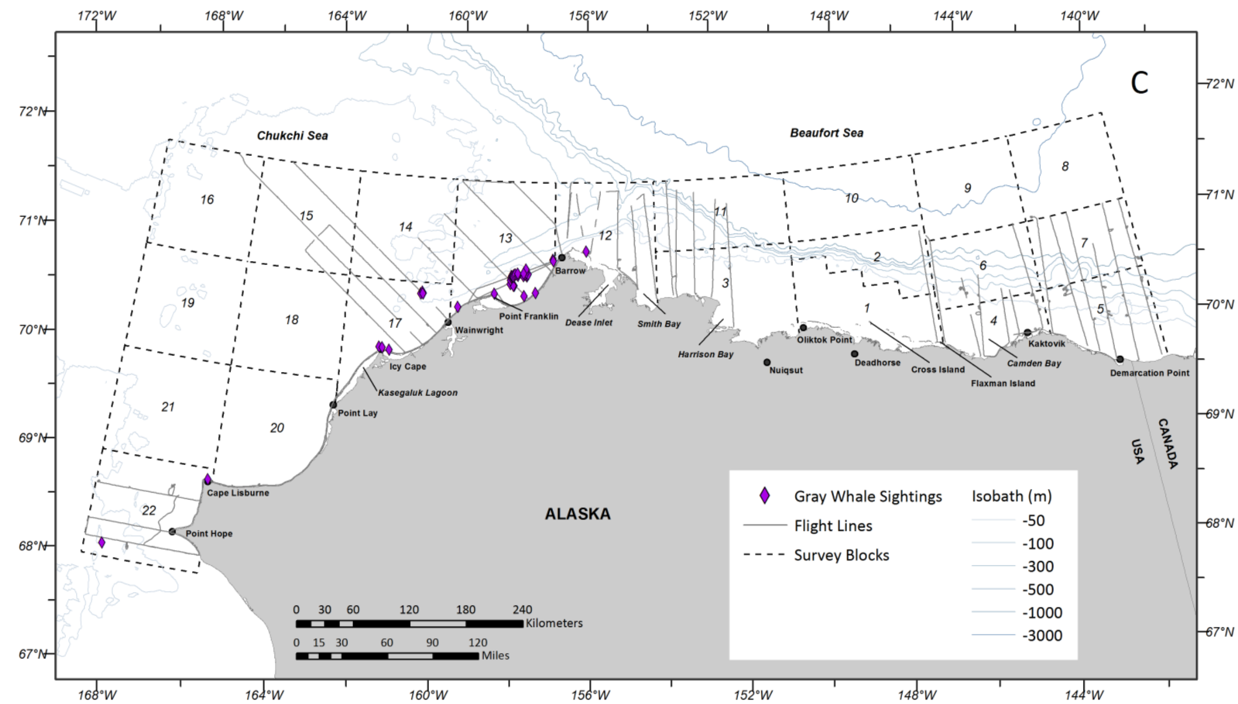


Figure 21. ASAMM 2013 semimonthly gray whale sightings, with transect, search and circling effort. Deadhead flight tracks are not shown. A: 2-15 July; B: 16-31 July.



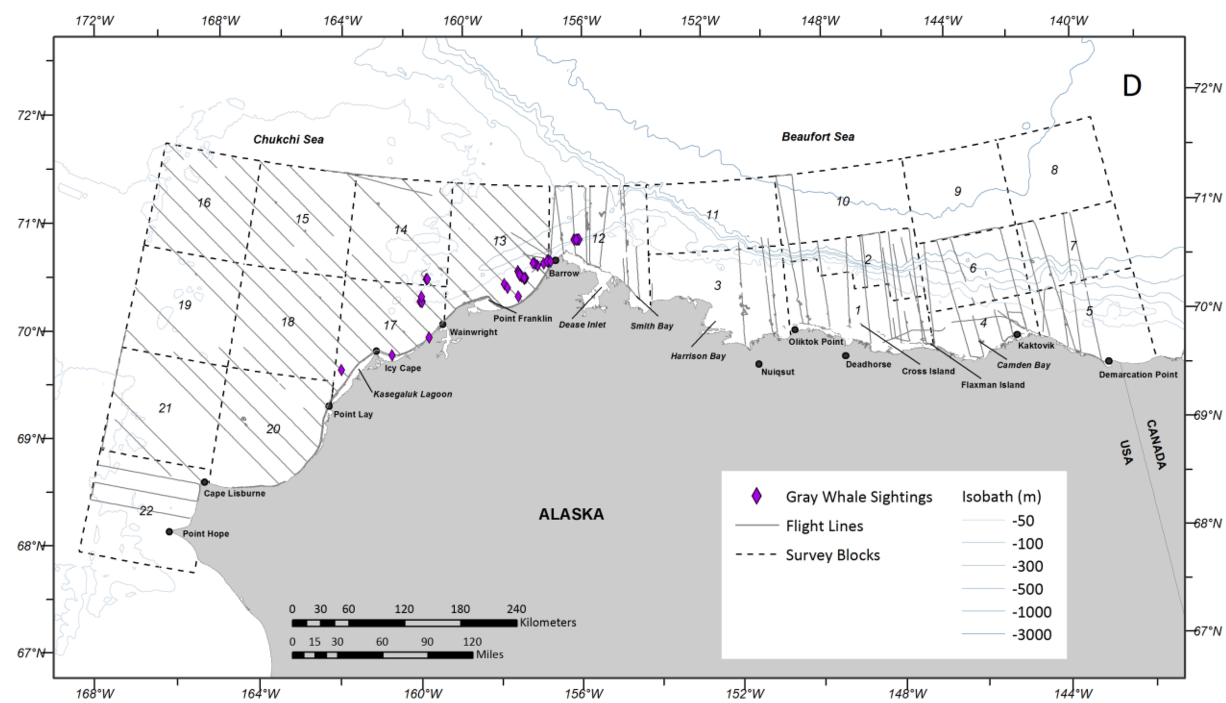
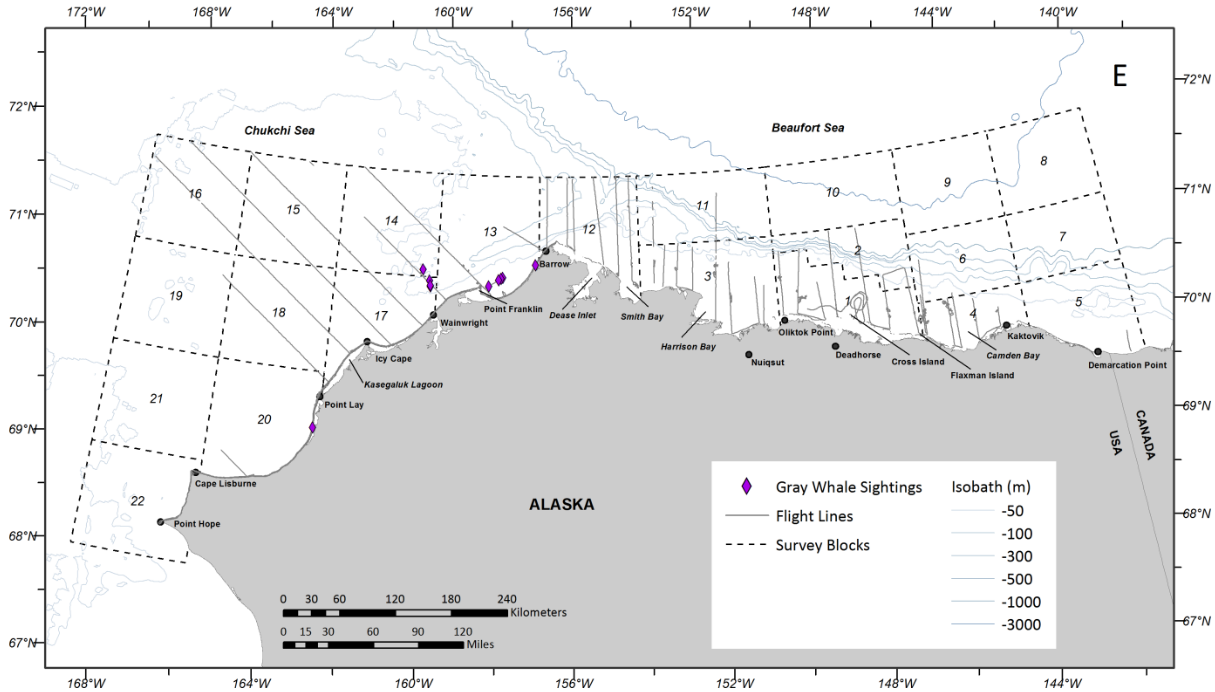


Figure 21 (cont). ASAMM 2013 semimonthly gray whale sightings, with transect, search and circling effort. Deadhead flight tracks are not shown. C: 1-15 August; D: 16-31 August.



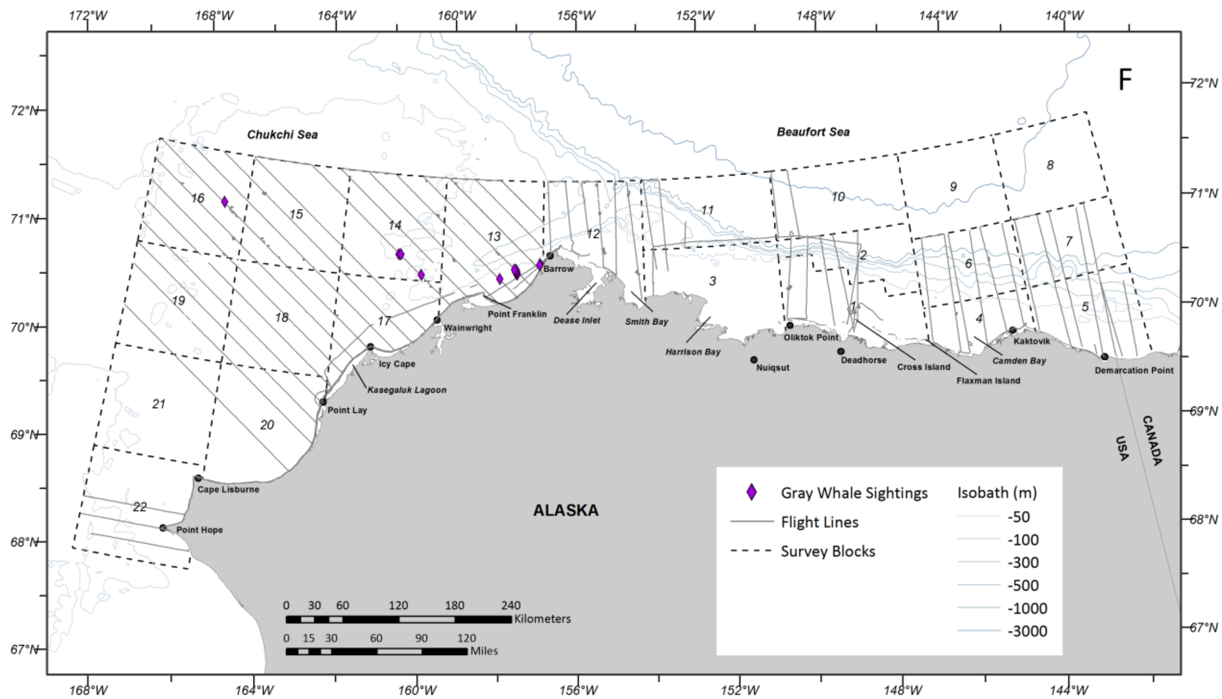


Figure 21 (cont). ASAMM 2013 semimonthly gray whale sightings, with transect, search and circling effort. Deadhead flight tracks are not shown. E: 1-15 September; F: 16-30 September.

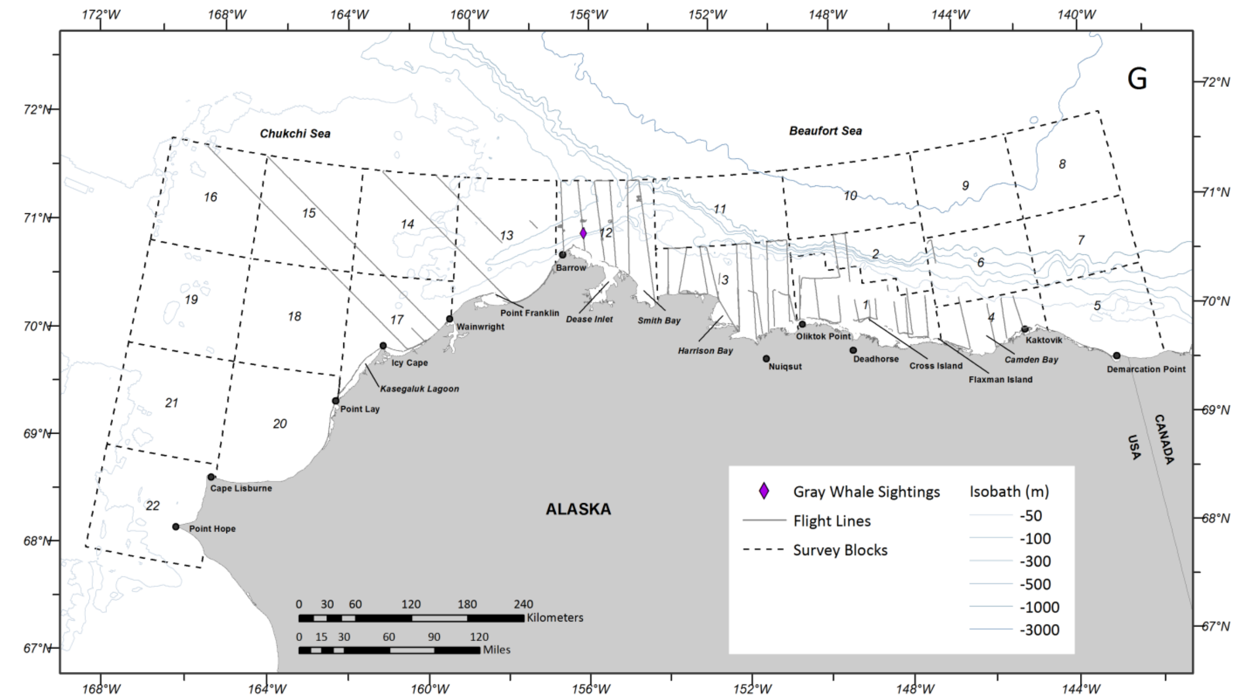


Figure 21 (cont). ASAMM 2013 semimonthly gray whale sightings, with transect, search and circling effort. Deadhead flight tracks are not shown. G: 20-28 October.

Gray Whale Sighting Rates

In summer and fall 2013, gray whales were seen on transect from 68°N to 71.5°N and 155°W to 169°W. There were 67 sightings of 110 gray whales on transect by primary observers, ranging from 1 whale per sighting (n = 42) to 9 whales per sighting (n=1). The greatest number of sightings on transect were in blocks 13 and 17, with 24 sightings each. The highest sighting rates per survey block for the entire study period were in block 17 (0.011 WPUE) and block 22 (0.008 WPUE) (Table 11). The highest monthly sighting rate was in July (0.008 WPUE); monthly sighting rate decreased through August and September; no gray whales were seen on transect during the limited survey effort conducted in October.

The highest sighting rate per depth zone in the northeastern Chukchi Sea (157°W-169°W) for the entire study period was in the ≤35 m zone (0.008 WPUE) (Table 12). The sighting rate in July and August combined was highest in the ≤35 m depth zone (0.013 WPUE), and in September it was highest in the 51-200 m North depth zone (0.010 WPUE).

The highest sighting rate per depth zone in the western Alaskan Beaufort Sea (154°W-157°W) for gray whales for the entire study period was in the 21-50 m zone (0.009 WPUE); only one gray whale was seen in depths >50 m east of 157°W.

Table 11. ASAMM 2013 transect (Tr) effort (km), gray whale transect sightings (primary observers only) and gray whale sighting rate (WPUE = gray whales per transect km surveyed) per survey block per month. NA – surveys were not conducted. Minor discrepancies within the table are due to rounding error.

	JUL				AUG				SUMMER			
Block	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**
12	20	1	3	0.1484	1,117	2	3	0.0027	1,137	3	6	0.0053
13	1,489	1	3	0.0020	1,786	17	26	0.0146	3,275	18	29	0.0089
14	858	1	2	0.0023	572	2	2	0.0035	1,430	3	4	0.0028
15	419	0	0	0.0000	851	0	0	0.0000	1,270	0	0	0.0000
16	395	0	0	0.0000	608	0	0	0.0000	1,003	0	0	0.0000
17	586	12	21	0.0359	1,184	11	15	0.0127	1,770	23	36	0.0203
18	335	0	0	0.0000	661	0	0	0.0000	995	0	0	0.0000
19	234	0	0	0.0000	330	0	0	0.0000	564	0	0	0.0000
20	228	0	0	0.0000	1,023	0	0	0.0000	1,251	0	0	0.0000
21	0	0	0	NA	360	0	0	0.0000	360	0	0	0.0000
22	329	5	11	0.0335	857	2	3	0.0035	1,186	7	14	0.0118
Total*	**4,891**	**20**	**40**	**0.0082**	**9,349**	**34**	**49**	**0.0052**	**14,241**	**54**	**89**	**0.0062**

Block	SEP Tr Km	Tr Sightings	Tr Whales	WPUE	OCT Tr Km	Tr Sightings	Tr Whales	WPUE	FALL Tr Km	Tr Sightings	Tr Whales	WPUE
12	1,122	0	0	0.0000	557	0	0	0.0000	1,680	0	0	0.0000
13	1,503	6	6	0.0040	212	0	0	0.0000	1,715	6	6	0.0035
14	757	4	12	0.0159	188	0	0	0.0000	945	4	12	0.0127
15	781	0	0	0.0000	235	0	0	0.0000	1,017	0	0	0.0000
16	811	1	1	0.0012	79	0	0	0.0000	890	1	1	0.0011
17	1,295	1	1	0.0008	208	0	0	0.0000	1,503	1	1	0.0007
18	924	0	0	0.0000	29	0	0	0.0000	953	0	0	0.0000
19	491	0	0	0.0000	0	0	0	NA	491	0	0	0.0000
20	1,443	1	1	0.0007	0	0	0	NA	1,443	1	1	0.0007
21	63	0	0	0.0000	0	0	0	NA	63	0	0	0.0000
22	514	0	0	0.0000	0	0	0	NA	514	0	0	0.0000
Total*	**9,705**	**13**	**21**	**0.0022**	**1,509**	**0**	**0**	**0.0000**	**11,213**	**13**	**21**	**0.0019**

* Total transect effort (Tr km) may differ from values in Tables 2 and 11 because effort between barrier islands and the mainland was not included in the sighting rate per survey block analysis.

Table 12. ASAMM 2013 transect (Tr) effort (km), gray whale transect sightings (primary observers only) and gray whale sighting rate (WPUE = gray whales per transect km surveyed) per depth zone per month. NA – surveys were not conducted. Minor discrepancies within the table are due to rounding error.

	JUL				**AUG**				**SUMMER**			
Depth Zone	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**
157W-169W												
≤35 m	1,237	11	22	0.0178	2,696	17	28	0.0104	3,933	28	50	0.0127
36-50 m	2,435	5	12	0.0049	4,041	8	9	0.0022	6,476	13	21	0.0032
51-200 m N	1,104	3	3	0.0027	1,080	6	7	0.0065	2,184	9	10	0.0046
51-200 m S	96	0	0	0.0000	239	1	2	0.0084	336	1	2	0.0060
154W-157W												
≤20 m	12	0	0	0.0000	266	0	0	0.0000	277	0	0	0.0000
21-50 m	9	1	3	0.3448	191	1	2	0.0105	200	2	5	0.0251
51-200 m	0	0	0	NA	546	1	1	0.0018	546	1	1	0.0018
201-2,000 m	0	0	0	NA	114	0	0	0.0000	114	0	0	0.0000
Total*	**4,893**	**20**	**40**	**0.0082**	**9,173**	**34**	**49**	**0.0053**	**14,066**	**54**	**89**	**0.0063**

Depth Zone	SEP Tr Km	Tr Sightings	Tr Whales	WPUE	OCT Tr Km	Tr Sightings	Tr Whales	WPUE	FALL Tr Km	Tr Sightings	Tr Whales	WPUE
157W-169W												
≤35 m	3,058	4	4	0.0013	197	0	0	0.0000	3,255	4	4	0.0012
36-50 m	4,057	7	7	0.0017	632	0	0	0.0000	4,689	7	7	0.0015
51-200 m N	965	2	10	0.0104	132	0	0	0.0000	1,096	2	10	0.0091
51-200 m S	95	0	0	0.0000	0	0	0	NA	95	0	0	0.0000
154W-157W												
≤20 m	215	0	0	0.0000	124	0	0	0.0000	339	0	0	0.0000
21-50 m	263	0	0	0.0000	119	0	0	0.0000	381	0	0	0.0000
51-200 m	531	0	0	0.0000	257	0	0	0.0000	788	0	0	0.0000
201-2,000 m	114	0	0	0.0000	57	0	0	0.0000	171	0	0	0.0000
Total*	**9,297**	**13**	**21**	0.0023	**1,518**	**0**	**0**	0.0000	**10,815**	**13**	**21**	0.0019

* Total transect effort (Tr km) may differ from values in Tables 2 and 10 because effort between barrier islands and the mainland was included in the sighting rate per depth zone analysis.

Areas of highest fine-scale sighting rates were nearshore between Barrow and Point Franklin and offshore northwest of Wainwright (block 14) (Figure 22).

Overall, the 2013 gray whale sighting rate of 0.0044 gray whales on transect/transect km flown was lower than that calculated for 1982-1991 combined (0.0052 WPUE), 2008-2010 combined (0.0052 WPUE), 2011 (0.0067 WPUE) (Clarke et al. 2012) and 2012 (0.0070 WPUE) (Clarke et al. 2013a). Note that sighting rate analyses conducted prior to 2011 included transect sightings from both primary and secondary observers, whereas sighting rate analyses in 2011 and 2012 included sightings from primary observers only.

The peak monthly gray whale sighting rate in the northeastern Chukchi Sea (157°W-169°W) in 2013 was in July (Figure 23), dropping off substantially in August and September, which is similar to what was observed in 2011 and 2012. Depth zone preference was for shallower water (≤35 m in the northeastern Chukchi Sea and ≤20 m in the western Beaufort Sea) in summer months (July-August), and deeper water (51-200 m) in fall (September), which is a trend noted since aerial surveys recommenced in the northeastern Chukchi Sea in 2008 (Clarke et al. 2012, 2013a). Gray whale distribution in 2013 using sightings on transect only did not appear to differ noticeably from the distribution of transect-only sightings observed in previous years having light sea ice cover, except for the continued lack of sightings near Hanna Shoal and the single sighting in block 16 (Figure 24).

Gray Whale Habitat Associations

Most gray whales (52%, n=147) were observed in 0% sea ice cover. Gray whales were observed in areas with sea ice in July (1-75% sea ice cover) and August (1-6% sea ice cover). Sea ice remained in the study area until mid-September (Appendix A), but mainly in offshore areas where gray whales were rarely observed. Both feeding behavior and calves were observed in areas of up to 75% sea ice cover. Sea ice cover does not appear to be an impediment to gray whale occurrence.

Gray Whale Behaviors

Behaviors of 281 gray whales observed during all survey modes (transect, search and circling) in 2013 are summarized in Table 13. The behaviors most often recorded were feeding (68%) and swimming (21%). Milling was recorded for 21 whales (7%) and resting was recorded for 8 whales (3%). Fine-scale sighting rates of feeding and milling gray whales observed on transect in 2013 are shown in Figure 25. One gray whale (<1% of all gray whales sighted) appeared to respond to the survey aircraft by diving.

Fifty-seven gray whale calves were seen in 2013 (Figure 26); the calf ratio (number of calves/number of total whales) was 0.203, which is more than three times greater than that observed from 2008-2011 (2008 = 0.005; 2009 = 0.026; 2010 = 0.000; 2011 = 0.055) (Clarke et al. 2011d, 2012) and almost twice the ratio observed in 2012 (0.120) (Clarke et al. 2013a). Calf distribution overlapped that of adult gray whales both temporally and spatially in 2013. Most calves (91%, n=52) were within 25 km of shore, but five calves were 41-77 km offshore. Forty-seven calves were observed in July, 9 calves were seen in August, and 1 calf was seen in

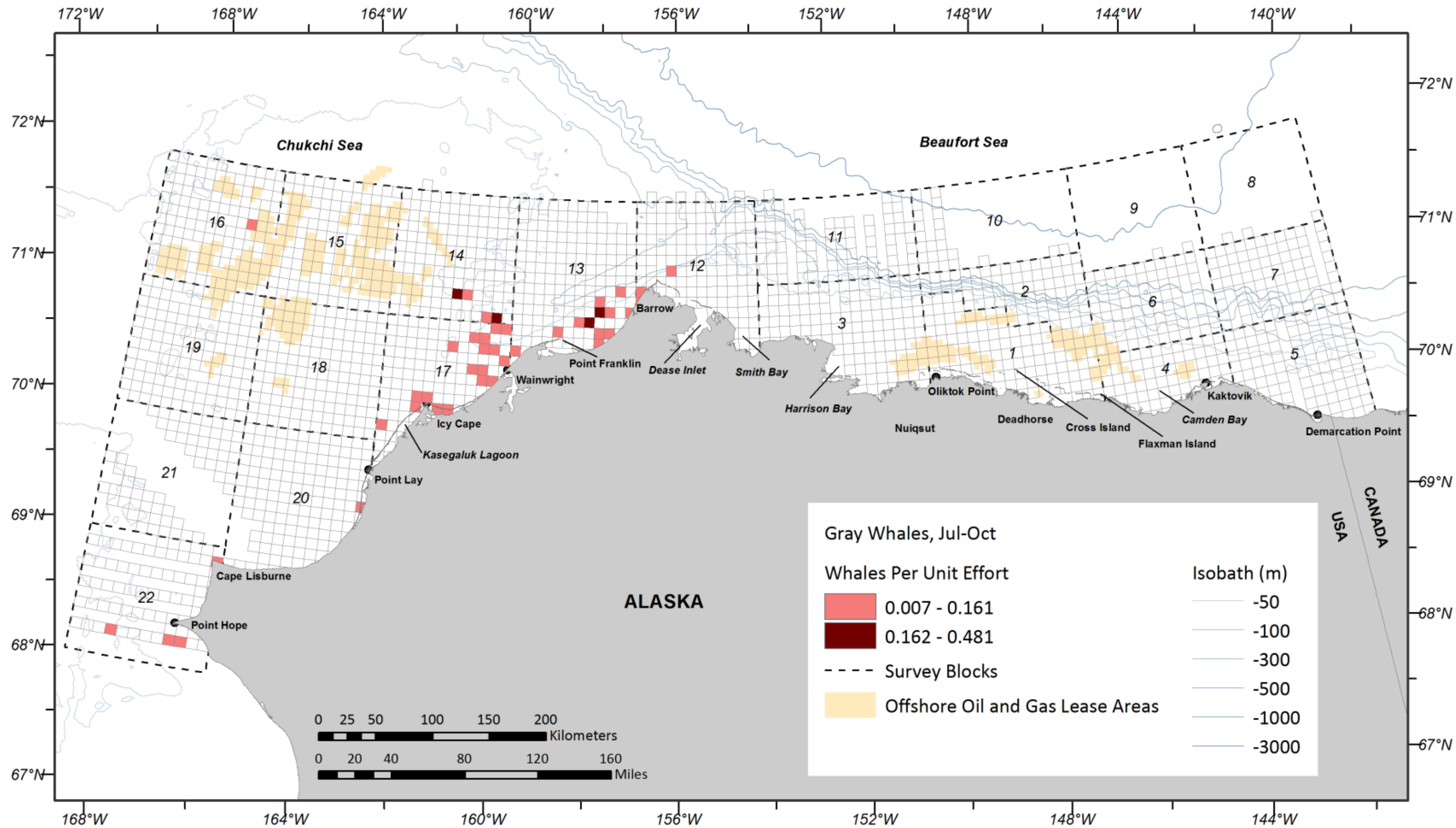


Figure 22. ASAMM 2013 gray whale sighting rates (WPUE, transect sightings from primary observers only), July-October. Empty grid cells indicate sighting rates of zero. Transect survey effort was not conducted in areas without grid cells.

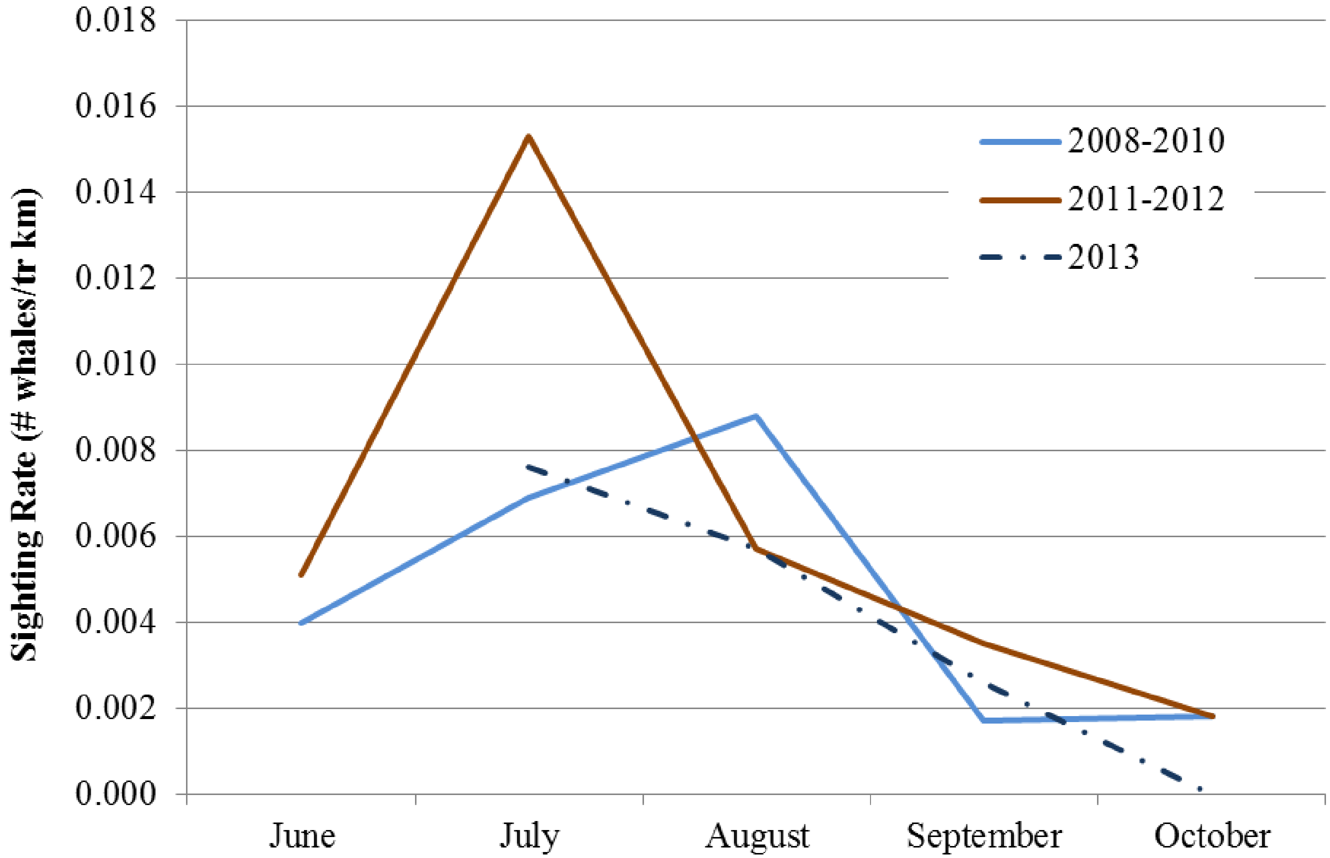


Figure 23. ASAMM monthly sighting rates (WPUE) of gray whales on transect (made by primary observers only) in the northeastern Chukchi Sea, 2008-2010, 2011-2012, and 2013.

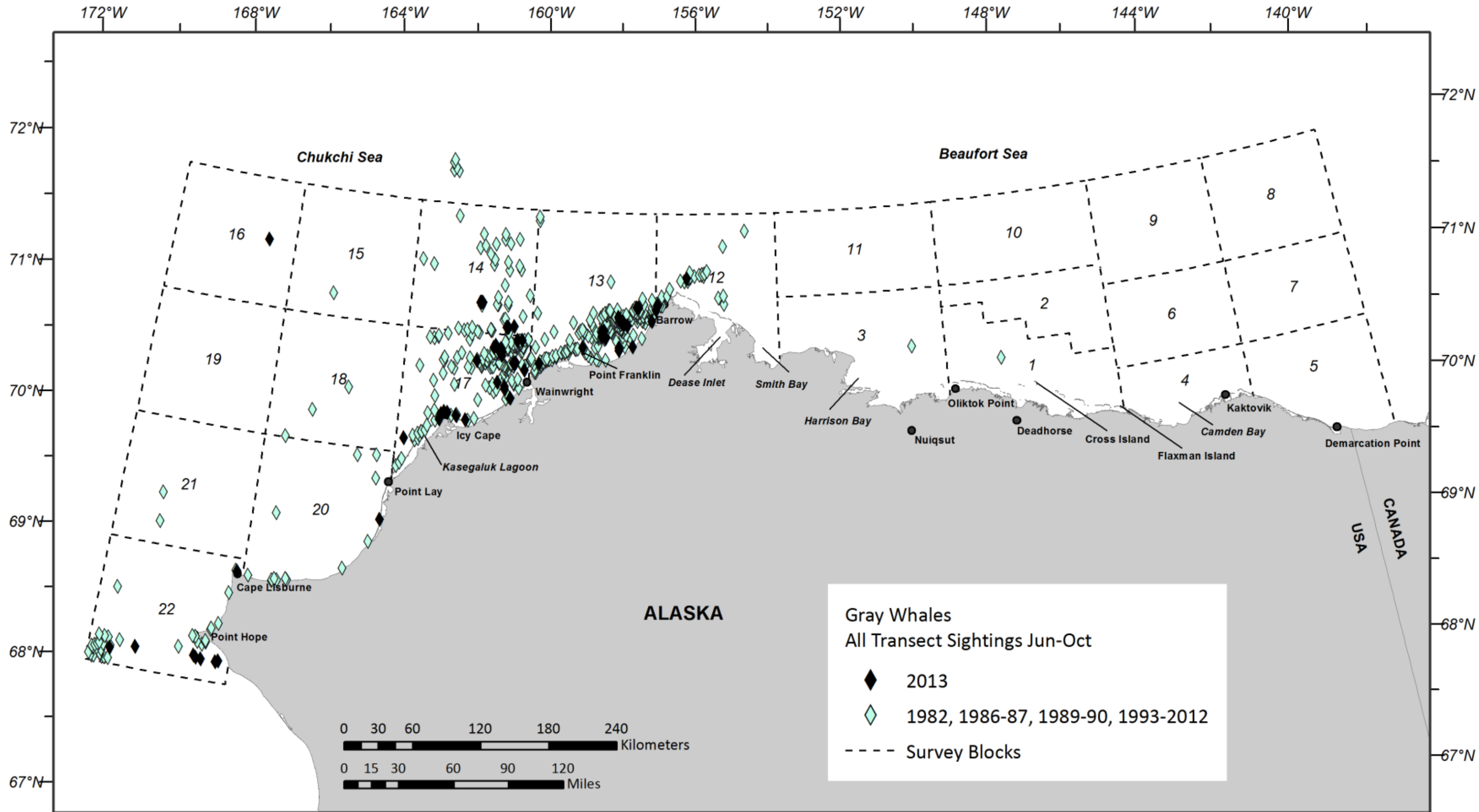


Figure 24. ASAMM gray whale sightings on transect in years with light sea ice cover: 1982, 1986-87, 1989-90, 1993-2012, and 2013. Includes all sightings on transect, from primary and secondary observers.

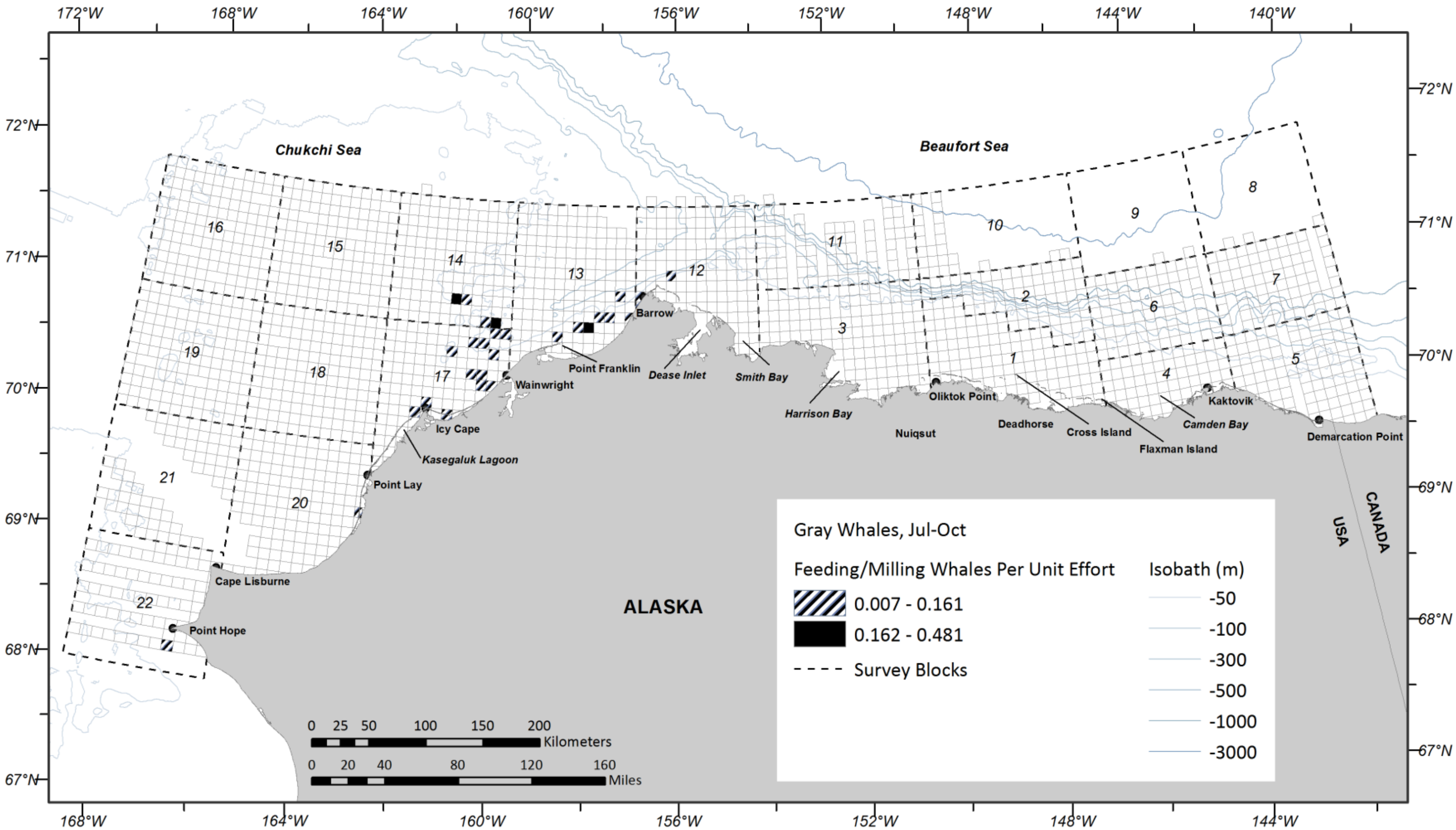


Figure 25. ASAMM 2013 feeding and milling gray whale sighting rates (WPUE, transect sightings from primary observers only). Empty grid cells indicate sighting rates of zero. Transect survey effort was not conducted in areas without grid cells.

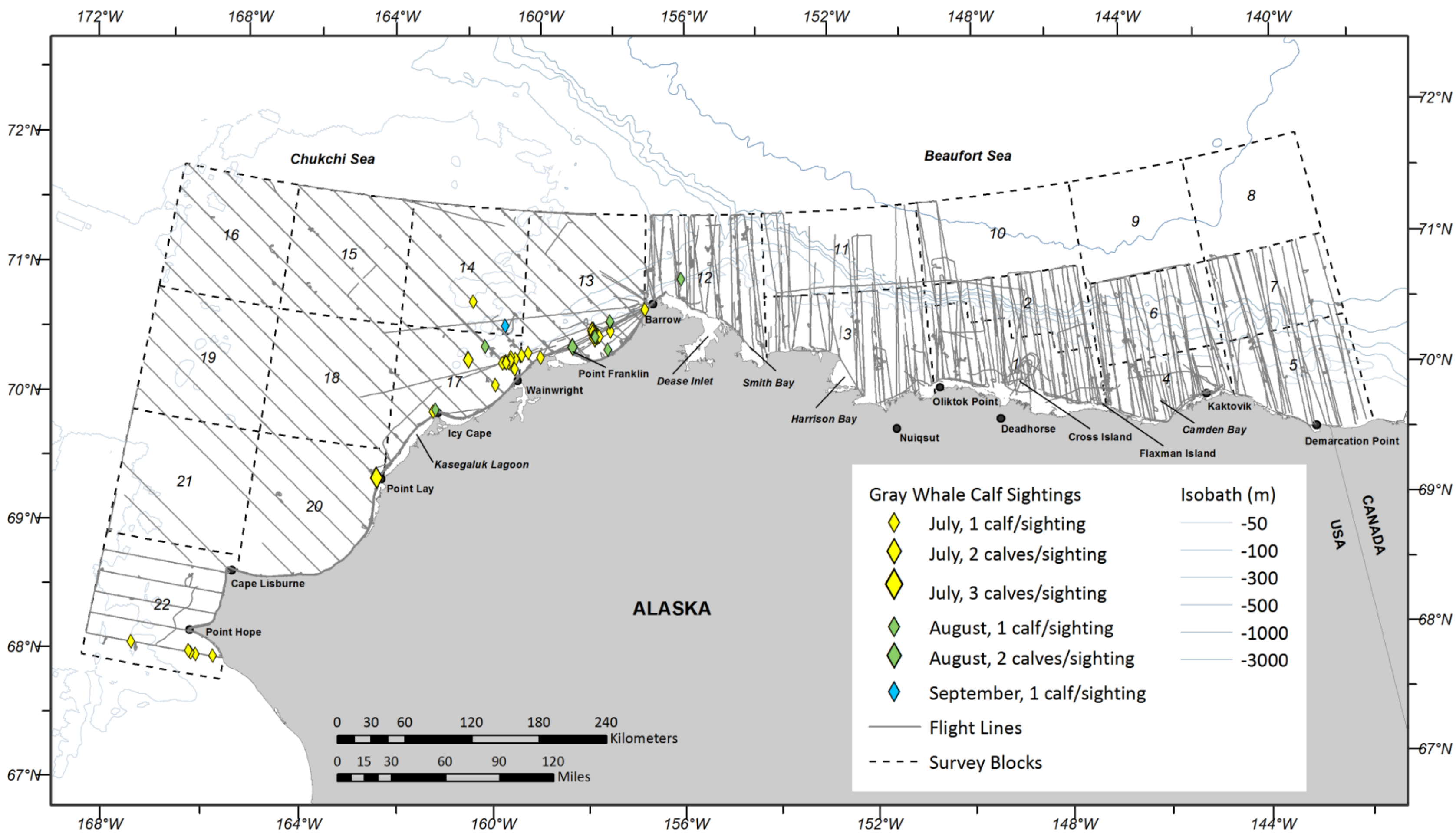


Figure 26. ASAMM 2013 gray whale calf sightings, with transect, search, and circling effort. Deadhead flight tracks are not shown.

Table 13. ASAMM 2013 semimonthly summary of gray whales (number of sightings/number of individuals) observed during all survey modes (transect, search and circling), by behavioral category. Excludes dead and repeat sightings.

Behavior	1-15 Jul	16-31 Jul	1-15 Aug	16-31 Aug	1-15 Sep	16-30 Sep	20-28 Oct	Total
Dive	0	1/1	1/1	0	0	1/1	0	3/3
Feed	14/26	32/58	24/38	33/49	7/16	3/3	0	113/190
Mill	8/14	1/2	1/3	0	1/2	0	0	11/21
Rest	3/5	0	1/1	2/2	0	0	0	6/8
Swim	8/15	4/7	12/17	3/6	2/2	10/10	1/1	40/58
Unknown	0	0	0	1/1	0	0	0	1/1
TOTAL	33/60	38/68	39/60	39/58	10/20	14/14	1/1	174/281

September. On 9 occasions, multiple calves were seen in 1 day, with the highest daily total on 21 July (23 calves). Some calves may have been sighted on more than one day. One calf that was likely sighted twice was seen with a white gray whale cow on 7 July near Point Lay (Appendix B, Flight 204) and again near the white gray whale cow on 21 July between Point Franklin and Barrow (Appendix B, Flight 211). Even with the possibility that some calves were sighted more than once, gray whale calf occurrence in the northeastern Chukchi Sea in 2013 was unprecedented, particularly because it follows high gray whale calf occurrence in 2012 (Clarke et al. 2013a). When calf sightings were corrected for survey effort, gray whale calf sighting rate in 2013 (calves on transect per transect km) was 0.0009, which is lower than that observed in 2012 but three times higher than any previous year (1979-2011) in which these broad-scale marine mammal aerial surveys have been conducted.

Gray whale swim direction was significantly clustered about a mean heading of 276°T ($Z=3.508$, $P=0.026$) in July, but not clustered around any heading in August or September. Most gray whales observed during ASAMM are at the far northern extent of the species' range and are feeding, so a lack of directed migratory movement during August and September is not surprising.

Humpback Whales

There were two sightings of four humpback whales (*Megaptera novaeangliae*) in 2013, all in the northeastern Chukchi Sea (Table 3; Figure 27). All four humpback whales were seen on 27 August, approximately 80 km northeast of Cape Lisburne (Appendix B, Flight 227), in two distinct pairs. All humpback whales sighted were adults. None of the humpback whales appeared to respond to the survey aircraft.

Fin Whales

There were three sightings of three fin whales (*Balaenoptera physalus*) in 2013 (Table 3; Figure 27), all single animals. Two of the fin whales were seen in block 22, one on 12 July and one on 1 August (symbol is obscured by block number on Figure 27). One adult was seen in block 20 on 27 August, closely associated with the two pairs of humpback whales (symbol is obscured by humpback whale symbol on Figure 27). All of the fin whales sighted were adults. None of the fin whales appeared to respond to the survey aircraft.

Minke Whales

There were five sightings of five single minke whales (*Balaenoptera acutorostrata*) in 2013 (Table 3; Figure 27). Minke whale sightings were scattered geographically, although all sightings were close to shore (<11 km). One minke whale was observed east of Icy Cape on 4 July, two minke whales were sighted just west of Point Lay on 7 July, and two minke whales were sighted east of Cape Lisburne on 13 August. All minke whales sighted were adults. None of the minke whales appeared to respond to the survey aircraft.

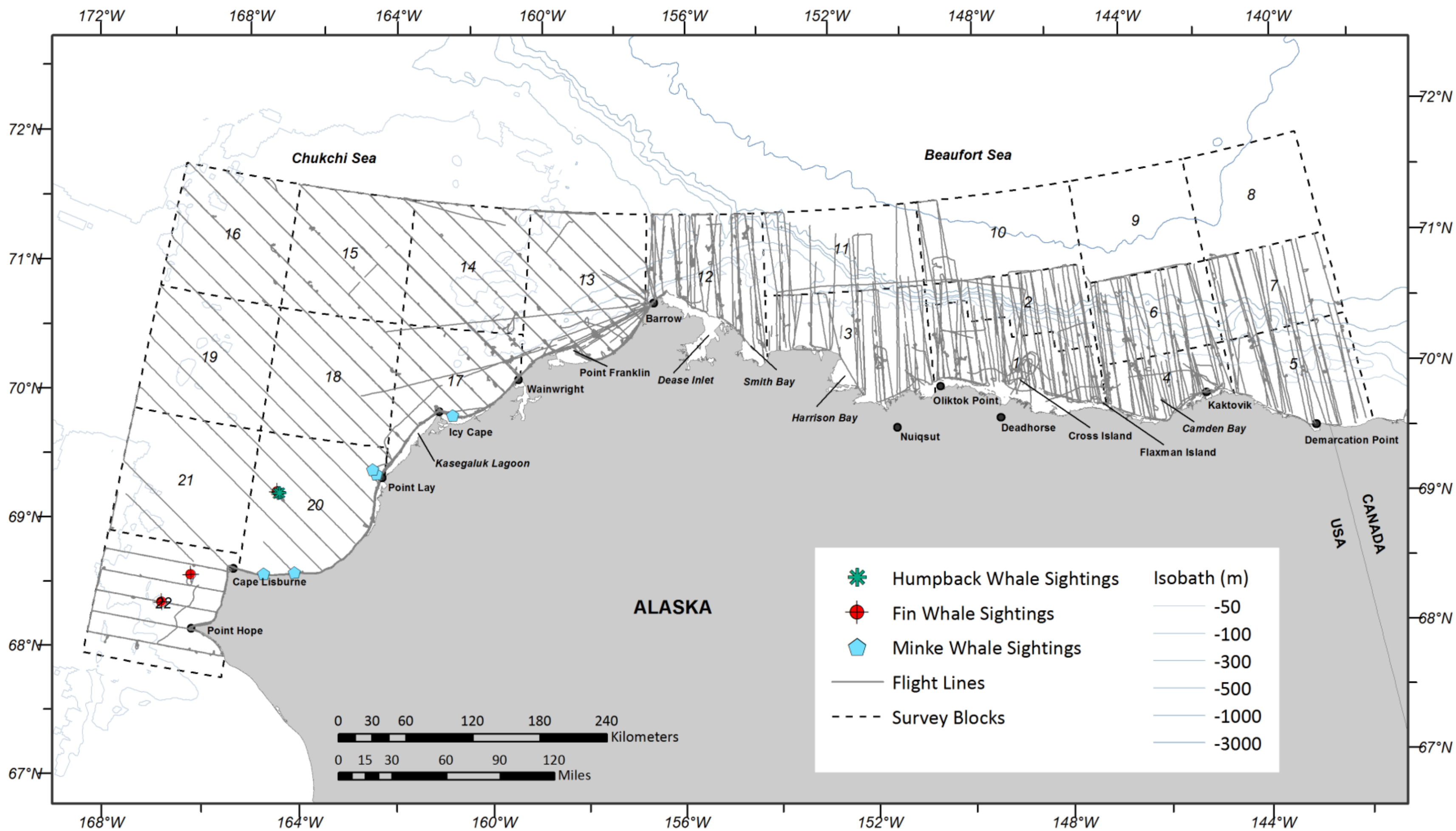


Figure 27. ASAMM 2013 humpback, fin, and minke whale sightings, with transect, search, and circling effort. Deadhead flight tracks are not shown.

Belugas

BELUGA SIGHTING SUMMARY

During the 2013 ASAMM surveys, 446 sightings of 1,601 belugas (*Delphinapterus leucas*) were observed during all survey modes (transect, search and circling) in the study area (Table 3). Belugas were seen in the Chukchi Sea in all months, although sightings were few and scattered (Figure 28). In the western Beaufort Sea, belugas were seen along the continental slope in all months surveyed (July through October), with scattered sightings nearshore. Belugas were also seen near Barrow Canyon from August through October.

Beluga distribution in 2013 was generally similar to that documented in previous years with light sea ice cover, particularly in the western Beaufort Sea (Figure 29). Beluga distribution in the northeastern Chukchi Sea documented by ASAMM in 2013 was similar to observations in 1989-1990, 2008-2010, and 2012, when few belugas were sighted, particularly in summer months (Moore et al. 2000; Clarke et al. 2011d, 2013a). In 2011, belugas were distributed throughout the Chukchi Sea study area in all months (Clarke et al. 2012).

Aerial survey effort conducted north of the current ASAMM study area from 1989-1991 (Moore and Clarke 1992) and results from beluga satellite tagging efforts (Suydam et al. 2001) indicated that belugas regularly traversed the northeastern Chukchi and western Beaufort seas much farther north than the current ASAMM study area. It is therefore likely that ASAMM effort does not document the full extent of beluga range in the northeastern Chukchi and western Beaufort seas. Distribution patterns south of 72°N have remained remarkably similar over the past 30 years, particularly in the western Beaufort Sea.

BELUGA SIGHTING RATES

In summer and fall 2013, belugas were seen from 68.4°N to 72°N between 140°W and 169°W. There were 363 sightings of 1,446 belugas on transect by primary observers, ranging from 1 beluga per sighting (n = 202) to 400 belugas per sighting (n=1). The highest number of sightings on transect per survey block was in block 7 (94 sightings), followed by blocks 6 (59 sightings) and 12 (46 sightings). The highest beluga sighting rate in 2013 in the northeastern Chukchi Sea occurred in July, decreased substantially in August, and increased slightly in September and October (Figure 30). Sighting rates in the western Beaufort Sea were highest in July and August before declining in September and October. Sighting rates perhaps reflect the presence of the Eastern Chukchi Sea stock in the northeastern Chukchi and western Beaufort seas in summer (July-August) (Hauser et al. 2014). Relatively low sighting rates in the ASAMM study area in fall 2013 might be indicative of greater abundance north (north of 72°N) or east (east of 140°W) of the ASAMM study area. Areas of highest fine-scale sighting rates in the Beaufort Sea were offshore on the continental slope northeast of Kaktovik (block 7), north of Flaxman Island (block 6), and north of Smith Bay (block 11) (Figure 31). In the northeastern Chukchi Sea, areas of highest fine-scale sighting rates were offshore in block 19 and nearshore south of Point Lay (block 20) (based on a single sighting of 400 belugas).

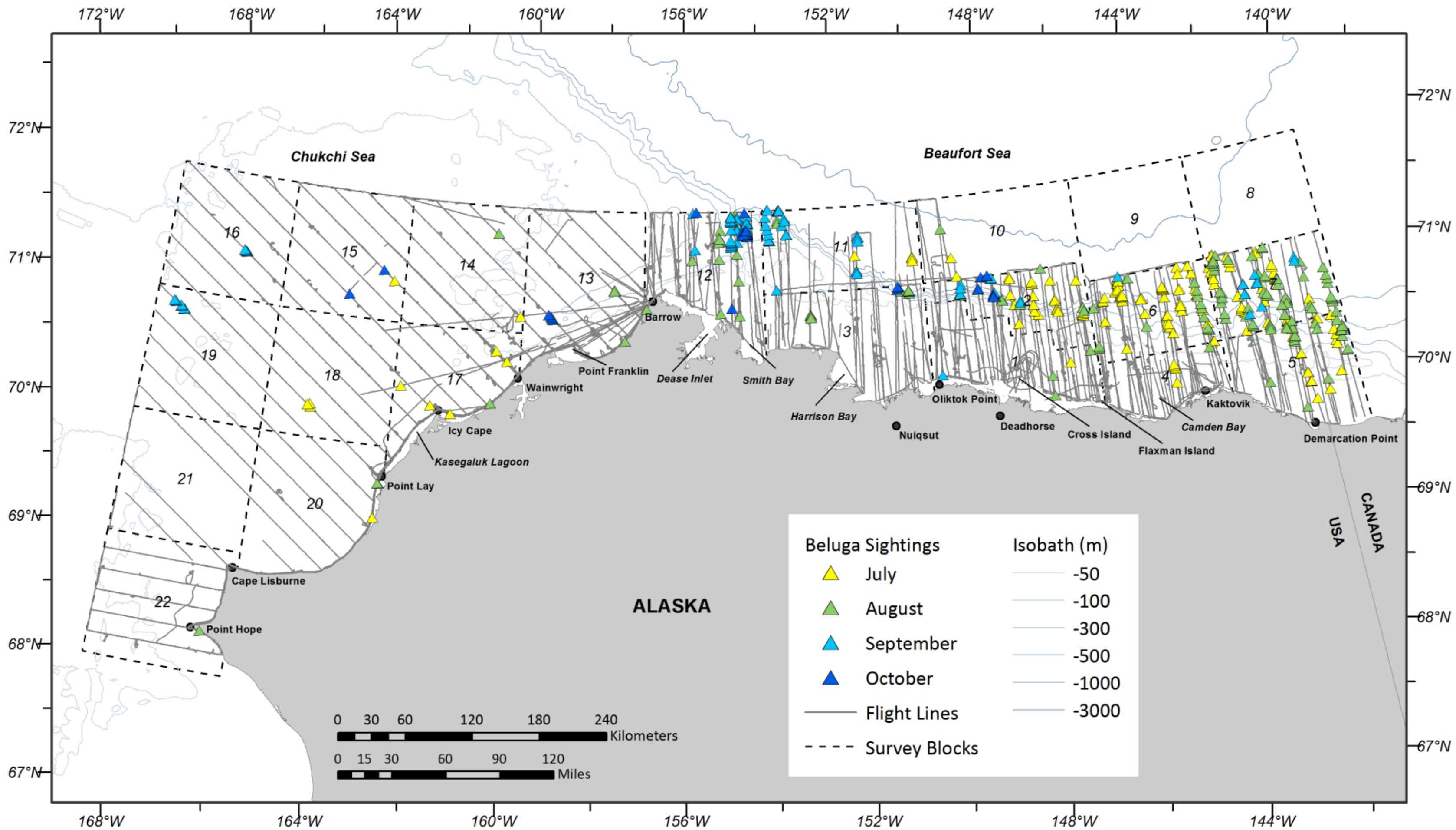


Figure 28. ASAMM 2013 beluga sightings plotted by month, with transect, search, and circling effort. Deadhead flight tracks are not shown.

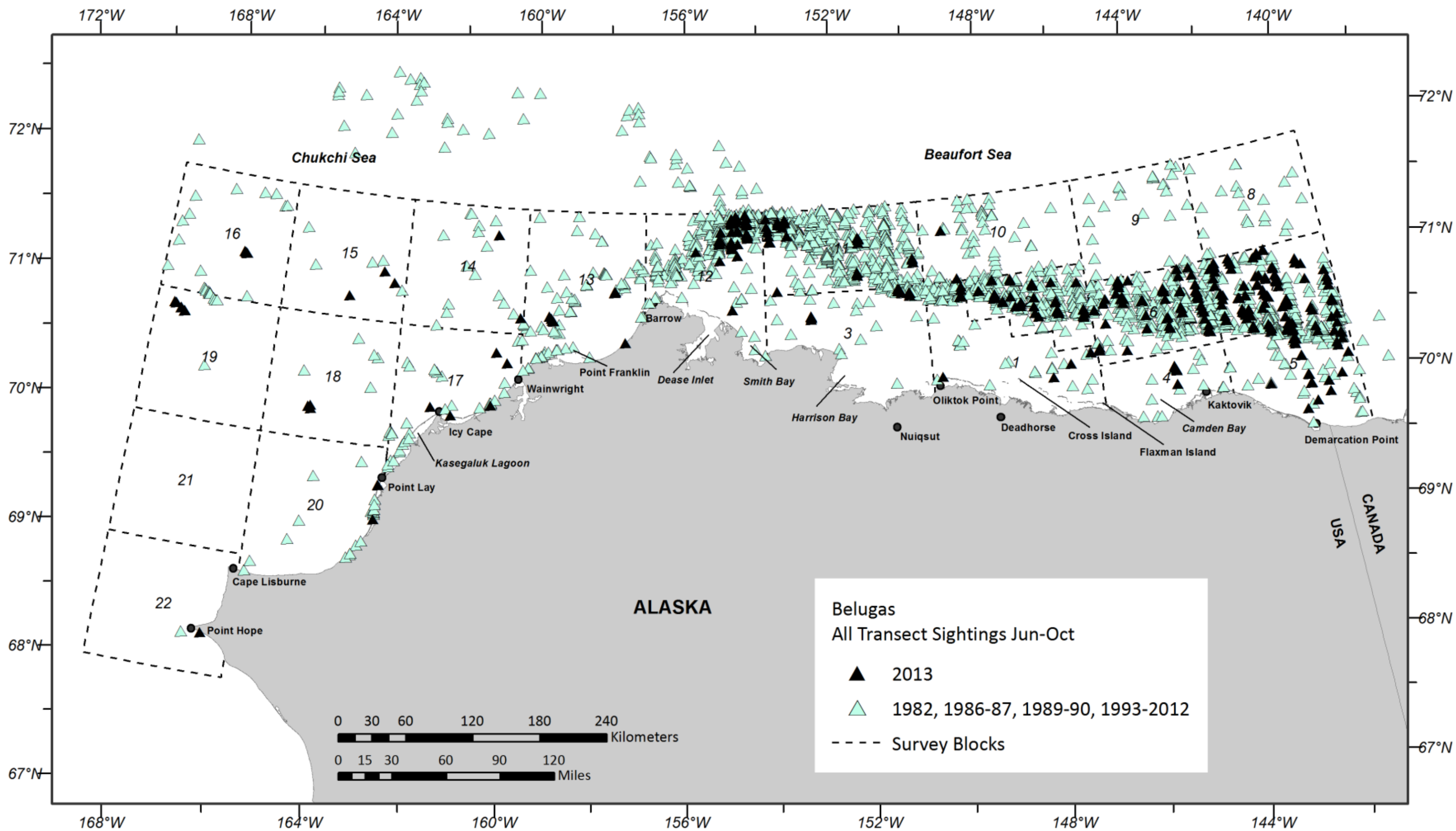


Figure 29. ASAMM beluga sightings on transect in years with light sea ice cover: 1982, 1986-87, 1989-90, 1993-2012, and 2013. Includes all sightings on transect, from primary and secondary observers.

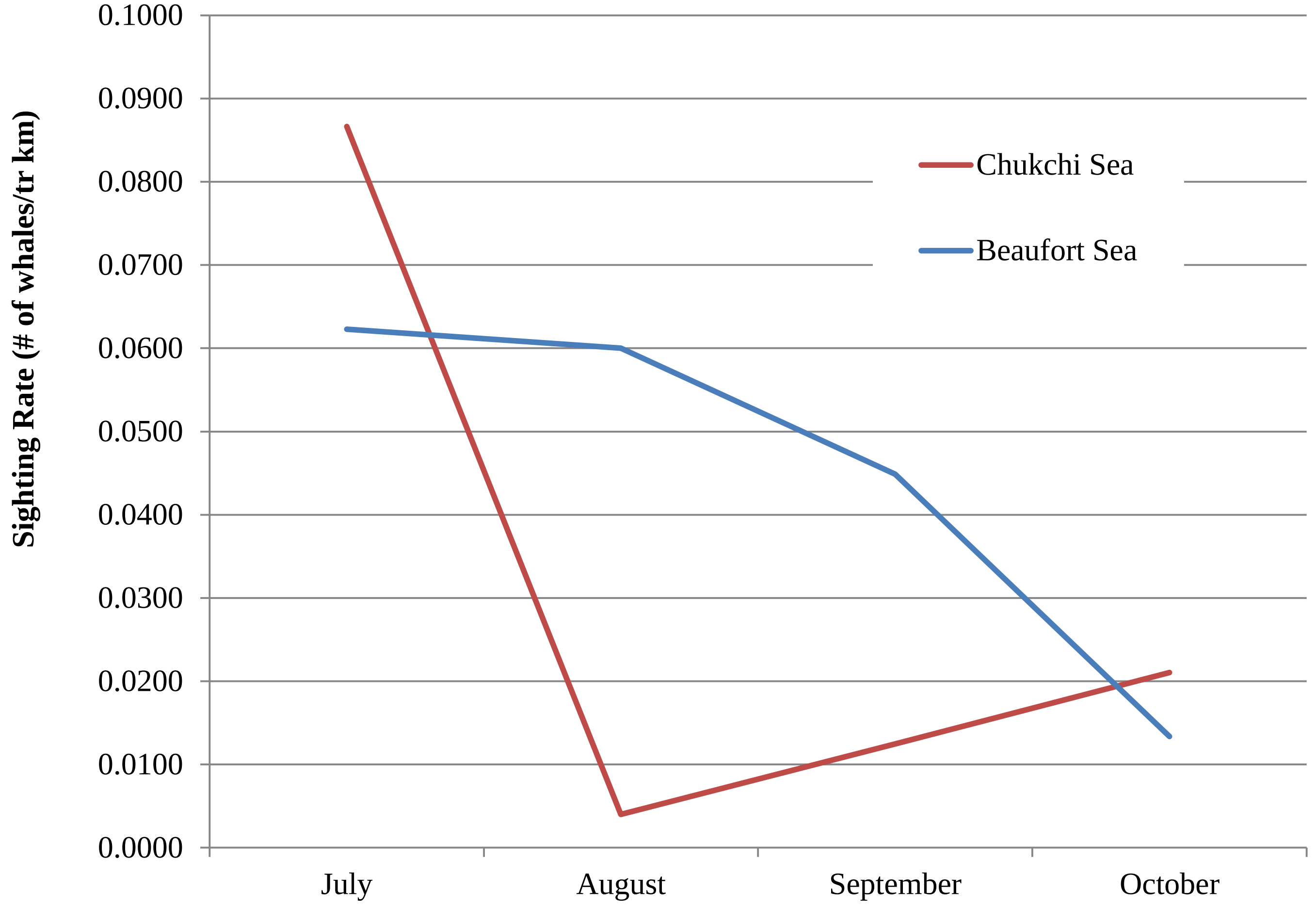


Figure 30. ASAMM 2013 monthly sighting rates (WPUE) of belugas on transect (made by primary observers only) in the western Beaufort and northeastern Chukchi seas.

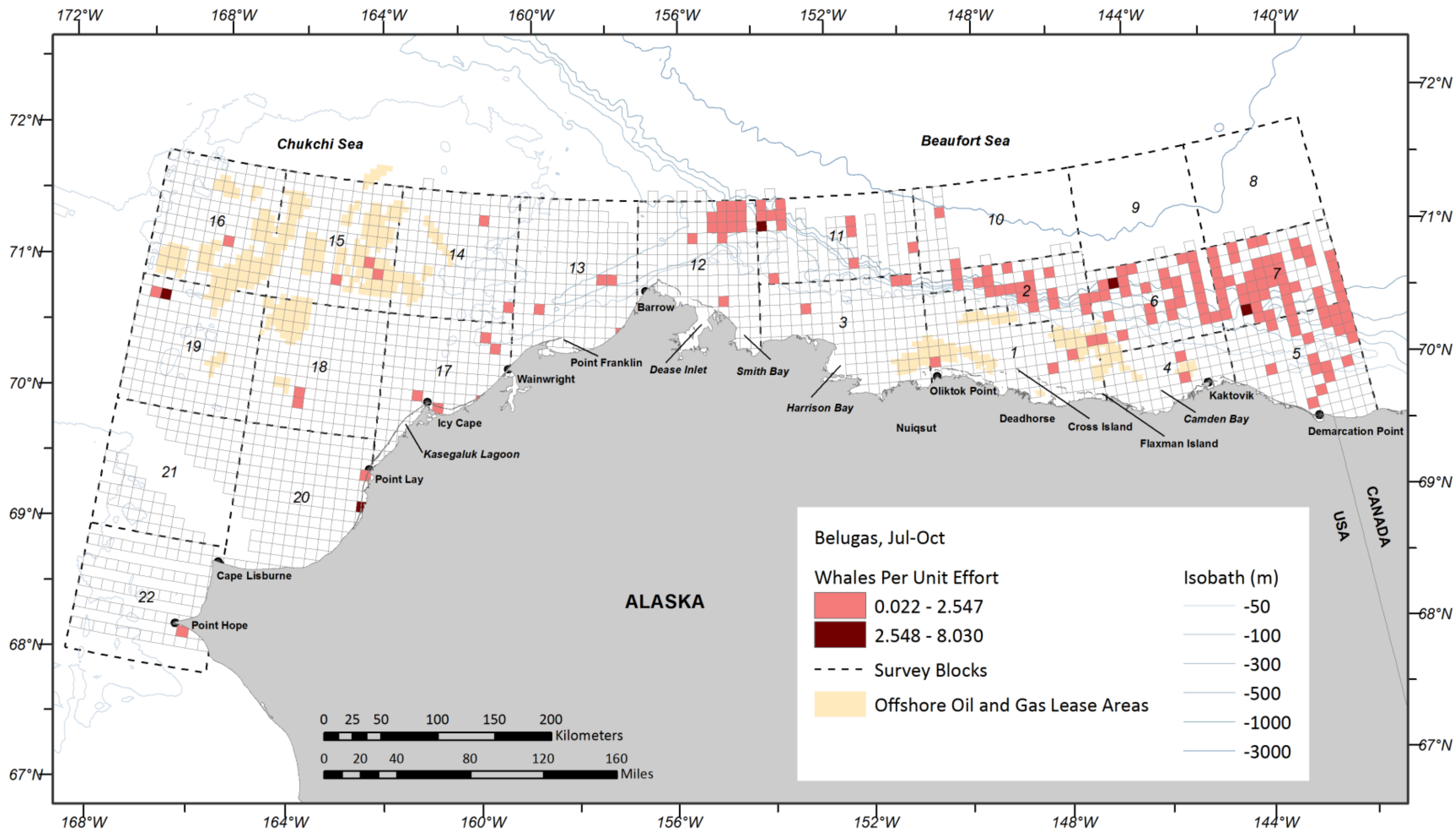


Figure 31. ASAMM 2013 beluga sighting rates (WPUE, transect sightings from primary observers only). Empty grid cells indicate sighting rates of zero. Transect survey effort was not conducted in areas without grid cells.

In 2013, beluga sighting rates per depth zone were highest in the 201-2,000 m depth zone near Barrow Canyon (154°W-157°W) and in the western Beaufort Sea (140°W-154°W) (Table 14). In the northeastern Chukchi Sea (157°W-169°W), beluga sighting rate per depth zone was highest in the ≤35 m North depth zone (Table 14). Sighting rates in 2013 were lower overall compared to observations in previous years (Clarke et al. 2013a).

BELUGA HABITAT ASSOCIATIONS

Belugas were observed in sea ice cover ranging from no ice to 90% broken floe. Most belugas (88%, n=410) were observed in ≤10% sea ice cover. Belugas were observed in association with sea ice cover (1-95% sea ice cover) from July through mid-August. Sea ice was not present in the western Beaufort Sea study area in September (Appendix A), and very few belugas were seen in the northeastern Chukchi Sea where remnant sea ice remained. Belugas were seen in new/grease ice that was forming offshore in the Beaufort Sea after surveys recommenced on 19 October.

BELUGA BEHAVIORS

Behaviors of belugas observed during all survey modes (transect, search and circling) in 2013 are summarized in Table 15. The behavior most often recorded was swimming (54%). Milling was recorded for 572 belugas (36%), including the only large group of belugas seen in 2013. Twelve belugas (<1% of all belugas sighted) appeared to respond to the survey aircraft by diving.

Swim direction was evaluated for all "swimming" belugas for different regions and time periods. The mean vector swim direction for belugas in the northeastern Chukchi Sea (154°W-169°W, to incorporate Barrow Canyon) in summer (July-August) or fall (September-October) was not significantly clustered around mean headings. Swim direction was clustered around a mean heading of 290°T (Z=4.054, P=0.017) in the western Beaufort Sea (140°W-154°W) in summer. In fall (September-October) in the western Beaufort Sea, the mean vector swim direction was significantly clustered around a mean heading of 131°T (Z=8.04, P=0.0003).

There were 114 sightings of 193 beluga calves, including 46 cow-calf pairs and 5 calves without adults, observed during all survey modes (transect, search and circling). Beluga calf sightings were scattered across the western Beaufort Sea slope (Figure 32), although a few were seen in the offshore survey blocks of the Chukchi Sea. Calves were seen throughout summer and fall, with the largest number of calves seen near the southern end of Kasegaluk Lagoon in July. Beluga calves are likely underrepresented in the dataset because of their small size and the infrequency of circling over beluga sightings.

Table 14. ASAMM 2013 transect (Tr) effort (km), beluga transect sightings (primary observers only) and beluga sighting rate (WPUE = belugas per transect km surveyed) per depth zone per month. NA – surveys were not conducted. Minor discrepancies within the table are due to rounding error.

	JUL				AUG				SUMMER			
Depth Zone	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**	**Tr Km**	**Tr Sightings**	**Tr Whales**	**WPUE**
157W-169W												
≤35 m	1,237	3	412	0.3330	2,696	5	8	0.0030	3,933	8	420	0.1068
36-50 m	2,435	5	5	0.0021	4,041	1	1	0.0002	6,476	6	6	0.0009
51-200 m N	1,104	2	5	0.0045	1,080	3	24	0.0222	2,184	5	29	0.0133
51-200 m S	96	0	0	0.0000	239	0	0	0.0000	336	0	0	0.0000
154W-157W												
≤20 m	12	0	0	0.0000	266	0	0	0.0000	277	0	0	0.0000
21-50 m	9	0	0	0.0000	191	0	0	0.0000	200	0	0	0.0000
51-200 m	0	0	0	NA	546	0	0	0.0000	546	0	0	0.0000
201-2,000 m	0	0	0	NA	114	10	45	0.3947	114	10	45	0.3947
140W-154W												
≤20 m	506	0	0	0.0000	560	1	1	0.0018	1,066	1	1	0.0009
21-50 m	1,574	13	24	0.0152	1,630	11	50	0.0307	3,204	24	74	0.0231
51-200 m	618	10	33	0.0534	994	6	34	0.0342	1,611	16	67	0.0416
201-2,000 m	1,068	77	168	0.1573	1,222	68	201	0.1645	2,290	145	369	0.1612
>2,000 m	341	23	32	0.0939	490	19	29	0.0592	830	42	61	0.0735
TOTAL	**9,000**	**133**	**679**	**0.0754**	**14,067**	**124**	**393**	**0.0279**	**23,067**	**257**	**1072**	**0.0465**

	SEP Tr Km	Tr Sightings	Tr Whales	WPUE	OCT Tr Km	Tr Sightings	Tr Whales	WPUE	FALL Tr Km	Tr Sightings	Tr Whales	WPUE
157W-169W												
≤35 m	3,058	0	0	0.0000	197	0	0	0.0000	3,255	0	0	0.0000
36-50 m	4,057	13	107	0.0264	632	2	11	0.0174	4,689	15	118	0.0252
51-200 m N	965	0	0	0.0000	132	4	9	0.0682	1,096	4	9	0.0082
51-200 m S	95	0	0	0.0000	0	0	0	NA	95	0	0	0.0000
154W-157W												
≤20 m	215	0	0	0.0000	124	1	2	0.0161	339	1	2	0.0059
21-50 m	263	0	0	0.0000	119	0	0	0.0000	381	0	0	0.0000
51-200 m	531	17	73	0.1375	257	4	4	0.0155	788	21	77	0.0977
201-2,000 m	114	13	21	0.1842	57	1	1	0.0175	171	14	22	0.1286
140W-154W												
≤20 m	585	1	1	0.0017	623	0	0	0.0000	1,208	1	1	0.0008
21-50 m	1,478	1	1	0.0007	686	0	0	0.0000	2,164	1	1	0.0005
51-200 m	673	7	76	0.1129	76	0	0	0.0000	749	7	76	0.1015
201-2,000 m	743	30	44	0.0592	78	8	20	0.2564	821	38	64	0.0780
>2,000 m	311	4	4	0.0128	0	0	0	NA	311	4	4	0.0128
TOTAL	**13,088**	**86**	**327**	**0.0250**	**2,981**	**20**	**47**	**0.0158**	**16,068**	**106**	**374**	**0.0233**

* Total transect effort (Tr km) may differ from values in Table 2 because effort between barrier islands and the mainland was included in the sighting rate per depth zone analysis.

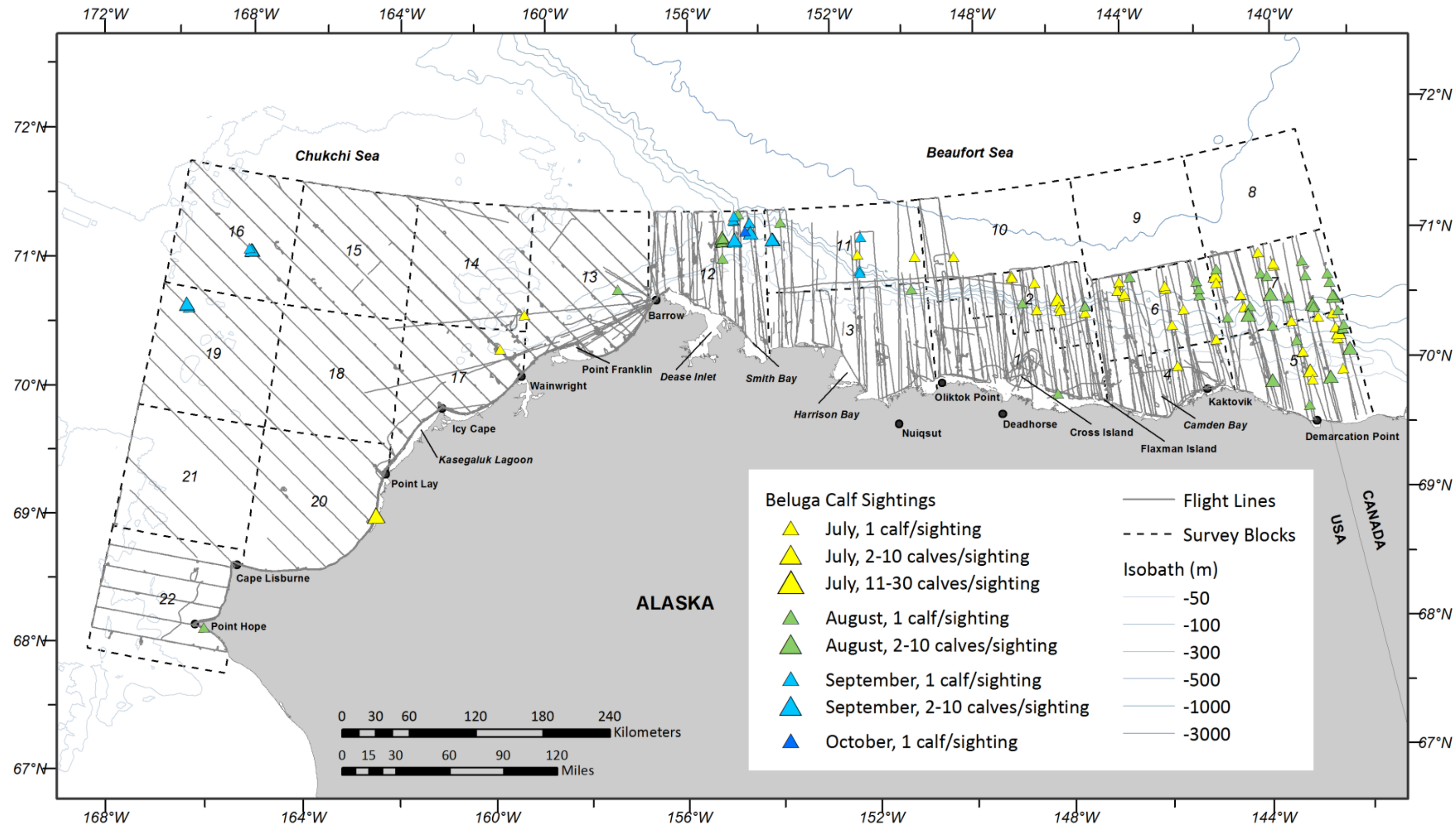


Figure 32. ASAMM 2013 beluga calf sightings, with transect, search, and circling effort. Deadhead flight tracks are not shown.

Table 15. ASAMM 2013 semimonthly summary of belugas (number of sightings/number of individuals) observed during all survey modes (transect, search and circling), by behavioral category. Excludes dead and repeat sightings.

Behavior	1-15 Jul	16-31 Jul	1-15 Aug	16-31 Aug	1-15 Sep	16-30 Sep	20-28 Oct	Total
Dive	0	11/13	1/1	0	0	1/1	0	13/15
Mill	3/402	8/32	3/7	6/80	2/2	6/34	4/15	32/572
Rest	1/1	44/68	10/16	27/50	5/9	7/7	2/2	96/153
Swim	6/20	88/204	83/249	17/32	7/13	75/291	29/52	305/861
TOTAL	10/423	151/317	97/273	50/162	14/24	89/333	35/69	446/1,601

Unidentified Cetaceans and Unidentified Marine Mammals

There were 46 sightings of 47 unidentified cetaceans in 2013 (Table 3; Figure 33). Sightings were recorded as unidentified whenever a positive species identification was not possible. This usually occurred when an animal dived and could not be resighted or when environmental conditions such as fog, low cloud ceilings, or glare prevented circling to relocate the initial sighting. Seventeen of the unidentified cetaceans were in the northeastern Chukchi Sea, and 30 unidentified cetaceans were in the western Beaufort Sea. Ten of the unidentified cetaceans were probable bowhead whales, based on their size and darker color. Three unidentified cetaceans were possible minke whales, based on size and shape. The majority of unidentified cetacean sightings were not seen clearly enough to identify to species with any probability. There were also five sightings of five single unidentified marine mammals (Figure 33); none of them were seen clearly enough to identify to species with any probability.

One of the unidentified cetaceans appeared to respond to the survey aircraft by submerging under the surface.

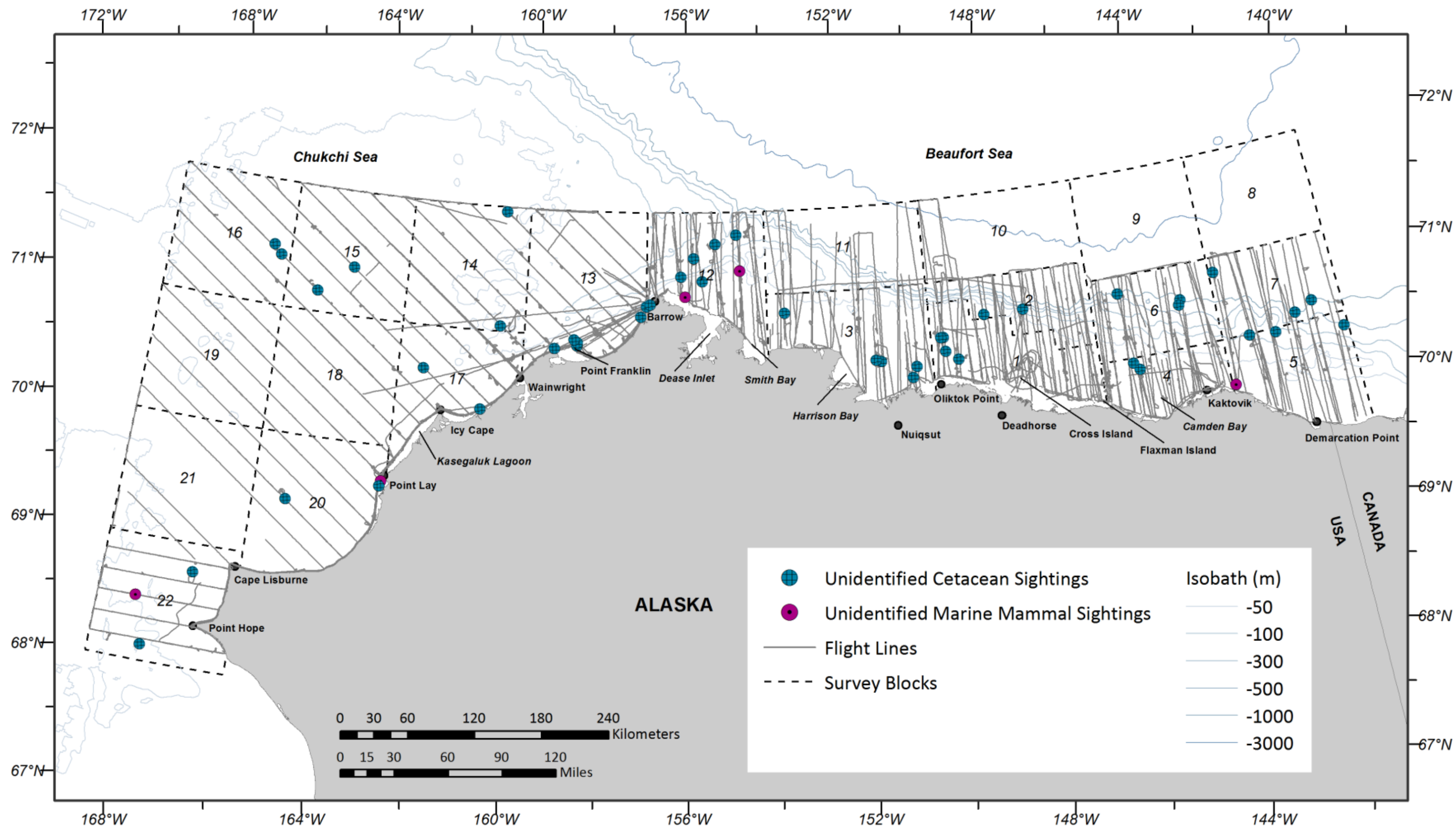


Figure 33. ASAMM 2013 unidentified cetacean and unidentified marine mammal sightings, with transect, search, and circling effort. Deadhead flight tracks are not shown.

Pinnipeds

Walruses

Pacific walruses (*Odobenus rosmarus divergens*) were observed in July, August, and September throughout the northeastern Chukchi Sea (Figure 34). Excluding dead walruses and walruses that were known to be duplicate sightings within the same day, there were 370 sightings of 33,392 walruses observed from July to September (Table 16). This total is artificially high because it includes resightings of a large, coastal walrus haulout near Point Lay. When only the highest group size estimate of the haulout is taken into account (1 sighting of 10,000 walruses) and resightings of the haulout are excluded, there were 367 sightings of 20,892 walruses in 2013. Excluding all sightings of the Point Lay haulout, most walruses (88%, n=9,545) were sighted in July and August, with the majority of sightings in the northeastern Chukchi Sea. Walruses were not seen in October, likely due to greatly reduced survey effort. A few walruses (5 sightings of 12 animals) were observed in the western Beaufort Sea from Point Barrow east to 151.8°W.

In July and August, when sea and shorefast ice were still present in the study area, walruses were either hauled out on ice (98% of July-August total walruses observed, 74 sightings of 9,308 walruses) or swimming in open water. Walruses hauled out on ice were in groups ranging in size from 1 animal to 800 animals. In early September, when sea ice had receded north and the study area was essentially ice-free (Appendix A), walruses were observed only in open water and were starting to congregate nearshore. On 12 September, the first aggregation of walruses to haulout on the northwestern Alaskan coastline during the 2013 field season was observed (Figure 35).

The haulout was located approximately 6 km northeast of Point Lay, Alaska, close to the location of walrus haulouts documented during ASAMM surveys in 2010 (Clarke et al. 2011d) and 2011 (Clarke et al. 2012). The aggregation was observed on three subsequent surveys in September (14, 22, and 27 September). Group size estimates ranged from 3,000 to 10,000 individuals. The haulout was last documented during an aerial survey on 27 September. Surveys were not conducted from 1-19 October due to the government shutdown; when surveys recommenced in late October, there was no opportunity to survey near Point Lay, so it was not possible to document when the haulout dispersed in 2013. In past years, haulouts on shore have dispersed by early October (Clarke et al. 2012); villagers at Point Lay confirmed that walruses were no longer present in late October 2013 (T. Fischbach, USGS, pers comm. to J. Clarke, 21 October 2013).

There were 522 walruses (representing 2% of all walruses sighted) that appeared to respond to the survey aircraft. Reactions included flushing from an ice floe into the water (481 walruses) and diving (31 walruses); type of response was not noted for 10 walruses. No walruses in the large coastal haulout appeared to respond to the survey aircraft.

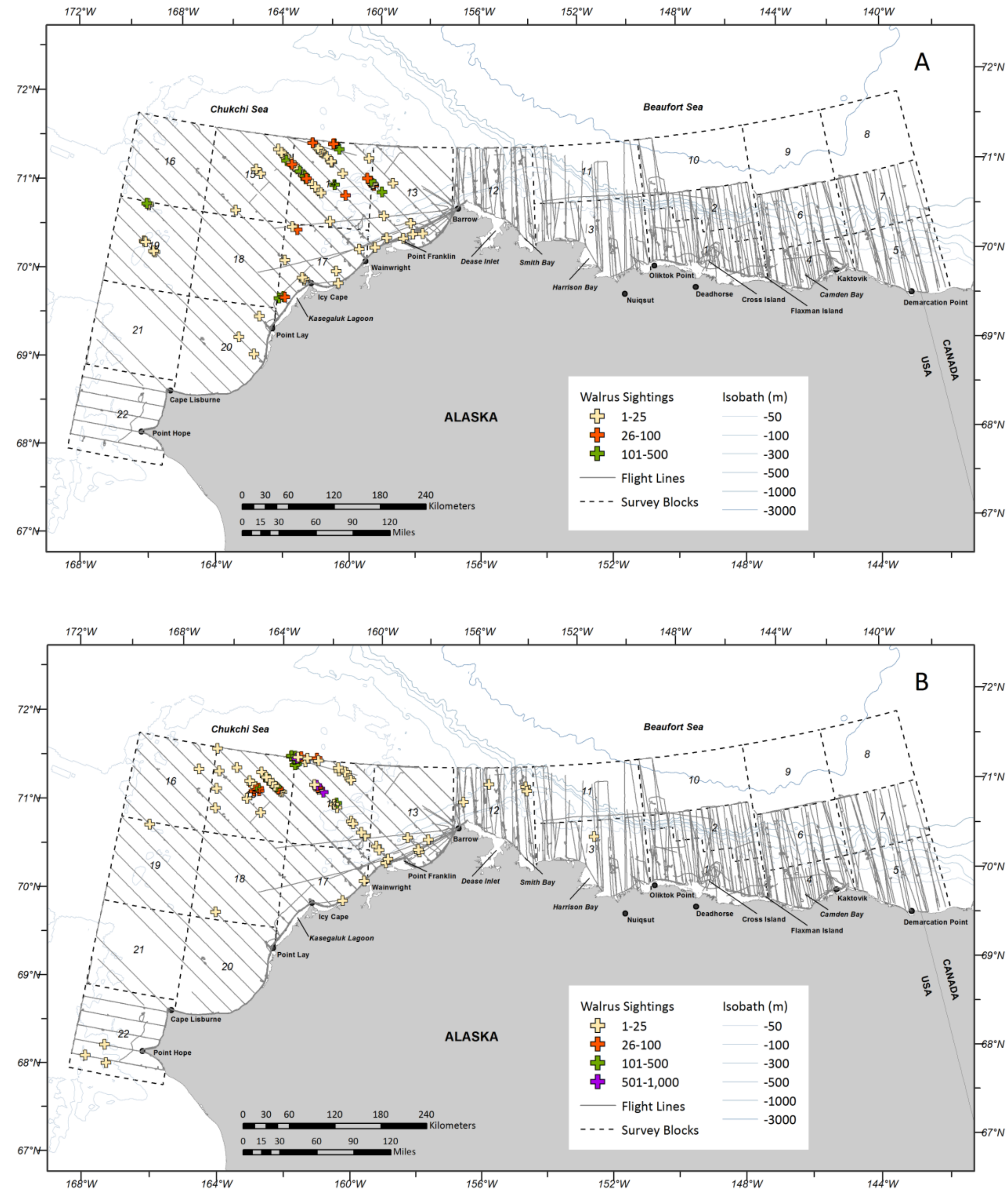


Figure 34. ASAMM 2013 walrus sightings plotted by month, with transect, search, and circling effort. Deadhead flight tracks are not shown. A: July; B: August.

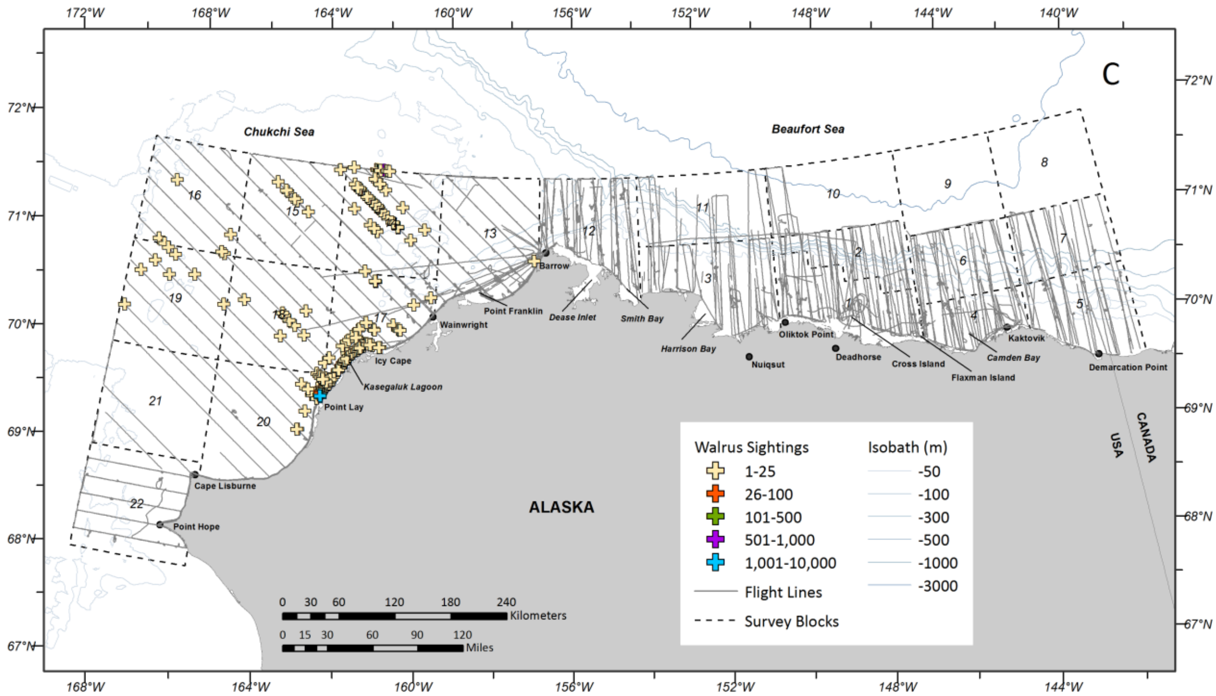


Figure 34 (cont.). ASAMM 2013 walrus sightings plotted by month, with transect, search, and circling effort. C: September.

Table 16. ASAMM 2013 walrus sightings observed during all survey modes (transect, search and circling).

	No. Sightings	No. Individuals
Dead*	9	9
Highest estimate of Point Lay haulout**	1	10,000
Total, including all sightings	379	33,401
Total, excluding dead & repeat sightings	370	33,392
Total, excluding dead, repeat, & additional Point Lay haulout sightings***	367	20,892

* May include duplicates of carcasses sighted on different survey dates.

** Highest group size estimate was observed on 9/27/2013.

*** Includes only the highest estimate of the Point Lay haulout.

Figure 35. Walrus haulout near Point Lay, Alaska, 12 Sepetmber 2013. Photo by Stan Churches (Clearwater Air) under U.S. Fish and Wildlife Permit No. MA212570.

Other Pinnipeds

Bearded seals (*Erignathus barbatus;* 79 sightings of 82 seals) were observed scattered throughout the ASAMM study area (Figure 36). One bearded seal was observed hauled out on sea ice in early July; all other bearded seals were observed in the water. Seven bearded seals (9%) appeared to respond to the survey aircraft by diving. There were five sightings of five single ringed seals (*Pusa hispida*) (Figure 36); none of the ringed seals appeared to respond to the aircraft.

Other pinnipeds were not identifiable to species and were recorded as unidentified pinnipeds (136 sightings of 152 animals) or small unidentified pinnipeds (879 sightings of 1,581 animals) (Figure 37). The unidentified pinniped categories included sightings of pinnipeds that could not be identified to species due to the short amount of time that the animal was visible and the altitude of the survey aircraft (>305 m). "Unidentified pinnipeds" likely included sightings of ringed, spotted (*Phoca largha*), and bearded seals, in addition to small walruses.   "Small unidentified pinnipeds" included sightings of small pinnipeds (ringed and spotted seals and possibly juvenile bearded seals) only. The distributions of ringed, spotted and bearded seals overlap in the western Beaufort Sea (Lowry et al. 1998; Boveng et al. 2009; Angliss and Allen 2009); behaviors and physical characteristics observable from the survey altitude of the ASAMM aircraft are not distinguishable enough to allow positive species identification (NMML, unpublished data; D. Rugh and D. Withrow, NMML-AFSC, pers. comm. to J. Clarke, 8

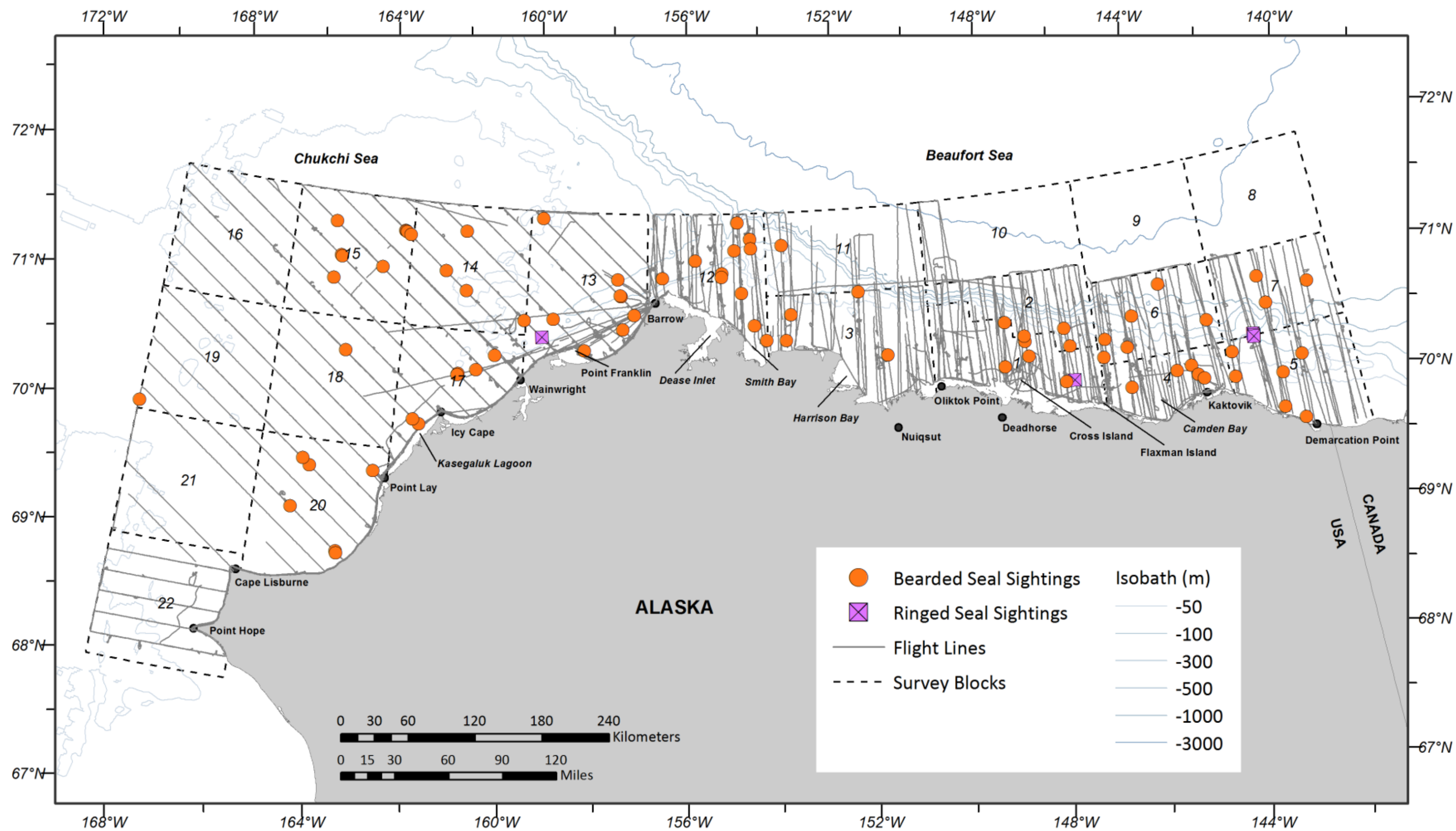


Figure 36. ASAMM 2013 bearded and ringed seal sightings, with transect, search, and circling effort. Deadhead flight tracks are not shown.

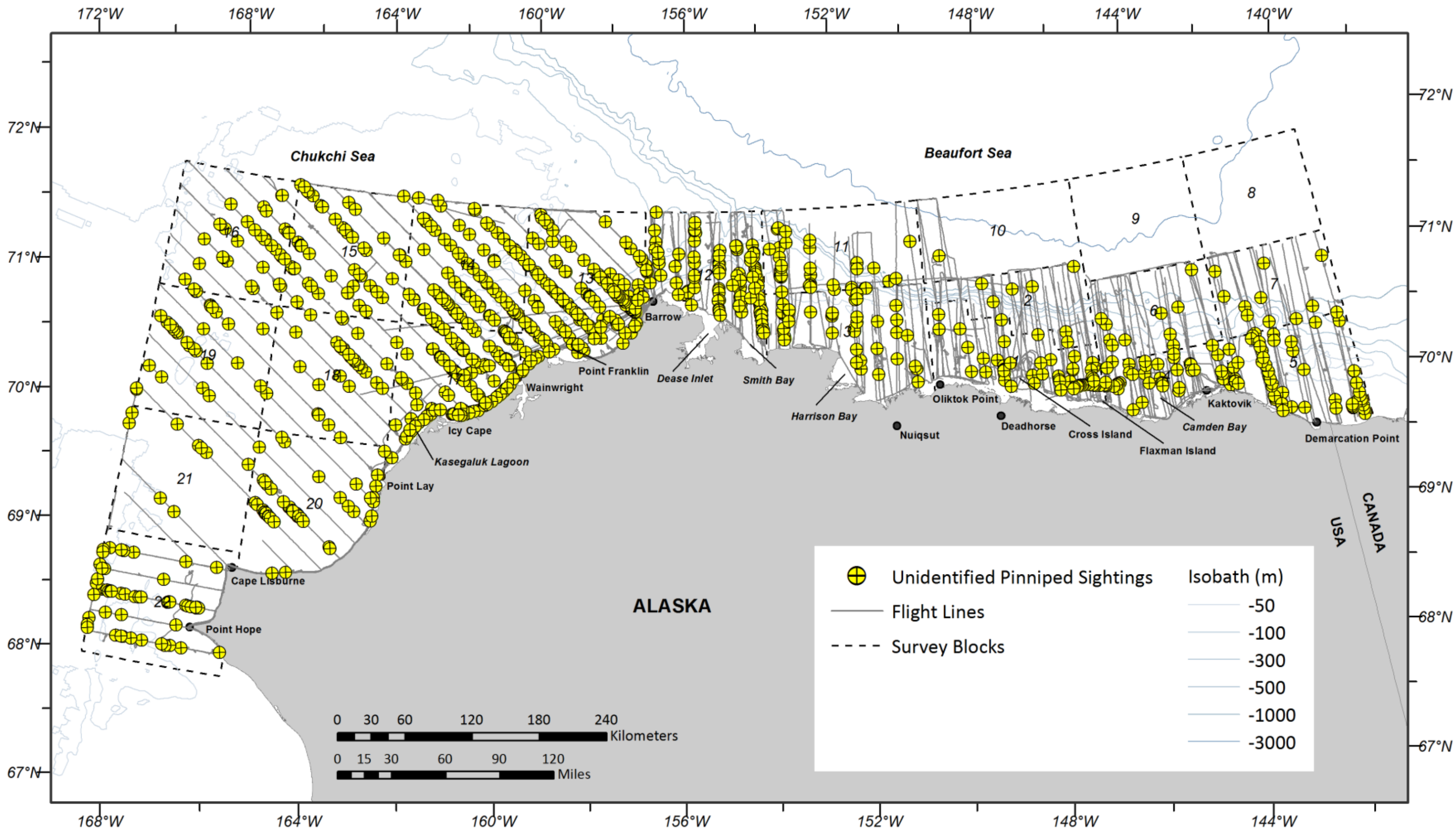


Figure 37. ASAMM 2013 unidentified pinniped sightings (including small unidentified pinniped sightings), with transect, search, and circling effort. Deadhead flight tracks are not shown.

December 2009). Pinnipeds were distributed throughout the extent of the study area, both on the continental shelf and in deeper areas of the continental slope. One hundred three unidentified and small unidentified pinnipeds (6%) appeared to respond to the aircraft by diving.

Polar Bears

There were 19 sightings of 42 polar bears (*Ursus maritimus*) during ASAMM 2013 (Figure 38). In the northeastern Chukchi Sea, three sightings of five polar bears were observed, all in September. On 11 September, one bear was sighted south of Barrow swimming within one km of the beach. On 12 September, a group of three polar bears was sighted walking on the beach east of Icy Cape. Also on 12 September, one bear was sighted southwest of Icy Cape swimming one km from the beach. All of the polar bears in the Chukchi Sea region were sighted during surveys of the coastal transect.

In the western Beaufort Sea, most polar bear sightings were nearshore. There were 12 sightings of 33 polar bears found onshore between Demarcation Point and Point Barrow. These sightings were concentrated in the following areas: between Demarcation Point and Kaktovik, on Bernard Spit near Kaktovik, between Cross Island and Oliktok Point, and between Harrison and Smith bays (Figure 39). There is no coastal transect in the Beaufort Sea, and transits to and from survey blocks were often on deadhead or over land. Therefore, there is less opportunity to observe polar bears along the Beaufort Sea coastline, where they would most likely be seen when the ice edge has receded offshore, than in the Chukchi Sea where a coastal transect is frequently flown. There were four bears sighted 61-96 km offshore in the western Beaufort Sea; all four bears were near broken floe sea ice. On 4 August, two bears were sighted 5 km from each other in an area with 75% ice cover. One of these bears was swimming; the other bear dove from an ice floe into the water. On 11 August, one bear was sighted swimming in an area with 20% sea ice. On 25 September, one bear was sighted in an area with 2% sea ice cover; this bear was resting on an ice floe.

More than half of the polar bears (64%, n=27) observed in 2013 were seen at two locations, Cross Island and near Kaktovik. These locations attract polar bears because bowhead whale carcasses from fall subsistence harvests are hauled there by villagers from Nuiqsut (who base from Cross Island), and Kaktovik, and the carcasses provide a source of food for polar bears. Bears were seen on Cross Island on four days: one bear on 16 September, three bears on 23 September, eight bears on 20 October, and four bears on 22 October. Some of these bears may have been repeat sightings. Eleven polar bears were seen near Kaktovik on 22 September.

Polar bears on land were observed resting, walking, and milling.

There was one polar bear cub sighted in 2013. This cub was sighted on 12 September with two other bears east of Icy Cape on the Chukchi Sea coast.

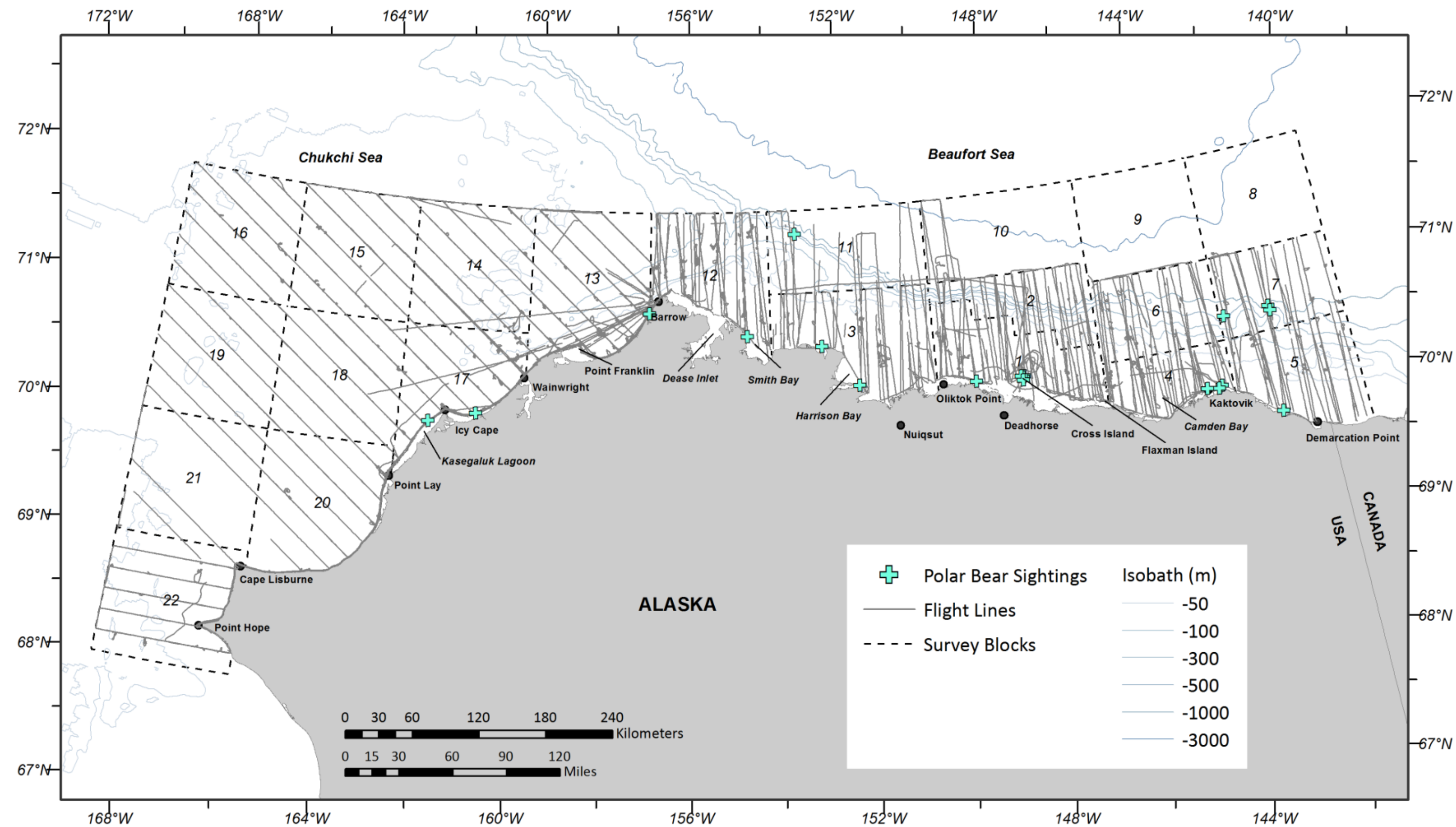


Figure 38. ASAMM 2013 polar bear sightings, with transect, search, and circling effort. Deadhead flight tracks are not shown.

The majority of bears (88%) sighted did not respond to the survey aircraft. Five bears (12%) did appear to react to the survey aircraft. Reactions included standing up from a sitting position (one bear), looking up at the aircraft (two bears), and diving from sea ice into the water (two bears).

Beginning in 2012, photographs were occasionally taken of polar bears on Cross Island and Bernard Spit near Kaktovik, and analyzed post-flight to count the total number of bears. In some of these instances, the final group size more than doubled the initial estimate once the photo analysis was completed. In 2013, there were few opportunities to photograph these locations due to inclement weather, survey priorities, and/or fuel limitations. Photographs were taken of Cross Island on one day in 2013, but post-flight analysis of the images did not change the number of bears initially sighted and recorded.

Dead Marine Mammals

There were 35 sightings of 35 dead marine mammals in 2013 (Table 17), although it is possible that some sightings were repeats of earlier observations. Half of the carcasses observed were cetaceans, including bowhead whales (six sightings of six animals), gray whales (three sightings of three animals), belugas (four sightings of four animals) and unidentified cetaceans (five sightings of five animals). Nine carcasses were walruses, five carcasses were unidentified pinnipeds, and three carcasses were in an advanced state of decomposition and were not identifiable beyond "marine mammal". Seventeen of the carcasses were observed in open water and 18 were on the beach.

Level A stranding forms were completed by field teams and forwarded to personnel at the North Slope Borough (NSB) Department of Wildlife Management (all sightings), NMFS (cetaceans and ice seals) and U.S. Fish and Wildlife Service (USFWS; walruses).

Table 17. ASAMM 2013 sightings of dead marine mammals, all survey modes (transect, search and circling).

Flight No.	Date	Latitude (°N)	Longitude (°W)	Species	No. Individuals	Habitat
214	1-Aug-13	70.593	160.623	walrus	1	open water
214	1-Aug-13	70.401	161.492	walrus	1	open water
214	1-Aug-13	68.689	168.950	gray whale	1	open water
214	1-Aug-13	68.682	168.380	walrus	1	open water
214	1-Aug-13	68.720	167.045	unidentified cetacean	1	open water
217	7-Aug-13	71.648	165.429	walrus	1	open water
217	7-Aug-13	71.221	156.978	walrus	1	beach
219	13-Aug-13	70.930	158.750	walrus	1	open water
219	13-Aug-13	70.872	159.203	beluga	1	beach
219	13-Aug-13	70.826	159.484	small unidentified marine mammal	1	beach
219	13-Aug-13	70.541	160.266	beluga	1	beach
219	13-Aug-13	69.186	163.469	beluga	1	beach
219	13-Aug-13	68.279	166.253	beluga	1	beach
219	13-Aug-13	68.259	166.183	walrus	1	beach
219	13-Aug-13	68.244	166.142	unidentified pinniped	1	beach
222	20-Aug-13	71.195	156.997	walrus	1	beach
222	20-Aug-13	71.247	156.885	unidentified pinniped	1	beach
223	21-Aug-13	70.943	161.816	walrus	1	open water
20	26-Aug-13	70.795	142.774	small unidentified marine mammal	1	open water
229	30-Aug-13	70.785	163.643	unidentified cetacean	1	open water
22	30-Aug-13	71.380	156.942	small unidentified cetacean	1	open water
231	1-Sep-13	69.946	162.784	unidentified pinniped	1	beach
231	1-Sep-13	70.082	162.569	unidentified pinniped	1	beach
231	1-Sep-13	70.180	162.398	unidentified pinniped	1	beach
235	11-Sep-13	71.172	162.642	bowhead whale	1	open water
237	14-Sep-13	68.414	166.419	gray whale	1	beach
29	16-Sep-13	70.605	147.825	bowhead whale	1	open water
239	19-Sep-13	68.417	166.421	gray whale	1	beach
239	19-Sep-13	70.486	160.431	bowhead whale	1	beach
242	24-Sep-13	70.873	157.765	bowhead whale	1	beach
243	25-Sep-13	70.591	162.922	unidentified cetacean	1	open water
33	25-Sep-13	70.635	142.160	small unidentified marine mammal	1	open water
244	26-Sep-13	70.878	159.103	bowhead whale	1	beach
247	30-Sep-13	71.623	167.994	bowhead whale	1	open water
254	28-Oct-13	71.543	157.581	unidentified cetacean	1	open water

Accomplishments

ASAMM incorporated walrus reconnaissance surveys into survey effort in mid-July to assist with USGS satellite tagging efforts.

Data from ASAMM 2013 were shared throughout the field season with researchers and interested parties within BOEM and other agencies:

- Daily reports of flight and sighting information were posted to the ASAMM project website (USDOC, NOAA, NMFS, AFSC 2013).
- Ice data, including photos of representative sea ice cover, were sent to the National Weather Service Ice Desk, Alaska Center for Climate Assessment and Policy, NOAA National Ocean Service, U.S. Coast Guard (USCG), USFWS, University of Alaska Fairbanks (UAF), Pacific Marine Environmental Laboratory (PMEL), Shell, and BOEM.
- Biweekly effort and sighting summary figures were sent to BOEM, NMML, PMEL, NSB and the USCG to provide an overview of data collected.
- Biweekly walrus sighting figures showing distribution and group size were sent to researchers at BOEM, USFWS, USGS, Alaska Department of Fish and Game (ADFG), NSB, Shell, and the Alaska SeaLife Center.
- Biweekly polar bear sighting figures were sent to BOEM, USFWS, USGS, ADFG and NSB.
- Cetacean sighting data were shared with UAF and Woods Hole Oceanographic Institution (WHOI) to assist with underwater glider research.
- Sightings of open ocean drifting oceanographic buoys were shared with institutions that deployed them.
- All Level A stranding forms (35 total forms) were sent to the relevant agencies: NMFS and NSB received forms for cetaceans and ice seals, and USFWS and NSB received forms for walruses.

Community outreach in 2013 included:

- Met with the North Slope Borough Search and Rescue to familiarize them with our project.
- Sent the Deadhorse and Kaktovik Whaling Communications Centers emails with flight plans prior to and after every survey flight that occurred in the Beaufort Sea.
- Pre-season and in-season communication with Principal Investigators of unmanned aircraft projects operating in the study area to minimize risk to both projects.
- Posted daily reports to the NMML website within ~24-48 hrs after completion of each ASAMM flight.

Marine mammal photos taken by ASAMM personnel in 2013 were shared with interested parties in the federal government, media and non-governmental organizations, including NOAA, BOEM, NSB, and World Wildlife Fund. Media efforts were coordinated through NOAA and BOEM Public Affairs Offices.

ASAMM provided subsets of the 1982-2012 database to several research groups planning or conducting various studies in, or near, the ASAMM study area. These groups included, but were not limited to: BOEM, NMFS Alaska Regional Office, PMEL, NMFS Protected Resources

Division, USFWS, UAF, World Wildlife Fund, University of Texas, NSB, Greeneridge Sciences, the University of Washington Applied Physics Laboratory, and the USCG.

Results from the 2013 ASAMM field season were presented at several venues, including:

Brower, A. 2013. Gray Whale Calf Occurrence in the Alaskan Arctic, Summer and Fall 2013, with Comparisons to Previous Years. Alaska Fisheries Science Center Quarterly Report October-November-December.

Brower, A., M. Ferguson, C. Christman, and J. Clarke. 2014. Gray whale calf occurrence in the Alaskan Arctic, summer and fall 2013, with comparisons to previous years. Poster presented at the Alaska Marine Science Symposium, Anchorage, AK, 20-24 January.

Brower, A., J. Clarke , M. Ferguson, and C. Christman. 2014. Gray whale foraging habits in the Alaskan Arctic, summer and fall 2009-2013. Poster presented at the Alaska Marine Science Symposium, Anchorage, AK, 20-24 January.

Christman, C., A. Brower, J. Clarke, and M. Ferguson. 2014. Pacific walrus (*Odobenus rosmarus divergens*) haulouts along the northwestern Alaskan coastline, summer and fall 2009-2013. Poster presented at the Alaska Marine Science Symposium, Anchorage, AK, 20-24 January.

Clarke, J., M. Ferguson, C. Christman, A. Brower, and V. Beaver. 2014. Why one year is never enough: comparison of bowhead whale (*Balaena mysticetus*) distribution, relative density, habitat use and behavior in the western Beaufort Sea in July-August, 2012 and 2013. Poster presented at the Alaska Marine Science Symposium, Anchorage, AK, 20-24 January.

Ferguson, M.C., J.T. Clarke, A.A. Brower, and C.L. Christman. 2014. Modeling Western Arctic bowhead whale high-use areas in the Western Beaufort Sea, 2000-2012. Poster presented at the Alaska Marine Science Symposium, Anchorage, AK, 20-24 January.

Kuletz, K., M. Ferguson, A. Gall, B. Hurley, E. Labunski, T. Morgan, and R. Day. 2014. Seasonal and spatial patterns of marine-bird and -mammal distributions in the Pacific Arctic: a delineation of biologically important marine areas. Presentation at the Alaska Marine Science Symposium, Anchorage, AK, 20-24 January.

Kuletz, K., M. Ferguson, A. Gall, B. Hurley, E. Labunski, T. Morgan, and R. Day. 2014. Seasonal and spatial patterns of marine bird and mammal distributions in the Pacific Arctic. Poster presented at the Bering Sea Open Science Meeting, Honolulu, HI, 22-23 February.

Okkonen, S.R., C.A. Ashjian, R.G. Campbell, K.M. Stafford, and J.T. Clarke. 2014. Variability of late summer oceanographic conditions in Barrow Canyon. Presentation at the Ocean Sciences Meeting, Chukchi Sea Region: Physical Forcing and Ecosystem Response in the Pacific Arctic, Honolulu, HI, 23-28 February.

Stafford, K.M., J.T. Clarke, and S.E. Moore. 2014. Acoustic and visual detections of sub-arctic cetaceans in the southern Chukchi Sea-Bering Strait region, 2009-2012. Presentation at the Ocean Sciences Meeting, Chukchi Sea Region: Physical Forcing and Ecosystem Response in the Pacific Arctic, Honolulu, HI, 23-28 February.

A complete listing of publications, posters and oral presentations from the ASAMM project (and its precursors BWASP and COMIDA) from 2008-2013 is included in Appendix C. Also included are PDF copies of 2013 media reports related to ASAMM.

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DISCUSSION

Conclusions

Sea ice conditions in 2013 were similar to conditions observed in most recent years. Sea ice remained in the study area through mid- to late August before receding north of 72°N. Environmental conditions related to large expanses of relatively warm water overlaid by colder air temperatures include low cloud ceilings, fog, and high sea states. These conditions were often encountered in 2013 and adversely affected survey effort, particularly in late July in the northeastern Chukchi Sea and early August throughout the ASAMM study area.

The greater impact to survey effort in 2013, however, was the partial government shutdown that occurred from 1-17 October. ASAMM field teams were instructed on 1 October to cease operations and demobilize from the field. When the partial government shutdown ended on 17 October, ASAMM quickly mobilized a team and returned to the field on 19 October, with a successful survey on 20 October. ASAMM surveys commenced in 1979 and were conducted every year for 34 years during the first half of October; 2013 will be the first year without data during this critical time period. This gap in survey effort will impact analyses of the ASAMM database from here forward. In recent years, early October has been the time period when the greatest proportion of bowhead whales migrate through Chukchi Sea lease areas, the largest bowhead whale feeding aggregations have occurred east and southeast of Barrow, walrus haulouts on shore break up, and gray whales depart the nearshore area between Point Franklin and Barrow. When ASAMM returned to conduct surveys in late October 2013 after the shutdown ended, bowhead whales were not observed in the Chukchi Sea nor seen in large feeding aggregations, gray whales were nearly non-existent, and walruses had departed the haulout. We can only speculate when or if these events occurred in early October 2013.

Broad-scale aerial surveys were conducted regularly in the western Beaufort Sea in summer months (mid-July to August) in 2013 for the second consecutive year. Bowhead whale distributions in July (on the outer continental slope and shelf; 51-200 m depth) and August (on the inner and outer continental shelf; 0-200 m depth) 2013 were similar to those observed in summer 2012 (Clarke et al. 2013a), but the total number of animals observed was far higher in 2013 (Figure 39). The higher number of whales sighted may have been due to fewer feeding opportunities in the Canadian Beaufort Sea. There are four to five recurrent bowhead whale feeding areas in the Canadian Beaufort Sea (Harwood and Smith 2002), and the shallow shelf offshore of the Tuktoyaktuk Peninsula and Cape Bathurst is one of the areas used most consistently (Harwood et al. 2010). In this area, strong upwelling may occur wherein Pacific-derived, cold, nutrient rich water from Amundsen Gulf is carried onto the Canadian Beaufort Shelf (Walkusz et al. 2012). Upwelling is strongest when a northward-flowing current converges near Cape Bathurst (Williams and Carmack 2008), conditions that concentrate bowhead whale prey. In 2013, dispersed sea ice remained present near Cape Bathurst until early September (U.S. National Ice Center 2013), which suggests that the northward-flowing current, and associated upwelling winds, were relatively weak in July and August. One-third of the bowhead whales observed by ASAMM in the western Beaufort Sea in summer 2013 were feeding or milling, suggesting that some bowhead whales left the Canadian Beaufort in summer

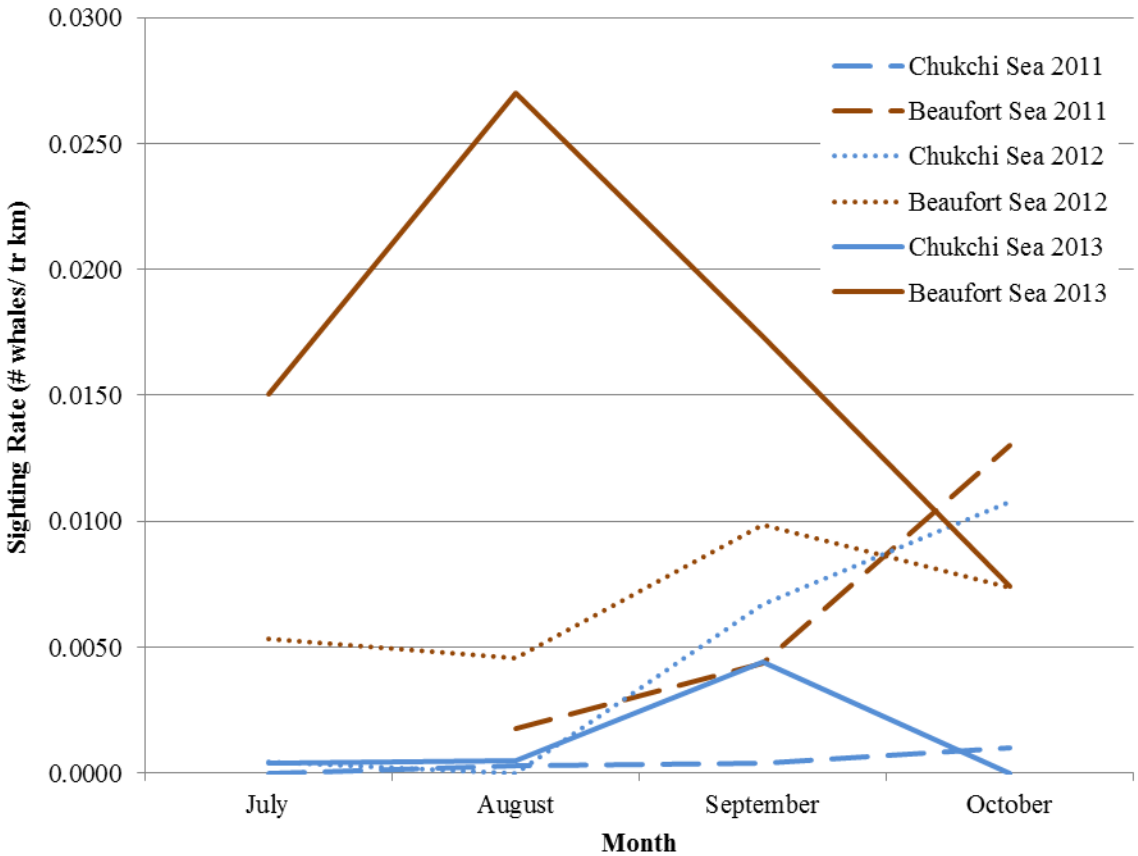


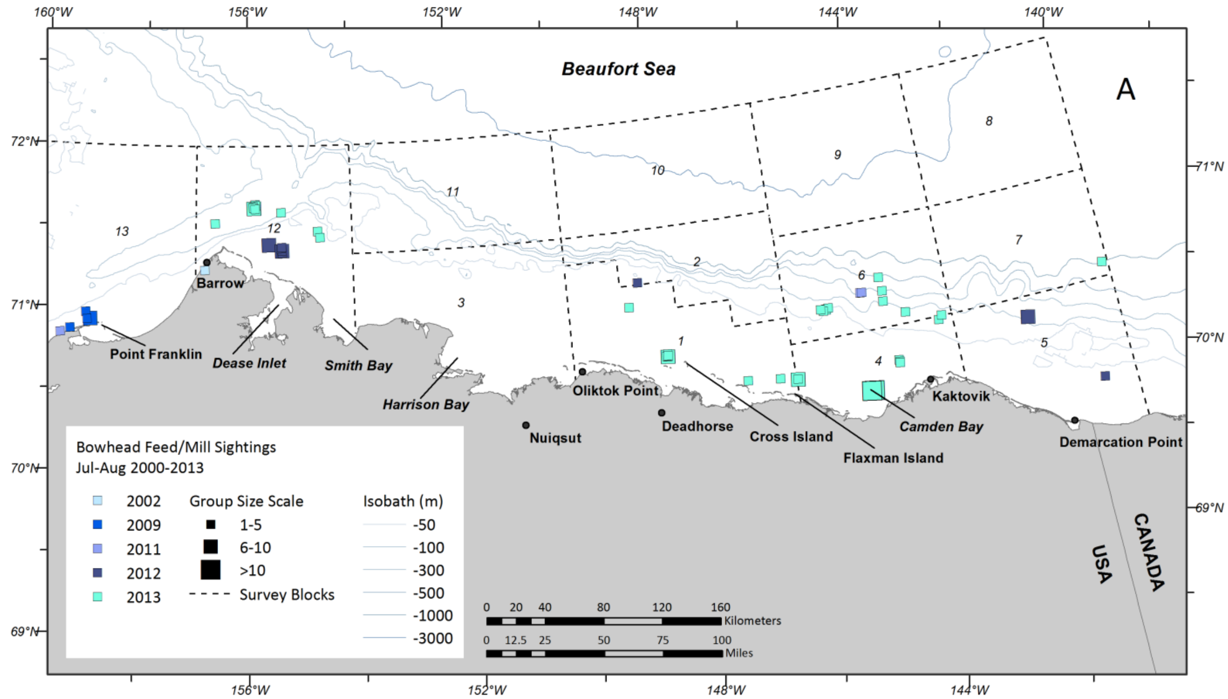
Figure 39. ASAMM monthly sighting rates (WPUE) of bowhead whales on transect (made by primary observers only) in the northeastern Chukchi and western Beaufort seas, 2011, 2012, and 2013.

to search for feeding opportunities elsewhere. Bowhead whale swim directions were not clustered around any particular heading in summer 2013, indicating a lack of directed movement or migration, and satellite tag data has suggested that some bowhead whales actively travel back and forth between the Canadian and Alaskan Beaufort Sea in summer (Quakenbush et al. 2012).

Bowhead whales have been observed feeding in the western Beaufort Sea, and occasionally in the northeastern Chukchi Sea, during summer in recent years (Figure 40), primarily at water depths ≤50 m with some whales sighted in deeper water (100-500 m). Bowhead whales observed in deeper waters offshore in the eastern Alaskan Beaufort Sea in July and August may be feeding on large copepods that have been found in the colder, more saline water of the outer shelf (Griffiths and Thomson 2002). These larger copepods (including *Calanus glacialis* and *C. hyperboreus*) may descend to overwintering depths (>100 m) in fall, and therefore not be as available to bowhead whales in offshore areas of the eastern Alaskan Beaufort Sea. In fall, feeding behavior is often observed in the western Beaufort Sea within the 50 m isobath (e.g., Ljungblad et al. 1987; Landino et al. 1994; Clarke et al. 2011c, 2013a) (Figure 40). With the exception of the western Alaskan Beaufort Sea (154°W to 157°W), however, feeding opportunities appear to be short-lived, ephemeral and transient, and show both intra- and inter-year variability. Feeding behavior is often detected in a particular area just one time, both within and between years, despite repeated surveying of the area. For example, in 2013, feeding behavior was observed in blocks 1 and 4 on one day in fall (13 September 2013) despite several surveys of those blocks. Bowhead whale feeding studies conducted in the eastern Alaskan Beaufort Sea (140°W-145°W) in the mid-1980s and late 1990s (Richardson and Thomson 2002) documented bowhead whale feeding in that area only three of the five years that the study was conducted. The widespread distribution of observed bowhead whale feeding in the western Beaufort Sea, combined with the apparent transient nature of those feeding opportunities, may indicate that opportunistic bowhead whale feeding in the western Beaufort Sea occurs much more often than currently documented via aerial surveys. Highest zooplankton biomass is often lower in surface waters (generally warmer and fresher) than in samples taken at depth (colder and more saline) (Griffiths and Thomson, 2002), and bowhead whale feeding in mid-water or near the bottom is especially difficult to detect during aerial surveys. Evidence for bowhead whale feeding in the western Beaufort Sea was also provided from stomach samples collected from bowhead whales harvested from 1979-2000 during subsistence hunts based at Kaktovik, Cross Island (Nuiqsut whalers), and Barrow (Lowry et al. 2004). Lowry et al. (2004) found that over 70% of bowhead whales harvested during the fall subsistence hunt were considered to have been feeding, based on stomach content analysis. Whales taken during fall whaling have presumably been feeding in the eastern, central, and western Beaufort Sea.

Large groups of feeding bowhead whales were observed in block 12 (154°W to 157°W) in fall 2013, similar to other years (Figure 40). This area is a well-documented bowhead whale feeding ground (Moore and Reeves 1993; Mocklin et al. 2011) and the site of the BOEM-sponsored Bowhead Whale Feeding Ecology Study (BOWFEST 2007-2011). Results from BOWFEST indicate that krill are advected onto the Beaufort Sea shelf from the Beaufort Sea slope during sustained winds from the east or southeast, or possibly from Barrow Canyon during sustained winds from the north or northeast. This causes the wind-driven, northwestward-flowing shelf current to carry krill toward Barrow (Ashjian et al. 2010). When winds weaken or change to blow from the south, the northeastward-flowing Alaska Coastal Current moves adjacent to the southern edge of Barrow Canyon, thereby blocking the off-shelf movement of krill. This phenomenon results in the aggregation of krill at the western end of the Beaufort shelf near Barrow. The oceanographic response to the sequence of upwelling-favorable winds followed by weak or southerly winds produces conditions conducive to energetically efficient feeding by bowhead whales.

Spatial modeling of bowhead whale HUAs from data collected since 2000, when signs of a regime shift in the Arctic first became apparent (Maslanik et al. 2011; Kortsch et al. 2012; Overland et al. 2013), showed clear monthly differences in bowhead whale habitat use across the western Beaufort Sea from July through October. July and August data were primarily collected in 2012 and 2013 due to lack of summer surveys in recent years. In July, the HUAs were located over the outer continental shelf, the farthest offshore of the four months examined. The HUAs in August had the broadest latitudinal distribution, encompassing the offshore distribution of bowhead whales in August 2012 and the nearshore distribution in 2013. The August HUAs were closer to shore in the western and central Alaskan Beaufort Sea compared to the eastern Alaskan Beaufort Sea. Although the August HUA analysis was predominantly based on data from 2012-2013, it reinforces the patterns described by Moore et al. (1989) for data collected during



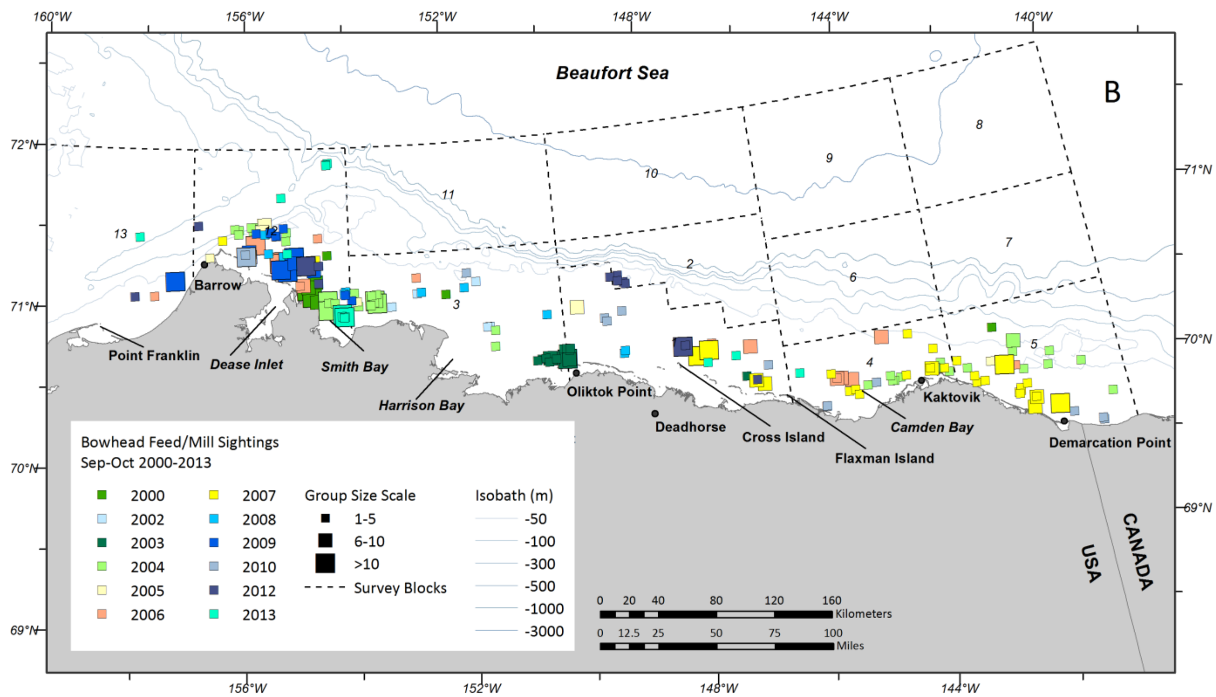


Figure 40. ASAMM 2000-2013 bowhead whale feeding and milling sightings, by group size, all survey modes (transect, search, and circling), summer (July-August) (A) and fall (September-October) (B). There were no feeding or milling sightings in 2001 and 2011.

aerial surveys conducted in 1979-1986. The spatial patterns in relative abundance in September were similar to those for October, with the highest predicted values located east of Kaktovik, between Deadhorse and Flaxman Island, and in the vicinity of Barrow Canyon in the western Alaskan Beaufort Sea. Relative abundance predictions from the spatial model built on only 2013 data from September and October (both months pooled) retained the high density areas east of Kaktovik and between Deadhorse and Flaxman Island, but the high density area in the far western Beaufort Sea followed the bathymetry of Barrow Canyon more closely than the model based on the 14-year time series. In addition, the predictions from the 2013 model suggested that the HUAs were farther offshore in both the eastern and western Alaskan Beaufort sea in 2013 compared to the most recent 14 years.

Bowhead whale distribution in the northeastern Chukchi Sea in summer 2013 was similar to that observed in past years, exemplified by relatively few scattered sightings, mainly nearshore. Sightings in September 2013 were reminiscent of September 2012, with respect to distribution and the increased sighting rate compared to summer months. Sighting rates in September 2013 in the northeastern Chukchi Sea were lower than those observed in 2012 but higher than 2011 (Figure 39), although transect survey effort was similar in 2011, 2012, and 2013. Distribution and sighting rates in October 2013 are not a good indication of bowhead occurrence in either the Beaufort or Chukchi seas. For example, the lack of survey effort in October 2013 in the Chukchi Sea due to the partial government shutdown and poor survey conditions made it impossible to determine if bowhead whales were along the southern margin of Hanna Shoal in block 14, where they had been frequently observed in October 2012.

Several bowhead whale calves were observed in the western Alaskan Beaufort Sea (140°W-147°W) in summer for the second straight year. Koski and Miller (2009) reported on bowhead whale size segregation in the central Beaufort Sea (139°W to 146°W, shore to 71°N) from photographic data collected from mid-August through early October, 1982-2000, in which small subadult whales were present in their study area from late August through September, and large subadults and cows with calves were most common in early September. Whalers from Kaktovik also report some segregation of age classes during the fall migration, with bowhead whale cow-calf pairs passing by the village later than subadult whales (Braham et al. 1984). However, bowhead whale calves were seen during aerial surveys conducted in the western Beaufort Sea in August 1982-1985 (Clarke et al. 1987). Bowhead whale cow-calf pairs may be regular visitors to the western Beaufort Sea in July and August, and not detected previously due to the relative lack of survey effort and the whales' distribution farther offshore during this time period. Bowhead whale calf occurrence in the western Beaufort Sea in summer 2013 may also reflect annual variation, as suggested by Koski and Miller (2009).

Bowhead whale calf ratios in fall were the highest since ASAMM surveys started in 1979. Calves were sighted in September nearshore between Kaktovik and Barrow, offshore in Barrow Canyon and scattered in the northeastern Chukchi Sea. In late October, four calves were seen in Barrow Canyon. The relatively high recruitment rate observed in 2013 may be tied to the overall apparently good condition of the Western Arctic bowhead whale stock (George et al. 2014), as determined from analyses of bowhead whales harvested by Inupiat whalers.

Gray whale distribution in 2013 was similar to that seen in recent years (2008-2012), although relative abundance was lower. Gray whale use of the northeastern Chukchi Sea is likely closely associated with prey availability including, but not limited to, benthic amphipods. The primary behavior observed of gray whales in the ASAMM study area was feeding, more specifically benthic feeding because non-benthic feeding is difficult to detect via aerial surveys. Intense feeding in local areas, for example, between Barrow Canyon and the adjacent Alaskan shoreline, in early summer may reduce the density of available gray whale prey. Unlike amphipods in temperate areas, high latitude amphipods tend to have slow maturation and low growth rates, long generation times, and low production to biomass ratios (Highsmith and Coyle 1992). If amphipod patches are depleted locally due to gray whale feeding in early summer, gray whales may disperse to additional feeding areas in late summer and fall to take advantage of higher density prey patches elsewhere. Gray whales are opportunistic foragers (Dunham and Duffus 2002; Newell and Cowles 2006; Moore et al. 2007; Feyrer and Duffus 2011). Bluhm et al. (2007) found gray whales in the southern Chukchi Sea concentrated at frontal systems that had high densities of clams, epibenthic megafauna, pelagic crustaceans and Arctic cod (*Boreogadus saida*). Inter- and intra-annual variation in gray whale distribution may be influenced by the relative availability of several prey types, which are in turn dependent on oceanographic phenomena that may vary annually.

The ratio of gray whale calves to total gray whales was the highest ever recorded during ASAMM. July remained the month when most calves were seen. Weaning likely takes place in late summer or early fall (Sumich, 1986); therefore, all gray whales identified as calves or yearlings, based on significantly smaller size and close association with an adult, were likely calves of the year. It is also possible that small gray whales seen in late August or September that were not closely associated with an adult may have been calves of the year that had already been weaned, but were not identified as such and not included in the calf count. Gray whales, including calves, can be individually identified through photographic identification research that is nearly always conducted from vessels (e.g., Calambokidis et al. 2002; Bradford et al. 2011), but identification during systematic aerial surveys is difficult particularly when photographs are not regularly collected. Although some of the calves seen in 2013 were undoubtedly resighted on more than one day, results of annual gray whale calf counts conducted by the NMFS Southwest Fisheries Science Center at Piedras Blancas, California, in late winter-early spring 2013 also suggest that 2013 was a relatively good year for gray whale calves (USDOC, NOAA, NMFS, SWFSC, 2013).

One almost certain resight of a gray whale cow-calf pair, consisting of a nearly completely white adult and normally pigmented calf, over a two-week time period illustrates the range of movement that gray whales may undergo on arctic feeding grounds: the pair moved more than 230 km between Point Lay and Point Franklin. Investigations into gray whale movements on the northeastern Chukchi Sea feeding grounds via satellite tagged whales have also shown substantial movement over relatively short periods of time (ADFG, unpublished data), although some tagged gray whales have remained very near to their tag deployment locations for up to 45 days (Friday et al. 2013; A. Kennedy, NMML, pers comm. to J. Clarke, 16 January 2014). Gray whale movements are probably related to the availability and density of gray whale prey patches.

Gray whale calf occurrence in the northeastern Chukchi Sea has been inconsistent among years. In the 16 years that aerial surveys have been conducted with some regularity (1982-1991, 2008-2013), gray whale calves have been seen in 11 of those years and sightings of more than one gray whale calf per year were recorded in only 6 of the 16 years (Clarke et al. 1989, 2012, 2013a). Maher (1960) noted that several gray whales taken by hunters in the 1950s from the villages of Wainwright and Barrow were calves of the previous winter, so the importance of the northeastern Chukchi Sea to gray whale calves has likely persevered for several decades.

Beluga distribution in the western Beaufort Sea was primarily over the continental slope, regardless of season. Belugas were once again relatively scarce in the ASAMM study area in fall, with the exception of Barrow Canyon, similar to observations from 2007-2010 and 2012 (Clarke et al. 2011a, 2011b, 2011c, 2011d, 2013a). The lack of belugas in the study area in fall may be due to the timing of the migration relative to when ASAMM surveys are conducted. Data from two passive acoustic recorders located in the northeastern Chukchi Sea, offshore of Icy Cape, Alaska (the "inshore" recorder was ~64 km from shore, and the "offshore" recorder was ~193 km from shore), from September 2010 to June 2011, detected only sporadic beluga vocalizations during the fall prior to a strong peak in late November on the inshore recorder and a weak peak in late November on the offshore recorder (Garland et al. 2013). Alternatively, or in conjunction, the absence of beluga sightings may reflect a migration that occurs farther north than the ASAMM (or any other project with marine mammal observers) study area. Satellite tag data from both the eastern Chukchi Sea and Beaufort Sea beluga stocks indicate that belugas venture much farther north than 72°N (Richard et al. 2001; Suydam et al. 2001). Moore et al. (2012) reported beluga calls recorded from May through August 2009 on a passive acoustic recorder moored on the Chukchi Plateau (75.1°N, 168°W), more than 340 km north of the ASAMM study area. Surveys conducted in the late 1980s and early 1990s also suggested that beluga distribution in the Chukchi Sea is bifurcated, with some belugas heading through Barrow Canyon and continuing southwesterly while others head west-northwest toward the Chukotka coast before heading south (Clarke et al. 1993). Beluga occurrence in Barrow Canyon may be related to the relatively high densities of Arctic cod and other benthic and pelagic fish (Logerwell et al. 2011; Sousa et al. 2014) that comprise beluga diet.

Marine mammal data collected during the 2013 ASAMM field effort is vital in contributing to the overall understanding of marine mammal ecosystems in the northeastern Chukchi and western Beaufort seas. In addition to continuing to document bowhead whale, gray whale and beluga distribution, relative abundance, and habitat during summer and fall, important information was also obtained in 2013 relating to unique situations and other species.

Humpback, fin, and minke whales were once again observed in the northeastern Chukchi Sea. Unlike past years, all sightings were south of 70.5°N and all sightings occurred in July and August. These species seasonally inhabit arctic and subarctic habitats (Higdon and Ferguson 2011; Laidre and Heide-Jørgensen 2012; Clarke et al. 2013b). Humpback whales are occasionally observed in the northeastern Chukchi Sea (Hashagen et al. 2009; Clarke et al. 2011d, 2013a), but their occurrence is not regular or frequent. Twenty-nine humpback whales were seen during ASAMM surveys in 2012, although most sightings (24 whales) were south and west of Point Hope (Clarke et al. 2013a, 2013b). One humpback whale was seen west of Barrow in summer 2012 during oceanographic surveys conducted by the oil industry (L. Aerts, LAMA

Ecological, pers. comm. to J. Clarke, 12 April 2013). Two humpback whales were seen in the northeastern Chukchi Sea by industry observers in fall 2013 (Smultea et al. 2014). Humpback whales have been frequently encountered since 2009 in the southern Chukchi Sea (from the Bering Strait to 69°N) (Clarke et al. 2013b), which may be due to increased research in the area, population recovery from commercial whaling and/or responses to oceanographic changes.

Fin whales occur regularly in the northern Bering Sea (Moore et al. 2002) and have been documented every year since 2010 in the southern Chukchi Sea (from the Bering Strait to 69°N) (Clarke et al. 2013b), but their occurrence in the northeastern Chukchi Sea is not well documented. Prior to the sighting in block 20 in 2013, one fin whale had been seen in the northeastern Chukchi Sea during ASAMM, in July 2008 east of Point Lay (Clarke et al. 2011d). One fin whale was seen in the northeastern Chukchi Sea during vessel-based oceanographic surveys conducted by the oil industry in July 2013 (L. Aerts, LAMA Ecological, pers comm. to J. Clarke, 10 February 2014).

Minke whales were seen exclusively in very shallow nearshore waters in 2013, including in Ledyard Bay, where they were previously documented in 2011 and 2012. This is the third consecutive year that ASAMM has documented minke whales in the northeastern Chukchi Sea (Clarke et al. 2012, 2013a). Minke whales were also sighted in summer 2009, summer and fall 2012, and fall 2013 in the northeastern Chukchi Sea during marine mammal aerial surveys and vessel-based oceanographic surveys conducted by the oil industry (Brueggeman 2010; Bisson et al. 2013; Smultea et al. 2014; L. Aerts, LAMA Ecological, pers. comm. to J. Clarke, 12 April 2013 and 10 February 2014). Dave Roseneau, of the U.S. Fish and Wildlife Service (USFWS), reported seeing one to three minke whales per year near Cape Lisburne from 1995-2009 (pers. comm. to J. Denton, BOEM, 15 October 2010). Minke whales were encountered from 2010-2012 during surveys conducted in the southern Chukchi Sea (from the Bering Strait to 69°N) (Clarke et al. 2013b), although less frequently than either humpback or fin whales.

Humpback, fin and minke whales were not sighted in the northeastern Chukchi Sea study area during aerial surveys conducted in 1982-1991 (Moore and Clarke 1992). Continued sightings of these species in the northeastern Chukchi Sea by ASAMM and other researchers reinforce the possibility of species expanding (or perhaps re-inhabiting) their range in the Arctic. The annual occurrence of humpback, fin and minke whales in the ASAMM study area underscores the importance of carefully investigating and documenting all cetacean sightings to confirm species verification.

The coastal walrus haulout near Point Lay formed in mid-September, considerably later than in 2011 when coastal haulout formation occurred in mid-August. Sea ice near Hanna Shoal persisted into late August 2013 and ice movement towards deeper water undoubtedly was a catalyst to the haulout formation. Group size at the haulout was dynamic between 12 September (first haulout observation) and 26 September (last haulout observation). ASAMM has collaborated with USGS and USFWS biologists since 2009 to monitor coastal haulout size and composition, but the location of the haulout near Point Lay makes it difficult to monitor on a regular basis while still meeting ASAMM objectives because of the distance between Point Lay and Barrow. Unmanned aerial systems (UAS) may be a better means of documenting the dynamic nature of walrus haulout formation with greater regularity.

Fewer polar bears were sighted in 2013 than have been sighted since broad-scale surveys of the entire ASAMM study area recommenced in 2008, although numbers were similar to 2009-2011 (Clarke et al. 2011a, 2011c, 2011d, 2012, 2013a). The number of polar bear sightings was highest in 2012 (65 sightings of 277 polar bears) and 2008 (22 sightings of 103 polar bears) when sea ice remained in some of the study area. The high sighting numbers in 2012 also may have been related to greater overall survey effort and post-flight analysis of photographs taken where bears were concentrated in high numbers. The lack of survey effort in the first half of October due to the partial government shutdown likely impacted polar bear observations as well. The first half of October has traditionally been a time period when many polar bears are seen along the coast, including large groups on Cross Island and near Kaktovik.

The use of UASs in the Arctic, overlapping temporally and geographically with ASAMM, presented unique challenges in 2013. The Federal Aviation Administration (FAA) Modernization and Reform Act of 2012 (49 USC 40101 note) was tasked with integrating UASs into the National Airspace System. The act included provisions for instituting a test site program, finding solutions for “sense and avoid,” establishing standards for airworthiness, lost link procedures, and command and control, and interfacing with the air traffic control system; however, none of this was implemented by 2013. UASs are difficult to see and there is currently not a standardized way for UAS and manned aircraft to communicate their position to each other to allow real-time flight tracking. UASs also do not have “sense and avoid” capabilities and rely entirely on operators on ships or land for control and navigation, with no means of “seeing” what else is flying in the same area at or near the same altitude. Three separate UAS programs were active in the Alaskan Arctic concurrent with the ASAMM project. All three projects fortunately agreed that maintaining safety of flight for manned aircraft was first priority, and worked closely with the ASAMM team, NOAA, and BOEM to establish detailed communication protocols that allowed project objectives to be met while successfully deconflicting airspace (see Appendix D). This level of cooperation will be absolutely imperative to ensure that manned and unmanned aerial platforms can continue to operate safely in the Arctic.

A novel use of ASAMM marine mammal sighting data in 2013 was through a collaborative effort with a multi-disciplinary team operating an underwater glider in the northeastern Chukchi Sea. The project was designed to test an autonomous marine mammal acoustic detection and classification system and examine the relationships between marine mammal distribution and oceanographic conditions. ASAMM provided near real-time information on marine mammal sightings to assist with decision-making regarding where to fly the glider (Baumgartner et al. 2014).

Changes to the arctic marine environment observed over the past several decades (increasing mean annual temperatures, increasing mean annual wind speed, increasing storm frequency, decreasing annual sea ice thickness and extent; Wendler et al. 2009) accelerated in the 2000s (Walsh 2008), perhaps most noticeably in the record-low sea ice extent observed in 2007 and again in 2012 (National Snow and Ice Data Center 2007, 2012). The arctic summer and fall seasons are predicted to have continued decreasing sea ice cover and younger ice, and associated climatic impacts (e.g., Simmonds et al. 2008), and these changes have likely impacted or will impact most marine mammal species (Kovacs et al. 2011). Comparisons of marine mammal distributions over time periods spanning three decades (1982-2013) should be interpreted with caution because different ecological mechanisms could have been acting at different time periods over the duration of the study.

Ongoing interest in sea ice distribution and movement, ice forecasting, and the relationship of sea ice to marine mammals and other biological systems has been a catalyst to realize other benefits from ASAMM. Because ASAMM has such a large study area and collects visual data in regions where no one else does, it has become a useful platform for collecting aerial digital photographs of sea ice. These images are shared throughout the field season with multiple institutions to assist with ground-truthing sea ice data from remote sensing. These associations, ongoing since 2010, underscore the multidisciplinary nature of ASAMM and render it more than simply a "marine mammal survey."

Huntington (2009) identified six areas of human influence that will pose threats to arctic marine mammals and their conservation over the next several decades: climate change, environmental contaminants, offshore oil and gas activities, shipping, hunting, and commercial fisheries. He hypothesized the likely effects of each factor on arctic marine mammals in the future.

- Climate change has the greatest potential impact among the factors considered;
- Industrial development is a "tractable" issue, given stringent regulations and strong enforcement;
- The threat from commercial fishing is the least well understood, but examples of conflict between commercial fisheries and marine mammals in other regions warrant that precautionary measures be taken in the Arctic;
- Hunting ranked relatively low because it is "well understood" and existing management structures are already in place;
- Shipping is likely to have a modest impact, but those impacts could be mitigated or minimized with effective regulation; and
- Chronic environmental contaminants do not appear to pose a "substantial threat," although there are many uncertainties surrounding this issue.

Examined in isolation, each potential threat appears to be manageable. However, Huntington (2009) argues that the combined effects of all six factors "are perhaps the most daunting threat." Considerable information gaps exist in simply understanding the effects of single stressors on individual marine mammals. The uncertainty is magnified in reality, where inference must be broadened to include the effects of multiple stressors on the interconnected biological, physical, chemical, and acoustic aspects of the ecosystem that interact directly and indirectly to affect marine mammal health and fitness. Given the changes observed to date in the physical environment and marine mammal distributions in the Arctic, and the expected increases in anthropogenic pressures on the arctic ecosystem, effective conservation and management of arctic natural resources will require continuous monitoring of those resources to try to understand variability inherent in the ecosystem, predict potential effects of anthropogenic activities, and detect when changes are occurring. To better understand, manage, and conserve the new Arctic, it is essential to continue to actively study the new Arctic.

Management Use of Real-Time Field Information

BOEM issues various permits to industry for gas and oil exploration, including open water and on-ice seasonal vessel-based geophysical permits for exploration using array(s) of deep-seismic airguns, vessel-based geological-geophysical permits for shallow-seismic exploration using airguns, on-ice geophysical permits using VIBROSEIS technology, both vessel-based and on-ice geological permits for obtaining core samples, and permits to drill for gas and oil. ASAMM aerial survey data were made available to representatives of oil companies, the North Slope Borough Department of Wildlife Management, federal agencies, and the general public on a near real-time basis to encourage data transfer and enhance management via a web site maintained by NMML (USDOC, NOAA, NMFS, AFSC, 2013).

Management Use of Interannual Monitoring

This BOEM-sponsored bowhead whale monitoring study began in 1979 and has continued every year up to the present. While some aspects of this study have been updated, the data recorded have remained remarkably consistent (especially data from 1982-2012), thus permitting many direct comparisons across years. Such continuous, long-term, broad-scale, aerial monitoring of a large whale migration and associated marine mammals is indeed unique. In addition to the accomplishments specifically mentioned in the results, the ASAMM historical dataset has been used by industry, government and academic entities (e.g., Schick and Urban 2000; Manly et al. 2007; Givens et al. 2010; Okkonen et al. 2011; Clarke et al. 2013b; Stafford et al. 2013; Schonberg et al. in press;) to better understand, manage, and conserve arctic resources.

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APPENDIX A: 2013 ICE CONCENTRATION MAPS

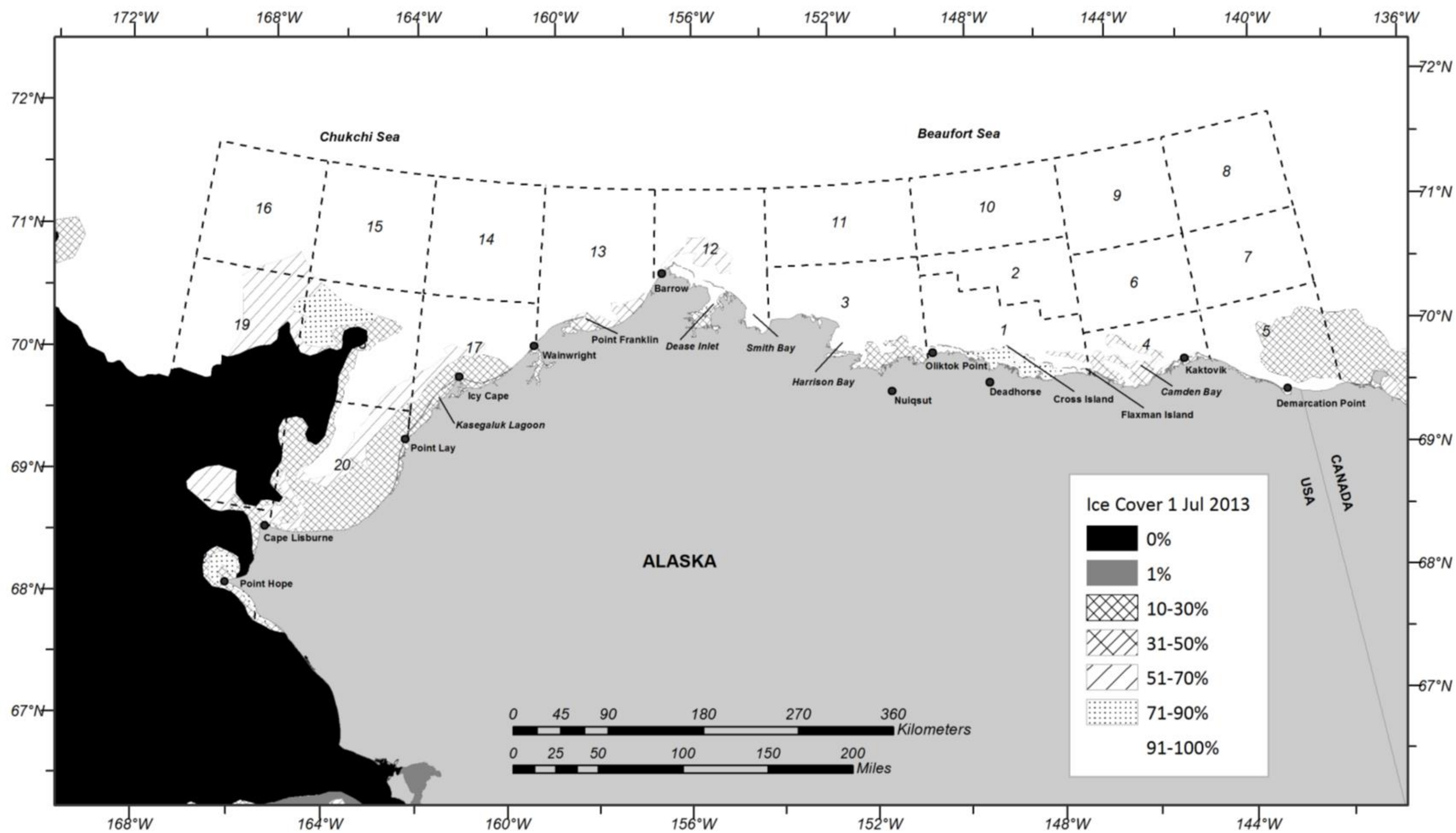

Figure A-1. Ice concentrations in the northeastern Chukchi and Alaskan Beaufort seas, 1 July 2013. Sea ice information was obtained from the National Ice Center (U.S. National Ice Center, 2013).

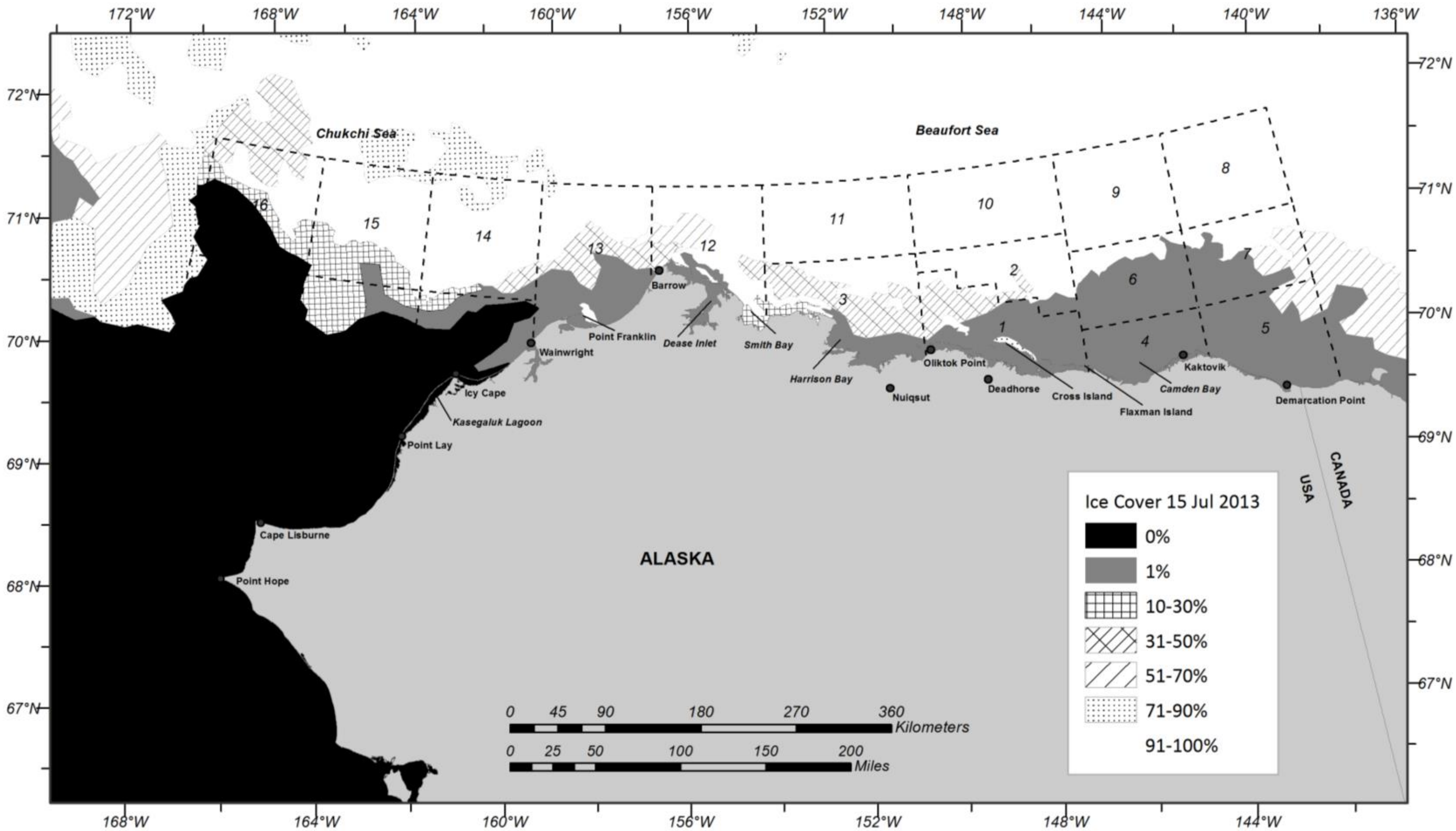

Figure A-2. Ice concentrations in the northeastern Chukchi and Alaskan Beaufort seas, 15 July 2013. Sea ice information was obtained from the National Ice Center (U.S. National Ice Center, 2013).

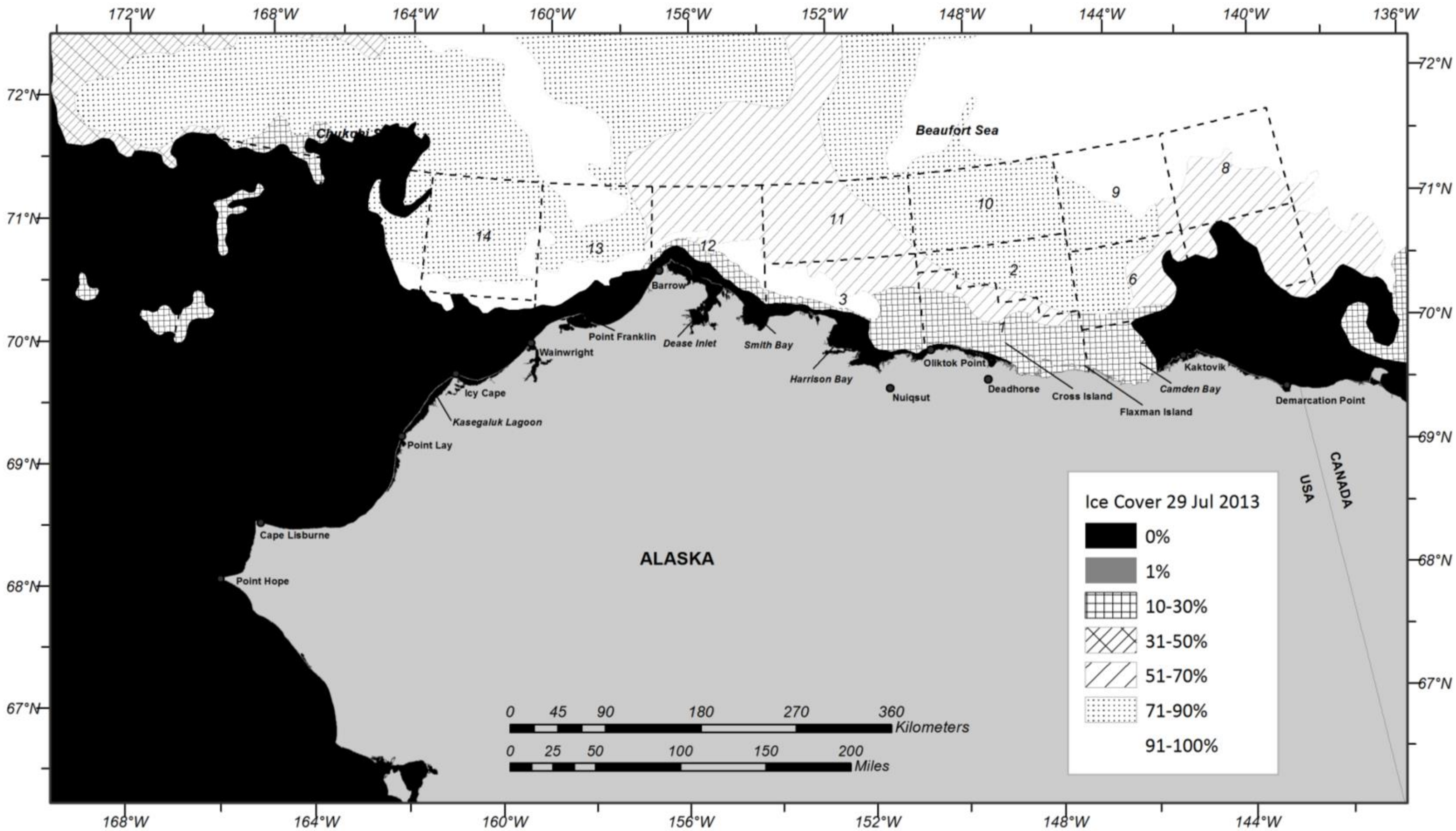

Figure A-3. Ice concentrations in the northeastern Chukchi and Alaskan Beaufort seas, 29 July 2013. Sea ice information was obtained from the National Ice Center (U.S. National Ice Center, 2013).

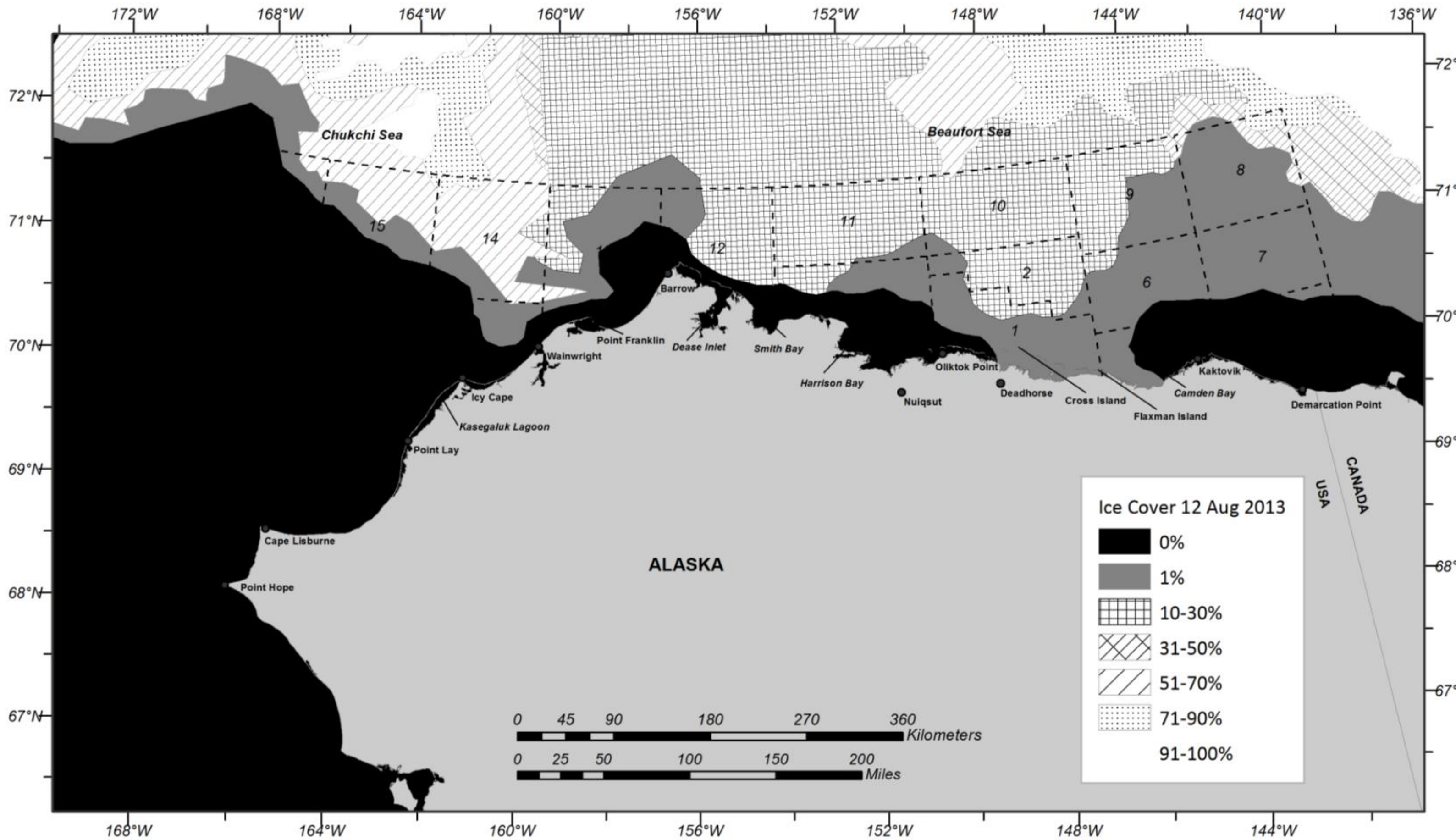

Figure A-4. Ice concentrations in the northeastern Chukchi and Alaskan Beaufort seas, 12 August 2013. Sea ice information was obtained from the National Ice Center (U.S. National Ice Center, 2013).

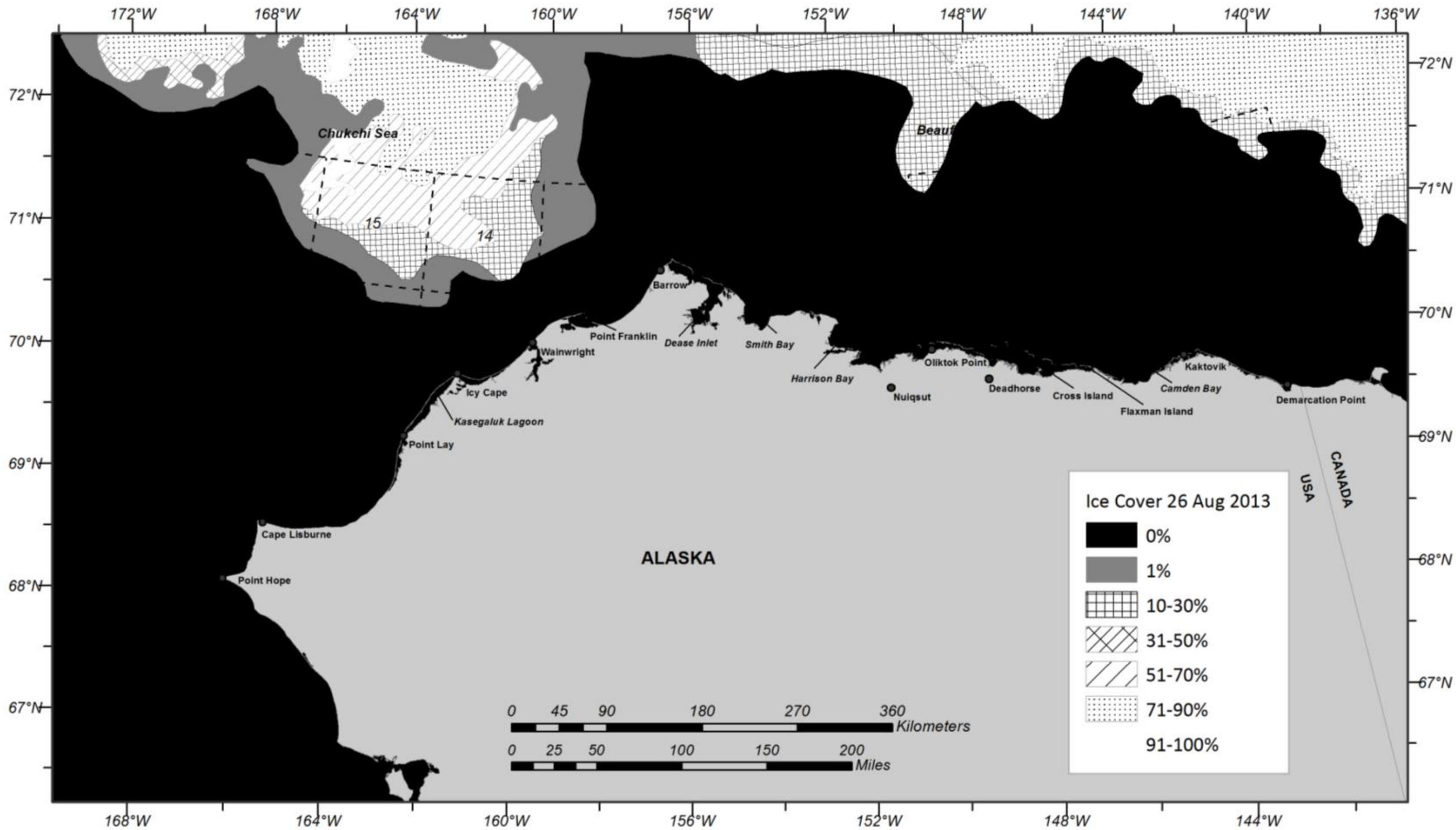

Figure A-5. Ice concentrations in the northeastern Chukchi and Alaskan Beaufort seas, 26 August 2013. Sea ice information was obtained from the National Ice Center (U.S. National Ice Center, 2013).

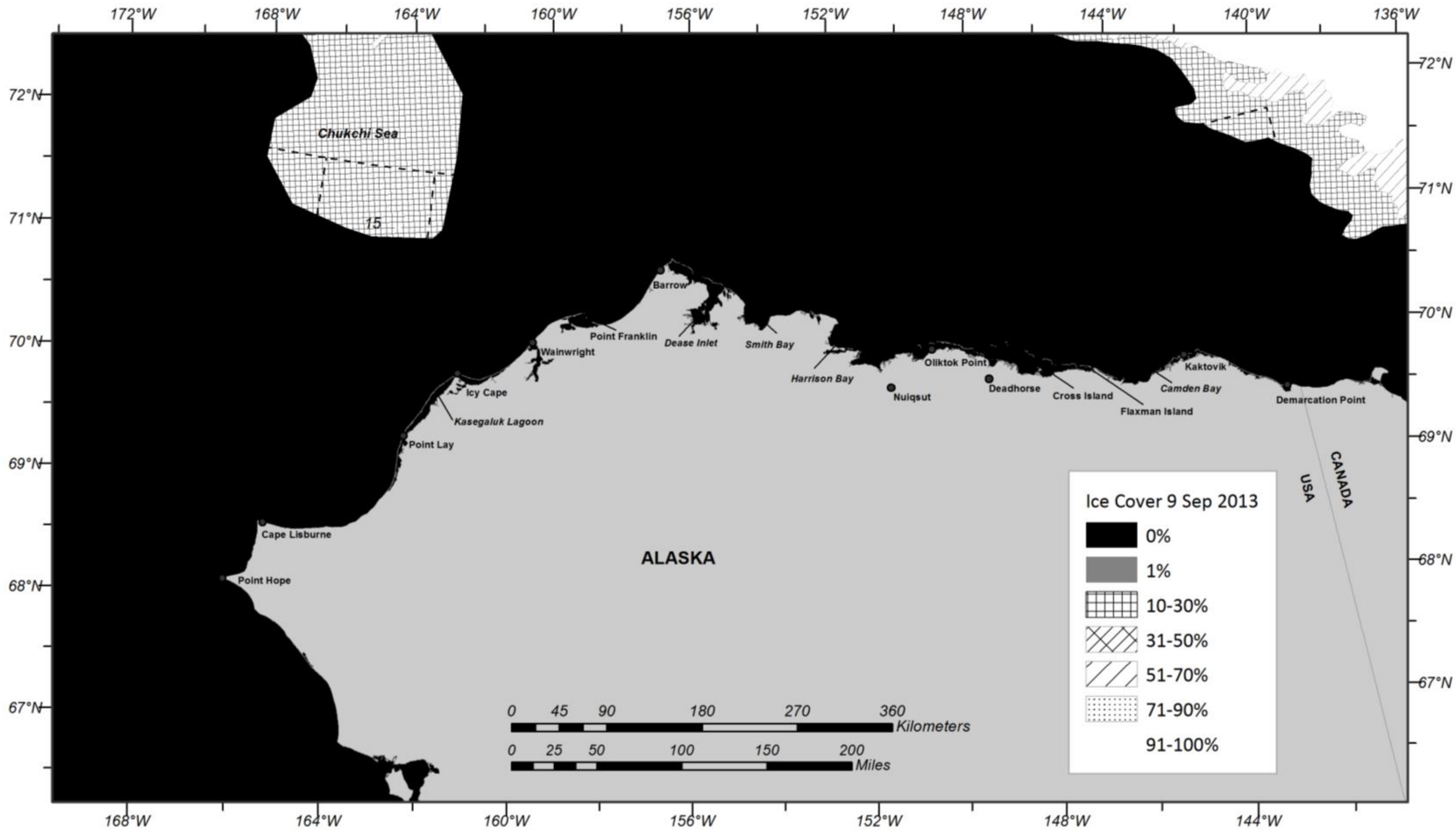

Figure A-6. Ice concentrations in the northeastern Chukchi and Alaskan Beaufort seas, 9 September 2013. Sea ice information was obtained from the National Ice Center (U.S. National Ice Center, 2013).

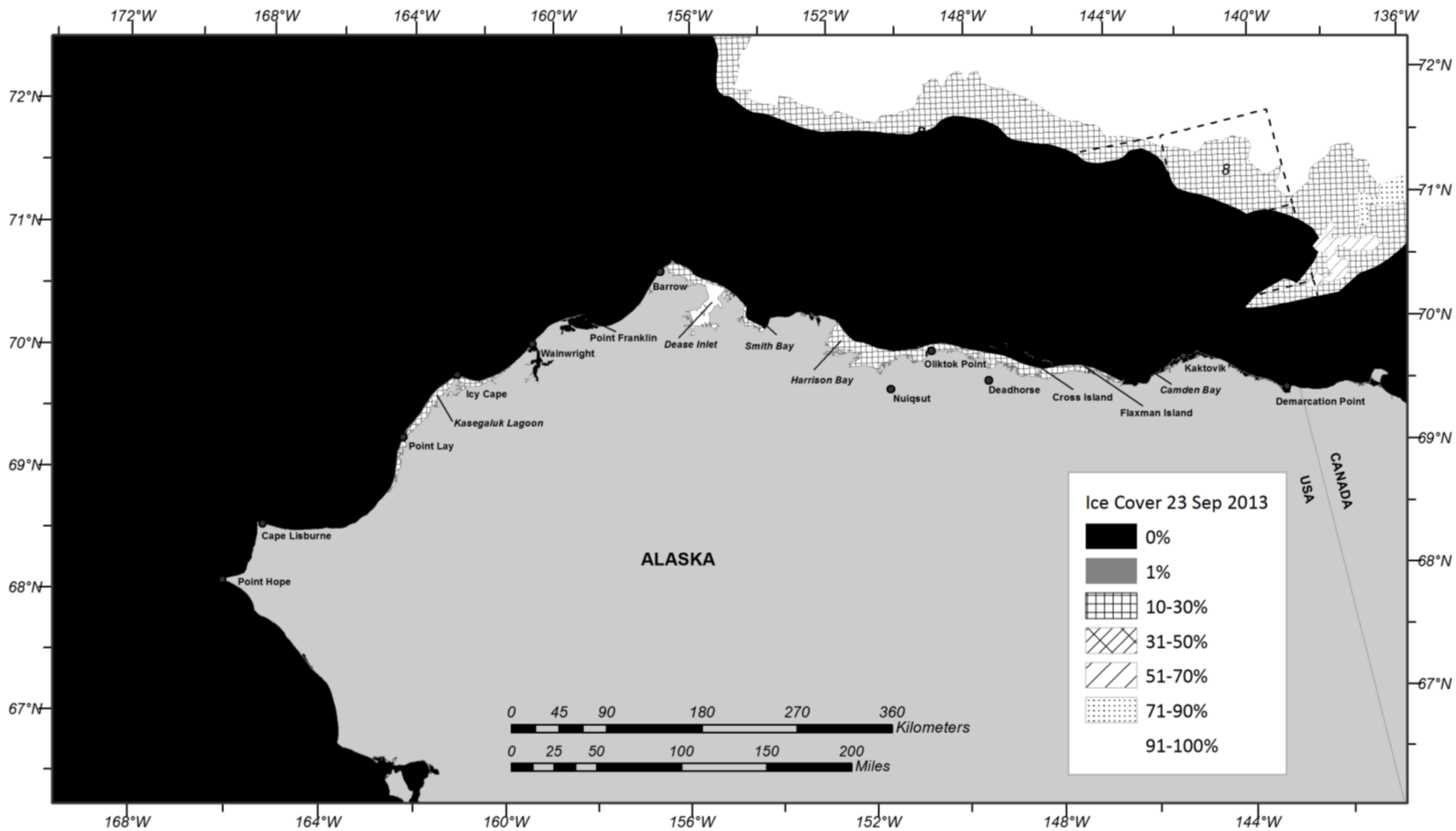

Figure A-7. Ice concentrations in the northeastern Chukchi and Alaskan Beaufort seas, 23 September 2013. Sea ice information was obtained from the National Ice Center (U.S. National Ice Center, 2013).

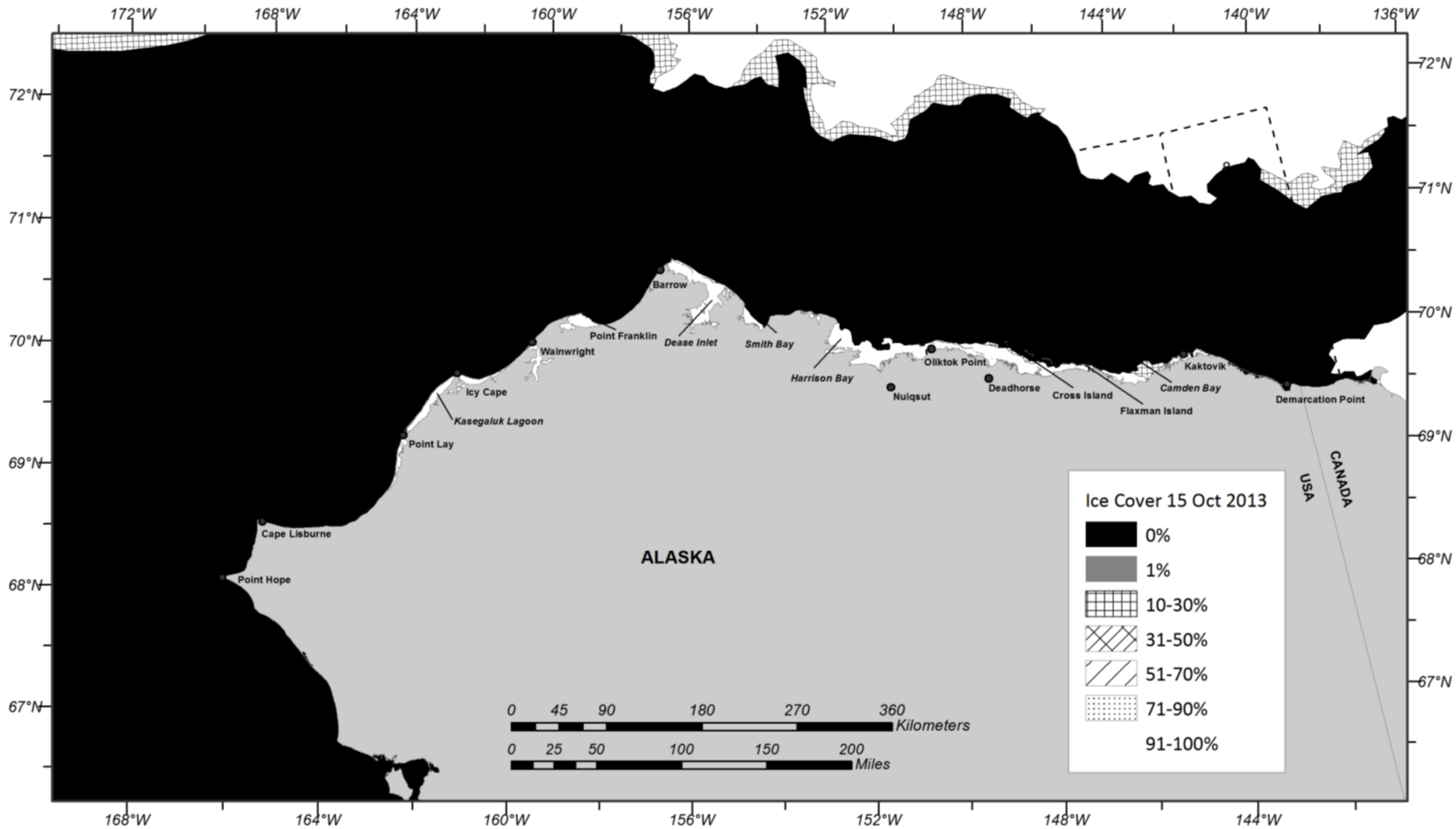

Figure A-8. Ice concentrations in the northeastern Chukchi and Alaskan Beaufort seas, 15 October 2013. Sea ice information was obtained from the National Ice Center (U.S. National Ice Center, 2013).

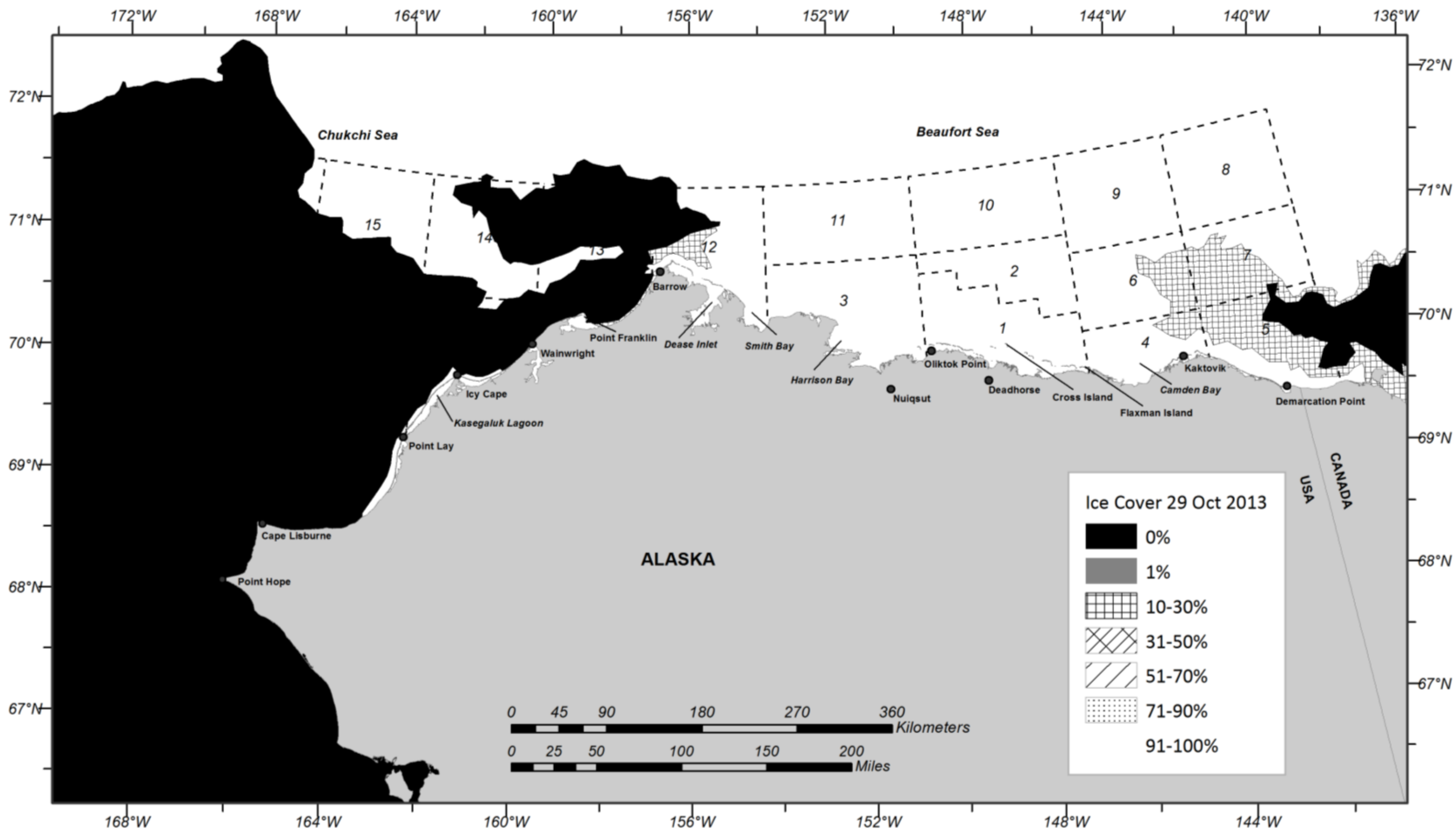

Figure A-9. Ice concentrations in the northeastern Chukchi and Alaskan Beaufort seas, 29 October 2013. Sea ice information was obtained from the National Ice Center (U.S. National Ice Center, 2013).

APPENDIX B: 2013 DAILY FLIGHT SUMMARIES

2 July 2013, Flight 201

Flight was a complete survey of transect 1; partial survey of transects 3, 5, and 7; and the coastal transect from Point Franklin to Barrow. Survey conditions included partly cloudy to overcast skies, <1-10 km visibility (with low lying fog and occasional glare), and Beaufort 0-1 sea states. Ice cover was 18-98% broken floe sea ice in the area surveyed. With the exception of areas closest to shore, ice cover was >90% broken floe. There was no shorefast ice from Point Franklin to Barrow. Sightings included belugas (including one calf), walruses, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
201	7/2/13 16:21	71.131	160.069	beluga	swim	3	1	14

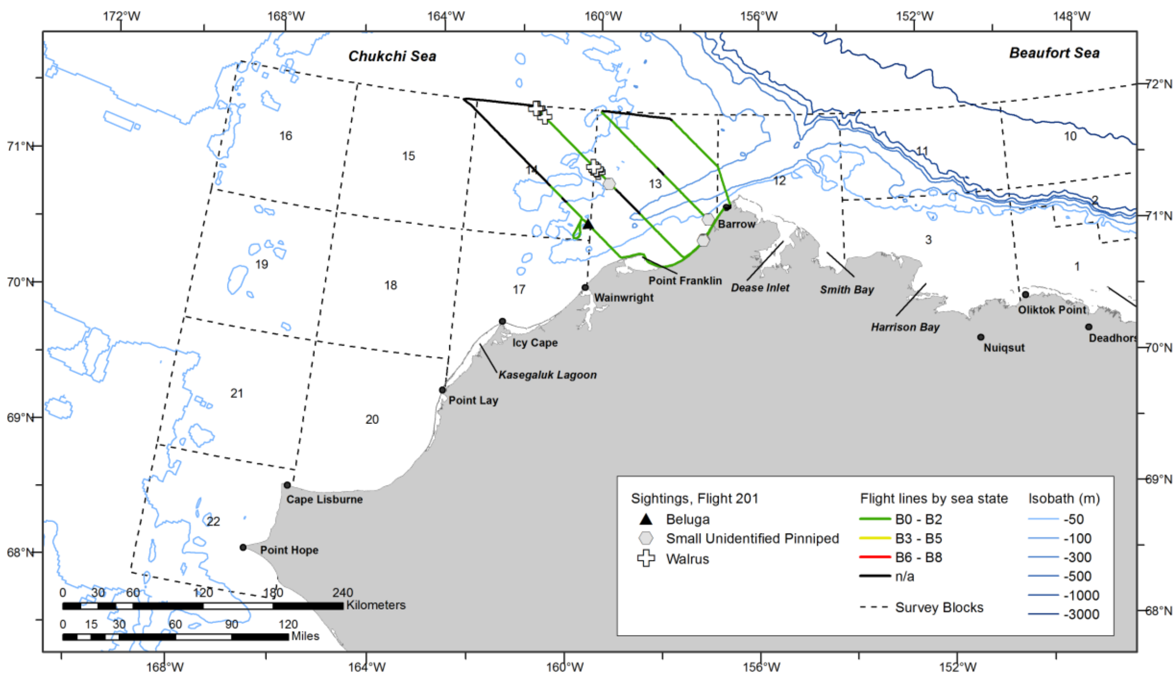

Figure B-1. ASAMM Flight 201 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

4 July 2013, Flight 202

Flight was a partial survey of transects 9, 11, 13, and 15, and the coastal transect from north of Point Lay to Point Franklin. Survey conditions included partly cloudy skies, <1-10 km visibility (with low lying fog and occasional glare), and Beaufort 0-4 sea states. Ice cover was 0-95% in the area surveyed. Sightings included gray whales (including two calves), one minke whale, belugas (including one calf), one small unidentified cetacean, walruses, bearded seals, small unidentified pinnipeds, and caribou.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
202	7/4/13 11:24	70.775	160.395	gray whale	rest	1	1	17
202	7/4/13 11:27	70.842	160.610	beluga	swim	2	1	17
202	7/4/13 13:06	70.335	162.007	gray whale	swim	2	1	17
202	7/4/13 13:07	70.363	162.098	beluga	rest	1	0	17
202	7/4/13 13:53	70.290	162.046	gray whale	feed	1	0	17
202	7/4/13 13:59	70.309	161.600	beluga	swim	11	0	17
202	7/4/13 14:00	70.311	161.568	minke whale	swim	1	0	17
202	7/4/13 14:15	70.363	160.956	small unid cetacean	dive	1	0	17

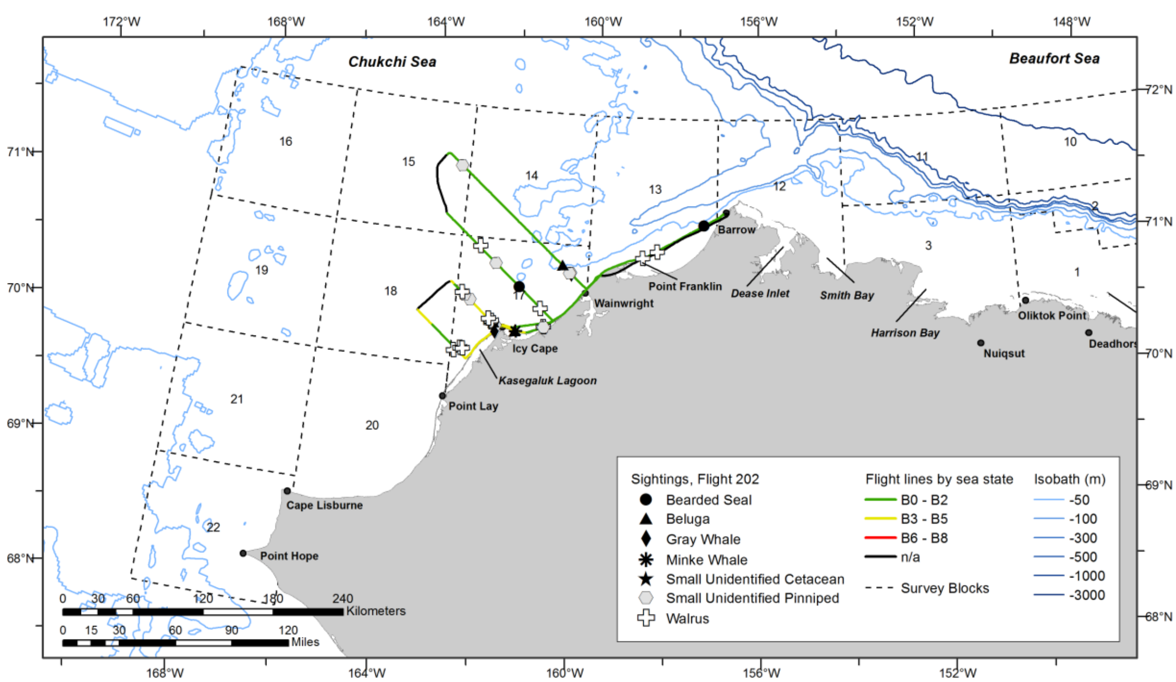

Figure B-2. ASAMM Flight 202 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

6 July 2013, Flight 203

Flight was a partial survey of transects 13 and 15, and search effort from north of Point Lay to Point Franklin. Survey conditions included overcast to partly cloudy skies, no visibility to unlimited visibility (with low lying fog and occasional glare), and Beaufort 0-4 sea states. Ice cover was 0-90% in the area surveyed. Sightings included bowhead whales, gray whales (including eight calves), belugas, walruses, bearded seals, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
203	7/6/13 10:40	70.622	163.143	bowhead whale	swim	1	0	18
203	7/6/13 10:42	70.609	163.053	bowhead whale	swim	1	0	18
203	7/6/13 12:57	70.498	162.839	beluga	swim	2	0	17
203	7/6/13 13:22	70.767	160.436	gray whale	feed	2	1	17
203	7/6/13 13:27	70.818	160.244	gray whale	swim	2	1	17
203	7/6/13 13:28	70.814	160.207	gray whale	mill	1	0	17
203	7/6/13 13:28	70.809	160.252	gray whale	mill	1	0	17
203	7/6/13 13:33	70.824	160.260	gray whale	mill	1	0	17
203	7/6/13 13:35	70.795	160.243	gray whale	mill	2	1	17
203	7/6/13 13:44	70.770	160.319	gray whale	feed	2	0	17
203	7/6/13 13:44	70.773	160.296	gray whale	mill	2	1	17
203	7/6/13 13:48	70.773	160.358	gray whale	mill	2	1	17
203	7/6/13 13:52	70.807	160.128	gray whale	mill	2	1	17
203	7/6/13 13:56	70.816	160.093	gray whale	swim	1	0	17
203	7/6/13 13:57	70.840	159.988	gray whale	swim	2	1	13
203	7/6/13 14:00	70.862	159.828	gray whale	swim	2	1	13
203	7/6/13 14:04	70.905	159.535	bowhead whale	swim	1	0	13
203	7/6/13 14:08	70.926	159.343	bowhead whale	swim	2	0	13
203	7/6/13 14:09	70.919	159.338	bowhead whale	swim	1	0	13

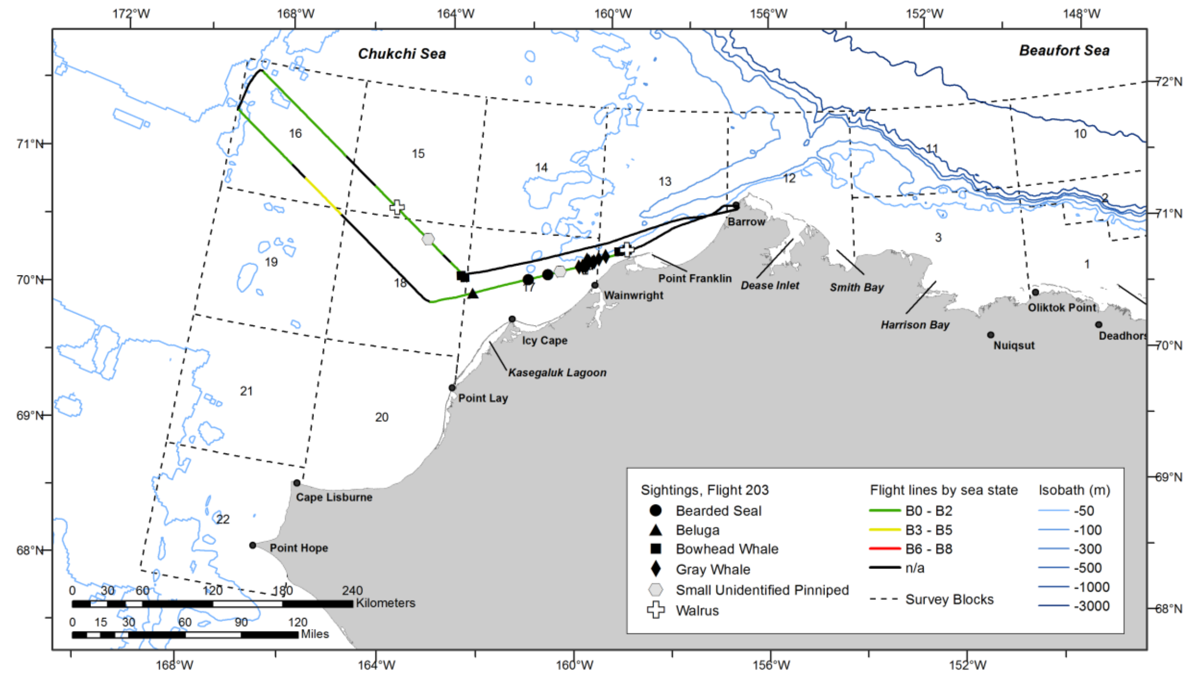

Figure B-3. ASAMM Flight 203 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

7 July 2013, Flight 204

Flight was a complete survey of transects 17 and 19, and the coastal transect north and south of Point Lay. Survey conditions included overcast to partly cloudy skies, 5-10 km visibility (with occasional glare), and Beaufort 1-5 sea states. Ice cover was 0-80% broken floe sea ice in the area surveyed. Sightings included gray whales (including 3 calves), minke whales, belugas (including 25 calves), walruses, bearded seals, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
204	7/7/13 11:26	69.782	163.203	minke whale	dive	1	0	20
204	7/7/13 11:31	69.761	163.153	gray whale	feed	6	3	20
204	7/7/13 11:41	69.813	163.307	minke whale	swim	1	0	20
204	7/7/13 12:04	70.240	164.916	beluga	swim	1	0	18
204	7/7/13 12:05	70.265	164.933	beluga	mill	1	0	18
204	7/7/13 12:05	70.255	164.989	beluga	swim	1	0	18
204	7/7/13 14:27	69.418	163.159	beluga	mill	400	25	20

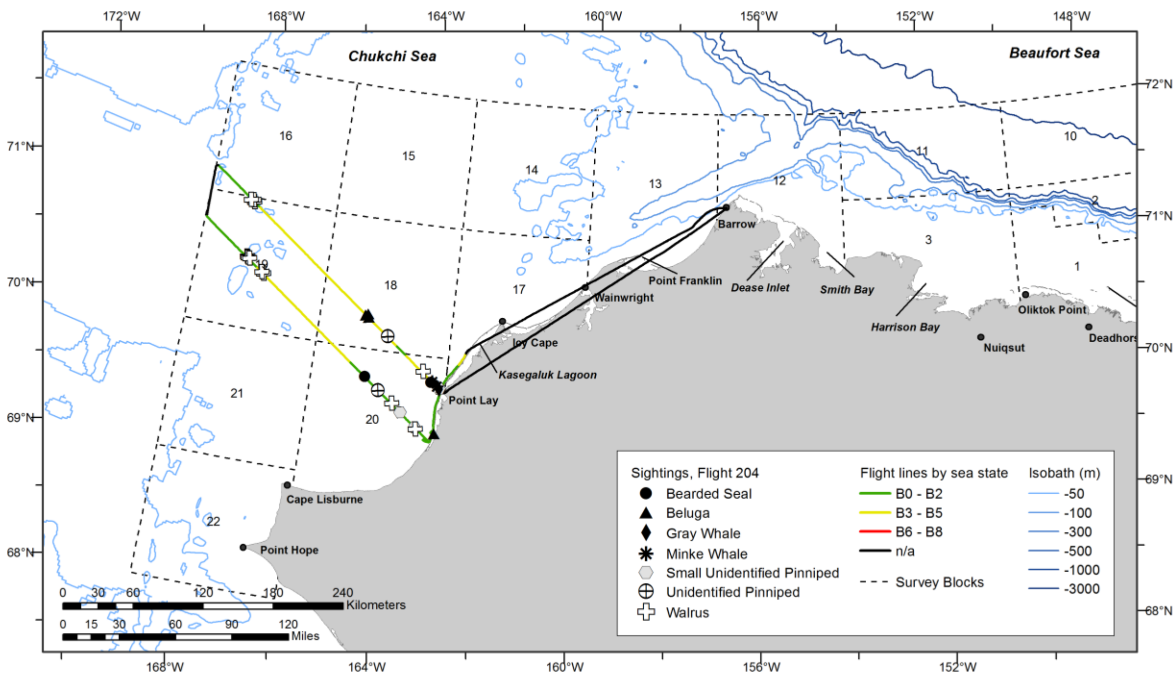

Figure B-4. ASAMM Flight 204 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

White gray whale with calf seen during flight 204, 7 July 2013. Two additional gray whale cow-calf pairs were feeding in the immediate vicinity.

Belugas, in a large group south of Point Lay, seen during flight 204, 7 July 2013.

10 July 2013, Flight 205

Flight was a complete survey of transects 2, 4, 6, and 8; the coastal transect between transects 4 and 8; and search effort from Point Franklin to Barrow. Survey conditions included clear to partly cloudy skies, <1-10 km visibility (with low patchy fog and glare), and Beaufort 1-7 sea states. Higher sea states were nearshore in areas with little to no ice. Ice cover was 1-95% in the area surveyed. Sightings included one bowhead whale, gray whales, walruses, bearded seals, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
205	7/10/13 13:33	70.863	158.351	bowhead whale	dive	1	0	13
205	7/10/13 15:35	70.958	160.334	gray whale	feed	1	0	17
205	7/10/13 16:03	71.006	158.250	gray whale	feed	1	0	13
205	7/10/13 16:07	71.033	158.219	gray whale	feed	1	0	13
205	7/10/13 16:09	71.048	158.212	gray whale	feed	1	0	13
205	7/10/13 16:25	71.284	156.977	gray whale	feed	1	0	12

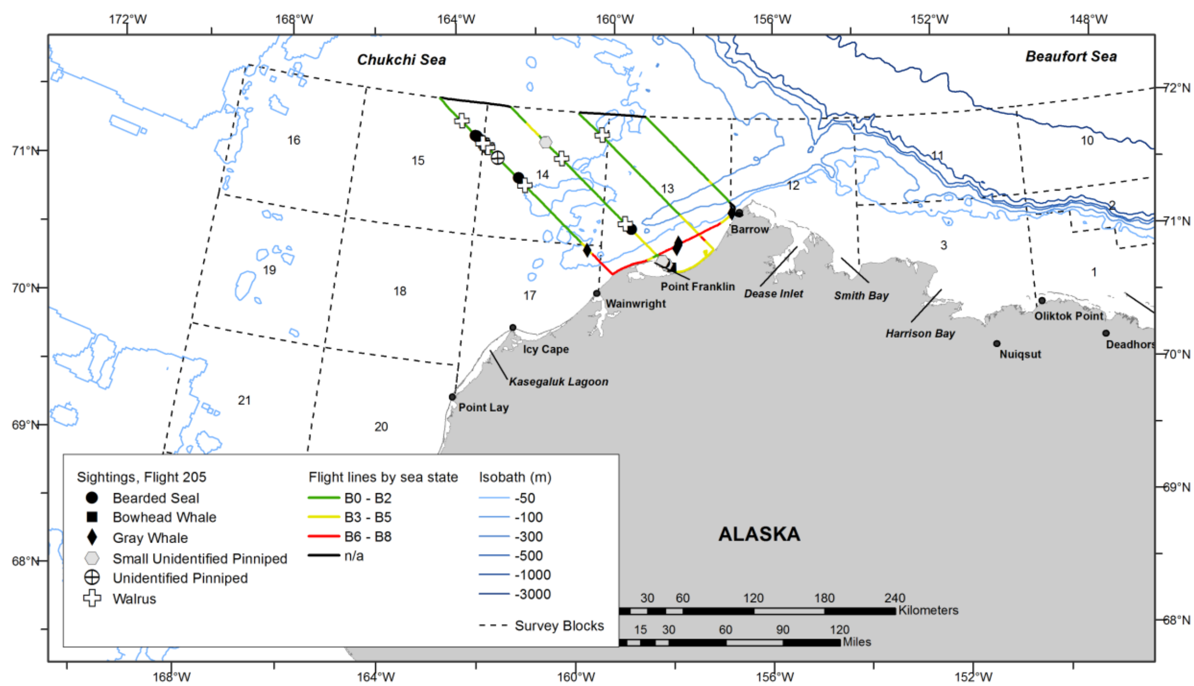

Figure B-5. ASAMM Flight 205 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

11 July 2013, Flight 206

Flight was a complete survey of transect 10, partial survey of transect 12, and search effort from transect 12 to Barrow. Survey conditions included clear to partly cloudy skies, 5-10 km visibility (with glare), and Beaufort 0-7 sea states. Higher sea states were in areas with little to no ice. Ice cover was 1-90% in the area surveyed. Sightings included gray whales (including three calves), one beluga, walruses, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
206	7/11/13 10:06	70.568	160.575	gray whale	feed	1	0	17
206	7/11/13 10:06	70.588	160.572	gray whale	feed	2	1	17
206	7/11/13 10:12	70.615	160.751	gray whale	feed	1	0	17
206	7/11/13 10:16	70.617	160.785	gray whale	feed	1	0	17
206	7/11/13 10:23	70.776	161.276	gray whale	feed	5	2	17
206	7/11/13 10:52	71.322	163.273	beluga	mill	1	0	15

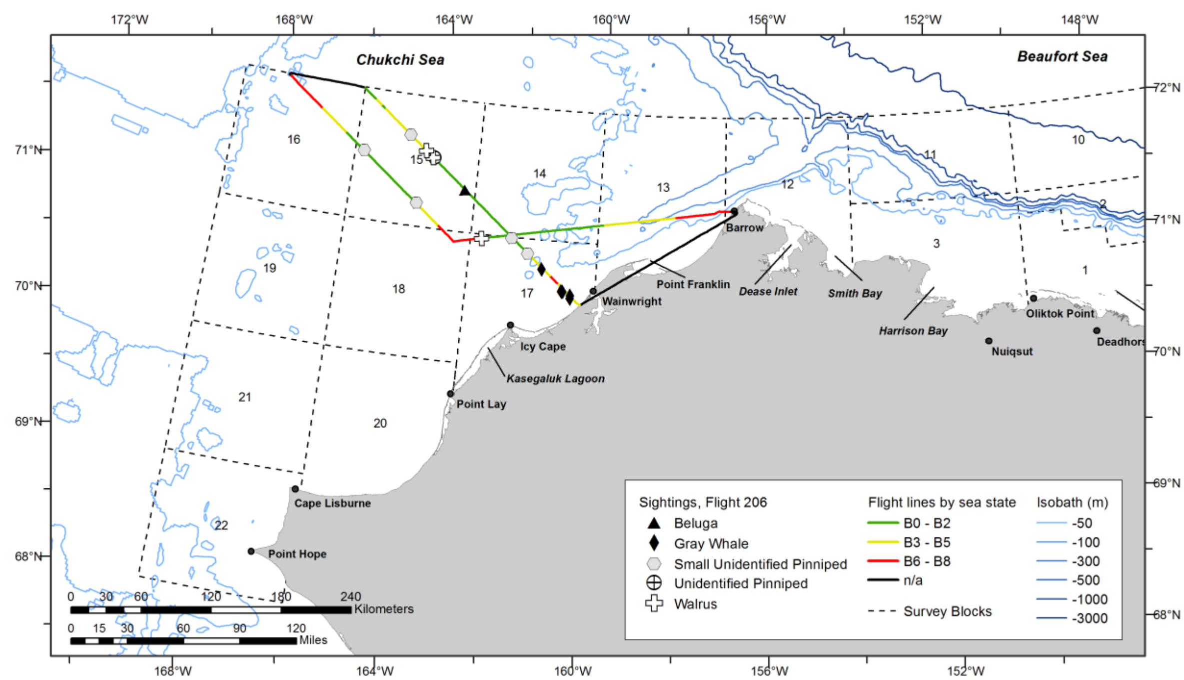

Figure B-6. ASAMM Flight 206 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

12 July 2013, Flight 207

Flight was a complete survey of transects 28, 30, and 32. Survey conditions included clear skies, 5-10 km visibility (with occasional glare), and Beaufort 1-3 sea states. There was no sea ice observed in the area surveyed. Sightings included gray whales (including five calves), one fin whale, one small unidentified marine mammal (probable walrus), and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
207	7/12/13 12:21	68.511	167.561	fin whale	dive	1	0	22
207	7/12/13 12:57	68.170	166.237	gray whale	swim	2	1	22
207	7/12/13 13:01	68.160	166.290	gray whale	swim	2	0	22
207	7/12/13 13:05	68.163	166.610	gray whale	swim	2	1	22
207	7/12/13 13:09	68.169	166.715	gray whale	rest	2	1	22
207	7/12/13 13:10	68.183	166.766	gray whale	mill	3	1	22
207	7/12/13 13:27	68.169	168.017	gray whale	rest	2	1	22

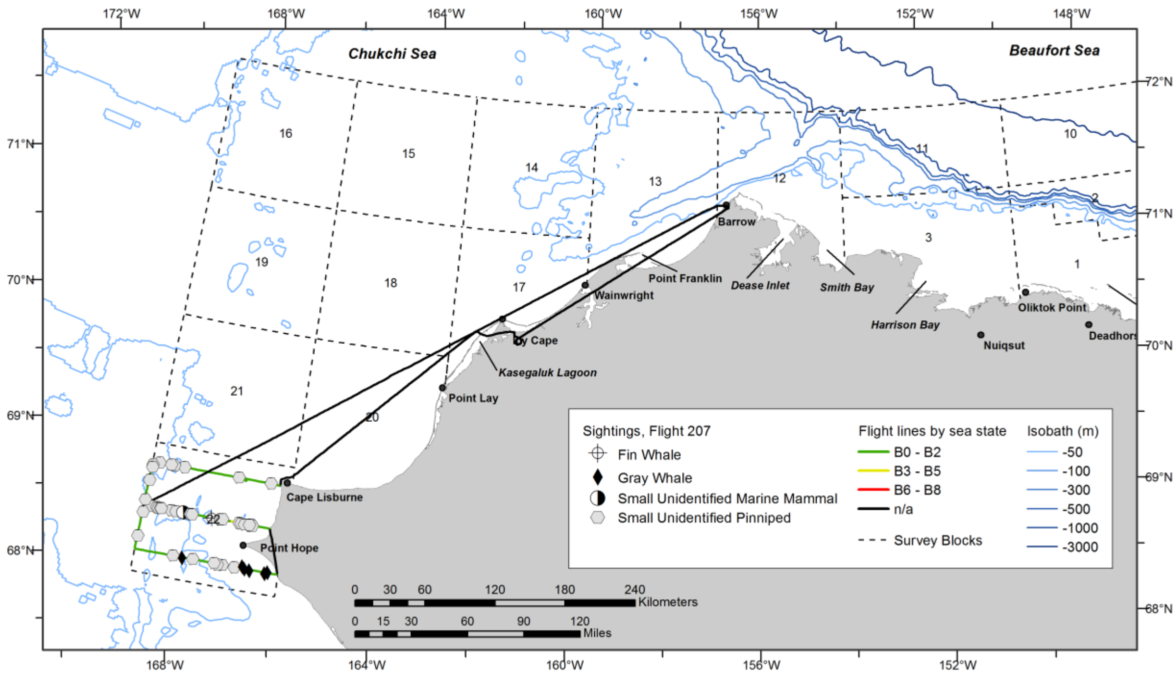

Figure B-7. ASAMM Flight 207 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Left: Gray whale cow-calf pair, with calf directly underneath cow's body, seen south of Point Hope, Alaska, during flight 207, 12 July 2013. The calf's flukes are visible under the cow's flukes.

Right: Fin whale seen northeast of Point Hope, Alaska, during flight 207, 12 July 2013.

14 July 2013, Flight 208

Flight was a partial survey of transect 14 and deadhead effort along the ice edge in support of the USGS walrus satellite-tagging project. Survey conditions included partly cloudy skies, 5-10 km visibility (with glare), and Beaufort 1-6 sea states. Ice cover was 1-15% broken floe in the area surveyed. Sightings included bearded seals and small unidentified pinnipeds.

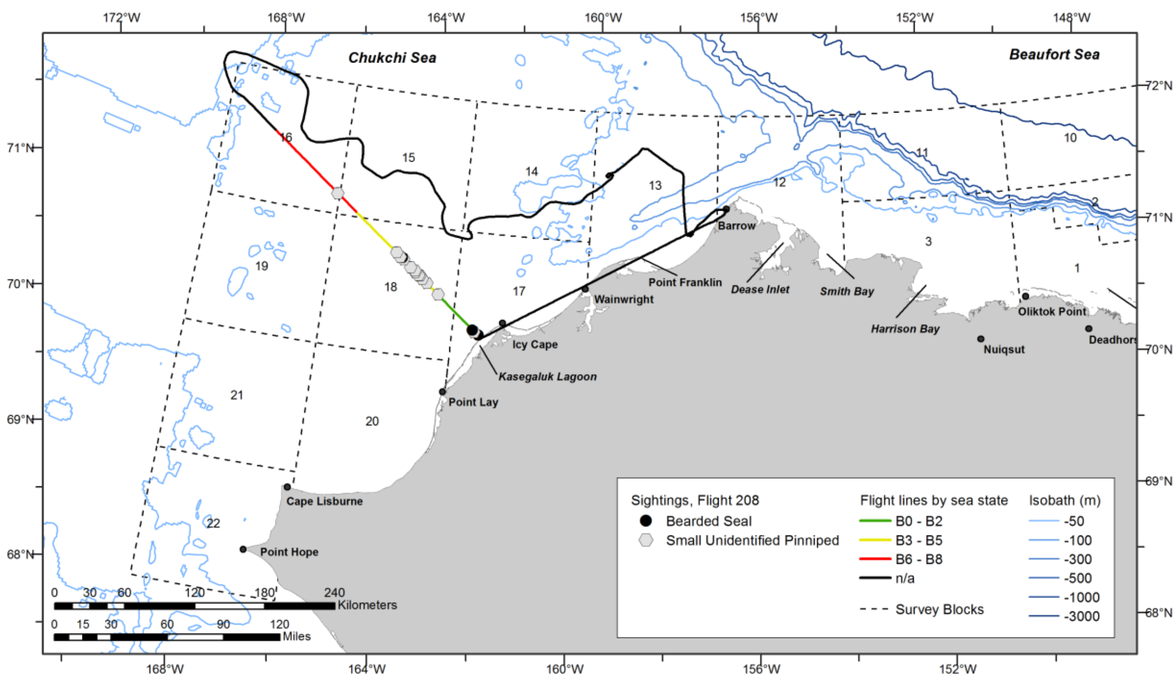

Figure B-8. ASAMM Flight 208 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

15 July 2013, Flight 209

Flight was a survey of the coastal transect from Barrow to Wainwright. Survey conditions included overcast skies, 0-10 km visibility (with fog and precipitation), and Beaufort 1-2 sea states. Ice cover was 0-40% broken floe in the area surveyed. Sightings included unidentified pinnipeds and small unidentified pinnipeds.

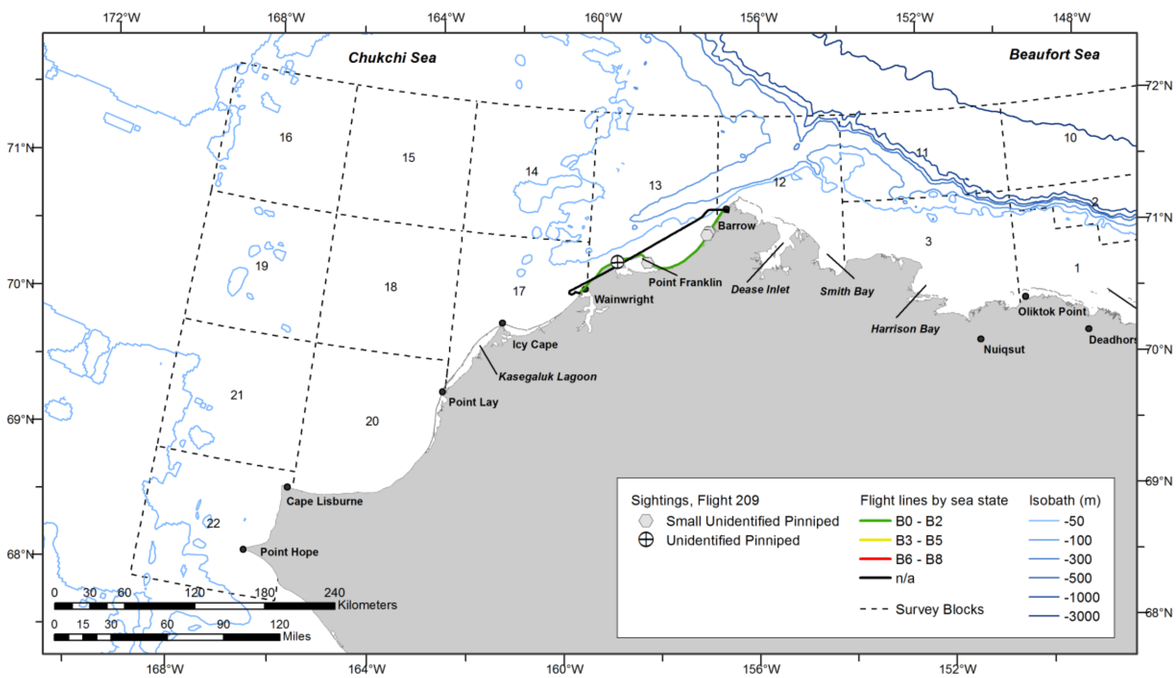

Figure B-9. ASAMM Flight 209 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

19 July 2013, Flight 1

Flight was a survey of portions of blocks 4 and 6. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with glare, fog, and low ceilings), and Beaufort 1-3 sea states. Ice cover was 0-40% broken floe in the area surveyed. Sightings included bowhead whales (including six calves), belugas (including eight calves), unidentified cetaceans, bearded seals, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
1	7/19/13 15:02	70.481	143.175	bowhead whale	swim	2	0	4
1	7/19/13 15:02	70.487	143.191	bowhead whale	swim	2	0	4
1	7/19/13 15:03	70.499	143.161	bowhead whale	swim	4	0	4
1	7/19/13 15:04	70.506	143.178	beluga	swim	2	1	6
1	7/19/13 15:11	70.475	143.173	bowhead whale	swim	2	0	4
1	7/19/13 15:11	70.485	143.181	bowhead whale	swim	4	0	4
1	7/19/13 15:12	70.501	143.187	bowhead whale	mill	5	0	6
1	7/19/13 15:12	70.509	143.190	beluga	swim	1	0	6
1	7/19/13 15:16	70.655	143.229	beluga	swim	2	0	6
1	7/19/13 15:19	70.766	143.278	beluga	mill	1	0	6
1	7/19/13 15:23	70.901	143.359	beluga	swim	1	0	6
1	7/19/13 15:23	70.904	143.335	beluga	swim	1	0	6
1	7/19/13 15:25	70.948	143.367	beluga	swim	1	0	6
1	7/19/13 15:29	71.077	143.385	beluga	swim	1	0	6
1	7/19/13 15:30	71.140	143.436	beluga	swim	1	0	6
1	7/19/13 15:35	71.147	143.712	beluga	swim	1	0	6
1	7/19/13 15:37	71.091	143.710	beluga	rest	2	0	6
1	7/19/13 15:41	70.974	143.743	beluga	rest	1	0	6
1	7/19/13 15:41	70.966	143.760	beluga	rest	1	0	6
1	7/19/13 15:43	70.890	143.828	unid cetacean	swim	1	0	6
1	7/19/13 15:50	70.856	143.793	beluga	swim	1	0	6
1	7/19/13 15:50	70.840	143.804	beluga	rest	1	0	6
1	7/19/13 15:50	70.833	143.790	beluga	rest	2	0	6
1	7/19/13 15:52	70.797	143.780	beluga	rest	1	0	6
1	7/19/13 15:52	70.797	143.803	beluga	rest	2	1	6
1	7/19/13 15:57	70.615	143.862	bowhead whale	rest	1	0	6
1	7/19/13 15:58	70.602	143.852	bowhead whale	rest	1	0	6
1	7/19/13 16:31	70.351	144.202	beluga	swim	1	0	4
1	7/19/13 16:31	70.361	144.206	beluga	swim	2	1	4
1	7/19/13 16:32	70.377	144.236	beluga	swim	1	0	4
1	7/19/13 16:32	70.390	144.236	beluga	swim	1	0	4
1	7/19/13 16:40	70.659	144.162	bowhead whale	swim	1	0	6
1	7/19/13 16:40	70.660	144.189	bowhead whale	swim	1	0	6

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
1	7/19/13 16:40	70.665	144.137	bowhead whale	swim	2	0	6
1	7/19/13 16:41	70.677	144.186	bowhead whale	swim	1	0	6
1	7/19/13 16:41	70.690	144.171	beluga	swim	1	0	6
1	7/19/13 16:41	70.686	144.151	beluga	swim	3	0	6
1	7/19/13 16:42	70.671	144.165	bowhead whale	swim	2	0	6
1	7/19/13 16:42	70.660	144.179	bowhead whale	swim	1	0	6
1	7/19/13 16:42	70.658	144.193	bowhead whale	swim	1	0	6
1	7/19/13 16:43	70.658	144.186	bowhead whale	feed	5	1	6
1	7/19/13 16:48	70.634	144.103	beluga	swim	1	0	6
1	7/19/13 16:51	70.694	144.152	beluga	swim	3	1	6
1	7/19/13 16:52	70.721	144.170	bowhead whale	mill	2	0	6
1	7/19/13 16:53	70.726	144.147	bowhead whale	swim	6	1	6
1	7/19/13 16:54	70.722	144.177	bowhead whale	swim	1	0	6
1	7/19/13 16:57	70.733	144.186	beluga	swim	1	0	6
1	7/19/13 16:58	70.753	144.171	bowhead whale	swim	1	0	6
1	7/19/13 16:58	70.777	144.191	beluga	swim	1	0	6
1	7/19/13 16:58	70.783	144.159	beluga	swim	2	0	6
1	7/19/13 16:59	70.806	144.187	bowhead whale	mill	4	0	6
1	7/19/13 17:01	70.805	144.169	bowhead whale	rest	2	1	6
1	7/19/13 17:06	70.929	144.145	beluga	rest	2	0	6
1	7/19/13 17:08	70.989	144.131	beluga	rest	6	1	6
1	7/19/13 17:08	70.997	144.132	beluga	swim	2	0	6
1	7/19/13 17:08	71.003	144.164	beluga	swim	1	0	6
1	7/19/13 17:09	71.009	144.141	beluga	dive	3	1	6
1	7/19/13 17:09	71.019	144.148	beluga	swim	2	0	6
1	7/19/13 17:09	71.032	144.132	bowhead whale	tail slap	2	1	6
1	7/19/13 17:28	71.143	145.204	beluga	swim	1	0	6
1	7/19/13 17:28	71.136	145.191	beluga	rest	1	0	6
1	7/19/13 17:29	71.126	145.191	beluga	mill	3	0	6
1	7/19/13 17:29	71.113	145.231	beluga	rest	3	1	6
1	7/19/13 17:29	71.111	145.214	beluga	swim	1	0	6
1	7/19/13 17:30	71.089	145.204	beluga	swim	1	0	6
1	7/19/13 17:31	71.070	145.372	bowhead whale	swim	1	0	6
1	7/19/13 17:31	71.064	145.217	bowhead whale	swim	2	0	6
1	7/19/13 17:33	71.060	145.236	beluga	mill	2	0	6
1	7/19/13 17:34	71.046	145.306	beluga	swim	45	1	6
1	7/19/13 17:35	71.031	145.313	unid cetacean	swim	1	0	6
1	7/19/13 17:39	71.000	145.219	beluga	rest	1	0	6
1	7/19/13 17:49	70.666	145.306	bowhead whale	feed	3	0	6
1	7/19/13 17:51	70.678	145.351	bowhead whale	mill	5	1	6
1	7/19/13 17:57	70.584	145.271	beluga	mill	7	0	6
1	7/19/13 18:36	70.764	145.619	bowhead whale	swim	1	0	6

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
1	7/19/13 18:36	70.783	145.671	bowhead whale	rest	1	0	6
1	7/19/13 18:40	70.822	145.440	bowhead whale	breach	4	0	6
1	7/19/13 18:40	70.826	145.678	beluga	swim	1	0	6
1	7/19/13 18:47	70.910	145.591	bowhead whale	unknown	2	0	6
1	7/19/13 18:47	70.929	145.669	bowhead whale	unknown	1	1	6
1	7/19/13 18:52	70.986	145.654	beluga	swim	1	0	6
1	7/19/13 18:52	70.992	145.638	bowhead whale	swim	1	0	6
1	7/19/13 18:56	70.990	145.645	beluga	swim	1	0	6

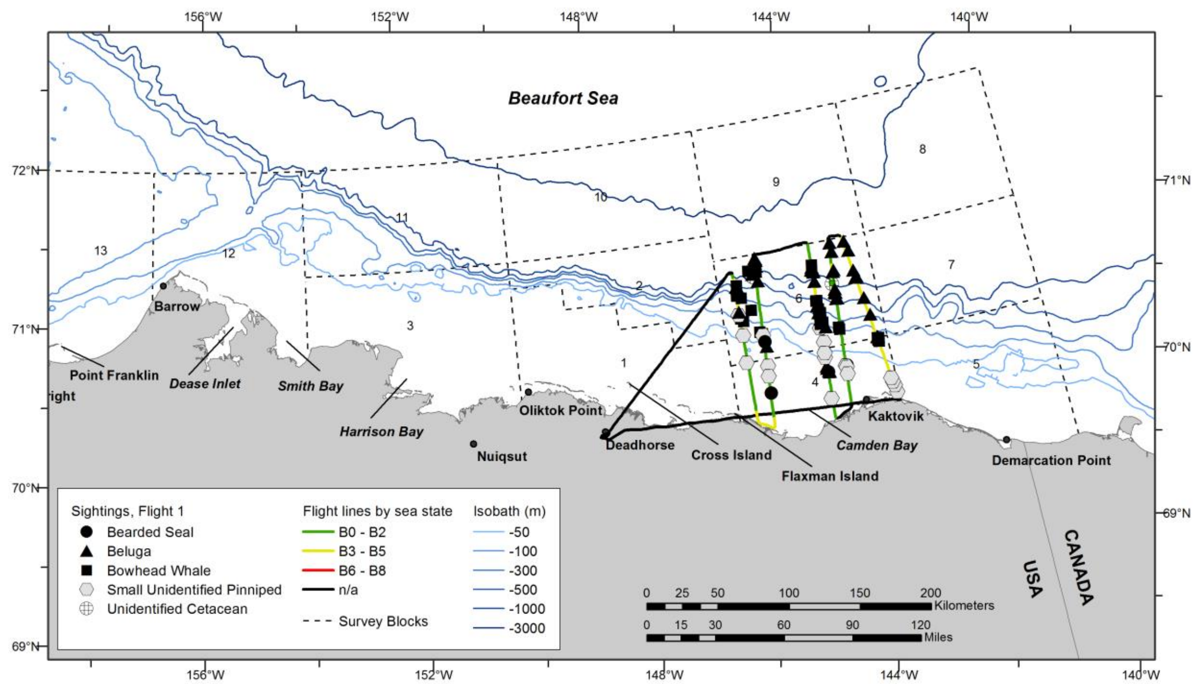

Figure B-10. ASAMM Flight 1 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Bowhead whale cow-calf pair in the western Beaufort Sea seen during flight 1, 19 July 2013.

Bowhead whale breaching in the western Beaufort Sea during flight 1,19 July 2013. This whale breached five times in succession.

20 July 2013, Flight 2

Flight was a survey of portions of blocks 1, 2, and 3. Survey conditions included clear to overcast skies, 1-10 km visibility (with glare, fog, and low ceilings), and Beaufort 0-4 sea states. Ice cover was 0-95% in the area surveyed. Sightings included one beluga and one small unidentified pinniped.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
2	7/20/13 19:19	71.215	149.127	beluga	swim	1	0	2

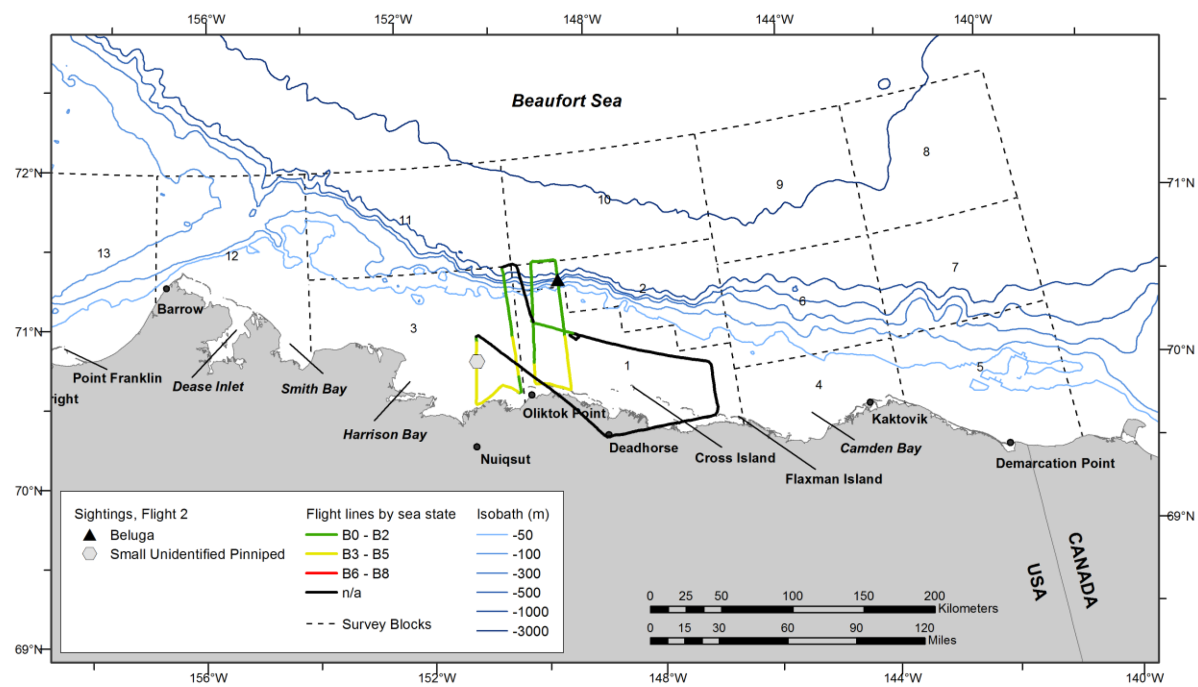

Figure B-11. ASAMM Flight 2 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

20 July 2013, Flight 210

Flight was a partial survey of transect 5, the coastal transect from transect 5 to Barrow, and deadhead effort along the ice edge in support of the USGS walrus satellite-tagging project. Survey conditions included overcast skies, 0-2 km visibility (with fog and low ceilings), and Beaufort 0-1 sea states. Ice cover was 1-90% broken floe in the area surveyed. Sightings included gray whales (including one calf) and walruses.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
210	7/20/13 13:05	71.242	156.992	gray whale	feed	3	1	12
210	7/20/13 13:12	71.248	156.946	gray whale	dive	1	0	12

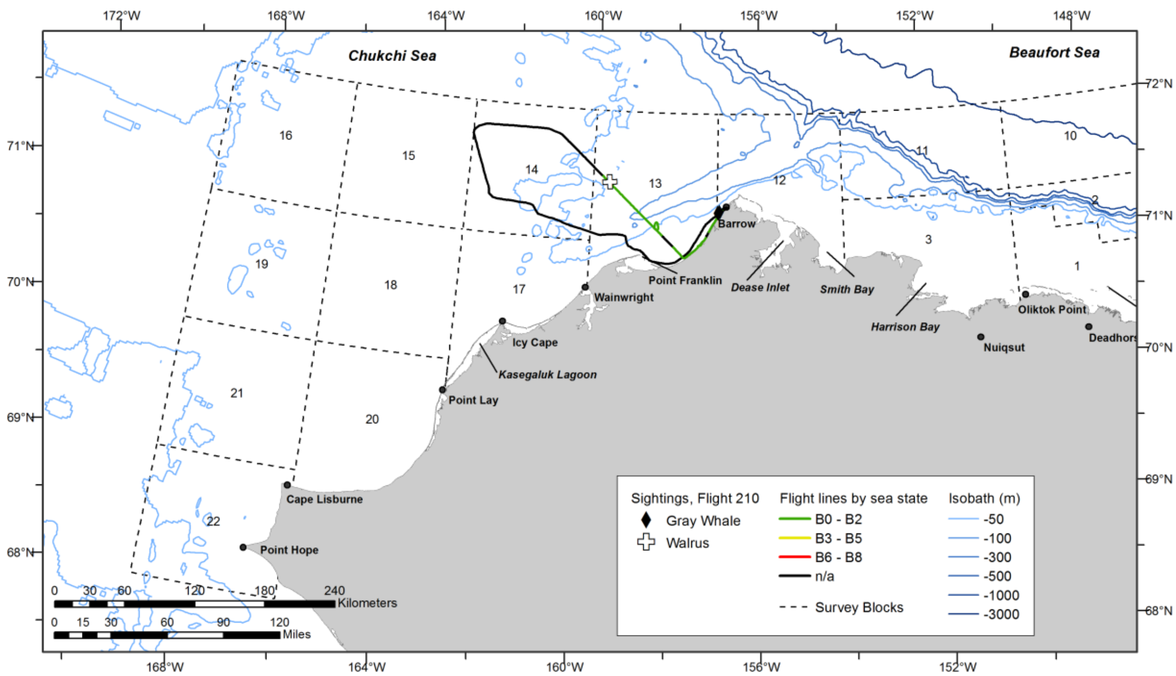

Figure B-12. ASAMM Flight 210 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

21 July 2013, Flight 3

Flight was a survey of portions of blocks 1 and 2. Survey conditions included clear to overcast skies, 2-10 km visibility (with glare, fog, and haze), and Beaufort 0-4 sea states. Ice cover was 1-95% broken floe in the area surveyed. Sightings included bowhead whales (including two calves), belugas, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
3	7/21/13 13:04	70.771	146.374	bowhead whale	swim	1	0	2
3	7/21/13 13:19	71.034	146.393	bowhead whale	rest	2	1	2
3	7/21/13 13:41	71.064	146.558	bowhead whale	rest	2	1	2
3	7/21/13 14:36	70.968	147.267	beluga	swim	2	0	2
3	7/21/13 14:59	71.157	147.885	beluga	rest	1	0	2

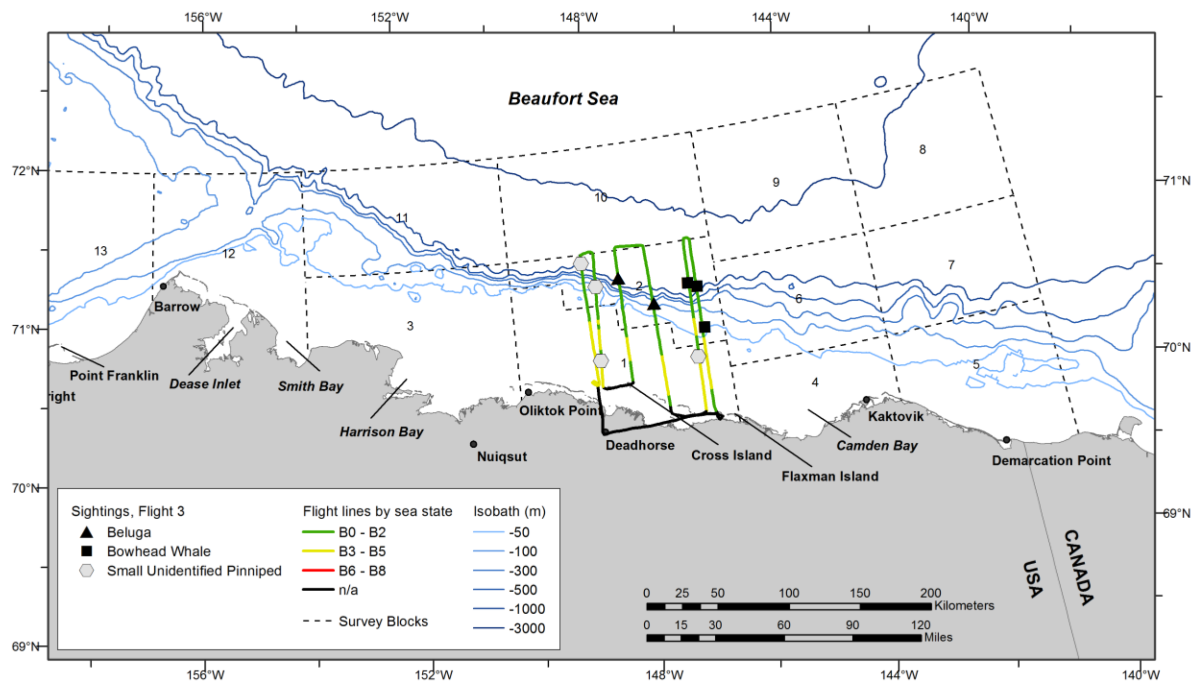

Figure B-13. ASAMM Flight 3 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

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21 July 2013, Flight 211

Flight was a partial survey of transects 5, 7, and 9 and deadhead effort along the ice edge in support of the USGS walrus satellite-tagging project. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with fog and low ceilings), and Beaufort 0-3 sea states. Ice cover was 0-90% broken floe in the area surveyed. Sightings included gray whales (including 23 calves), one beluga, unidentified cetaceans, walruses, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
211	7/21/13 12:57	70.871	160.702	gray whale	feed	1	0	17
211	7/21/13 12:57	70.862	160.685	gray whale	feed	1	0	17
211	7/21/13 13:01	70.782	160.350	gray whale	feed	2	1	17
211	7/21/13 13:03	70.772	160.351	gray whale	feed	2	1	17
211	7/21/13 13:07	70.760	160.329	beluga	swim	1	0	17
211	7/21/13 13:09	70.728	160.130	gray whale	swim	3	1	17
211	7/21/13 13:18	70.786	159.699	gray whale	swim	1	0	13
211	7/21/13 13:20	70.830	159.526	gray whale	mill	2	1	13
211	7/21/13 13:28	70.886	159.252	unid cetacean	dive	1	0	13
211	7/21/13 14:42	71.066	158.249	gray whale	feed	3	2	13
211	7/21/13 14:44	71.064	158.280	gray whale	feed	2	2	13
211	7/21/13 14:45	71.052	158.270	gray whale	feed	2	1	13
211	7/21/13 14:46	71.041	158.228	gray whale	feed	1	0	13
211	7/21/13 14:48	71.024	158.228	gray whale	feed	1	0	13
211	7/21/13 14:49	71.036	158.277	gray whale	feed	2	1	13
211	7/21/13 14:49	71.039	158.254	gray whale	feed	2	1	13
211	7/21/13 14:50	71.042	158.284	gray whale	feed	2	1	13
211	7/21/13 14:51	71.020	158.198	gray whale	feed	1	0	13
211	7/21/13 14:52	71.011	158.190	gray whale	feed	2	1	13
211	7/21/13 14:52	71.004	158.218	gray whale	feed	4	2	13
211	7/21/13 14:52	71.011	158.254	gray whale	feed	2	1	13
211	7/21/13 14:53	71.016	158.227	gray whale	feed	2	1	13
211	7/21/13 14:56	71.024	158.114	gray whale	feed	3	0	13
211	7/21/13 14:56	71.031	158.139	gray whale	feed	2	1	13
211	7/21/13 14:57	71.030	158.142	gray whale	feed	2	1	13
211	7/21/13 14:58	71.017	158.139	gray whale	feed	2	1	13
211	7/21/13 14:58	71.019	158.112	gray whale	feed	2	1	13
211	7/21/13 15:02	71.009	158.157	gray whale	feed	2	1	13
211	7/21/13 15:02	71.009	158.180	gray whale	feed	2	1	13
211	7/21/13 15:02	71.005	158.181	gray whale	feed	1	0	13
211	7/21/13 15:03	71.017	158.147	gray whale	feed	1	0	13
211	7/21/13 15:04	71.003	158.180	gray whale	feed	1	0	13

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
211	7/21/13 15:23	71.241	157.001	unid cetacean	dive	1	0	13

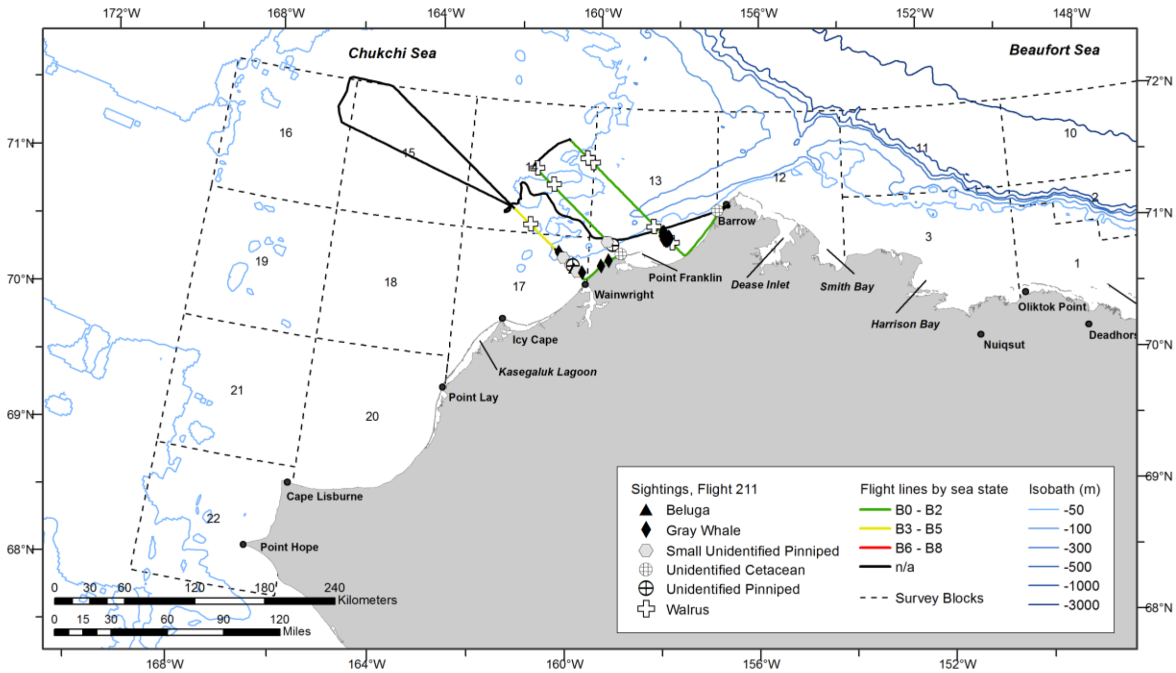
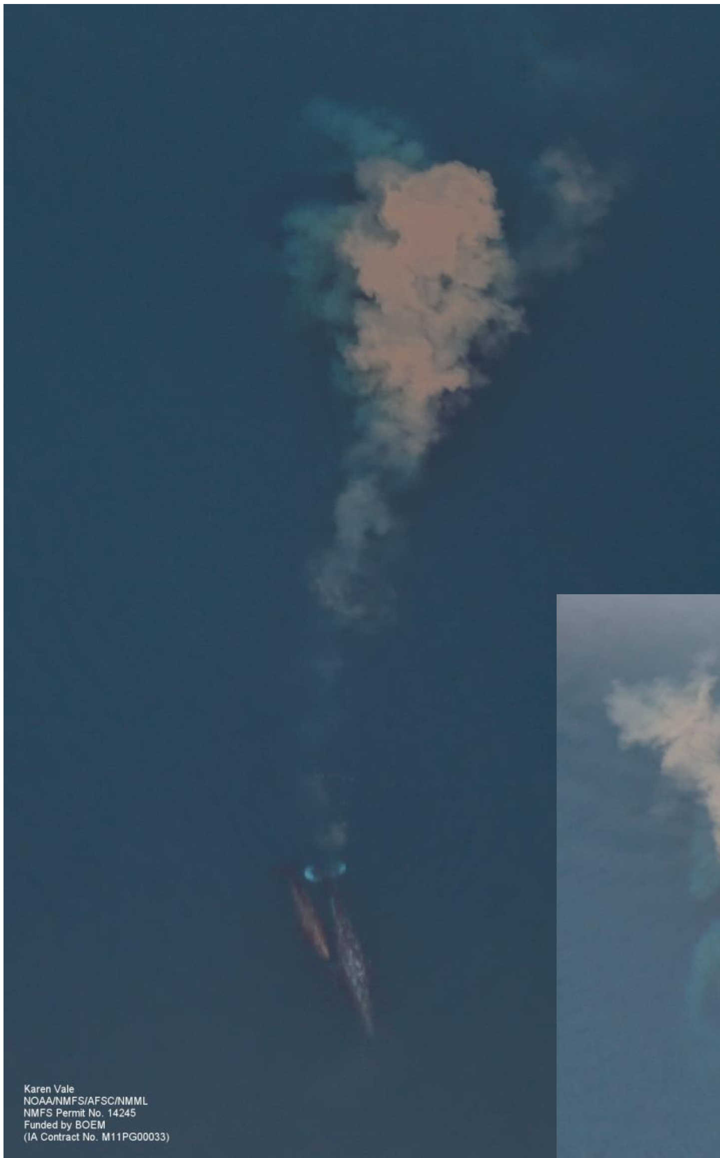
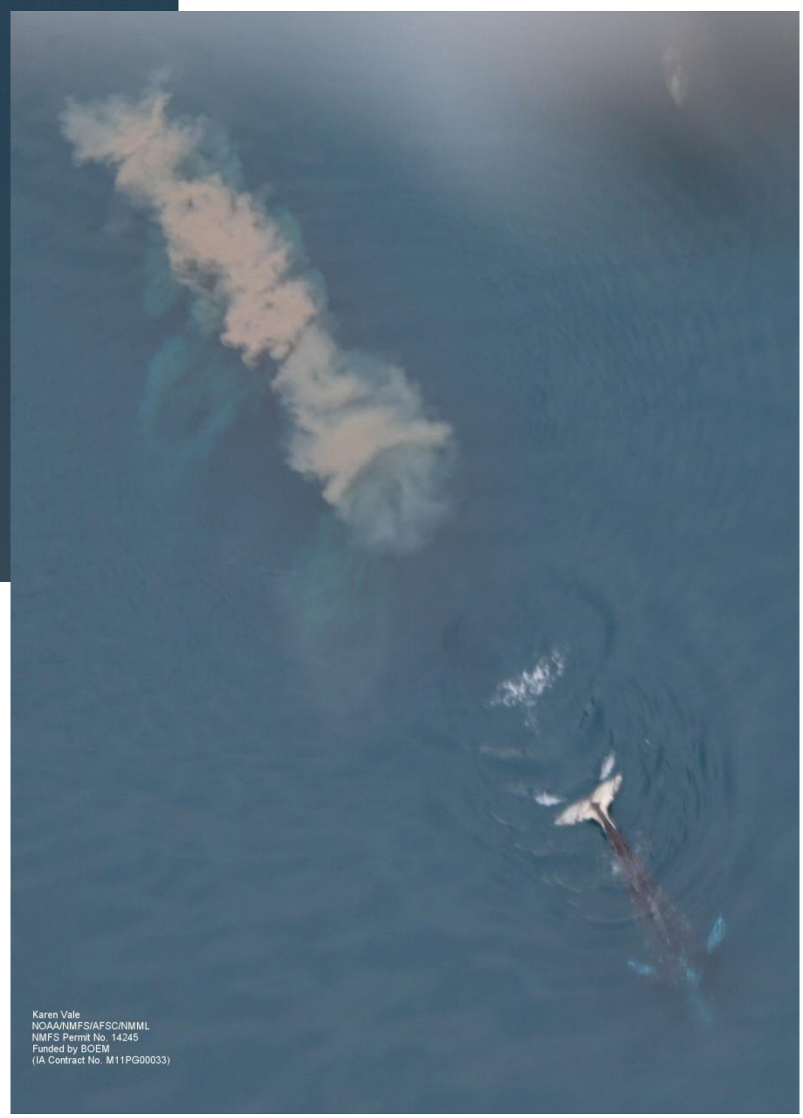


Figure B-14. ASAMM Flight 211 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

White gray whale seen during flight 211, 21 July 2013. This was possibly the same white gray whale seen on 7 July 2013 near Point Lay, Alaska; both white gray whale sightings were of cow-calf pairs.



Left: Gray whale cow-calf pair with mud plume, between Point Franklin and Barrow, seen during flight 211, 21 July 2013.



Right: Feeding gray whale, between Point Franklin and Barrow, seen during flight 211, 21 July 2013.

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22 July 2013, Flight 4

Flight was a survey of portions of blocks 3, 5, 7, and 11. Survey conditions included partly cloudy to overcast skies, <1-10 km visibility (with glare, fog, haze, and precipitation), and Beaufort 0-3 sea states. Ice cover was 0-95% broken floe in the area surveyed. Sightings included bowhead whales (including 3 calves), belugas (including 28 calves), unidentified cetaceans (probable bowhead whales), bearded seals, unidentified pinnipeds, small unidentified pinnipeds, and caribou.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
4	7/22/13 10:41	70.038	140.402	beluga	swim	4	1	5
4	7/22/13 10:50	70.257	140.335	beluga	swim	1	0	5
4	7/22/13 10:51	70.287	140.336	beluga	swim	2	1	5
4	7/22/13 10:52	70.315	140.305	bowhead whale	swim	2	0	5
4	7/22/13 10:53	70.331	140.306	beluga	swim	4	2	5
4	7/22/13 10:56	70.375	140.328	beluga	swim	2	1	5
4	7/22/13 10:59	70.491	140.312	beluga	swim	2	1	5
4	7/22/13 11:10	70.647	140.708	unid cetacean	swim	1	0	7
4	7/22/13 11:13	70.663	140.720	beluga	swim	1	0	7
4	7/22/13 11:18	70.607	140.738	beluga	swim	1	0	7
4	7/22/13 11:21	70.505	140.659	bowhead whale	swim	2	1	7
4	7/22/13 11:22	70.494	140.670	beluga	rest	2	1	5
4	7/22/13 11:23	70.491	140.652	beluga	rest	1	0	5
4	7/22/13 11:41	69.920	140.763	beluga	swim	1	0	5
4	7/22/13 12:01	69.872	141.108	beluga	rest	2	0	5
4	7/22/13 12:05	70.016	141.166	beluga	mill	2	1	5
4	7/22/13 12:05	70.019	141.147	beluga	rest	1	0	5
4	7/22/13 12:07	70.089	141.166	beluga	swim	6	0	5
4	7/22/13 12:08	70.091	141.182	beluga	mill	15	6	5
4	7/22/13 12:13	70.250	141.240	beluga	swim	2	1	5
4	7/22/13 12:13	70.252	141.228	beluga	swim	2	1	5
4	7/22/13 12:18	70.389	141.264	beluga	rest	1	0	5
4	7/22/13 12:18	70.400	141.313	beluga	swim	1	0	5
4	7/22/13 12:22	70.513	141.315	beluga	swim	3	1	7
4	7/22/13 12:23	70.547	141.355	bowhead whale	swim	1	0	7
4	7/22/13 12:24	70.544	141.341	beluga	swim	1	0	7
4	7/22/13 12:26	70.525	141.323	beluga	dive	1	0	7
4	7/22/13 12:27	70.526	141.312	beluga	swim	1	0	7
4	7/22/13 12:27	70.525	141.330	beluga	mill	1	0	7
4	7/22/13 12:27	70.525	141.341	beluga	mill	1	0	7
4	7/22/13 12:28	70.525	141.354	beluga	dive	1	0	7
4	7/22/13 12:35	70.871	141.398	beluga	dive	1	0	7

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
4	7/22/13 12:36	70.883	141.406	beluga	dive	1	0	7
4	7/22/13 12:37	70.929	141.394	beluga	dive	1	0	7
4	7/22/13 12:39	70.980	141.402	beluga	rest	2	1	7
4	7/22/13 12:39	70.996	141.405	beluga	rest	2	1	7
4	7/22/13 12:48	71.129	141.709	beluga	swim	1	0	7
4	7/22/13 12:48	71.113	141.706	beluga	swim	2	1	7
4	7/22/13 12:53	70.953	141.771	beluga	rest	2	0	7
4	7/22/13 12:57	70.831	141.764	beluga	rest	1	0	7
4	7/22/13 13:00	70.725	141.792	beluga	dive	1	0	7
4	7/22/13 13:02	70.655	141.803	bowhead whale	swim	3	1	7
4	7/22/13 13:06	70.556	141.822	beluga	rest	1	0	7
4	7/22/13 13:50	70.491	142.361	unid cetacean	swim	1	0	5
4	7/22/13 13:55	70.514	142.370	bowhead whale	rest	4	0	7
4	7/22/13 13:58	70.530	142.355	beluga	rest	6	0	7
4	7/22/13 14:00	70.536	142.338	bowhead whale	rest	1	0	7
4	7/22/13 14:04	70.674	142.308	beluga	dive	1	0	7
4	7/22/13 14:04	70.687	142.320	beluga	rest	1	0	7
4	7/22/13 14:05	70.699	142.364	beluga	rest	1	0	7
4	7/22/13 14:05	70.711	142.345	beluga	rest	2	1	7
4	7/22/13 14:05	70.721	142.357	beluga	rest	1	0	7
4	7/22/13 14:08	70.811	142.379	beluga	rest	1	1	7
4	7/22/13 14:08	70.812	142.359	beluga	swim	2	1	7
4	7/22/13 14:09	70.815	142.390	beluga	rest	1	0	7
4	7/22/13 14:16	71.056	142.397	beluga	rest	1	0	7
4	7/22/13 14:17	71.094	142.393	beluga	rest	1	0	7
4	7/22/13 14:19	71.143	142.429	beluga	rest	1	0	7
4	7/22/13 14:23	71.183	142.778	beluga	rest	1	0	8
4	7/22/13 14:23	71.177	142.795	beluga	dive	1	0	8
4	7/22/13 14:27	71.090	142.924	beluga	rest	1	0	7
4	7/22/13 14:28	71.056	142.886	bowhead whale	swim	1	1	7
4	7/22/13 14:30	71.053	142.897	beluga	swim	1	0	7
4	7/22/13 14:30	71.049	142.893	unid cetacean	rest	1	0	7
4	7/22/13 14:33	71.011	142.882	beluga	swim	4	2	7
4	7/22/13 14:33	71.004	142.837	bowhead whale	swim	2	0	7
4	7/22/13 14:34	70.994	142.891	bowhead whale	rest	2	0	7
4	7/22/13 14:34	70.992	142.875	beluga	swim	5	0	7
4	7/22/13 14:38	70.951	142.882	beluga	dive	1	1	7
4	7/22/13 17:21	71.594	151.689	bowhead whale	rest	1	0	11
4	7/22/13 17:23	71.601	151.673	beluga	swim	3	1	11
4	7/22/13 19:10	71.556	150.224	beluga	rest	1	0	11
4	7/22/13 19:11	71.544	150.227	beluga	rest	2	1	11
4	7/22/13 19:11	71.523	150.222	beluga	dive	1	0	11

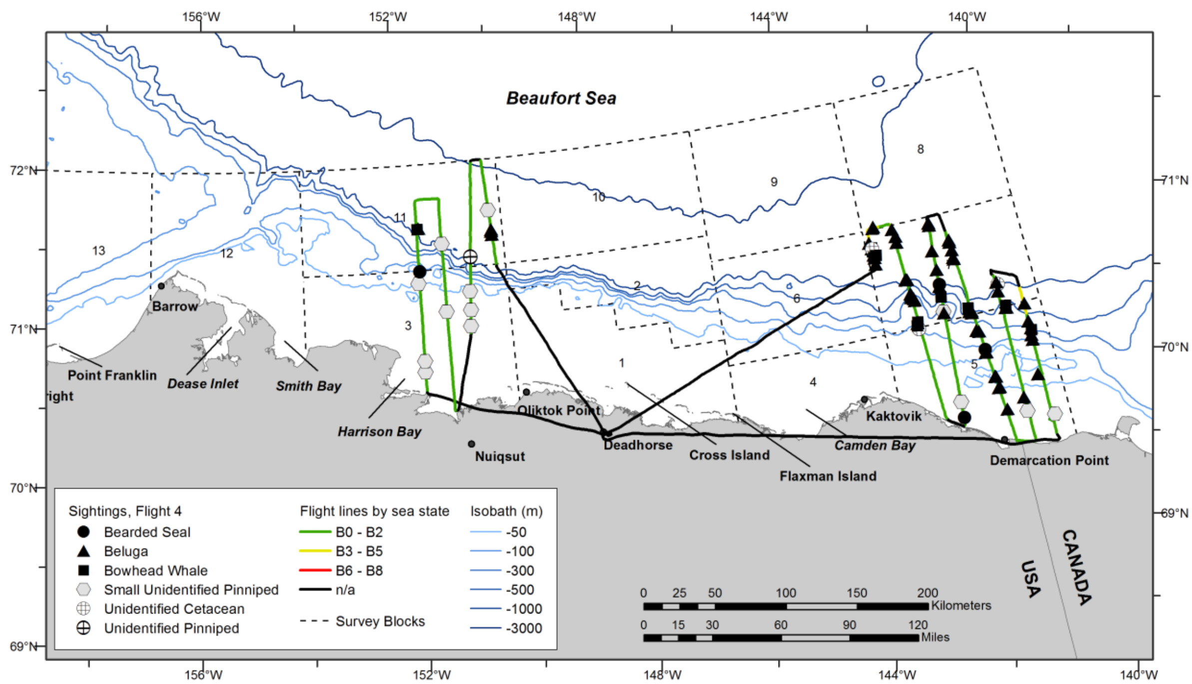

Figure B-15. ASAMM Flight 4 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Caribou sighted on the beach east of Demarcation Bay in the western Beaufort Sea during flight 4, 22 July 2013.

23 July 2013, Flight 212

Flight was a partial survey of the coastal transect north of Point Franklin; flight was aborted due to connectivity problems with the aircraft's satellite phone. Survey conditions included overcast skies, 2-5 km visibility (with low ceilings), and Beaufort 4-5 sea states. Ice cover was 0-40% broken floe in the area surveyed. No sightings were observed.

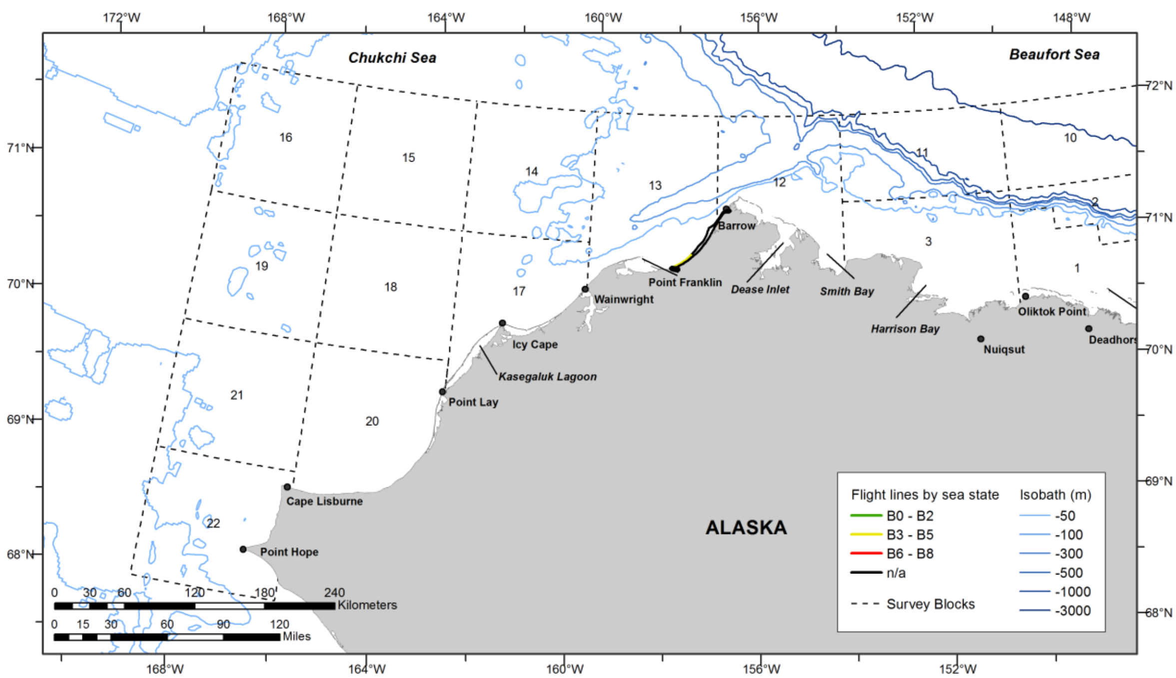

Figure B-16. ASAMM Flight 212 survey track, depicted by sea state.

24 July 2013, Flight 5

Flight was a survey of block 3; however, there was minimal effort due to extensive low ceilings. Survey conditions included overcast skies, 0-10 km visibility (with low ceilings), and Beaufort 3-7 sea states. Ice cover was 20-22% broken floe in the area surveyed. No sightings were observed.

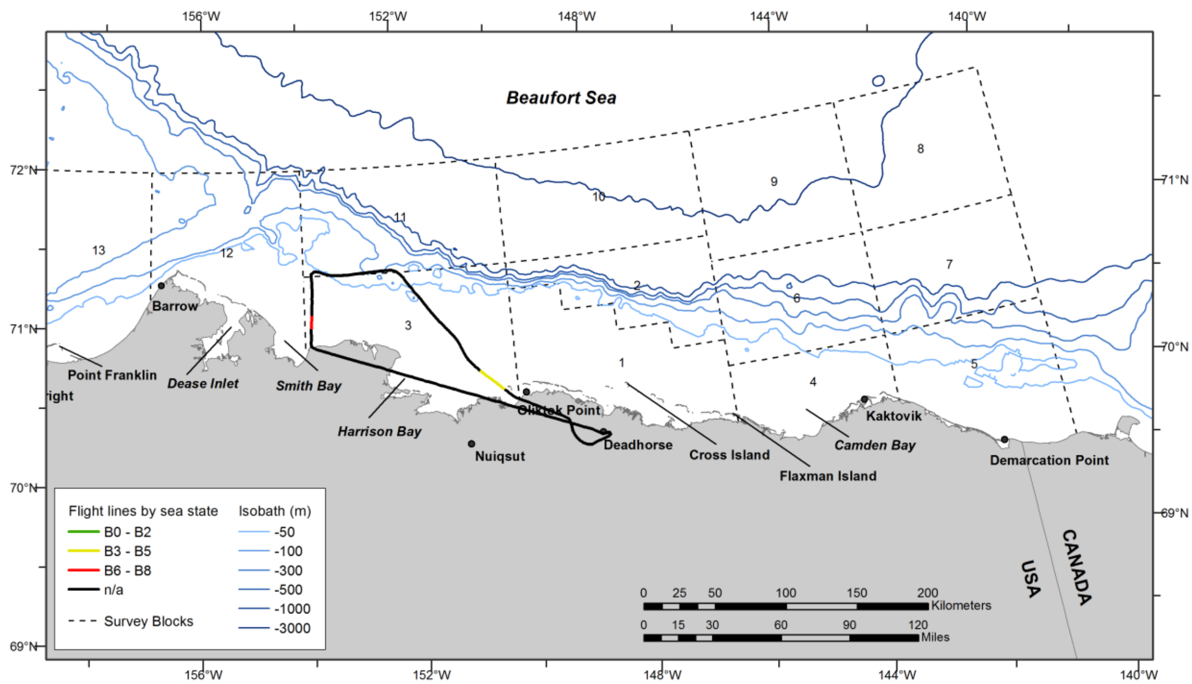

Figure B-17. ASAMM Flight 5 survey track, depicted by sea state.

25 July 2013, Flight 213

Flight was a partial survey of transects 2, 4, 6, and 8. Survey conditions included overcast to partly cloudy skies, <1-10 km visibility (with low ceilings, fog, rain, haze, and glare), and Beaufort 1-7 sea states. Ice cover was 0-95% broken floe in the area surveyed. Sightings included gray whales (including two calves), one unidentified cetacean, walruses, bearded seals, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
213	7/25/13 15:38	71.065	157.838	gray whale	swim	2	1	13
213	7/25/13 15:39	71.088	157.942	gray whale	feed	1	0	13
213	7/25/13 15:43	71.092	157.912	gray whale	feed	1	0	13
213	7/25/13 15:44	71.083	157.945	gray whale	feed	1	0	13
213	7/25/13 15:47	71.103	158.145	gray whale	swim	1	0	13
213	7/25/13 17:38	71.241	161.274	gray whale	feed	2	1	14
213	7/25/13 17:52	71.044	160.606	unid cetacean	swim	1	0	14

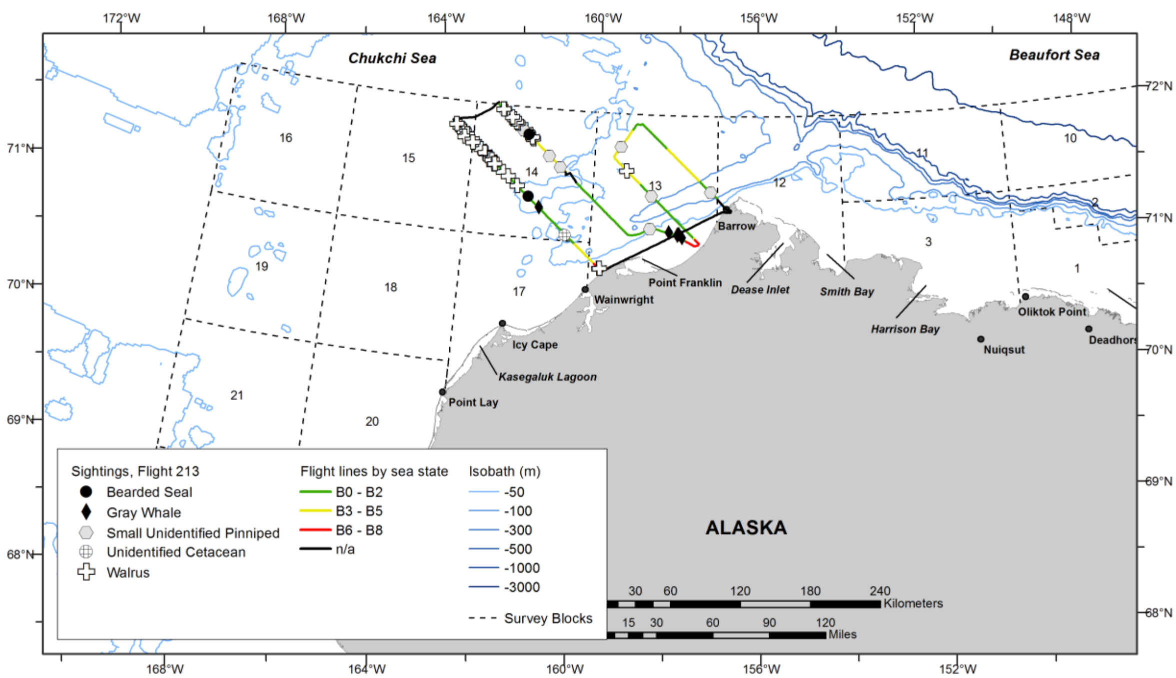

Figure B-18. ASAMM Flight 213 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

26 July 2013, Flight 6

Flight was a survey of portions of blocks 4 and 6, and deadhead effort in blocks 3 and 11 to find weather suitable for surveying. Survey conditions included partly cloudy to overcast skies, <1-10 km visibility (with fog, low ceilings, glare, and haze), and Beaufort 0-6 sea states. Ice cover was 0-95% broken floe in the area surveyed. Sightings included bowhead whales (including one calf), belugas (including two calves), and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
6	7/26/13 10:58	71.017	145.594	beluga	swim	1	0	6
6	7/26/13 11:40	70.429	145.324	bowhead whale	swim	2	1	4
6	7/26/13 11:58	70.964	145.172	beluga	rest	1	0	6
6	7/26/13 11:59	70.995	145.152	beluga	swim	3	1	6
6	7/26/13 12:00	71.002	145.200	beluga	swim	1	0	6
6	7/26/13 12:00	71.006	145.183	bowhead whale	swim	1	0	6
6	7/26/13 12:00	71.011	145.172	beluga	swim	1	0	6
6	7/26/13 12:00	71.008	145.152	beluga	swim	6	1	6
6	7/26/13 12:21	70.960	144.699	beluga	swim	1	0	6
6	7/26/13 12:21	70.958	144.713	beluga	swim	1	0	6
6	7/26/13 12:21	70.952	144.695	beluga	swim	2	0	6
6	7/26/13 12:21	70.952	144.724	beluga	swim	2	0	6
6	7/26/13 12:24	70.830	144.684	beluga	swim	1	0	6
6	7/26/13 12:59	70.243	144.242	beluga	rest	1	0	4
6	7/26/13 13:00	70.263	144.252	bowhead whale	swim	1	0	4
6	7/26/13 13:20	70.713	144.171	beluga	swim	1	0	6
6	7/26/13 13:49	70.567	143.823	bowhead whale	feed	1	0	6

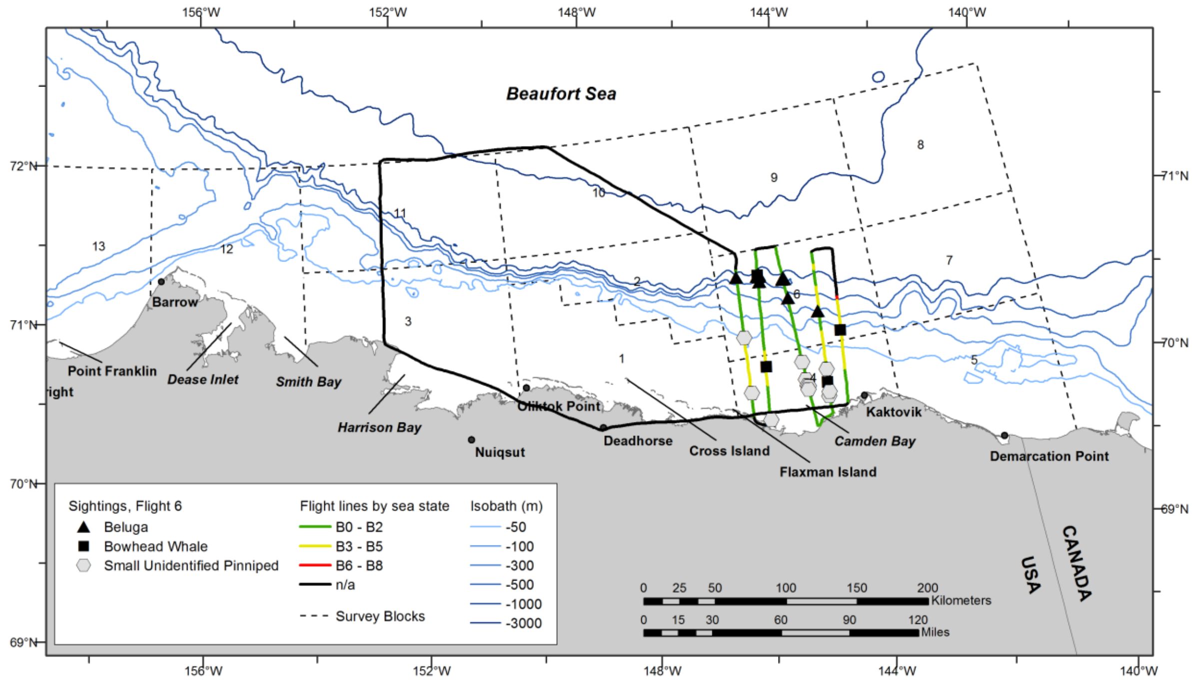

Figure B-19. ASAMM Flight 6 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

28 July 2013, Flight 7

Flight was a survey of portions of blocks 1, 2, and 10. Survey conditions included overcast skies, <1-10 km visibility (with glare and fog), and Beaufort 1-2 sea states. Ice cover was 0-90% broken floe in the area surveyed. Sightings included one bowhead whale, belugas (including one calf), one bearded seal, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
7	7/28/13 10:25	71.513	149.246	beluga	swim	4	1	10
7	7/28/13 10:30	71.358	149.160	beluga	rest	1	0	10
7	7/28/13 10:35	71.206	149.144	beluga	swim	1	0	2
7	7/28/13 11:10	70.867	148.861	bowhead whale	feed	1	0	1

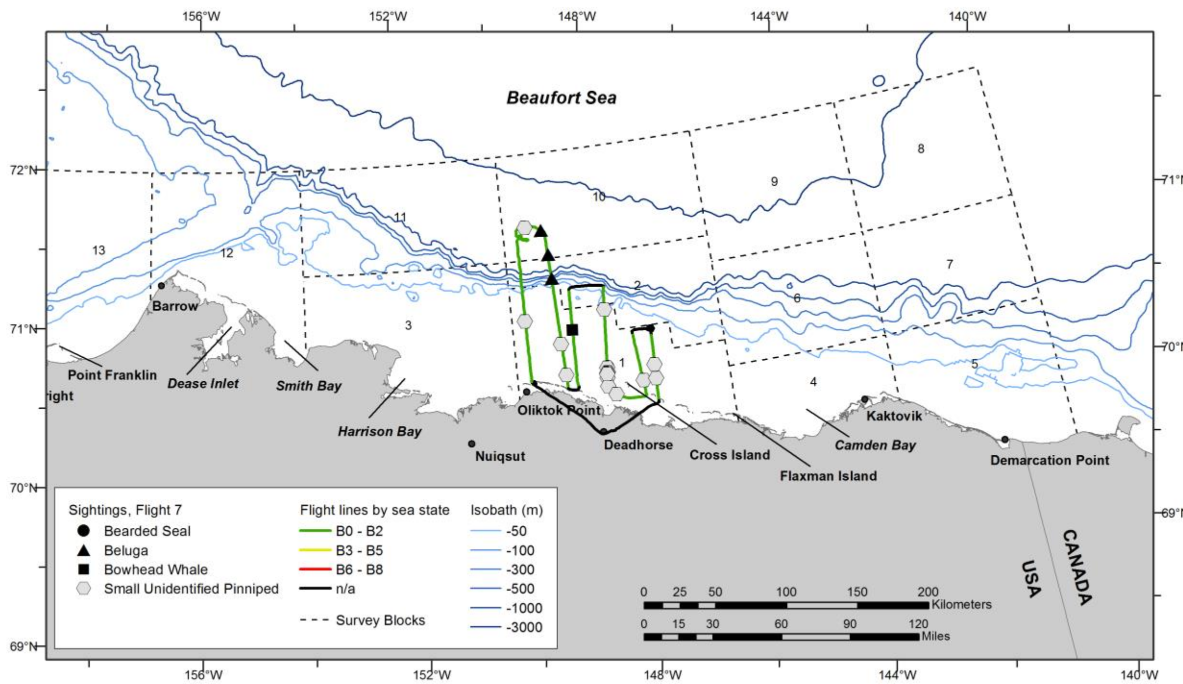

Figure B-20. ASAMM Flight 7 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

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30 July 2013, Flight 8

Flight was a survey of portions of blocks 1 and 2. Survey conditions included partly cloudy to overcast skies, 1-10 km visibility (with glare, haze, fog, low ceilings, and precipitation), and Beaufort 1-3 sea states. Ice cover was 7-85% broken floe sea ice with patches of grease ice in the area surveyed. Sightings included bowhead whales (including one calf), belugas (including nine calves), bearded seals, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
8	7/30/13 14:28	70.596	146.148	bowhead whale	swim	2	1	1
8	7/30/13 14:43	70.905	146.176	beluga	swim	1	0	2
8	7/30/13 14:43	70.916	146.183	beluga	swim	3	1	2
8	7/30/13 14:43	70.924	146.174	beluga	swim	3	0	2
8	7/30/13 14:51	71.191	146.224	beluga	swim	1	0	2
8	7/30/13 15:04	71.225	146.849	beluga	swim	1	0	2
8	7/30/13 15:08	71.071	146.801	beluga	rest	1	0	2
8	7/30/13 15:09	71.059	146.818	beluga	swim	6	2	2
8	7/30/13 15:15	70.997	146.793	beluga	swim	2	1	2
8	7/30/13 15:16	70.986	146.801	beluga	swim	1	0	2
8	7/30/13 15:16	70.982	146.766	beluga	rest	1	0	2
8	7/30/13 15:16	70.969	146.770	beluga	rest	2	1	2
8	7/30/13 15:29	70.552	146.663	beluga	rest	1	0	1
8	7/30/13 16:11	70.922	147.337	bowhead whale	breach	1	0	2
8	7/30/13 16:16	71.000	147.348	beluga	swim	2	1	2
8	7/30/13 16:17	71.054	147.347	beluga	swim	2	0	2
8	7/30/13 16:19	71.124	147.320	beluga	swim	1	0	2
8	7/30/13 16:22	71.216	147.312	beluga	swim	2	1	2
8	7/30/13 16:22	71.229	147.326	beluga	swim	2	0	2
8	7/30/13 16:22	71.236	147.317	beluga	swim	1	0	2
8	7/30/13 16:32	71.298	147.852	beluga	swim	3	1	2
8	7/30/13 16:33	71.286	147.848	beluga	swim	2	1	2
8	7/30/13 16:39	71.074	147.802	beluga	swim	4	0	2
8	7/30/13 16:46	70.920	147.758	beluga	swim	1	0	2

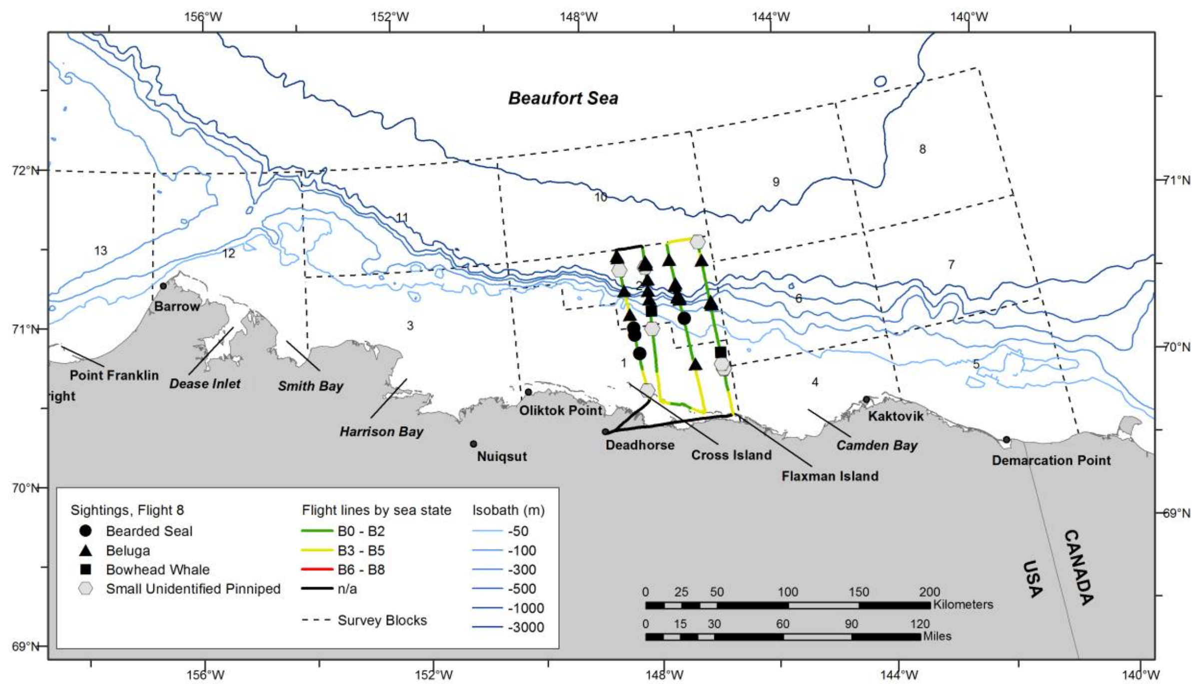

Figure B-21. ASAMM Flight 8 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

The survey team leading off the 2013 ASAMM surveys in the western Beaufort Sea (left to right): Megan Ferguson, Dan Twyman, Jake Turner (couldn't wait to take off his flight suit!), John Siegel, and Vicki Beaver. Photo by Vicki Beaver.

1 August 2013, Flight 214

Flight was a partial survey of transects 10 and 12, complete survey of transect 29, and the coastal transect from south of Cape Lisburne to Barrow. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with low ceilings, fog, haze, and glare), and Beaufort 2-6 sea states. There was no sea ice observed in the area surveyed. Sightings included gray whales (including one calf and one dead), one fin whale, unidentified cetaceans (including one dead), walruses (including three dead), unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
214	8/1/13 13:11	70.653	162.402	unid cetacean	rest	1	0	17
214	8/1/13 13:51	70.785	159.791	gray whale	swim	1	0	13
214	8/1/13 14:27	71.261	156.912	unid cetacean	swim	1	0	12
214	8/1/13 17:14	68.689	168.950	gray whale	dead	1	0	22
214	8/1/13 17:38	68.720	167.045	unid cetacean	dead	1	0	22
214	8/1/13 17:42	68.775	167.032	unid cetacean	swim	1	0	22
214	8/1/13 17:47	68.770	167.036	fin whale	swim	1	0	22
214	8/1/13 19:18	70.353	161.952	gray whale	swim	2	1	17
214	8/1/13 19:25	70.348	161.868	gray whale	feed	1	0	17
214	8/1/13 19:29	70.331	161.667	gray whale	swim	2	0	17

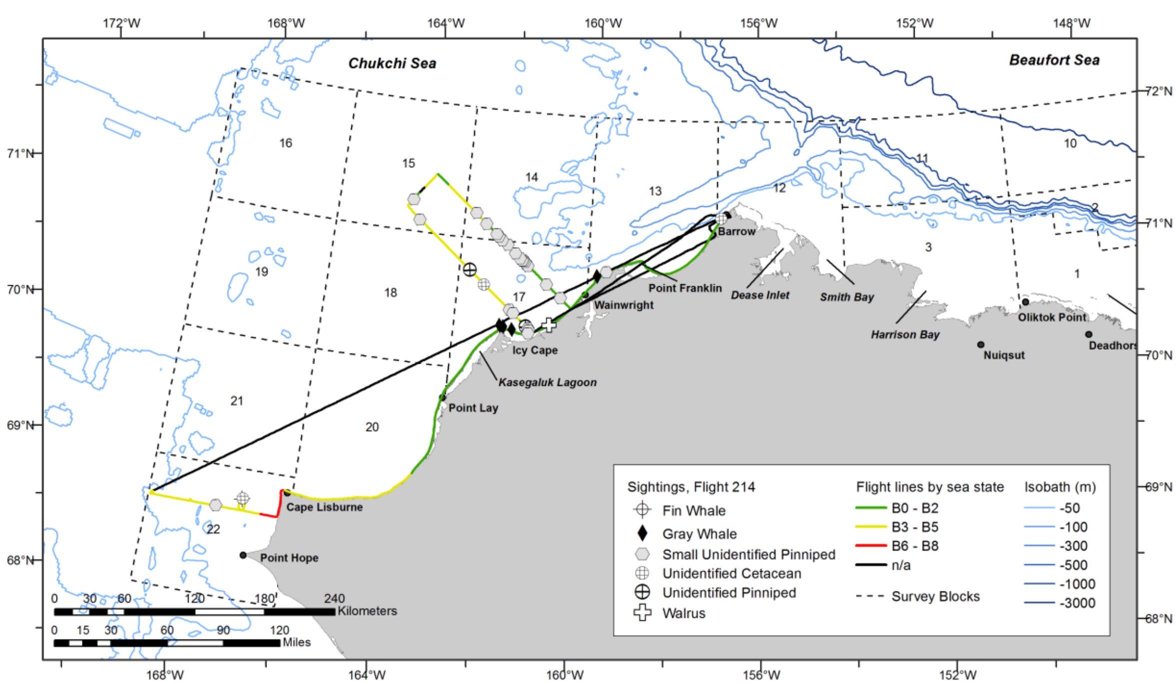

Figure B-22. ASAMM Flight 214 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

2 August 2013, Flight 215

Flight was a survey of portions of block 12. Survey conditions included partly cloudy skies, 0-3 km visibility (with fog), and Beaufort 1 sea state. Ice cover was 20-50% broken floe in the area surveyed. Sightings included one walrus.

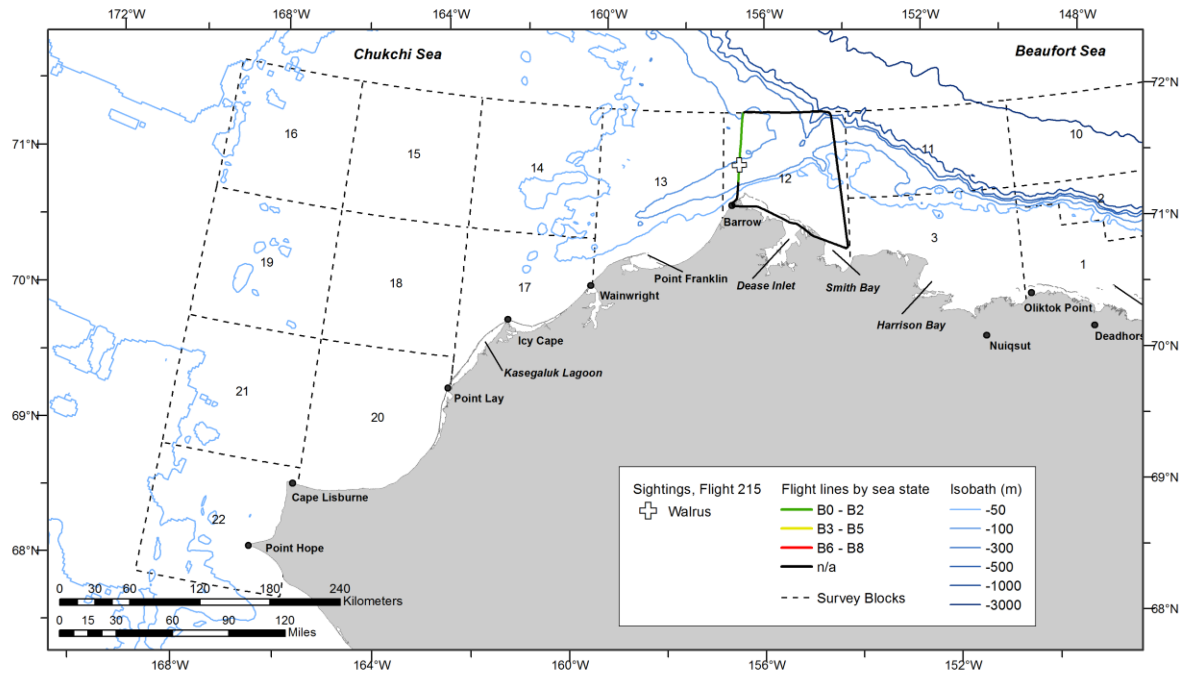

Figure B-23. ASAMM Flight 215 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

4 August 2013, Flight 9

Flight was a survey of portions of blocks 4, 5, 6, and 7. Survey conditions included partly cloudy to overcast skies, 3-10 km visibility (with glare), and Beaufort 0-2 sea states. Ice cover was 0-80% broken floe sea ice in the area surveyed. Sightings included bowhead whales (including 2 calves), belugas (including 10 calves), one unidentified cetacean, one small unidentified marine mammal, bearded seals, small unidentified pinnipeds, and polar bears. Both polar bears were seen approximately 90 km from land in a region of 75% ice cover.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
9	8/4/13 17:25	70.315	143.179	bowhead whale	rest	1	0	4
9	8/4/13 17:27	70.317	143.181	bowhead whale	swim	1	0	4
9	8/4/13 17:28	70.333	143.140	bowhead whale	swim	1	0	4
9	8/4/13 17:29	70.330	143.201	bowhead whale	swim	1	0	4
9	8/4/13 17:30	70.362	143.189	bowhead whale	swim	2	0	4
9	8/4/13 17:31	70.384	143.170	bowhead whale	swim	2	0	4
9	8/4/13 17:32	70.416	143.149	bowhead whale	swim	1	0	4
9	8/4/13 17:36	70.477	143.250	bowhead whale	mill	2	1	4
9	8/4/13 17:37	70.468	143.241	bowhead whale	swim	1	0	4
9	8/4/13 17:39	70.470	143.261	bowhead whale	swim	3	0	4
9	8/4/13 17:41	70.466	143.310	beluga	swim	1	0	4
9	8/4/13 17:44	70.537	143.263	bowhead whale	swim	2	0	6
9	8/4/13 17:46	70.602	143.221	beluga	swim	3	0	6
9	8/4/13 17:47	70.611	143.257	beluga	swim	7	0	6
9	8/4/13 17:47	70.622	143.254	beluga	swim	2	0	6
9	8/4/13 17:49	70.710	143.301	beluga	swim	2	0	6
9	8/4/13 17:52	70.786	143.309	beluga	swim	1	0	6
9	8/4/13 17:52	70.819	143.308	beluga	swim	1	0	6
9	8/4/13 17:54	70.883	143.347	beluga	swim	10	1	6
9	8/4/13 17:56	70.931	143.334	beluga	swim	2	1	6
9	8/4/13 17:57	70.996	143.352	beluga	swim	2	1	6
9	8/4/13 18:08	71.200	142.806	bowhead whale	swim	1	0	8
9	8/4/13 18:13	71.171	142.705	beluga	swim	1	0	8
9	8/4/13 18:22	70.864	142.740	beluga	swim	1	0	7
9	8/4/13 18:28	70.659	142.796	beluga	swim	3	1	7
9	8/4/13 18:36	70.387	142.827	bowhead whale	tail slap	1	0	5
9	8/4/13 18:37	70.381	142.819	bowhead whale	swim	1	0	5
9	8/4/13 18:39	70.381	142.848	bowhead whale	swim	1	0	5
9	8/4/13 19:06	70.086	142.089	beluga	swim	10	3	5
9	8/4/13 19:18	70.462	142.131	bowhead whale	swim	1	0	5
9	8/4/13 19:19	70.480	142.283	bowhead whale	swim	1	0	5
9	8/4/13 19:25	70.450	142.375	bowhead whale	swim	1	1	5

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
9	8/4/13 19:33	70.442	142.311	bowhead whale	swim	1	0	5
9	8/4/13 19:36	70.432	142.283	bowhead whale	swim	1	0	5
9	8/4/13 19:37	70.420	142.359	bowhead whale	swim	6	0	5
9	8/4/13 19:43	70.470	142.156	bowhead whale	swim	1	0	5
9	8/4/13 19:45	70.549	142.188	beluga	swim	1	0	7
9	8/4/13 19:45	70.559	142.173	beluga	swim	1	0	7
9	8/4/13 19:46	70.571	142.185	beluga	swim	2	0	7
9	8/4/13 19:50	70.706	142.199	beluga	swim	3	1	7
9	8/4/13 20:11	71.102	141.812	beluga	swim	1	0	7
9	8/4/13 20:16	70.946	141.769	beluga	mill	2	1	7
9	8/4/13 20:20	70.795	141.755	beluga	swim	1	0	7
9	8/4/13 20:28	70.532	141.790	beluga	swim	1	0	7
9	8/4/13 20:28	70.529	141.778	beluga	swim	1	0	7
9	8/4/13 20:28	70.514	141.776	beluga	swim	5	1	7
9	8/4/13 20:29	70.496	141.796	beluga	swim	1	0	5
9	8/4/13 20:29	70.468	141.734	unid cetacean	swim	1	0	5
9	8/4/13 20:35	70.255	141.769	bowhead whale	swim	1	0	5
9	8/4/13 20:39	70.134	141.706	bowhead whale	swim	1	0	5
9	8/4/13 20:40	70.116	141.690	bowhead whale	swim	1	0	5
9	8/4/13 20:42	70.076	141.793	bowhead whale	breach	1	0	5
9	8/4/13 20:43	70.038	141.736	bowhead whale	unknown	1	0	5

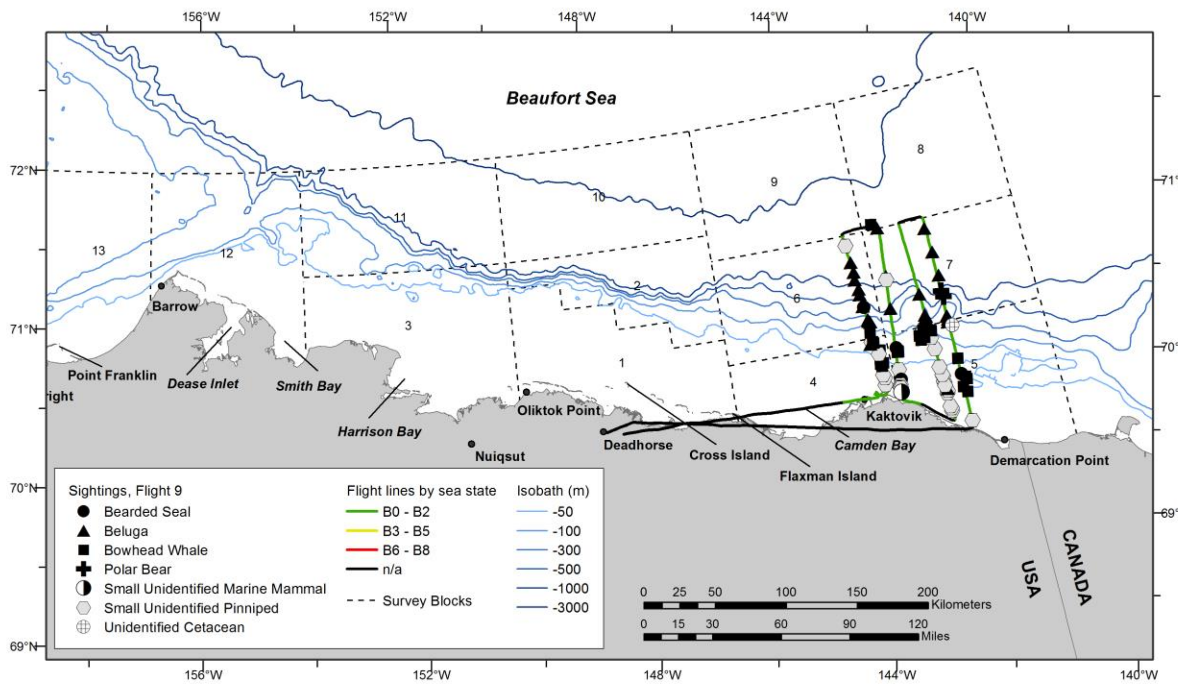

Figure B-24. ASAMM Flight 9 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Bowhead whale tail-slapping in the western Beaufort Sea northeast of Kaktovik, Alaska, during flight 9, 4 August 2013.

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5 August 2013, Flight 10

Flight was a survey of portions of blocks 5 and 7. Survey conditions included partly cloudy skies, 0-10 km visibility (with glare and fog), and Beaufort 1-4 sea states. Ice cover was 0-30% broken floe in the area surveyed. Sightings included bowhead whales (including 7 calves), belugas (including 31 calves), unidentified cetaceans, bearded seals, and small unidentified pinnipeds. There were two separate incidences of bowhead whales with logs, one a cow-calf pair and the other a single whale.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
10	8/5/13 15:58	69.814	140.163	bowhead whale	swim	1	0	5
10	8/5/13 16:09	70.185	140.136	beluga	swim	6	2	5
10	8/5/13 16:10	70.197	140.131	beluga	rest	1	0	5
10	8/5/13 16:15	70.304	140.188	beluga	swim	1	0	5
10	8/5/13 16:16	70.348	140.168	beluga	swim	2	1	5
10	8/5/13 16:17	70.354	140.185	beluga	swim	1	0	5
10	8/5/13 16:17	70.357	140.185	beluga	rest	2	1	5
10	8/5/13 16:17	70.361	140.171	bowhead whale	swim	2	1	5
10	8/5/13 16:18	70.365	140.135	beluga	swim	1	0	5
10	8/5/13 16:18	70.360	140.134	bowhead whale	swim	1	0	5
10	8/5/13 16:21	70.350	140.155	beluga	swim	4	0	5
10	8/5/13 16:21	70.350	140.171	beluga	swim	2	1	5
10	8/5/13 16:23	70.386	140.106	unid cetacean	swim	1	0	5
10	8/5/13 16:24	70.395	140.109	beluga	swim	1	0	5
10	8/5/13 16:24	70.380	140.119	beluga	swim	2	1	5
10	8/5/13 16:27	70.437	140.207	beluga	swim	2	0	5
10	8/5/13 16:29	70.504	140.166	beluga	mill	3	1	7
10	8/5/13 16:31	70.585	140.094	bowhead whale	mill	4	2	7
10	8/5/13 16:31	70.591	140.180	beluga	swim	3	0	7
10	8/5/13 16:34	70.577	140.091	bowhead whale	.	2	0	7
10	8/5/13 16:42	70.611	140.179	beluga	swim	3	1	7
10	8/5/13 16:42	70.622	140.193	beluga	swim	8	4	7
10	8/5/13 16:43	70.632	140.196	beluga	swim	3	1	7
10	8/5/13 16:46	70.741	140.182	beluga	rest	2	1	7
10	8/5/13 16:47	70.780	140.170	beluga	rest	1	0	7
10	8/5/13 16:48	70.811	140.182	beluga	swim	3	1	7
10	8/5/13 16:50	70.873	140.202	beluga	rest	2	0	7
10	8/5/13 16:50	70.887	140.182	bowhead whale	swim	2	1	7
10	8/5/13 17:16	70.963	140.705	beluga	swim	3	1	7
10	8/5/13 17:18	70.908	140.583	bowhead whale	swim	2	1	7
10	8/5/13 17:27	70.841	140.709	beluga	swim	2	1	7
10	8/5/13 17:34	70.606	140.732	beluga	swim	7	2	7

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
10	8/5/13 17:34	70.580	140.714	beluga	swim	4	1	7
10	8/5/13 17:38	70.454	140.732	beluga	swim	1	0	5
10	8/5/13 17:38	70.445	140.745	bowhead whale	swim	1	0	5
10	8/5/13 17:39	70.409	140.720	beluga	swim	3	0	5
10	8/5/13 17:41	70.363	140.752	bowhead whale	swim	1	0	5
10	8/5/13 17:43	70.276	140.770	bowhead whale	swim	2	1	5
10	8/5/13 17:54	70.081	140.816	bowhead whale	log play	2	1	5
10	8/5/13 18:05	70.004	140.752	beluga	swim	20	7	5
10	8/5/13 18:26	69.825	141.377	beluga	swim	3	1	5
10	8/5/13 18:35	70.097	141.360	bowhead whale	.	1	0	5
10	8/5/13 18:36	70.096	141.339	bowhead whale	swim	1	0	5
10	8/5/13 18:38	70.096	141.330	bowhead whale	.	2	0	5
10	8/5/13 18:40	70.115	141.258	bowhead whale	.	1	0	5
10	8/5/13 18:40	70.125	141.365	bowhead whale	swim	1	0	5
10	8/5/13 18:41	70.133	141.281	bowhead whale	.	1	0	5
10	8/5/13 18:41	70.115	141.248	bowhead whale	.	1	0	5
10	8/5/13 18:43	70.114	141.209	bowhead whale	.	2	0	5
10	8/5/13 18:47	70.126	141.342	bowhead whale	unknown	4	0	5
10	8/5/13 18:49	70.157	141.233	bowhead whale	log play	1	0	5
10	8/5/13 18:50	70.167	141.303	bowhead whale	swim	1	0	5
10	8/5/13 18:50	70.159	141.254	bowhead whale	swim	1	0	5
10	8/5/13 18:59	70.353	141.301	beluga	swim	2	1	5
10	8/5/13 19:00	70.368	141.314	beluga	swim	2	0	5
10	8/5/13 19:00	70.385	141.210	bowhead whale	rest	2	0	5
10	8/5/13 19:01	70.395	141.306	beluga	swim	1	0	5
10	8/5/13 19:01	70.401	141.264	beluga	swim	1	0	5
10	8/5/13 19:05	70.459	141.299	beluga	swim	1	0	5
10	8/5/13 19:06	70.467	141.279	beluga	swim	1	0	5
10	8/5/13 19:07	70.523	141.258	beluga	swim	2	0	7
10	8/5/13 19:08	70.533	141.271	bowhead whale	swim	1	0	7
10	8/5/13 19:09	70.587	141.169	unid cetacean	swim	1	0	7
10	8/5/13 19:12	70.669	141.271	beluga	swim	1	0	7
10	8/5/13 19:12	70.689	141.249	beluga	swim	1	0	7
10	8/5/13 19:13	70.697	141.245	beluga	swim	1	1	7
10	8/5/13 19:13	70.707	141.249	beluga	rest	1	1	7
10	8/5/13 19:13	70.714	141.262	beluga	swim	1	0	7

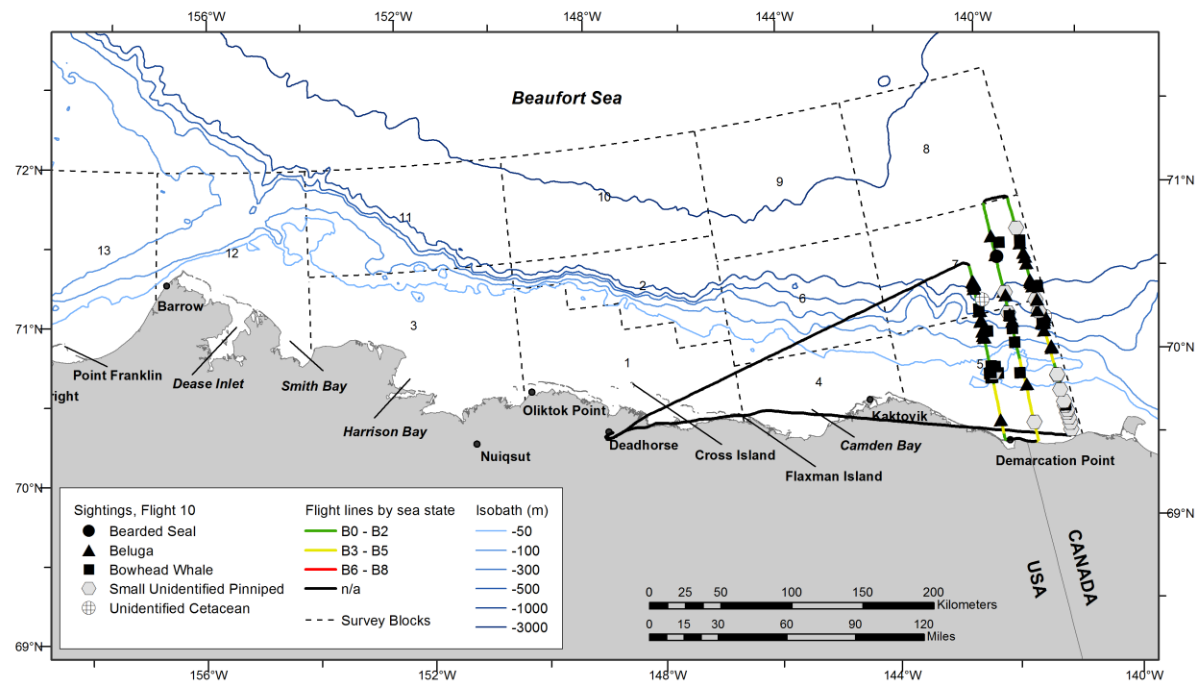

Figure B-25. ASAMM Flight 10 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Bowhead whale cow-calf pair with log in the western Beaufort Sea during flight 10, 5 August 2013. The calf is to the right of the cow.

Bowhead whale with log in the western Beaufort Sea during flight 10, 5 August 2013. The whale's back is flexed as it lifts the log out of the water.

5 August 2013, Flight 216

Flight was a partial survey of transect 32 and search effort in block 22. Survey conditions included partly cloudy skies, <1-10 km visibility (with fog, haze, low ceilings, and glare), and Beaufort 4-7 sea states. There was no sea ice observed in the area surveyed. No sightings were observed.

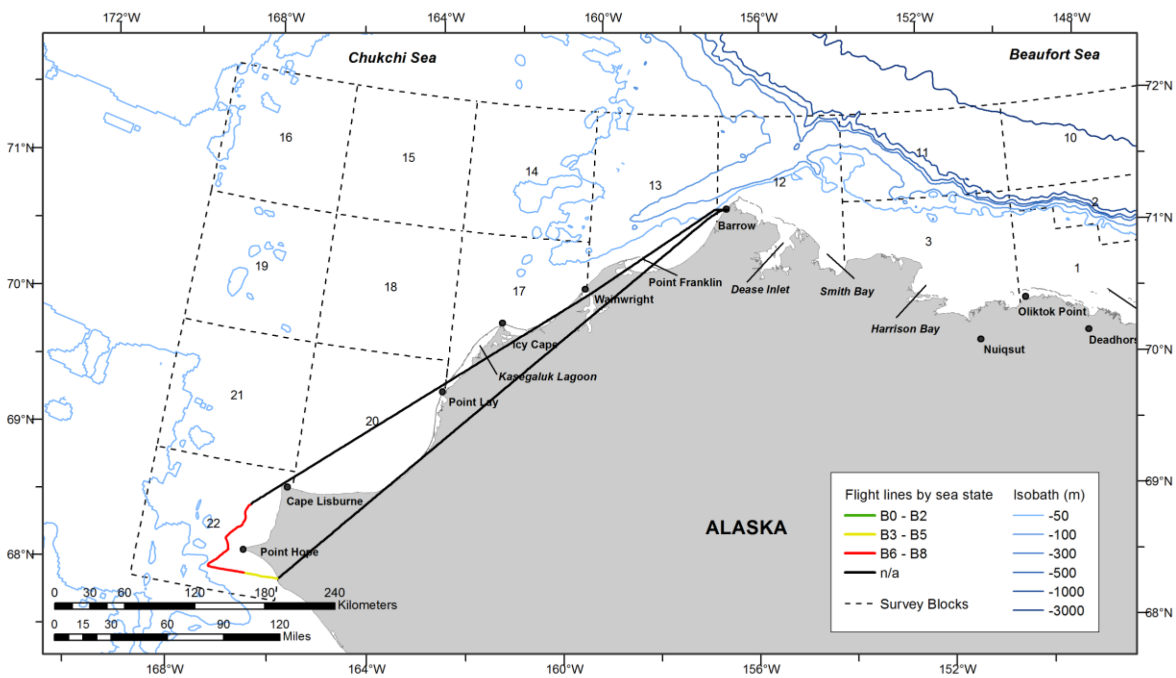

Figure B-26. ASAMM Flight 216 survey track, depicted by sea state.

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7 August 2013, Flight 11

Flight was a survey of portions of blocks 1, 2, 4 and 6. Survey conditions included partly cloudy to clear skies, <1-10 km visibility (with glare and fog), and Beaufort 2-4 sea states. Ice cover was 0-45% broken floe in the area surveyed. Sightings included bowhead whales (including two calves) and belugas (including two calves).

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
11	8/7/13 15:46	70.341	144.812	bowhead whale	swim	1	0	4
11	8/7/13 15:47	70.407	144.951	bowhead whale	swim	1	0	4
11	8/7/13 15:52	70.440	144.810	bowhead whale	swim	1	0	4
11	8/7/13 16:04	70.567	144.786	bowhead whale	swim	2	0	6
11	8/7/13 16:05	70.582	144.791	bowhead whale	swim	1	0	6
11	8/7/13 16:09	70.603	144.749	bowhead whale	swim	1	0	6
11	8/7/13 16:13	70.728	144.710	beluga	swim	1	0	6
11	8/7/13 16:22	70.659	145.152	bowhead whale	swim	2	1	6
11	8/7/13 16:22	70.647	145.148	bowhead whale	swim	1	0	6
11	8/7/13 16:23	70.662	145.179	bowhead whale	rest	2	1	6
11	8/7/13 16:30	70.673	145.224	bowhead whale	rest	1	0	6
11	8/7/13 16:37	70.680	145.205	bowhead whale	mill	2	0	6
11	8/7/13 16:41	70.670	145.278	bowhead whale	rest	1	0	6
11	8/7/13 16:43	70.676	145.245	bowhead whale	mill	1	0	6
11	8/7/13 16:44	70.669	145.253	bowhead whale	mill	1	0	6
11	8/7/13 16:49	70.610	145.085	bowhead whale	rest	1	0	6
11	8/7/13 16:53	70.595	145.115	bowhead whale	dive	1	0	6
11	8/7/13 17:32	70.620	145.942	beluga	swim	20	0	6
11	8/7/13 17:32	70.630	145.933	beluga	swim	6	0	6
11	8/7/13 17:32	70.642	145.920	beluga	swim	4	0	6
11	8/7/13 17:34	70.715	145.910	bowhead whale	rest	1	0	6
11	8/7/13 17:41	70.947	145.904	beluga	rest	1	0	6
11	8/7/13 18:01	70.970	146.156	beluga	swim	2	1	2
11	8/7/13 18:01	70.967	146.157	beluga	swim	3	1	2
11	8/7/13 18:02	70.939	146.142	beluga	swim	1	0	2
11	8/7/13 18:12	70.620	146.149	beluga	swim	1	0	1

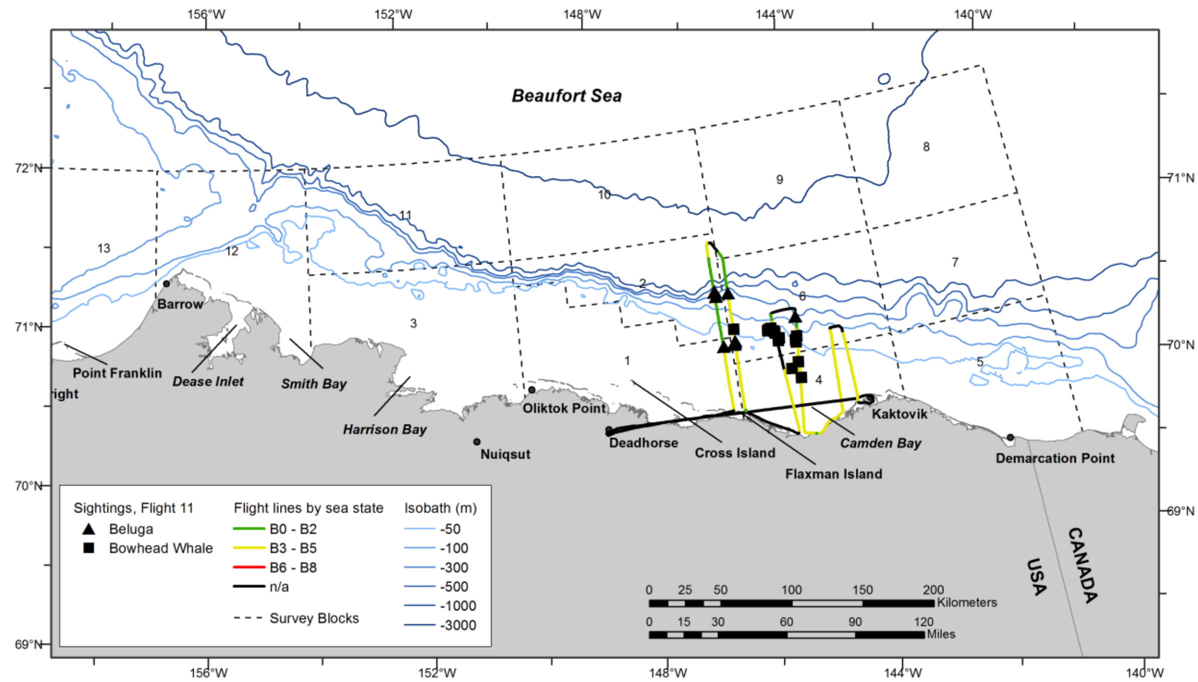

Figure B-27. ASAMM Flight 11 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

7 August 2013, Flight 217

Flight was a partial survey of transects 9 and 11, and the coastal transect from south of Wainwright to Barrow. Survey conditions included partly cloudy skies, no visibility to unlimited visibility (with fog, haze, low ceilings, and glare), and Beaufort 2-6 sea states. Ice cover was 0-25% broken floe sea ice in the area surveyed. Sightings included gray whales (including three calves), belugas, walruses, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
217	8/7/13 15:30	70.892	160.826	gray whale	feed	1	0	17
217	8/7/13 15:30	70.891	160.889	gray whale	feed	2	1	17
217	8/7/13 15:31	70.908	160.847	gray whale	feed	2	0	17
217	8/7/13 15:34	70.895	160.819	gray whale	swim	1	0	17
217	8/7/13 15:35	70.893	160.832	gray whale	feed	1	0	17
217	8/7/13 18:15	70.416	160.664	beluga	rest	1	0	17
217	8/7/13 18:43	70.929	158.755	gray whale	mill	3	2	13
217	8/7/13 19:25	71.225	156.946	beluga	swim	1	0	12

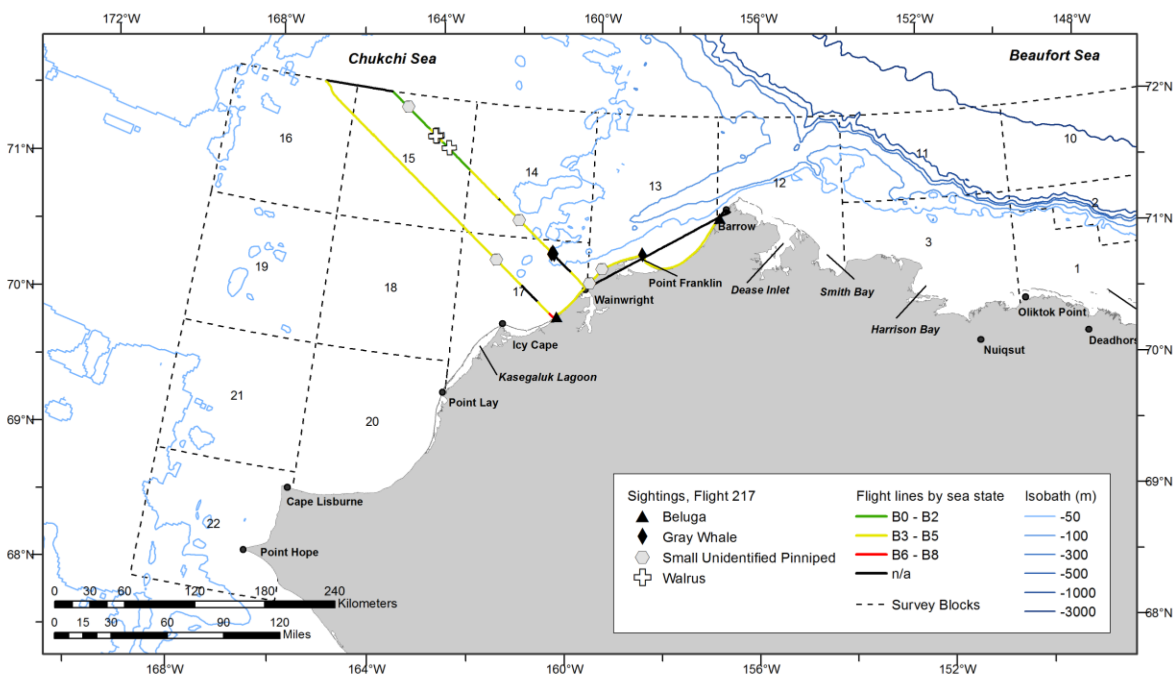

Figure B-28. ASAMM Flight 217 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

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11 August 2013, Flight 12

Flight was a survey of portions of blocks 3, 11, and 12. Survey conditions included clear to partly cloudy skies, 0-10 km visibility (with glare, fog, and low ceilings), and Beaufort 0-4 sea states. Ice cover was 0-40% broken floe sea ice in the area surveyed. Sightings included bowhead whales, one gray whale, belugas (including 11 calves), walruses, bearded seals, small unidentified pinnipeds, and polar bears. Two polar bears were on a barrier island east of Smith Bay, and one polar bear was swimming approximately 103 km northeast of Smith Bay in an area of 20% broken floe ice.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
12	8/11/13 10:32	71.524	156.641	bowhead whale	swim	1	0	12
12	8/11/13 11:01	71.347	156.076	gray whale	swim	1	0	12
12	8/11/13 11:30	71.854	155.074	beluga	swim	1	0	12
12	8/11/13 11:32	71.793	155.100	beluga	dive	1	1	12
12	8/11/13 11:32	71.790	155.119	beluga	swim	12	3	12
12	8/11/13 11:32	71.783	155.093	beluga	swim	6	1	12
12	8/11/13 11:33	71.765	155.094	beluga	swim	6	1	12
12	8/11/13 11:33	71.764	155.114	beluga	swim	6	2	12
12	8/11/13 11:33	71.754	155.121	beluga	swim	3	1	12
12	8/11/13 11:37	71.624	155.112	beluga	swim	2	1	12
12	8/11/13 11:55	71.186	155.092	beluga	swim	1	0	12
12	8/11/13 12:12	71.187	154.608	bowhead whale	swim	2	0	12
12	8/11/13 12:16	71.170	154.637	bowhead whale	swim	2	0	12
12	8/11/13 12:17	71.164	154.626	beluga	swim	2	0	12
12	8/11/13 12:17	71.178	154.615	bowhead whale	swim	1	0	12
12	8/11/13 12:36	71.659	154.662	beluga	mill	2	0	12
12	8/11/13 13:31	71.216	153.571	bowhead whale	swim	1	0	3
12	8/11/13 13:50	71.898	153.597	beluga	swim	2	1	11
12	8/11/13 13:50	71.913	153.589	beluga	rest	3	0	11
12	8/11/13 13:50	71.923	153.599	beluga	swim	1	0	11
12	8/11/13 18:55	71.153	152.867	beluga	swim	1	0	3
12	8/11/13 18:55	71.151	152.867	beluga	swim	1	0	3
12	8/11/13 18:55	71.149	152.867	beluga	swim	1	0	3
12	8/11/13 18:55	71.139	152.860	beluga	rest	2	0	3
12	8/11/13 18:56	71.125	152.865	beluga	swim	1	0	3
12	8/11/13 18:57	71.082	152.890	bowhead whale	swim	1	0	3
12	8/11/13 19:16	71.186	152.320	bowhead whale	swim	1	0	3
12	8/11/13 19:18	71.251	152.290	bowhead whale	swim	1	0	3
12	8/11/13 19:58	71.145	151.847	bowhead whale	swim	1	0	3

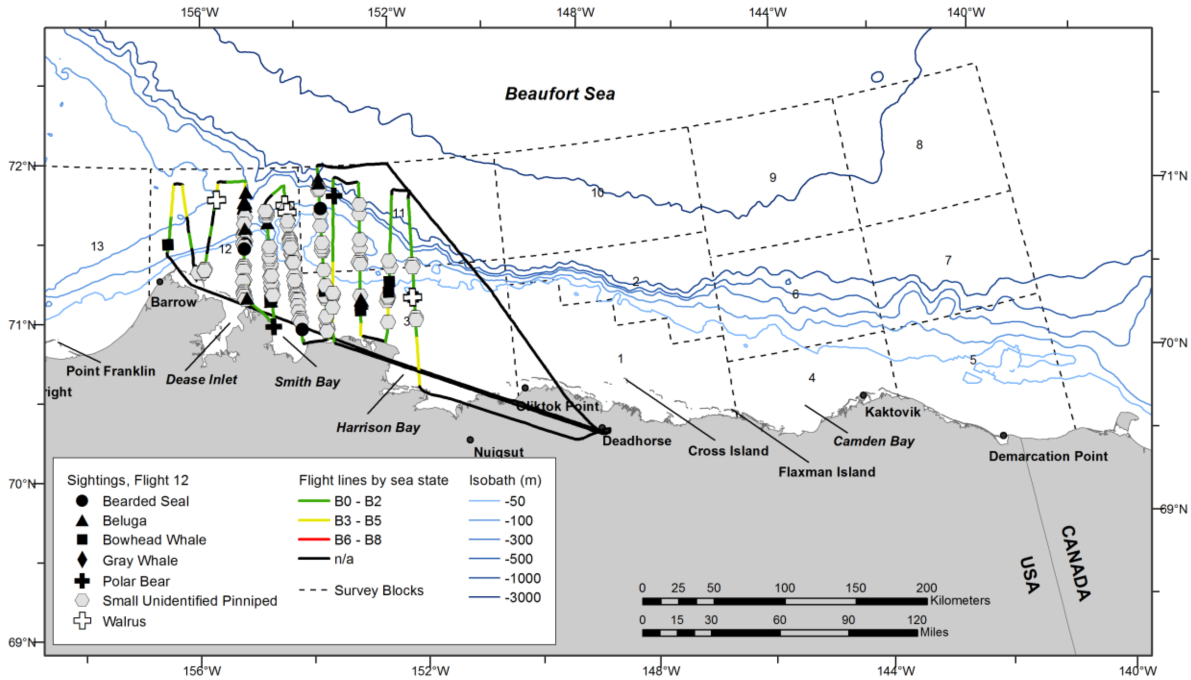

Figure B-29. ASAMM Flight 12 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

11 August 2013, Flight 218

Flight was a complete survey of transects 1 and 3, partial survey of transects 5 and 7, the coastal transect between transects 3 and 5, and search effort between the offshore ends of transects 1 and 3 and from Point Franklin to Barrow. Survey conditions included partly cloudy skies, no visibility to unlimited visibility (with fog, haze, precipitation, and glare), and Beaufort 1-4 sea states. Ice cover was 0-40% broken floe in the area surveyed. Sightings included gray whales (including one calf), walruses, one bearded seal, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
218	8/11/13 18:28	70.946	157.552	gray whale	swim	1	0	13
218	8/11/13 18:32	70.914	157.881	gray whale	swim	2	1	13
218	8/11/13 18:44	71.015	158.198	gray whale	feed	1	0	13
218	8/11/13 18:45	71.010	158.191	gray whale	feed	2	0	13
218	8/11/13 18:46	71.010	158.205	gray whale	feed	2	0	13
218	8/11/13 18:48	71.025	158.304	gray whale	feed	2	0	13
218	8/11/13 18:52	71.063	158.294	gray whale	feed	1	0	13
218	8/11/13 20:17	71.105	157.918	gray whale	feed	1	0	13
218	8/11/13 20:17	71.117	157.886	gray whale	feed	1	0	13
218	8/11/13 20:18	71.104	157.820	gray whale	feed	1	0	13
218	8/11/13 20:18	71.113	157.812	gray whale	feed	2	0	13
218	8/11/13 20:18	71.122	157.784	gray whale	rest	1	0	13
218	8/11/13 20:27	71.266	157.060	gray whale	feed	7	0	13

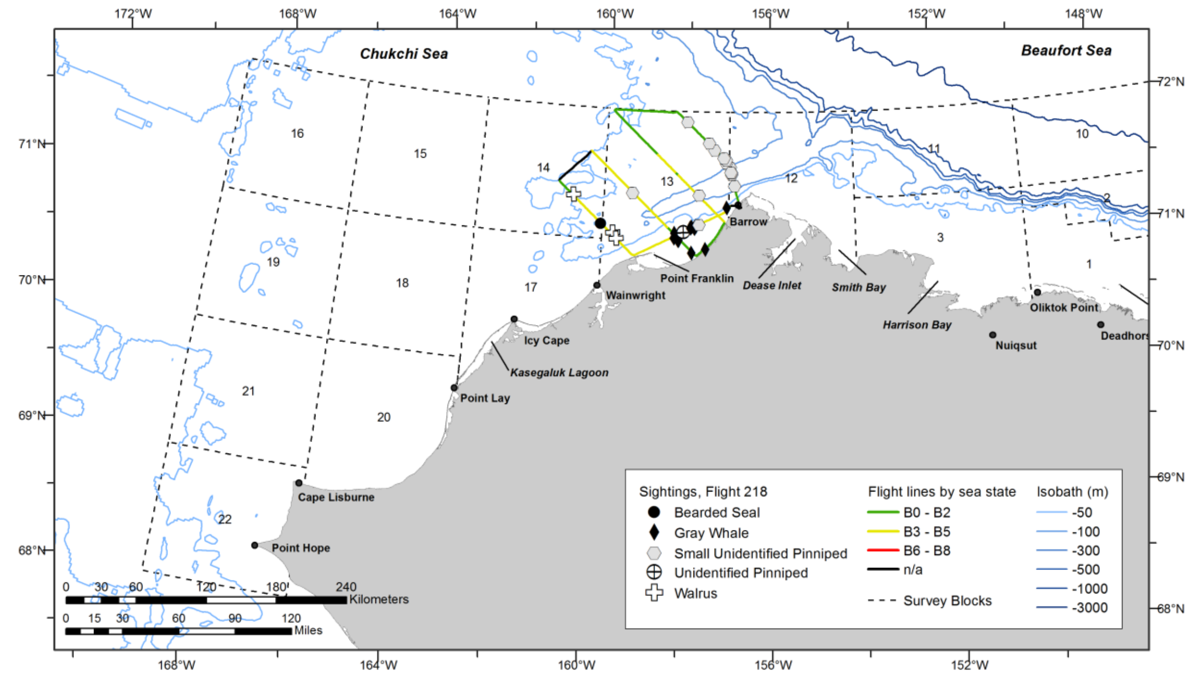

Figure B-30. ASAMM Flight 218 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

13 August 2013, Flight 219

Flight was a complete survey of transects 31 and 32, the coastal transect from Barrow to south of Wainwright and south of Point Lay to Point Hope, and search effort between the offshore ends of transects 31 and 32 and from Point Franklin to Barrow. Survey conditions included clear to overcast skies, <1-10 km visibility (with low ceilings and glare), and Beaufort 2-5 sea states. Ice cover was 0-5% broken floe sea ice in the area surveyed. Sightings included gray whales, minke whales, belugas (including one calf and four dead), one unidentified cetacean, one small unidentified marine mammal (dead), walruses (including two dead), unidentified pinnipeds (including one dead), small unidentified pinnipeds, brown bears (including three cubs), musk ox, and caribou.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
219	8/13/13 14:26	70.872	159.203	beluga	dead	1	0	13
219	8/13/13 14:46	70.541	160.266	beluga	dead	1	0	17
219	8/13/13 15:33	69.186	163.469	beluga	dead	1	0	20
219	8/13/13 15:51	68.917	164.769	minke whale	swim	1	0	20
219	8/13/13 16:06	68.871	165.448	minke whale	swim	1	0	20
219	8/13/13 16:17	68.894	166.134	gray whale	swim	1	0	22
219	8/13/13 16:45	68.331	166.611	beluga	swim	2	1	22
219	8/13/13 16:49	68.279	166.253	beluga	dead	1	0	22
219	8/13/13 17:20	68.130	167.888	unid cetacean	.	1	0	22
219	8/13/13 17:36	68.123	168.537	gray whale	swim	2	0	22
219	8/13/13 21:15	71.090	158.275	gray whale	dive	1	0	13
219	8/13/13 21:16	71.103	158.263	gray whale	swim	1	0	13
219	8/13/13 21:16	71.098	158.248	gray whale	feed	1	0	13
219	8/13/13 21:16	71.096	158.216	gray whale	feed	1	0	13
219	8/13/13 21:16	71.112	158.192	gray whale	swim	1	0	13
219	8/13/13 21:17	71.119	158.156	gray whale	swim	2	0	13
219	8/13/13 21:17	71.108	158.089	gray whale	feed	2	0	13
219	8/13/13 21:18	71.128	158.084	gray whale	feed	1	0	13
219	8/13/13 21:19	71.128	157.918	gray whale	feed	1	0	13
219	8/13/13 21:19	71.137	157.907	gray whale	feed	1	0	13
219	8/13/13 21:20	71.137	157.848	gray whale	feed	2	0	13
219	8/13/13 21:20	71.168	157.850	gray whale	feed	1	0	13
219	8/13/13 21:31	71.252	157.042	gray whale	feed	1	0	13

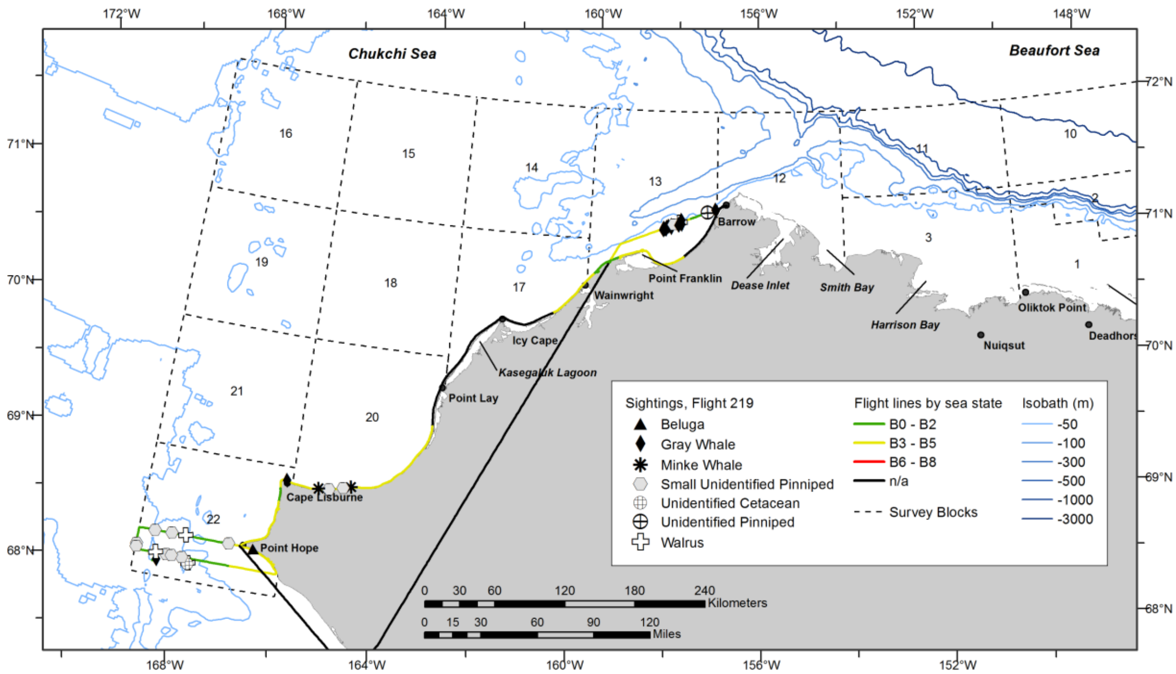

Figure B-31. ASAMM Flight 219 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

16 August 2013, Flight 13

Flight was a survey of portions of blocks 4 and 6. Survey conditions included overcast skies, 0-5 km visibility (with low ceilings), and Beaufort 4-7 sea states. There was no sea ice observed in the area surveyed. No sightings were observed.

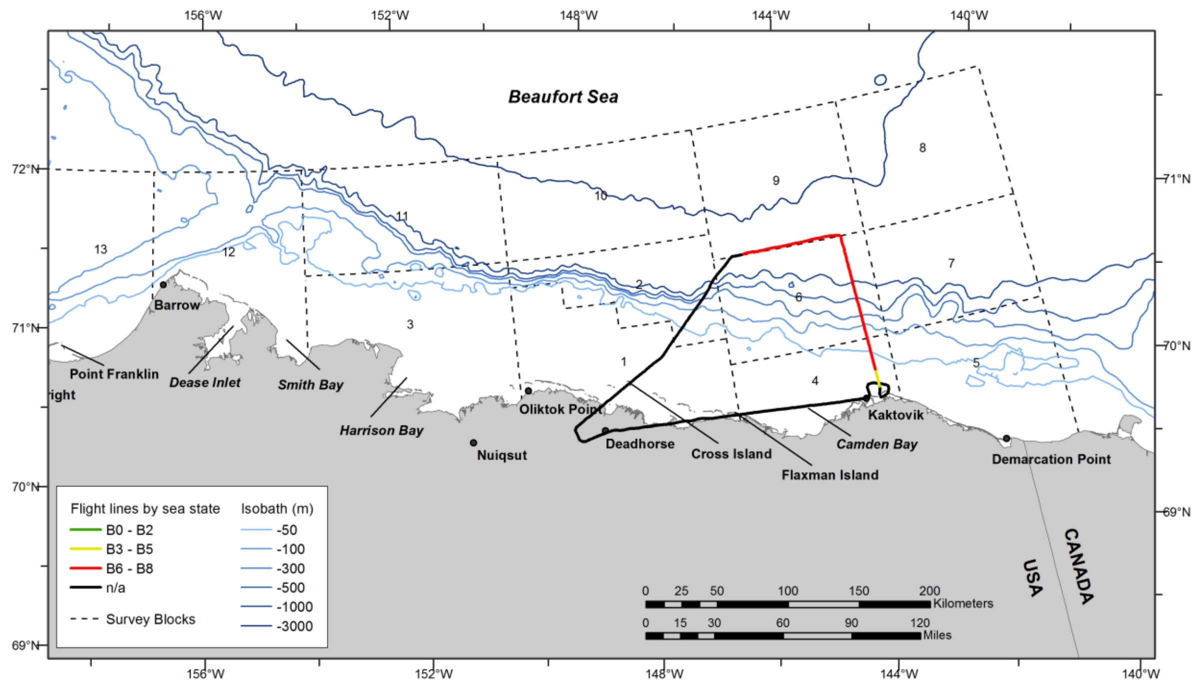

Figure B-32. ASAMM Flight 13 survey track, depicted by sea state.

17 August 2013, Flight 14

Flight was a survey of portions of block 4. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with low ceilings, fog, and glare), and Beaufort 2-4 sea states. There was no sea ice observed in the area surveyed. Sightings included one bowhead whale calf (no adult seen despite circling effort to locate one), belugas (including one calf), bearded seals, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
14	8/17/13 17:14	70.282	143.725	bowhead whale	swim	1	1	4
14	8/17/13 17:55	70.309	147.139	beluga	swim	2	1	1

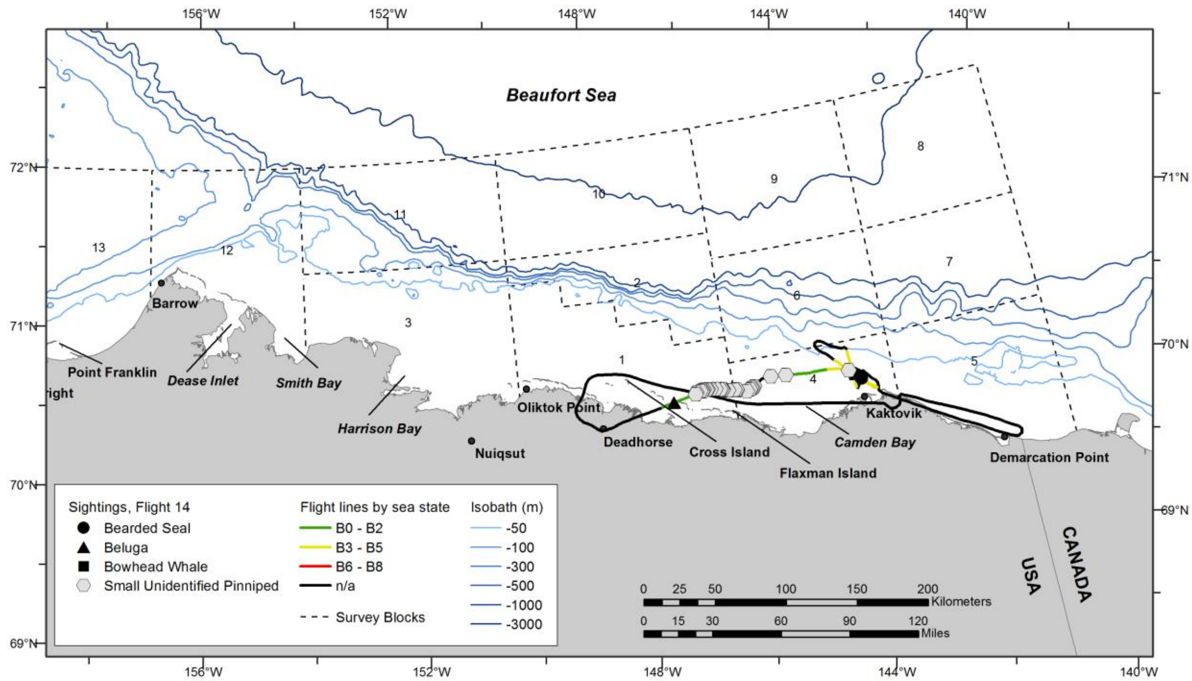

Figure B-33. ASAMM Flight 14 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

18 August 2013, Flight 220

Flight was a partial survey of transects 2 and 3, and search effort near the offshore end of transect 3 and between the inshore ends of transects 2 and 3. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with low ceilings and glare), and Beaufort 3-6 sea states. Ice cover was 0-3% broken floe sea ice in the area surveyed. Sightings included gray whales, belugas (including one calf), and one unidentified cetacean.

Cetacean sightings only, all effort (transect, search, circling)

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
220	8/18/13 11:34	71.367	157.758	beluga	mill	12	1	13
220	8/18/13 11:34	71.370	157.742	beluga	swim	8	0	13
220	8/18/13 11:34	71.363	157.764	beluga	swim	4	0	13
220	8/18/13 11:43	71.162	157.141	unid cetacean	swim	1	0	13
220	8/18/13 11:47	71.282	157.000	gray whale	feed	1	0	13
220	8/18/13 11:47	71.284	157.022	gray whale	feed	1	0	13
220	8/18/13 11:50	71.286	157.035	gray whale	feed	1	0	13
220	8/18/13 11:50	71.276	157.029	gray whale	feed	1	0	13

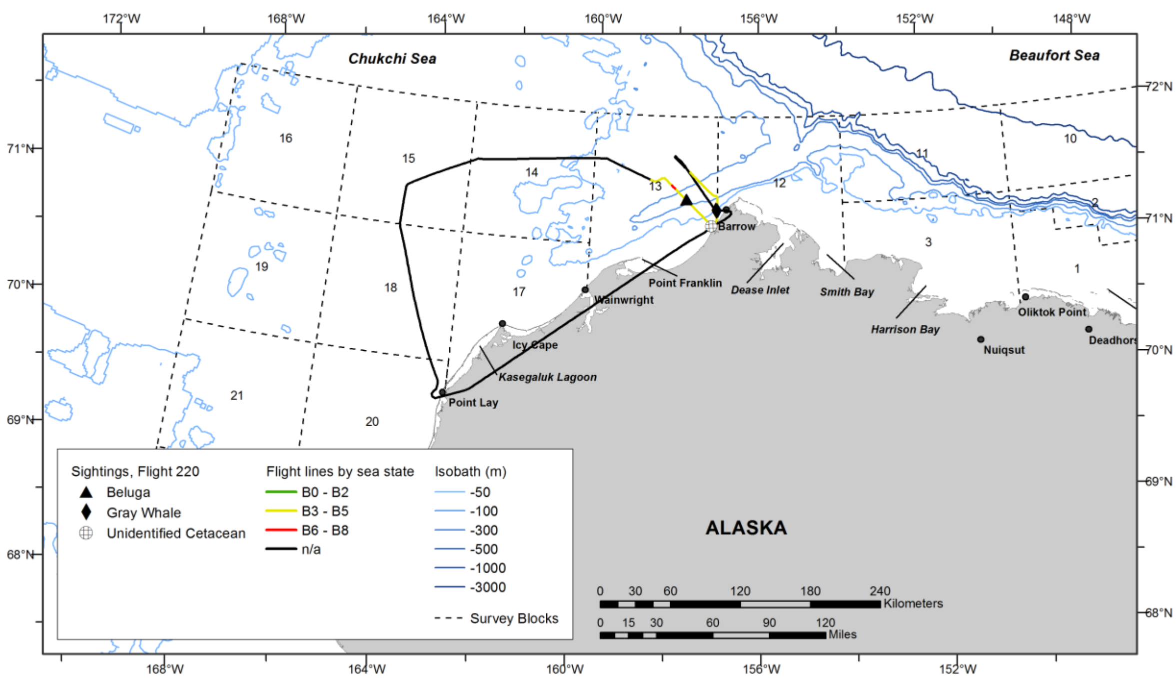

Figure B-34. ASAMM Flight 220 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

19 August 2013, Flight 221

Flight was a survey of the coastal transect between Barrow and Point Franklin. Survey conditions included overcast skies, 0-5 km visibility (with fog), and Beaufort 7-8 sea states. There was no sea ice observed in the area surveyed. No sightings were observed.

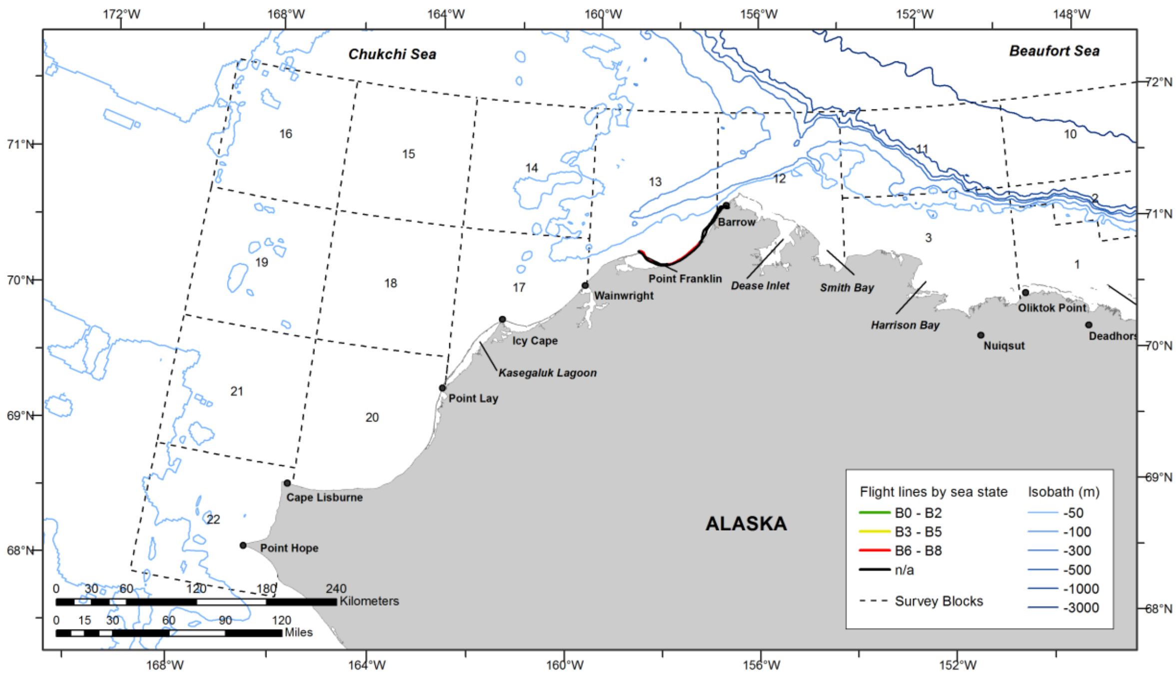

Figure B-35. ASAMM Flight 221 survey track, depicted by sea state.

20 August 2013, Flight 15

Flight was a survey of portions of blocks 1, 2, 4, 6, and 10. Survey conditions included overcast skies, 0-10 km visibility (with low ceilings), and Beaufort 3-5 sea states. Ice cover was 0-1% broken floe sea ice in the area surveyed. Sightings included bowhead whales (including one calf), belugas (including one calf), one unidentified cetacean, bearded seals, small unidentified pinnipeds, and one polar bear. Most of the bowhead whales (72%) were feeding or milling. One whale was observed with a log. The polar bear was on a barrier island west of Prudhoe Bay.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
15	8/20/13 10:19	70.773	149.671	unid cetacean	swim	1	0	1
15	8/20/13 11:13	71.751	149.433	beluga	swim	1	0	10
15	8/20/13 11:43	70.636	149.466	bowhead whale	swim	2	0	1
15	8/20/13 11:43	70.629	149.454	bowhead whale	log play	1	0	1
15	8/20/13 11:46	70.633	149.446	bowhead whale	swim	2	0	1
15	8/20/13 11:51	70.601	149.415	bowhead whale	rest	1	0	1
15	8/20/13 11:51	70.602	149.407	bowhead whale	swim	1	0	1
15	8/20/13 11:52	70.601	149.428	bowhead whale	swim	1	0	1
15	8/20/13 12:05	70.625	148.876	bowhead whale	swim	1	0	1
15	8/20/13 12:42	71.130	148.102	beluga	swim	1	0	2
15	8/20/13 12:43	71.121	148.101	beluga	swim	1	0	2
15	8/20/13 12:58	70.550	148.268	bowhead whale	swim	1	0	1
15	8/20/13 12:58	70.542	148.266	bowhead whale	swim	2	0	1
15	8/20/13 12:58	70.539	148.259	bowhead whale	mill	1	0	1
15	8/20/13 13:00	70.539	148.276	bowhead whale	mill	8	0	1
15	8/20/13 13:01	70.555	148.258	bowhead whale	mill	1	0	1
15	8/20/13 13:01	70.545	148.255	bowhead whale	mill	5	0	1
15	8/20/13 13:01	70.541	148.278	bowhead whale	mill	2	0	1
15	8/20/13 13:43	71.070	147.673	beluga	swim	2	1	2
15	8/20/13 13:56	71.330	147.053	beluga	swim	1	0	2
15	8/20/13 14:20	70.466	147.125	beluga	swim	1	0	1
15	8/20/13 15:48	70.322	146.875	bowhead whale	mill	2	0	1
15	8/20/13 15:48	70.350	146.883	bowhead whale	rest	1	0	1
15	8/20/13 15:49	70.356	146.895	bowhead whale	swim	1	0	1
15	8/20/13 15:50	70.392	146.872	bowhead whale	swim	1	0	1
15	8/20/13 16:52	70.304	146.283	bowhead whale	mill	2	0	1
15	8/20/13 17:00	70.283	145.985	bowhead whale	feed	7	0	4
15	8/20/13 17:02	70.284	145.996	bowhead whale	swim	1	0	4
15	8/20/13 17:04	70.281	146.007	bowhead whale	swim	2	1	1
15	8/20/13 17:05	70.278	145.974	bowhead whale	swim	2	0	4
15	8/20/13 17:09	70.283	145.970	bowhead whale	mill	3	0	4
15	8/20/13 17:22	70.638	145.883	bowhead whale	swim	1	0	6

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
15	8/20/13 17:56	70.627	145.198	bowhead whale	swim	2	0	6
15	8/20/13 18:10	70.119	145.069	bowhead whale	swim	1	0	4
15	8/20/13 18:21	70.133	144.648	bowhead whale	feed	14	0	4
15	8/20/13 18:21	70.134	144.697	bowhead whale	feed	20	0	4
15	8/20/13 18:35	70.156	144.713	bowhead whale	swim	2	0	4
15	8/20/13 18:52	70.313	144.113	bowhead whale	swim	1	0	4
15	8/20/13 18:52	70.286	144.112	bowhead whale	mill	1	0	4
15	8/20/13 18:53	70.274	144.098	bowhead whale	mill	1	0	4
15	8/20/13 18:53	70.269	144.099	bowhead whale	mill	1	0	4

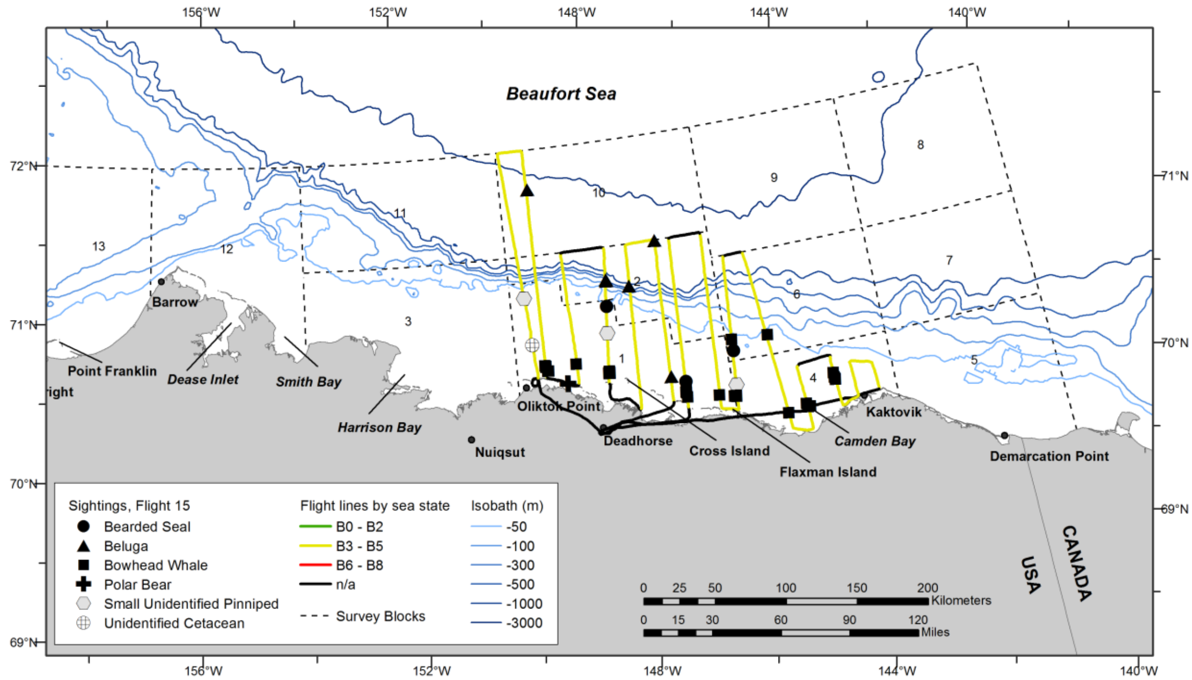

Figure B-36. ASAMM Flight 15 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Left: Bowhead whale with log in the western Beaufort Sea during flight 15, 20 August 2013.

Right: Six bowhead whales in echelon feeding formation in the western Beaufort Sea during flight 15, 20 August 2013.

Left: Two bowhead whales feeding in the western Beaufort Sea during flight 15, 20 August 2013. The track of a third whale is also visible.

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20 August 2013, Flight 222

Flight was a complete survey of transects 2, 4, 14, and 16, and a partial survey of transects 6 and 8. Survey conditions included overcast skies, 0-10 km visibility (with low ceilings and precipitation), and Beaufort 2-6 sea states. Ice cover was 0-35% broken floe sea ice in the area surveyed. Sightings included bowhead whales, gray whales (including two calves), belugas, walruses (including one dead), bearded seals, unidentified pinnipeds (including one dead), and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
222	8/20/13 15:19	71.430	157.197	bowhead whale	swim	1	0	13
222	8/20/13 15:22	71.476	157.399	bowhead whale	swim	1	0	13
222	8/20/13 16:28	71.179	157.909	gray whale	.	1	0	13
222	8/20/13 16:29	71.165	157.891	gray whale	feed	1	0	13
222	8/20/13 16:29	71.163	157.887	gray whale	feed	1	0	13
222	8/20/13 16:30	71.141	157.828	gray whale	feed	1	0	13
222	8/20/13 16:30	71.125	157.801	gray whale	feed	1	0	13
222	8/20/13 16:31	71.135	157.855	gray whale	feed	3	1	13
222	8/20/13 16:32	71.141	157.852	gray whale	feed	4	1	13
222	8/20/13 16:34	71.115	157.682	gray whale	feed	1	0	13
222	8/20/13 16:36	71.104	157.718	gray whale	feed	4	0	13
222	8/20/13 16:37	71.113	157.721	gray whale	feed	1	0	13
222	8/20/13 16:44	70.965	157.465	beluga	swim	3	0	13
222	8/20/13 17:29	71.054	160.618	gray whale	feed	1	0	14
222	8/20/13 17:29	71.057	160.580	gray whale	feed	1	0	14

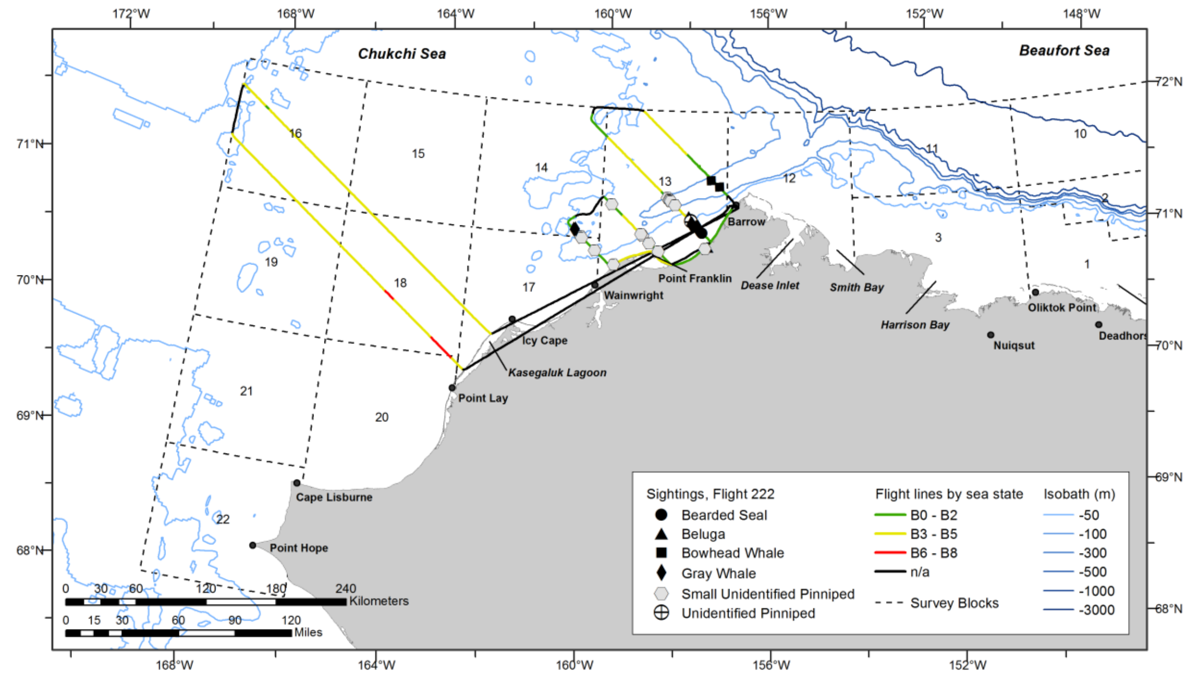

Figure B-37. ASAMM Flight 222 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

21 August 2013, Flight 16

Flight was a survey of portions of block 3. Survey conditions included overcast skies, 0-10 km visibility (with low ceilings), and Beaufort 4 sea state. There was no sea ice observed in the area surveyed. No sightings were observed.

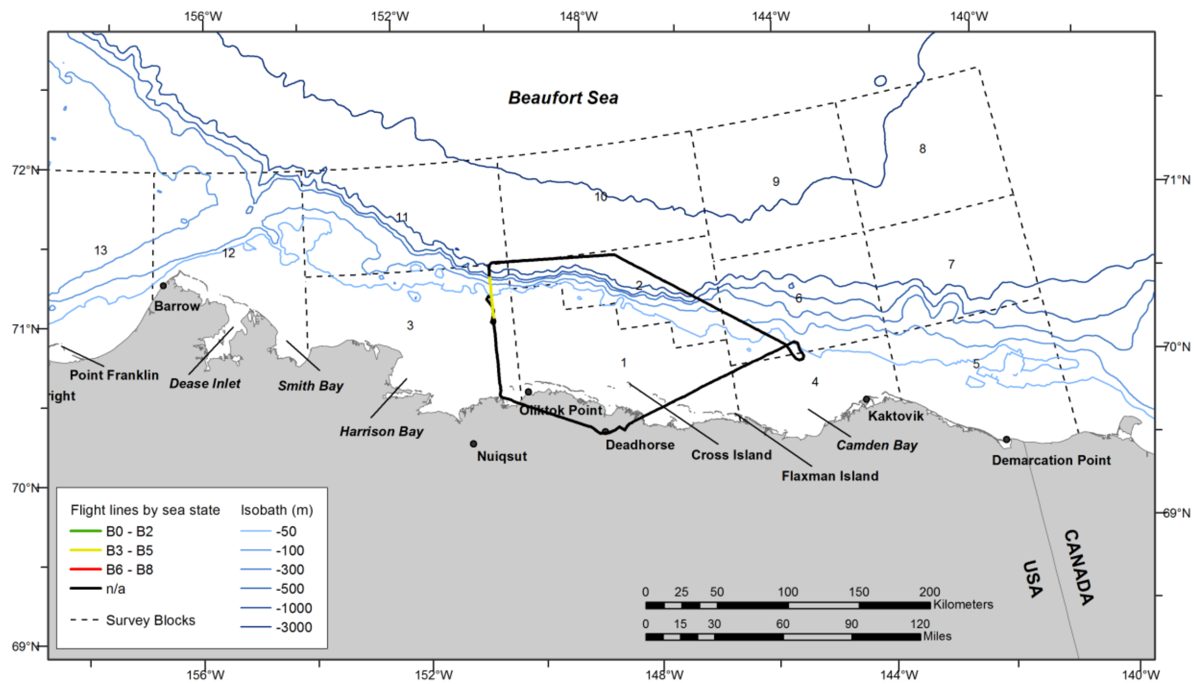

Figure B-38. ASAMM Flight 16 survey track, depicted by sea state.

21 August 2013, Flight 223

Flight was a complete survey of transects 10 and 12. Survey conditions included overcast skies, 0-10 km visibility (with fog, low ceilings, and snow showers), and Beaufort 0-4 sea states. Ice cover was 0-80% broken floe sea ice in the area surveyed. Sightings included walruses (including one dead), one bearded seal, unidentified pinnipeds, and small unidentified pinnipeds.

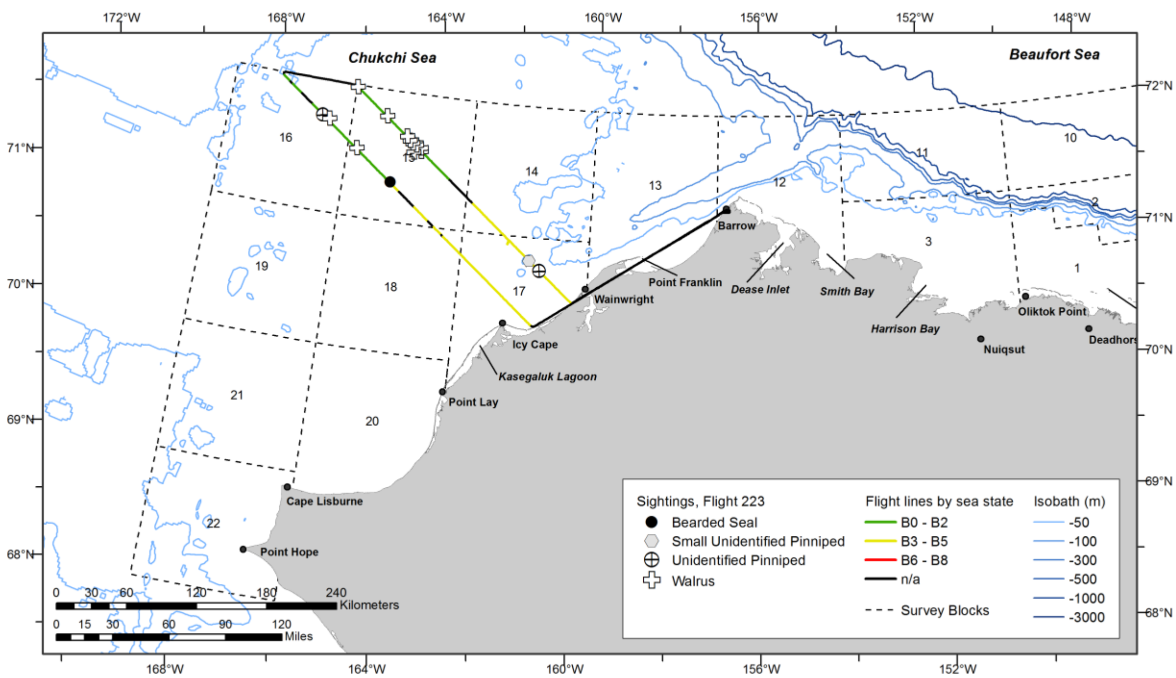

Figure B-39. ASAMM Flight 223 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

23 August 2013, Flight 17

Flight was a survey of portions of block 12. Survey conditions included overcast to partly cloudy skies, 0-10 km visibility (with low ceilings, scattered snow showers, and glare), and Beaufort 2-3 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales, gray whales (including one calf), belugas (including one calf), unidentified cetaceans, bearded seals, unidentified pinnipeds, small unidentified pinnipeds, and small unidentified marine mammals (possible pinnipeds).

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
17	8/23/13 15:44	71.503	156.610	bowhead whale	rest	1	0	12
17	8/23/13 15:52	71.522	156.618	bowhead whale	swim	1	0	12
17	8/23/13 15:57	71.491	156.586	bowhead whale	dive	1	0	12
17	8/23/13 16:00	71.527	156.629	bowhead whale	mill	1	0	12
17	8/23/13 16:26	71.755	156.276	bowhead whale	swim	1	0	12
17	8/23/13 16:33	71.493	156.235	gray whale	feed	1	0	12
17	8/23/13 16:36	71.485	156.240	gray whale	feed	1	0	12
17	8/23/13 16:38	71.489	156.172	gray whale	feed	1	0	12
17	8/23/13 16:43	71.489	156.136	gray whale	feed	2	0	12
17	8/23/13 16:45	71.488	156.090	gray whale	feed	2	1	12
17	8/23/13 16:45	71.492	156.091	gray whale	rest	1	0	12
17	8/23/13 16:47	71.483	156.141	bowhead whale	dive	1	0	12
17	8/23/13 17:09	71.631	155.815	unid cetacean	.	1	0	12
17	8/23/13 17:24	71.831	155.745	bowhead whale	swim	1	0	12
17	8/23/13 17:40	71.974	154.691	beluga	mill	6	1	12
17	8/23/13 17:41	71.949	154.698	beluga	mill	2	0	12
17	8/23/13 17:41	71.934	154.685	beluga	mill	2	0	12
17	8/23/13 17:44	71.817	154.730	unid cetacean	.	1	0	12
17	8/23/13 17:58	71.444	154.628	beluga	mill	1	0	12
17	8/23/13 18:01	71.435	154.612	bowhead whale	mill	2	0	12
17	8/23/13 18:12	71.473	154.651	bowhead whale	feed	1	0	12
17	8/23/13 18:14	71.426	154.659	bowhead whale	dive	1	0	12
17	8/23/13 18:21	71.184	154.630	bowhead whale	swim	1	0	12

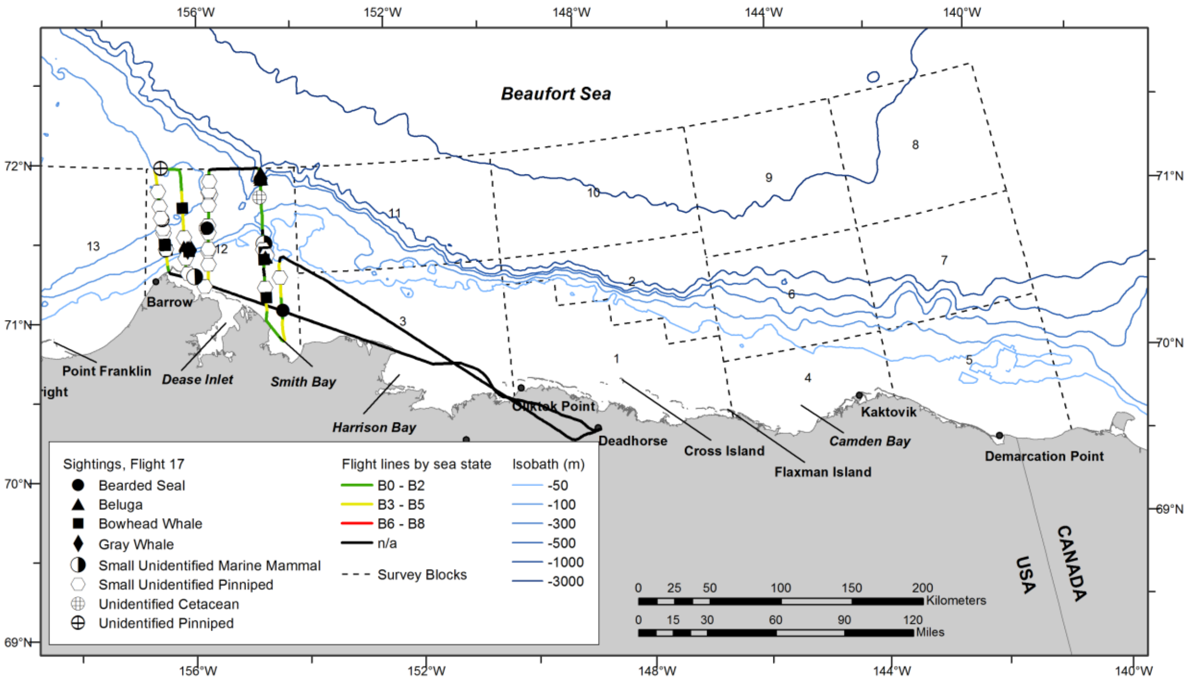

Figure B-40. ASAMM Flight 17 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

23 August 2013, Flight 224

Flight was a partial survey of transects 3 and 18. Survey conditions included overcast skies, 0-10 km visibility (with glare, low ceilings, and precipitation), and Beaufort 2-4 sea states. There was no sea ice observed in the area surveyed. Sightings included one walrus, bearded seals, unidentified pinnipeds, and small unidentified pinnipeds.

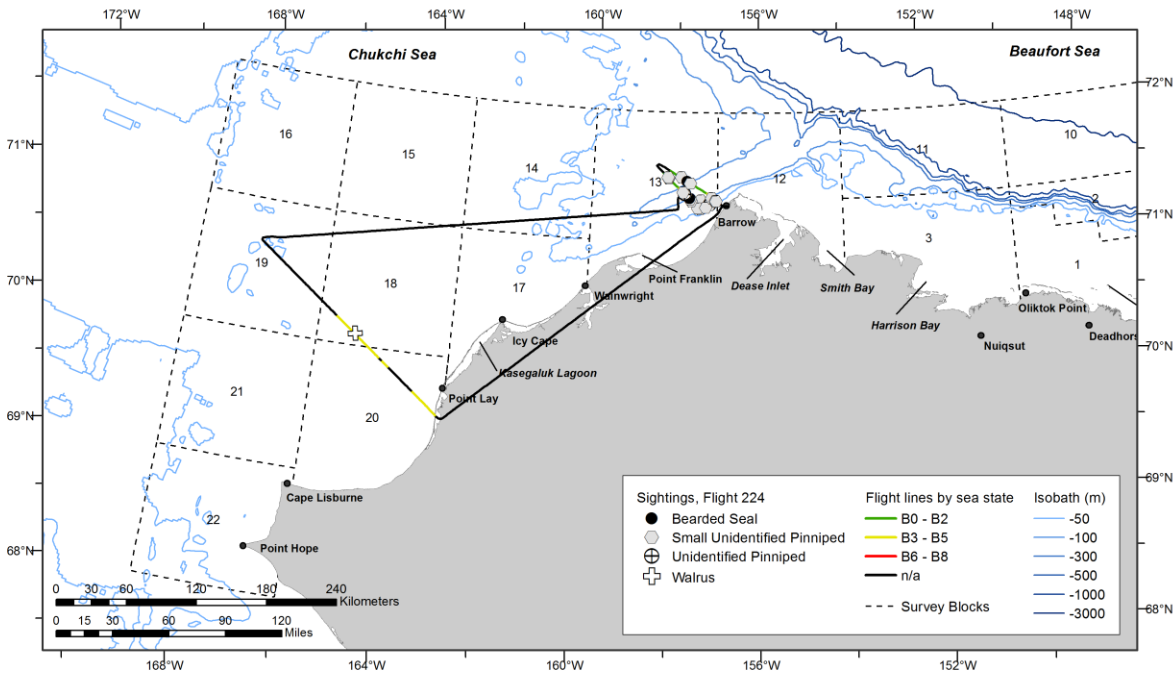

Figure B-41. ASAMM Flight 224 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

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24 August 2013, Flight 18

Flight was a survey of portions of blocks 3, 6, and 11. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with low ceilings and occasional glare), and Beaufort 2-5 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including two calves), belugas (including two calves), unidentified cetaceans, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
18	8/24/13 11:36	70.741	151.255	unid cetacean	dive	1	0	3
18	8/24/13 11:42	70.813	151.306	bowhead whale	.	1	0	3
18	8/24/13 11:44	70.815	151.353	bowhead whale	rest	2	0	3
18	8/24/13 11:46	70.796	151.360	bowhead whale	rest	1	0	3
18	8/24/13 11:53	70.778	151.345	bowhead whale	rest	1	0	3
18	8/24/13 11:56	70.766	151.188	bowhead whale	rest	2	0	3
18	8/24/13 11:56	70.764	151.195	bowhead whale	rest	2	0	3
18	8/24/13 11:59	70.755	151.114	bowhead whale	dive	1	0	3
18	8/24/13 12:01	70.786	151.196	bowhead whale	rest	1	0	3
18	8/24/13 12:05	70.872	151.296	bowhead whale	dive	3	0	3
18	8/24/13 12:09	70.870	151.388	bowhead whale	rest	1	0	3
18	8/24/13 12:18	70.877	151.346	bowhead whale	rest	3	0	3
18	8/24/13 12:22	70.982	151.314	bowhead whale	rest	1	0	3
18	8/24/13 12:23	71.002	151.323	bowhead whale	rest	2	0	3
18	8/24/13 12:53	71.287	150.582	beluga	rest	1	0	3
18	8/24/13 13:17	70.589	150.516	unid cetacean	dive	1	0	3
18	8/24/13 13:38	70.676	150.402	unid cetacean	rest	1	0	3
18	8/24/13 13:49	70.855	150.382	bowhead whale	rest	1	0	3
18	8/24/13 14:09	71.262	150.383	beluga	rest	1	0	3
18	8/24/13 14:09	71.279	150.366	beluga	rest	4	0	3
18	8/24/13 14:09	71.283	150.395	beluga	rest	1	0	3
18	8/24/13 14:09	71.285	150.389	beluga	rest	5	1	3
18	8/24/13 14:49	71.134	144.953	beluga	rest	2	1	6
18	8/24/13 15:06	70.526	144.657	bowhead whale	swim	2	1	6
18	8/24/13 15:06	70.518	144.649	bowhead whale	swim	2	1	6

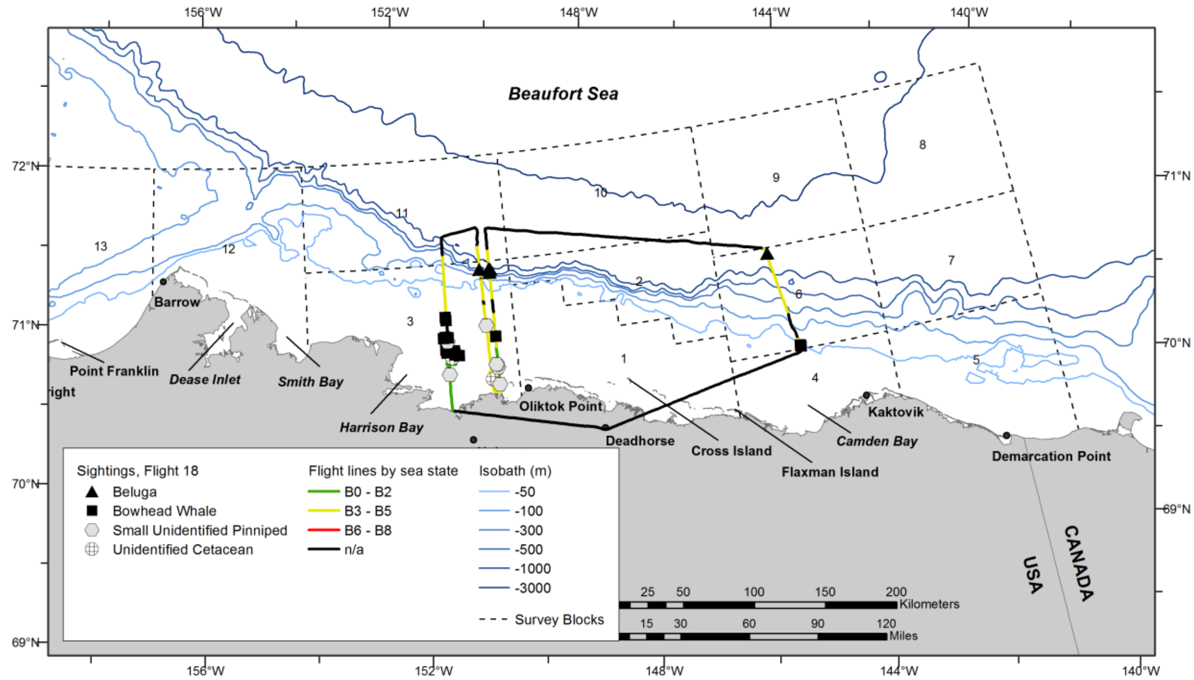
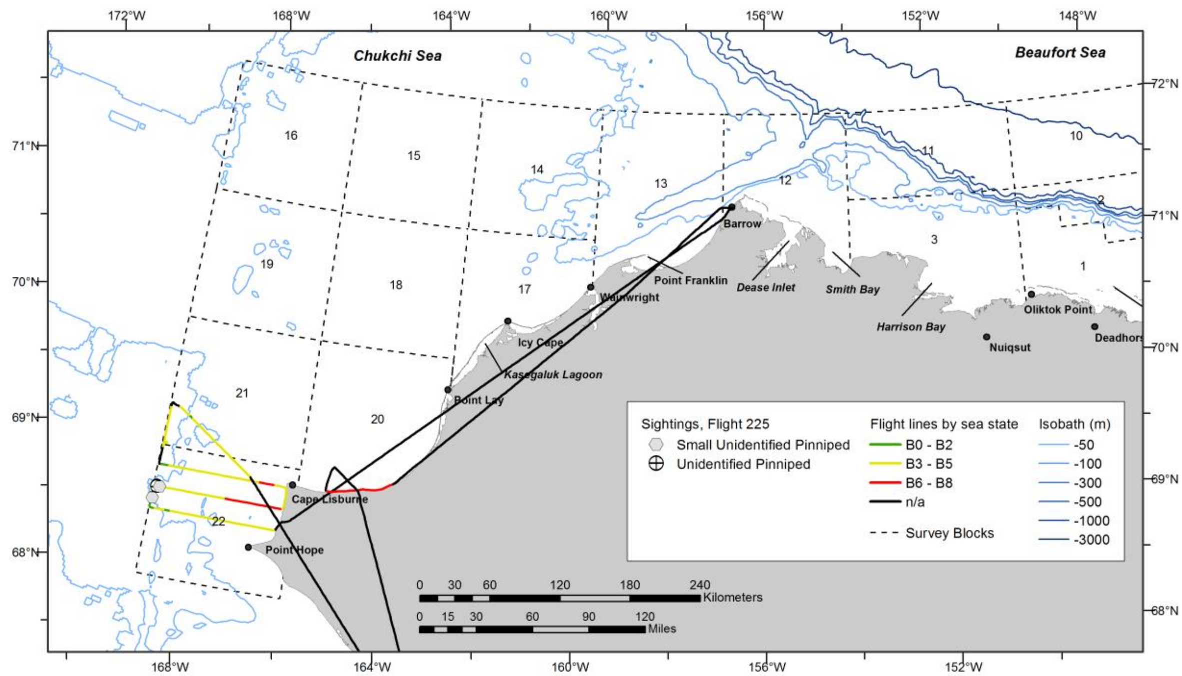


Figure B-42. ASAMM Flight 18 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

24 August 2013, Flight 225

Flight was a complete survey of transects 26, 28, 29, and 30, and the coastal transect south and east of Cape Lisburne. Survey conditions included clear to overcast skies, 0-10 km visibility (with low ceilings, glare, and precipitation), and Beaufort 2-7 sea states. There was no sea ice observed in the area surveyed. Sightings included unidentified pinnipeds and small unidentified pinnipeds.



Flight B-43. ASAMM Flight 225 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

25 August 2013, Flight 19

Flight was a survey of portions of blocks 5 and 6. Survey conditions included overcast skies, 0-10 km visibility (with low ceilings and occasional glare), and Beaufort 3-5 sea states. There was no ice observed in the area surveyed. Sightings included one bowhead whale and one small unidentified pinniped.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
19	8/25/13 15:38	70.159	142.229	bowhead whale	rest	1	0	5

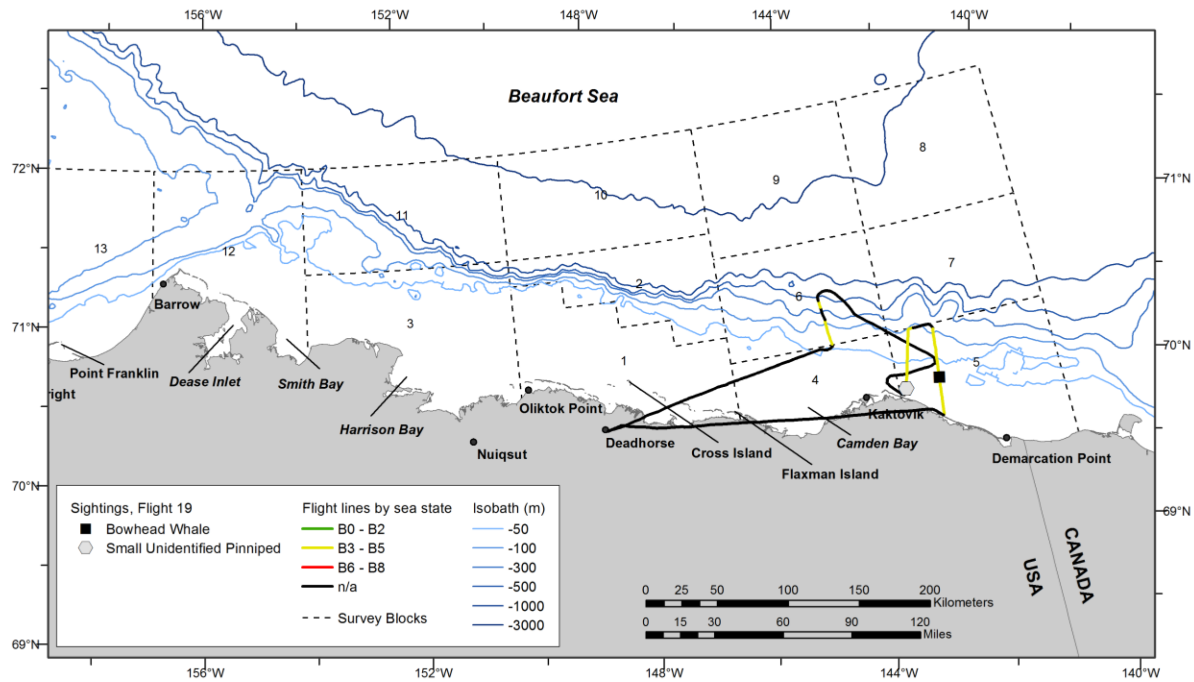


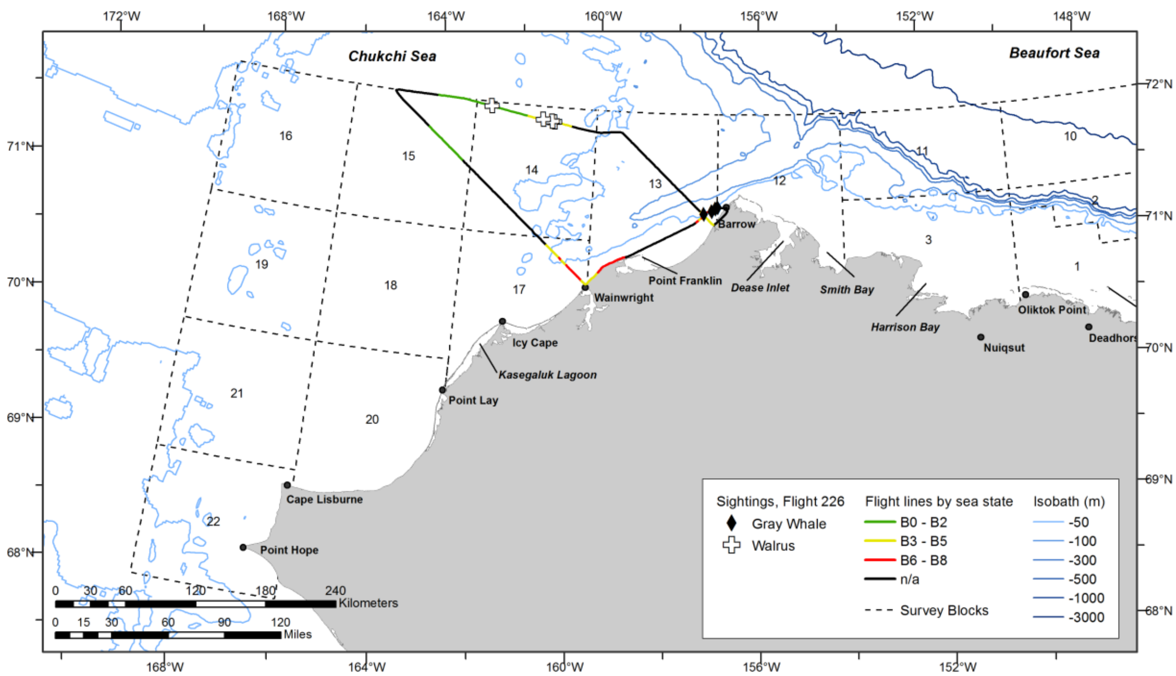
Figure B-44. ASAMM Flight 19 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

25 August 2013, Flight 226

Flight was a partial survey of transects 3 and 9, the coastal transect east of Wainwright, and search effort between the offshore ends of transects 3 and 9. Survey conditions included clear to overcast skies, 0-10 km visibility (with low ceilings, glare, and fog), and Beaufort 2-7 sea states. There was no sea ice observed in the area surveyed. Sightings included gray whales and walruses.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
226	8/25/13 17:12	71.234	157.327	gray whale	feed	1	0	13
226	8/25/13 17:15	71.257	157.143	gray whale	feed	2	0	13
226	8/25/13 17:16	71.278	157.051	gray whale	feed	3	0	13
226	8/25/13 17:17	71.287	156.999	gray whale	feed	1	0	12



Flight B-45. ASAMM Flight 226 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

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26 August 2013, Flight 20

Flight was a survey of portions of blocks 5 and 7. Survey conditions included overcast to partly cloudy skies, 0-10 km visibility (with low ceilings, scattered snow showers, and glare), and Beaufort 2-4 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including one calf), belugas (including seven calves), ringed seals, unidentified pinnipeds, small unidentified pinnipeds, one polar bear, and one small unidentified marine mammal (dead, probable pinniped). The polar bear was on the beach between Kaktovik and the Alaska-Canada border.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
20	8/26/13 15:30	70.700	142.799	beluga	rest	3	0	7
20	8/26/13 15:33	70.791	142.816	beluga	rest	1	0	7
20	8/26/13 15:45	70.831	142.770	beluga	rest	1	0	7
20	8/26/13 15:46	70.878	142.792	beluga	rest	1	0	7
20	8/26/13 15:52	71.060	142.808	beluga	rest	3	1	7
20	8/26/13 15:53	71.093	142.790	beluga	rest	2	0	7
20	8/26/13 15:54	71.111	142.805	beluga	rest	1	0	7
20	8/26/13 15:54	71.121	142.819	beluga	rest	2	0	7
20	8/26/13 15:55	71.130	142.791	beluga	rest	1	0	7
20	8/26/13 16:01	71.117	142.419	beluga	rest	1	0	7
20	8/26/13 16:14	70.642	142.303	beluga	mill	57	3	7
20	8/26/13 16:35	70.131	142.210	bowhead whale	rest	1	0	5
20	8/26/13 16:37	70.131	142.238	bowhead whale	tail slap	3	1	5
20	8/26/13 17:16	70.764	141.664	beluga	rest	8	2	7
20	8/26/13 17:16	70.781	141.684	beluga	rest	1	0	7
20	8/26/13 17:20	70.910	141.630	beluga	rest	2	1	7
20	8/26/13 17:20	70.925	141.632	beluga	swim	1	0	7
20	8/26/13 17:26	71.141	141.526	beluga	rest	1	0	7
20	8/26/13 17:27	71.148	141.524	beluga	rest	1	0	7
20	8/26/13 17:37	70.882	141.359	beluga	swim	1	0	7
20	8/26/13 17:37	70.878	141.373	beluga	rest	1	0	7
20	8/26/13 17:37	70.876	141.357	beluga	swim	2	0	7
20	8/26/13 17:38	70.829	141.373	beluga	rest	1	0	7
20	8/26/13 17:43	70.664	141.398	beluga	rest	1	0	7
20	8/26/13 17:46	70.583	141.384	beluga	rest	1	0	7
20	8/26/13 17:48	70.486	141.415	beluga	rest	2	0	5
20	8/26/13 17:49	70.474	141.410	beluga	rest	1	0	5

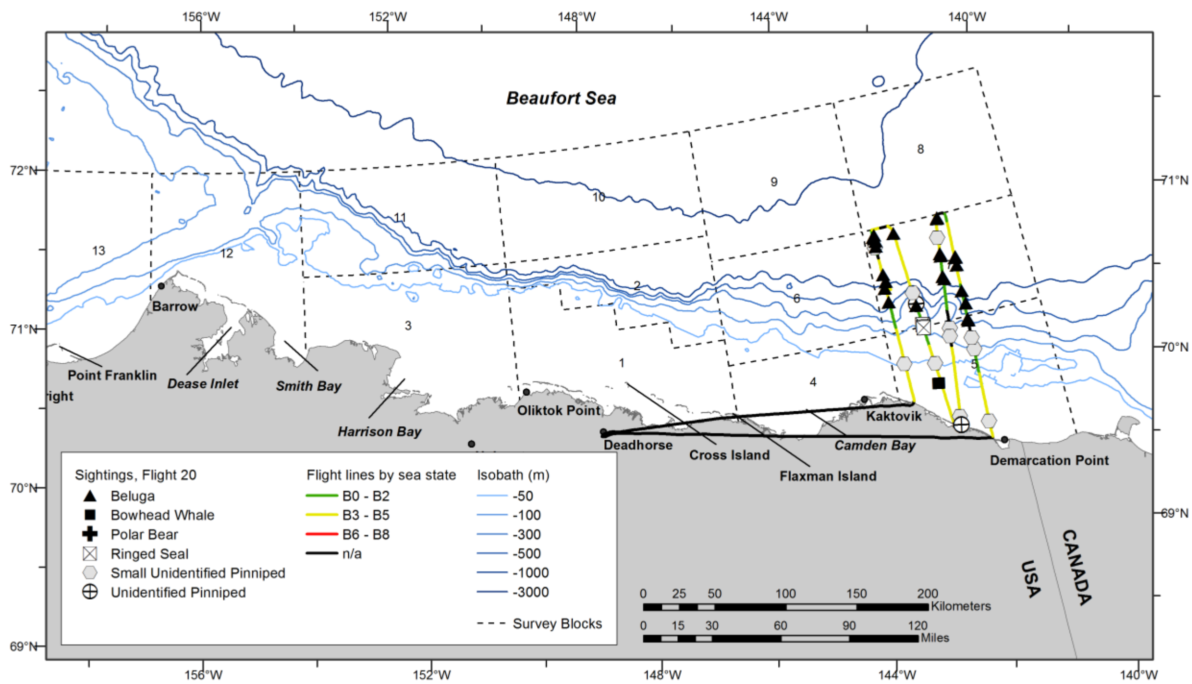

Figure B-46. ASAMM Flight 20 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

27 August 2013, Flight 227

Flight was a partial survey of transects 19 and 21, and the coastal transect from transect 21 to Barrow. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with low ceilings, glare, fog, and precipitation), and Beaufort 2-5 sea states. There was no sea ice observed in the area surveyed. Sightings included humpback whales, one fin whale, gray whales, belugas, one unidentified cetacean, walruses, bearded seals, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
227	8/27/13 12:14	69.535	165.423	fin whale	swim	1	0	20
227	8/27/13 12:14	69.526	165.389	humpback whale	swim	2	0	20
227	8/27/13 12:15	69.531	165.354	humpback whale	swim	2	0	20
227	8/27/13 12:28	69.474	165.244	unid cetacean	swim	1	0	20
227	8/27/13 13:18	69.694	163.118	beluga	swim	1	0	20
227	8/27/13 13:18	69.699	163.133	beluga	swim	1	0	20
227	8/27/13 13:46	70.302	161.430	gray whale	feed	1	0	17
227	8/27/13 13:58	70.501	160.413	gray whale	feed	1	0	17

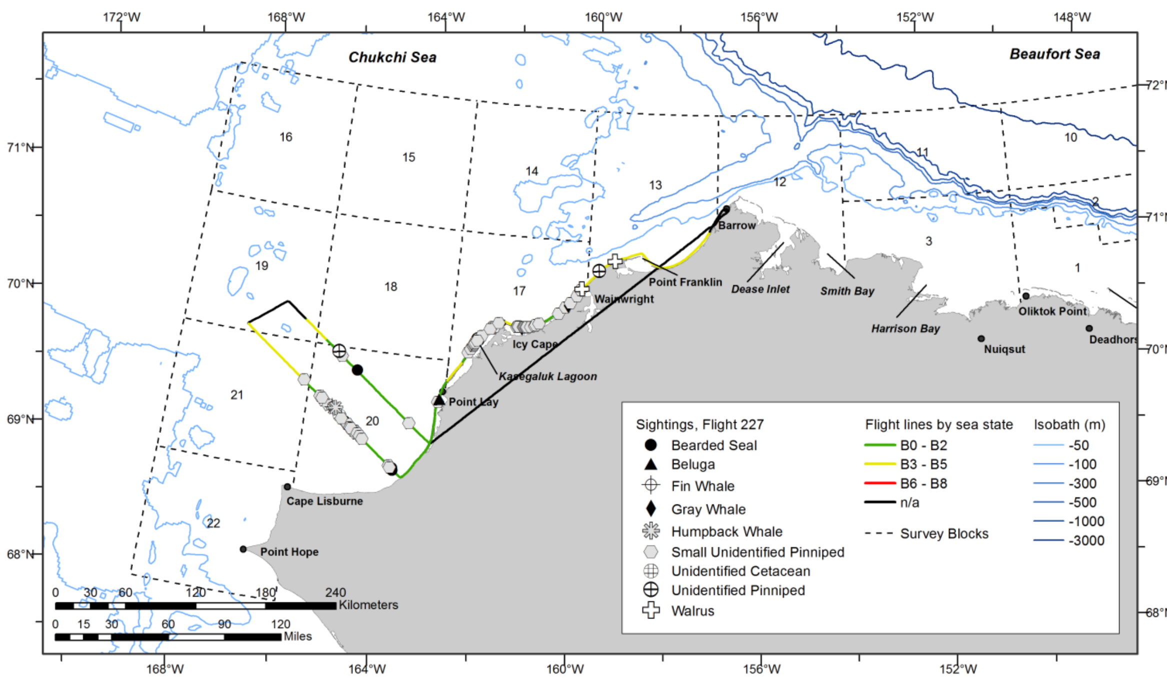

Figure B-47. ASAMM Flight 227 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Two humpback whales sighted approximately 100 km northeast of Cape Lisburne during flight 227, 27 August 2013.

Fin whale sighted approximately 100 km northeast of Cape Lisburne during flight 227, 27 August 2013.

28 August 2013, Flight 21

Flight was a survey of portions of blocks 1, 2, and 3. Survey conditions included partly cloudy skies, 0-10 km visibility (with widespread, dense fog and occasional glare and haze), and Beaufort 1-5 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales, one bearded seal, one ringed seal, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
21	8/28/13 12:26	70.436	146.638	bowhead whale	dive	1	0	1
21	8/28/13 13:19	70.427	146.182	bowhead whale	rest	1	0	1

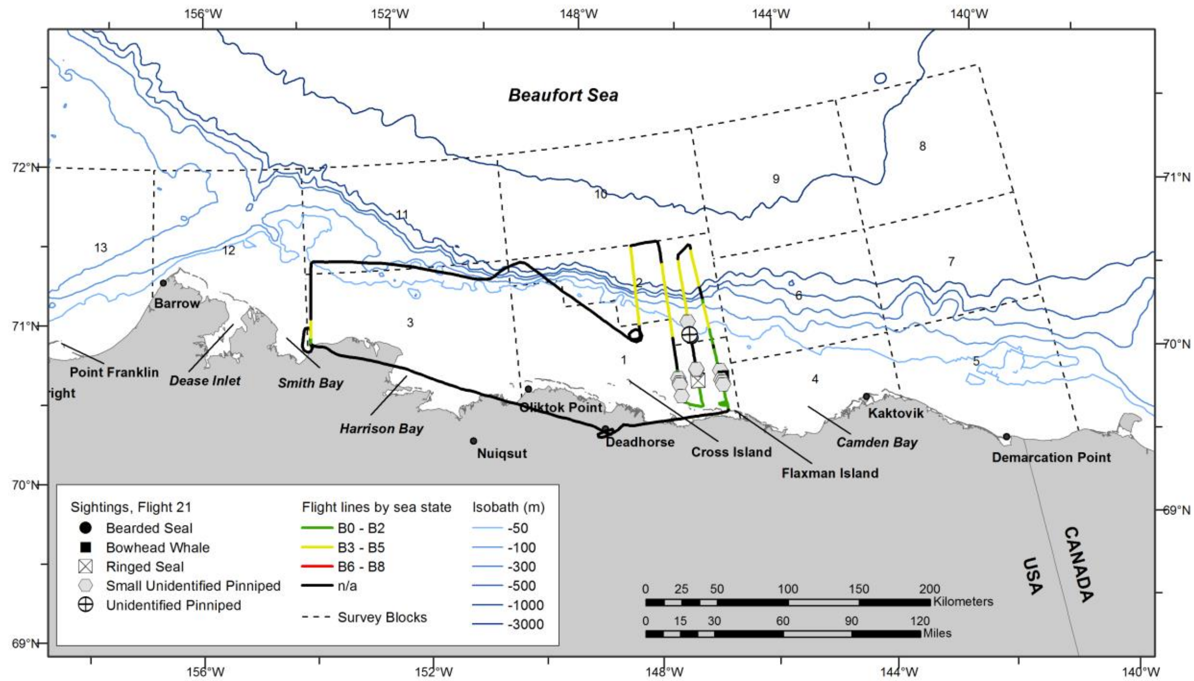

Figure B-48. ASAMM Flight 21 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

29 August 2013, Flight 228

Flight was a complete survey of transects 9, 11, 15, and 17. Survey conditions included clear to partly cloudy skies, 3-10 km visibility (with glare and precipitation), and Beaufort 0-5 sea states. Ice cover was 0-50% broken floe sea ice in the area surveyed. Sightings included one bowhead whale, gray whales, one unidentified cetacean, walruses, bearded seals, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
228	8/29/13 10:40	70.115	162.819	gray whale	swim	1	0	17
228	8/29/13 15:50	70.831	160.694	gray whale	swim	1	0	17
228	8/29/13 15:53	70.839	160.690	gray whale	feed	1	0	17
228	8/29/13 15:55	70.838	160.744	gray whale	feed	1	0	17
228	8/29/13 15:57	70.885	160.718	gray whale	feed	1	0	17
228	8/29/13 17:38	71.630	165.359	bowhead whale	swim	1	0	15
228	8/29/13 18:00	71.391	164.372	unid cetacean	unknown	1	0	15

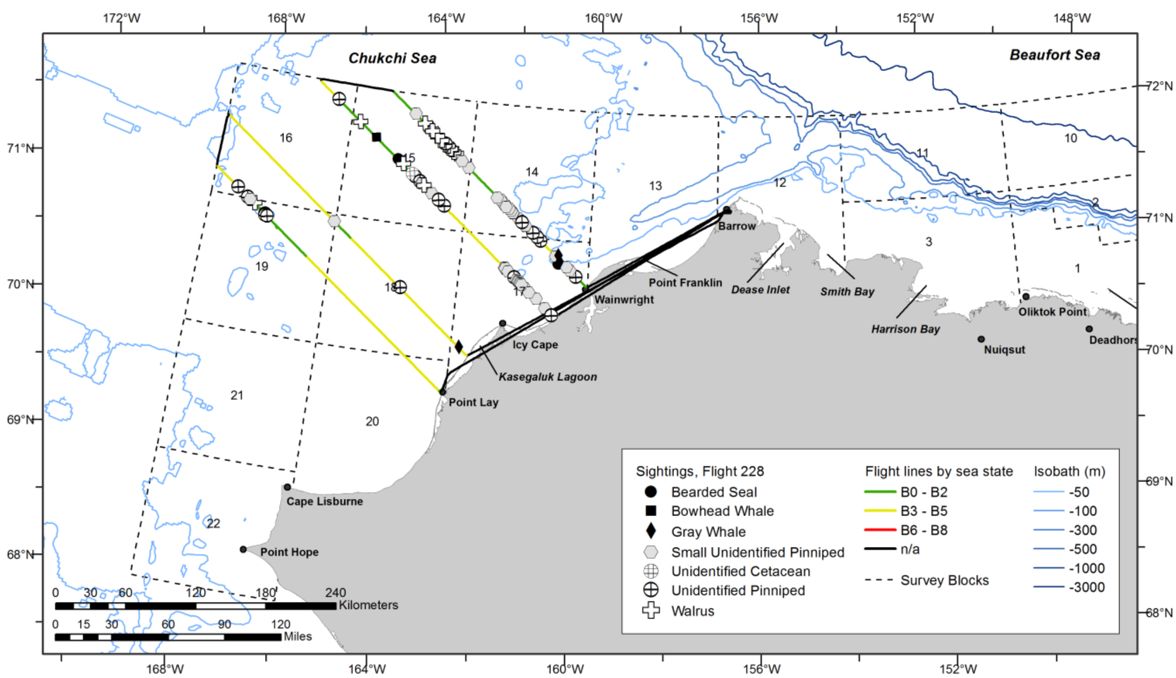

Figure B-49. ASAMM Flight 228 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

30 August 2013, Flight 22

Flight was a complete survey of transects 1, 3, 5, and 7, and portions of block 12. Survey conditions included partly cloudy to overcast skies, 3 km to unlimited visibility (with glare and occasional low ceilings), and Beaufort 1-7 sea states. Ice cover was 0-25% broken floe sea ice in the area surveyed. Sightings included bowhead whales, gray whales (including one calf), belugas, unidentified cetaceans, walruses, one bearded seal, one ringed seal, unidentified pinnipeds, and small unidentified pinnipeds. One small unidentified cetacean carcass in an advanced state of decomposition was observed approximately 20 km north of Barrow. Most walruses were in the northernmost part of blocks 14 and 15, hauled out on ice in groups ranging from 10-700 individuals.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
22	8/30/13 14:00	72.000	161.840	bowhead whale	swim	1	0	14
22	8/30/13 14:12	71.780	160.752	beluga	swim	1	0	14
22	8/30/13 14:44	71.049	158.299	gray whale	feed	1	0	13
22	8/30/13 14:48	71.013	158.208	gray whale	feed	3	1	13
22	8/30/13 14:54	70.935	157.881	gray whale	swim	4	0	13
22	8/30/13 15:11	71.259	157.414	gray whale	rest	1	0	13
22	8/30/13 15:11	71.256	157.466	gray whale	feed	1	0	13
22	8/30/13 15:40	71.759	159.093	bowhead whale	swim	1	0	13
22	8/30/13 17:28	71.275	156.941	gray whale	feed	2	0	12
22	8/30/13 17:31	71.380	156.943	small unid cetacean	dead	1	0	12
22	8/30/13 18:18	71.636	155.843	bowhead whale	mill	2	0	12
22	8/30/13 18:18	71.635	155.837	bowhead whale	mill	1	0	12
22	8/30/13 18:18	71.630	155.885	bowhead whale	mill	2	0	12
22	8/30/13 18:19	71.623	155.890	bowhead whale	mill	2	0	12
22	8/30/13 18:19	71.618	155.894	bowhead whale	mill	9	0	12
22	8/30/13 18:19	71.614	155.851	bowhead whale	mill	2	0	12
22	8/30/13 18:43	71.617	155.798	beluga	swim	1	0	12
22	8/30/13 18:45	71.641	155.851	bowhead whale	mill	1	0	12
22	8/30/13 19:10	71.592	155.353	bowhead whale	mill	1	0	12
22	8/30/13 19:15	71.739	155.454	bowhead whale	unknown	2	0	12
22	8/30/13 19:17	71.729	155.434	bowhead whale	rest	2	0	12
22	8/30/13 19:31	71.747	155.272	unid cetacean	unknown	2	0	12

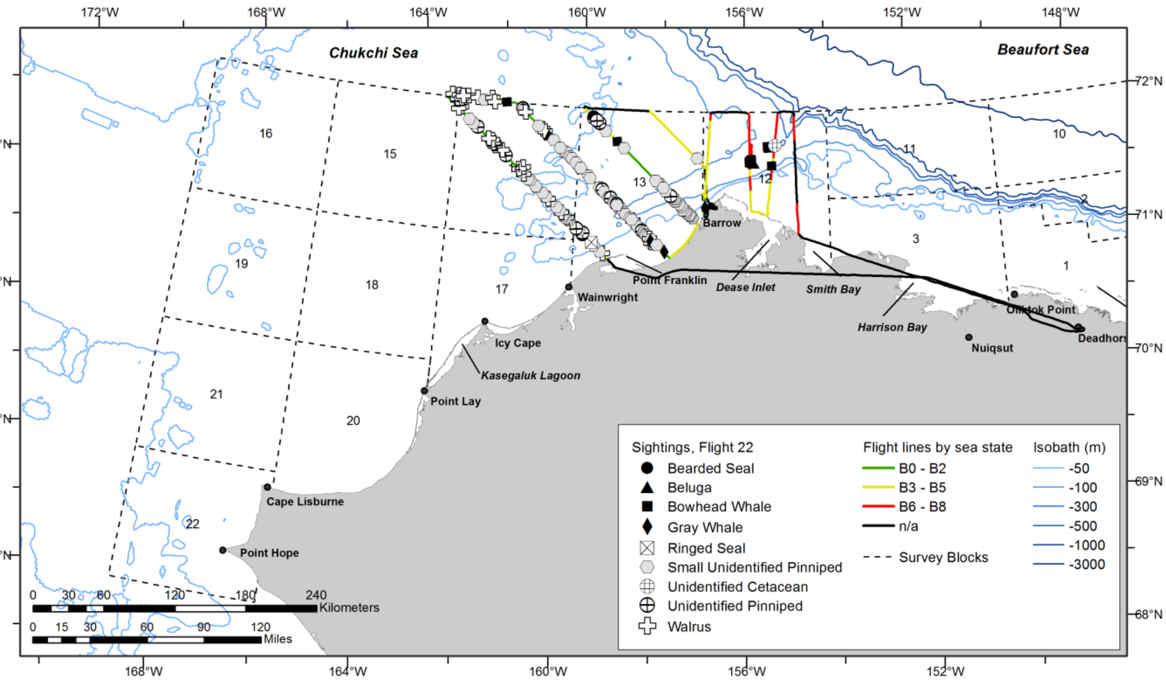

Figure B-50. ASAMM Flight 22 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

30 August 2013, Flight 229

Flight was a complete survey of transects 13 and 20. Survey conditions included clear to overcast skies, 0-10 km visibility (with fog, low ceilings, glare, and precipitation), and Beaufort 1-4 sea states. Ice cover was 0-1% broken floe sea ice in the area surveyed. Sightings included one unidentified cetacean (dead), walruses, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
229	8/30/13 11:27	70.785	163.643	unid cetacean	dead	1	0	18

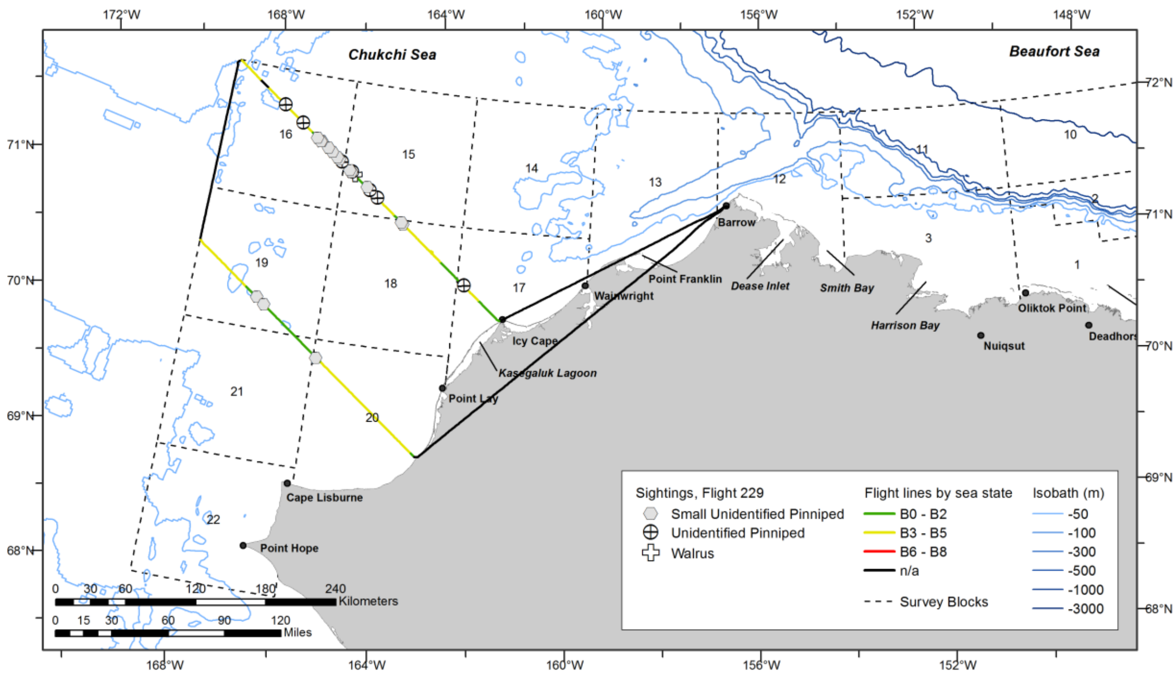

Figure B-51. ASAMM Flight 229 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

31 August 2013, Flight 230

Flight was a complete survey of transects 22 and 25. Survey conditions included partly cloudy to overcast skies, <1-10 km visibility (with fog, low ceilings, glare, and precipitation), and Beaufort 1-4 sea states. There was no sea ice observed in the area surveyed. Sightings included one bearded seal, unidentified pinnipeds, and small unidentified pinnipeds.

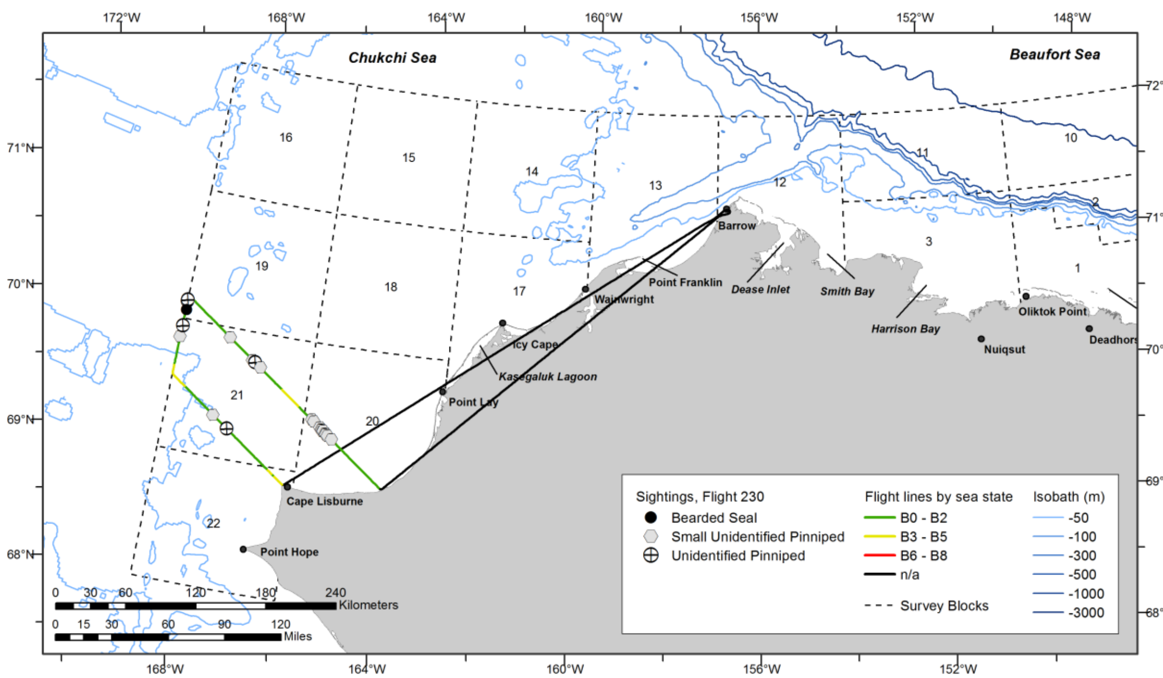

Figure B-52. ASAMM Flight 230 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

1 September 2013, Flight 23

Flight was a survey of portions of blocks 3 and 11. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with widespread low ceilings and snow showers), and Beaufort 1-4 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including one calf), belugas (including three calves), one unidentified cetacean, small unidentified pinnipeds, and one polar bear located on a barrier island.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
23	9/1/13 11:15	71.175	153.570	unid cetacean	swim	1	0	3
23	9/1/13 11:45	71.878	153.492	beluga	rest	1	0	11
23	9/1/13 12:06	71.758	151.582	beluga	mill	1	0	11
23	9/1/13 12:06	71.749	151.550	beluga	mill	1	0	11
23	9/1/13 12:07	71.741	151.558	beluga	swim	2	1	11
23	9/1/13 12:07	71.714	151.563	beluga	rest	5	0	11
23	9/1/13 12:14	71.478	151.644	beluga	swim	1	0	11
23	9/1/13 12:14	71.474	151.653	beluga	swim	2	1	11
23	9/1/13 12:15	71.457	151.646	beluga	swim	3	1	11
23	9/1/13 12:25	71.104	151.751	bowhead whale	swim	1	0	3
23	9/1/13 12:26	71.102	151.765	bowhead whale	swim	3	1	3
23	9/1/13 12:38	71.029	151.754	bowhead whale	swim	1	0	3
23	9/1/13 12:38	71.005	151.769	bowhead whale	swim	1	0	3

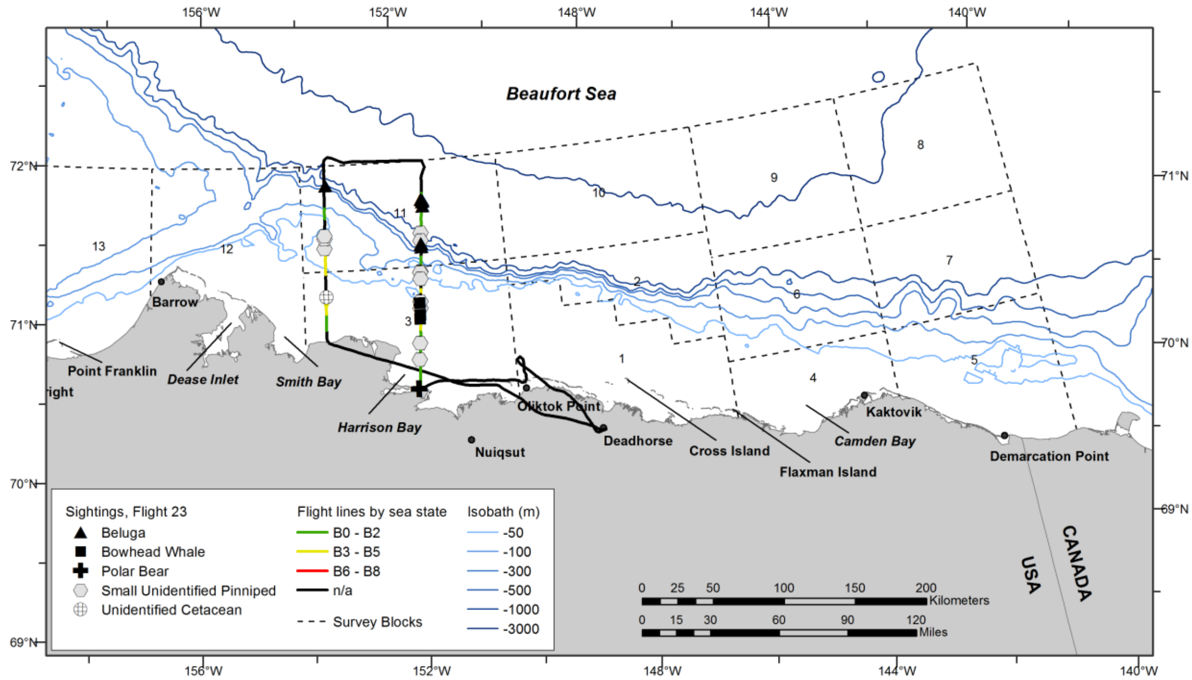

Figure B-53. ASAMM Flight 23 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

1 September 2013, Flight 231

Flight was a partial survey of transect 23 and the coastal transect from Cape Lisburne to south of Icy Cape. Survey conditions included clear to partly cloudy skies, <1-10 km visibility (with low ceilings and glare), and Beaufort 2-7 sea states. There was no sea ice observed in the area surveyed. Sightings included one small unidentified pinniped and two unidentified pinniped carcasses.

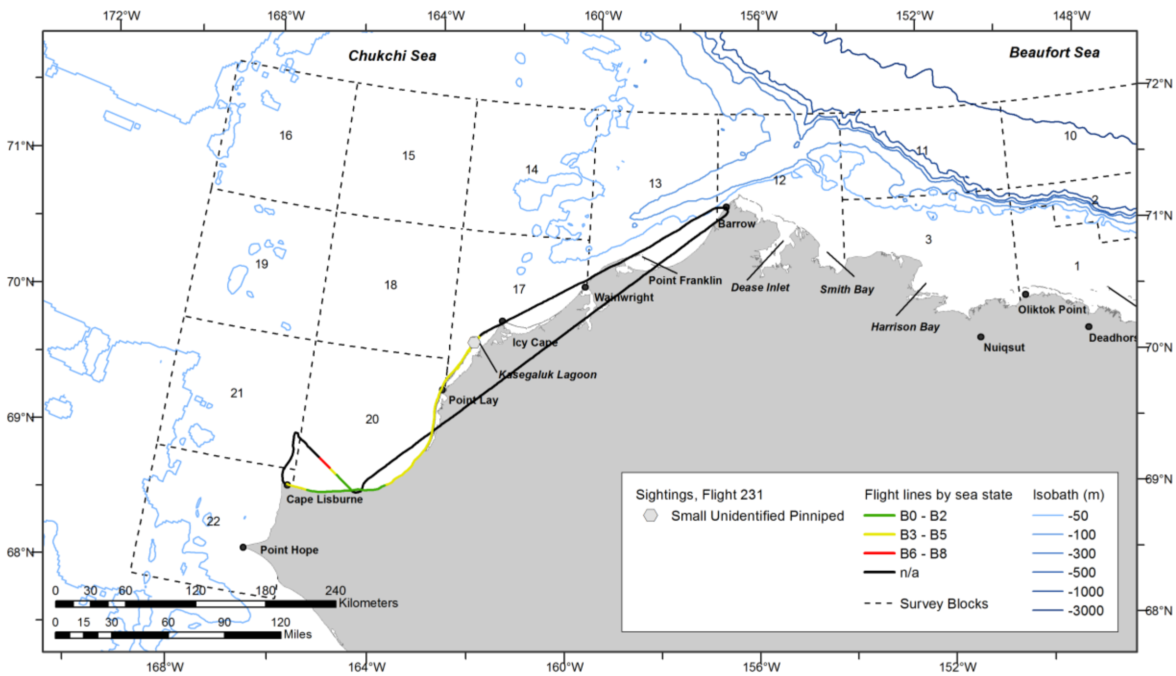

Figure B-54. ASAMM Flight 231 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

4 September 2013, Flight 232

Flight was deadhead effort in search of conditions suitable for surveying. Survey conditions included widespread strong winds and low ceilings. No sightings were observed.

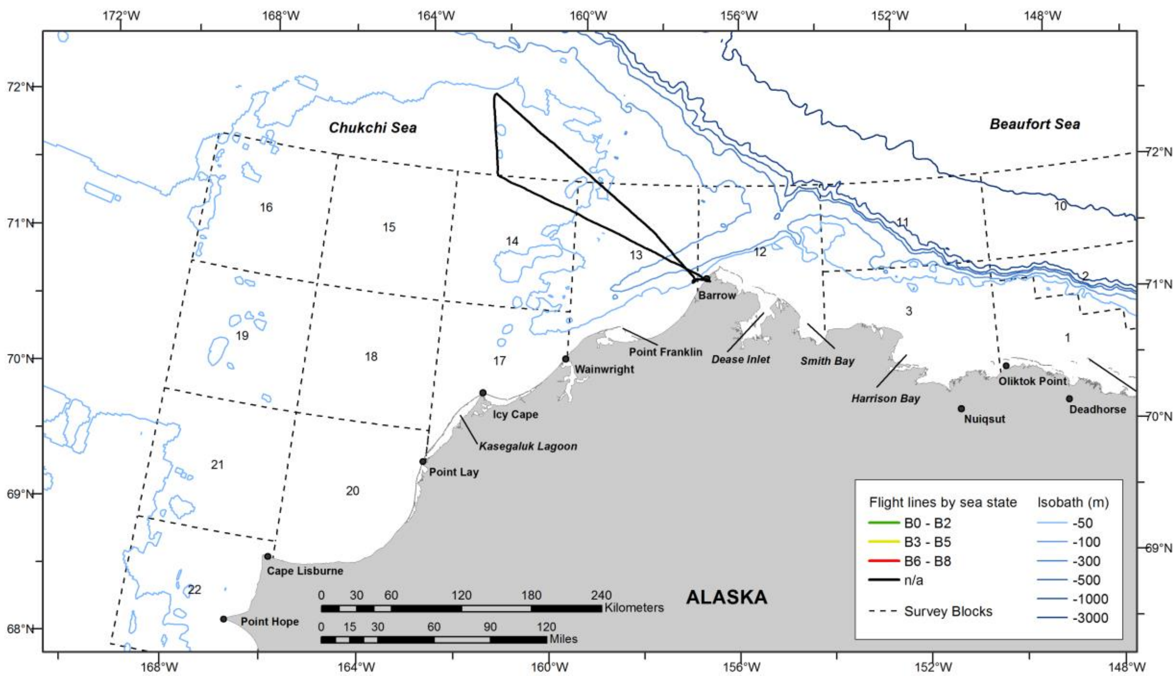

Figure B-55. ASAMM Flight 232 survey track, depicted by sea state.

6 September 2013, Flight 24

Flight was a survey of portions of blocks 1 and 4. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with widespread fog offshore and occasional glare), and Beaufort 2-6 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including nine calves) and unidentified cetaceans.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
24	9/6/13 10:01	70.926	149.901	bowhead whale	swim	2	1	1
24	9/6/13 10:38	70.827	149.374	bowhead whale	swim	2	1	1
24	9/6/13 10:38	70.804	149.376	bowhead whale	rest	1	0	1
24	9/6/13 10:39	70.781	149.424	bowhead whale	swim	1	0	1
24	9/6/13 10:43	70.725	149.299	bowhead whale	rest	4	0	1
24	9/6/13 10:47	70.714	149.263	bowhead whale	rest	2	0	1
24	9/6/13 10:49	70.698	149.192	bowhead whale	rest	2	0	1
24	9/6/13 10:50	70.719	149.205	bowhead whale	rest	1	0	1
24	9/6/13 10:50	70.725	149.175	bowhead whale	rest	1	0	1
24	9/6/13 10:51	70.718	149.176	bowhead whale	swim	1	0	1
24	9/6/13 10:54	70.703	149.355	bowhead whale	rest	3	0	1
24	9/6/13 10:55	70.707	149.318	bowhead whale	rest	1	0	1
24	9/6/13 10:55	70.698	149.353	bowhead whale	rest	1	0	1
24	9/6/13 10:56	70.698	149.375	unid cetacean	unknown	1	0	1
24	9/6/13 10:57	70.705	149.359	bowhead whale	rest	2	1	1
24	9/6/13 10:57	70.696	149.342	bowhead whale	rest	3	1	1
24	9/6/13 12:12	70.356	145.904	bowhead whale	rest	1	0	4
24	9/6/13 12:13	70.355	145.942	bowhead whale	swim	1	0	4
24	9/6/13 12:18	70.350	145.958	bowhead whale	rest	1	0	4
24	9/6/13 12:20	70.359	145.922	bowhead whale	rest	1	0	4
24	9/6/13 12:22	70.374	145.974	bowhead whale	rest	2	1	4
24	9/6/13 12:28	70.333	145.991	bowhead whale	rest	1	0	4
24	9/6/13 12:32	70.356	145.889	bowhead whale	rest	1	0	4
24	9/6/13 12:34	70.395	145.907	bowhead whale	rest	2	1	4
24	9/6/13 12:35	70.438	145.862	bowhead whale	dive	1	0	4
24	9/6/13 12:48	70.476	145.147	bowhead whale	roll	1	0	4
24	9/6/13 12:51	70.387	145.112	bowhead whale	rest	1	0	4
24	9/6/13 12:51	70.378	145.142	bowhead whale	rest	1	0	4
24	9/6/13 12:52	70.384	145.109	bowhead whale	rest	1	0	4
24	9/6/13 12:52	70.389	145.111	bowhead whale	rest	1	0	4
24	9/6/13 12:53	70.374	145.084	bowhead whale	rest	2	1	4
24	9/6/13 12:54	70.365	145.069	bowhead whale	rest	2	0	4
24	9/6/13 12:57	70.396	145.088	bowhead whale	rest	1	0	4
24	9/6/13 13:00	70.444	145.138	bowhead whale	rest	2	0	4

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
24	9/6/13 13:07	70.460	145.223	unid cetacean	dive	1	0	4
24	9/6/13 13:11	70.346	145.037	bowhead whale	rest	2	1	4
24	9/6/13 13:37	70.384	144.946	bowhead whale	rest	2	0	4
24	9/6/13 13:52	70.290	144.445	bowhead whale	swim	1	0	4
24	9/6/13 13:54	70.246	144.471	bowhead whale	dive	2	1	4
24	9/6/13 14:11	70.290	143.795	bowhead whale	roll	2	0	4

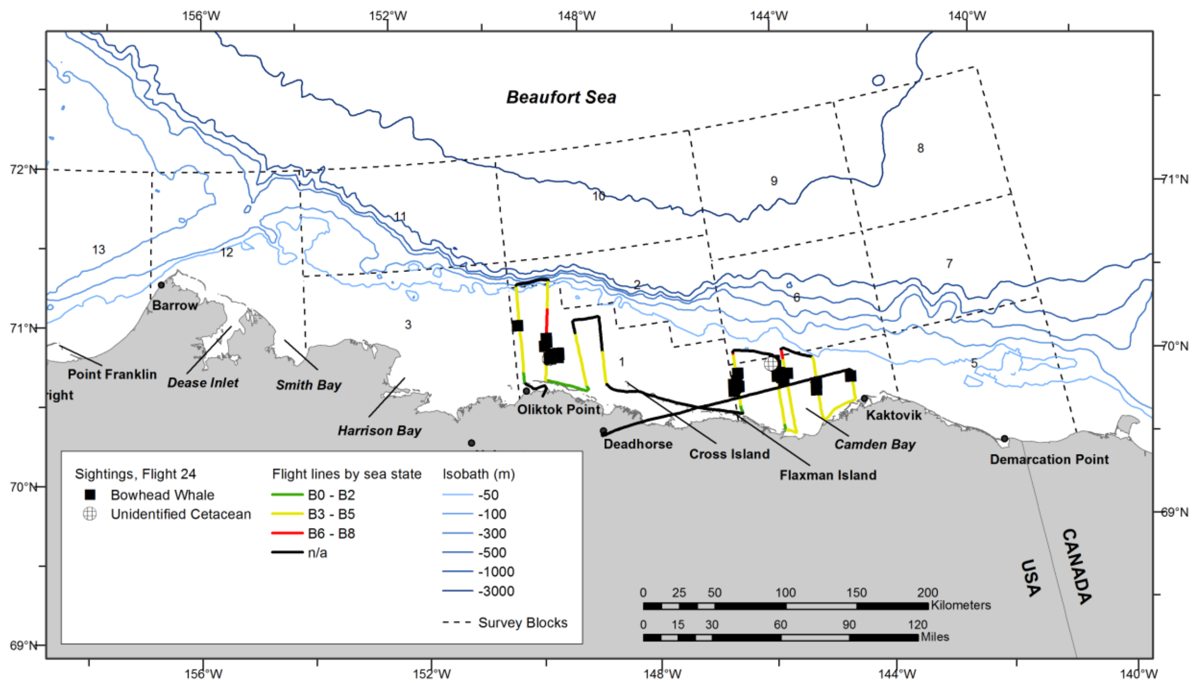

Figure B-56. ASAMM Flight 24 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

6 September 2013, Flight 233

Flight was a survey of the coastal transect from Point Barrow to Cape Lisburne. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with fog, glare, low ceilings, and precipitation), and Beaufort 1-6 sea states. There was no sea ice observed in the area surveyed. Sightings included one gray whale, one unidentified marine mammal, unidentified pinnipeds, small unidentified pinnipeds, and brown bears.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
233	9/6/13 11:58	69.453	163.163	gray whale	feed	1	0	20

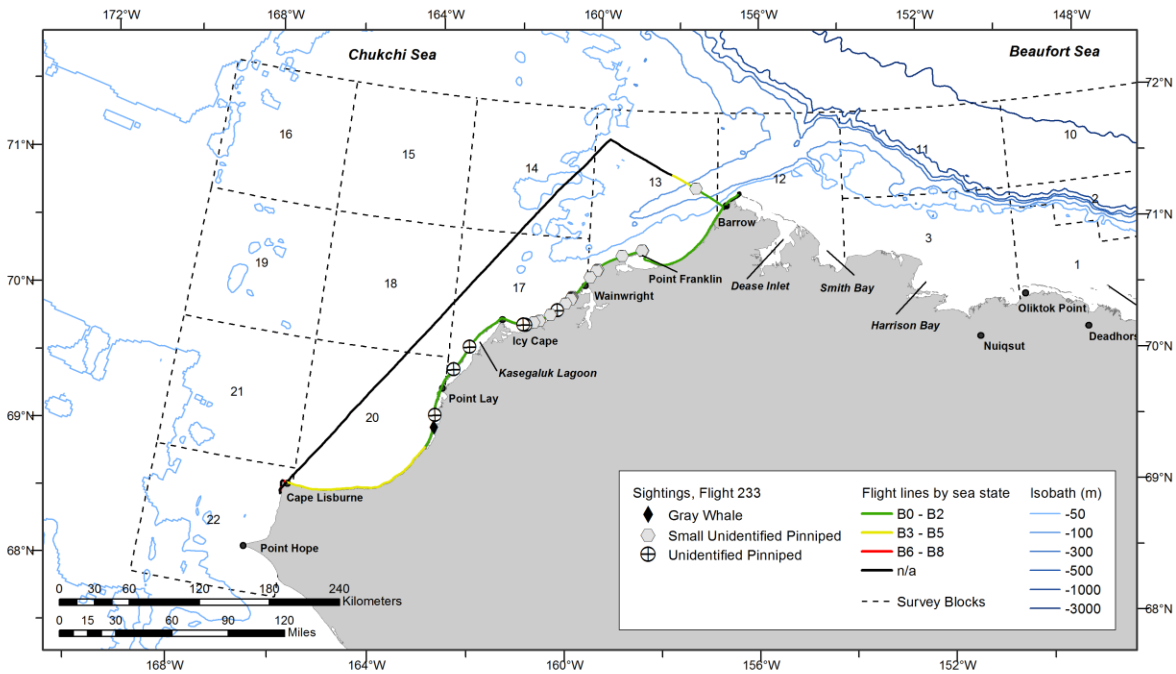

Figure B-57. ASAMM Flight 233 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

7 September 2013, Flight 234

Flight was a partial survey of transect 16. Survey conditions included partly cloudy skies, 0-10 km visibility (with precipitation, glare, and low ceilings), and Beaufort 2-6 sea states. There was no sea ice observed in the area surveyed. Sightings included one unidentified pinniped.

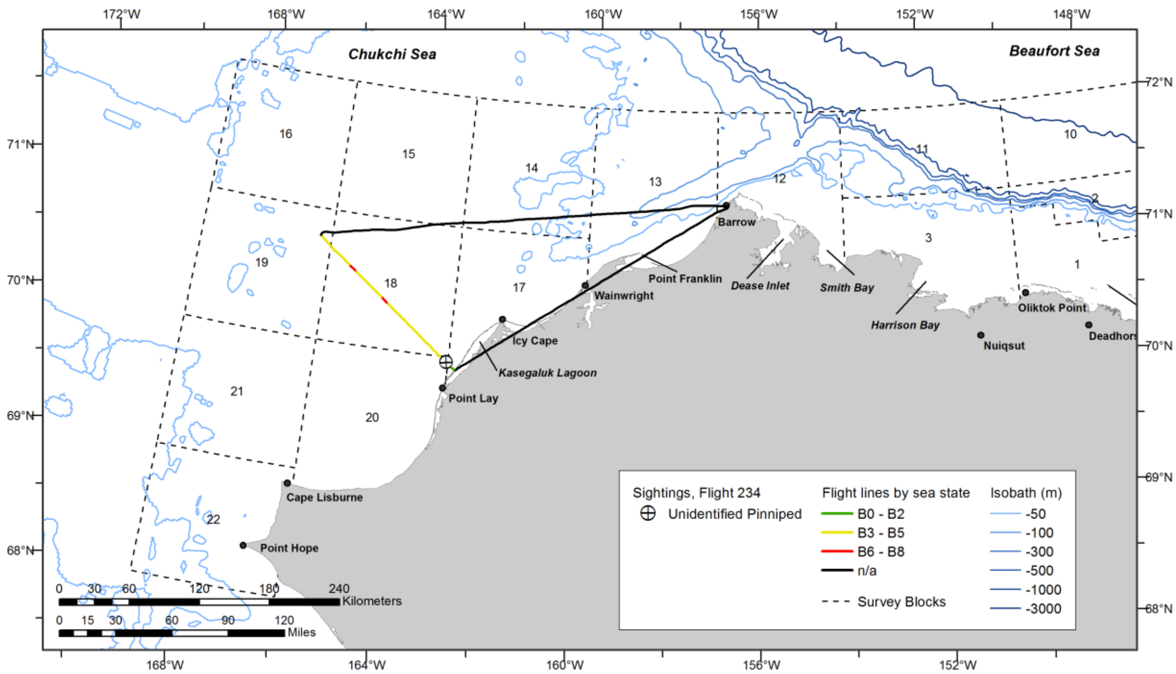

Figure B-58. ASAMM Flight 234 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

10 September 2013, Flight 25

Flight was deadhead effort in search of suitable conditions for surveying. Survey conditions included widespread dense fog and high sea states (Beaufort 6+) where water was visible. No sightings were observed.

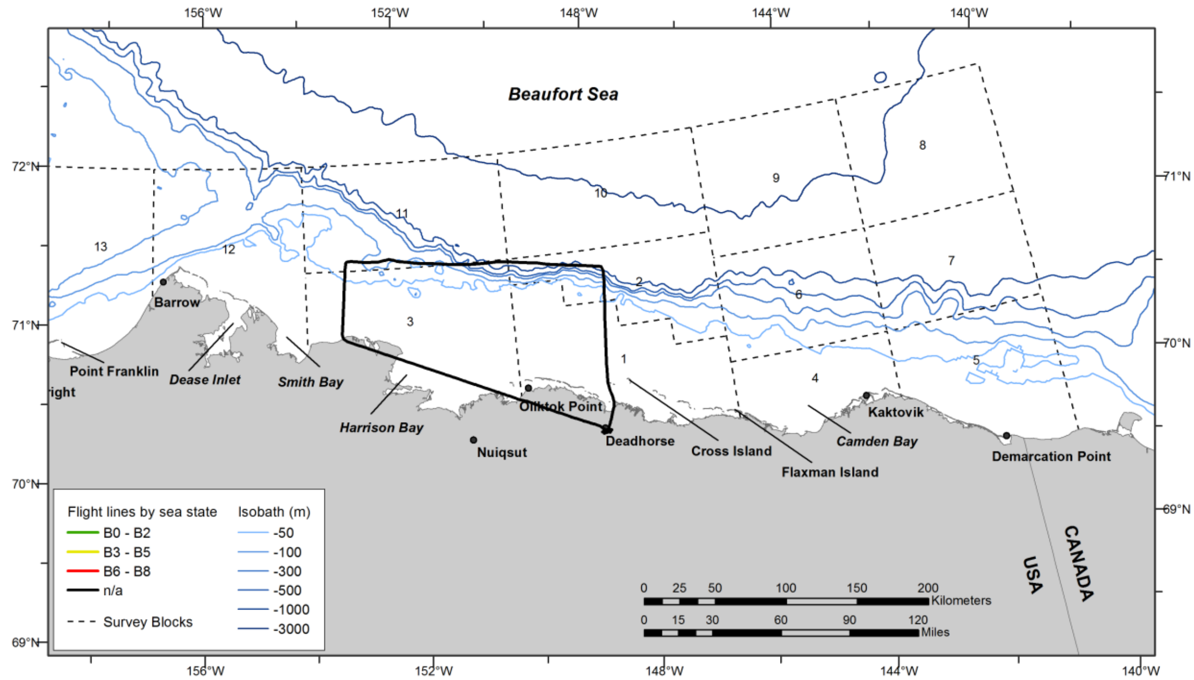

Figure B-59. ASAMM Flight 25 survey track, depicted by sea state.

11 September 2013, Flight 26

Flight was a survey of portions of block 3. Survey conditions included partly cloudy skies, 0-10 km visibility (with glare and widespread dense fog offshore), and Beaufort 3-6 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales, one unidentified cetacean, and one polar bear. The polar bear was on shore west of Cape Halkett.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
26	9/11/13 14:36	71.115	153.265	bowhead whale	dive	1	0	3
26	9/11/13 15:04	71.158	152.855	bowhead whale	rest	1	0	3
26	9/11/13 15:06	71.088	152.943	bowhead whale	dive	1	0	3
26	9/11/13 15:51	70.752	151.386	unid cetacean	unknown	1	0	3

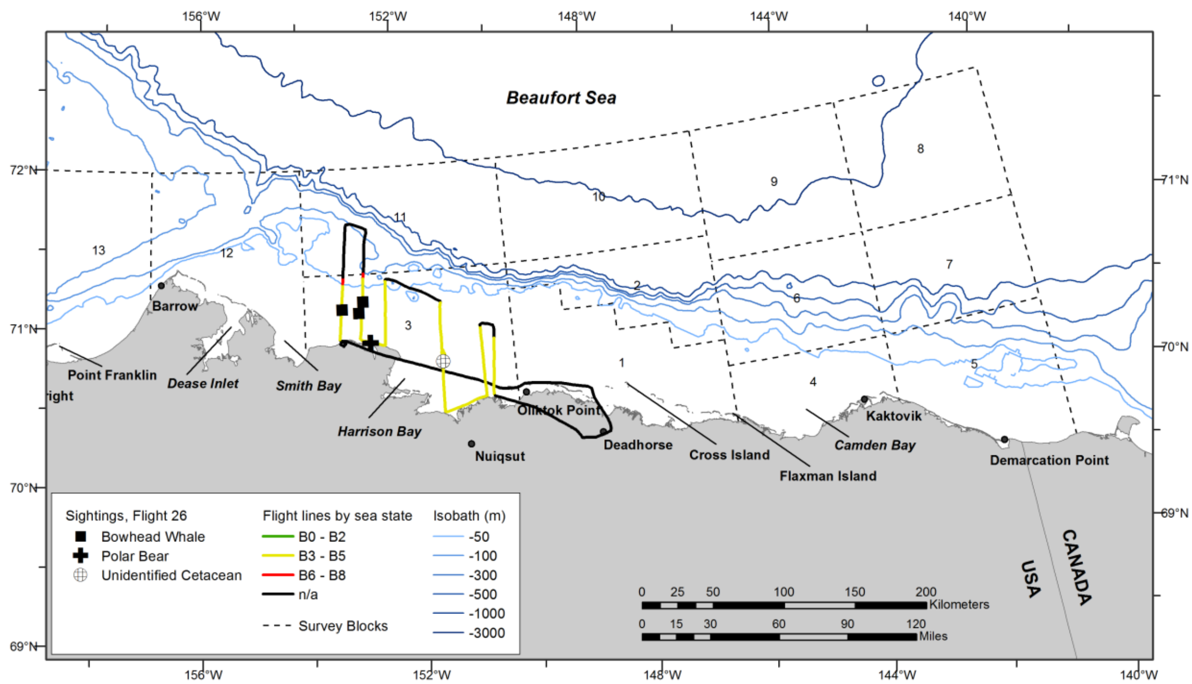

Figure B-60. ASAMM Flight 26 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

11 September 2013, Flight 235

Flight was a partial survey of transects 8 and 10, complete survey of transect 6, and the coastal survey from Point Barrow to Wainwright. Survey conditions included partly cloudy to overcast skies, 2-10 km visibility (with glare, fog, and haze), and Beaufort 2-5 sea states. Ice cover was 0-1% broken floe sea ice in the area surveyed. Sightings included bowhead whales (including one calf carcass), gray whales (including one calf), unidentified cetaceans, one unidentified pinniped and one polar bear. The polar bear was swimming a few kilometers from the beach in the area between Barrow and Peard Bay.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
235	9/11/13 10:02	71.150	157.097	gray whale	feed	1	0	13
235	9/11/13 10:27	70.916	158.698	unid cetacean	swim	1	0	13
235	9/11/13 11:23	71.172	162.642	bowhead whale	dead	1	1	14
235	9/11/13 12:09	71.067	160.438	gray whale	feed	9	1	14
235	9/11/13 12:20	70.961	160.224	gray whale	feed	1	0	17
235	9/11/13 12:26	70.912	160.162	bowhead whale	swim	1	0	17
235	9/11/13 12:27	70.907	160.185	gray whale	swim	1	0	17
235	9/11/13 12:28	70.915	160.188	gray whale	feed	1	0	17
235	9/11/13 12:56	70.943	158.699	unid cetacean	swim	1	0	13
235	9/11/13 13:04	70.963	158.782	unid cetacean	swim	1	0	13
235	9/11/13 13:14	71.069	159.072	bowhead whale	rest	1	0	13
235	9/11/13 13:20	71.118	159.242	bowhead whale	swim	1	0	13

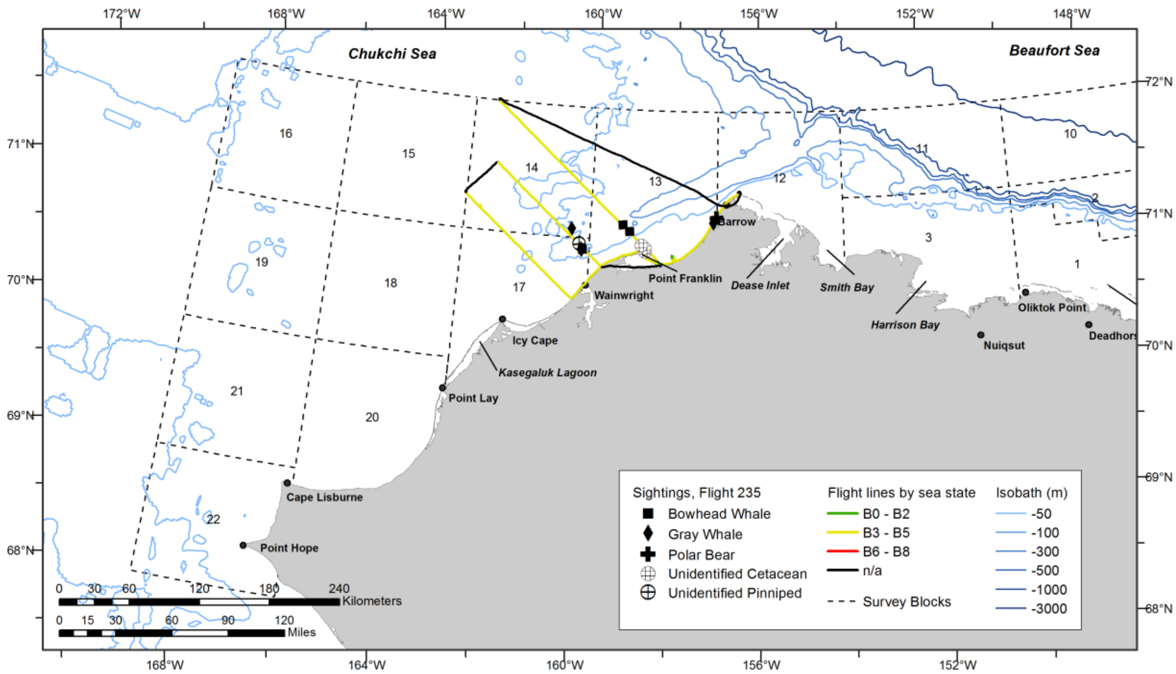

Figure B-61. ASAMM Flight 235 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Bowhead whale calf carcass sighted approximately 115 km northwest of Wainwright, Alaska, during flight 235, 11 September 2013.

Feeding gray whale group sighted approximately 50 km north of Wainwright, Alaska, during flight 235, 11 September 2013.

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12 September 2013, Flight 236

Flight was a partial survey of transect 10, and the coastal transect from Wainwright to Cape Lisburne. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with glare, low ceilings, and precipitation), and Beaufort 2-6 sea states. There was no sea ice observed in the area surveyed. Sightings included gray whales, one unidentified cetacean, walruses (including one calf), bearded seals, unidentified pinnipeds, small unidentified pinnipeds, polar bears (including one cub/yearling), Dall sheep, brown bears, and one sleeper shark. One group of three polar bears was observed walking on the beach, and a single polar bear was observed swimming within one kilometer of shore. A walrus haulout, with an estimated 1,500-4,000 individuals, was observed on the beach near Point Lay.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
236	9/12/13 9:57	71.021	158.066	gray whale	feed	1	0	13
236	9/12/13 9:57	71.010	158.120	gray whale	feed	2	0	13
236	9/12/13 9:58	70.997	158.188	gray whale	swim	1	0	13
236	9/12/13 10:00	70.936	158.472	gray whale	mill	2	0	13
236	9/12/13 11:16	69.671	163.147	unid cetacean	rest	1	0	20

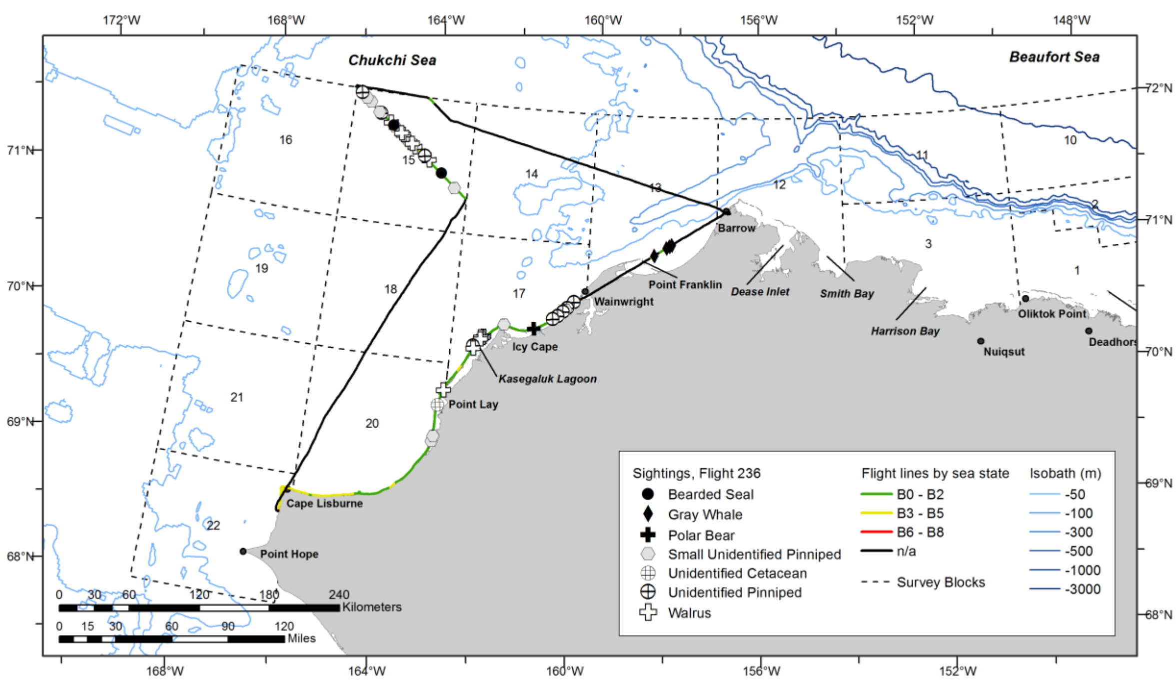

Figure B-62. ASAMM Flight 236 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Polar bears (including one cub/yearling) sighted on the beach during flight 236, 12 September 2013.

Walrus haulout sighted on a barrier island near Point Lay, Alaska, during flight 236, 12 September 2013. The total group size was estimated at 1,500-4,000 individuals, with approximately 5-15% of the walruses in the water near the haulout.

13 September 2013, Flight 27

Flight was a survey of portions of blocks 1, 2, 4, 5, and 6. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with low ceilings and fog), and Beaufort 2-5 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including nine calves), one bearded seal, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
27	9/13/13 16:16	70.428	145.848	bowhead whale	rest	2	0	4
27	9/13/13 16:16	70.417	145.847	bowhead whale	rest	2	1	4
27	9/13/13 16:16	70.411	145.859	bowhead whale	rest	1	0	4
27	9/13/13 16:17	70.415	145.890	bowhead whale	dive	1	0	4
27	9/13/13 16:25	70.406	145.848	bowhead whale	dive	1	0	4
27	9/13/13 16:27	70.381	145.894	bowhead whale	thrash	3	0	4
27	9/13/13 16:31	70.391	145.851	bowhead whale	swim	1	0	4
27	9/13/13 16:35	70.352	145.873	bowhead whale	rest	1	0	4
27	9/13/13 16:35	70.322	145.866	bowhead whale	rest	1	0	4
27	9/13/13 16:36	70.309	145.858	bowhead whale	log play	1	1	4
27	9/13/13 16:36	70.305	145.857	bowhead whale	rest	1	0	4
27	9/13/13 16:45	70.297	145.856	bowhead whale	rest	1	0	4
27	9/13/13 16:47	70.303	145.903	bowhead whale	dive	1	0	4
27	9/13/13 16:51	70.316	145.776	bowhead whale	mill	4	2	4
27	9/13/13 17:06	70.416	146.147	bowhead whale	swim	3	1	1
27	9/13/13 17:10	70.418	146.138	bowhead whale	swim	1	0	1
27	9/13/13 17:39	70.488	146.884	bowhead whale	mill	2	0	1
27	9/13/13 17:40	70.498	146.909	bowhead whale	swim	2	0	1
27	9/13/13 17:43	70.483	146.861	bowhead whale	swim	3	1	1
27	9/13/13 17:44	70.468	146.842	bowhead whale	rest	3	1	1
27	9/13/13 17:46	70.475	146.883	bowhead whale	rest	1	1	1
27	9/13/13 17:47	70.477	146.904	bowhead whale	dive	2	0	1
27	9/13/13 17:50	70.488	146.916	bowhead whale	rest	2	0	1
27	9/13/13 17:52	70.434	146.885	bowhead whale	rest	1	0	1
27	9/13/13 17:53	70.423	146.880	bowhead whale	swim	1	0	1
27	9/13/13 18:08	70.472	147.416	bowhead whale	mill	3	0	1
27	9/13/13 18:13	70.667	147.449	bowhead whale	swim	2	1	1

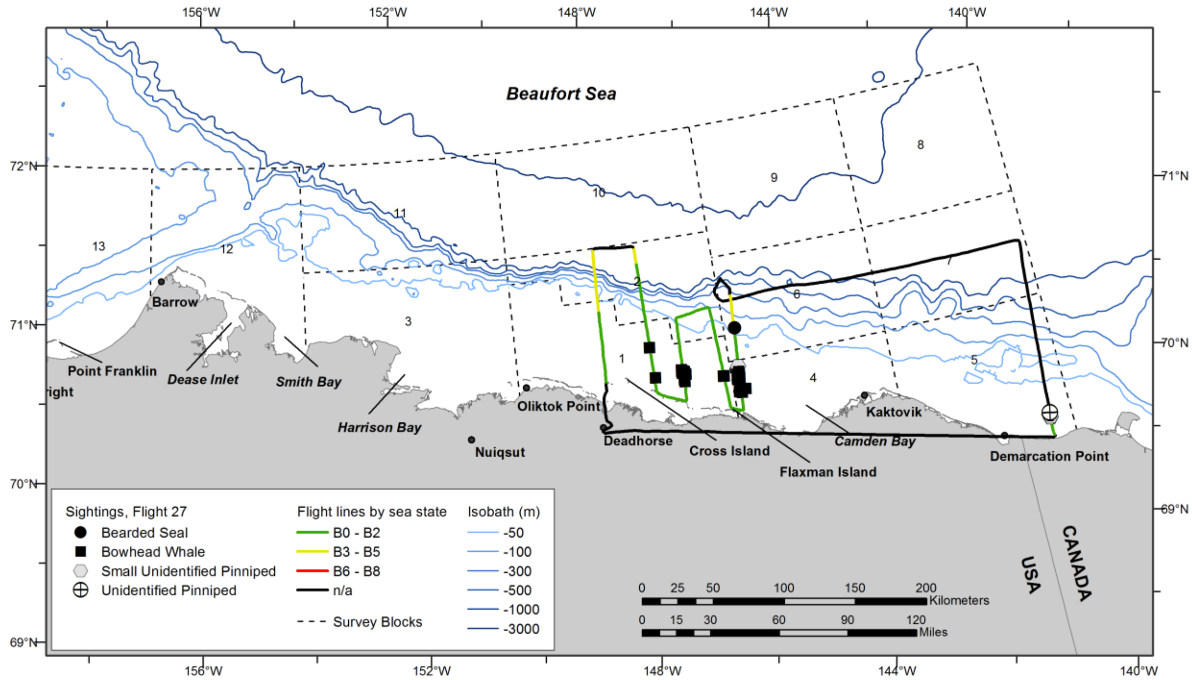

Figure B-63. ASAMM Flight 27 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

14 September 2013, Flight 237

Flight was a survey of the coastal transect from Point Lay to Point Hope. Survey conditions included partly cloudy to overcast skies, <1-5 km visibility (with glare, low ceilings, and precipitation), and Beaufort 3-6 sea states. There was no sea ice observed in the area surveyed. Sightings included one gray whale carcass and walruses. A walrus haulout, with an estimated 2,000-4,000 individuals, was observed on the beach near Point Lay.

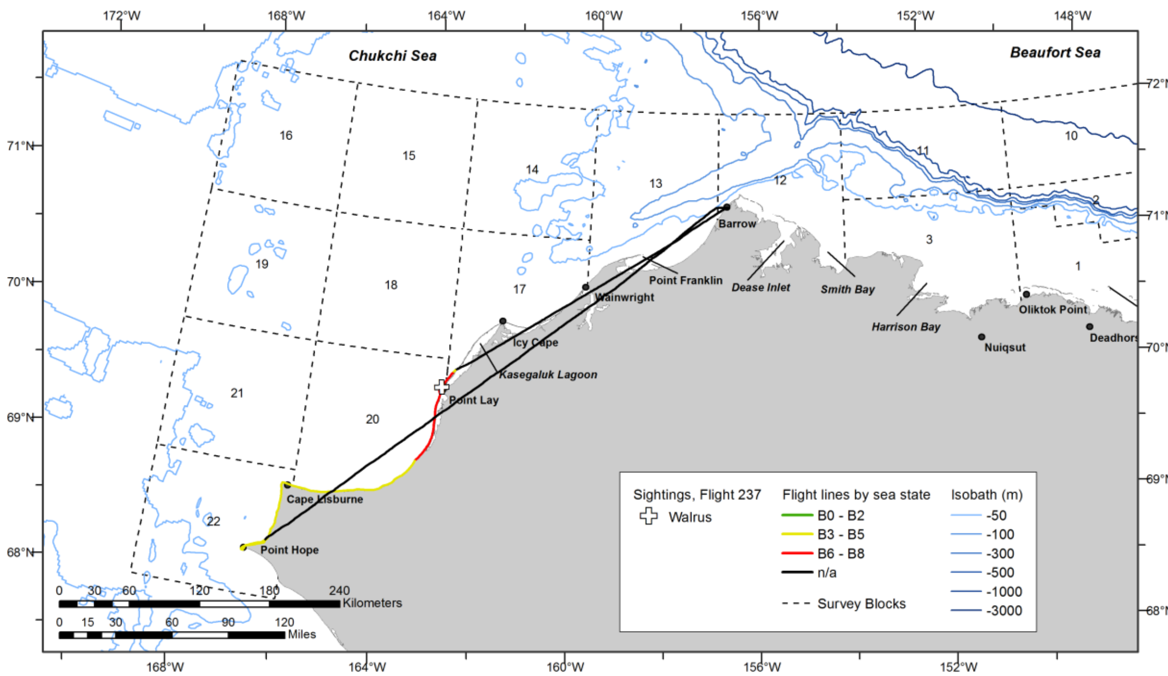

Figure B-64. ASAMM Flight 237 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Gray whale carcass sighted near Point Hope, Alaska, during flight 237, 14 September 2013.

Walrus haulout sighted on a barrier island near Point Lay, Alaska, during flight 237, 14 September 2013.

15 September 2013, Flight 28

Flight was a survey of block 12. Survey conditions included overcast skies, 0-10 km visibility (with low ceilings and precipitation), and Beaufort 3-6 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales, belugas, one bearded seal, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
28	9/15/13 11:48	70.664	147.749	bowhead whale	swim	1	0	1
28	9/15/13 12:30	70.972	154.158	bowhead whale	feed	17	0	12
28	9/15/13 12:31	70.957	154.156	bowhead whale	feed	1	0	12
28	9/15/13 12:31	70.954	154.119	bowhead whale	feed	20	0	12
28	9/15/13 12:33	70.947	154.120	bowhead whale	feed	3	0	12
28	9/15/13 12:33	70.953	154.113	bowhead whale	feed	2	0	12
28	9/15/13 12:34	70.953	154.100	bowhead whale	feed	1	0	12
28	9/15/13 12:44	71.013	154.238	bowhead whale	swim	1	0	12
28	9/15/13 12:48	71.158	154.231	bowhead whale	swim	1	0	12
28	9/15/13 12:49	71.163	154.205	bowhead whale	swim	1	0	12
28	9/15/13 13:10	71.707	154.308	bowhead whale	breach	1	0	12
28	9/15/13 13:25	71.976	154.646	bowhead whale	swim	1	0	12
28	9/15/13 13:28	71.952	154.620	beluga	swim	2	0	12
28	9/15/13 13:28	71.942	154.632	beluga	swim	1	0	12
28	9/15/13 13:30	71.867	154.646	beluga	rest	1	0	12
28	9/15/13 13:30	71.862	154.621	bowhead whale	rest	1	0	12
28	9/15/13 13:31	71.857	154.642	beluga	rest	1	0	12
28	9/15/13 13:31	71.854	154.647	beluga	rest	1	0	12
28	9/15/13 13:33	71.755	154.640	beluga	swim	2	0	12
28	9/15/13 13:51	71.061	154.629	bowhead whale	swim	2	0	12
28	9/15/13 13:51	71.060	154.580	bowhead whale	swim	2	0	12
28	9/15/13 13:52	71.044	154.635	bowhead whale	swim	2	0	12
28	9/15/13 13:55	71.066	154.668	bowhead whale	swim	1	0	12
28	9/15/13 14:47	71.530	155.947	bowhead whale	swim	1	0	12
28	9/15/13 14:47	71.530	155.906	bowhead whale	swim	1	0	12
28	9/15/13 14:48	71.477	155.954	bowhead whale	dive	1	0	12
28	9/15/13 14:49	71.464	155.913	bowhead whale	swim	1	0	12
28	9/15/13 14:50	71.407	155.938	bowhead whale	swim	1	0	12
28	9/15/13 14:51	71.382	155.922	bowhead whale	swim	1	0	12
28	9/15/13 15:00	71.474	156.146	bowhead whale	swim	1	0	12
28	9/15/13 15:00	71.475	156.132	bowhead whale	swim	1	0	12
28	9/15/13 15:04	71.602	156.223	bowhead whale	rest	1	0	12
28	9/15/13 15:36	71.404	156.767	bowhead whale	swim	1	0	12
28	9/15/13 15:36	71.397	156.741	bowhead whale	swim	1	0	12

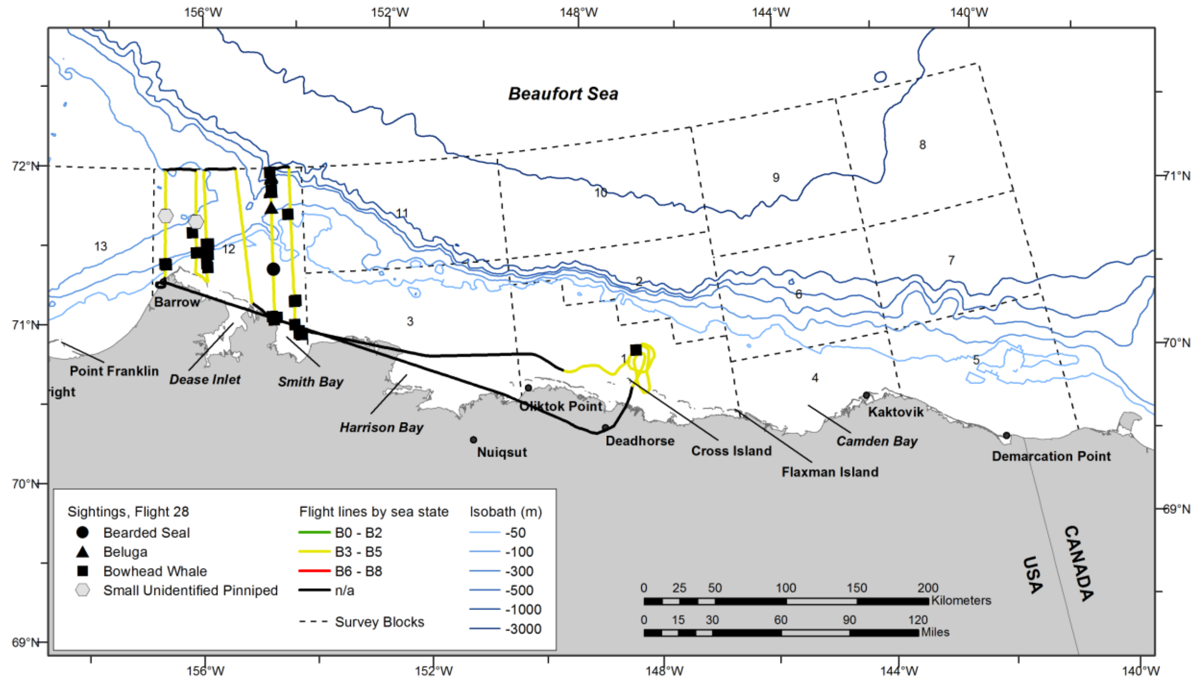

Figure B-65. ASAMM Flight 28 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Bowhead whales feeding in echelon formation in block 12 in the western Beaufort Sea during flight 28, 15 September 2013.

Bowhead whales surface skim-feeding in block 12 in the western Beaufort Sea during flight 28, 15 September 2013.

15 September 2013, Flight 238

Flight was a complete survey of transects 12 and 14, and the coastal transect near Icy Cape. Survey conditions included partly cloudy to overcast skies, 0-5 km visibility (with glare, low ceilings, and precipitation), and Beaufort 4-7 sea states. There was no sea ice observed in the area surveyed. Sightings included walruses.

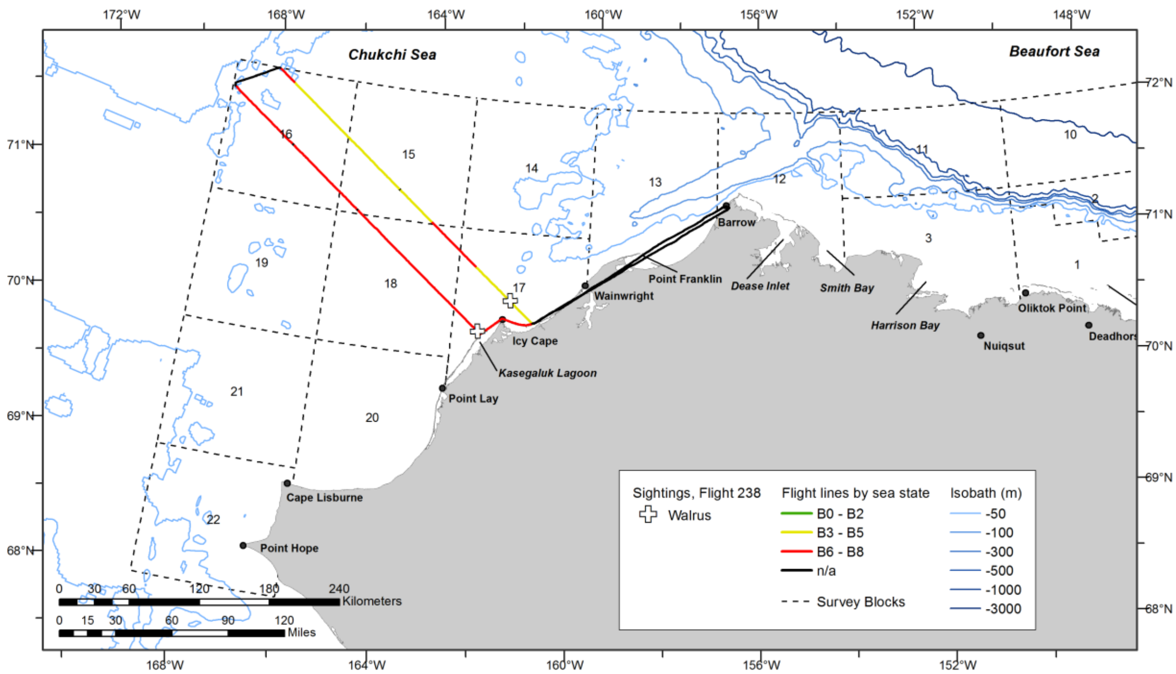

Figure B-66. ASAMM Flight 238 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

16 September 2013, Flight 29

Flight was a survey of portions of block 5. Survey conditions included partly cloudy to overcast skies, no visibility to unlimited visibility (with low ceilings, fog, and precipitation), and Beaufort 2-7 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including one dead), one bearded seal, and one polar bear resting on Cross Island.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
29	9/16/13 9:45	70.605	147.825	bowhead whale	dead	1	0	1
29	9/16/13 9:53	70.567	147.446	bowhead whale	swim	1	0	1
29	9/16/13 9:55	70.511	147.362	bowhead whale	swim	1	0	1

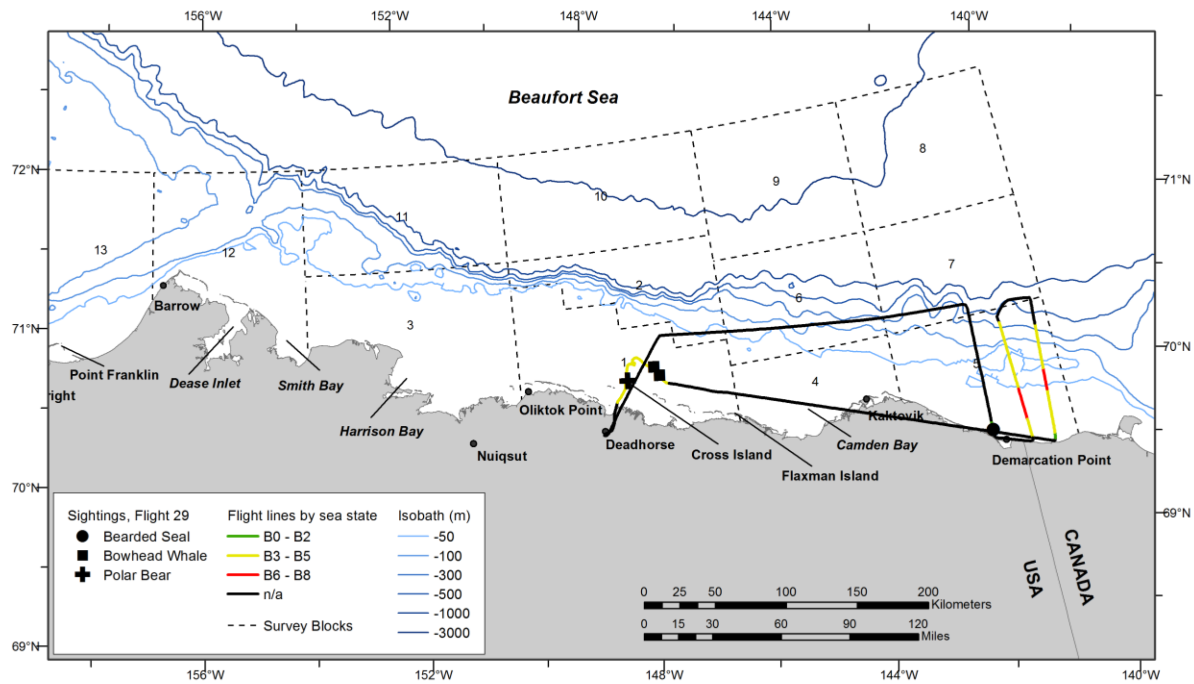

Figure B-67. ASAMM Flight 29 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

17 September 2013, Flight 30

Flight was a survey of portions of block 3, and search effort to find conditions suitable for surveying. Survey conditions included partly cloudy to overcast skies, <1-10 km visibility (with low ceilings, glare, and precipitation), and Beaufort 4-7 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales and one small unidentified pinniped.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
30	9/17/13 10:34	71.011	153.742	bowhead whale	swim	1	0	3
30	9/17/13 10:41	71.230	153.716	bowhead whale	swim	1	0	3

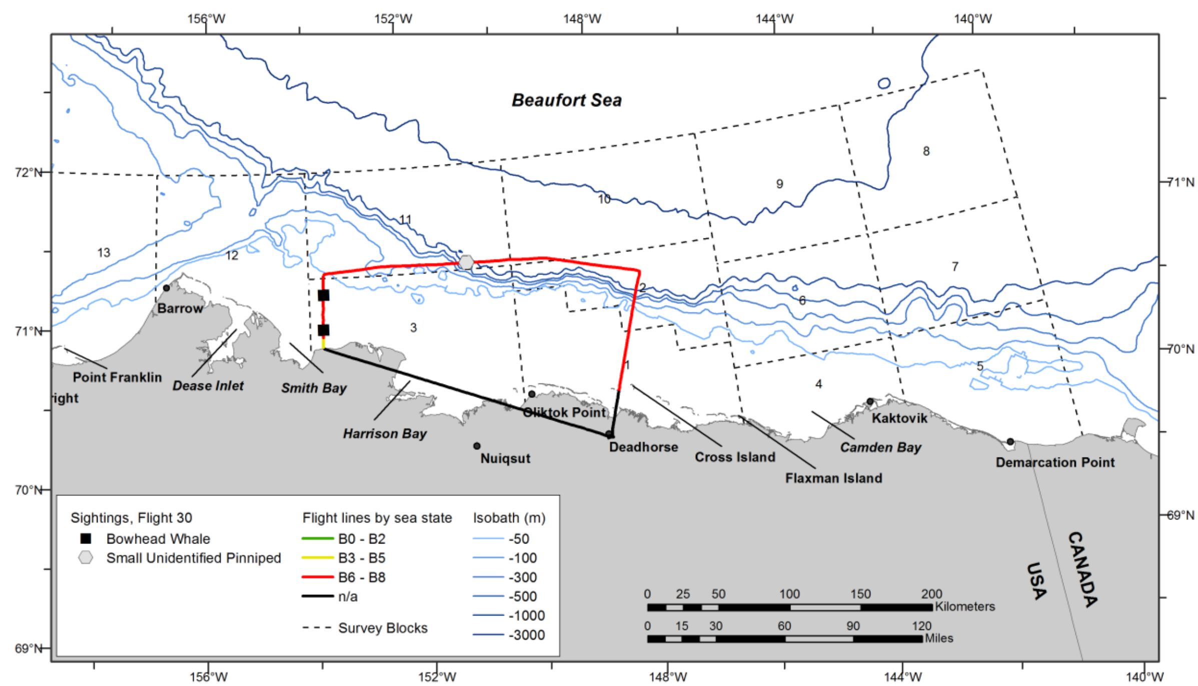

Figure B-68. ASAMM Flight 30 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

19 September 2013, Flight 239

Flight was a survey of the coastal transect from Point Hope to Barrow. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with glare, low ceilings, and precipitation), and Beaufort 3-7 sea states. There was no sea ice observed in the area surveyed. Sightings included one bowhead whale (dead), one gray whale (dead), walruses, and small unidentified pinnipeds. Survey effort near the Point Lay walrus haulout was not possible due to low ceilings.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
239	9/19/13 14:55	68.417	166.421	gray whale	dead	1	0	22
239	9/19/13 17:02	70.486	160.431	bowhead whale	dead	1	0	17

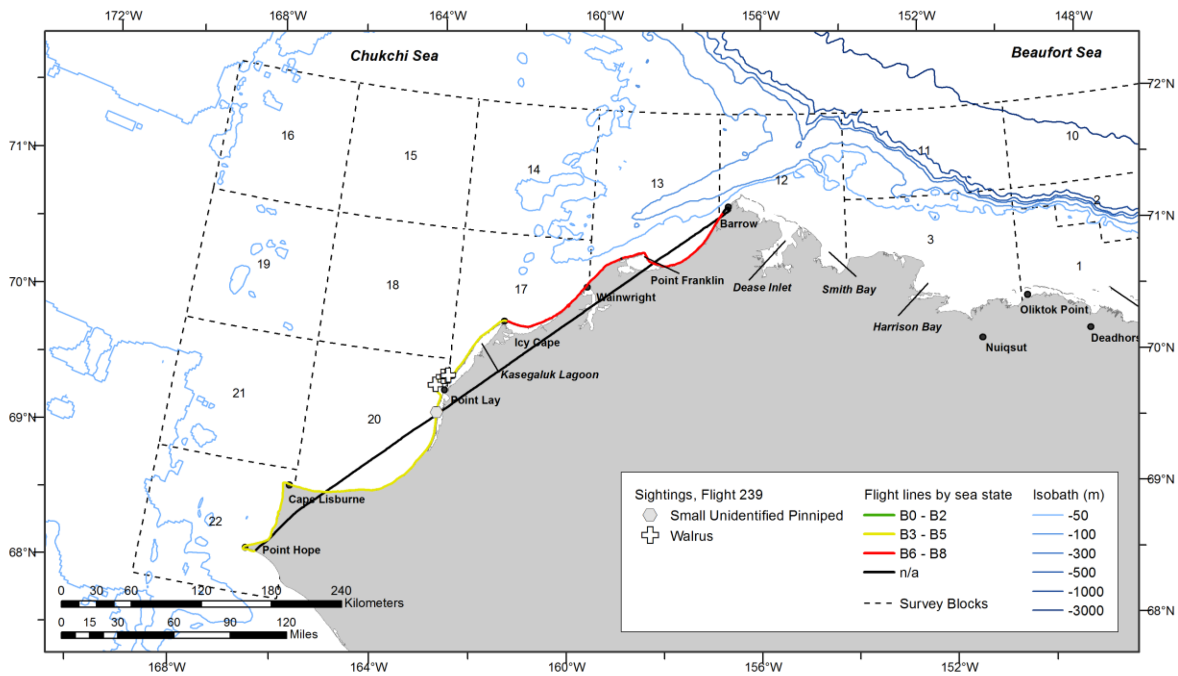

Figure B-69. ASAMM Flight 239 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

22 September 2013, Flight 31

Flight was a survey of blocks 4 and 6. Survey conditions included partly cloudy to overcast skies, no visibility to unlimited visibility (with low ceilings, glare, and precipitation), and Beaufort 2-4 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales, one beluga, unidentified cetaceans, bearded seals, small unidentified pinnipeds, and polar bears on barrier islands near Barter Island.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
31	9/22/13 15:04	70.593	145.827	bowhead whale	swim	1	0	6
31	9/22/13 15:24	71.163	145.178	beluga	swim	1	0	6
31	9/22/13 15:48	70.401	145.090	unid cetacean	swim	1	0	4
31	9/22/13 17:50	70.850	143.878	unid cetacean	swim	1	0	6
31	9/22/13 18:44	70.168	143.283	bowhead whale	swim	1	0	4

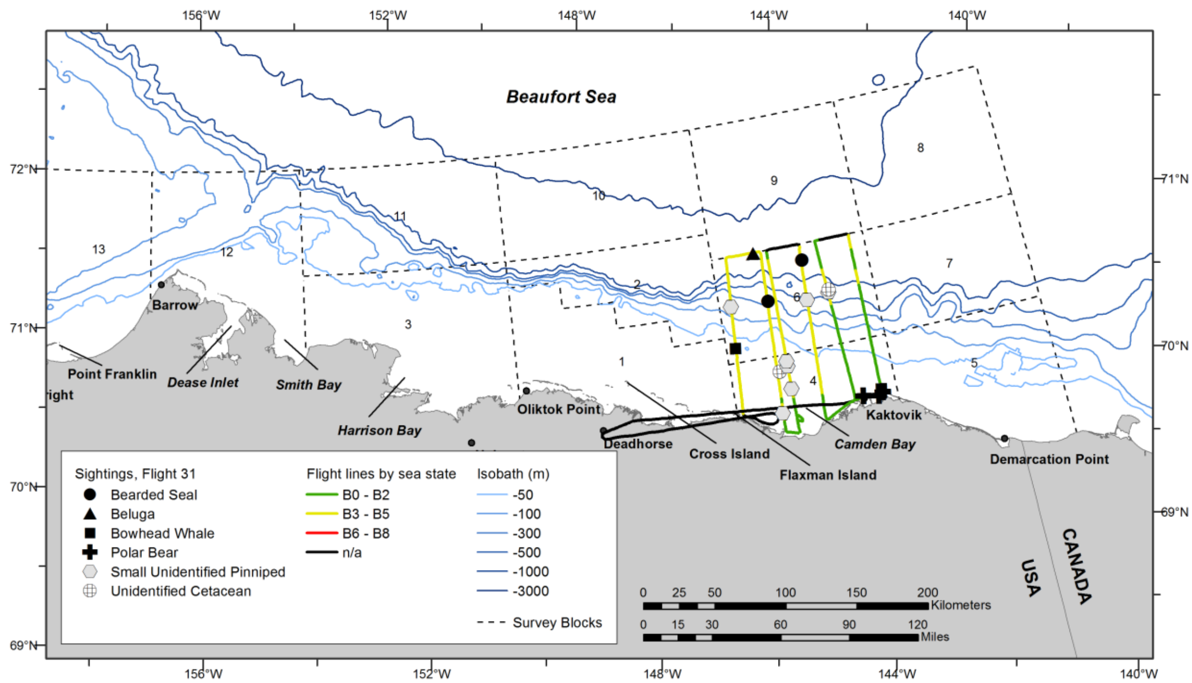

Figure B-70. ASAMM Flight 31 survey track, depicted by sea state, and marine mammal sightings, excluding carcasses.

22 September 2013, Flight 240

Flight was a complete survey of transects 15 and 17, the coastal transect near Point Lay, and search effort from Point Lay to Point Franklin. Survey conditions included partly cloudy to overcast skies, 0-10 km visibility (with glare, low ceilings, and precipitation), and Beaufort 2-4 sea states. There was no sea ice observed in the area surveyed. Sightings included walruses, unidentified pinnipeds, and small unidentified pinnipeds. The walrus haulout near Point Lay was resighted and estimated at 5,500-8,000 individuals.

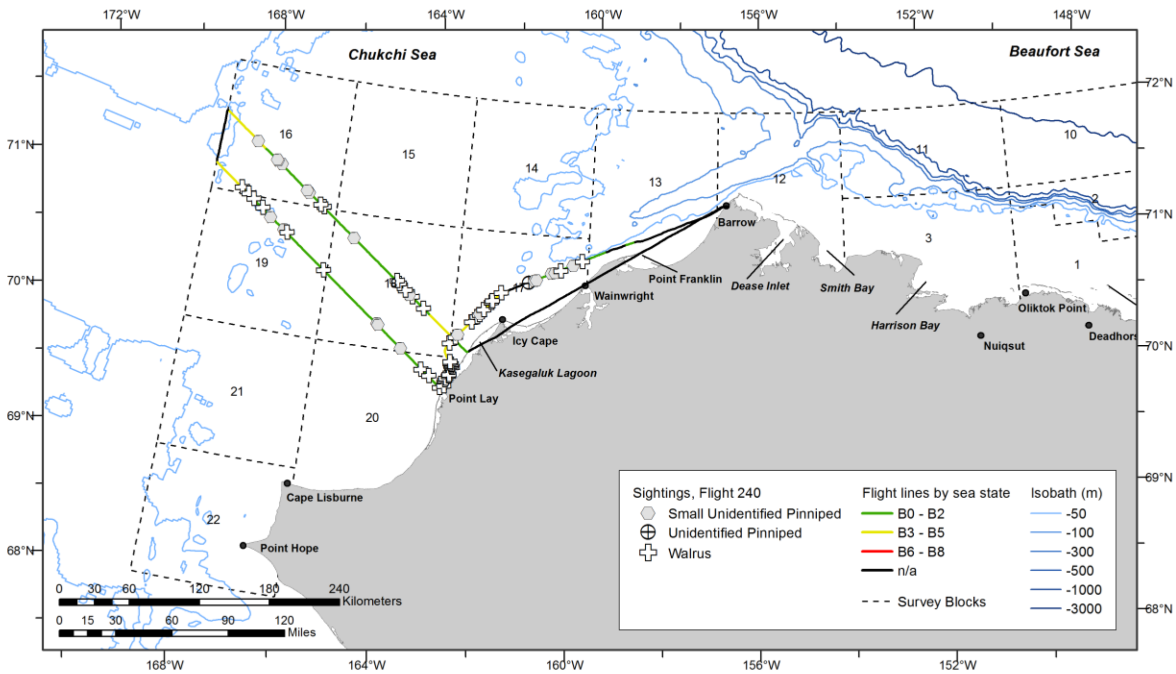

Figure B-71. ASAMM Flight 240 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Walrus haulout near Point Lay, Alaska, during flight 240, 22 September 2013.

23 September 2013, Flight 32

Flight was a survey of portions of blocks 1, 2, 3, 10 and 11. Survey conditions included partly cloudy to overcast skies, <1 km to unlimited visibility (with low ceilings and glare), and Beaufort 1-6 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales, belugas, unidentified cetaceans, small unidentified pinnipeds, and polar bears on Cross Island.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
32	9/23/13 11:54	70.860	149.753	bowhead whale	swim	1	0	1
32	9/23/13 11:56	70.887	149.702	unid cetacean	swim	1	0	1
32	9/23/13 12:00	70.862	149.858	bowhead whale	swim	1	0	1
32	9/23/13 12:01	70.870	149.838	bowhead whale	swim	1	0	1
32	9/23/13 12:03	70.862	149.818	bowhead whale	swim	1	0	1
32	9/23/13 12:06	70.885	149.757	unid cetacean	swim	1	0	1
32	9/23/13 12:22	70.585	149.758	beluga	swim	1	0	1
32	9/23/13 12:44	71.213	149.100	beluga	mill	3	0	2
32	9/23/13 12:44	71.214	149.125	beluga	swim	1	0	2
32	9/23/13 12:44	71.214	149.121	beluga	swim	1	0	2
32	9/23/13 12:44	71.214	149.116	beluga	swim	1	0	2
32	9/23/13 12:46	71.260	149.095	beluga	swim	1	0	2
32	9/23/13 12:46	71.289	149.079	beluga	swim	1	0	2
32	9/23/13 16:02	70.595	148.120	bowhead whale	swim	1	0	1
32	9/23/13 16:02	70.605	148.114	bowhead whale	swim	1	0	1
32	9/23/13 16:04	70.552	148.135	bowhead whale	swim	1	0	1
32	9/23/13 16:05	70.562	148.120	bowhead whale	swim	1	0	1
32	9/23/13 16:07	70.566	148.001	bowhead whale	swim	1	0	1
32	9/23/13 16:33	71.156	148.250	beluga	swim	1	0	2
32	9/23/13 16:33	71.159	148.273	beluga	swim	2	0	2
32	9/23/13 16:33	71.165	148.259	beluga	swim	1	0	2
32	9/23/13 16:33	71.166	148.272	beluga	swim	1	0	2
32	9/23/13 16:34	71.194	148.273	beluga	swim	1	0	2
32	9/23/13 16:37	71.306	148.316	beluga	swim	1	0	2
32	9/23/13 16:37	71.312	148.299	beluga	swim	1	0	2
32	9/23/13 16:52	71.100	147.649	beluga	rest	1	0	2
32	9/23/13 16:52	71.086	147.661	beluga	swim	1	0	2
32	9/23/13 16:54	71.031	147.668	unid cetacean	swim	1	0	2

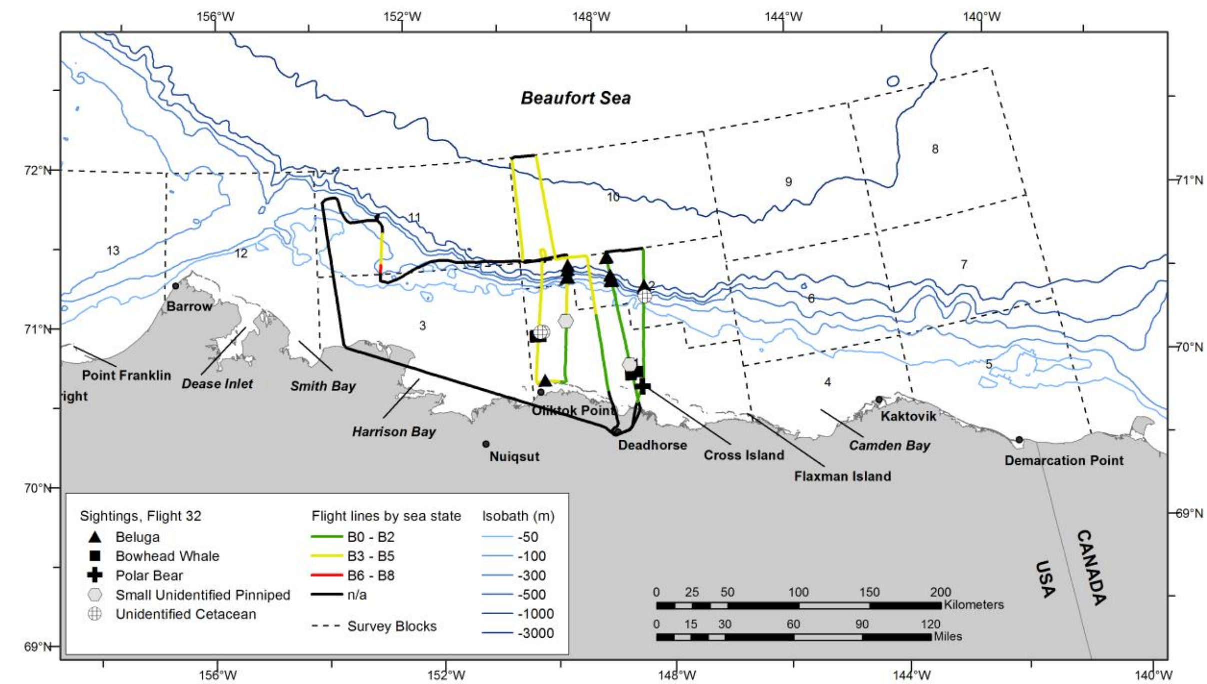

Figure B-72. ASAMM Flight 32 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

23 September 2013, Flight 241

Flight was a complete survey of transects 19 and 21, and search effort from Peard Bay to Barrow. Survey conditions included partly cloudy skies, 0-10 km visibility (with glare, low ceilings, and precipitation), and Beaufort 2-7 sea states. There was no sea ice observed in the area surveyed. Sightings included one bowhead whale, gray whales, walruses, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
241	9/23/13 16:41	71.196	157.101	gray whale	swim	1	0	13
241	9/23/13 16:42	71.208	157.081	gray whale	feed	1	0	13
241	9/23/13 16:43	71.245	156.955	bowhead whale	swim	1	0	12

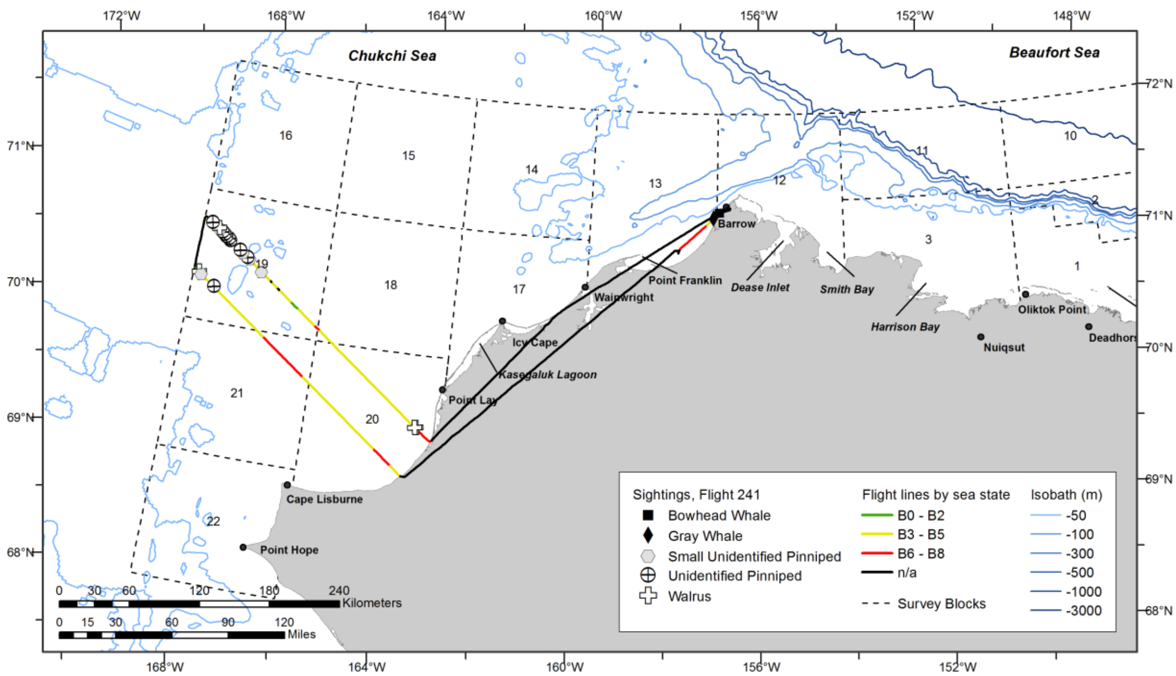

Figure B-73. ASAMM Flight 241 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

24 September 2013, Flight 242

Flight was a partial survey of transects 3 and 5. Survey conditions included partly cloudy skies, 5-10 km visibility (with haze and precipitation), and Beaufort 6-8 sea states. There was no sea ice observed in the area surveyed. Sightings included one bowhead whale carcass.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
242	9/24/13 10:06	70.873	157.765	bowhead whale	dead	1	0	13

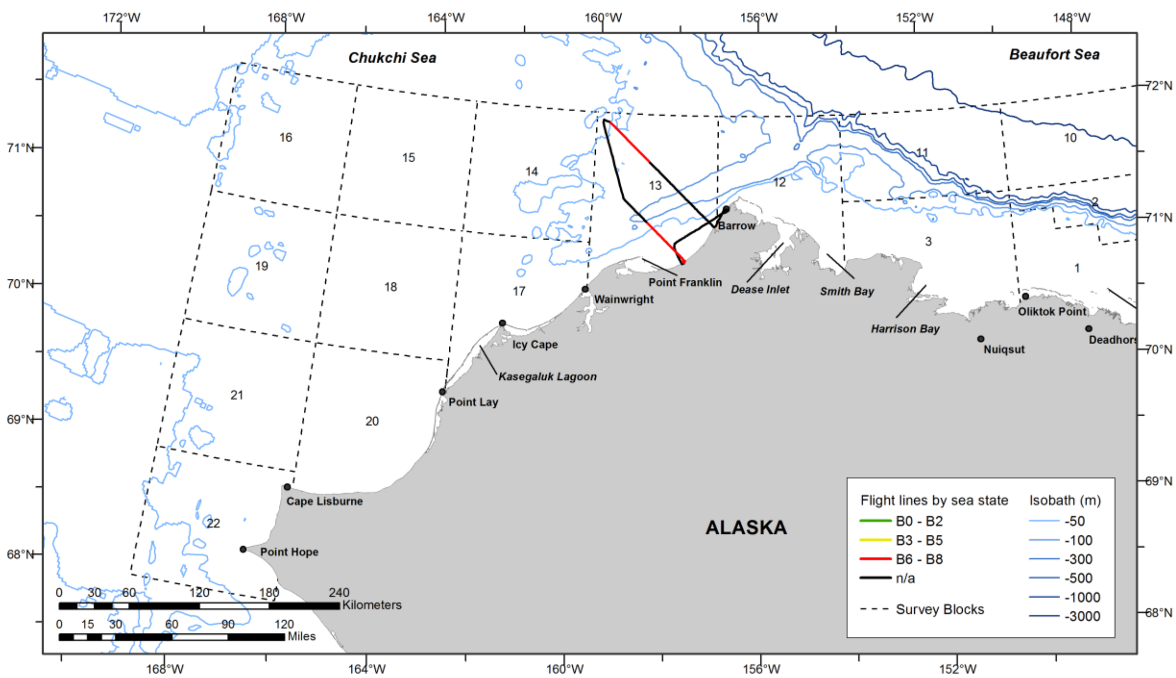

Figure B-74. ASAMM Flight 242 survey track, depicted by sea state.

25 September 2013, Flight 33

Flight was a survey of portions of blocks 5 and 7. Survey conditions included partly cloudy to overcast skies, no visibility to unlimited visibility (with fog, haze, low ceilings, and glare), and Beaufort 2-7 sea states. Ice cover was 0-5% broken floe sea ice in the area surveyed. Sightings included bowhead whales, belugas, one small unidentified marine mammal (dead), bearded seals, small unidentified pinnipeds, and one polar bear on broken floe sea ice.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
33	9/25/13 16:12	70.901	142.190	beluga	swim	1	0	7
33	9/25/13 16:12	70.898	142.194	beluga	swim	1	0	7
33	9/25/13 16:14	70.822	142.199	beluga	swim	1	0	7
33	9/25/13 16:14	70.819	142.209	beluga	swim	2	0	7
33	9/25/13 16:19	70.653	142.193	beluga	swim	1	0	7
33	9/25/13 16:56	70.263	141.838	bowhead whale	swim	2	0	5
33	9/25/13 17:08	70.691	141.869	beluga	rest	1	0	7
33	9/25/13 17:14	70.881	141.879	beluga	swim	1	0	7
33	9/25/13 17:14	70.882	141.846	beluga	swim	1	0	7
33	9/25/13 17:16	70.952	141.856	beluga	swim	1	0	7
33	9/25/13 18:48	70.982	140.835	beluga	swim	1	0	7
33	9/25/13 18:48	71.014	140.823	beluga	rest	1	0	7

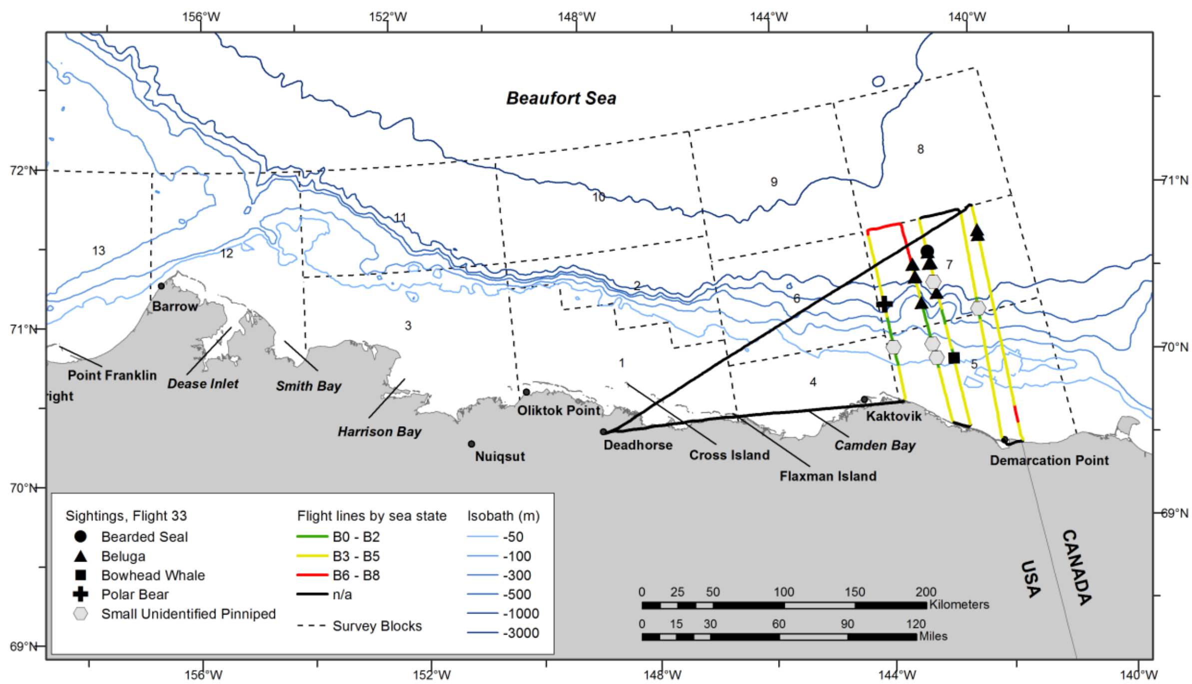

Figure B-75. ASAMM Flight 33 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

25 September 2013, Flight 243

Flight was a complete survey of transects 11 and 13, and search effort between Point Franklin and Barrow. Survey conditions included partly cloudy skies, 0-10 km visibility (with glare, low ceilings, and precipitation), and Beaufort 2-6 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including one calf), one gray whale, unidentified cetaceans (including one dead), walruses, unidentified pinnipeds, and small unidentified pinnipeds. All walruses were in the water; no onshore haulouts were observed.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
243	9/25/13 13:10	70.591	162.922	unid cetacean	dead	1	0	17
243	9/25/13 13:38	71.075	164.809	bowhead whale	swim	1	0	15
243	9/25/13 13:46	71.167	165.203	unid cetacean	swim	1	0	15
243	9/25/13 13:52	71.205	165.314	bowhead whale	swim	3	0	15
243	9/25/13 13:56	71.234	165.385	bowhead whale	swim	2	0	15
243	9/25/13 14:14	71.482	166.441	unid cetacean	dive	1	0	16
243	9/25/13 14:27	71.410	166.232	unid cetacean	unknown	1	0	16
243	9/25/13 14:33	71.519	166.683	gray whale	swim	1	0	16
243	9/25/13 15:31	71.672	165.545	bowhead whale	swim	2	1	15
243	9/25/13 15:34	71.673	165.478	bowhead whale	unknown	2	0	15
243	9/25/13 15:43	71.648	165.532	bowhead whale	dive	2	0	15
243	9/25/13 17:19	71.213	157.077	bowhead whale	swim	1	0	13
243	9/25/13 17:20	71.219	157.026	bowhead whale	swim	1	0	13

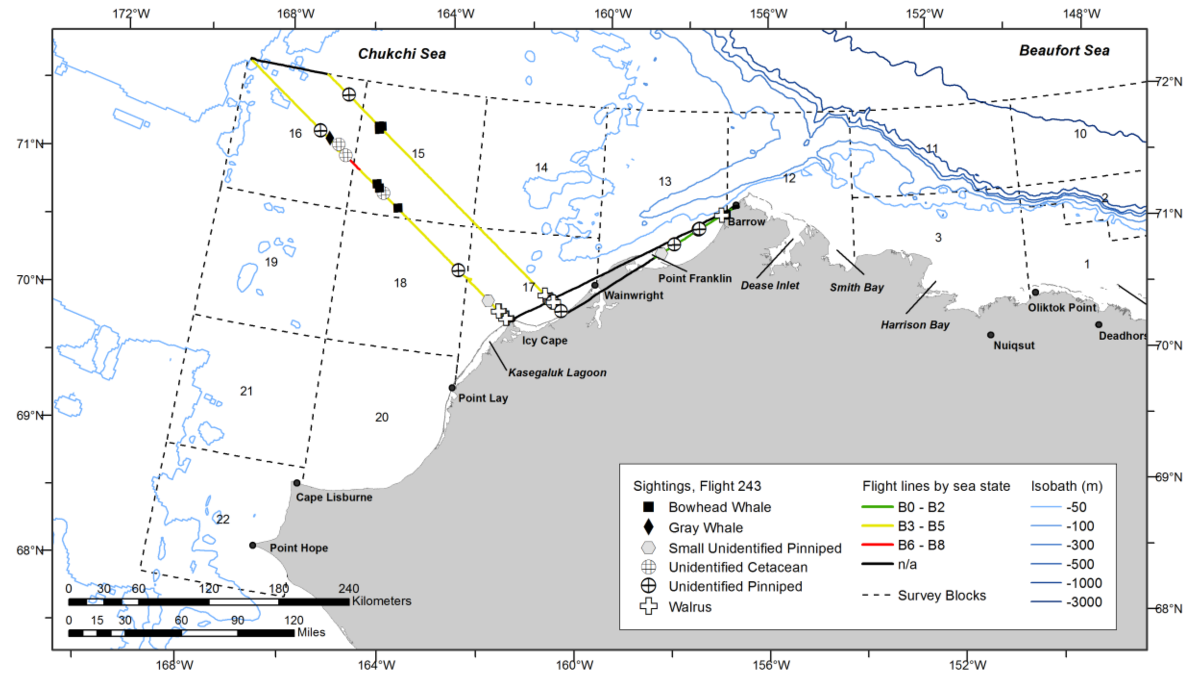

Figure B-76. ASAMM Flight 243 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

26 September 2013, Flight 244

Flight was a complete survey of transects 1, 3, 5, and 7. Survey conditions included partly cloudy skies, 0-10 km visibility (with glare, low ceilings, and precipitation), and Beaufort 2-6 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including one dead), one gray whale, walruses, unidentified pinnipeds, and small unidentified pinnipeds. Approximately 600 walruses were sighted milling near the northern edge of block 14; no walruses were sighted onshore.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
244	9/26/13 12:11	70.878	159.103	bowhead whale	dead	1	0	13
244	9/26/13 13:47	71.639	160.238	bowhead whale	swim	1	0	14
244	9/26/13 14:20	71.056	158.276	gray whale	swim	1	0	13
244	9/26/13 15:12	71.950	159.746	bowhead whale	swim	1	0	13

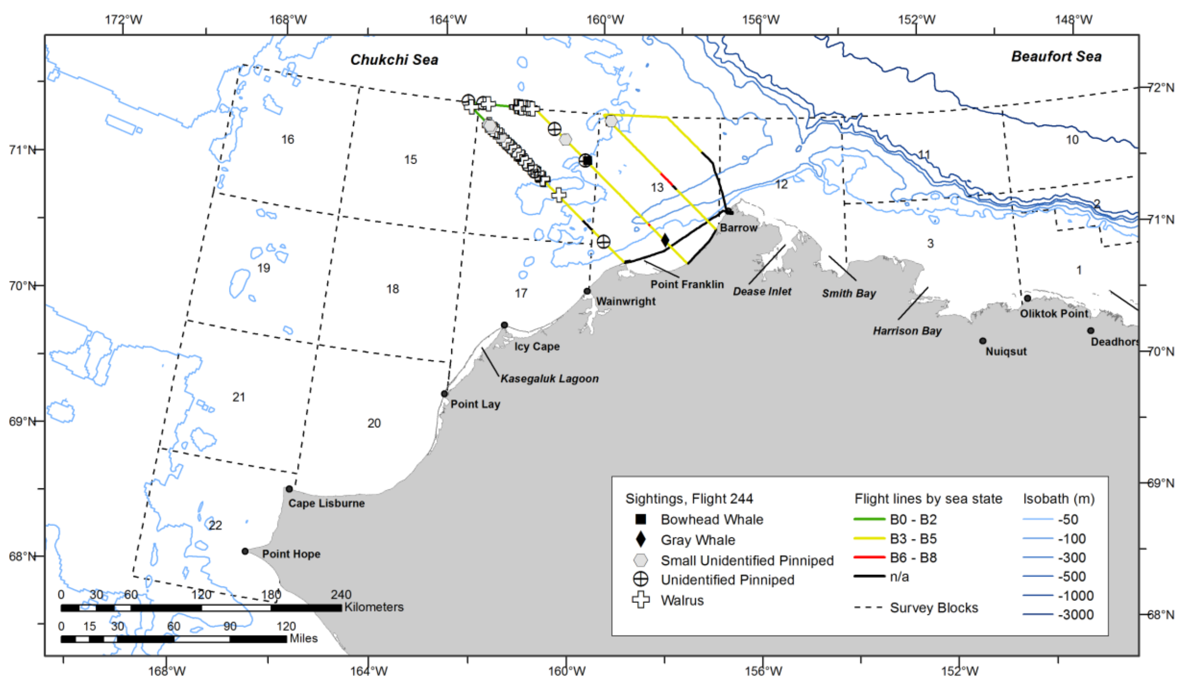

Figure B-77. ASAMM Flight 244 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

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27 September 2013, Flight 34

Flight was a survey of portions of block 12. Survey conditions included overcast skies, 0-10 km visibility (with low ceilings and precipitation), and Beaufort 3-6 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including two calves), belugas, and one unidentified cetacean.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
34	9/27/13 12:38	71.484	156.145	unid cetacean	dive	1	0	12
34	9/27/13 13:00	71.700	155.719	beluga	dive	1	0	12
34	9/27/13 13:08	71.989	155.832	bowhead whale	swim	1	0	12
34	9/27/13 13:09	71.989	155.736	bowhead whale	mill	2	1	12
34	9/27/13 13:10	71.995	155.766	beluga	swim	3	0	12
34	9/27/13 13:18	72.004	155.368	bowhead whale	swim	2	1	0
34	9/27/13 13:18	72.013	155.355	bowhead whale	swim	1	0	0
34	9/27/13 13:19	72.006	155.328	bowhead whale	swim	1	0	0
34	9/27/13 13:19	72.007	155.365	bowhead whale	swim	1	0	0
34	9/27/13 13:20	72.004	155.381	bowhead whale	swim	1	0	0
34	9/27/13 13:23	71.964	155.361	bowhead whale	swim	1	0	12

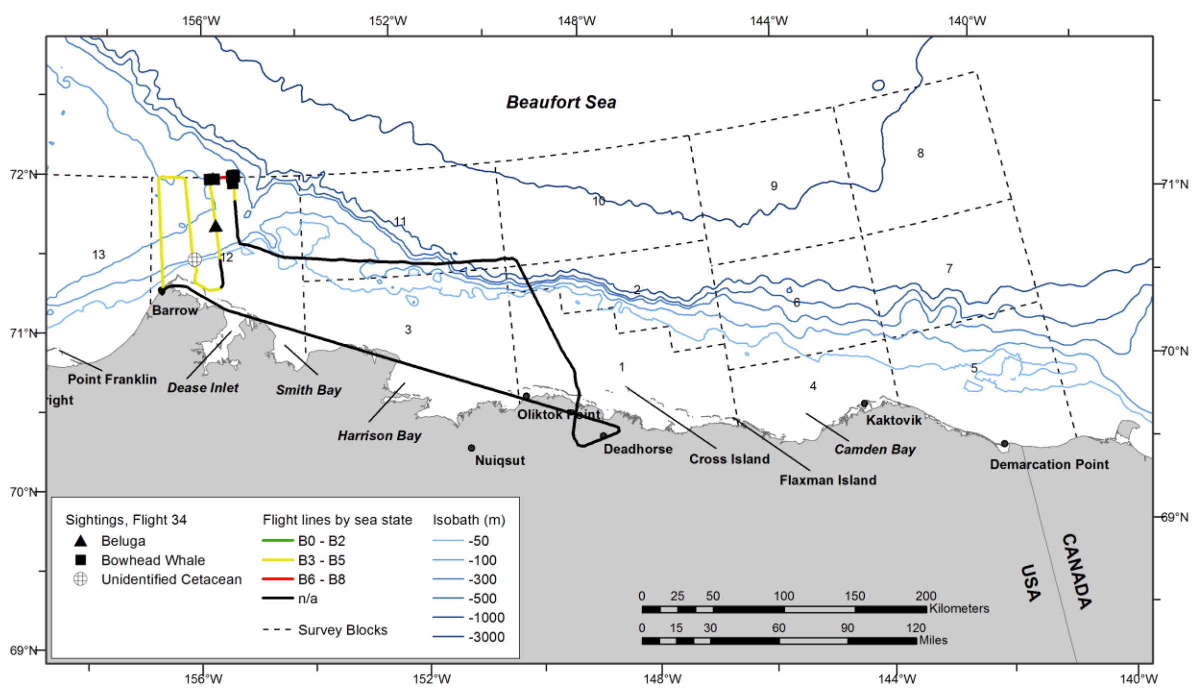


Figure B-78. ASAMM Flight 34 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Bowhead whale cow-calf pair sighted during flight 34, 27 September 2013.
The cow has scarring on her head.

27 September 2013, Flight 245

Flight was a complete survey of transects 30 and 31, a partial survey of transect 32, and the coastal transect from east of Cape Lisburne to east of Icy Cape and Peard Bay to Point Barrow. Survey conditions included partly cloudy skies, 0-10 km visibility (with glare, low ceilings, and precipitation), and Beaufort 1-8 sea states. New/grease sea ice was observed in one area nearshore; no other sea ice was observed in the area surveyed. Sightings included walruses and small unidentified pinnipeds. The walrus haulout near Point Lay was resighted and estimated at roughly 10,000 animals. Over 400 walruses were seen along the coastal transect from Point Lay to east of Icy Cape.

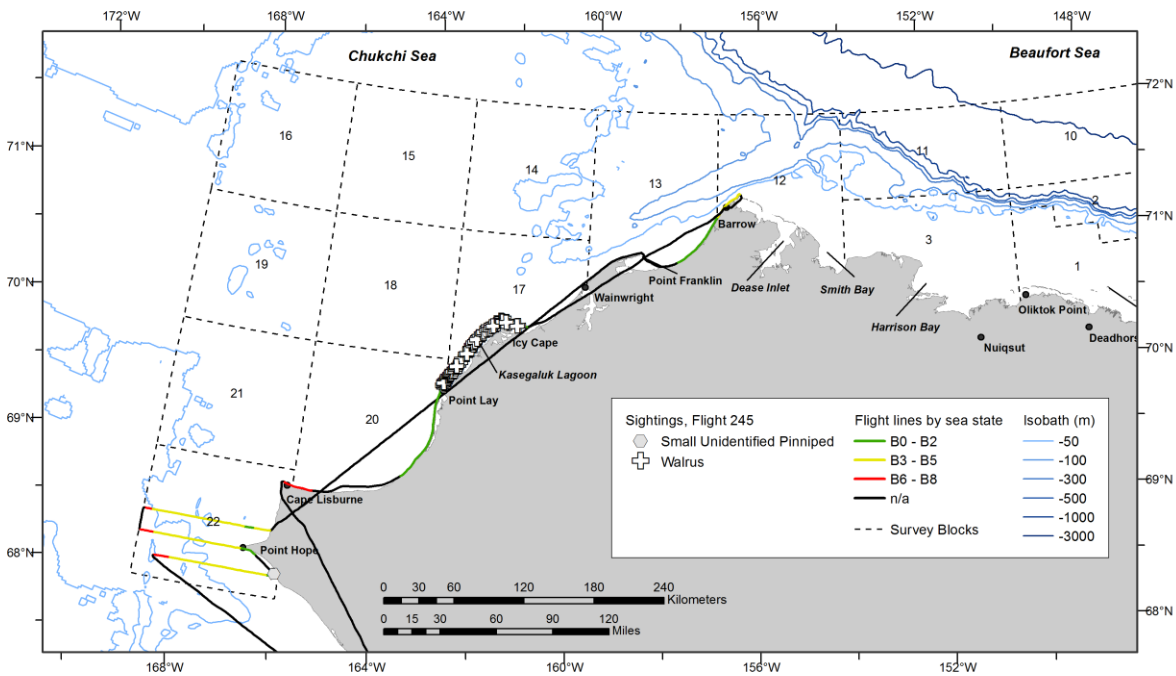


Figure B-79. ASAMM Flight 245 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Walrus haulout near Point Lay, Alaska, sighted during flight 245, 27 September 2013. In addition to the beach haulout, this image shows the large number of walruses in the water just offshore of the haulout.

Zoomed in view of walrus haulout near Point Lay, Alaska, sighted during flight 245, 27 September 2013.

29 September 2013, Flight 35

Flight was a survey of portions of blocks 3, 11, and 12. Survey conditions included partly cloudy to overcast skies, no visibility to unlimited visibility (with low ceilings, glare, fog, and precipitation), and Beaufort 2-5 sea states. Ice cover was 0-1% new/grease ice in the area surveyed. Sightings included bowhead whales (including 7 calves), belugas (including 25 calves), one bearded seal, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
35	9/29/13 12:09	71.698	155.292	bowhead whale	mill	2	1	12
35	9/29/13 12:17	71.695	155.307	bowhead whale	swim	2	1	12
35	9/29/13 12:30	71.353	155.189	bowhead whale	mill	3	1	12
35	9/29/13 12:40	71.322	155.213	bowhead whale	swim	1	0	12
35	9/29/13 13:11	71.716	154.801	beluga	swim	1	0	12
35	9/29/13 13:11	71.726	154.805	beluga	rest	1	0	12
35	9/29/13 13:11	71.734	154.804	beluga	swim	1	0	12
35	9/29/13 13:12	71.748	154.785	beluga	swim	1	0	12
35	9/29/13 13:12	71.755	154.792	beluga	swim	6	0	12
35	9/29/13 13:12	71.761	154.804	beluga	swim	12	2	12
35	9/29/13 13:12	71.773	154.804	beluga	swim	20	6	12
35	9/29/13 13:15	71.856	154.794	beluga	swim	1	0	12
35	9/29/13 13:16	71.917	154.784	beluga	swim	2	0	12
35	9/29/13 13:16	71.923	154.797	beluga	mill	2	1	12
35	9/29/13 13:17	71.930	154.795	beluga	swim	1	0	12
35	9/29/13 13:17	71.931	154.813	beluga	swim	2	1	12
35	9/29/13 13:17	71.952	154.767	beluga	swim	1	0	12
35	9/29/13 13:17	71.958	154.793	beluga	swim	5	1	12
35	9/29/13 13:19	71.963	154.798	beluga	swim	5	0	12
35	9/29/13 13:24	71.963	154.394	beluga	rest	1	0	12
35	9/29/13 13:25	71.928	154.429	beluga	swim	1	0	12
35	9/29/13 13:25	71.918	154.410	beluga	swim	1	0	12
35	9/29/13 13:25	71.917	154.384	beluga	swim	2	0	12
35	9/29/13 13:25	71.906	154.408	beluga	swim	2	1	12
35	9/29/13 13:26	71.897	154.389	bowhead whale	mill	2	1	12
35	9/29/13 13:27	71.893	154.385	bowhead whale	mill	2	1	12
35	9/29/13 13:28	71.899	154.364	beluga	mill	1	0	12
35	9/29/13 13:29	71.905	154.358	bowhead whale	mill	1	0	12
35	9/29/13 13:31	71.902	154.395	beluga	swim	6	1	12
35	9/29/13 13:32	71.874	154.396	bowhead whale	swim	5	1	12
35	9/29/13 13:32	71.869	154.412	bowhead whale	swim	1	0	12
35	9/29/13 13:37	71.865	154.388	beluga	mill	3	0	12
35	9/29/13 13:43	71.836	154.409	beluga	swim	2	0	12

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
35	9/29/13 13:43	71.825	154.384	beluga	swim	1	0	12
35	9/29/13 13:43	71.823	154.389	beluga	swim	14	4	12
35	9/29/13 13:44	71.815	154.389	beluga	swim	5	1	12
35	9/29/13 14:02	71.145	154.218	bowhead whale	swim	2	0	12
35	9/29/13 14:02	71.134	154.175	bowhead whale	swim	2	0	12
35	9/29/13 14:02	71.133	154.178	bowhead whale	swim	1	0	12
35	9/29/13 14:02	71.132	154.197	bowhead whale	swim	1	0	12
35	9/29/13 14:03	71.142	154.204	bowhead whale	swim	3	0	12
35	9/29/13 14:03	71.142	154.204	bowhead whale	swim	1	0	12
35	9/29/13 14:06	71.112	154.169	bowhead whale	swim	1	0	12
35	9/29/13 14:10	71.123	154.191	bowhead whale	swim	2	1	12
35	9/29/13 14:13	71.110	154.207	bowhead whale	swim	1	0	12
35	9/29/13 18:00	71.361	153.684	beluga	swim	1	0	11
35	9/29/13 18:12	71.761	153.818	beluga	swim	3	0	11
35	9/29/13 18:12	71.762	153.818	beluga	swim	38	5	11
35	9/29/13 18:12	71.767	153.842	beluga	mill	17	2	11
35	9/29/13 18:13	71.809	153.844	beluga	swim	3	0	11
35	9/29/13 18:14	71.834	153.860	bowhead whale	swim	1	0	11
35	9/29/13 18:15	71.849	153.876	beluga	mill	8	0	11
35	9/29/13 18:16	71.887	153.899	beluga	rest	1	0	11
35	9/29/13 18:18	71.949	153.917	beluga	swim	3	0	11
35	9/29/13 18:20	72.005	153.849	beluga	swim	1	0	0
35	9/29/13 18:20	72.006	153.841	beluga	swim	1	0	0
35	9/29/13 18:22	71.995	153.590	beluga	swim	1	0	11
35	9/29/13 18:22	71.996	153.578	beluga	swim	1	0	11
35	9/29/13 18:22	71.999	153.567	beluga	swim	1	0	11
35	9/29/13 18:22	72.004	153.559	beluga	swim	1	0	0
35	9/29/13 18:22	71.996	153.550	beluga	swim	1	0	11
35	9/29/13 18:25	71.935	153.428	beluga	swim	1	0	11
35	9/29/13 18:26	71.911	153.404	beluga	rest	1	0	11
35	9/29/13 18:28	71.806	153.383	beluga	swim	1	0	11
35	9/29/13 18:28	71.803	153.380	beluga	swim	6	0	11

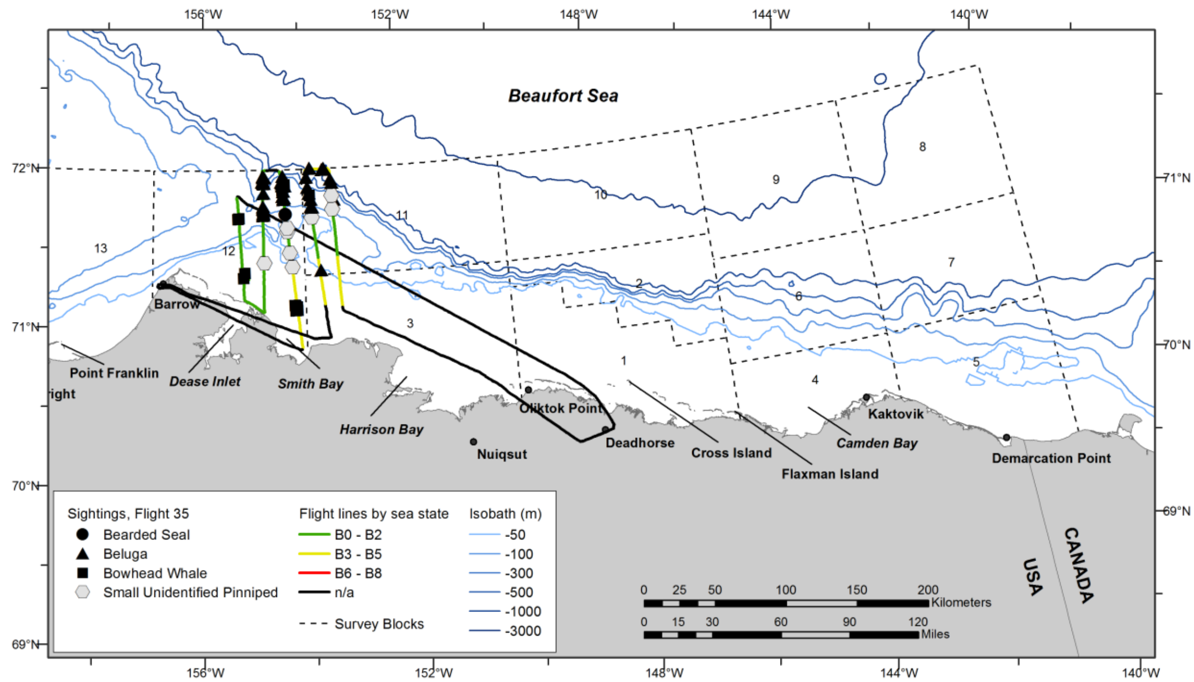
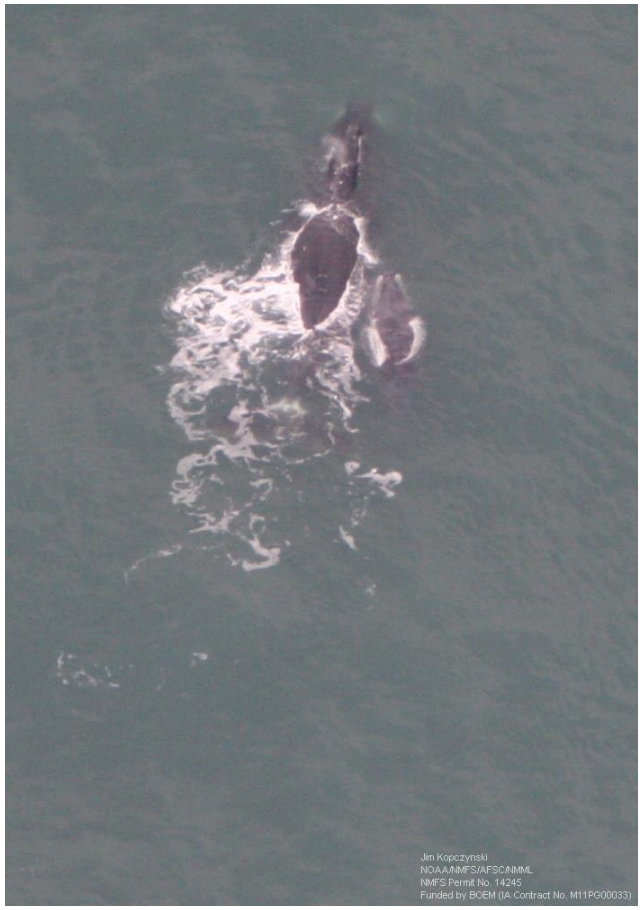


Figure B-80. ASAMM Flight 35 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Two adult bowhead whales with a calf in between them sighted during flight 35, 29 September 2013.



Bowhead whale cow-calf pair sighted during flight 35, 29 September 2013.
The cow has scarring on her head.

29 September 2013, Flight 246

Flight was a complete survey of transects 1, 2, 3, 4, 6, 8, and 10. Survey conditions included partly cloudy to overcast skies, <1-10 km visibility (with glare, low ceilings, and precipitation), and Beaufort 1-5 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including two calves), gray whales, one unidentified cetacean, walruses, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
246	9/29/13 12:32	71.237	161.295	gray whale	feed	1	0	14
246	9/29/13 12:32	71.238	161.241	gray whale	feed	1	0	14
246	9/29/13 12:41	71.056	160.597	gray whale	swim	1	0	14
246	9/29/13 12:45	70.944	160.326	bowhead whale	swim	2	0	17
246	9/29/13 13:30	71.225	159.662	bowhead whale	swim	3	1	13
246	9/29/13 13:36	71.204	159.636	bowhead whale	swim	3	0	13
246	9/29/13 13:36	71.212	159.673	bowhead whale	swim	1	0	13
246	9/29/13 16:22	71.123	157.780	gray whale	swim	1	0	13
246	9/29/13 16:22	71.128	157.768	gray whale	swim	1	0	13
246	9/29/13 16:23	71.127	157.813	gray whale	swim	1	0	13
246	9/29/13 16:24	71.105	157.783	gray whale	swim	1	0	13
246	9/29/13 16:24	71.105	157.761	gray whale	swim	1	0	13
246	9/29/13 16:28	71.146	157.792	gray whale	swim	1	0	13
246	9/29/13 16:28	71.149	157.844	gray whale	dive	1	0	13
246	9/29/13 16:35	71.293	158.335	bowhead whale	swim	1	0	13
246	9/29/13 16:36	71.290	158.352	bowhead whale	swim	5	0	13
246	9/29/13 16:36	71.286	158.335	bowhead whale	swim	3	0	13
246	9/29/13 16:39	71.307	158.345	bowhead whale	swim	2	0	13
246	9/29/13 16:39	71.306	158.364	bowhead whale	swim	8	1	13
246	9/29/13 16:39	71.308	158.373	bowhead whale	swim	2	0	13
246	9/29/13 16:39	71.317	158.390	bowhead whale	swim	2	0	13
246	9/29/13 16:40	71.315	158.409	bowhead whale	swim	2	0	13
246	9/29/13 17:13	71.961	160.632	unid cetacean	swim	1	0	14
246	9/29/13 17:56	71.452	158.041	bowhead whale	feed	1	0	13

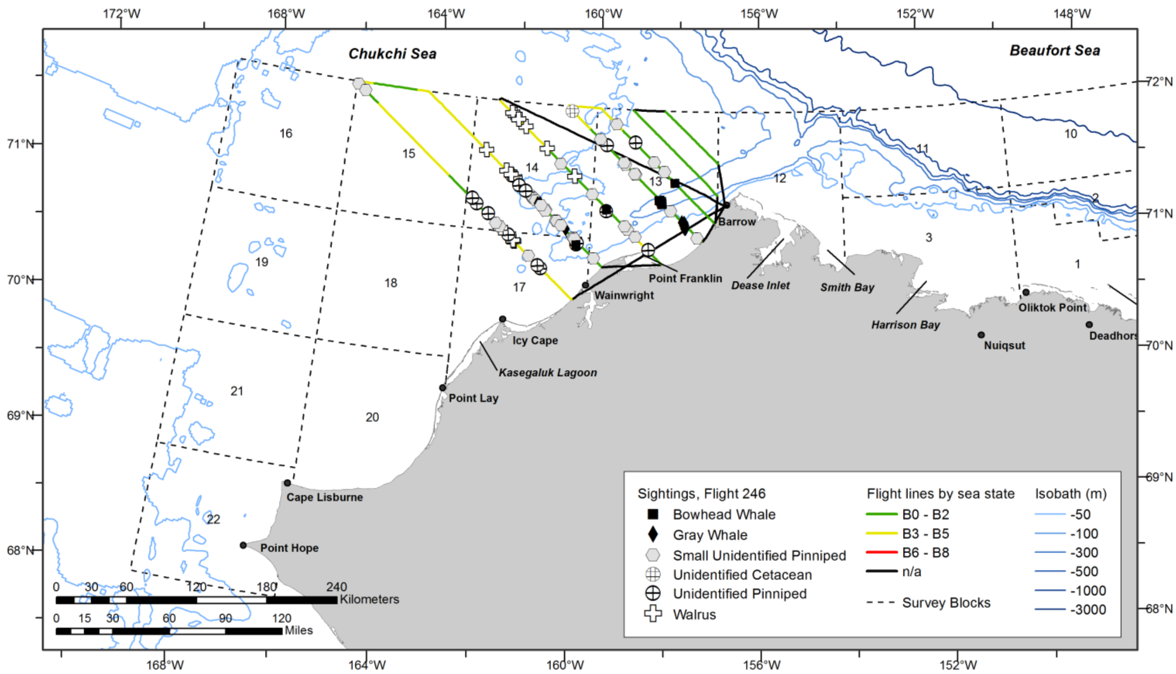


Figure B-81. ASAMM Flight 246 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Bowhead whale cow-calf pair sighted during flight 246, 29 September 2013.

30 September 2013, Flight 36

Flight was deadhead effort in search of suitable conditions for surveying. Survey conditions included widespread fog and high sea states. No sightings were observed.

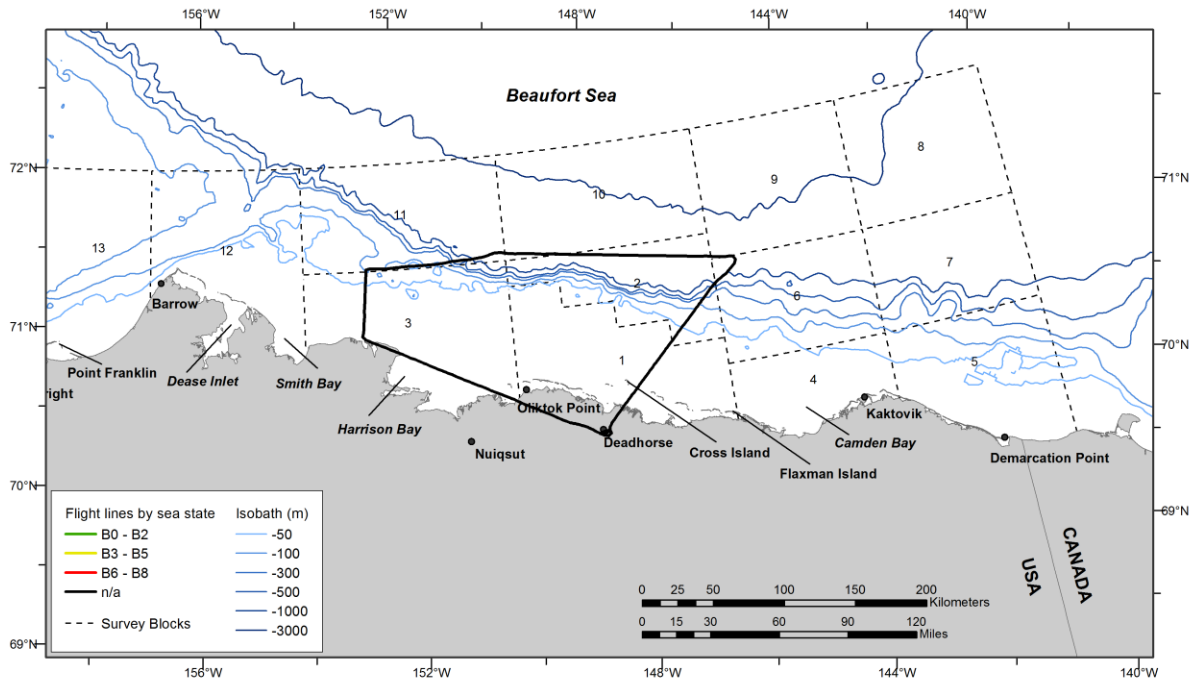


Figure B-82. ASAMM Flight 36 survey track, depicted by sea state.

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30 September 2013, Flight 247

Flight was a complete survey of transects 12, 14, 16, and 18. Survey conditions included partly cloudy skies, 0-10 km visibility (with glare, low ceilings, and precipitation), and Beaufort 1-5 sea states. There was no sea ice observed in the area surveyed. Sightings included bowhead whales (including 2 calves), belugas (including 21 calves), walruses, unidentified pinnipeds, and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
247	9/30/13 11:54	70.837	168.294	beluga	swim	1	0	19
247	9/30/13 11:54	70.842	168.287	beluga	swim	4	1	19
247	9/30/13 11:54	70.839	168.297	beluga	swim	6	1	19
247	9/30/13 11:54	70.842	168.295	beluga	swim	8	0	19
247	9/30/13 11:55	70.859	168.387	beluga	swim	37	8	19
247	9/30/13 11:55	70.864	168.383	beluga	swim	28	5	19
247	9/30/13 11:56	70.890	168.532	beluga	swim	4	0	19
247	9/30/13 11:56	70.893	168.526	beluga	swim	1	0	19
247	9/30/13 11:57	70.896	168.572	beluga	swim	1	0	19
247	9/30/13 16:51	71.197	166.223	bowhead whale	swim	1	0	16
247	9/30/13 17:15	71.384	167.029	beluga	swim	6	3	16
247	9/30/13 17:16	71.387	167.052	beluga	swim	6	2	16
247	9/30/13 17:16	71.391	167.071	beluga	swim	1	0	16
247	9/30/13 17:16	71.397	167.098	beluga	swim	4	1	16
247	9/30/13 17:31	71.623	167.994	bowhead whale	dead	1	0	16
247	9/30/13 18:41	71.094	164.101	bowhead whale	rest	5	1	15
247	9/30/13 18:42	71.083	164.095	bowhead whale	rest	1	0	15
247	9/30/13 18:42	71.088	164.111	bowhead whale	rest	1	0	15
247	9/30/13 18:42	71.094	164.092	bowhead whale	swim	1	0	15
247	9/30/13 18:45	71.095	164.074	bowhead whale	swim	2	1	15
247	9/30/13 18:51	71.027	163.772	bowhead whale	swim	1	0	15

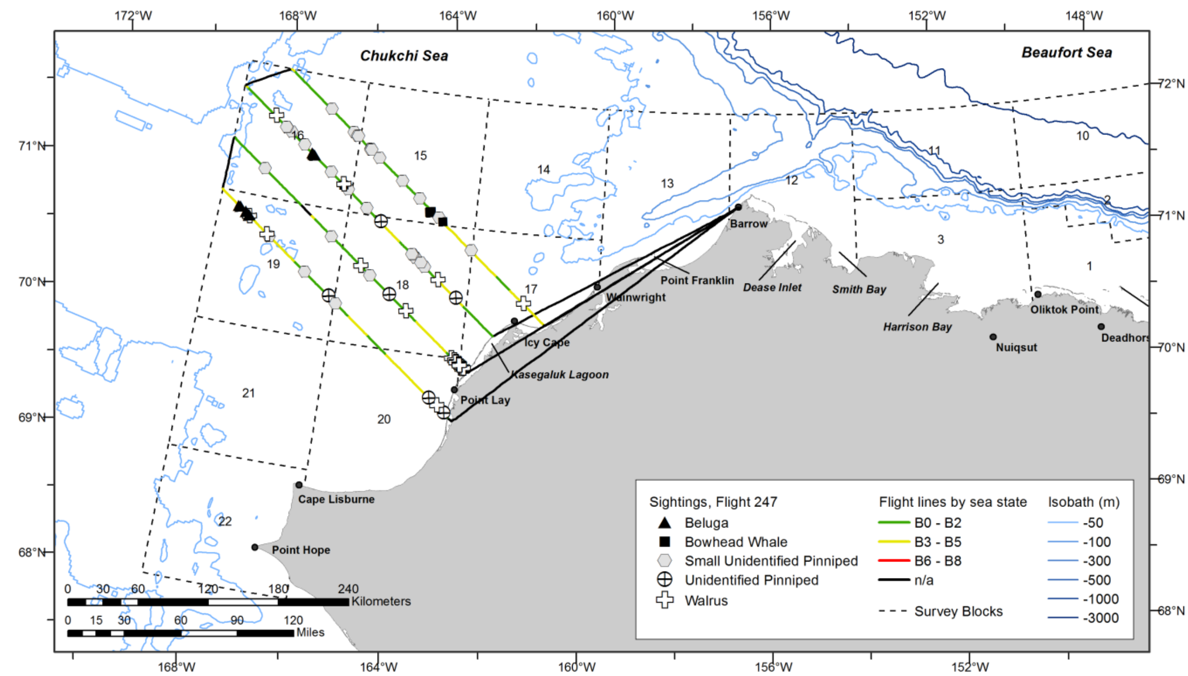

Figure B-83. ASAMM Flight 247 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

Surveys were not conducted from 1-17 October 2013 due to the partial shutdown of the Federal Government. One survey team returned to the field on 19 October, and surveys recommenced on 20 October 2013.

20 October 2013, Flight 248

Flight was a survey of portions of blocks 1, 2, 4, and 6. Survey conditions included overcast to partly cloudy skies, 0-10 km visibility (with glare, fog, and low ceilings), and Beaufort 1-5 sea states. Ice cover was 0-30% new/grease ice in the area surveyed. Sightings included one unidentified cetacean, belugas, and polar bears. Eight polar bears were observed on Cross Island.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
248	10/20/13 11:16	71.031	148.643	unid cetacean	unknown	1	0	2
248	10/20/13 11:24	71.234	148.671	beluga	swim	1	0	2
248	10/20/13 11:24	71.235	148.652	beluga	swim	1	0	2
248	10/20/13 11:28	71.329	148.557	beluga	swim	2	0	2
248	10/20/13 11:29	71.332	148.402	beluga	swim	1	0	2
248	10/20/13 11:29	71.335	148.397	beluga	swim	2	0	10
248	10/20/13 11:35	71.179	148.295	beluga	mill	12	0	2
248	10/20/13 11:35	71.166	148.303	beluga	swim	2	0	2
248	10/20/13 11:35	71.160	148.308	beluga	swim	1	0	2

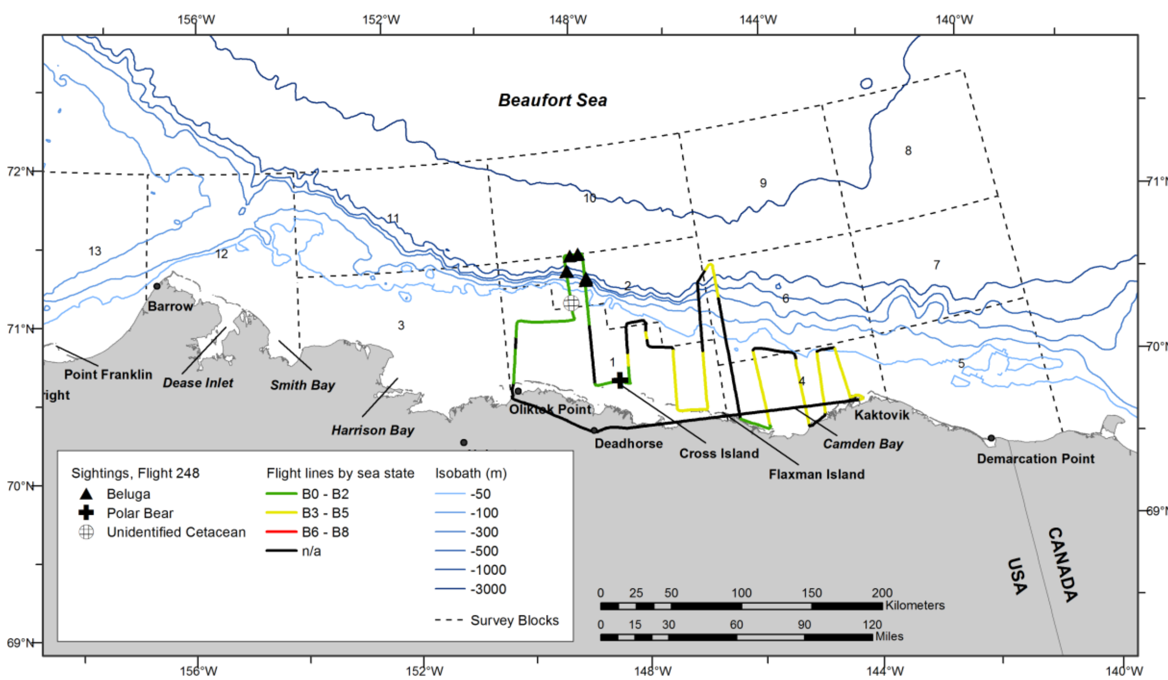

Figure B-84. ASAMM Flight 248 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

21 October 2013, Flight 249

Flight was deadhead effort in search of suitable conditions for surveying. Survey conditions included widespread fog and low ceilings. No sightings were observed.

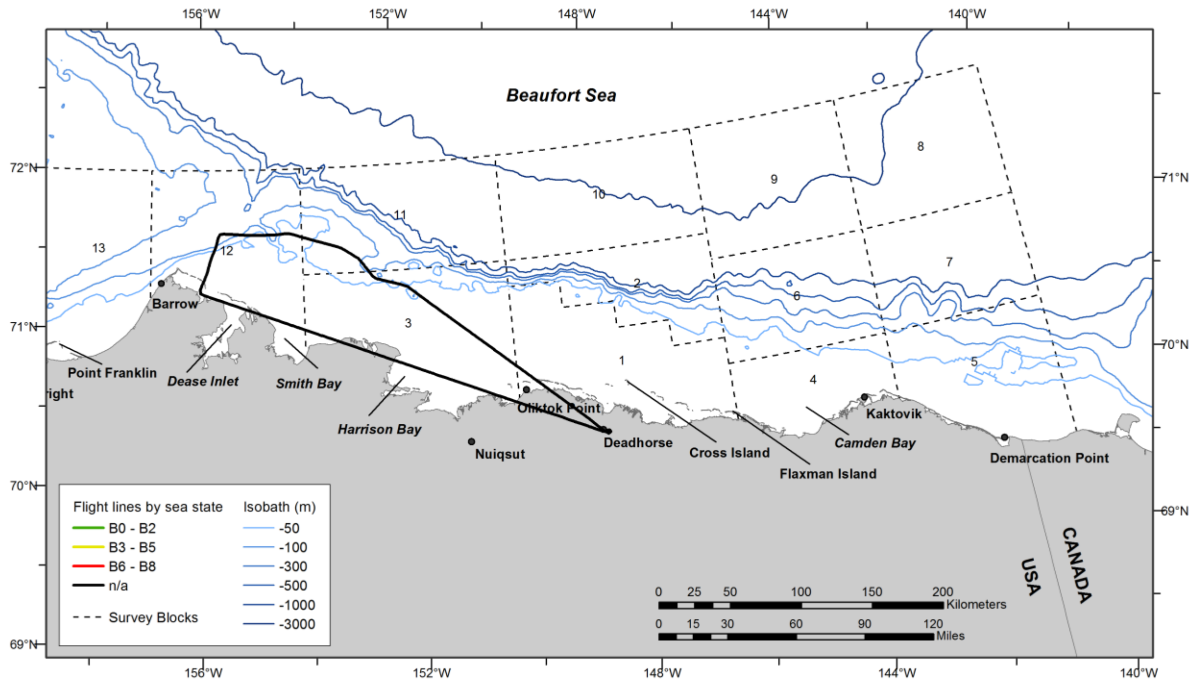

Figure B-85. ASAMM Flight 249 survey track, depicted by sea state.

22 October 2013, Flight 250

Flight was a survey of portions of blocks 1 and 3. Survey conditions included partly cloudy skies, 0-10 km visibility (with glare, fog, and low ceilings), and Beaufort 0-3 sea states. Ice cover was 1-100% broken floe and new/grease ice in the area surveyed. Sightings included bearded seals, small unidentified pinnipeds, and polar bears. Four polar bears were sighted near a bone pile on Cross Island.

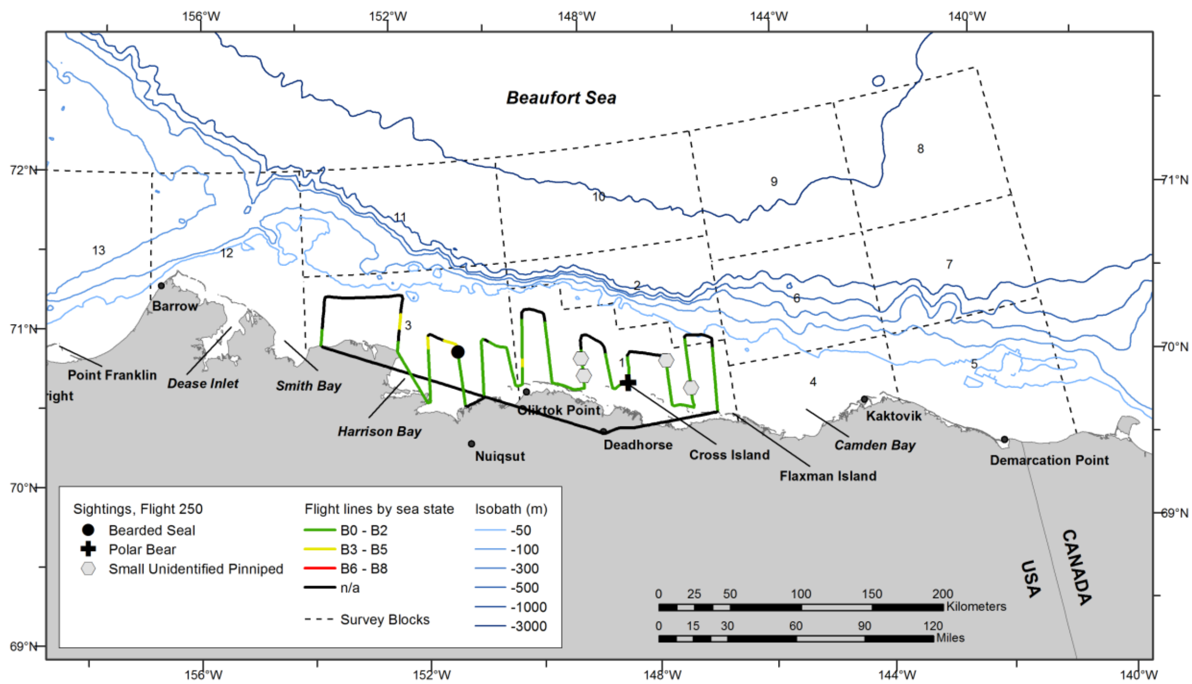

Figure B-86. ASAMM Flight 250 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

24 October 2013, Flight 251

Flight was a complete survey of transects 6, 10, and 12, a partial survey of transect 4, and the coastal survey between Icy Cape and Barrow. Survey conditions included partly cloudy skies, 0-10 km visibility (with glare, fog, precipitation, low ceilings, and haze), and Beaufort 0-6 sea states. Ice cover was 0-95% new/grease and broken floe sea ice in the area surveyed. Sightings included belugas.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
251	10/24/13 11:56	71.177	164.350	beluga	swim	10	0	15
251	10/24/13 13:23	71.401	163.556	beluga	swim	1	0	15
251	10/24/13 15:59	71.119	159.258	beluga	swim	3	0	13
251	10/24/13 15:59	71.124	159.283	beluga	swim	3	0	13
251	10/24/13 16:00	71.141	159.312	beluga	swim	2	0	13
251	10/24/13 16:01	71.155	159.369	beluga	mill	1	0	13

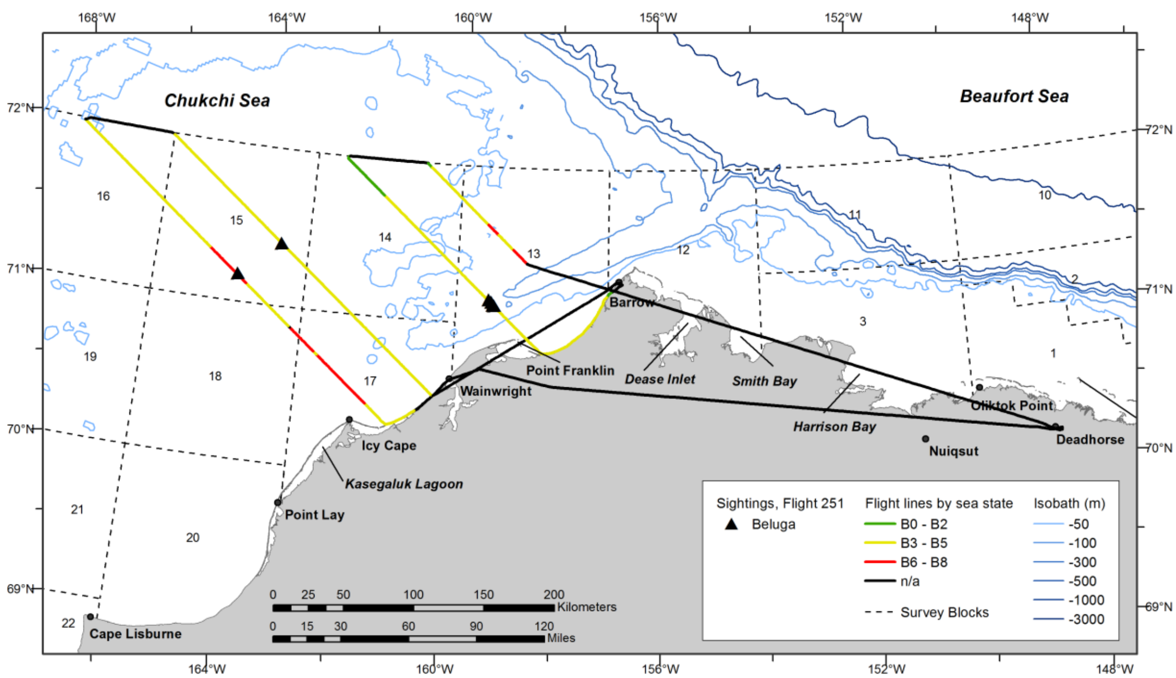

Figure B-87. ASAMM Flight 251 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

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26 October 2013, Flight 252

Flight was a survey of block 12. Survey conditions included overcast skies, 0-10 km visibility (with glare, fog, precipitation, low ceilings, and haze), and Beaufort 0-5 sea states. Ice cover was 0-100% new/grease and broken floe sea ice in the area surveyed. Sightings included bowhead whales (including four calves), one gray whale, belugas (including one calf), one unidentified cetacean, and one bearded seal. One of the bowhead whale cow-calf pairs was comprised of a single adult with two calves.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
252	10/26/13 12:29	71.799	154.379	beluga	swim	1	0	12
252	10/26/13 12:29	71.799	154.389	beluga	swim	1	0	12
252	10/26/13 12:30	71.816	154.378	beluga	swim	1	0	12
252	10/26/13 12:30	71.821	154.429	bowhead whale	swim	1	0	12
252	10/26/13 12:30	71.834	154.394	beluga	swim	1	0	12
252	10/26/13 12:31	71.844	154.395	beluga	swim	1	0	12
252	10/26/13 12:37	71.817	154.400	beluga	mill	1	0	12
252	10/26/13 12:37	71.830	154.403	beluga	swim	1	0	12
252	10/26/13 12:38	71.847	154.439	beluga	swim	3	0	12
252	10/26/13 12:39	71.836	154.518	beluga	swim	2	1	12
252	10/26/13 12:40	71.827	154.456	beluga	swim	1	0	12
252	10/26/13 12:47	71.809	154.508	beluga	swim	1	0	12
252	10/26/13 12:48	71.815	154.473	beluga	swim	1	0	12
252	10/26/13 12:49	71.836	154.482	bowhead whale	swim	2	0	12
252	10/26/13 12:51	71.845	154.411	beluga	swim	3	0	12
252	10/26/13 12:51	71.845	154.408	beluga	swim	1	0	12
252	10/26/13 12:51	71.845	154.407	beluga	swim	1	0	12
252	10/26/13 12:55	71.989	154.442	beluga	swim	1	0	12
252	10/26/13 13:06	71.755	154.812	bowhead whale	swim	1	0	12
252	10/26/13 13:24	71.225	154.820	beluga	swim	2	0	12
252	10/26/13 13:46	71.603	155.334	bowhead whale	swim	2	0	12
252	10/26/13 13:51	71.605	155.311	bowhead whale	swim	1	0	12
252	10/26/13 13:53	71.618	155.270	bowhead whale	swim	1	0	12
252	10/26/13 13:54	71.625	155.271	bowhead whale	swim	1	0	12
252	10/26/13 14:07	72.001	155.687	beluga	swim	1	0	0
252	10/26/13 14:26	71.447	155.605	unid cetacean	swim	1	0	12
252	10/26/13 15:01	71.495	156.189	bowhead whale	swim	1	0	12
252	10/26/13 15:01	71.498	156.175	bowhead whale	swim	1	0	12
252	10/26/13 15:01	71.510	156.195	bowhead whale	swim	1	0	12
252	10/26/13 15:03	71.495	156.177	gray whale	swim	1	0	12
252	10/26/13 15:12	71.525	156.179	bowhead whale	swim	1	0	12
252	10/26/13 15:12	71.517	156.180	bowhead whale	swim	2	0	12

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
252	10/26/13 15:14	71.534	156.164	bowhead whale	swim	2	0	12
252	10/26/13 15:16	71.534	156.130	bowhead whale	swim	3	2	12
252	10/26/13 15:23	71.608	156.189	bowhead whale	swim	1	1	12
252	10/26/13 15:23	71.610	156.263	bowhead whale	swim	2	1	12
252	10/26/13 15:23	71.613	156.179	bowhead whale	dive	1	0	12
252	10/26/13 16:03	71.577	156.824	bowhead whale	swim	1	0	12
252	10/26/13 16:03	71.570	156.837	bowhead whale	swim	1	0	12
252	10/26/13 16:04	71.558	156.810	bowhead whale	swim	2	0	12
252	10/26/13 16:04	71.565	156.848	bowhead whale	swim	1	0	12
252	10/26/13 16:09	71.563	156.889	bowhead whale	swim	2	0	12
252	10/26/13 16:10	71.554	156.925	bowhead whale	swim	1	0	12
252	10/26/13 16:12	71.553	156.859	bowhead whale	swim	1	0	12
252	10/26/13 16:18	71.516	156.788	bowhead whale	swim	1	0	12
252	10/26/13 16:23	71.521	156.735	bowhead whale	swim	1	0	12
252	10/26/13 16:24	71.487	156.785	bowhead whale	swim	1	0	12
252	10/26/13 16:25	71.479	156.793	bowhead whale	swim	1	0	12

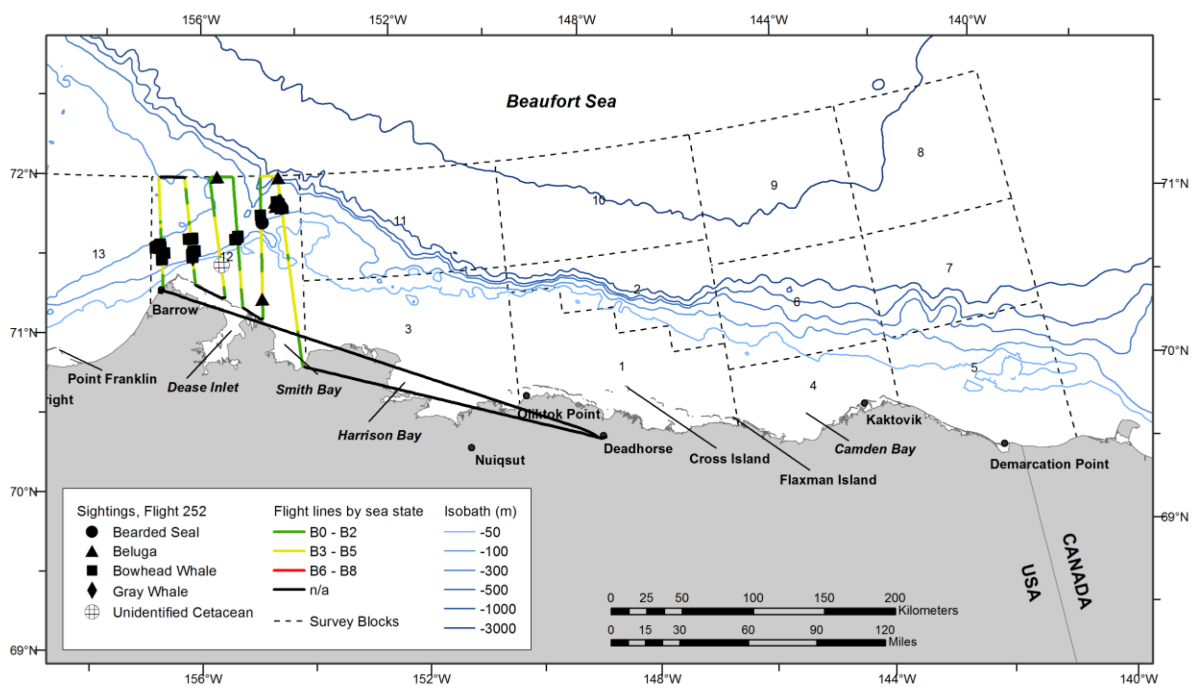

Figure B-88. ASAMM Flight 252 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

27 October 2013, Flight 253

Flight was deadhead effort to look for conditions suitable for surveying. Survey conditions included overcast skies, 5-10 km visibility, and Beaufort 6-8 sea states. There was no sea ice observed in the area surveyed. No sightings were observed.

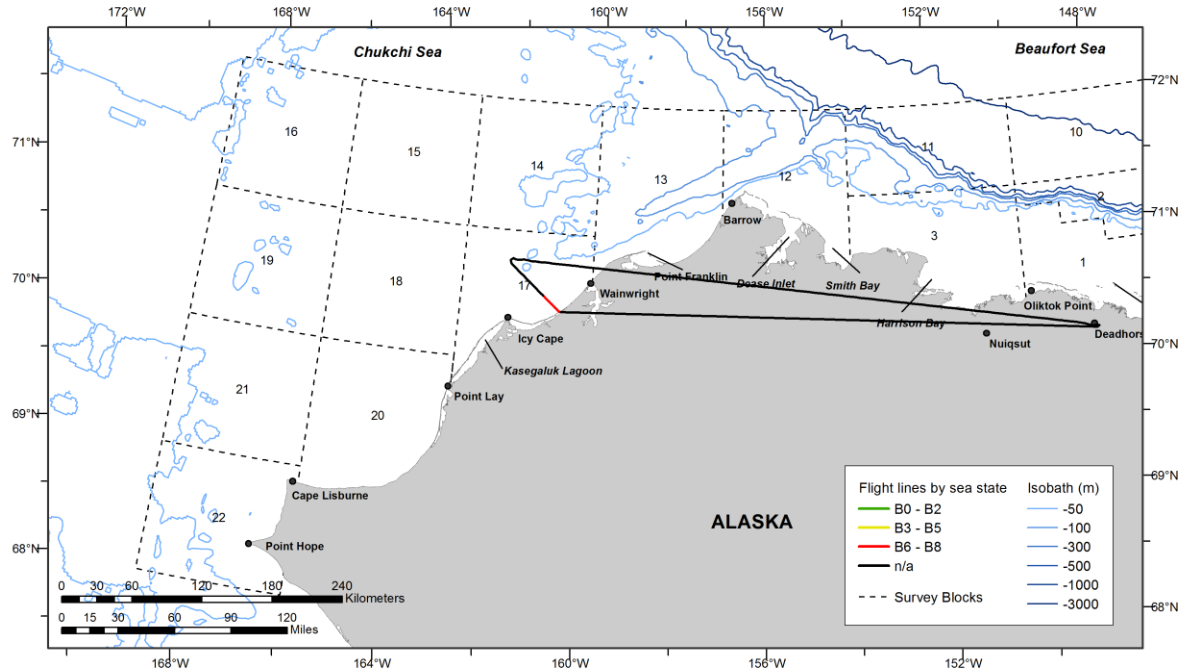

Figure B-89. ASAMM Flight 253 survey track, depicted by sea state.

28 October 2013, Flight 254

Flight was a partial survey of transect 2, and a survey of portions of block 3. Survey conditions included overcast skies, 5-10 km visibility (with low ceilings and glare), and Beaufort 0-3 sea states. Ice cover was 0-100% new/grease and broken floe sea ice in the area surveyed. Sightings included belugas, one unidentified cetacean (dead), and small unidentified pinnipeds.

Cetacean sightings only, all effort (transect, search, circling):

Flight No.	Date/Time (AK Local)	Latitude °N	Longitude °W	Species	Behavior	Group Size	Calf No.	Block
254	10/28/13 11:01	71.543	157.581	unid cetacean	dead	1	0	13
254	10/28/13 14:31	71.305	150.665	beluga	mill	1	0	3
254	10/28/13 14:32	71.320	150.637	beluga	rest	1	0	3
254	10/28/13 14:32	71.324	150.658	beluga	rest	1	0	3

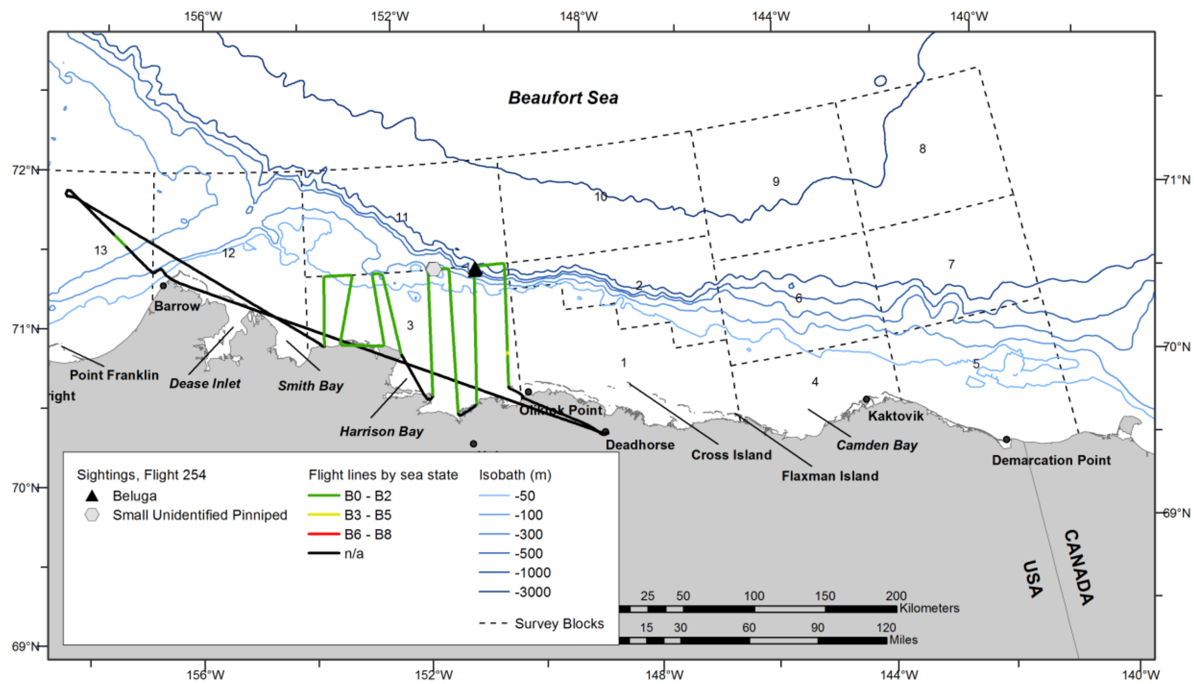

Figure B-90. ASAMM Flight 254 survey track, depicted by sea state, and all marine mammal sightings, excluding carcasses.

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APPENDIX C: PUBLICATIONS, POSTERS, and PRESENTATIONS FROM ASAMM 2008-2014, and MEDIA OUTREACH FROM ASAMM 2013

LIST OF PUBLICATIONS, POSTERS AND PRESENTATIONS

2008

Clarke, J., L. Morse and D. Rugh. 2008. Marine Mammal Occurrence in the Northeastern Chukchi Sea, Alaska – Comparison of Data from Autumn 1989-91 and Autumn 2008. Poster: American Cetacean Society 11th International Conference, Monterey, CA, November 2008.

Clarke, J. 2008. Monitoring the Distribution of Arctic Whales. Presentation: 11th MMS Information Transfer Meeting, Anchorage, AK, October 2008.

Clarke, J. 2008. COMIDA Distribution and Abundance of Marine Mammals, Aerial Surveys. Presentation: 11th MMS Information Transfer Meeting, Anchorage, AK, October 2008.

Morse, L. and J. Clarke. 2008. Swimming polar bears in the Alaskan Chukchi Sea – the REAL story. Poster: American Cetacean Society 11th International Conference, Monterey, CA, November 2008.

2009

Clarke, J. 2009. Bowhead whale aerial survey project (BWASP), 2008. Report: Prepared for NMML-NMFS and MMS-Alaska. 15 pp.

Clarke, J. 2009. Chukchi Offshore Monitoring in Drilling Area, 2008. Report: Prepared for NMML-NMFS and MMS-Alaska. 15 pp.

Clarke, J. 2009. COMIDA and BWASP, Aerial Surveys Conducted by NMML. Presentation: Arctic Seismic Open Water Meeting, Anchorage, AK, April 2009. Similar presentation at BOWFEST workshop, Anchorage, AK, January 2009.

Clarke, J., L. Morse and D. Rugh. 2009. Marine Mammal Occurrence in the Northeastern Chukchi Sea, Alaska – Comparison of Data from Autumn 1989-91 and Autumn 2008. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2009.

Ferguson, M., R. Angliss, D. Rugh, J. Mocklin, and L. Vate Brattström. 2009. Comparison of UASs and manned aircraft for surveying bowhead whale distribution and density. Presentation: workshop *Using Unmanned Aircraft Systems to Study Marine Mammals and Other Wildlife Species*, Quebec City, Canada, October 2009.

Morse, L., J. Clarke and D. Rugh. 2009. Marine mammal occurrence in the northeastern Chukchi Sea, Alaska – summer 2008. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2009.

2010

Christman, C., M. Ferguson, G. Friedrichsen, B. Rone and J. Clarke. 2010. Pacific Walrus Sightings Documented by Aerial Surveys of the Northeastern Chukchi Sea in 2009. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2010.

Clarke, J. 2010. Chukchi Offshore Monitoring in Drilling Area, 2009. Report: Prepared for NMML-NMFS and MMS-Alaska. 26 pp.

Clarke, J., C. Christman, M. Ferguson and L. Morse. 2010. Bowhead Whale Aerial Survey Project (BWASP) Status Update in 2009. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2010.

Clarke, J. and M. Ferguson. 2010. Aerial surveys of large whales in the Northeastern Chukchi Sea, 2008-2009, with review of 1982-1991 data. Paper: SC/62/BRG13 presented at the International Whaling Commission Scientific Committee Meetings, Morocco, June 2010. 18 pp.

Clarke, J. and M. Ferguson. 2010. Aerial surveys for bowhead whales in the Alaskan Beaufort Sea: BWASP update 2000-2009 with comparisons to historical data. Paper: SC/62/BRG14 presented at the International Whaling Commission Scientific Committee Meetings, Morocco, June 2010. 11 pp.

Clarke, J., M. Ferguson, L. Morse, G. Friedrichsen, B. Rone and C. Christman. 2010. Aerial Survey for Marine Mammals in the Northeastern Chukchi Sea: 2009. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2010.

Clarke, J. and B. Rone. 2010. Annual Report for Activities Conducted by the National Marine Mammal Laboratory under Federal Fish and Wildlife Permit MA212570-0 for Calendar Year 2009. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for U.S. Fish and Wildlife Service. 11 pp.

Ferguson, M. and R. Angliss. 2010. Efficiency of Unmanned Aircraft Systems (UAS) relative to manned aircraft for surveying bowhead whale distribution and density in the Arctic. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2010.

Ferguson, M. and J. Clarke. 2010. COMIDA and BWASP aerial surveys conducted by NMML, 2009. Presentation: Arctic Seismic Open Water Meeting, Anchorage, AK, May 2010. Similar presentation at BOWFEST workshop, Anchorage, AK, January 2010.

2011

Brower, A., J. Clarke, M. Ferguson, C. Christman and S. Grassia. 2011. Eastern North Pacific gray whale distribution and habitat use in the Chukchi Sea from aerial surveys: 1982-1991, 2008-2010. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2011.

Brower, A., J. Clarke, M. Ferguson, C. Christman and S. Grassia. 2011. Eastern North Pacific gray whale distribution and habitat use in the Chukchi Sea from aerial surveys: 1982-1991, 2008-2010. Poster: Society for Marine Mammalogy 19th Biennial Conference on the Biology of Marine Mammals, Tampa, FL, November/December 2011.

Christman, C., A. Brower, J. Clarke, M. Ferguson and S. Grassia. 2011. Pacific walrus sightings documented by COMIDA aerial surveys of the Northeastern Chukchi Sea in 2010. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2011.

Christman, C. and B. Rone. 2011. Annual Report for Activities Conducted by the National Marine Mammal Laboratory under Federal Fish and Wildlife Permit MA212570-0 for Calendar Year 2010. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for U.S. Fish and Wildlife Service. 12 pp.

Clarke, J., C. Christman, A.A. Brower, M.C. Ferguson and S.L. Grassia. 2011. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2010. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for the BOEMRE, OCS Study BOEMRE 2011-35. 119 pp.

Clarke, J., C. Christman, M. Ferguson and S. Grassia. 2011. Aerial surveys of endangered whales in the Beaufort Sea, Fall 2006-2008. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for the BOEMRE, OCS Study BOEMRE 2010-42. 240 pp.

Clarke, J., C. Christman, S. Grassia, A. Brower and M. Ferguson. 2011. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2009. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for the BOEMRE, OCS Study BOEMRE 2010-40. 92 pp.

Clarke, J., M. Ferguson, C. Christman, S. Grassia, A. Brower and L. Morse. 2011. Chukchi Offshore Monitoring in Drilling Area (COMIDA) Distribution and Relative Abundance of Marine Mammals: Aerial Surveys. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for the BOEMRE, OCS Study BOEMRE 2011-06. 296 pp.

Ferguson, M., J. Clarke, C. Christman, S. Grassia and A. Brower. 2011. A tale of two seas: lessons from multi-decadal aerial surveys for cetaceans in the Beaufort and Chukchi seas. Presentation: Alaska Marine Science Symposium, Anchorage, AK, January 2011.

Grassia, S., J. Clarke, M. Ferguson, C. Christman and A. Brower. 2011. Distribution, relative abundance and behaviors of bowhead whales in the Alaskan Beaufort and Northeastern Chukchi seas – Autumn 2007-2010. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2011.

Lemons, P. and C. Christman. 2011. Pacific Walrus (*Odobenus rosmarus divergens*) Abundance and Use of the Northeast Chukchi Sea Based on COMIDA Aerial Surveys. Poster: Society for Marine Mammalogy 19th Biennial Conference on the Biology of Marine Mammals, Tampa, FL, November/December 2011.

Okkonen, S., C. Ashjian, R. Campbell, J. Clarke, S. Moore and K. Taylor. 2011. Satellite observations of circulation features associated with a bowhead whale feeding 'hotspot' near Barrow, Alaska. *Remote Sensing of Environment* 115: 2168-2174.

2012

Brower, A., C. Christman, M. Ferguson, J. Clarke, S. Grassia, R. Shea, B. Rone and A. Kennedy. 2012. Eastern North Pacific Gray Whales and Minke Whales from Aerial Surveys in the Alaskan Arctic, Summer and Fall 2011. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2012.

Christman, C. and B. Rone. 2012. Annual Report for Activities Conducted by the National Marine Mammal Laboratory under Federal Fish and Wildlife Permit MA212570-0 in Calendar Year 2011. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for U.S. Fish and Wildlife Service. 16 pp.

Christman, C., A. Brower, J. Clarke, M. Ferguson, S. Grassia, A. Kennedy, B. Rone and R. Shea. 2012. Aerial Observations of Pacific Walruses (*Odobenus rosmarus divergens*) in the Northeastern Chukchi Sea, Summer and Fall 2011. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2012.

Christman, C., M. Ferguson, J. Clarke and A. Brower. 2012. Marine mammal aerial surveys in the Chukchi Sea. Presentation: Workshop on Assessing Pacific Walrus Population Attributes from Coastal Haul-Outs, Anchorage, AK, March 2012.

Clarke, J. and M. Ferguson. 2012. Beluga distribution from aerial surveys conducted July-October 2012. Presentation: Alaska Beluga Whale Committee 5th Workshop on Research about Beluga Whales, Anchorage, AK, November 2012.

Clarke, J., C. Christman, A. Brower and M. Ferguson. 2012. Distribution and relative abundance of marine mammals in the Alaskan Chukchi and Beaufort Seas, 2011. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for the BOEM, OCS Study BOEMRE 2012-009. 344 pp.

Clarke, J., M. Ferguson, C. Christman and A. Brower. 2012. Broad-scale aerial surveys of marine mammals in the western Beaufort and northeastern Chukchi Seas, 2011-2012, results from the ASAMM project. Presentation: 2012 United States-Canada Northern Oil and Gas Forum, Anchorage, AK, November 2012.

Clarke, J., M. Ferguson, C. Christman, A. Brower, S. Grassia, R. Shea, B. Rone, and A. Kennedy. 2012. Distribution and Relative Abundance of Belugas (*Delphinapterus leucas*) in the Alaskan Arctic, Summer and Fall 2011. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2012.

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Ferguson, M., J. Clarke, A. Brower, C. Christman, S. Grassia, A. Kennedy, B. Rone and R. Shea. 2012. Bowhead Whale (*Balaena mysticetus*) Distribution and Relative Abundance in the Alaskan Arctic, Summer and Autumn 2011. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2012.

Lemons, P. and C. Christman. 2012. Pacific Walrus (*Odobenus rosmarus divergens*) Abundance and Use of the Northeast Chukchi Sea Based on COMIDA Aerial Surveys. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2012.

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Brower, A., C. Christman, J. Clarke and M. Ferguson. 2013. Gray whale calf occurrence in the Alaskan Arctic, summer and fall 2012. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2013.

Christman, C., J. Citta, L. Quakenbush, J. Clarke, B. Rone, R. Shea, M. Ferguson and M. Heide-Jørgensen. 2013. Presence and behavior of bowhead whales (*Balaena mysticetus*) in the Alaskan Beaufort Sea in July 2011. *Polar Biology* 36(12): 1851-1856. DOI 10.1007/s00300-013-1395-4.

Christman, C., M. Ferguson, A. Brower and J. Clarke. 2013. Aerial sightings of Pacific walruses (*Odobenus rosmarus divergens*) in the Alaskan Arctic, summer and fall 2012, with a comparison to sightings from 2009-2011. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2013.

Christman, C. and B. Rone. 2013. Annual Report for Activities Conducted by the National Marine Mammal Laboratory under Federal Fish and Wildlife Permit MA212570-0 in Calendar Year 2012. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for U.S. Fish and Wildlife Service. 13 pp.

Christman, C. and B. Rone. 2013. Annual Report for Activities Conducted by the National Marine Mammal Laboratory under Federal Fish and Wildlife Permit MA212570-0 in Calendar Year 2013. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for U.S. Fish and Wildlife Service. 10 pp.

Clarke, J., C. Christman, A. Brower, and M. Ferguson. 2013. Distribution and Relative Abundance of Marine Mammals in the Northeastern Chukchi and Western Beaufort Seas, 2012. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for the BOEM, OCS Study BOEM 2013-00117. 349 pp.

Clarke, J., M. Ferguson, A. Brower and C. Christman. 2013. It's not just about bowhead whales – collaborations between ASAMM and other research. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2013.

Clarke, J., M. Ferguson, C. Christman, A. Brower, B. Small and R. Suydam. 2013. Distribution and relative abundance of belugas (*Delphinapterus leucas*) in the Alaskan Arctic, summer and fall 2012, with comparisons to 2007-2011. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2013.

Ferguson, M. and J. Clarke. 2013. Estimates of detection probability for BWASP bowhead whale, gray whale, and beluga sightings collected from Twin Otter and Aero Commander aircraft, 1989 to 2007 and 2008 to 2011. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-261, 52 p.

Ferguson, M., J. Clarke, R. Shea, A. Brower and C. Christman. 2013. Summer in the western Beaufort Sea: results from aerial surveys of Arctic marine mammals, July and August, 2012. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2013.

Schonberg, S., J. Clarke and K. Dunton. 2013. Distribution, abundance, biomass and diversity of benthic infauna in the northeast Chukchi Sea, Alaska: Relation to environmental variables and marine mammals. *Deep Sea Research Part II: Topical Studies in Oceanography* DOI 10.1016/j.dsr2.2013.11.004

Sims, C., A. Brower, C. Christman, M. Ferguson and J. Clarke. 2013. Sightings of humpback, fin, minke, and killer whales in the Alaskan Arctic from aerial surveys in 2012. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2013.

Stafford, K., S. Okkonen, and J. Clarke. 2013. Correlation of a strong Alaska Coastal Current with the presence of beluga whales (*Delphinapterus leucas)* near Barrow, Alaska. *Marine Ecology Progress Series* 474: 287-297.

2014

Brower, A. 2013. Gray Whale Calf Occurrence in the Alaskan Arctic, Summer and Fall 2013, with Comparisons to Previous Years. Alaska Fisheries Science Center Quarterly Report Oct-Nov-Dec.

Brower, A., M. Ferguson, C. Christman and J. Clarke. 2014. Gray Whale Calf Occurrence in the Alaskan Arctic, Summer and Fall 2013, with Comparisons to Previous Years. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2014.

Brower, A., J. Clarke, M. Ferguson and C. Christman. 2014. Gray Whale Foraging Habitats in the Alaskan Arctic, Summer and Fall 2009-2013. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2014.

Brower, A., M. Ferguson and J. Clarke. *In prep*. Gray whale distribution in the northeastern Chukchi Sea, 2008-2010, with comparison to historical data.

Christman, C., M. Ferguson, J. Clarke and A. Brower. 2014. Pacific walrus (*Odobenus rosmarus divergens*) haulouts along the northwestern Alaskan coastline, summer and fall 2009-2013. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2014.

Clarke, J., A. Brower, C. Christman and M. Ferguson. *In prep*. Distribution and Relative Abundance of Marine Mammals in the Northeastern Chukchi and Western Beaufort Seas, 2013. Report: Prepared by the National Marine Mammal Laboratory (NMFS) for the BOEM.

Clarke, J. and M. Ferguson. *In prep.* Distribution, Behavior, and Habitat Use of Bowhead Whales (*Balaena mysticetus*) and Gray Whales (*Eschrichtius robustus*) in Summer and Autumn in the Northeastern Chukchi Sea, 2009-2012.

Clarke, J., M. Ferguson, C. Christman, A. Brower and V. Beaver. 2014. Why One Year is NEVER Enough – Comparison of Bowhead Whale Distribution, Relative Abundance, Habitat Use and Behaviors in the Western Beaufort Sea in July-August, 2012 and 2013. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2014.

Clarke, J., K. Stafford, S. Moore, B. Rone and J. Crance. 2014. Subarctic cetaceans in the southern Chukchi Sea: evidence of recovery or response to a changing ecosystem. *Oceanography* 24(4):46-59.

Ferguson, M., J. Clarke, A. Brower and C. Christman. 2014. Modeling Western Arctic Bowhead Whale High Use Areas in the Western Beaufort Sea, 2000-2012. Poster: Alaska Marine Science Symposium, Anchorage, AK, January 2014.

Ferguson, M. and J. Clarke. *In prep*. Detecting spatial variability in the autumn migration of the Bering-Chukchi-Beaufort stock of bowhead whales across the Alaskan Beaufort Sea.

Ferguson, M. and J. Clarke. *In prep*. Distribution and relative density of bowhead whales and belugas in the Alaskan Beaufort Sea: similarities and differences between 1982-2006 and 2007-2010.

Kuletz, K., M. Ferguson, A. Gall, B. Hurley, E. Labunski, T. Morgan and R. Day. 2014. Seasonal and spatial patterns of marine-bird and -mammal distributions in the Pacific Arctic: a delineation of biologically important marine areas. Presentation at the Alaska Marine Science Symposium, Anchorage, AK, 20-24 January.

Kuletz, K., M. Ferguson, A. Gall, B. Hurley, E. Labunski, T. Morgan and R. Day. 2014. Seasonal and spatial patterns of marine bird and mammal distributions in the Pacific Arctic. Poster presented at the Bering Sea Open Science Meeting, Honolulu, HI, 22-23 February.

Okkonen, S.R., C.A. Ashjian, R.G. Campbell, K.M. Stafford and J.T. Clarke. 2014. Variability of late summer oceanographic conditions in Barrow Canyon. Presentation at the Ocean Sciences Meeting, Chukchi Sea Region: Physical Forcing and Ecosystem Response in the Pacific Arctic, Honolulu, HI, 23-28 February.

Stafford, K.M., J.T. Clarke and S.E. Moore. 2014. Acoustic and visual detections of sub-arctic cetaceans in the southern Chukchi Sea-Bering Strait region, 2009-2012. Presentation at the Ocean Sciences Meeting, Chukchi Sea Region: Physical Forcing and Ecosystem Response in the Pacific Arctic, Honolulu, HI, 23-28 February.

BOEM OCEAN SCIENCE
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VOLUME 10 ISSUE 2 • APRIL/MAY/JUNE 2013

Partnerships in Science:
Research on the Alaska OCS

Aerial Surveys of Arctic Marine Mammals (ASAMM)

Bowhead whale pod feeding in the Arctic. *Photo by Amelia Brower, NOAA.*

Another important partnership with NOAA is the current ASAMM study. This study documents annual distribution and abundance of bowhead, right, fin, and gray whales, and other marine mammals in areas of potential seismic survey, exploration, development, and production activities. The roots of ASAMM can be traced to the "Bowhead Whale Aerial Survey Project" (BWASP), which began in 1979 in the U.S. Beaufort Sea and included aerial surveys in the U.S. Chukchi Sea from 1982 to 1991. Until 1987, the ESP sponsored BWASP in collaboration with the Naval Ocean Systems Center. The ESP then conducted

BWASP as an in-house research effort for nearly two decades. In 2008, the ESP established a pair of interagency agreements with NOAA's National Marine Mammal Laboratory to conduct all aspects of the aerial surveys in the Beaufort Sea and to resume surveys in the Chukchi Sea. The two studies were combined into the single ASAMM project in 2011.

http://www.boem.gov/Ocean-Science-2013-Apr-May-Jun/

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BOEM Funding and NOAA Science Keep an Eye on Marine Mammals in the Arctic

NOAA scientists kicked off their annual Aerial Surveys of Arctic Marine Mammals (ASAMM) project this month, thanks to funding again this year by the Bureau of Ocean Energy Management (BOEM). Started in 1979, ASAMM is the longest-running and most extensive ongoing effort by federal agencies to monitor marine mammals in the Arctic.

Scientists will fly transects over the northeastern Chukchi and western Beaufort seas to survey whales and other marine mammals in areas of potential oil and natural gas exploration, development, and production activities. The goal of the surveys is to document the distribution and relative abundance of bowhead, gray, right, fin, and beluga whales, as well as other marine mammals.

The ASAMM project took to the skies July 2 from Barrow, Alaska, with additional effort based out of Deadhorse beginning in mid-July. NOAA scientists from the Alaska Fisheries Science Center's National Marine Mammal Laboratory will conduct almost daily flights through October, weather permitting.

Survey conditions are sometimes less than optimal in the Arctic, with periods of fog and low cloud ceilings. High winds and seas can limit visibility and flight safety. Scientists post nearreal-time updates on the surveys online.

ASAMM demonstrates good stewardship of taxpayer dollars, as federal agencies work collaboratively and with limited resources to gather needed data. NOAA and BOEM also collaborate with several other federal, state, and local agencies and universities by sharing field resources, data, and information. For example, the survey team will also help the U.S. Geological Survey's walrus satellite tag team find large groups of walrus suitable for tagging, and they are providing the National Sea Ice Center and U.S. Coast Guard with geo-referenced photographs of sea ice.

Bowhead whale seen during an aerial survey in the Arctic.

Additional Information

NOAA scientists are at the forefront of using new technology, such as unmanned aerial vehicles, to study marine mammal populations. For instance, NOAA scientists are using aerial drones to Spy on Sperm Whales and also to get A Whole new Perspective on life in Antarctica.

Other agencies and organizations that benefit from this research include the U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, North Slope Borough, University of Alaska Fairbanks, and other entities conducting research in the Arctic.

http://www.nmfs.noaa.gov/stories/2013/07/7_29_13aerial_surveys_arctic_marine_mammals.html

NOAA Fisheries News Releases

NEWS RELEASE
September 30, 2013
Julie Speegle, 907-586-7032 w., 907-321-7032 c.

NOAA'S AERIAL SURVEYS OF ARCTIC MARINE MAMMALS PHOTOGRAPH WALRUS HAULOUT SITE - SCIENTISTS CALL BEHAVIOR A NEW PHENOMENON

NOAA scientists participating in this year's annual Aerial Surveys of Arctic Marine Mammals project in Alaska say they have photographed an area where thousands of Pacific walruses haul out of the ocean on a remote barrier island in the Chukchi Sea, near Pt. Lay.

Pacific walruses hauled out on a remote barrier island in the Chukchi Sea, near Pt. Lay. Photo: NOAA Fisheries. (Click for larger version)

This study is being funded and co-managed by the Bureau of Ocean Energy Management (BOEM)'s environmental studies program.

Scientists say it is difficult to provide an accurate count of the number of walruses densely packed together on coastal haulouts. Using aerial photographs, scientists estimated that this year's haulout at Pt. Lay initially contained 1,500 to 4,000 animals on Sept. 12. The number of walruses had increased to 5,500 to 8,000 when sighted on Sept. 22, and on Sept. 27, biologists estimated that there were approximately 10,000 walruses.

In 2011, scientists estimated that 30,000 walruses were hauled out along one kilometer of beach near Pt. Lay.

"Large walrus haulouts along the Alaskan coasts in the northeastern Chukchi Sea are a relatively new phenomenon," said Megan Ferguson, marine mammal scientist with NOAA Fisheries. "NOAA's research doesn't typically extend to studying walruses, since this is a species managed by the U.S. Fish and Wildlife Service (USFWS), so you can imagine how exciting it was for us to be able to collect such valuable data for our partner agencies."

Conserving and restoring protected species such as whales is one of NOAA Fisheries' core missions. The goal of the surveys is to document the distribution and relative abundance of bowhead, gray, minke, fin whales, beluga whales and other marine mammals in areas of potential oil and natural gas exploration, development and production activities in the Alaskan Arctic.

Full article at http://alaskafisheries.noaa.gov/newsreleases/2013/walrushaulout093013.htm

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National Marine Mammal Laboratory

NOAA Scientists Document New Walrus Haulout in Alaskan Arctic

An adult female walrus. Photo by Ryan Kingsbery, U.S. Geological Survey.

Tipped off by reports from the local community, NOAA scientists were the first to photograph from the air and document thousands of burly, mustachioed mammals lounging on the shore near Pt. Lay, Alaska this summer.

The team's small airplane carried digital cameras for documenting whale sightings, so they took aerial photos of the crowded beach and shared them with colleagues at partner agencies. It turned out those photos were evidence of a relatively new phenomenon. Due to loss of sea ice in offshore areas, Pacific walruses are foraging in more coastal areas and using beaches for resting, or hauling out.

The number of walruses at the Pt. Lay haulout keeps growing. Estimates from the photos are 1,500 to 4,000 animals when first seen on 12 September, and 5,500 to 8,000 on 22 September. On 27 September, biologists report that there were approximately 10,000 walruses.

Every year, a team from the Alaska Fisheries Science Center's National Marine Mammal Laboratory surveys the Alaskan Arctic from a small airplane to study the distribution and abundance of marine mammals. These flights are part of the Aerial Surveys of Arctic Marine Mammals (ASAMM) project funded and co-managed by the Bureau of Ocean Energy Management Environmental Studies Program. The aim of the project is to monitor the patterns of marine mammal density in areas of the Arctic where oil and gas exploration may take place.

An aerial photograph of an estimated 8,000 walruses taken near Pt. Lay, Alaska, 22 September 2013. Photo by Stan Churches.

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Full article at http://www.afsc.noaa.gov/NMML/cetacean/research/Walrus-ASAMM2013.php

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February 26, 2014

Whales, ships more common through Bering Strait

Hannah Hickey
News and Information

Posted under: ***Environment, News Releases, Research, Science***

The Arctic is home to a growing number of whales and ships, and to populations of sub-Arctic whales that are expanding their territory into newly ice-free Arctic waters.

A study of the narrow passage of the Bering Strait uses underwater microphones to track the whales by their sounds. Three years of recordings reveal more detections of both Arctic and sub-Arctic whales traveling through the narrow choke point.

Wikimedia / Gillfoto

Humpback whale breaching off the coast of Juneau, Alaska. They are now heard traveling north to feed in the Chukchi Sea.

Kate Stafford, an oceanographer with the University of Washington's Applied Physics Laboratory, will present the results Feb. 26 at the Ocean Sciences meeting in Honolulu.

The recordings show Arctic beluga and bowhead whales migrating seasonally through the region from the Arctic south to spend winter in the Bering Sea. They also detect large numbers of sub-Arctic humpback, fin and killer whales traveling north through the Bering Strait to feed in the biologically rich Chukchi Sea.

"It's not particularly surprising to those of us who work up in the Arctic," Stafford said. "The Arctic seas are changing. We are seeing and hearing more species, farther north, more often. And that's a trend that is going to continue."

Stafford placed microphones below the water's surface and recorded in summer and early winter from 2009 to 2012 as part of a U.S.-Russian scientific collaboration. Melodious humpback whale songs showed up regularly on recordings into late fall. Fin and killer whales, which are southern species that seldom travel into Arctic waters, were heard into early November.

"These animals are expanding their range," Stafford said. "They're taking advantage of regions in seasons that they may not have previously."

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Whales, ships more common through Bering Strait

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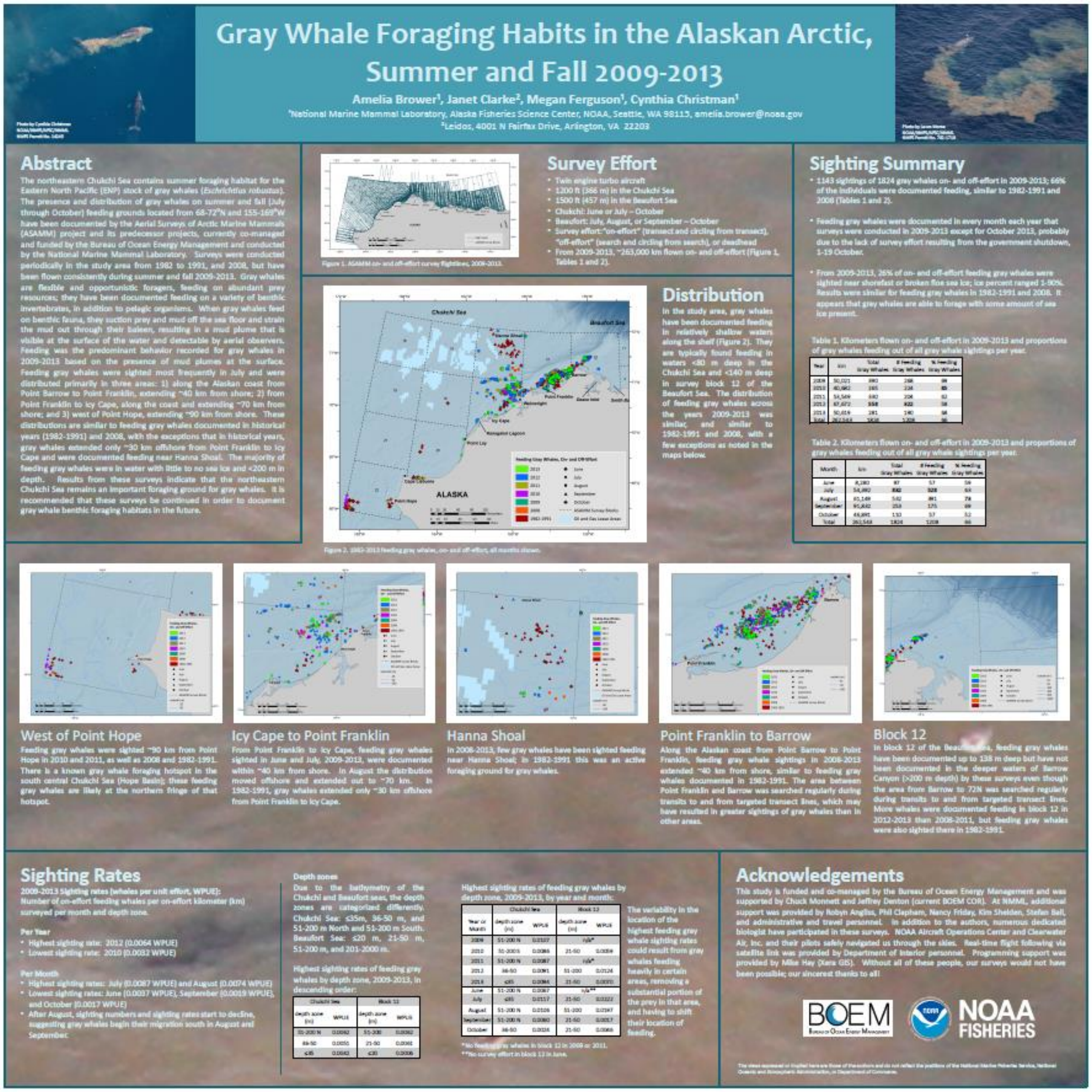
Gray Whale Foraging Habits in the Alaskan Arctic, Summer and Fall 2009-2013
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Abstract
Survey Effort
Sighting Summary
Distribution
West of Point Hope
Icy Cape to Point Franklin
Hanna Shoal
Point Franklin to Barrow
Block 12
Sighting Rates
Acknowledgements
BOEM
NOAA FISHERIES

Pacific walrus (*Odobenus rosmarus divergens*) haulouts along the northwestern Alaskan coastline, summer and fall 2009-2013

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ABSTRACT The Aerial Surveys of Arctic Marine Mammals (ASAMM) project, which is conducted by NOAA and co-managed and funded by BOEM, surveys the northeastern Chukchi and western Beaufort seas (68°N-72°N, 140°W-169°W). Flights consist of line-transect surveys that cover a wide range, from the northern Alaskan coastline to a maximum of 315 km offshore, and they are designed to document the distribution, relative abundance, and behaviors of marine mammals in the Arctic during the ice-free season (July-October). Pacific walruses (*Odobenus rosmarus divergens*) are frequently encountered during flights in the northeastern Chukchi Sea, and are seen in the water, hauled out on sea ice, and, in recent years, in large aggregations on land. During aerial surveys conducted in summer and fall 2009-2013, we observed large walrus haulouts along the northwestern Alaskan coastline in all years except 2012. Our initial encounters with coastal walrus haulouts occurred in either mid-August (2011) or early to mid-September (2009, 2010, and 2013). While the location of haulouts varied slightly among years (e.g., haulouts were documented near Icy Cape in 2009 and Cape Lisburne in 2010), walruses consistently hauled out near Point Lay, Alaska, in 2010, 2011, and 2013. The continued use of barrier islands near Point Lay for haul-out space suggests that it is important habitat for Pacific walruses, especially when sea ice habitat becomes less suitable. In 2009-2011 and 2013, years when coastal walrus haulouts were observed, sea ice was either sparse or absent in the study area by late summer. In 2012, when no coastal walrus haulouts were observed, diffuse sea ice persisted in the northern part of the study area near Hanna Shoal (~72°N, 162°W). The persistence of sea ice remnants near Hanna Shoal throughout the summer and fall of 2012 likely provided enough at-sea haul-out space, making land haulouts unnecessary. The amount and location of Arctic sea ice during summer and fall, and its suitability as an offshore haul-out platform for walruses, will be critical predictors of the occurrence and timing of walrus haulouts on land. Long-term, systematic aerial surveys along the coast can identify where and when walrus haulouts form.

PROJECT OVERVIEW

- ASAMM (Aerial Surveys of Arctic Marine Mammals) is a project conducted by the National Marine Mammal Laboratory, a division of NOAA's Alaska Fisheries Science Center. The project is co-managed and funded by the Bureau of Ocean Energy Management.
- The main objective of ASAMM is to document the relative abundance, spatial and temporal distribution, and behaviors (e.g., calving, feeding, hauling out) of marine mammals in the Alaskan Arctic.
- ASAMM conducts offshore, line-transect aerial surveys in the Alaskan Arctic. The primary study areas are in the northeastern Chukchi and western Beaufort seas (68-72°N, 140-169°W).
- Flights are conducted during the open water (ice-free) season, from June/July through October.

COASTAL WALRUS HAULOUTS

- Coastal walrus haulouts were sighted along the northwestern Alaskan coastline in all years from 2009-2013 except 2012 (Fig. 1).
- Coastal walrus haulouts were sighted by mid-August (2011) or early to mid-September (2009, 2010 and 2013) (Table 1).
- Sea ice was either sparse or absent in years when coastal walrus haulouts formed (Fig. 2).

Figure 1 (right).
Map showing locations (yellow stars) of walrus haulouts observed on the northwestern Alaskan coastline during ASAMM aerial surveys from 2009-2013. The ASAMM study area is shown in dark blue. Surrounding photographs show aerial views of haulouts each year they were encountered. In 2009, a haulout was observed on a sandy beach near Icy Cape. In 2010, three haulouts were observed on a rocky beach below cliffs near Cape Lisburne. In 2010, 2011 and 2013, haulouts were observed on a barrier island near Point Lay. Photographs were taken by Cynthia Christman, Mike Borden, Rebecca Shea, and Stan Churches under USFWS Permit No. MA212570.

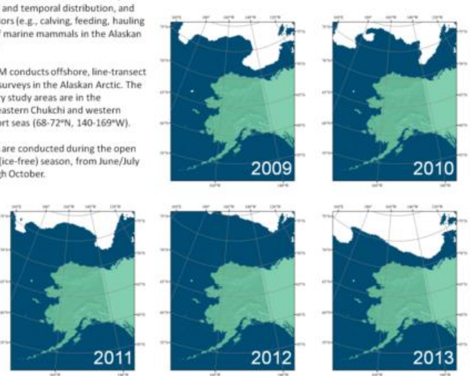

Figure 2 (left).
Maps showing Northern Hemisphere sea ice extent near Alaska for September 2009-2013. Ice extent is derived from satellite imagery and areas with 15% or less ice coverage may be depicted as "ice-free". Ice shapefiles are courtesy of the National Snow & Ice Data Center.

Maps depict large areas of open water in the northeastern Chukchi Sea, south of 75°N, in September of all years. These images correspond with observations made during ASAMM flights in 2009-2011 and 2013, when no sea ice was seen in the study area by September. In these years, coastal walrus haulouts were observed by mid-August (2011) or early September (2009, 2010, 2013).

Despite the lack of sea ice in satellite images of the northeastern Chukchi Sea in September 2012, walruses were observed hauled out on ice in this area during ASAMM surveys. Sea ice remnants persisted near Hanna Shoal (~72°N, 162°W), continuing to offer haul-out space over the continental shelf. It is likely that the ice provided enough at-sea haul-out space, making land haulouts unnecessary, as no walrus aggregations on the northwestern Alaskan coastline were observed.

Table 1 (right).
A comparison of haul-out locations, first encounter date, last encounter date, duration between first and last encounter, and minimum and maximum group size estimates for coastal walrus haulouts observed during aerial surveys from 2009-2013. With the exception of 2012, when no coastal haulouts were seen, a barrier island near Point Lay was consistently used as a haul-out location starting in 2010.

Year	Walrus Haulout Observed	Haulout Location(s)	First Encounter	Last Encounter†	Duration of Days from First to Last Encounter	Min. Group Size Estimate	Max. Group Size Estimate
2009	yes	Icy Cape	2-Sep	13-Sep	12	2,500	4,000
2010	yes	Point Lay Cape Lisburne*	30-Aug	24-Sep	26	800	15,000
2011	yes	Point Lay	17-Aug	6-Oct	51	1,000	20,000‡
2012	no	-	-	-	-	-	-
2013	yes	Point Lay	12-Sep	27-Sep	16	3,000	10,000

*Haulouts near Cape Lisburne were encountered only on 30-Aug.
†The last date the haulout was observed by ASAMM; may not be indicative of the last date the haul-out location was occupied.
‡Monson et al. (2013)§ estimated 30,000 walruses at this location in 2011 based on aerial images from a gyro-stabilized video system.

§Monson DH, Udevitz MS, Jay CV (2013) Estimating Age Ratios and Size of Pacific Walrus Herds on Coastal Haulouts using Video Imaging. PLoS ONE 8(7): e69806. doi:10.1371/journal.pone.0069806

The first large-scale coastal walrus haulout on the northwestern Alaskan coastline was observed in 2007 (Thomas et al. 2009*). No large haulouts were seen in this area in 2008.

ASAMM data, along with local observations and USGS satellite-tagging studies, provide valuable information about the timing and location of walrus haulout formation along the northwestern Alaskan coastline.

ACKNOWLEDGMENTS This project was funded by the Bureau of Ocean Energy Management (BOEM), with oversight provided by BOEM Contracting Officer Representative Jeffrey Denton. It has also been strongly supported by Dr. Charles Monnett. At NMML, we would like to thank Dr. Phillip Clapham, Dr. Nancy Friday, and Kim Shelden for their contributions, as well as the administrative and travel personnel for assistance throughout the field season. In 2013, the surveys would not have been possible without the help of Mike Hay (Xera GIS) for programming support, Clearwater Air, Inc., including pilots Andrew Harcombe, Stan Churches, John Siegel, Jacob Turner, Jim Kopczynski, and Alex Shibakov for aircraft support, and the Bureau of Land Management (DOI) for providing real-time flight-following. Special thanks go to biologists Corey Accardo, Lisa Barry, Vicki Beaver, Ianjon Brower, Peter Duley, Jennifer Gatzke, Suzie Hanlan, Qaiyaan Harcharek, Bob Lynch, Christy Sims, Jessica Thompson, Dan Twyman, and Karen Vale for collecting and managing data.

Why One Year is *NEVER* Enough
Comparison of Bowhead Whale (*Balaena mysticetus*) Distribution, Relative Density, Habitat Use and Behavior in the Western Beaufort Sea in July-August, 2012 and 2013

NOAA FISHERIES

Janet Clarke[1], Megan Ferguson[2], Cynthia Christman[2], Amelia Brower[2] and Vicki Beaver[2]

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BOEM Bureau of Ocean Energy Management

ABSTRACT

Bowhead whale data collected during aerial surveys conducted in the western Beaufort Sea in summer 2013 were noticeably different from data collected during summer 2012. Funded and co-managed by BOEM and conducted by NOAA, the Aerial Surveys of Arctic Marine Mammals (ASAMM) project encompasses a large (~107,000 km²) study area that includes continental shelf, slope and basin waters in the Beaufort Sea, between 140°W and 157°W. Broad-scale surveys have been conducted by ASAMM and its predecessor BWASP in this area in September and October since 1979. However, surveys in the western Beaufort Sea were flown for the first time in July and August in 2012 and replicated temporally and geographically in 2013. Surveys followed line-transect protocols, with randomly spaced transects oriented approximately north-south to bisect bowhead whale migratory paths. In 2012, 27 surveys were flown for a total of 28,500 km (14,800 km on transect), while in 2013, 23 surveys were flown for a total of 27,000 km (10,100 km on transect). There were 61 sightings of 118 bowhead whales in 2012 compared to 208 sightings of 382 bowhead whales in 2013. Variability was noted in bowhead whale relative density (0.005 whales per transect km in 2012; 0.022 whales per transect km in 2013), habitat use (predominantly slope in July and August 2012 versus slope in July 2013 and shelf in August 2013), and behavior. Eleven calves were seen in 2012 compared to 29 calves in 2013; 34 whales were observed milling or feeding in 2012 (29% of all bowheads seen) versus 129 whales (34% of all bowheads seen) in 2013.

The limited effort (2 years) makes it difficult to know if variation observed between 2012 and 2013 is typical or unique; factors affecting bowhead whale occurrence could include feeding opportunities throughout the Beaufort Sea and anthropogenic influences. Continuing physical, biological and anthropogenic data collection throughout the Beaufort Sea in upcoming years will be crucial to gain a better understanding of bowhead whale distribution, density, and the variability therein in the western Beaufort Sea in summer. This information will become increasingly relevant for managing arctic resources and understanding the arctic ecosystem.

METHODS

- Line transect aerial surveys
- Twin turbine, high wing aircraft
- 1500' (457 m) survey altitude
- Fly every day, weather permitting, 19 July through 31 August
- Two primary marine mammal observers, one data recorder
- Circle on most cetacean sightings to get positive species ID, determine group size, and look for calves

Figure 1. Western Beaufort Sea study area, part of the larger ASAMM study area.

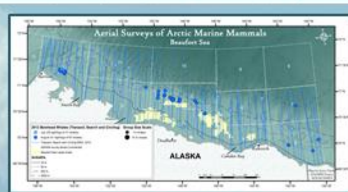

Figure 2. Bowhead whale sightings (transect, search and circling), summer 2012.

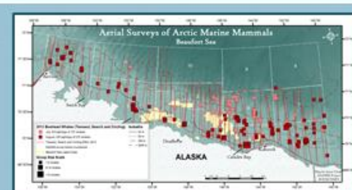

Figure 3. Bowhead whale sightings (transect, search and circling), summer 2013.

RESULTS

	2012		2013		Figure
	July	August	July	August	
Sightings (transect, search and circling)	20 sightings of 31 bowhead whales	41 sightings of 87 bowhead whales	53 sightings of 107 bowhead whales	155 sightings of 275 bowhead whales	Figures 2 and 3
Kilometers	28,500 total km (14,800 km on transect)		27,000 km (10,100 km on transect)		Figures 2 and 3
Distribution	Offshore, primarily over slope (51-2,000 m)	Scattered from shallow shelf (≤20 m) to shelf (21-50 m) to slope (51-2,000 m)	Offshore, primarily over slope (51-2,000 m)	Scattered from shallow shelf (≤20 m) to deep slope (200->2,000 m) waters, from 140°-157°W	Figures 2 and 3
Relative Density (WPUE = whales on transect per transect km)	Sighting rate: 0.005 whales per unit effort (WPUE); highest sighting rate in 51-100 m depth zone across entire western Beaufort Sea	Sighting rate: 0.005 whales per unit effort (WPUE); highest sighting rate in ≤20 m depth zone from 154°-157°W and 21-50 m depth zone from 140°-154°W	Sighting rate: 0.015 whales per unit effort (WPUE); highest sighting rate in 51-100 m depth zone from 140°-154°W	Sighting rate: 0.027 whales per unit effort (WPUE); highest sighting rate in 51-100 m depth zone from 154°-157°W and ≤20 m depth zone from 140°-154°W	
Habitat Preference (transect sightings, not corrected for effort or group size)	Depth: mean = 426 m (SD = 532.58), median = 200 m, range 49-1,681 m, n = 14	Depth: mean = 132 m (SD = 390.65), median = 45 m, range = 18-1,986 m, n = 25	Depth: mean = 531 m (SD = 617.82), median = 237 m, range = 33-1,985 m, n = 35	Depth: mean = 133 m (SD = 342.33), median = 47 m, range = 12-2,266, n = 82	
Behavior	54% of whales were swimming; swim direction was significantly clustered around 277°T (Rayleigh's Z = 9.612, P = 0.00001); 29% were milling or feeding; 12% resting; 3% breaching		41% of whales were swimming; swim direction was not significantly clustered around any mean direction; 34% were milling or feeding; 13% resting; 4% displaying including log rolling and tail-slapping; 2% diving and 5% had no behavior recorded		Figure 4
Calves	11 calves, calf ratio (# calves/total whales) = 9.3%		29 calves, calf ratio (# calves/total whales) = 7.6%		Figure 5

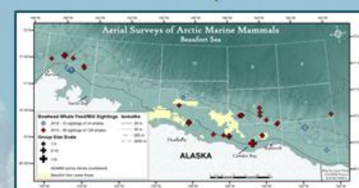

Figure 4. Bowhead whale feeding and milling sightings (transect, search and circling), summer 2012 and 2013.

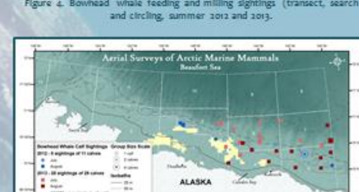

Figure 5. Bowhead whale calf sightings (transect, search and circling), summer 2012 and 2013.

SUMMARY

- Bowhead whales frequent the western Beaufort Sea in summer (July and August), including both shelf (≤50 m) and slope (>50 m) habitat; this is also corroborated by limited aerial survey data from the early 1980s (e.g., Ljungblad et al., 1987) and late 2000s (Brandon et al., 2011), and by satellite tag data (Quakenbush et al., 2012).
- The western Beaufort Sea appears to be important summer habitat for bowhead whale cow-calf pairs, also corroborated by aerial surveys conducted in the early 1980s (Clarke et al., 1987; Ljungblad et al., 1987).
- Relative density and distribution varied considerably from one year to another during the two years of consistent aerial survey observations.
- Understanding the mechanisms driving annual variation are essential to effective management of this bowhead whale stock. This includes a better understanding of the oceanographic influences on prey availability throughout the bowhead whale's summer range and closer monitoring of anthropogenic influences in both Alaskan and Canadian waters.

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Photo by Vicki Beaver, NMFS Permit #14245

Modeling Western Arctic Bowhead Whale High-use Areas in the Western Beaufort Sea, 2000-2013

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ABSTRACT

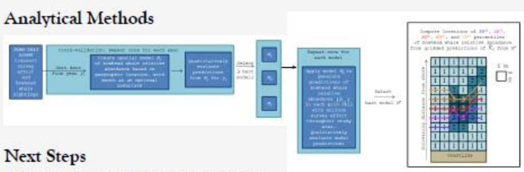
Characteristics of Western Arctic bowhead whale distribution vary spatially from the Bering to the Chukchi and Beaufort seas, and temporally across seasons. Quantitatively describing the variability in bowhead whale distribution can lead to insights into bowhead whale ecology and can inform conservation and management decisions. The spatial distribution of bowhead whales in the western Beaufort Sea (140°-156°W) in the summer (July and August) and fall (September and October) of 2000 through 2013 was quantitatively assessed using a geographically-explicit model of bowhead whale relative abundance (number of animals per kilometer) based on sightings made during the Aerial Surveys of Arctic Marine Mammals (ASAMM) line-transect surveys and preceding projects. ASAMM is currently funded and co-managed by BOEM and conducted by NMFS. The analysis was restricted to the 2000-2013 ASAMM data because experts believe that a regime shift occurred in the Arctic around 2000-2002. The model was based on a grid with a 5 km x 5 km resolution and incorporated spatial and temporal heterogeneity in bowhead whale group size and survey effort. The model did not account for sighting probabilities, although this is a natural extension that will be built into future models. Bowhead whale high-use areas (HUAs) were identified as the locations of the 30th, 40th, 50th, 60th, and 70th percentiles of predicted bowhead whale relative abundance for each north/south column of 5 km x 5 km grid cells in the study area. For example, the location of the 30th percentile in a specific column of cells referred to the location where 30% of the predicted number of bowhead whales was closer to shore and 70% were farther offshore. The midpoints of all cells corresponding to each percentile were connected across the study area to define linear boundaries across the western Beaufort Sea corresponding to each percentile of the bowhead whale HUA. Interannual variability was evident in bowhead whale sightings in all months; however, some patterns were evident in the analysis pooled across all years. The resulting HUAs were located relatively farther offshore in July. From August through October, the HUAs were nearshore from Dease Inlet to Cape Halkett, and they bordered the barrier islands between Cross and Flaxman islands. The HUAs were relatively far from shore north of Harrison Bay in all months, and north of Camden Bay in every month except August.

Study Area and Field Methods

- Location: Western Beaufort Sea (Figure 1)
- Timing: Primarily September through October, 2000-2011; July through October, 2012-2013
- Survey Aircraft and flight profiles: Line transect aerial surveys for marine mammals were conducted in de Havilland Twin Otter and twin turbine Aero Commander aircraft with bubble windows at 204 km/h and 305-458 m altitude
- Survey Protocols: Crew included two primary marine mammal observers, one data recorder who also served as a secondary observer, and two pilots. Data were recorded onto a laptop computer, including automatic updates on the aircraft's latitude, longitude, and altitude. Environmental conditions were recorded every 5 minutes, or whenever conditions changed. All marine mammal sightings were recorded. The highest priority sighting data included species identification, group size estimates, number of calves, angle of declination to sighting from the horizon, behavior, and whether the animals reacted to the survey aircraft. Transect effort was conducted on predetermined, randomly placed transects oriented generally north/south. Search effort was conducted whenever sighting conditions were adequate and the aircraft was not surveying a transect line. The aircraft circled some bowhead whale sightings to better estimate group size and determine whether calves were present. Deadhead effort was assigned to flightlines located over land, shoreward of the barrier islands, or when sighting conditions were poor.

Figure 1. ASAMM western Beaufort Sea study area, including survey blocks, isobaths, and offshore oil and gas lease areas

Analytical Methods



Next Steps

- Incorporate sighting probabilities into the spatial models
- Estimate uncertainty in the spatial model predictions
- Examine interannual variability in the spatial model predictions

ASAMM Transect Effort and Bowhead Whale Transect Sightings | **Predicted Bowhead Whale Relative Abundance and High-use Areas**

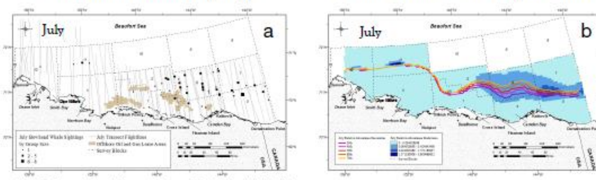


Figure 2a. The spatial model incorporated a total of 59 bowhead whale sightings made by primary observers on transect in July. All of the July sightings were from 2012 and 2013, and the majority of the sightings were located in the eastern half of the study area. b. The spatial model predicted that the bowhead whale high-use areas were farthest offshore in July. Limited sample size in the western half of the study area provided minimal information for the spatial models in July.

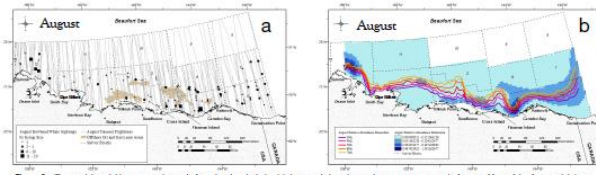


Figure 3a. The spatial model incorporated a total of 125 bowhead whale sightings made by primary observers on transect in August. Most of the August sightings were from 2012 and 2013. b. The spatial model predicted that the bowhead whale high-use areas were located relatively close to shore from Dease Inlet to Cape Halkett, and just outside the barrier islands from Oliktok Point to Flaxman Island. The high relative abundance predictions inside Camden Bay were heavily influenced by two sightings with large group sizes (14 and 20 animals) made on 20 August 2013. The percentile lines extending into Smith Bay are likely due to model misspecification because there were no sightings in the bay.

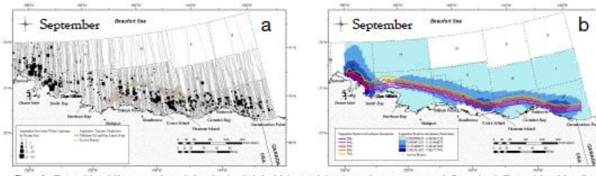


Figure 4a. The spatial model incorporated a total of 643 bowhead whale sightings made by primary observers on transect in September. b. The spatial model predicted that the bowhead whale high-use areas were located relatively close to shore from Dease Inlet to Cape Halkett, and just outside the barrier islands from Oliktok Point to Flaxman Island. The model predicted relatively low abundance in Harrison and Camden bays, and relatively high abundance in the Barrow Canyon area.

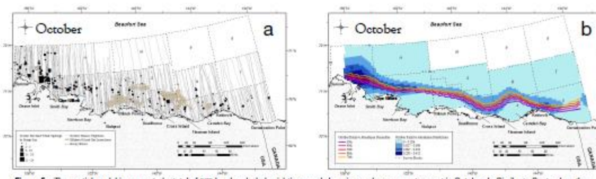


Figure 5a. The spatial model incorporated a total of 279 bowhead whale sightings made by primary observers on transect in October. b. Similar to September, the spatial model predicted that the bowhead whale high-use areas were located relatively close to shore from Dease Inlet to Cape Halkett, and just outside the barrier islands from Cross Island to Flaxman Island. The model predicted relatively low abundance in Harrison and Camden bays.

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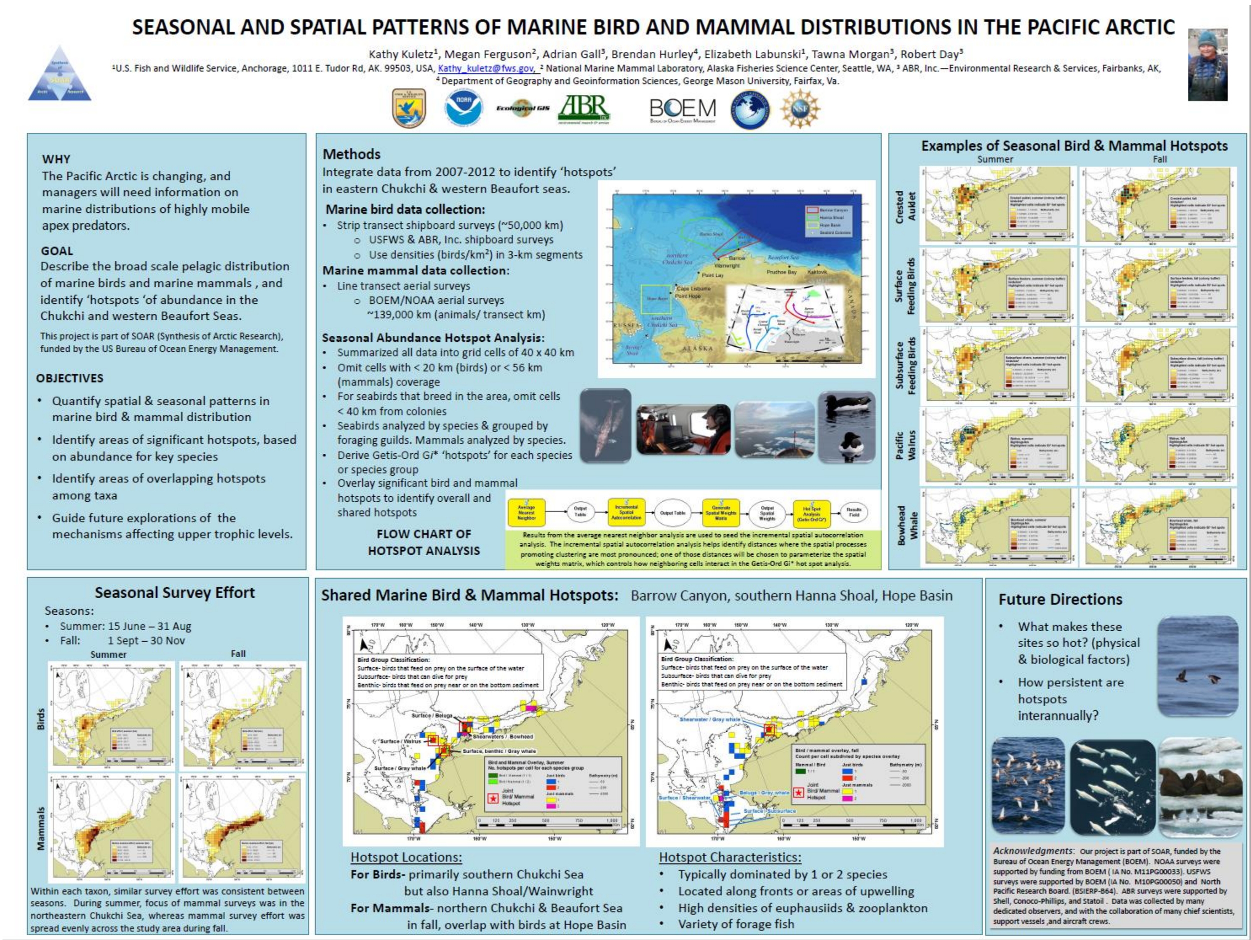

SEASONAL AND SPATIAL PATTERNS OF MARINE BIRD AND MAMMAL DISTRIBUTIONS IN THE PACIFIC ARCTIC

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WHY
The Pacific Arctic is changing, and managers will need information on marine distributions of highly mobile apex predators.

GOAL
Describe the broad scale pelagic distribution of marine birds and marine mammals , and identify 'hotspots 'of abundance in the Chukchi and western Beaufort Seas.

This project is part of SOAR (Synthesis of Arctic Research), funded by the US Bureau of Ocean Energy Management.

OBJECTIVES
- Quantify spatial & seasonal patterns in marine bird & mammal distribution
- Identify areas of significant hotspots, based on abundance for key species
- Identify areas of overlapping hotspots among taxa
- Guide future explorations of the mechanisms affecting upper trophic levels.

Methods
Integrate data from 2007-2012 to identify 'hotspots' in eastern Chukchi & western Beaufort seas.

Marine bird data collection:
- Strip transect shipboard surveys (~50,000 km)
  - USFWS & ABR, Inc. shipboard surveys
  - Use densities (birds/km^2) in 3-km segments

Marine mammal data collection:
- Line transect aerial surveys
  - BOEM/NOAA aerial surveys
    ~139,000 km (animals/ transect km)

Seasonal Abundance Hotspot Analysis:
- Summarized all data into grid cells of 40 x 40 km
- Omit cells with < 20 km (birds) or < 56 km (mammals) coverage
- For seabirds that breed in the area, omit cells < 40 km from colonies
- Seabirds analyzed by species & grouped by foraging guilds. Mammals analyzed by species.
- Derive Getis-Ord Gi* 'hotspots' for each species or species group
- Overlay significant bird and mammal hotspots to identify overall and shared hotspots

FLOW CHART OF HOTSPOT ANALYSIS

Average Nearest Neighbor → Output Table → Incremental Spatial Autocorrelation → Output Table → Generate Spatial Weights Matrix → Output Spatial Weights → Hot Spot Analysis (Getis-Ord Gi*) → Results Field

Results from the average nearest neighbor analysis are used to seed the incremental spatial autocorrelation analysis. The incremental spatial autocorrelation analysis helps identify distances where the spatial processes promoting clustering are most pronounced; one of those distances will be chosen to parameterize the spatial weights matrix, which controls how neighboring cells interact in the Getis-Ord Gi* hot spot analysis.

Examples of Seasonal Bird & Mammal Hotspots
Summer | Fall

Crested Auklet
Surface Feeding Birds
Subsurface Feeding Birds
Pacific Walrus
Bowhead Whale

Seasonal Survey Effort
Seasons:
- Summer: 15 June – 31 Aug
- Fall: 1 Sept – 30 Nov

Summer | Fall
Birds
Mammals

Within each taxon, similar survey effort was consistent between seasons. During summer, focus of mammal surveys was in the northeastern Chukchi Sea, whereas mammal survey effort was spread evenly across the study area during fall.

Shared Marine Bird & Mammal Hotspots: Barrow Canyon, southern Hanna Shoal, Hope Basin

Hotspot Locations:
For Birds- primarily southern Chukchi Sea but also Hanna Shoal/Wainwright
For Mammals- northern Chukchi & Beaufort Sea in fall, overlap with birds at Hope Basin

Hotspot Characteristics:
- Typically dominated by 1 or 2 species
- Located along fronts or areas of upwelling
- High densities of euphausiids & zooplankton
- Variety of forage fish

Future Directions
- What makes these sites so hot? (physical & biological factors)
- How persistent are hotspots interannually?

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APPENDIX D: 2013 OPERATIONS PROTOCOL FOR ASAMM AND MIZOPEX AERIAL RESEARCH IN THE ALASKAN ARCTIC

7/15/2013

2013 Operations Protocol for ASAMM and MIZOPEX
Aerial Research in the Alaskan Arctic

1) Aerial Surveys of Arctic Marine Mammals (ASAMM) and the Marginal Ice Zone Ocean and Ice Observations and Processes Experiment (MIZOPEX) agree that the safety of the manned aircraft is of paramount importance at all times and the manned aircraft will have priority in the airspace. No decisions will be made by MIZOPEX that will threaten the safety of the manned aircraft.

2) The ASAMM manned aircraft mission will have priority over the MIZOPEX mission for airspace access. The ASAMM project will accommodate the MIZOPEX mission to the extent feasible.
   a. ASAMM will reduce the number of survey aircraft operating in the Beaufort Sea for the duration of the MIZOPEX field study from two aircraft to one aircraft.

3) NOAA/Office of Marine and Aviation Operations (OMAO) will establish an independent panel to review all protocols and mitigation measures identified to ensure the safety of the joint NMFS/NOAA-DOI/BOEM ASAMM project.
   a. The panel will review the draft ASAMM-MIZOPEX operations protocol.
   b. The panel will review the safety case for the corridor prepared by NASA, the COA application(s), and the safety case for "due regard" flights in international airspace prepared by NASA. MIZOPEX is responsible for ensuring that these and any other relevant documents are provided from NASA to OMAO.
   c. The operations protocol will be considered draft until the protocol is:
      i. agreed to by ASAMM and MIZOPEX, and
      ii. reviewed by OMAO, and OMAO is of the opinion that ASAMM and MIZOPEX should be able to operate safely simultaneously, given that the protocol is adhered to.

4) ASAMM will not be in the air from 2200 hrs AKDT to 0830 hrs AKDT. MIZOPEX can conduct operations during these hours without coordinating with ASAMM.

5) The coordinates for the MIZOPEX operational blocks (hereafter referred to as "blocks") are defined in MIZOPEX Appendix A and shown in Figures 1 and 2. The shapefiles defining the ASAMM survey strata have been given to MIZOPEX, and are shown in Figure 2. MIZOPEX UAS operations will be limited to the restricted area (R-2204), the transit corridor, and directly to the 72D block (72N 151W, 72N 149W, 70.80 149W, 70.92N 151W) until both parties agree to an ASAMM-MIZOPEX operations protocol for airspace beyond these areas. MIZOPEX will give ASAMM access to the 72D block approximately once a week, as needed by ASAMM, until a final agreement on the protocol is made.
   a. MIZOPEX will provide ASAMM with a copy of the final Certificate of Authorization from the FAA as soon as it is available.

6) ASAMM and MIZOPEX will exchange detailed contact information, including the following:
   a. ASAMM aircraft satellite phone numbers.
   b. ASAMM alternate phone numbers, listed hierarchically according to the order in which attempts should be made to establish positive verbal communication. This will include the landlines/cell phones and email addresses.
   c. MIZOPEX satellite phone number(s).
   d. MIZOPEX alternate phone numbers (landlines/cell phones), listed hierarchically.
   e. MIZOPEX email addresses.
   f. Changes to any contact information will be circulated immediately to both teams.

7) ASAMM will provide MIZOPEX with the tail numbers of the ASAMM aircraft and an account on Spidertracks so that MIZOPEX can follow ASAMM aircraft in real time for purposes of deconflicting airspace. The Bureau of Land Management is under contract to provide the official real-time flight following for ASAMM. NASA will be responsible for ensuring separation of the UAS from the manned aircraft.

8) No later than 2200 hrs (AKDT) each evening before either team plans to conduct operations:
   a. ASAMM will send MIZOPEX an email that indicates ASAMM's top priority blocks to survey during the following day. ASAMM has priority for those blocks on the following day. If MIZOPEX has selected a focal area, ASAMM will avoid this area to the extent feasible. If MIZOPEX and ASAMM agree to conduct operations simultaneously in the same block(s), the UAS and manned aircraft shall maintain a minimum of 500' separation, with the UAS at the lower altitude.
   b. MIZOPEX will email (preferably) or deliver a hard copy of a detailed operation plan to ASAMM that includes the location of the blocks in which planned operations will occur, flight altitude, take-off time and flight duration of the planned flight for the next day.

9) Every morning before operations:
   a. ASAMM will email MIZOPEX by 0830 hrs AKDT every day with the ASAMM plan for the day. This email will include one of the following: the ASAMM operation plan for the day, including the tail number of the survey aircraft, intended survey block(s) (as defined in MIZOPEX Appendix A), flight altitude, take-off time, and flight duration; notification that ASAMM will be on stand-by until weather improves; notification that ASAMM will not be flying at all that day.
   b. If ASAMM is initially on stand-by and the opportunity for a survey flight arises later in the day, ASAMM will contact MIZOPEX by email and telephone (at the MIZOPEX sat phone or alternate phone numbers) to relay the revised flight plan. ASAMM will not initiate a flight without obtaining positive concurrence via email or verbal communication with MIZOPEX.
   c. If ASAMM is flying, ASAMM will not initiate a revised flight plan without obtaining positive concurrence via verbal communication with MIZOPEX.
   d. If MIZOPEX changes their flight plan prior to 0800 hrs AKDT on the day of the flight, MIZOPEX will contact ASAMM by email with the revised flight plan.
   e. If MIZOPEX changes their flight plan after 0800 hrs AKDT on the day of the flight,

MIZOPEX will contact ASAMM by email, telephone (to the ASAMM aircraft sat phone or alternate cell phone numbers), or hard copy to relay the revised flight plan. MIZOPEX will not initiate the revised flight plan without obtaining positive concurrence via verbal communication with ASAMM.

10) Before each UAS flight, MIZOPEX will provide ASAMM with the current altimeter settings.

11) Lost link procedures:
    a. In the event of a lost link resulting in a transit to the initial point (IP), the MIZOPEX UAS shall be programmed to decrease altitude to ≤ 500' AGL to avoid flying at an altitude flown by ASAMM. Upon arrival at the IP, the UAS will climb up to 2000' to reacquire a control link.
        i. IP is defined as the UAS loiter location in international airspace, 1 nm north of the transit corridor.

    b. If the ASAMM aircraft is in the air and there is a lost link scenario resulting in a transit to the IP:
        i. MIZOPEX will immediately try to contact the ASAMM aircraft by sat phone or radio (Channel 121.5) to make them aware of the situation and provide information on the last known position and altitude of the UAS transiting to the corridor. If the transition to the IP is deemed a risk, ASAMM will climb to a minimum of 500' above the UAS's profile and either:
            - Loiter in the survey area until the UAS regains link or lands, at which time the ASAMM survey can resume; or
            - Transit the shortest distance to land, avoiding the region of the Oliktok restricted airspace, to return to base (Deadhorse or Barrow).
        ii. If MIZOPEX cannot contact the ASAMM aircraft, MIZOPEX will contact ASAMM personnel on the ground at an alternate phone number according to the ASAMM hierarchy to inform them of the situation. ASAMM personnel on the ground will contact the DOI/BLM flight followers for help in communicating with the ASAMM aircraft.
    c. If MIZOPEX cannot contact the ASAMM aircraft or ASAMM personnel on the ground, MIZOPEX will contact the DOI/BLM flight followers directly and request assistance in communicating with the ASAMM aircraft.

12) Prior to the first MIZOPEX flight during which ASAMM is in the study area, MIZOPEX and ASAMM will conduct a practice exercise following the established operations protocol. This practice exercise will be conducted by the field teams and other personnel identified in the project hierarchies. The goal of this practice exercise is to test the communication technology and protocol in the event that a change of flight plan or lost link occurs.

13) Portions of these protocols may be delegated to team members. If there is a disagreement between team members about an issue, Megan Ferguson (ASAMM) and Jim Maslanik (MIZOPEX) have the lead for resolving the disagreement.

14) This protocol may be changed at any time by mutual agreement between Megan Ferguson (ASAMM) and Jim Maslanik (MIZOPEX). Updated protocols will be circulated to each field team. It is acknowledged that OMAO might not be asked to review changes made to this protocol after it has been finalized; without the opportunity to review changes, OMAO cannot provide an opinion about the likely effects to the safety of operations that the changes could create.

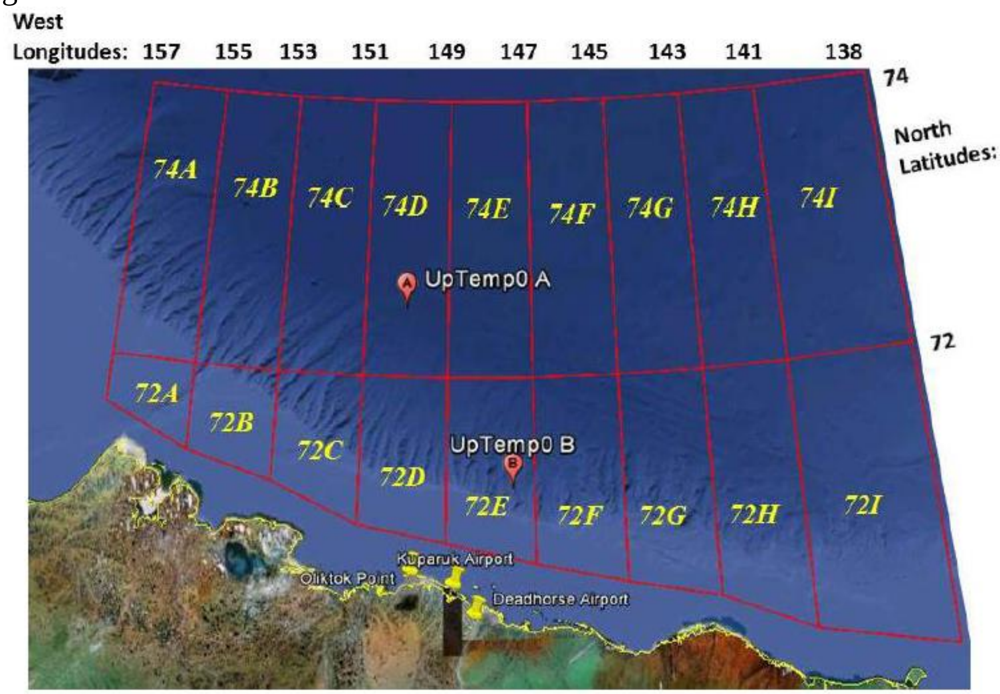

Figure 1. MIZOPEX operational blocks.

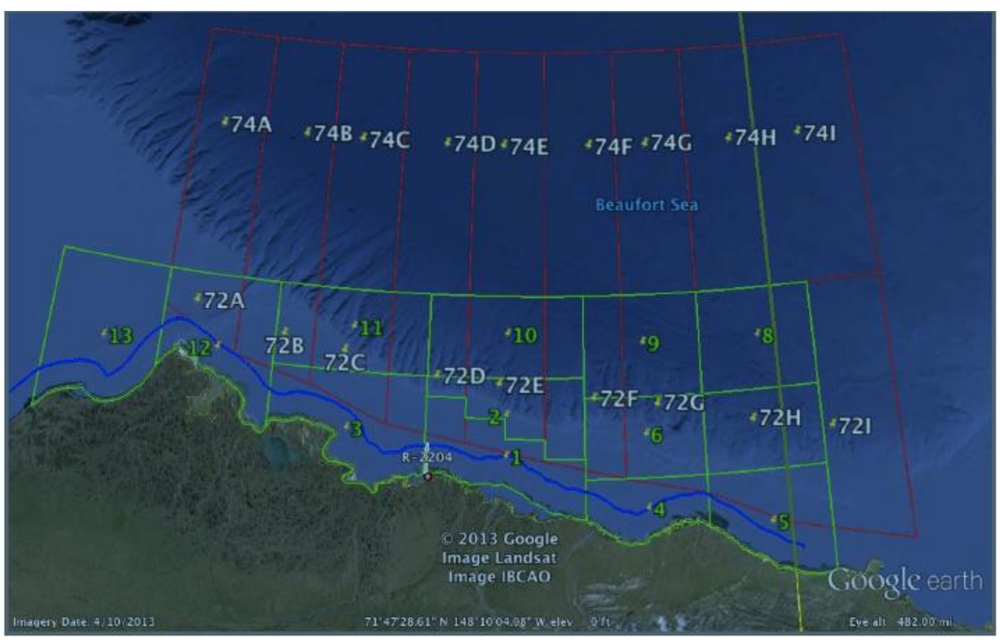

Figure 2. MIZOPEX operational blocks (red) and ASAMM survey strata (green).

MIZOPEX Appendix A: List of Latitude and Longitude Positions
for the MIZOPEX Operational Area

Initial Point (IP):
70.78N 149.935W

General Area:
69.77N 138W, 71.70N 157W, 74.00N 157W, 74.00N 138W

Operational Blocks:
72A: 71.70N 157W, 71.37N 155W, 72N 155W, 72N 157W
72B: 71.20N 153W, 71.37N 155W, 72N 155W, 72N 153W
72C: 71.20N 153W, 70.92N 151W, 72N 151W, 72N 153W
72D: 70.80N 149W, 70.92N 151W, 72N 151W, 72N 149W
72E: 70.80N 149W, 70.65N 147W, 72N 147W, 72N 149W
72F: 70.50N 145W, 70.65N 147W, 72N 147W, 72N 145W
72G: 70.50N 145W, 70.35N 143W, 72N 143W, 72N 145W
72H: 70.04N 141W, 70.35N 143W, 72N 143W, 72N 141W
72I: 70.04N 141W, 69.77N 138W, 72N 138W, 72N 141W
74A: 74.00N 157W, 74.00N 155W, 72N 155W, 72N 157W
74B: 74.00N 153W, 74.00N 155W, 72N 155W, 72N 153W
74C: 74.00N 153W, 74.00N 151W, 72N 151W, 72N 153W
74D: 74.00N 149W, 74.00N 151W, 72N 151W, 72N 149W
74E: 74.00N 149W, 74.00N 147W, 72N 147W, 72N 149W
74F: 74.00N 145W, 74.00N 147W, 72N 147W, 72N 145W
74G: 74.00N 145W, 74.00N 143W, 72N 143W, 72N 145W
74H: 74.00N 141W, 74.00N 143W, 72N 143W, 72N 141W
74I: 74.00N 141W, 74.00N 138W, 72N 138W, 72N 141W

The Department of the Interior Mission

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

The Bureau of Ocean Energy Management

As a bureau of the Department of the Interior, the Bureau of Ocean Energy (BOEM) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS) in an environmentally sound and safe manner.

The BOEM Environmental Studies Program

The mission of the Environmental Studies Program (ESP) is to provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments.