December 3, 2013

Mr. Tommy P. Beaudreau, Director
Bureau of Ocean Energy Management Headquarters
1849 C Street, NW
Washington, D.C. 20240

Submitted online via: http://www.regulations.gov, docket # BOEM–2013–0015.

Re: Call for Information and Nominations, Proposed Chukchi Sea Lease Sale 237

Dear Director Beaudreau:

National Audubon Society, Oceana, Ocean Conservancy, Pew Charitable Trusts, and World Wildlife Fund (WWF) appreciate the opportunity to comment on the Bureau of Ocean Energy Management's (BOEM) call for information and nominations for proposed Chukchi Sea lease sale 237 ("call for information").

While we recommend against proceeding with the lease sale at this time, our comments focus on providing BOEM with information and analysis necessary to follow through with a reasonable approach to targeted leasing separate and apart from the valid reasons not to hold the lease sale. Our recommendations also serve to assist BOEM in implementing the principles of Integrated Arctic Management (IAM). Specifically, we recommend the exclusion of four areas from the proposed Chukchi Sea lease sale. Based on existing scientific data, these areas are known with a high degree of confidence to be critical to maintaining ecosystem health. The recommended exclusions are:

- An expansion of the current Chukchi coastal exclusion (Chukchi Corridor);
- An expansion of the current Barrow Canyon exclusion (Barrow Canyon);
- The Hanna Shoal Region; and
- Herald Shoal.

Our comments begin with an overview of recommendations concerning proposed Chukchi Sea lease sale 237. Following the overview, we briefly explain our data collection and mapping methods, summarize information related to the four proposed exclusion areas, assess the implications of these exclusions on the National Energy Policy, and highlight considerations regarding later stages of the lease sale process.

Detailed supporting information is provided in two appendices: Appendix A contains maps that identify the proposed exclusion areas and graphically depict the ecosystem values that we used to define those areas. The appendix also includes a list of the references cited on each of the maps. Appendix B provides detailed information on the scientific research used to map ecosystem values that support exclusion of the four proposed areas.

1. Overview

1.1 The Five-Year Program and Proposed Lease Sale 237

BOEM's Outer Continental Shelf (OCS) Oil and Gas Leasing Program for 2012–2017 ("five-year program") recognized the need to take a different approach to oil and gas lease sales in America's Arctic Ocean (Bureau of Ocean Energy Management 2012). For the first time, BOEM acknowledged that areawide leasing was not appropriate in remote Arctic waters, where there are substantial concerns related to food security, ecological values, and the region's difficult environmental conditions. The five-year program called for a "targeted approach" to leasing in the Arctic, in which BOEM will weigh industry interest, oil and gas resource potential, subsistence values, and wildlife and ecological concerns to determine if leasing should take place, and if so, which areas should be open for leasing. In an initial implementation of this approach, the five-year program identified a new exclusion area outside of the city of Barrow, Alaska. Our organizations appreciate these improvements to the five-year program. The commitment to targeted leasing and adoption of a new Barrow exclusion area were key steps in the right direction.

Although our organizations applaud the five-year program's new approach to Arctic leasing, we recommend against moving forward with proposed Chukchi Sea lease sale 237 at this time. Since the last oil and gas lease sale in the Chukchi Sea, the 2010 Deepwater Horizon oil disaster in the Gulf of Mexico offered a stark reminder that offshore drilling can have serious consequences for fish and wildlife, marine and coastal environments, and residents of affected coastal communities. Two years after the Deepwater Horizon disaster, Shell experienced a host of well-publicized setbacks when it attempted to drill exploratory wells in the Arctic Ocean.

Both the Deepwater Horizon disaster and Shell's error-plagued 2012 drilling season prompted government regulators to acknowledge that existing safeguards are not sufficient to ensure safe oil and gas operations in Arctic waters. BOEM identified significant shortcomings in Shell's Arctic drilling effort and imposed new requirements (U.S. Department of the Interior 2013), BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) recognized the need for new region-specific rules to govern drilling offshore of Alaska, and the U.S. Coast Guard launched an investigation into the grounding of Shell's drillship *Kulluk* that could lead to additional regulatory or policy changes. BOEM should not proceed with a new oil and gas lease sale in the Chukchi Sea until it can ensure that operations can be conducted safely.

1.2 Implementing Targeted Leasing Through the Exclusion of Additional Areas

If BOEM does continue with the Chukchi Sea lease sale 237, it should use the first phase of the lease sale evaluation process as an opportunity to implement the targeted approach to Arctic leasing described in the 2012–2017 five-year program. In the five-year program, BOEM committed "to use incoming scientific information and stakeholder feedback to proactively determine, in advance of any potential sale, which specific areas offer the greatest resource potential while minimizing potential conflicts with environmental and subsistence considerations" (Bureau of Ocean Energy Management 2012). Under this targeted approach to leasing, BOEM should identify and exclude from further consideration areas that are especially important for Arctic wildlife and subsistence users.

Exclusion of important areas is consistent with key principles of IAM, as outlined in the April 2013 report "Managing for the Future in a Rapidly Changing Arctic: A Report to the President" (Clement et al. 2013) and incorporated in the President's May 2013 "National Strategy for the Arctic Region" (Obama 2013). Under the principles of IAM, BOEM should focus on "science-based decision-making focused on ensuring sustainable ecosystems" (Clement et al. 2013). Among other things, this means that BOEM should

> identify[ ] and protect[ ] areas of significant ecological or cultural importance and/or sensitivity, along with the variables that define them; us[e] the best available science to understand ecological processes, to identify and measure indicators of change, and to make policy and management decisions; [use] and integrat[e] traditional knowledge into decision-making; . . . and us[e] precaution in decision-making, especially where the health, productivity, and resilience of ecosystems may be compromised. (Clement et al. 2013).

To help BOEM fulfill those objectives, we collected, synthesized, and analyzed the best available scientific research and spatial data for the Chukchi Sea, using mapping to examine patterns of use and overlap of high-value habitats, including information on migration routes, subsistence use areas, seafloor habitats, ice concentration areas, breeding areas, foraging areas, and places with high primary productivity. Based on this information, we recommend excluding the following four areas from the proposed lease sale: an expansion of the current Chukchi coastal exclusion (hereinafter "Chukchi Corridor"), an expansion of the current Barrow Canyon exclusion (hereinafter "Barrow Canyon"), the Hanna Shoal Region, and Herald Shoal.

Our comments focus on providing information in support of these four exclusion areas, which are known based on existing data to have significant ecological or cultural importance. Excluding these areas is a necessary step toward realizing BOEM's Arctic Ocean management objectives; however, the agency should also take account of data gaps that prevent identification of other potentially important areas and the potential for cross-boundary effects from disturbances such as oil spills when designating exclusion areas. We note that the far northern portions of the Chukchi Sea Program Area (generally north of 72 degrees) pose additional risks and challenges. Compared to more southern portions of the Program Area, the far northern portions are even more remote, remain ice covered during a significantly greater portion of the year, and have less available scientific information available for decision making. BOEM should consider these challenges carefully before determining whether it is appropriate to make the far-northern portions of the Program Area available for leasing at this time.

We also note that impacts of activities outside exclusion areas, including the expected trajectory of spilled oil, are highly relevant to the selection of possible leasing tracts. Every effort should be made to avoid offering tracts where there is a significant risk of spilled oil moving into sensitive areas. A recent BOEM-funded report provides an "unprecedented view of the circulation and dynamics of the northeast Chukchi shelf" (Weingartner et al. 2013b). The report authors find, among other things, that the shelf circulation includes an eastward flow toward Barrow Canyon and that "(a)bout 15% of the time the onshore flow diverges with one branch flowing down canyon and the other turning southwest toward Point Lay." (Weingartner et al. 2013b). As described below, Barrow Canyon is a sensitive area, as is Kasegaluk Lagoon, where Point Lay is located. The subject of the marine transport of oil is complicated and highly technical, and we encourage BOEM to work with appropriate experts to interpret and apply the findings by Weingartner et al. to this issue, and to use the resulting projections to inform tract selections.

The sections that follow focus on the four proposed exclusion areas described above: the Chukchi Corridor, Barrow Canyon, the Hanna Shoal Region, and Herald Shoal. Section 2 briefly describes our approach to data collection and mapping methods, while Section 3 summarizes the distinguishing ecological features of the proposed exclusion areas. In Appendices A and B we provide maps and a summary of the scientific research and spatial data underlying our exclusion recommendations.

2. Data Collection and Mapping Methods

We are committed to using the best available information to inform decision making. To that end, we updated the maps that we submitted for consideration during the 2012–2017 planning process with new information and analysis (see maps in Appendix A). There are limitations on the quality and quantity of data available to describe the Arctic marine ecosystem (Holland-Bartels 2011; Smith 2010). Our maps draw on an extensive literature and data review of the current knowledge of the scientific community. Here, we highlight areas known to be ecologically important. Omission from our maps does not necessarily indicate that an area is unimportant, but may mean that adequate research has not yet been conducted (e.g. north of 72 degrees). Sources include tagging data, aerial surveys, published studies, scientifically documented local and traditional knowledge, or personal communications with experts. In seeking updated information and performing new analysis, we sought to identify areas that are important for maintaining habitat heterogeneity or the viability of a species, or contribute disproportionately to an ecosystem's health, including its productivity, biodiversity, function, structure, or resilience.

Our work is based on the extensive data collected in the Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas (Smith 2010) and the forthcoming atlas of Important Ecological Areas of the Beaufort and Chukchi Seas (Oceana 2013). In response to the call for information, we reviewed these data, adding more scientific papers and agency reports to our library of over 800 Artic marine references. Based on these references, we collected additional spatial information and further refined spatial boundaries based on the best available data and studies. Our maps are based primarily on western science but also include a significant number of studies documenting local and traditional knowledge. Inclusion of traditional knowledge and advice from local communities, governments, tribes and co-management organizations is a priority.

We strived to make our work as transparent as possible. On our maps, we separated known concentration areas from the extent of the known range of species to indicate relative importance. Map features are described in the legend and footnoted reflecting the abbreviated citation for the reference that established the data. We linked directly to primary literature where possible, then to white or gray literature. In some cases the spatial boundary of a concentration area was not presented in the literature, but textual descriptions documented an area as important. In such cases there was information that is known to be accurate (e.g. bowhead whales migrate north along the Chukchi coast) but is not spatially precise (e.g. no exact boundary lines determined). As necessary and as adequate information was available to interpret spatial boundaries, our science team drew boundary lines representing those studies. Those cases are documented on our maps as "based on" a list of multiple sources, rather than being taken directly from a map presented in such sources.

For maps composed of a complicated set of data, we provided a second map that spatially documents the references for concentration areas. In this way, the reader can see not only what set of references a concentration area is from, but which specific portions of that concentration area are from which specific sources. For more detailed information on the scientific and other sources used in our maps and analysis, please consult Appendix B.

Having briefly described our approach to data collection and mapping methods, the section that follows summarizes the four recommended exclusion areas and their distinguishing ecological features.

3. Summary of Recommended Exclusion Areas

People and wildlife rely on the Chukchi Sea for food and other important resources. Although all portions of the program area are home to multiple species of marine mammals, birds, fish, and other marine organisms, some areas clearly stand out as Important Ecological Areas (IEAs). IEAs are geographically delineated areas which by themselves or in a network have distinguishing ecological characteristics, are important for maintaining habitat heterogeneity or the viability of a species, or contribute disproportionately to an ecosystem's health, including its productivity, biodiversity, function, structure, or resilience. IEAs include places like migration routes, subsistence areas, sensitive seafloor habitats, breeding and spawning areas, foraging areas, and areas of high primary productivity (Ayers et al. 2010). In regard to climate change, the areas presented here are ecologically important largely due to persistent physical features. Because these areas are highly important now and because climate is changing the seascape rapidly, we suggest that these areas are likely to increase in importance to people and wildlife over time.

The outer boundary of each exclusion area was drawn using the most accurate and precise spatial data layers available to us, as described on the map in Appendix A. Each area is supported with data on wildlife concentration areas, key habitats, and subsistence hunting areas as described in this section and in Appendix B. The following sub-sections summarize the key ecological features of the four recommended exclusion areas.

3.1 The Chukchi Corridor Recommended Exclusion Area

The Chukchi Corridor, approximately 50 miles in width, follows the Chukchi Sea coast from Point Hope to Wainwright and offshore of Barrow. Within this corridor, there is significant wildlife activity, including one of the largest marine mammal migrations in the world. From winter through early summer, the area is covered in sea ice with recurring open leads and polynyas (Eicken et al. 2005) that allow wildlife to migrate north from the Bering Sea to areas of the Chukchi or Beaufort seas during spring and early summer. Birds follow the Chukchi Corridor to northern waters and inland to the North Slope. The entire Chukchi Sea coastline is an IEA that serves as an essential corridor for bowhead whales, Pacific walrus, ice seals, waterfowl, gulls, and seabirds, as well as for indigenous subsistence hunters (Oceana 2013).

Aside from its importance during migration, the Chukchi Corridor is an important place for resident animals. Breeding and feeding polar bears frequent the area (Kalxdorff 1997) because of the availability of denning habitat and high concentration of ice seals (NOAA 1988), particularly ringed seals (Frost et al. 2004; Kelly et al. 2010; Stirling 2002). Pacific walrus use this zone, particularly after the sea ice retreat in late summer. Walrus make trips to and from Hanna Shoal, hauling out on the coast off Icy Cape, and then forage on benthic organisms until they migrate south along the Chukchi coast (Jay et al. 2012). There are multiple globally significant Important Bird Areas (IBAs) located along this system used by nesting, foraging, and staging birds (Smith et al. 2012; Smith et al. in review).

The Chukchi Corridor recommended exclusion area would help protect the following values:

- **Subsistence hunting areas for the communities of Point Hope, Point Lay, Wainwright, and Barrow.** Studies conducted on behalf of BOEM and other organizations show that residents of Alaska Native villages rely extensively on areas in the Chukchi Corridor for hunting during the year (Braund 1993; Braund and Burnham 1984; Kassam and Wainwright Traditional Council 2001; Nelson c1982; Pedersen 1979a, b; Stephen R. Braund and Associates 2010). A large portion of the corridor is a designated Alaska Eskimo whaling community quiet area as well as hunting and search area (Alaska Eskimo Whaling Commission et al. 2003).

- **A major migration passageway for marine mammal species in the U.S. Arctic Ocean.** Open leads and recurring polynyas between the landfast ice and offshore pack ice are critical passageways for Arctic wildlife that migrate north in spring and south in fall (Stirling 1997). Most marine mammals that live in the Chukchi and Beaufort seas in summer spend the winter south of the Bering Strait (with the exception of polar bears and some seals). In spring, they disperse northward through the Strait into the Chukchi Sea and beyond (Smith 2010). A majority of individuals of all species of marine mammals move north in spring as the ice begins to thin and break apart, navigating the Chukchi lead system during this time period. The Chukchi Corridor is especially important for endangered migrating bowhead whales. Almost the entire population of bowhead whales travels along the Chukchi Sea coast out to approximately 60 miles from shore during spring months, from April through June (Quakenbush et al. 2013).
- **A major migration passageway for birds nesting on the North Slope in summer.** Many bird species that migrate to the North Slope for summer breeding travel past Point Hope, through the Chukchi Corridor, then around Point Barrow (or travel the route in reverse in the fall). This spring and fall migration and staging corridor is likely used by the entire breeding population of king eiders in Western North America (Oppel et al. 2009), which are an Audubon WatchList species due to depressed population numbers (Kirchhoff 2010). Kasegaluk Lagoon and Ledyard Bay host post-breeding staging and migration concentrations of threatened Steller's eiders (Martin et al. 2009). It is a migration area for as much as half of the Pacific brant population, which visits Kasegaluk Lagoon during fall migration (Johnson et al. 1993). Yellow-billed and red-throated loons migrate to and from wintering grounds in Russia through this corridor between May and October (Schmutz 2012). A variety of shorebirds stop over along the Chukchi coast and barrier islands in concentrated groups (Taylor et al. 2010), including tens of thousands of dunlin and red phalarope in spring, summer, and autumn (Alaska Shorebird Group 2008). Home to 19 shorebird species during fall migration and an important area for molting waterfowl, Kasegaluk Lagoon is a potential Western Hemisphere Shorebird Reserve Network (WHSRN) site (Alaska Shorebird Group 2008).
- **Critical habitat for threatened spectacled eiders.** In 2001, the U.S. Fish and Wildlife Service designated Ledyard Bay as critical habitat for spectacled eiders (Federal Register 2001). This is the principal molting and staging area for more than 10,000 females nesting on the North Slope (Petersen et al. 1999).
- **A network of globally significant Important Bird Areas (IBAs)** (Smith et al. 2012; Smith et al. in review). Chukchi nearshore waters host several IBAs. Lisburne Peninsula Marine IBA is a feeding hotspot for black-legged kittiwakes nesting on the peninsula's cliffs, as well as common and thick-billed murres that forage both in the IBA and also much farther out, over 100 miles offshore (Hatch et al. 2000). Icy Cape Marine IBA was established for significant numbers of foraging glaucous gulls and pomerine jaegers. Delineated using the most recent satellite telemetry data, Ledyard Bay IBA was designated for concentrations of spectacled eiders (Sexson et al. 2012), black-legged kittiwakes, and common murres.

Kasegaluk Lagoon IBA has a significant breeding population of Pacific brant and the highest diversity and abundance of birds of any lagoon system in Arctic Alaska (Johnson et al. 1993). Point Lay Marine IBA is home to more than 10,000 long-tailed ducks in summer. The Chukchi Sea Nearshore IBA hosts as much as 15% of the global population of glaucous gulls and 2% of the population of Sabine's gulls.

- **Nesting colonies that support one quarter million breeding birds** (World Seabird Union 2011). From Point Hope to Point Barrow there are 31 known nesting colonies along the coast from Point Hope to Point Barrow. The cliffs of the Lisburne Peninsula host approximately 245,000 seabirds, primarily thick-billed and common murres, black-legged kittiwakes, and horned puffins. Kasegaluk Lagoon is home to 1700 nesting birds—mostly common eiders, glaucous gulls, and Arctic terns. These birds forage in the offshore waters of the Chukchi Sea. Murres and kittiwakes forage over 100 miles offshore (Hatch et al. 2000; Smith et al. 2012).
- **Important habitat for foraging, transiting, and hauled-out walrus** (Huntington et al. 2012; Jay et al. 2012; Robards et al. 2007). Walrus move through the Chukchi Corridor when transiting between offshore and coastal haulout areas—an intensifying pattern due to loss of sea ice, which places greater importance on movement corridors and new concentration areas. These animals are increasing their use of nearshore foraging areas when ice cover is sparse (Jay et al. 2012). In recent years, walrus haulouts at Icy Cape and Point Lay have increased substantially, from what used to be a few individuals (Robards et al. 2007) to as many as 30,000 in 2011 (NOAA Fisheries 2013). This trend that will likely continue as late summer sea ice recedes earlier and further north due to climate warming (Clarke et al. 2012; Clarke et al. 2013; Jay et al. 2012; NOAA Fisheries 2013). When hauled out, walruses are sensitive to human disturbance, including aircraft or boat traffic (Garlich-Miller et al. 2011).
- **A significant concentration of molting and calving beluga whales** (Frost et al. 1993; Huntington et al. 1999; NOAA Office of Response and Restoration 2005; Suydam and Alaska Department of Fish and Game 2004). Kasegaluk Lagoon and the Kuk River estuary "are important seasonal summer habitats of beluga whales" (Bureau of Land Management 2003) as thousands of whales use the shallow lagoon as a molting area from mid-June to late July (Frost et al. 1993; NOAA Office of Response and Restoration 2005). Belugas are sensitive to human disturbance; airborne and waterborne noise may influence their distribution (Frost and Lowry 1990) and drive them from important habitats.
- **Critical sea ice habitat and known feeding and low-density denning areas for polar bears.** This is a prominent polar bear feeding area where the bears hunt seals along the coast, landfast ice, edges of open leads, and at seal breathing holes in the pack ice during all seasons of the year (Kalxdorff 1997). It is a coastal and sea ice denning area for expecting female polar bears in winter (Kalxdorff 1997; NOAA 1988; USFWS 1995, 2010), however the number of maternal dens on the Chukchi coast has decreased due to reduced connectivity with sea-ice during late fall (Fischbach et al. 2007; USFWS 2010).
- **Ice seal concentration areas.** Spotted seals haul out at multiple locations along the Chukchi coast (Alaska Department of Fish and Game Habitat and Restoration Division

2001; Frost et al. 1993; Lowry et al. 1998; NOAA Office of Response and Restoration 2005). Of 14 known spotted seal haulouts in Western Alaska and Eastern Russia, 4 located at Kasegaluk Lagoon (Lowry et al. 1998). Counts of over 1000 spotted seals have been recorded at Kasegaluk Lagoon haulouts repeatedly from mid-July through early September (Frost et al. 1993). Spotted seals are considered the most wary of seals, exhibiting high sensitivity to aircraft within 1.25 miles, and to human disturbances at their haulouts (Frost et al. 1993; Johnson et al. 1992; Quakenbush 1988). Bearded and ringed seals concentrate in the Chukchi Corridor in spring (Bengtson et al. 2005; NOAA 1988).

- **Three Most Environmentally Sensitive Areas (MESAs) identified by Alaska Department of Fish and Game.** The MESA program for oil spill contingency planning along the coast of Alaska (Alaska Department of Fish and Game Habitat and Restoration Division 2001) identified Kasegaluk Lagoon as important based on nearshore migration and rearing habitat for anadromous fish; waterfowl spring and fall staging, molting, and nesting; seabird colonies; spotted seal haulouts; ringed seal breeding and pupping; and regular occurrence of beluga whales nearshore. Cape Lisburne was identified based on seabird colonies, walrus haulouts, ringed seal breeding and pupping, and then-confirmed coastal polar bear denning. Cape Thompson was identified for seabird colonies and ringed seal breeding and pupping. Cape Lisburne and Cape Thompson are part of the Alaska Maritime Wildlife Refuge.
- **Gray whale feeding hotspots.** From wintering areas in the waters of northern Mexico, gray whales make the longest known migration of any mammal on earth to feed in the Chukchi and Bering seas in summer. These whales concentrate in an area of known high seafloor biomass (Grebmeier et al. 2006) from about 50 miles offshore of Wainwright tapering toward Barrow, sometimes as far out as the Hanna Shoal Region (Clarke et al. 2013; Clarke and Ferguson 2010; Moore et al. 2000).
- **Important Fish Habitat.** Saffron and Arctic cod are critical to the Arctic marine food web (NPFMC 2009). The National Marine Fisheries Service designated areas along the entire Chukchi coast out to 15-30 miles offshore as Essential Fish Habitat (EFH) for saffron cod. They are concentrated "in pelagic and epipelagic waters along the coastline, within nearshore bays, and under ice along the inner (0 to 50 m) shelf throughout Arctic waters and wherever there are substrates consisting of sand and gravel" (NMFS 2005). The whole of the U.S. continental shelf to 500 m depth was designated EFH for Arctic cod. Capelin, an important food source for seabirds, other fishes, and marine mammals (Rose 2005), spawn in sand and gravel in tidal areas (NPFMC 2009) along the Chukchi coast (NOAA 1988), coincident with areas designated for saffron and Arctic cod.
- **Ecosystem-level hotspots.** An integrated analysis of concentration areas for wildlife, hunting areas for local people, benthic and pelagic productivity, and sea ice habitat highlighted the Chukchi Corridor as having very high importance values based on multiple criteria (Ayers et al. 2010; Oceana 2013).
- **Ecosystem resilience and climate change refugia.** The Chukchi Corridor is likely to provide ecosystem resilience (Christie and Sommerkorn 2012; Gunderson 2000) to climate

> change due to the unique combination of environmental drivers (e.g. seasonal sea-ice dynamics and regional currents) that is responsible for the exceptional local diversity of species. Although the extent and timing of occurrence varies between years, regional circulation patterns and seasonal sea-ice dynamics that drive lead and polynya emergence in the Chukchi Corridor provide consistent sea ice habitat and migratory corridors (Martin et al. 2004; Weingartner et al. 2013a; Weingartner et al. 2005). This consistency during a time of rapid environmental change indicates that the polynya and lead system that distinguishes the Chukchi Corridor as a key feature is likely to persist in the future, thereby remaining a priority for conservation over the long term.

Currently, the first 25 miles of the Chukchi Corridor, from the coast seaward, are excluded from the Program Area. However, we recommend an expansion out to 50 miles. Persistent leads and polynyas have repeatedly been documented out to more than 60 miles from the Chukchi coastline (Eicken et al. 2006; Martin et al. 2004), and in some years extend as far as 90 miles (Martin et al. 2004). Because the location of leads and polynyas in a given year determines the location and spatial extent of this important wildlife habitat, we recommend an additional exclusion to cover the remainder of the Chukchi Corridor.

A review of the maps in Appendix A highlights habitats of concern specific to the expansion zone, with some specifics summarized here. Offshore of Point Hope are medium to high values for primary productivity and seafloor biomass; this area is a seabird foraging hotspot for as many as a quarter million seabirds nesting on the Lisburne Peninsula. Offshore of Ledyard Bay is a concentration area for beluga whales, bowhead whales, bearded seals, walrus, and a globally significant IBA inside of spectacled eider designated critical habitat. Offshore from Point Lay to Wainwright are medium to high values for primary productivity and seafloor biomass; a high concentration area for transiting and foraging walrus; a globally significant IBA and seabird foraging area; a concentration area for beluga whales, bowhead whales, and bearded seals; and a subsistence hunting area. In the remaining offshore area between Barrow Canyon and Hanna Shoal are medium to high values for primary productivity and seafloor biomass, a fall migration corridor for bowhead whales, a high concentration area for transiting and foraging walrus, and a subsistence hunting area. The corridor expansion is further supported by maps showing location and group size of marine mammals and birds on transects surveyed over 30 years.

3.2 The Barrow Canyon Recommended Exclusion Area

Barrow Canyon straddles the boundary between the Beaufort and Chukchi seas. Complex water mass mixing, upwelling, and sea ice dynamics make the waters around Point Barrow and Barrow Canyon very productive compared to other nearby areas and the nutrient-poor Canada Basin (Mathis et al. 2007). This submarine canyon runs along the Chukchi Sea coast, approximately 5 to 15 miles offshore from Point Franklin to Point Barrow, then cuts through the shelf break into the Canada Basin. It is 150 miles long, about 15 miles wide, and reaches depths that are about 1200 feet below the surrounding cliffs and peaks. The Alaska Coastal Current follows the Chukchi Sea coast through Barrow Canyon into the 4000-meter deep Canada Basin; part of the water mass flows east around Point Barrow eventually dispersing into the Beaufort Gyre (University of Alaska Fairbanks Institute of Marine Science 2009). Occasionally, warmer water originating in the Atlantic flows the other direction (southwestward) through the canyon (Garrison and Becker 1976), making this a place where the Atlantic and Pacific meet.

Barrow Canyon is important habitat for Arctic marine wildlife. As wildlife move between the Chukchi and Beaufort seas, they must round Point Barrow and pass over Barrow Canyon. The area is a concentrated migration passageway for birds and marine mammals, which pass there during both spring and fall migration, following open leads in the sea ice. The area has very high levels of primary productivity (Grebmeier et al. 2006), along with a high biomass of zooplankton. *Pseudocalanus* copepods and euphausiids concentrate off Point Barrow to the shelf break (Ashjian et al. 2010), serving as a very important food source (Moore and Laidre 2006), especially in the fall (Moore et al. 2010). Nearshore areas by Point Barrow are marine feeding areas for many species of birds, including yellow-billed and red-throated loons; spectacled, Steller's, king, and common eiders; long-tailed ducks; northern fulmars; and short-tailed shearwaters (Smith 2010). Like marine mammals, these and other bird species migrate through this area twice per year when moving between the Beaufort and Chukchi seas in spring and fall.

While there are no active leases in this area, it is "downstream" of the currently leased areas (i.e. currents often flow from the lease sale areas to Barrow Canyon). It is also important for subsistence hunting and wildlife migration. BOEM should give particular attention to potential pollution impacts in this region, including impacts from oil spills. The Barrow Canyon recommended exclusion area would help protect the following values:

- **Subsistence hunting areas for the communities of Barrow and Wainwright.** Studies conducted on behalf of BOEM and other organizations show that Alaska Native villages rely extensively on areas influenced by the high levels of productivity at Barrow Canyon for hunting during the year (Braund and Burnham 1984; Kassam and Wainwright Traditional Council 2001; Nelson c1982; Pedersen 1979b; Stephen R. Braund and Associates 2010; Stephen R. Braund and Associates and Institute of Social and Economic Research 1993a, b). Barrow Canyon also includes a designated Alaska Eskimo whaling community quiet area as well as hunting and search area (Alaska Eskimo Whaling Commission et al. 2003).
- **A major migration passageway for marine mammal species in the U.S. Arctic Ocean.** Marine mammals such as whales and ice seals that live in the Beaufort Sea in summer migrate across Barrow Canyon in spring and fall. For example, bowhead whales migrate northeast up the Chukchi coast past Point Barrow in April and May before heading farther offshore on their way to the Canadian Beaufort Sea for summer feeding. In the fall, they follow the Alaskan Beaufort Sea coast back west across Barrow Canyon in late August through early November (Alaska Department of Fish and Game 2010). Much like bowhead whales, beluga whales migrate through this area twice per year during spring and fall migration (Clarke et al. 1993; Moore et al. 1993; Moore et al. 2000).

- **A major migration passageway for birds nesting on the North Slope in summer.** Many bird species that migrate to the North Slope for summer breeding migrate through the Chukchi Corridor, then around Point Barrow, or in reverse in the fall. This spring and fall migration and staging corridor is likely used by the entire breeding population of king eiders in Western North America (Oppel et al. 2009), which are an Audubon WatchList species due to depressed population numbers (Kirchhoff 2010). Barrow and Peard Bay are Steller's eiders concentration areas (Martin et al. 2009; Smith 2010), and Peard Bay hosts summer and fall concentrations of long-tailed ducks (Smith et al. 2012). Yellow-billed and red-throated loons migrate to and from wintering grounds in Russia through this corridor between May and October (Schmutz 2012). A variety of shorebirds stop over along the northeast Chukchi coast in concentrated groups (Taylor et al. 2010). At Peard Bay, upwards of 56,000 shorebirds, mostly red phalaropes, move through during the post-breeding season (Alaska Shorebird Group 2008).
- **Globally significant Important Bird Areas (IBAs)** (Smith et al. 2012; Smith et al. in review). Nearly a quarter of North America's long-tailed ducks and king eiders use the Barrow Canyon & Smith Bay IBA, as well as globally significant numbers of Arctic terns, black-legged kittiwakes, red phalaropes, and Sabine's gulls. The Chukchi Sea Nearshore IBA hosts as much as 15% and 2%, respectively, of the global population of glaucous gulls and Sabine's gulls.
- **A major concentration area for bowhead whales feeding in the spring and fall.** Previously documented as an important fall feeding area (Ashjian et al. 2010; Moore et al. 2010), a recent study of the Barrow Canyon area found that 61% of bowhead whales migrating across Barrow Canyon in spring were actively feeding, as were 99% of the whales studied in the fall (Huntington and Quakenbush 2009; Mocklin et al. 2012).
- **Gray whale feeding hotspots.** As noted above, gray whales feed in the Chukchi and Bering seas in summer, including Barrow Canyon. The whales concentrate in an area of known high seafloor biomass (Grebmeier et al. 2006) from about 50 miles offshore of Wainwright tapering toward Barrow, sometimes as far out as the Hanna Shoal Region (Clarke et al. 2013; Clarke and Ferguson 2010; Moore et al. 2000).
- **Critical sea ice habitat and known feeding and denning concentration areas for polar bears.** This is a polar bear feeding area where the bears hunt seals along the coast, landfast ice, edges of open leads, and in holes in the pack ice during all seasons of the year (Kalxdorff 1997). The whaling bone pile at Point Barrow is another important aggregation and feeding area. Barrow Canyon is an important coastal and sea ice denning area for expecting female polar bears in winter (Kalxdorff 1997; NOAA 1988; USFWS 1995, 2010) however the number of maternal dens west of Point Barrow has decreased due to reduced connectivity with sea-ice during late fall (Fischbach et al. 2007; USFWS 2010).
- **Important habitat for walrus** (Clarke et al. 2012; Clarke et al. 2013; Huntington et al. 2012; Jay et al. 2012; Robards et al. 2007). Walrus forage in Peard Bay in June and move through the bay when transiting between offshore and coastal haulout areas in summer (Jay et al. 2012). Coastal haulouts and nearby benthic foraging resources are increasingly important as

offshore sea ice melts. In recent years high numbers of walrus have been documented on aerial surveys of Peard Bay and Barrow Canyon (Clarke et al. 2012; Clarke et al. 2013). When hauled out, walruses are sensitive to human disturbance, including aircraft or boat traffic (Garlich-Miller et al. 2011).

- **Ice seal concentration areas.** Spotted seals haul out along the coast and islands near Point Franklin between July and November (Huntington et al. 2012; NOAA Office of Response and Restoration 2005). Bearded and ringed seals concentrate in the Barrow Canyon area in spring (Bengtson et al. 2005; NOAA 1988).
- **Seafloor (benthic) biomass and primary productivity hotspots.** Benthic biomass is an excellent long-term indicator of physical processes that spur pelagic productivity (Dunton et al. 2005). Barrow Canyon and Peard Bay have high primary productivity as indicated by high concentrations of water column algae compared to other portions of the program area (Grebmeier et al. 2006). The area also has high values for benthic food resources compared to other portions of the program area (Grebmeier 2012; Grebmeier et al. 2006).
- **Important Fish Habitat.** As noted above, saffron and Arctic cod are critical to the Arctic marine food web (NPFMC 2009). The National Marine Fisheries Service designated areas along the entire Chukchi coast out to 15-30 miles offshore as EFH for saffron cod, and the U.S. continental shelf to 500 meters depth as EFH for Arctic cod. Capelin spawn in sand and gravel in tidal areas (NPFMC 2009) along the Chukchi coast (NOAA 1988), coincident with areas designated for saffron and Arctic cod.
- **A Most Environmentally Sensitive Area (MESA) identified by Alaska Department of Fish and Game.** The MESA program for oil spill contingency planning along the coast of Alaska identified Peard Bay as important based on waterfowl spring and fall staging, molting, and nesting; gray whale nearshore feeding; spotted seal haulouts; ringed seal breeding and pupping; bearded seals generally associated with active ice; and confirmed coastal polar bear denning (Alaska Department of Fish and Game Habitat and Restoration Division 2001).
- **Ecosystem-level hotspots.** An integrated analysis of concentration areas for wildlife, hunting areas for local people, benthic and pelagic productivity, and sea ice habitat highlighted this area as having very high importance values based on multiple criteria (Ayers et al. 2010; Oceana 2013).
- **Ecosystem resilience and climate change refugia.** A Rapid Assessment of Circum-arctic Ecosystem Resilience conducted in 2010 (Christie and Sommerkorn 2012) identified Barrow Canyon as a key feature in the Chukchi marine ecosystem. The assessment results indicate that the canyon is likely to provide ecosystem resilience (Gunderson 2000) to climate change due to the unique combination of environmental drivers (e.g. complex water mass mixing, upwelling, and sea ice dynamics) responsible for the high benthic biomass, primary productivity (Grebmeier et al. 2006), and local diversity. The topographic features in Barrow Canyon are fixed features that coincide with local circulation patterns and sea-ice dynamics to enhance local productivity and diversity, which may explain long-term high benthic biomass values documented by Grebmeier (2012). The unique combination of drivers that

distinguish Barrow Canyon as a key feature are likely to persist in future decades, thereby making it a priority for conservation over the long term.

The majority of Barrow Canyon-influenced waters are already excluded from leasing under the existing five-year program, but BOEM should exclude the remaining portions of Barrow Canyon to protect additional important resource values. A review of the maps in Appendix A highlights habitats of concern specific to the expansion zone, with some specifics summarized here: medium to high primary productivity values; fall concentration area for bowhead whales; fall migration zone for beluga whales; walrus foraging area in late summer; and perhaps most importantly, subsistence hunting areas for the community of Barrow.

3.3 The Hanna Shoal Region and Herald Shoal Recommended Exclusion Areas

During a time of rapid change, Hanna and Herald shoals appear to be important over the long-term. These shallow areas divert warm water masses flowing northward from the Bering Sea, entraining colder water long into the summer season (Weingartner et al. 2005). As a result, sea ice persists in these areas longer into the summer season as well (Martin and Drucker 1997; Spall 2007), although the duration and extent of ice retention varies between years. A pack ice feature at Herald Shoal called Post Office Point was historically an offshore meeting point known for its reliable ice all summer long. The area was given its name because ships would meet at this dependable location to exchange mail and information at sea (Aldrich 1915; Bockstoce 1986). Recent warming has changed the structure of this persistent lobe of ice. At the September sea ice minimum, Herald Shoal was ice-covered three out of ten years in the 1980s and the same in the 1990s, but not again since 1998 (National Snow and Ice Data Center 2010). In comparison, the higher-latitude Hanna Shoal Region was ice-covered in September during seven out of ten years in the 1980s; four out of ten years in the 1990s; and only once in the 2000s during the year 2001 (National Snow and Ice Data Center 2010).

Even though the shoals are no longer covered by continuous pack ice all year, they still have the most reliable ice present on the Chukchi shelf, in the form of broken ice floes. Weingartner et al. used synthetic aperture radar (SAR) to determine sea ice coverage during 2008-2010. SAR imagery for late July shows ice coverage of 30–50% over Herald Shoal in 2008 and 2010 and over Hanna Shoal in all years. August SAR imagery indicated that Hanna Shoal was ice-free in 2009 and 2010, however it was ice-covered during most of August 2008 (Weingartner et al. 2013a).

The trend toward a more northerly ice edge and earlier-receding summer ice means that the Hanna Shoal Region and Herald Shoal persistent ice floes are increasingly important for ice-associated wildlife. Although the pack ice is expected to further recede with climate change, the seafloor topography is likely to continue to divert warm waters. Hanna and Herald shoals have the potential to provide substantial lingering ice floes well into the future compared to other areas in the region (Spall 2007), and may become a last stronghold for some ice-obligate species such as Pacific walrus, polar bear, bearded seal, and ringed seal (Moore and Huntington 2008). Recent satellite-tracking data exhibits the periodic importance of the Hanna Shoal area during bowhead whale migration in the fall

(Quakenbush et al. 2010), and both shoals for walrus foraging and resting, especially during the summer (Jay et al. 2012; U.S. Geological Survey 2009-2013).

Neither the Hanna Shoal Region nor Herald Shoal is excluded from leasing under the current five-year program. The best available information indicates that these areas provide important ecosystem values deserving of protection. We recommend excluding the unleased acreage in the Hanna Shoal Region and Herald Shoal from the proposed lease sale to help protect significant resource values including:

- **Mid to late-summer lingering sea ice.** Sea ice haulout areas are necessary for walrus, polar bear, and seal species to rest between foraging/hunting trips. Maintaining the integrity of the area for walrus is of particular concern. Walrus are likely to continue relying on lingering ice and increase their use of shore-based haulouts over time (MacCracken 2012). In a worst-case scenario, walrus have a potential extinction risk due to compounding environmental stressors (MacCracken 2012), making these shoals a last stronghold on the shelf as ice continues to recede earlier each year.
- **Seafloor (benthic) biomass and primary productivity hotspots.** The Hanna Shoal Region has high levels of primary productivity (water column algae); Herald Shoal was not similarly sampled (Grebmeier et al. 2006). Both shoals have relatively high values for benthic food resources compared to other portions of the program area (Grebmeier et al. 2006).
- **High-concentration walrus summer haulout and foraging area** (Clarke et al. 2013)**.** Herald Shoal is visited by foraging and/or migrating walrus in early to mid-summer (U.S. Geological Survey 2009-2013), and is often one of the last stopover areas holding ice along the transit between Alaska waters and the Chukotka coast. Shallow water, late-summer ice for hauling out, and relatively high benthic biomass (Dunton et al. 2005; Grebmeier et al. 2006) make the Hanna Shoal Region a highly important conservation area for walrus. Recent satellite telemetry shows that walrus forage and haul out in high concentrations at Hanna Shoal from June through September (Jay et al. 2012).
- **Feeding area for gray whales, bearded seals, and marine birds.** Due to the relatively high seafloor biomass at Hanna Shoal, the area is a foraging area for benthic feeders such as bearded seal and gray whale (Aerts et al. 2011). Gray whale use has shifted toward areas more near shore in recent years (Clarke et al. 2013). However, as feeding areas in other regions change, this area could provide additional food resources for gray whales in the future (Moore et al. 2003). Several species of marine birds come here to forage, including black-legged kittiwake, black guillemot, crested auklet, glaucous gull, ivory gull, northern fulmar, pomerine jaeger, and Ross's gull (Drew and Piatt 2011).
- **Northern migration corridor for marine mammals and birds.** A major migration corridor for several species crosses the Hanna Shoal Region. Whales traveling past Barrow Canyon cross the region in autumn to access habitats in Russian waters. Bowhead whales utilize this corridor in fall when traveling in the direction of Wrangel Island before heading south to feeding areas north of the Chukotka Peninsula (Quakenbush et al. 2012; Quakenbush et al. 2010). Marine birds also migrate through this corridor, including Steller's

eiders (Martin et al. 2009), king eiders (Oppel et al. 2009), ivory gulls (Drew and Piatt 2011; Mallory et al. 2008), and Ross's gulls (Blomqvist and Elander 1981; Drew and Piatt 2011).

- **Ecosystem-level hotspots.** An integrated analysis of concentration areas for wildlife, hunting areas for local people, benthic and pelagic productivity, and sea ice habitat highlighted this area as having high importance values based on multiple criteria (Ayers et al. 2010; Oceana 2013).
- **Ecosystem resilience and climate change refugia.** Both Hanna and Herald shoals are likely to provide ecosystem resilience (Christie and Sommerkorn 2012; Gunderson 2000) to climate change due to the particular biophysical features of these sites (e.g. regional circulation patterns and seasonal sea-ice dynamics) responsible for the high benthic biomass at Hanna Shoal and to a lesser degree at Herald Shoal; persistence of sea-ice during the summer; and local wildlife diversity. The shallow topographic features of the shoals on the Chukchi shelf divert the flow of warmer Bering Sea water during springtime and form Taylor columns, an anti-cyclonic circulation pattern that entrains cold water and influences the persistence of sea-ice over the shoals (Martin and Drucker 1997; Weingartner et al. 2013a; Weingartner et al. 2005; Woodgate et al. 2005). The unique combination of drivers that distinguish Herald and Hanna shoals as key features are likely to persist in future decades, thereby making these areas a priority for conservation over the long term.

As noted above, more detailed information on the scientific research and spatial data used in our maps and analysis of the four proposed exclusion areas is available in Appendix B. The remaining sections address the implications of exclusion on the National Energy Policy and considerations regarding future stages of the leasing process.

4. Implications of Proposed Exclusions on National Energy Policy

President Obama's Blueprint for a Secure Energy Future identifies oil and natural gas supplies as an important component of the nation's energy portfolio. As part of this all-of-the-above energy strategy, the Administration has indicated its intent to proceed with energy exploration and production in Alaska—but only cautiously, safely, and incorporating the best available science. In particular, the Administration has called for a balanced and careful approach to offshore development in the Arctic that accounts for the resource potential; environmental protection; and the social, cultural and subsistence needs of Alaskan communities.

If adopted, our proposed exclusions areas would make significant oil and gas resources available while reducing possible conflicts with environmentally sensitive areas and the communities that rely on the ocean for subsistence. For example:

- The entire Chukchi Sea Program Area is 55.2 million acres.
- Active leases occupy 2.76 million acres (5.0%) of the Program Area.
- The four recommended exclusion areas total 12.3 million acres (22.3% of the Program Area).

If BOEM excluded from lease sale 237 an expansion of the current Chukchi coastal exclusion (Chukchi Corridor), an expansion of the current Barrow Canyon exclusion, the Hanna Shoal Region, and Herald Shoal as recommended in this comment letter:

- 40.14 million acres would still be available for lease (72.7 % of program area);
- 75.8% of high petroleum potential areas would still be available for lease;
- 64.4% of medium petroleum potential areas would still be available for lease; and
- 90.3% of low petroleum potential areas would still be available for lease.

By excluding recommended areas from proposed lease sale 237 at this stage of the pre-leasing process, BOEM has an opportunity to advance protection of the productivity, biodiversity, function, structure and resilience of the marine ecosystem while at the same time allowing for fulfillment of the President's energy mandate.

5. Considerations for Future Stages of OCSLA

Even if BOEM acts immediately to exclude the four areas identified in the preceding sections, the agency must continue to evaluate ecological concerns as it decides whether and how to proceed with proposed Chukchi Sea lease sale 237.

5.1 Continue Rigorous Environmental Analysis Throughout the Lease Sale Process

If BOEM proceeds with additional evaluation of potential lease sale 237, it must prepare a draft environmental impact statement (DEIS) that evaluates the impacts of alternative actions. In doing so, BOEM should ensure that the process is adaptive. Specifically, it should allow for the incorporation of new information that yields a better understanding of the Arctic waters and how they are changing. This information could reveal the existence of additional IEAs that should be excluded from the Chukchi lease sale or future five-year programs. As it evaluates new information, BOEM should give special consideration to areas where there are community subsistence use areas, regular aggregations of species, migration routes, and important zones of primary productivity, breeding, spawning and birthing habitat, as well as areas that are likely be resilient during climate changes.

BOEM's DEIS should also include a meaningful analysis of the cumulative effects of additional leasing in the Chukchi Sea. Ideally, analysis of cumulative impacts should be based on objective measures; a strong analysis would quantitatively assess impacts for all activities for potentially impacted species. In any event, the cumulative impact analysis must be more than a listing of existing or potential industrial activities. It must assess whether those activities will combine, in an additive or synergistic fashion, to have significant effects. BOEM's cumulative impact assessment may lead the agency to conclude that it is necessary to take additional action to limit the impacts of leasing, such as restricting the overall number of leases offered in the Chukchi Sea.

5.2 Incorporate Strong Mitigation Measures in Any New Leases

If BOEM completes lease sale 237 and sells new OCS leases in the Chukchi Sea, those leases should include restrictions and mitigation measures designed to maximize safety and minimize disturbance. For example, such restrictions may include time/area closures associated with important migratory phases or subsistence hunting periods near the lease tracts. Leases should include strict limits on the length of the Arctic drilling season to ensure operations are carried out only in ice-free waters and to provide an adequate buffer in the event of an end-of-season spill. New Chukchi Sea leases should include a provision that mandates the capacity for Arctic operators to drill a same-season relief well. BOEM and BSEE should also incorporate stringent mitigation measures to address impacts associated with air emissions, noise, discharge, and increased vessel and air traffic, among other things. Strong mitigation measures on new lease tracts are important to help reduce potential impacts to the health of the ecosystem but they do not replace the critical need for areas to be excluded.

5.3 Develop and Implement Alaska-specific Standards to Govern Future Operations

At the same time BOEM is accepting comments related to the call for information for Chukchi Sea lease sale 237, it is working with BSEE to develop new Alaska-specific rules relating to certain OCS issues. We urge BOEM and BSEE to develop stronger Alaska-specific drilling standards, including standards governing containment systems, relief well capability, mutual assistance and resource sharing, and agency processes for issuing exploration and spill response plans. A full list of recommended Arctic-specific standards can be found in The Pew Charitable Trusts' recently released report, "Arctic Standards: Recommendations for Oil Spill Prevention, Response, and Safety" (The Pew Charitable Trusts 2013). These reforms are necessary to ensure that future drilling, if it proceeds, is as safe as possible. At the same time, BOEM and BSEE should engage in a broader rulemaking process designed to address a wide range of issues. For example, new regulations should codify the "targeted leasing" approach to Arctic leasing described in the 2012–2017 five-year program; clarify the roles and responsibilities of BOEM and BSEE and formalize the process and timing of various permit approvals; explain how the agencies will comply with NEPA requirements at each stage of the OCS process in the Arctic; develop public disclosure requirements for information concerning seismic exploration, drilling operations, inspections and compliance, and other activities; provide specific direction for satisfying the agency's balancing obligations under Section 18 of OCSLA; and ensure that BOEM properly accounts for externalities, including climate change effects and other impacts associated with activities approved on the OCS. Again, strong regulatory standards do not replace the critical need for areas to be excluded.

6. CONCLUSION

We commend the Administration for its recent efforts to plan holistically for the Arctic region and to balance growing pressure for economic development with the clear need for responsible stewardship and integrated decision-making and management. We are heartened that the Administration recognizes the need to meet these challenges in light of the rapidly changing climate in the region and acknowledges the need to act to address those changes. Management of Arctic Ocean resources epitomizes the difficult challenges and opportunities identified in the National Arctic Strategy. In light of these challenges, we recommend against proceeding with the lease sale at this time. However, if BOEM does decide to proceed, by excluding recommended areas from proposed Chukchi lease sale 237 at this stage of the pre-leasing process, BOEM has an opportunity to reduce possible conflicts with environmentally sensitive areas and the communities that rely on the ocean for subsistence. This first step would signal a meaningful commitment by the Administration to protect the productivity, biodiversity, function, structure and resilience of the Arctic marine ecosystem. We have endeavored to make our recommendations as transparent and scientifically defensible as possible using the best available information. We look forward to continued dialogue as this process moves forward.

Sincerely,

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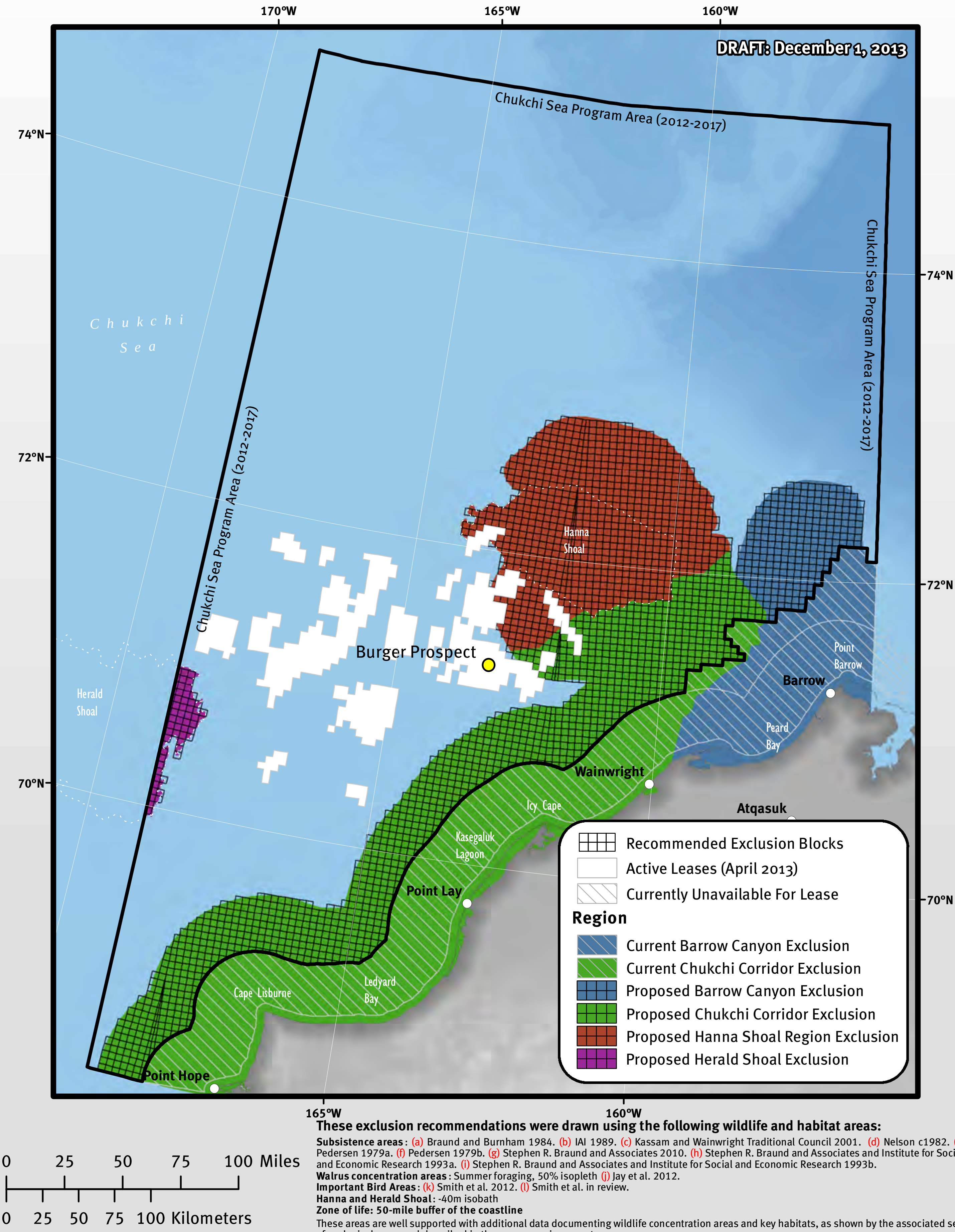
APPENDIX A

MAPS OF THE CHUKCHI SEA PROGRAM AREA

Recommended Exclusion Areas

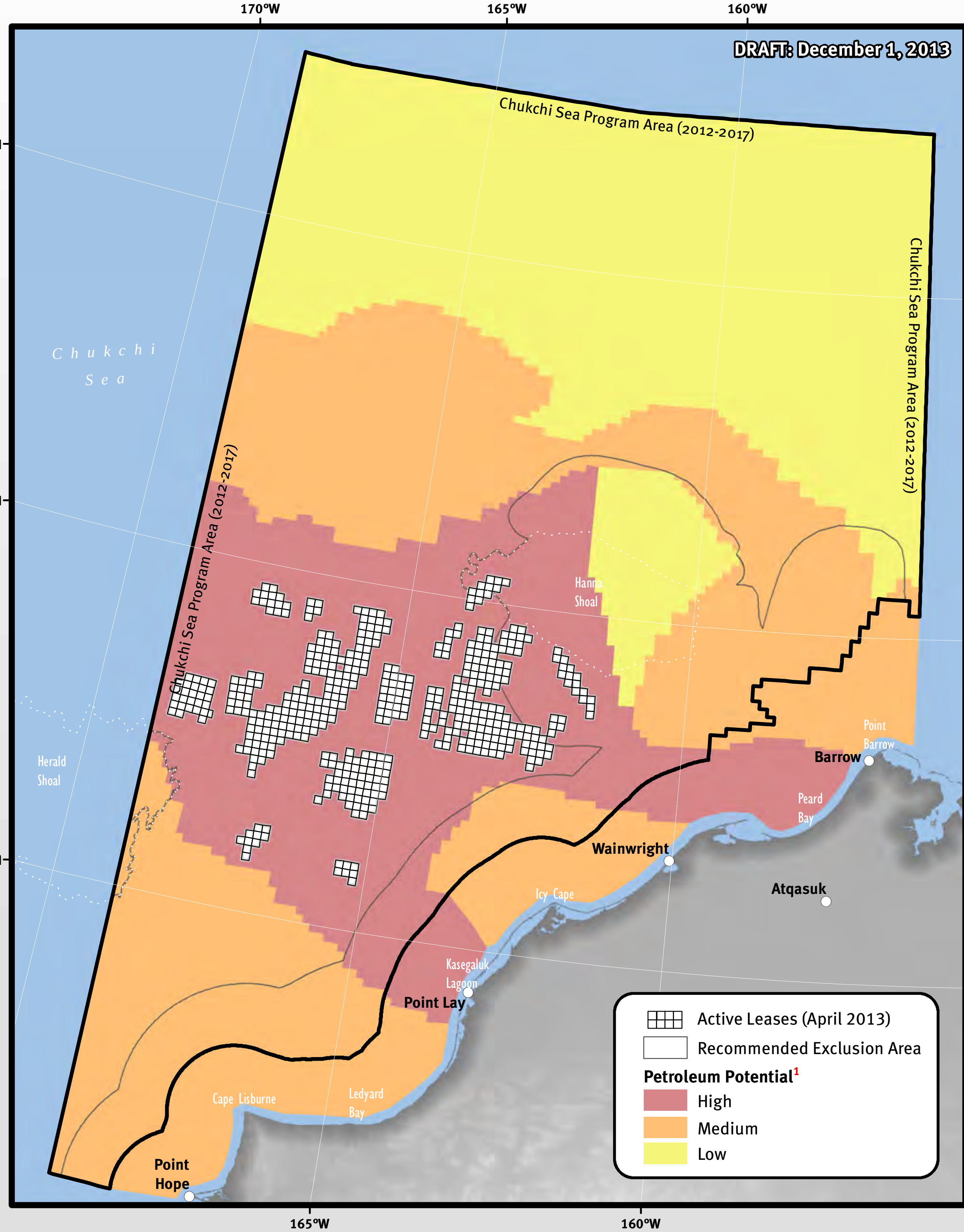


These exclusion recommendations were drawn using the following wildlife and habitat areas:

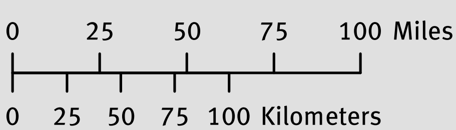
Subsistence areas: (a) Braund and Burnham 1984. (b) IAI 1989. (c) Kassam and Wainwright Traditional Council 2001. (d) Nelson c1982. (e) Pedersen 1979a. (f) Pedersen 1979b. (g) Stephen R. Braund and Associates 2010. (h) Stephen R. Braund and Associates and Institute for Social and Economic Research 1993a. (i) Stephen R. Braund and Associates and Institute for Social and Economic Research 1993b.
Walrus concentration areas: Summer foraging, 50% isopleth (j) Jay et al. 2012.
Important Bird Areas: (k) Smith et al. 2012. (l) Smith et al. in review.
Hanna and Herald Shoal: -40m isobath
Zone of life: 50-mile buffer of the coastline

These areas are well supported with additional data documenting wildlife concentration areas and key habitats, as shown by the associated set of ecological maps and described in the accompanying report.

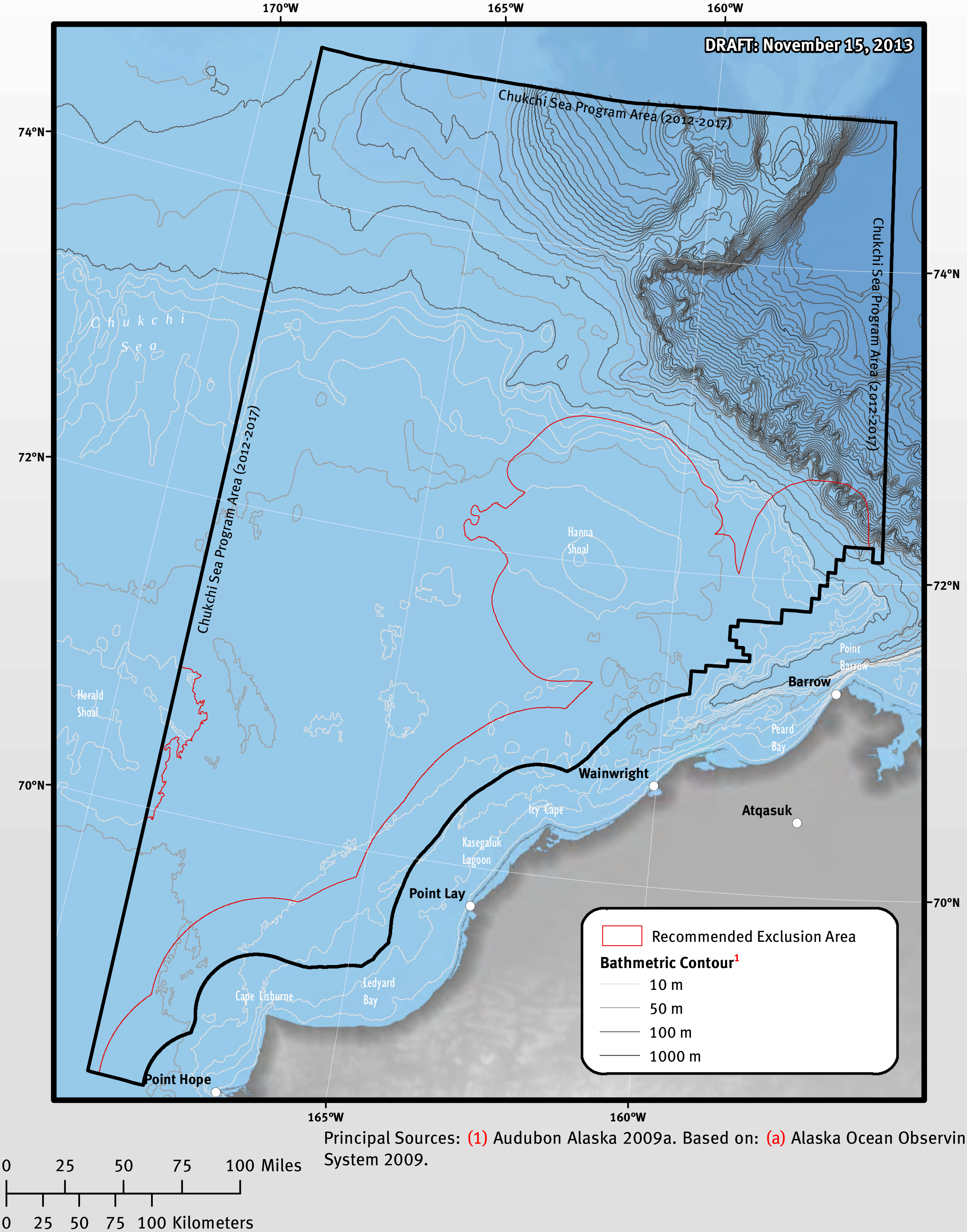
Petroleum Potential



Principal Sources: (1) BOEM 2012.

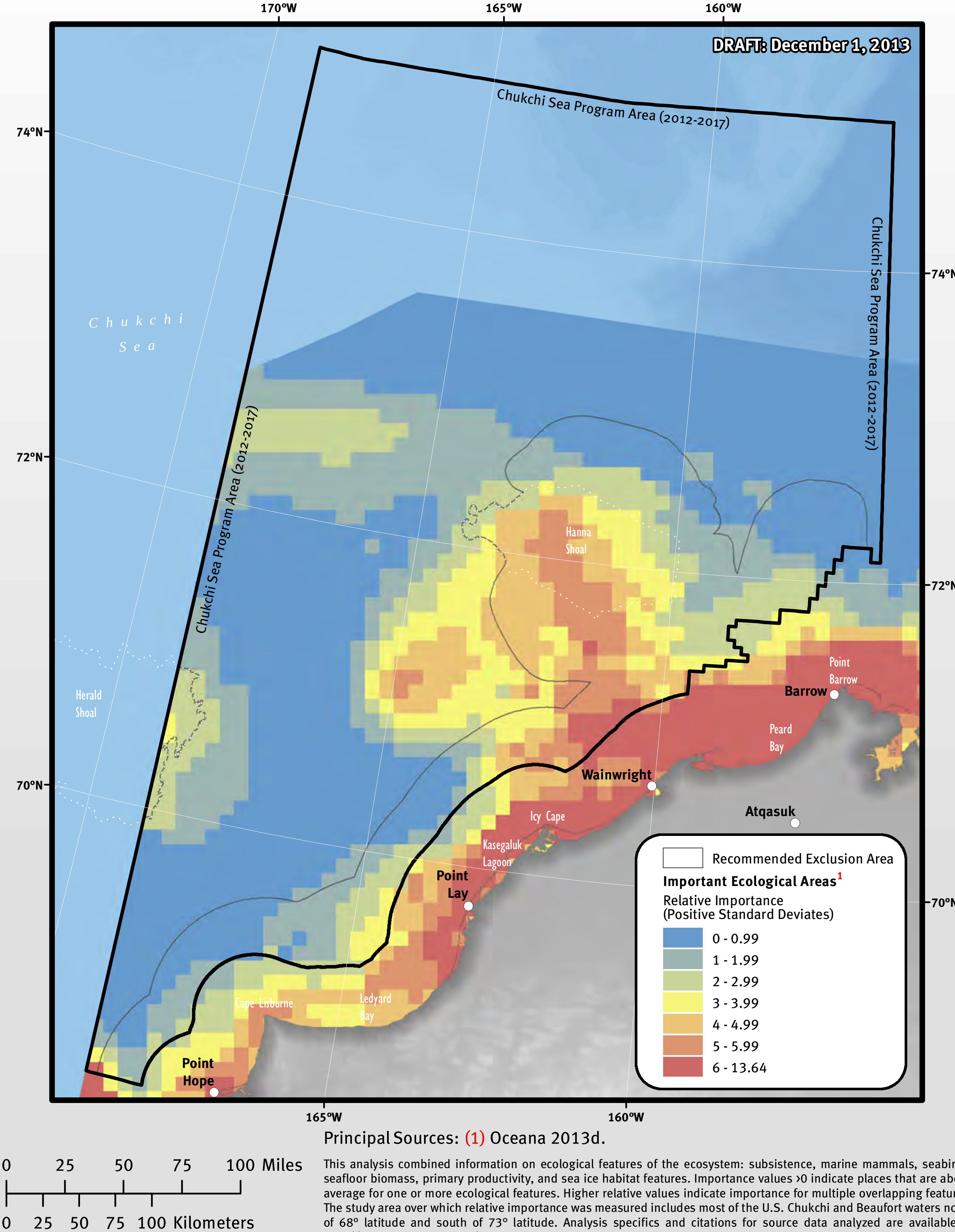


Seafloor Depth



Principal Sources: (1) Audubon Alaska 2009a. Based on: (a) Alaska Ocean Observing System 2009.

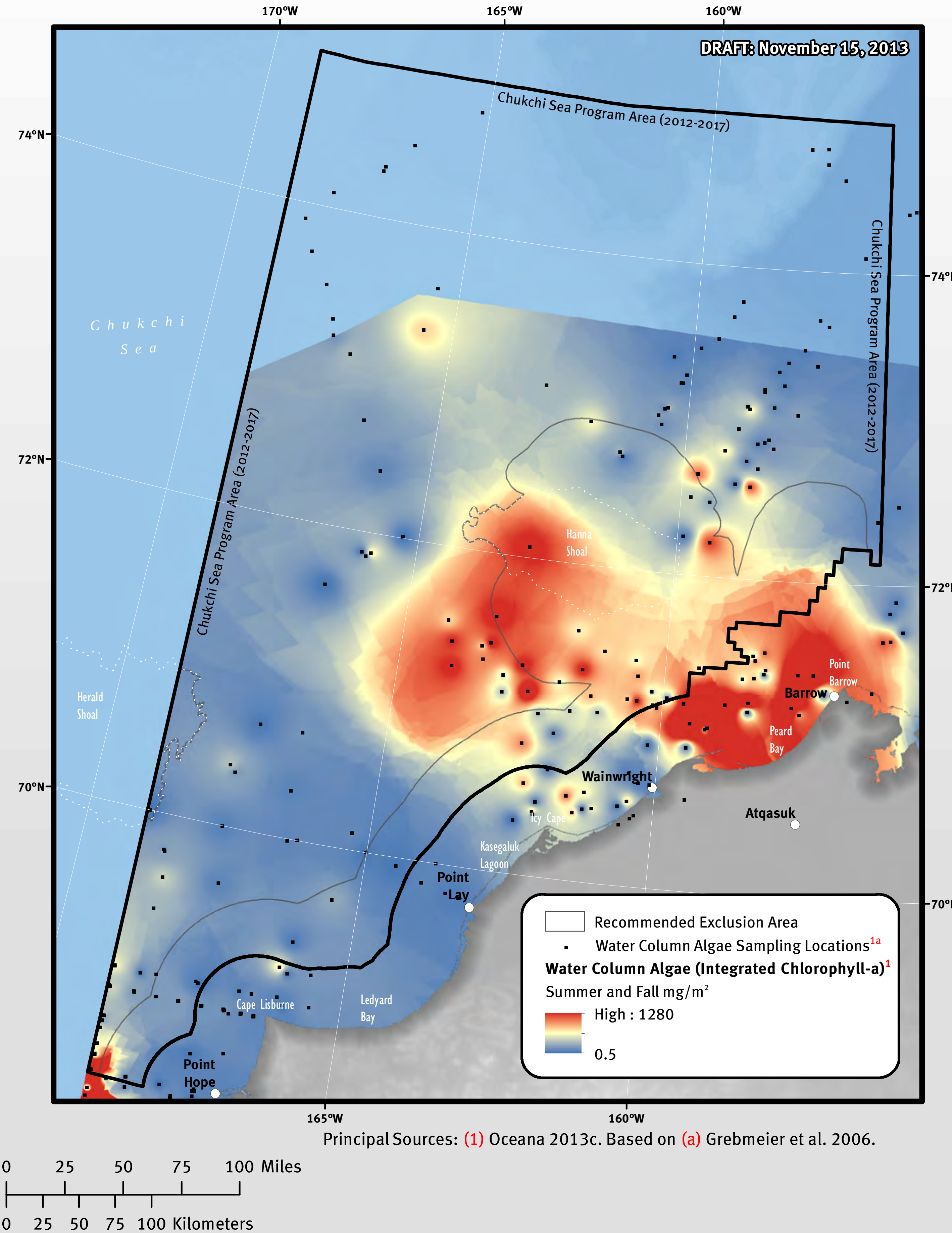
Important Ecological Area - Ecosystem Analysis



Principal Sources: (1) Oceana 2013d.

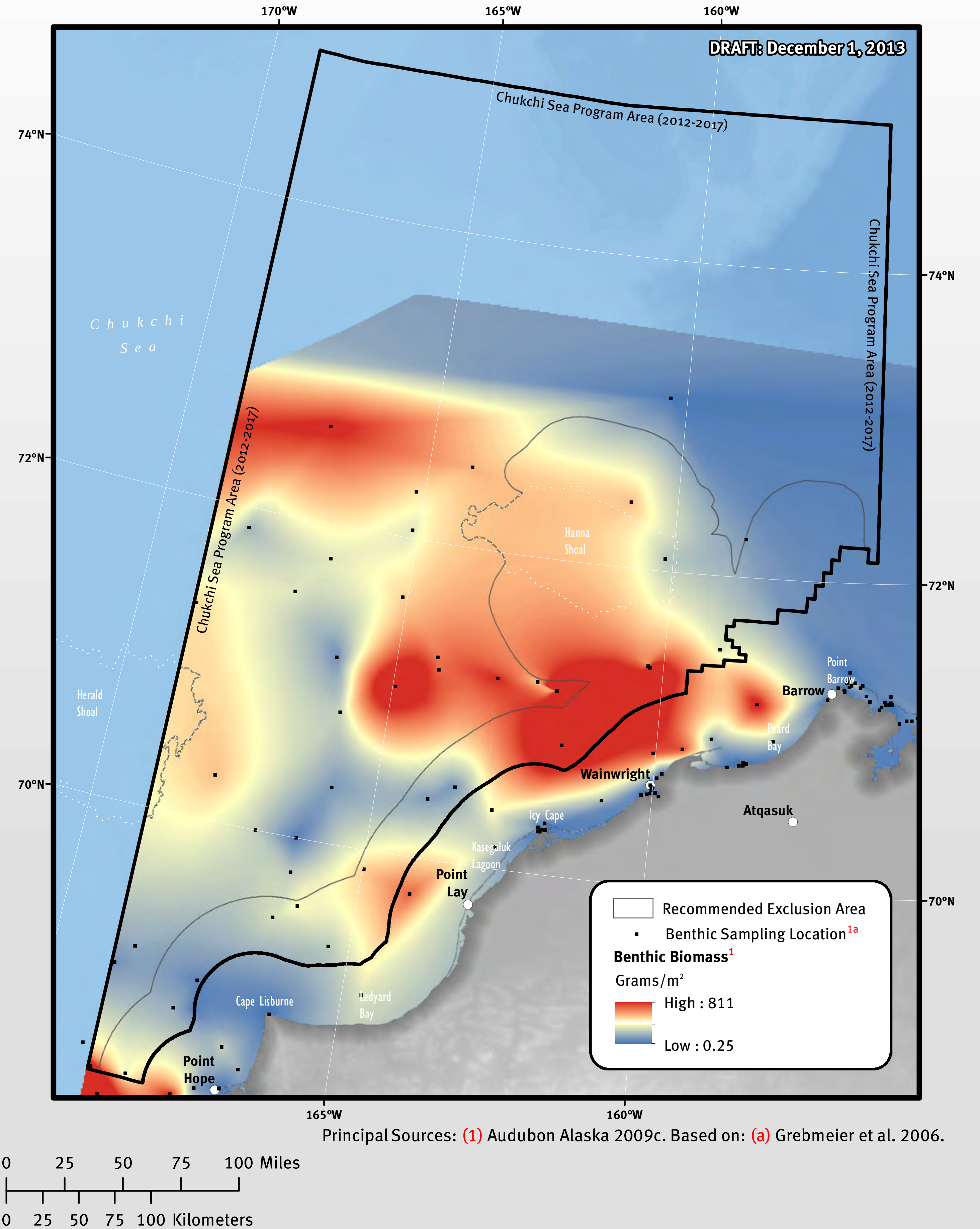
This analysis combined information on ecological features of the ecosystem: subsistence, marine mammals, seabirds, seafloor biomass, primary productivity, and sea ice habitat features. Importance values >0 indicate places that are above average for one or more ecological features. Higher relative values indicate importance for multiple overlapping features. The study area over which relative importance was measured includes most of the U.S. Chukchi and Beaufort waters north of 68° latitude and south of 73° latitude. Analysis specifics and citations for source data analyzed are available at http://www.regulations.gov/#!documentDetail;D=NOAA-NMFS-2013-0054-0070 or by contacting ckrenz@oceana.org.

Primary Productivity



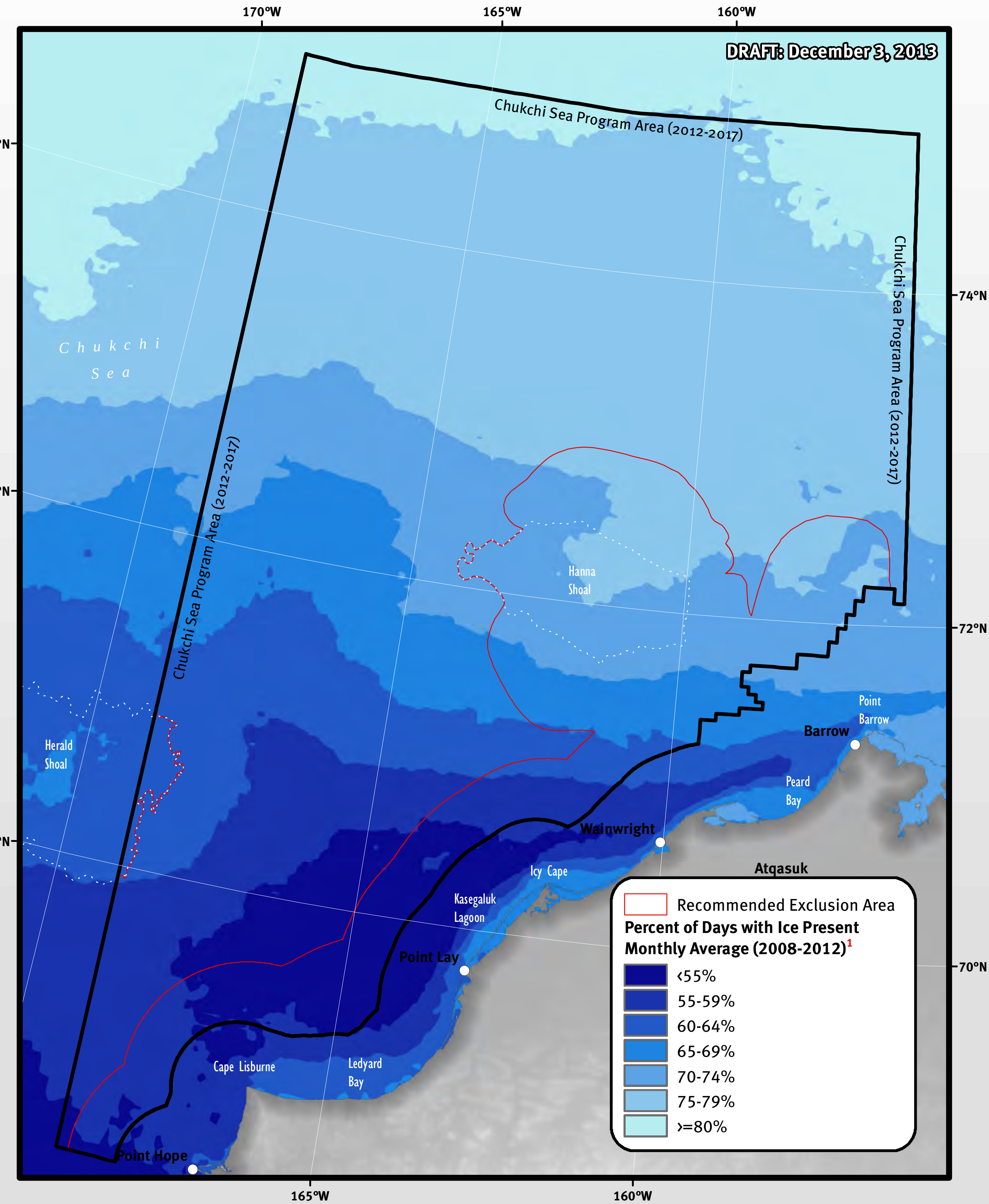
Principal Sources: (1) Oceana 2013c. Based on (a) Grebmeier et al. 2006.

Seafloor Biomass

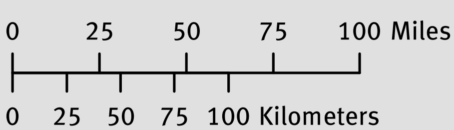


Principal Sources: (1) Audubon Alaska 2009c. Based on: (a) Grebmeier et al. 2006.

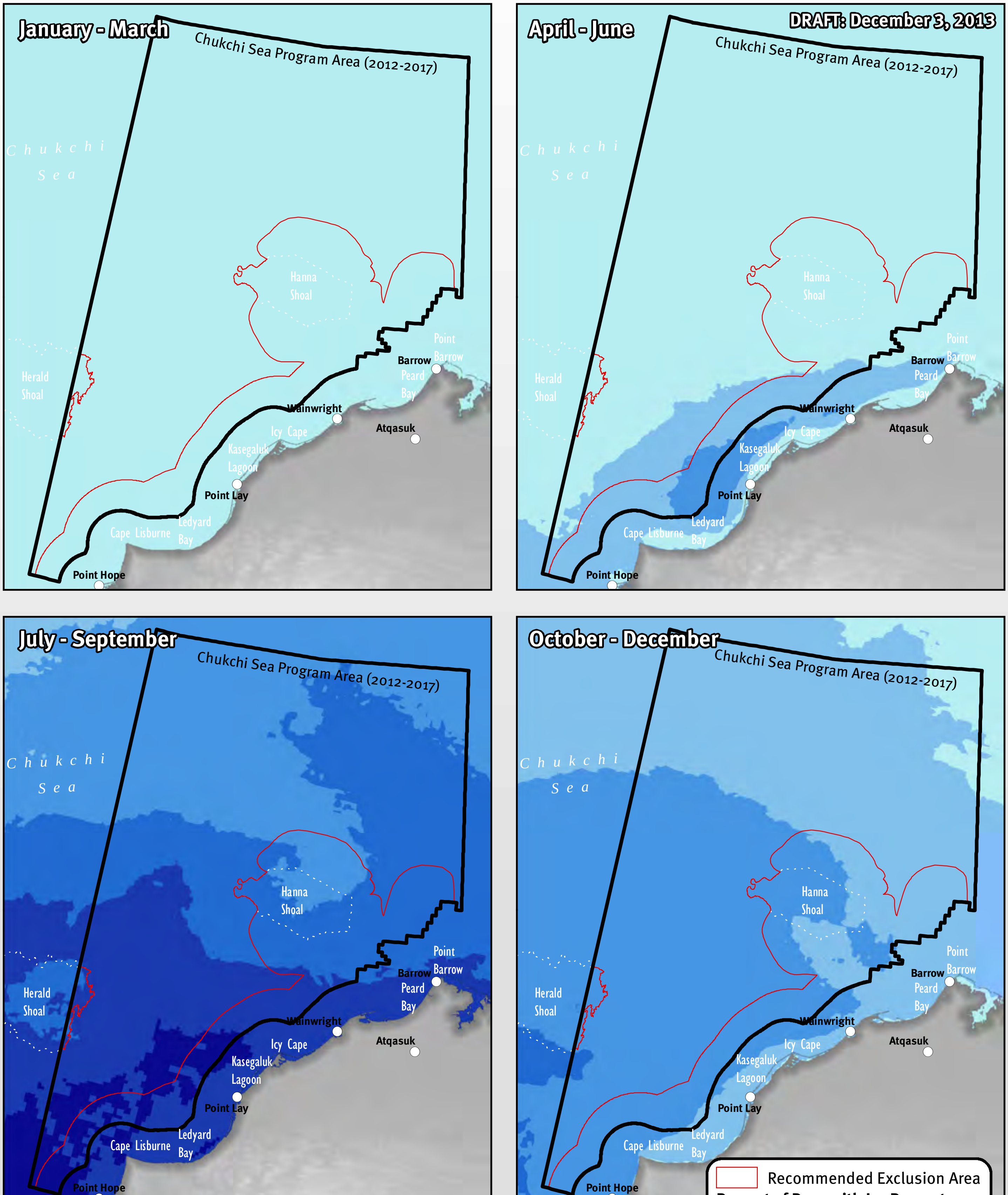
Sea Ice Extent (2008-2012)



Principal Sources: (1) Audubon Alaska 2013c. Based on: (a) National Snow and Ice Data Center 2013.



Sea Ice Extent, By Season (2008-2012)



0 50 100 150 200 Miles

0 50 100 150 200 Kilometers

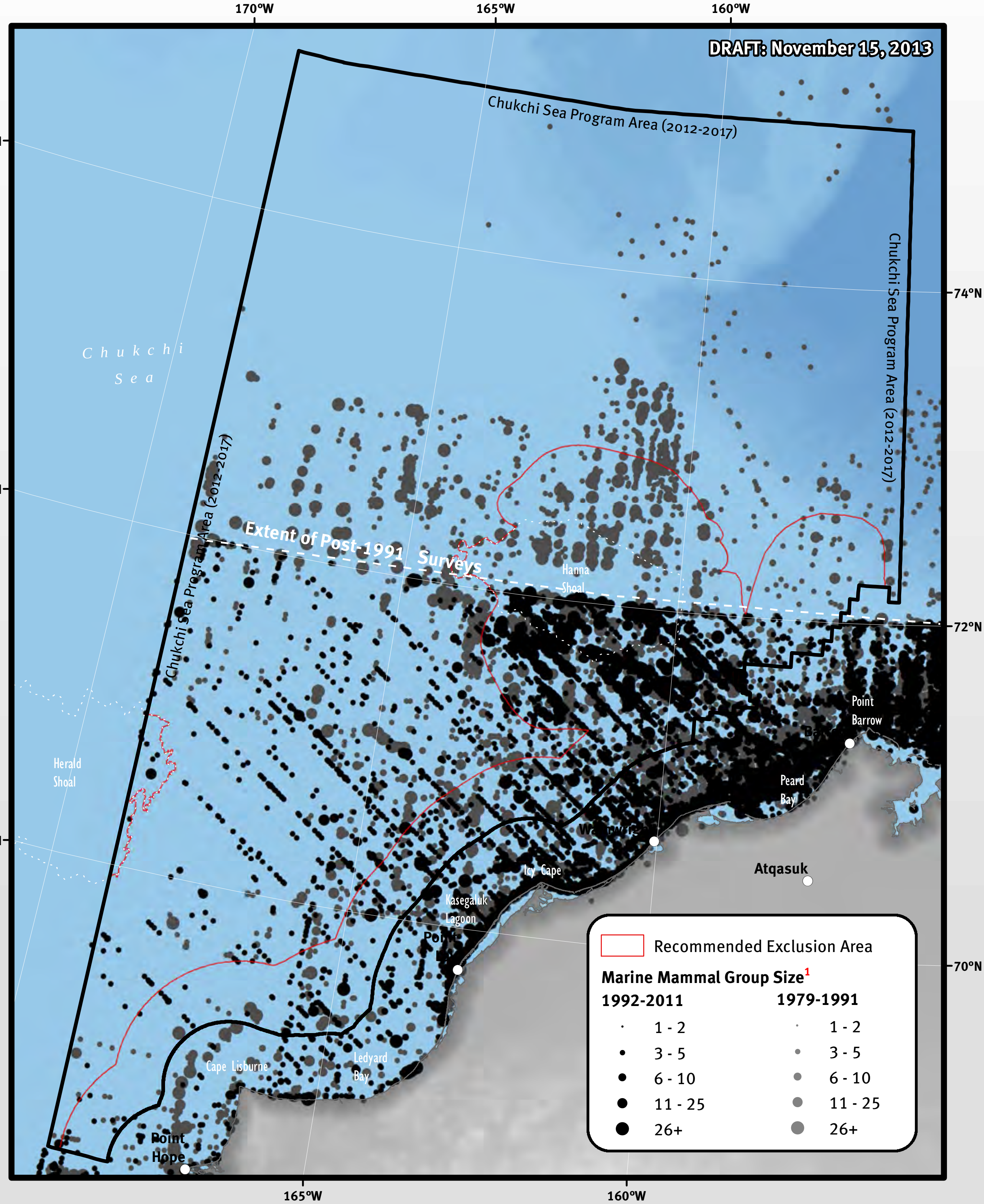
Principal Sources: (1) Audubon Alaska 2013c. Based on: (a) National Snow and Ice Data Center 2013.

Recommended Exclusion Area

Percent of Days with Ice Present, Monthly Average (2008-2012)[1]

0%
1 - 20%
21 - 40%
41 - 80%
61 - 80%
81 - 100%

Marine Mammal Observations (1979-2011)



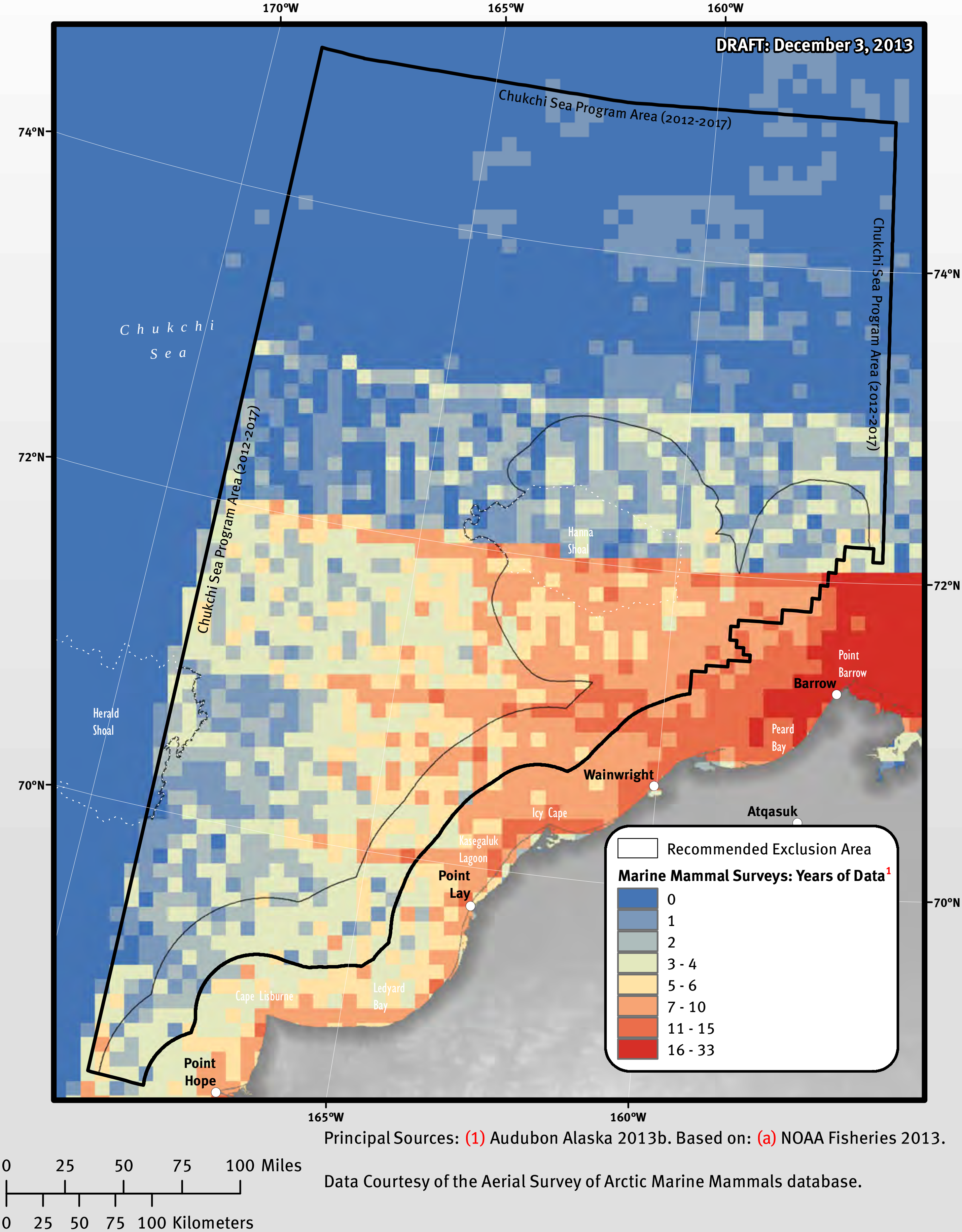
Principal Sources: (1) NOAA Fisheries 2013.

0 25 50 75 100 Miles

0 25 50 75 100 Kilometers

Data Courtesy of the Aerial Survey of Arctic Marine Mammals database.

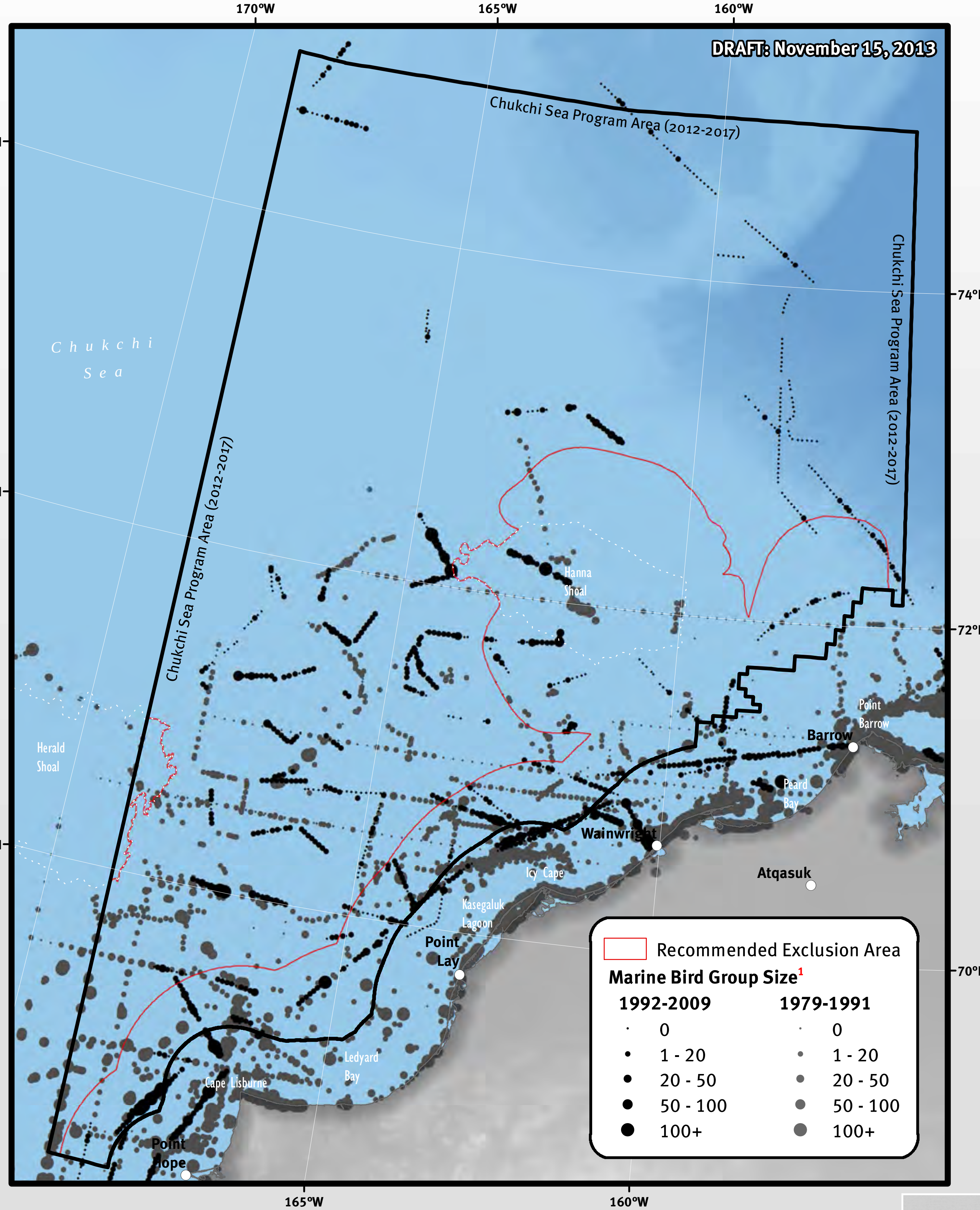
Marine Mammal Observations (1979-2011): Survey Effort



Principal Sources: (1) Audubon Alaska 2013b. Based on: (a) NOAA Fisheries 2013.

Data Courtesy of the Aerial Survey of Arctic Marine Mammals database.

Marine Bird Observations 1974-2009



Principal Sources: (1) Drew and Piatt 2011.

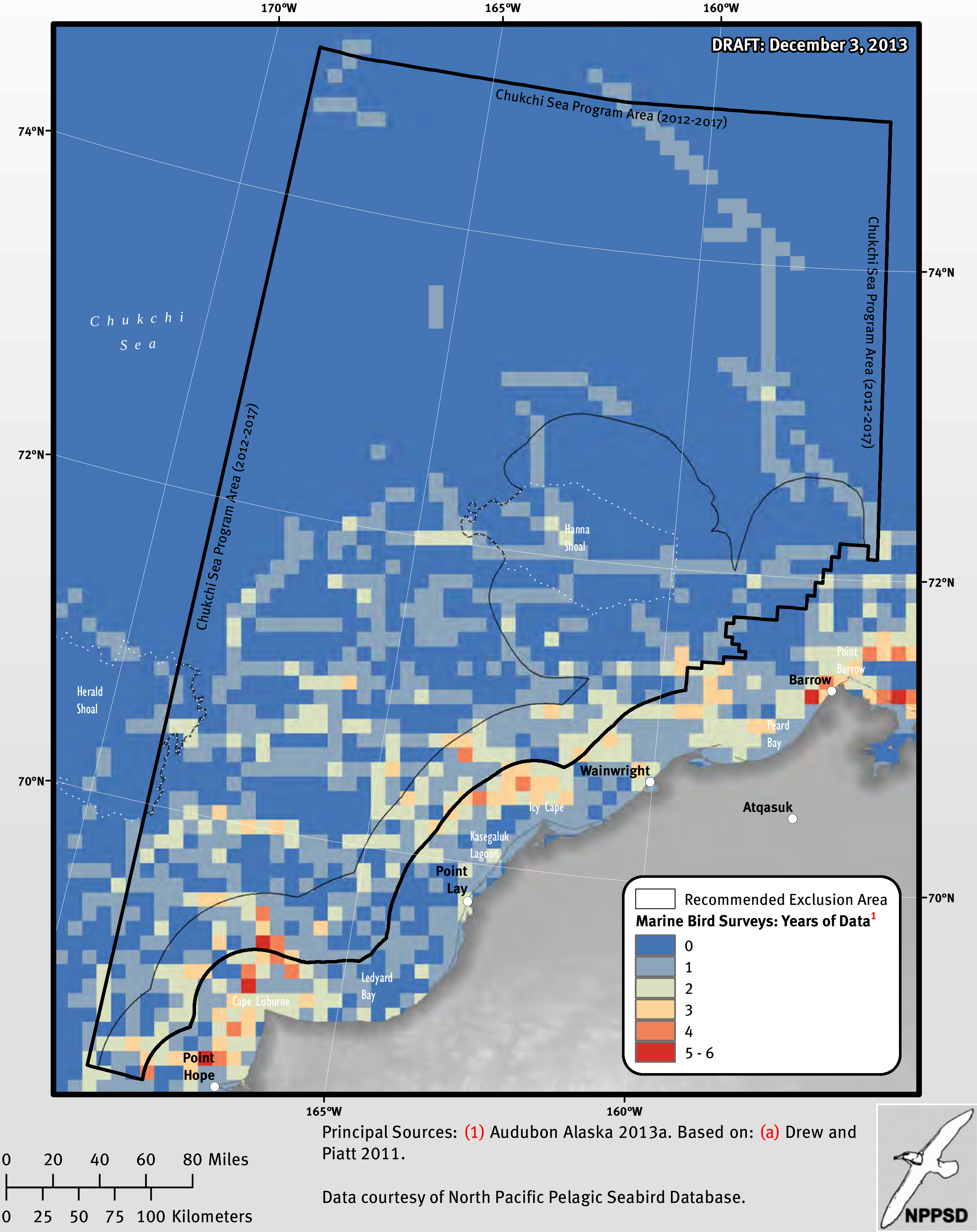
0 25 50 75 100 Miles

0 25 50 75 100 Kilometers

Data courtesy of North Pacific Pelagic Seabird Database.

NPPSD

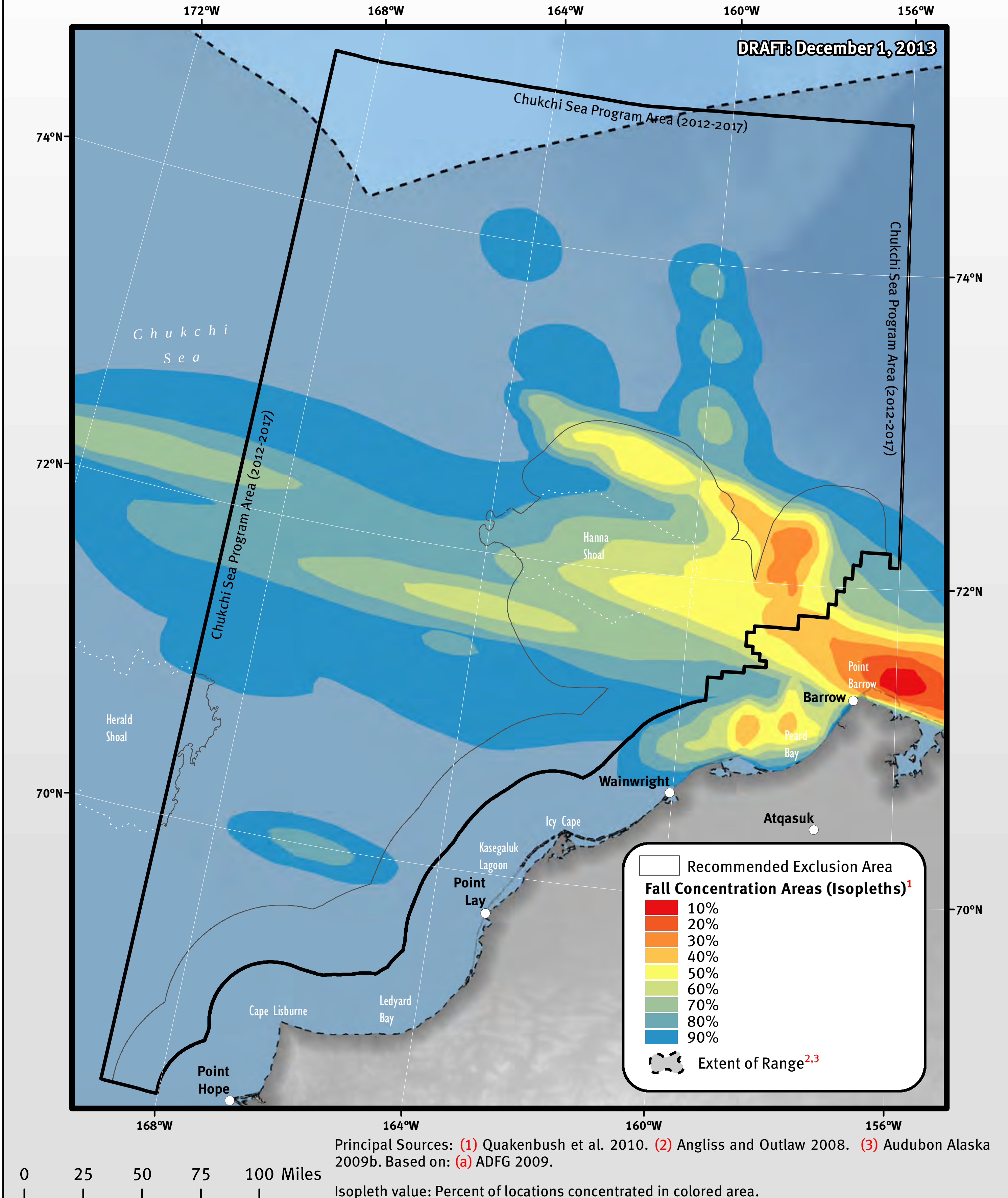
Marine Bird Observations (1974-2009): Survey Effort



Principal Sources: (1) Audubon Alaska 2013a. Based on: (a) Drew and Piatt 2011.

Data courtesy of North Pacific Pelagic Seabird Database.

Bowhead Fall Feeding and Migration Concentration Areas

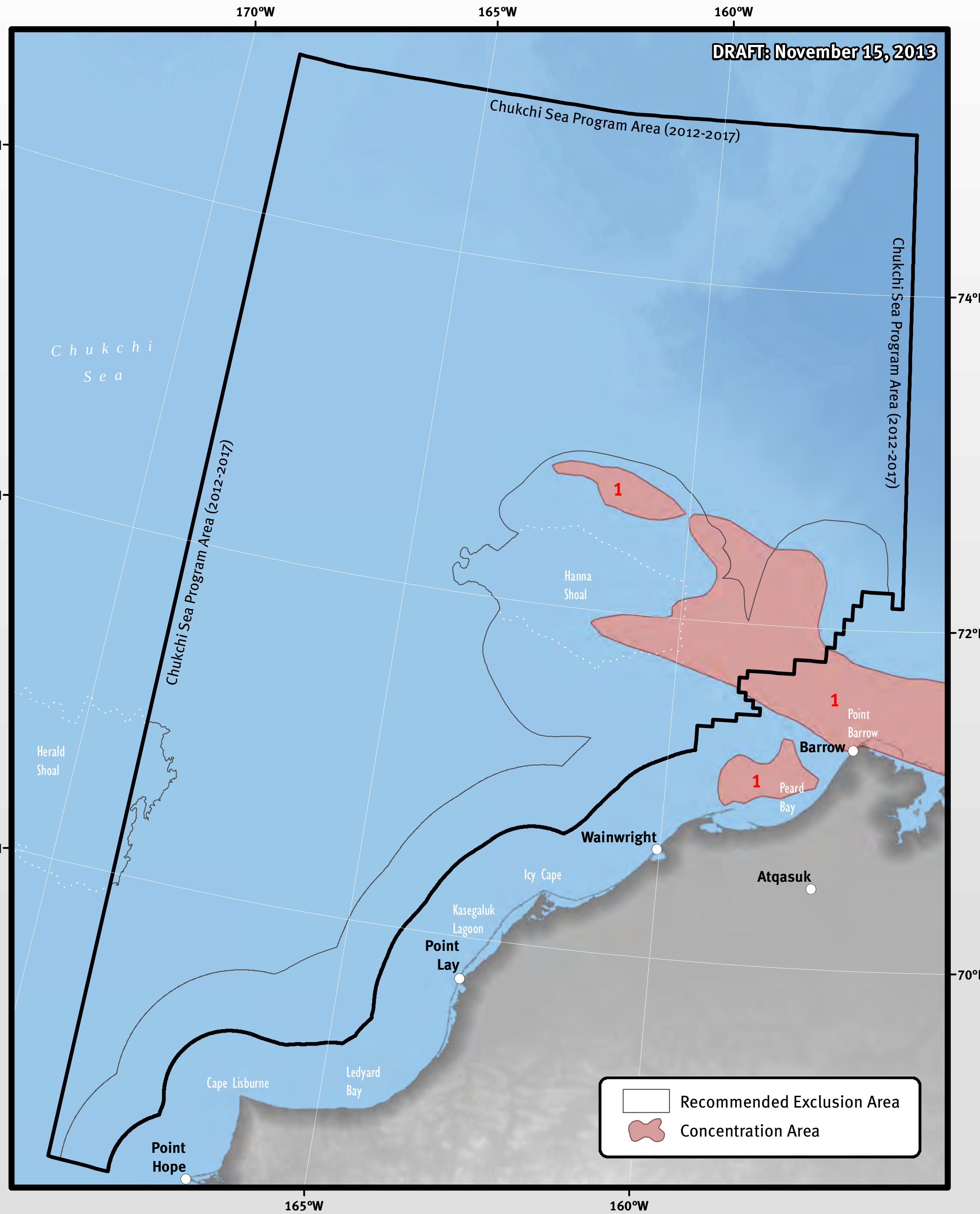


Principal Sources: (1) Quakenbush et al. 2010. (2) Angliss and Outlaw 2008. (3) Audubon Alaska 2009b. Based on: (a) ADFG 2009.

Isopleth value: Percent of locations concentrated in colored area.

Note: This map is based on only two years of data: additional recent data were not available at the time of publication.

Bowhead Fall Feeding and Migration Area Data Sources



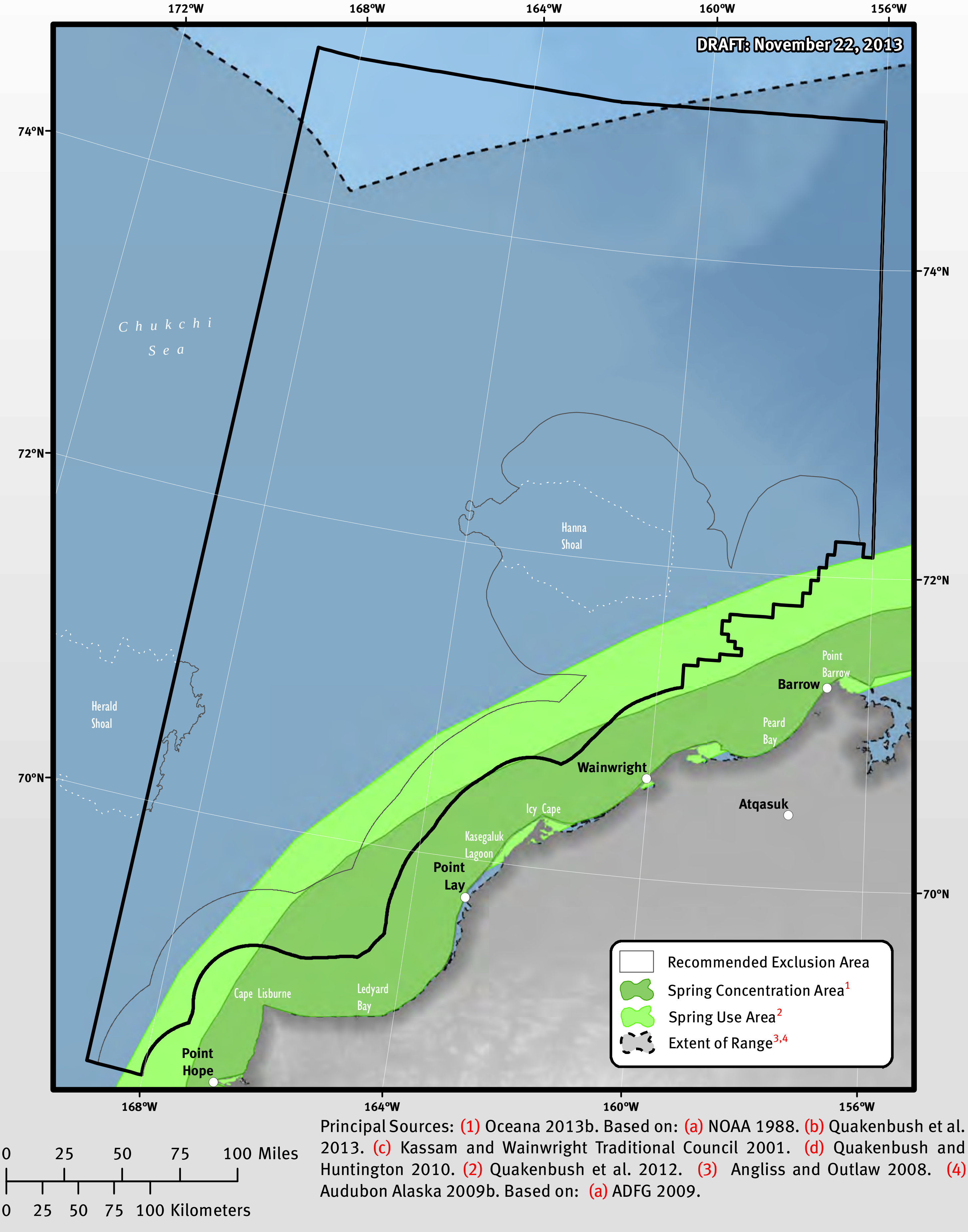
Principal Sources: (1) Quakenbush et al. 2010.

0 25 50 75 100 Miles

0 25 50 75 100 Kilometers

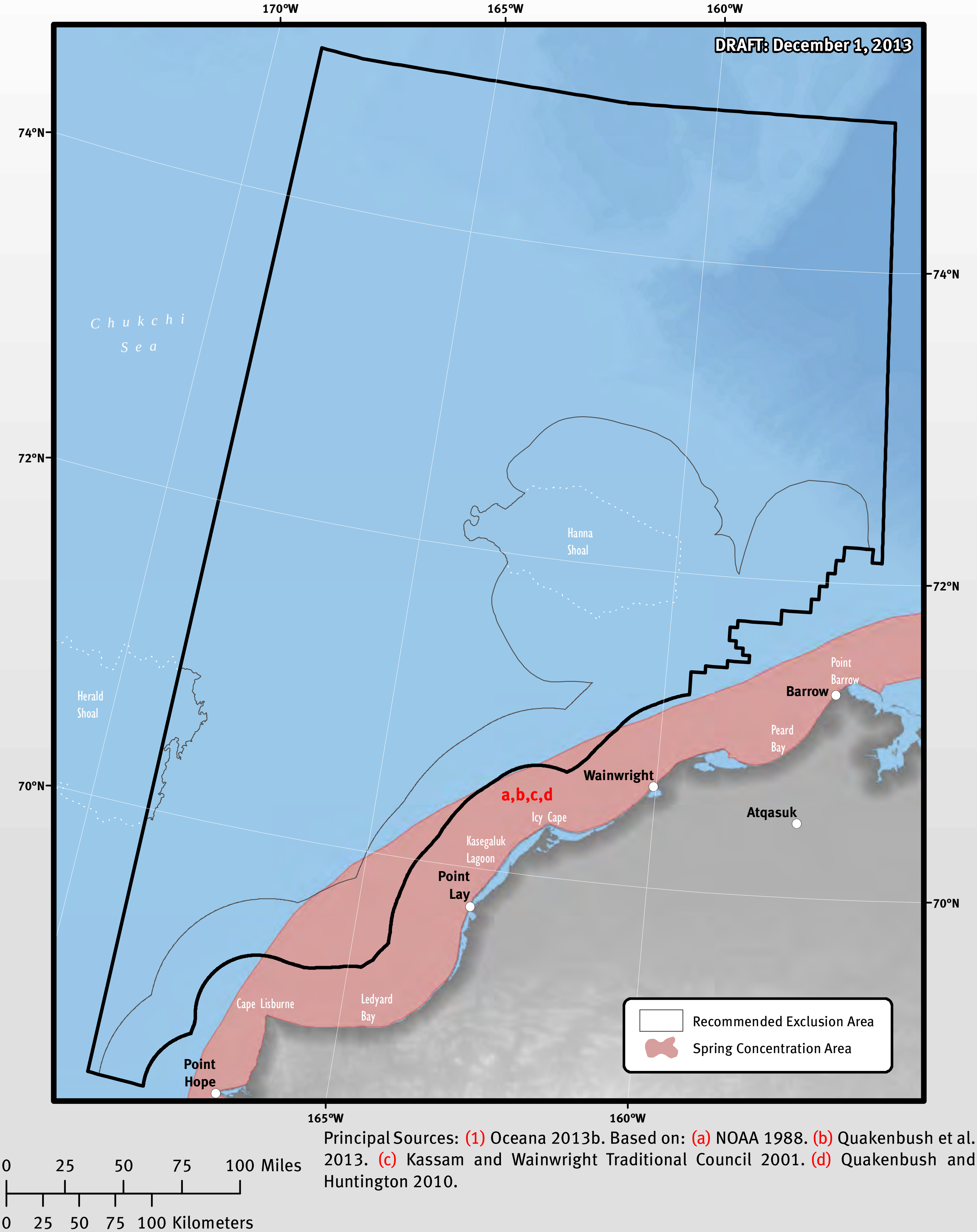
Note: This map is based on only two years of data: additional recent data were not available at the time of publication.

Bowhead Spring Feeding and Migration Concentration Areas



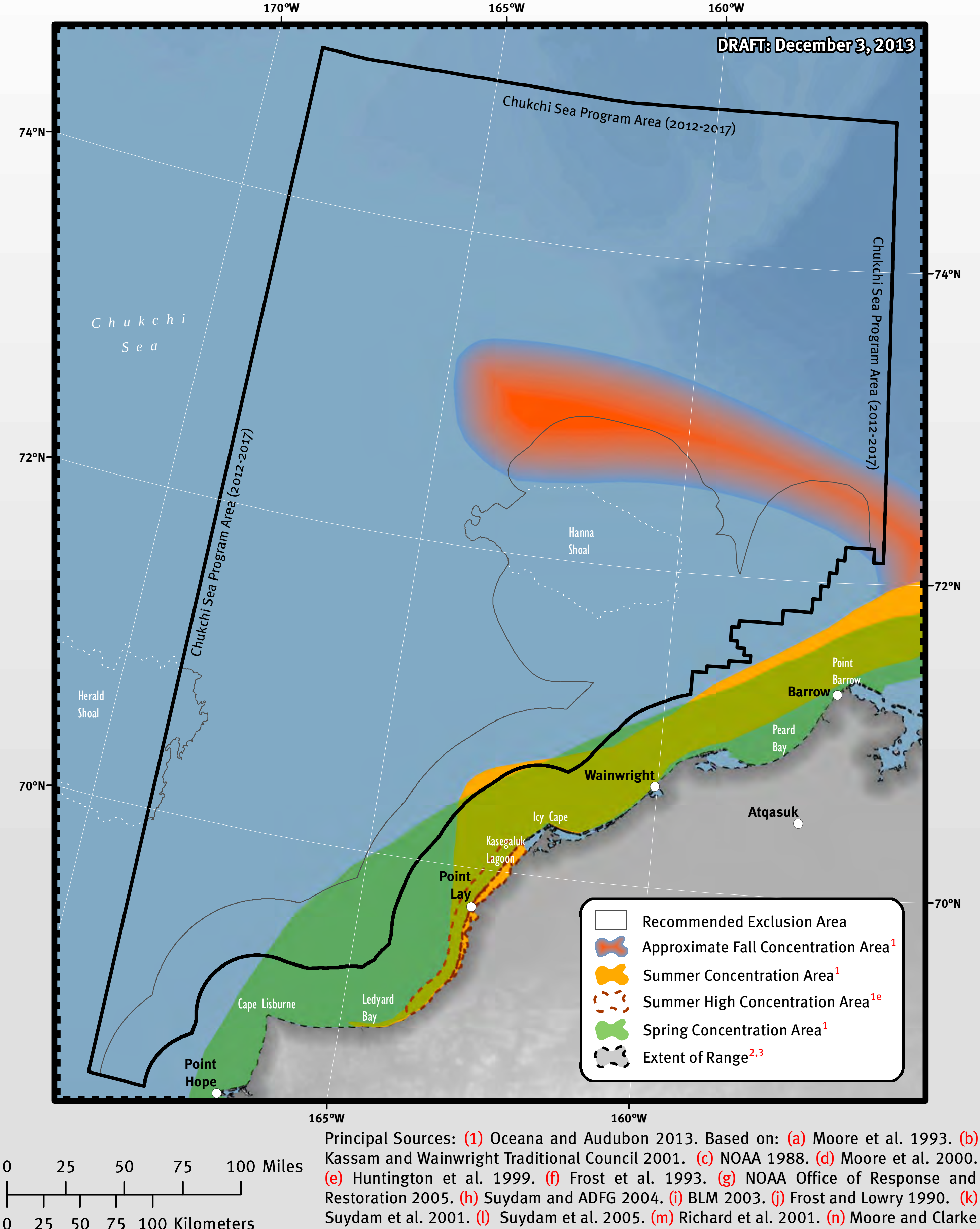
Principal Sources: (1) Oceana 2013b. Based on: (a) NOAA 1988. (b) Quakenbush et al. 2013. (c) Kassam and Wainwright Traditional Council 2001. (d) Quakenbush and Huntington 2010. (2) Quakenbush et al. 2012. (3) Angliss and Outlaw 2008. (4) Audubon Alaska 2009b. Based on: (a) ADFG 2009.

Bowhead Spring Feeding and Migration Area Data Sources



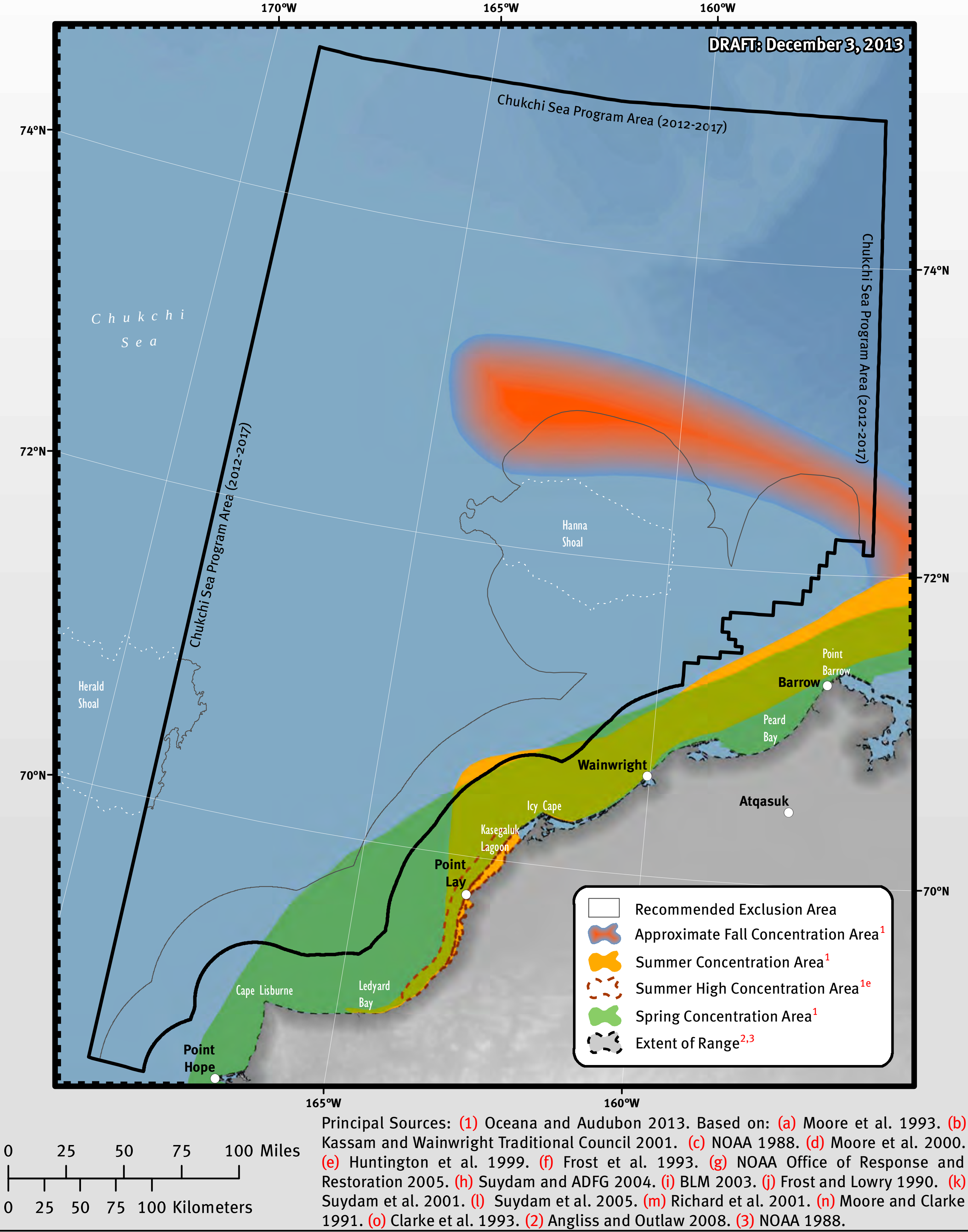
Principal Sources: (1) Oceana 2013b. Based on: (a) NOAA 1988. (b) Quakenbush et al. 2013. (c) Kassam and Wainwright Traditional Council 2001. (d) Quakenbush and Huntington 2010.

Beluga Calving and Molting Area



Principal Sources: (1) Oceana and Audubon 2013. Based on: (a) Moore et al. 1993. (b) Kassam and Wainwright Traditional Council 2001. (c) NOAA 1988. (d) Moore et al. 2000. (e) Huntington et al. 1999. (f) Frost et al. 1993. (g) NOAA Office of Response and Restoration 2005. (h) Suydam and ADFG 2004. (i) BLM 2003. (j) Frost and Lowry 1990. (k) Suydam et al. 2001. (l) Suydam et al. 2005. (m) Richard et al. 2001. (n) Moore and Clarke 1991. (o) Clarke et al. 1993. (2) Angliss and Outlaw 2008. (3) NOAA 1988.

Beluga Calving and Molting Area



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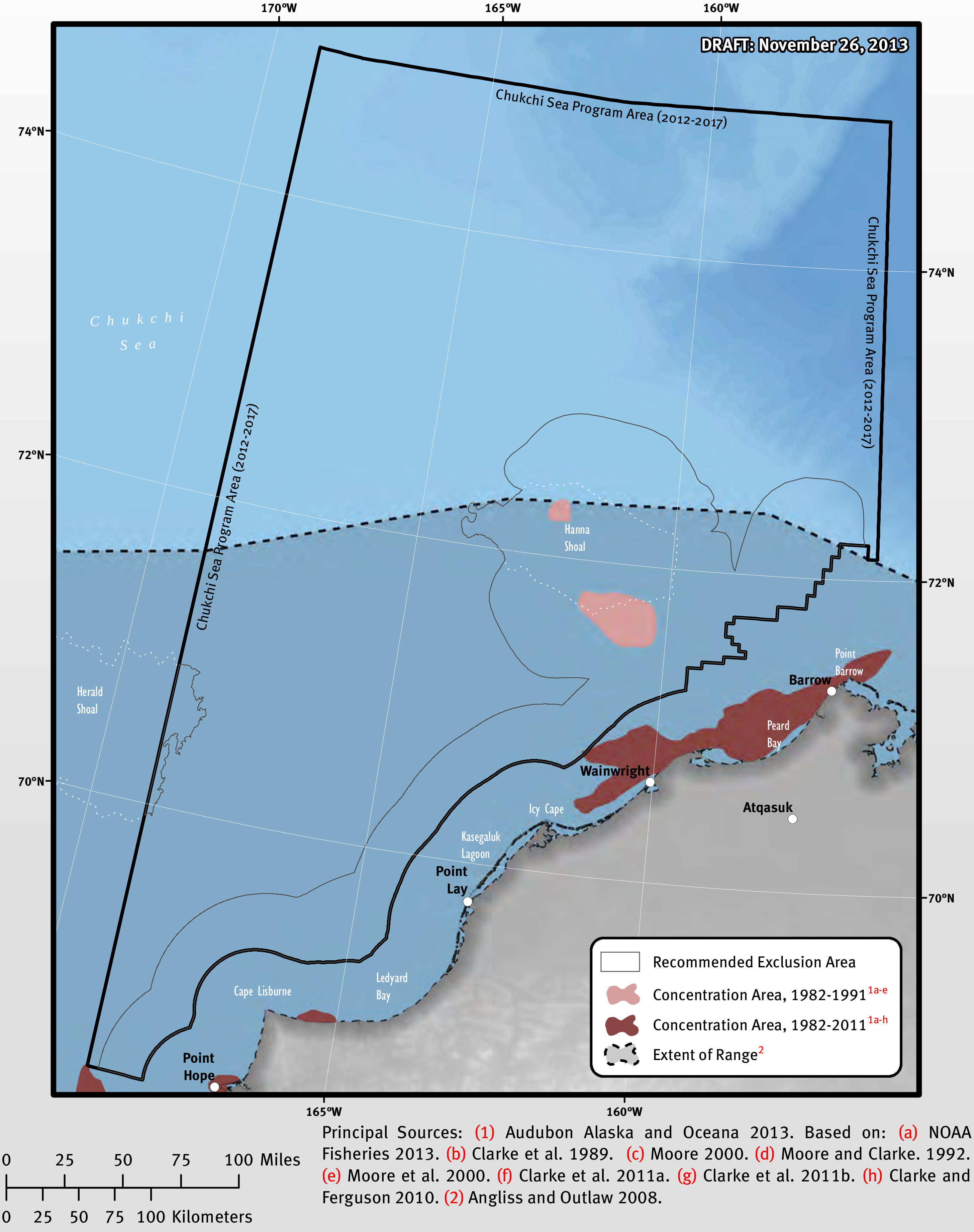
Gray Whale Concentration Areas



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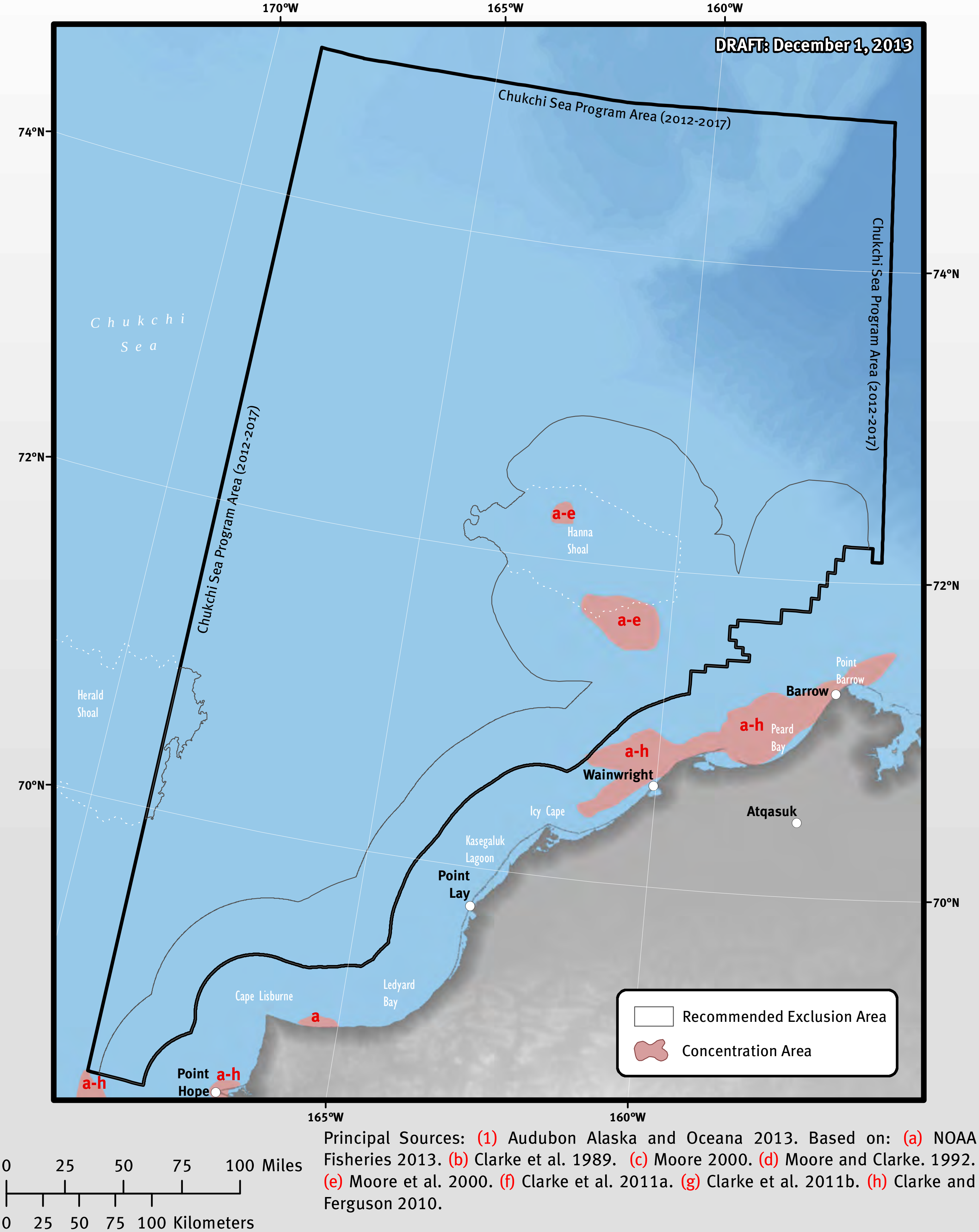
Gray Whale Concentration Area Data Sources



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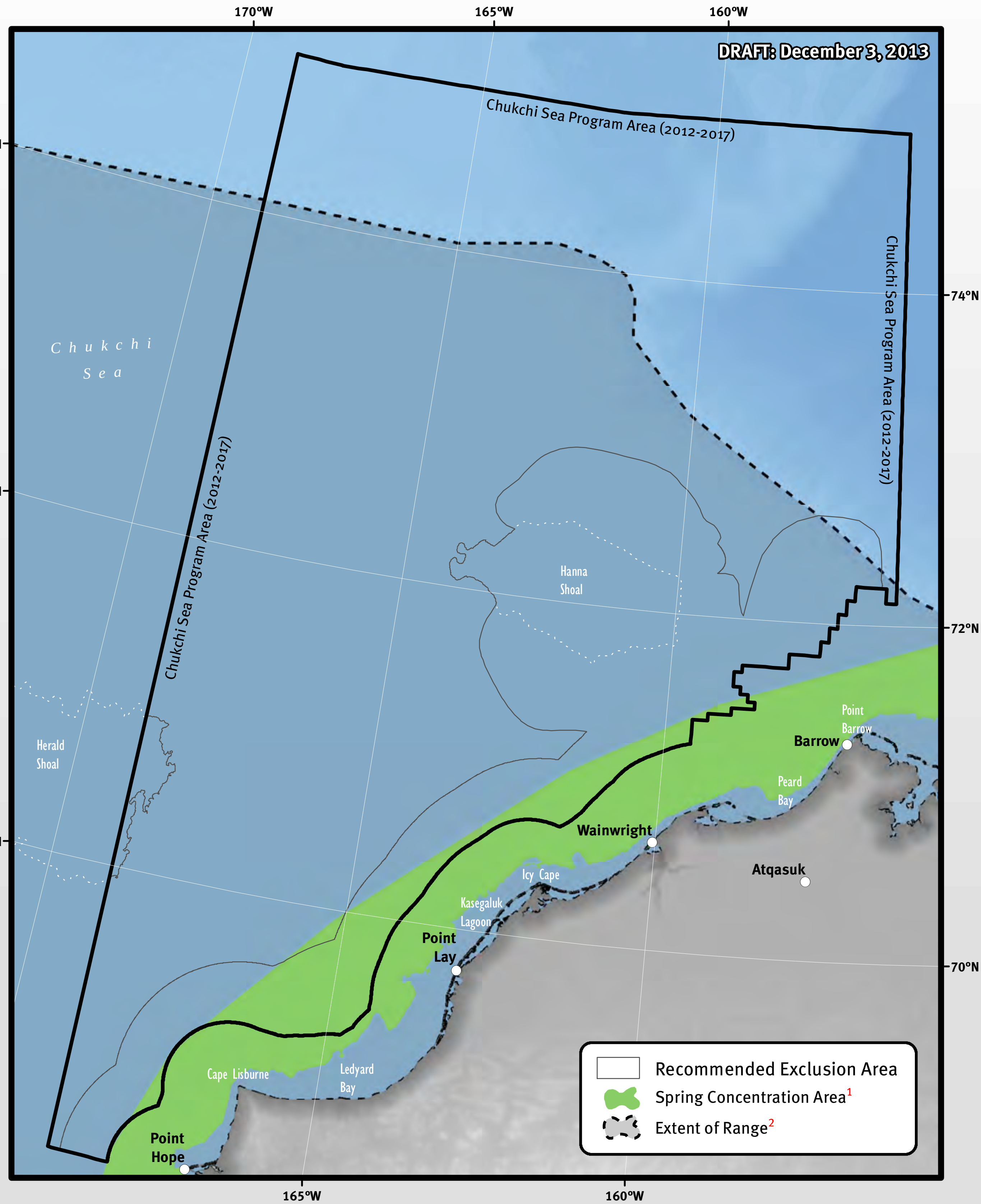
Bearded Seal Spring Concentration Areas

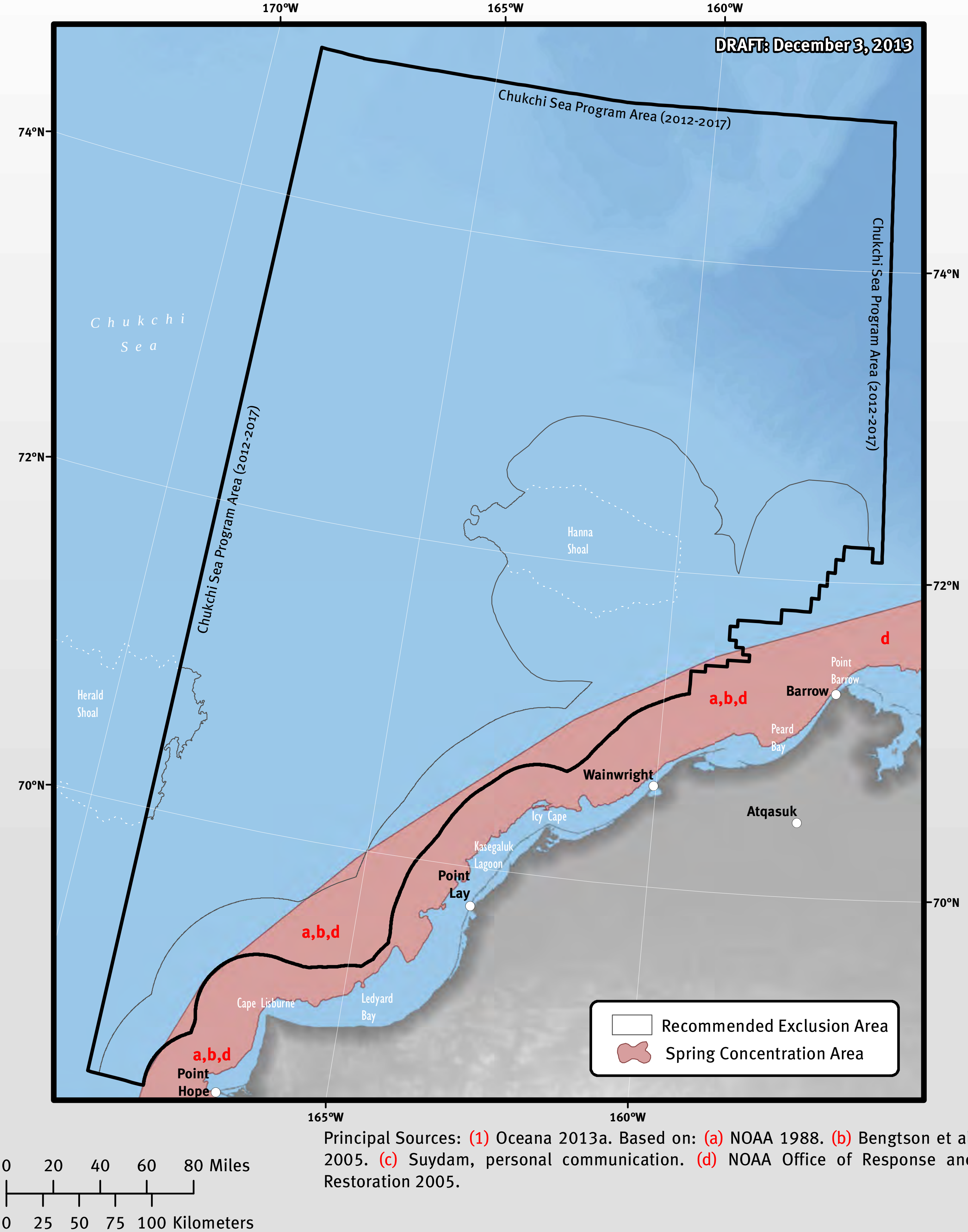


0 25 50 75 100 Miles

0 25 50 75 100 Kilometers

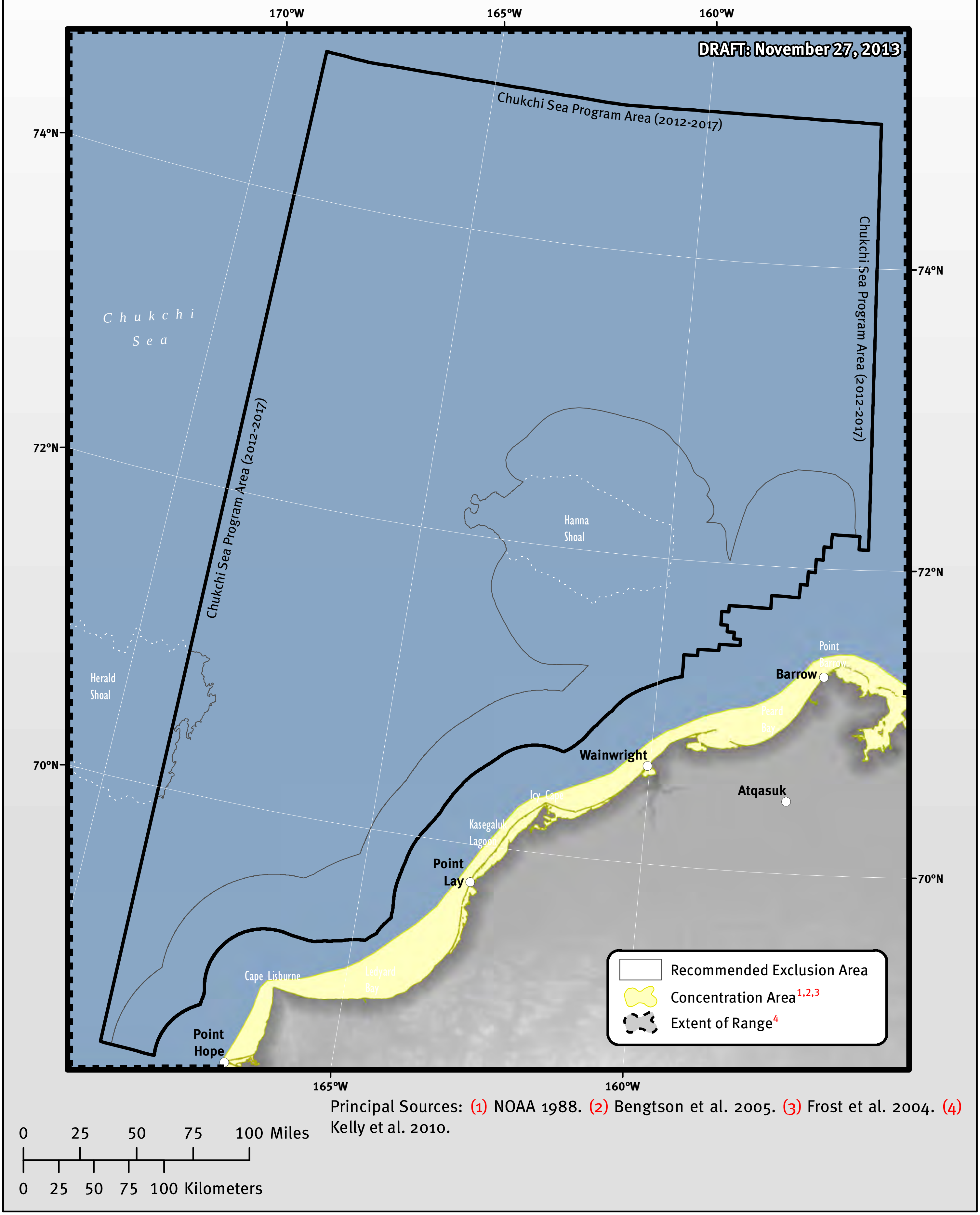
Principal Sources: (1) Oceana 2013a. Based on: (a) NOAA 1988. (b) Bengtson et al. 2005. (c) Suydam, personal communication. (d) NOAA Office of Response and Restoration 2005. (2) Cameron et al. 2010.

Bearded Seal Spring Concentration Area Data Sources



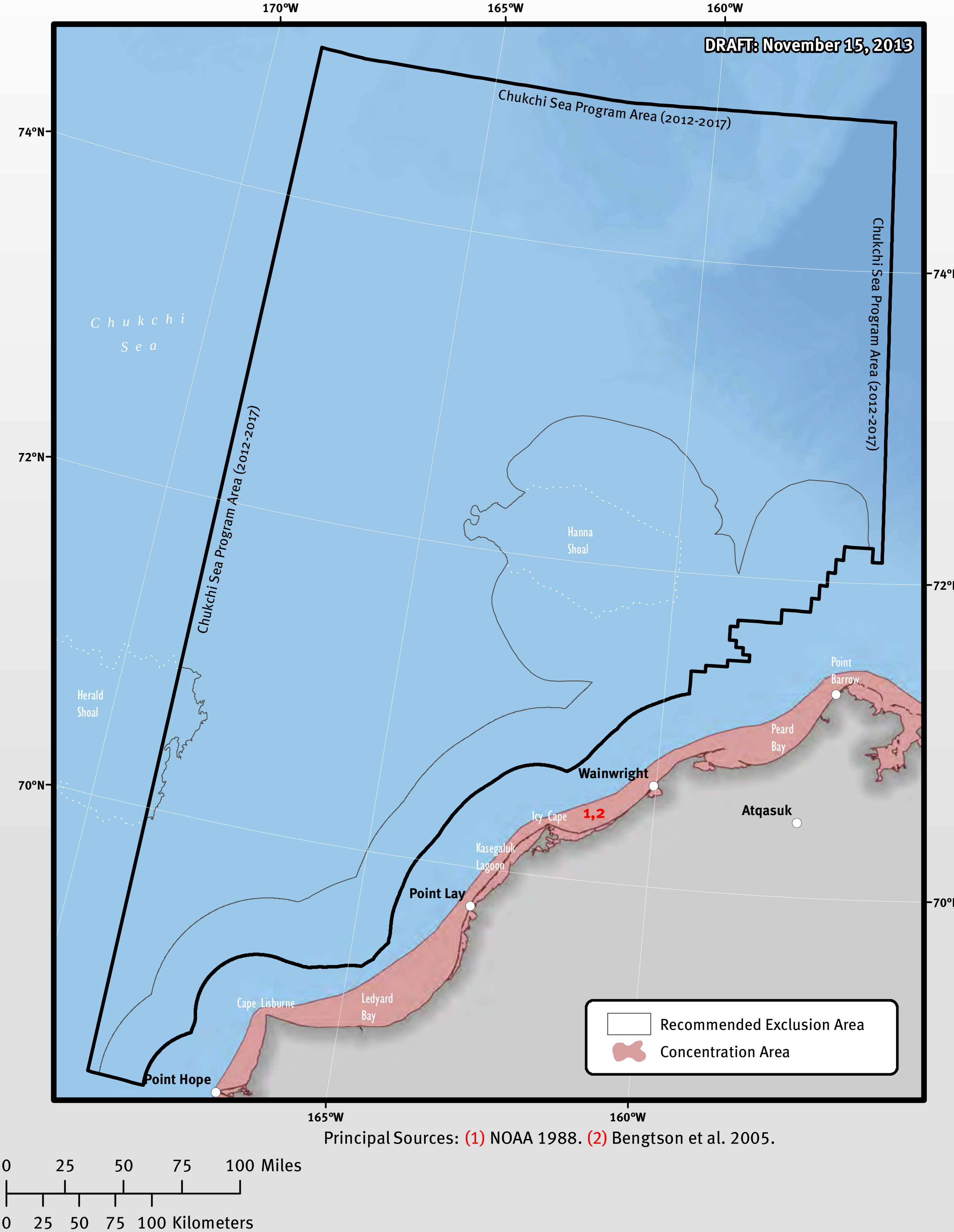
Principal Sources: (1) Oceana 2013a. Based on: (a) NOAA 1988. (b) Bengtson et al. 2005. (c) Suydam, personal communication. (d) NOAA Office of Response and Restoration 2005.

Ringed Seal Concentration Areas



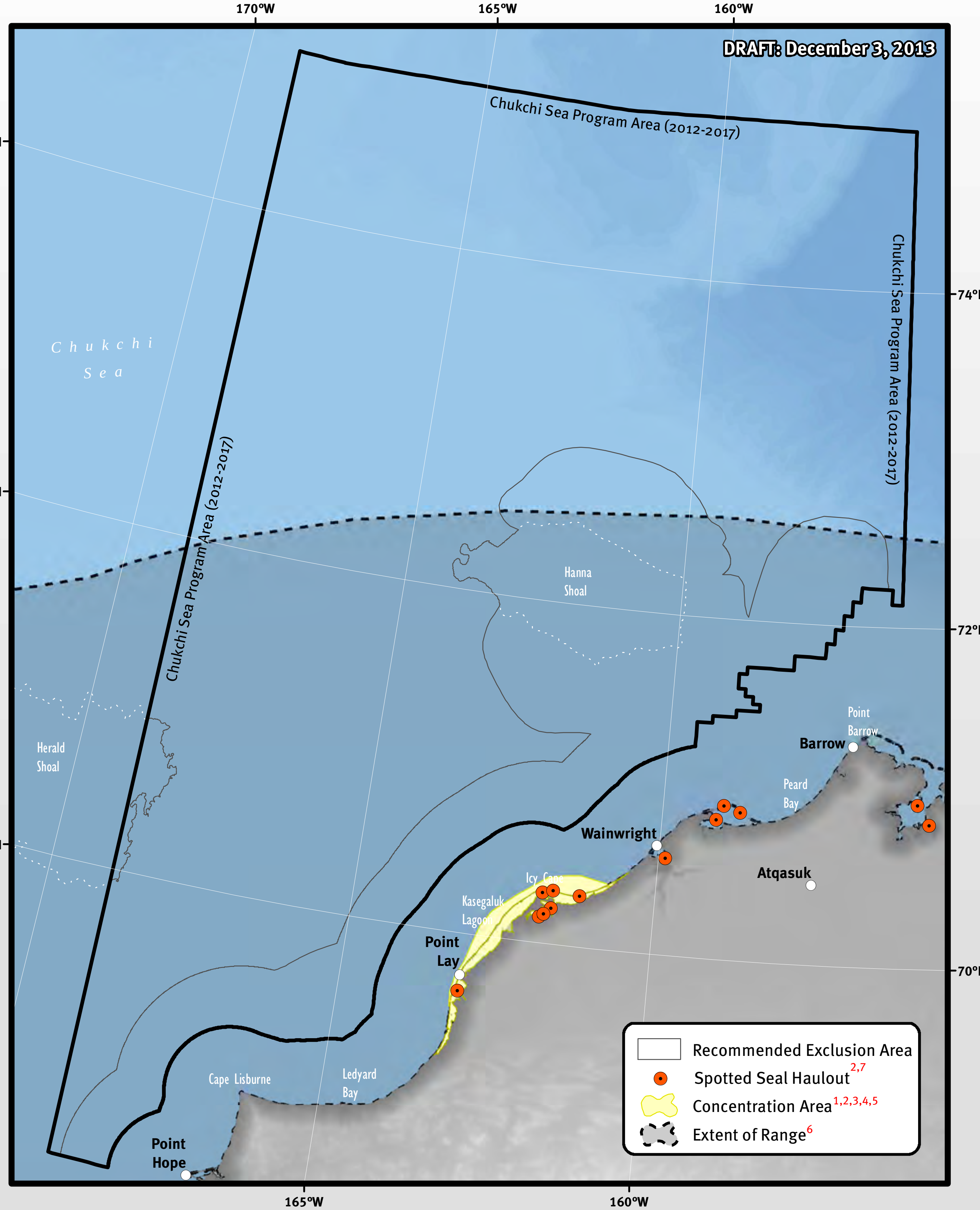
Principal Sources: (1) NOAA 1988. (2) Bengtson et al. 2005. (3) Frost et al. 2004. (4) Kelly et al. 2010.

Ringed Seal Concentration Area Data Sources



Principal Sources: (1) NOAA 1988. (2) Bengtson et al. 2005.

Spotted Seal Concentration Areas

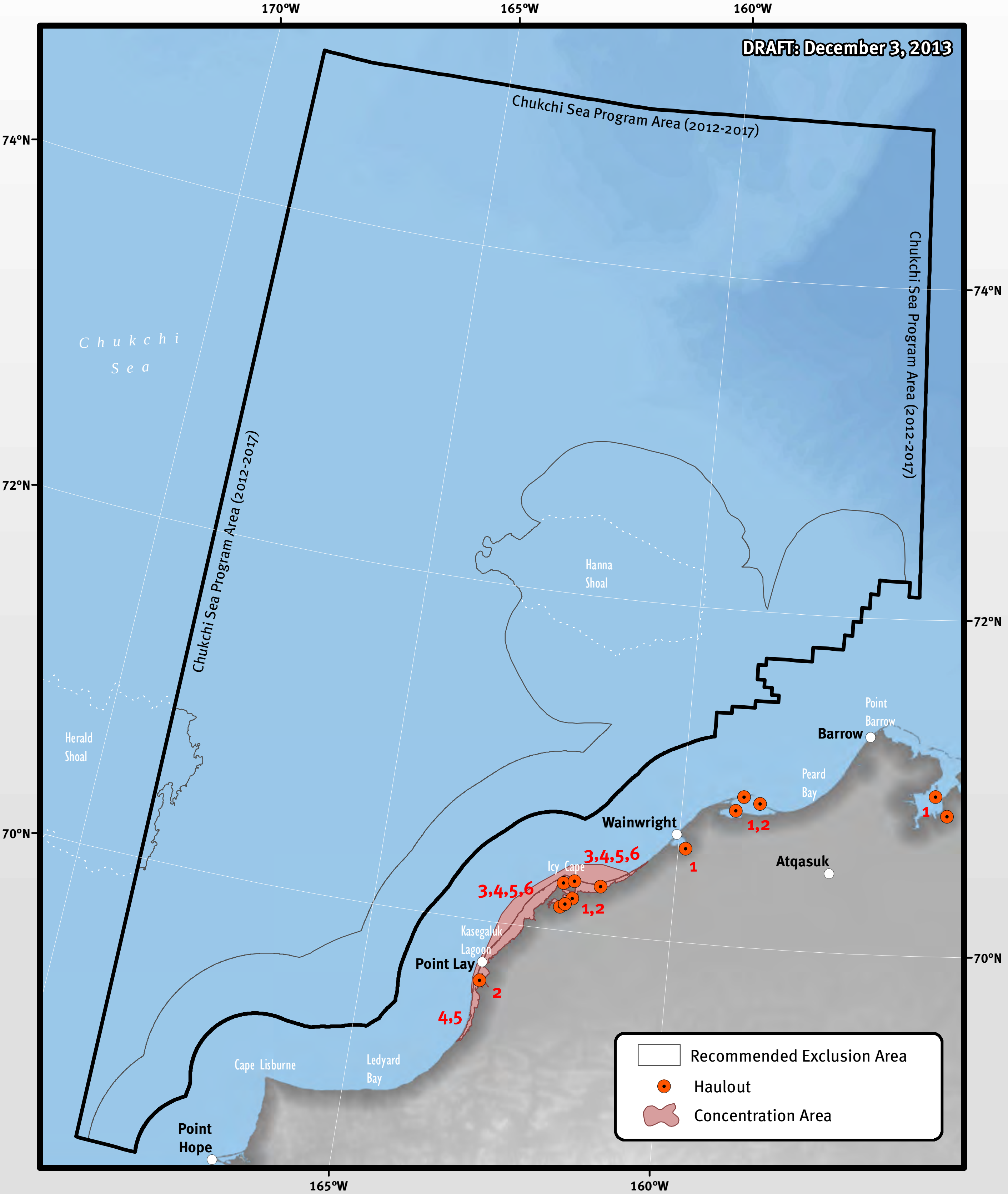


Principal Sources: (1) Lowry et al. 1998. (2) NOAA Office of Response and Restoration 2005. (3) Rugh et al. 1997. (4) ADFG Habitat and Restoration Division 2001. (5) Frost et al. 1993. (6) Boveng et al. 2009. (7) Huntington et al. 2012.

0 25 50 75 100 Miles

0 25 50 75 100 Kilometers

Spotted Seal Concentration Area Data Sources

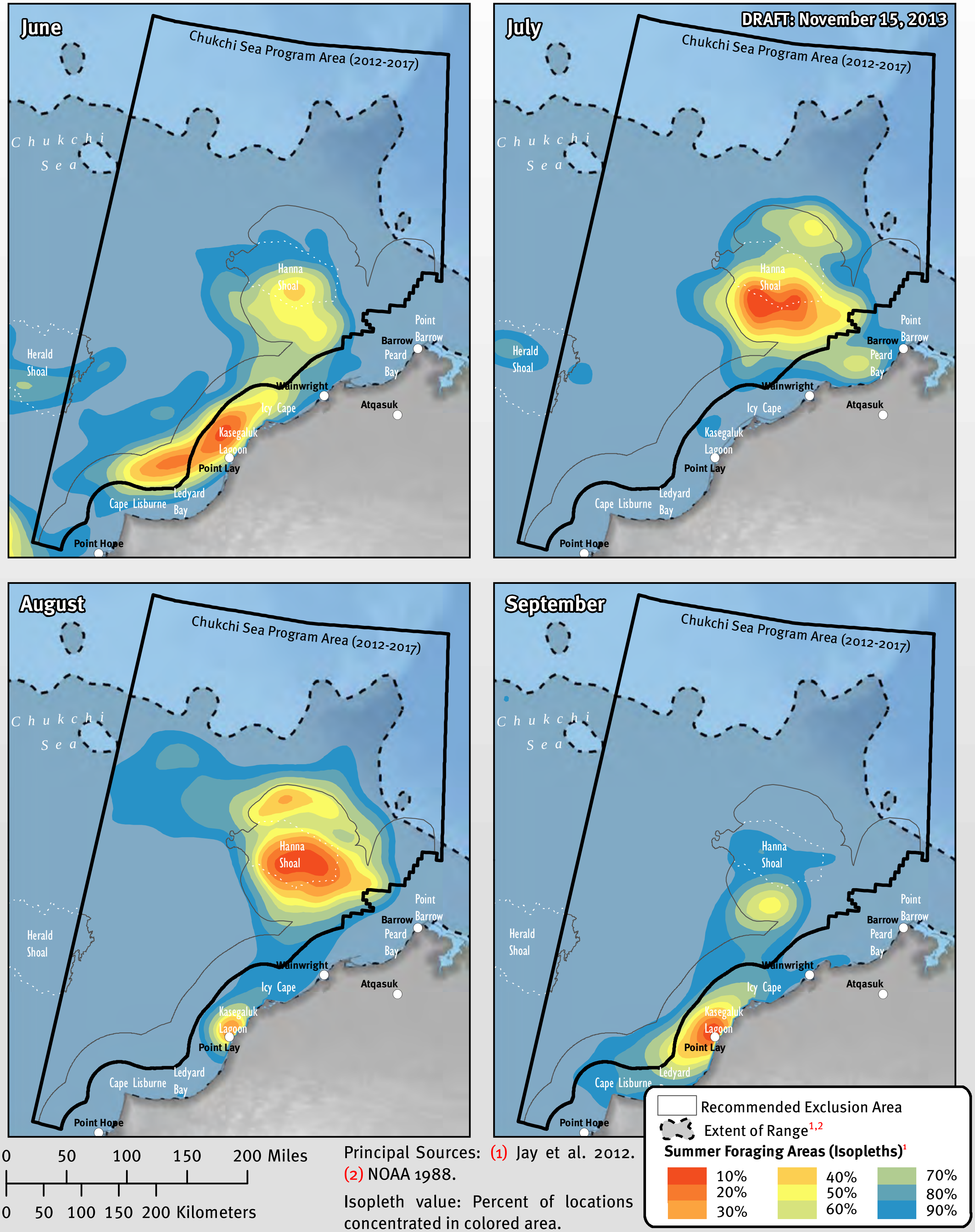


0 25 50 75 100 Miles

0 25 50 75 100 Kilometers

Principal Sources: (1) NOAA Office of Response and Restoration 2005. (2) Huntington et al. 2012. (3) Lowry et al. 1998. (4) Rugh et al. 1997. (5) ADFG Habitat and Restoration Division 2001. (6) Frost et al. 1993.

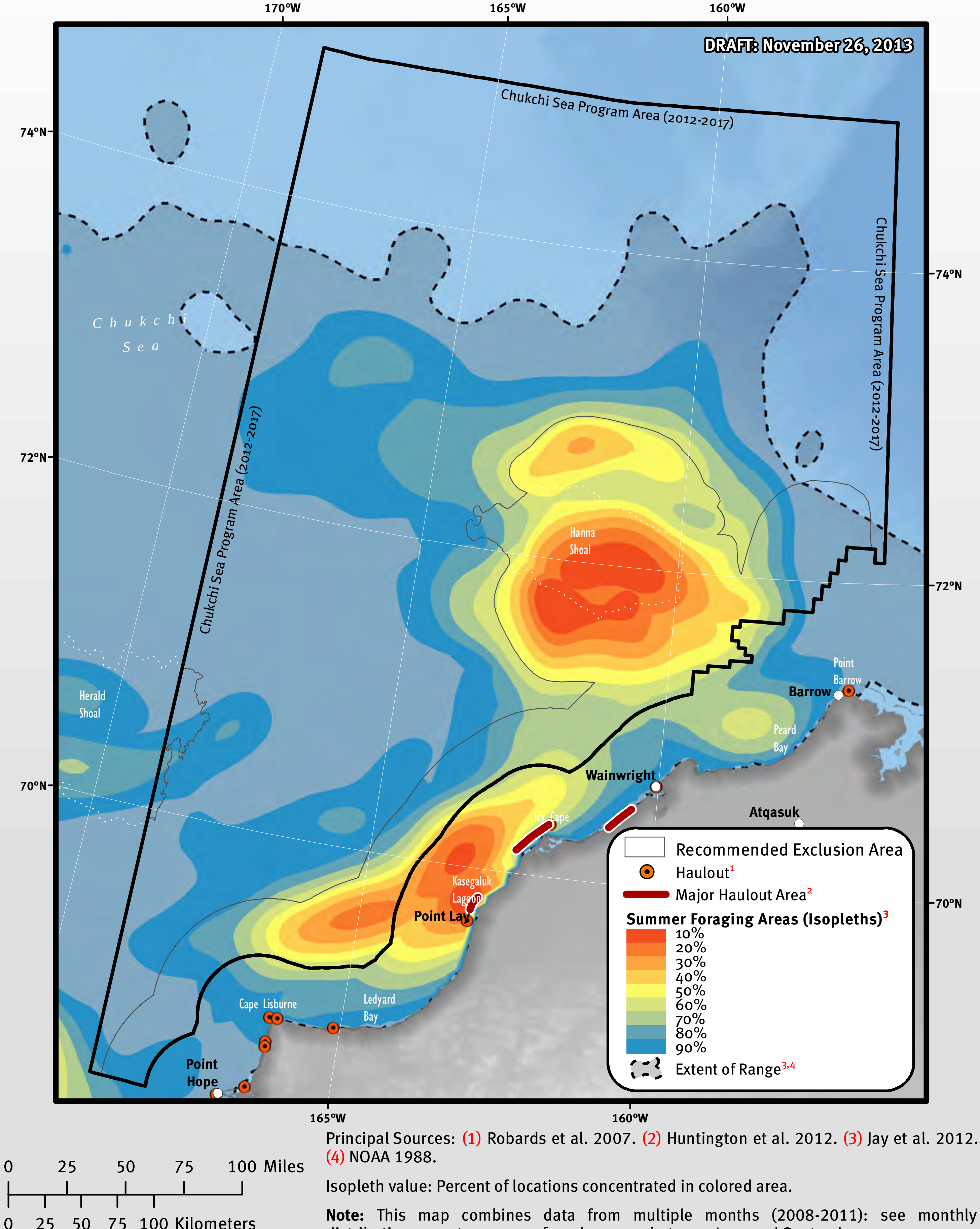
Walrus Summer Foraging Areas, By Month (2008-2011)



Principal Sources: (1) Jay et al. 2012. (2) NOAA 1988.

Isopleth value: Percent of locations concentrated in colored area.

Combined Walrus Summer Foraging and Haulout Areas

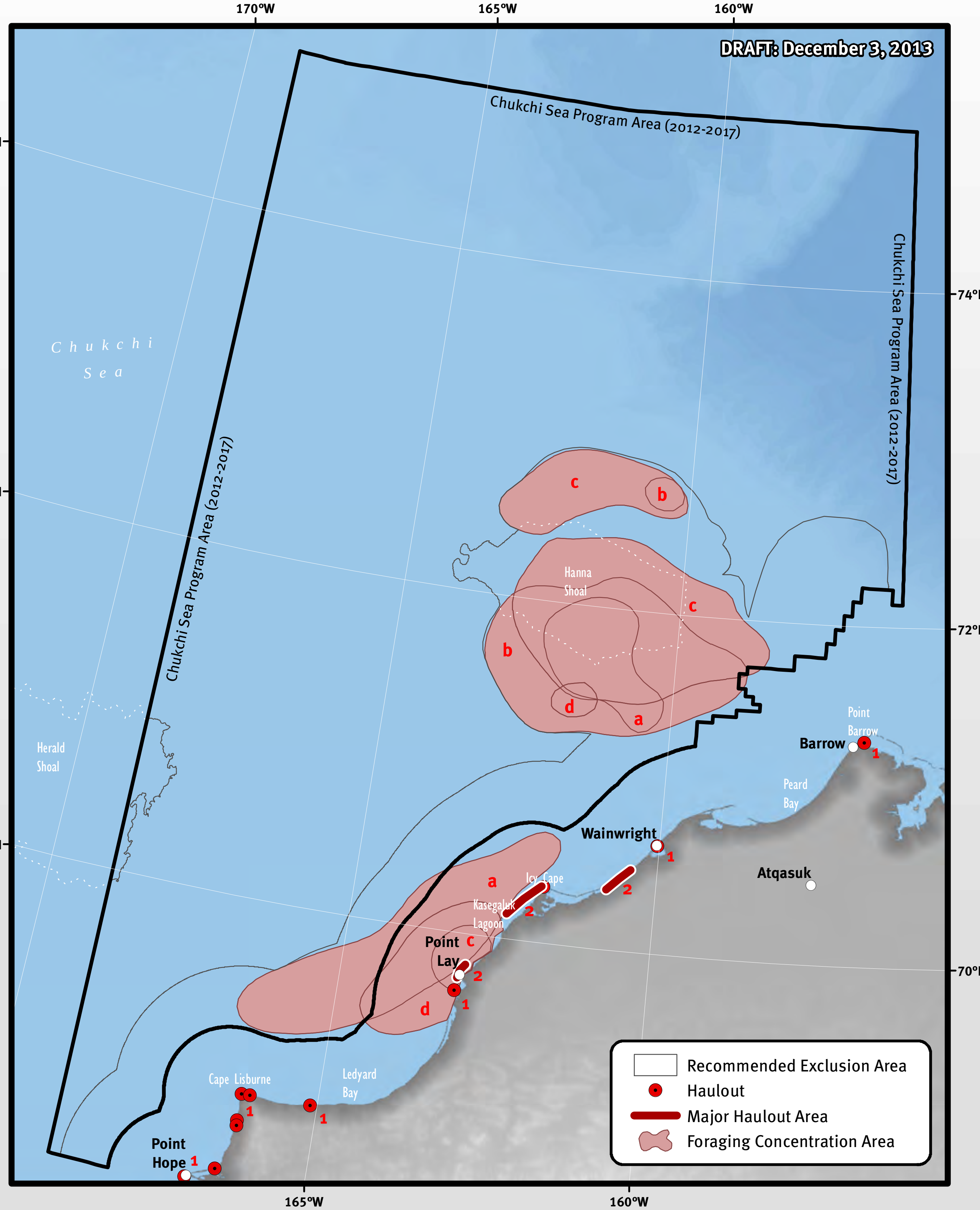


Principal Sources: (1) Robards et al. 2007. (2) Huntington et al. 2012. (3) Jay et al. 2012. (4) NOAA 1988.

Isopleth value: Percent of locations concentrated in colored area.

Note: This map combines data from multiple months (2008-2011): see monthly distribution maps to compare foraging areas between June and September.

Walrus Summer Foraging Data Sources

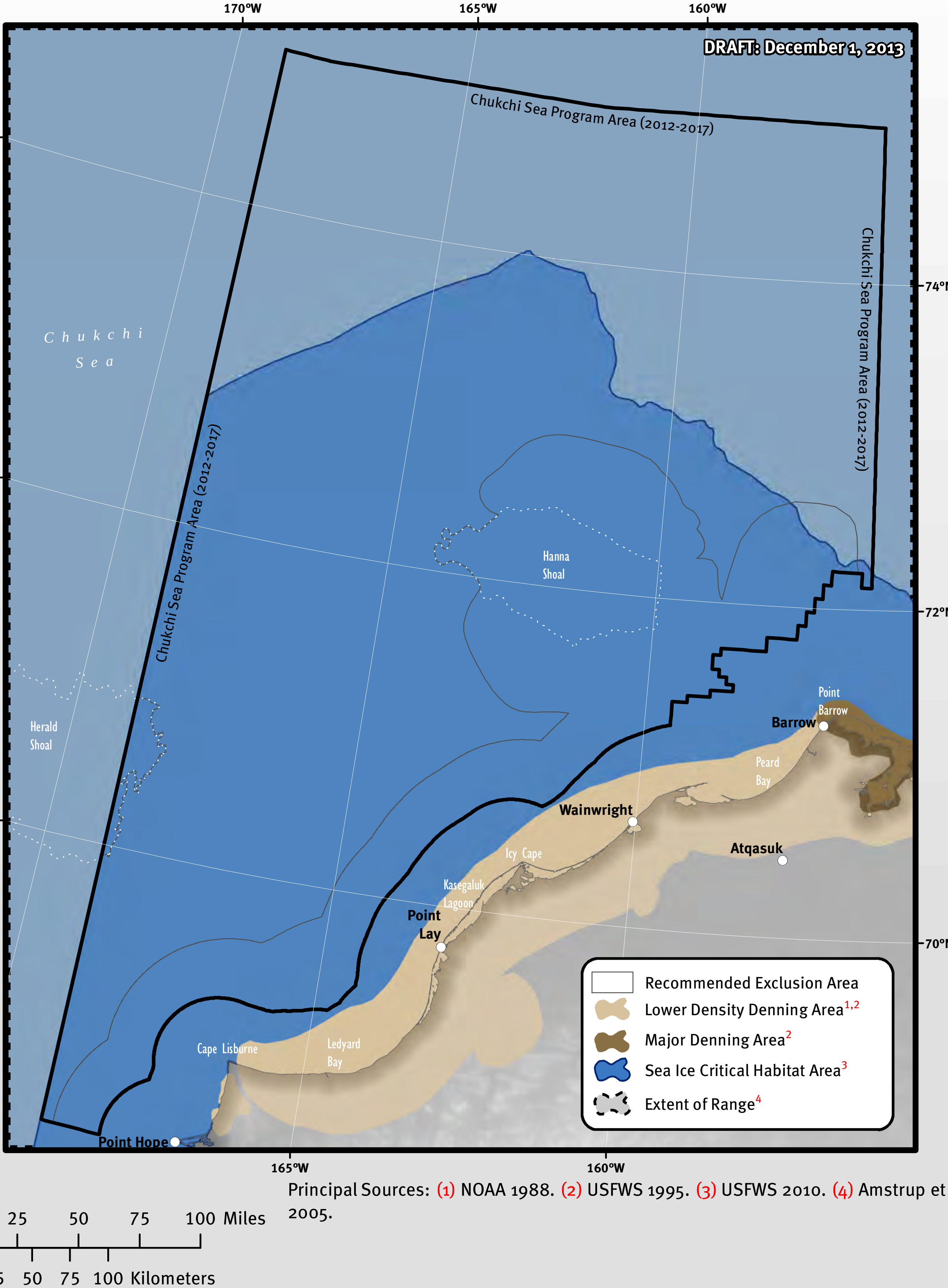


Principal Sources: (1) Robards et al. 2007. (2) Huntington et al. 2012. (3) Jay et al. 2012. Based on the following months: (a) June (b) July (c) August (d) September

0 25 50 75 100 Miles

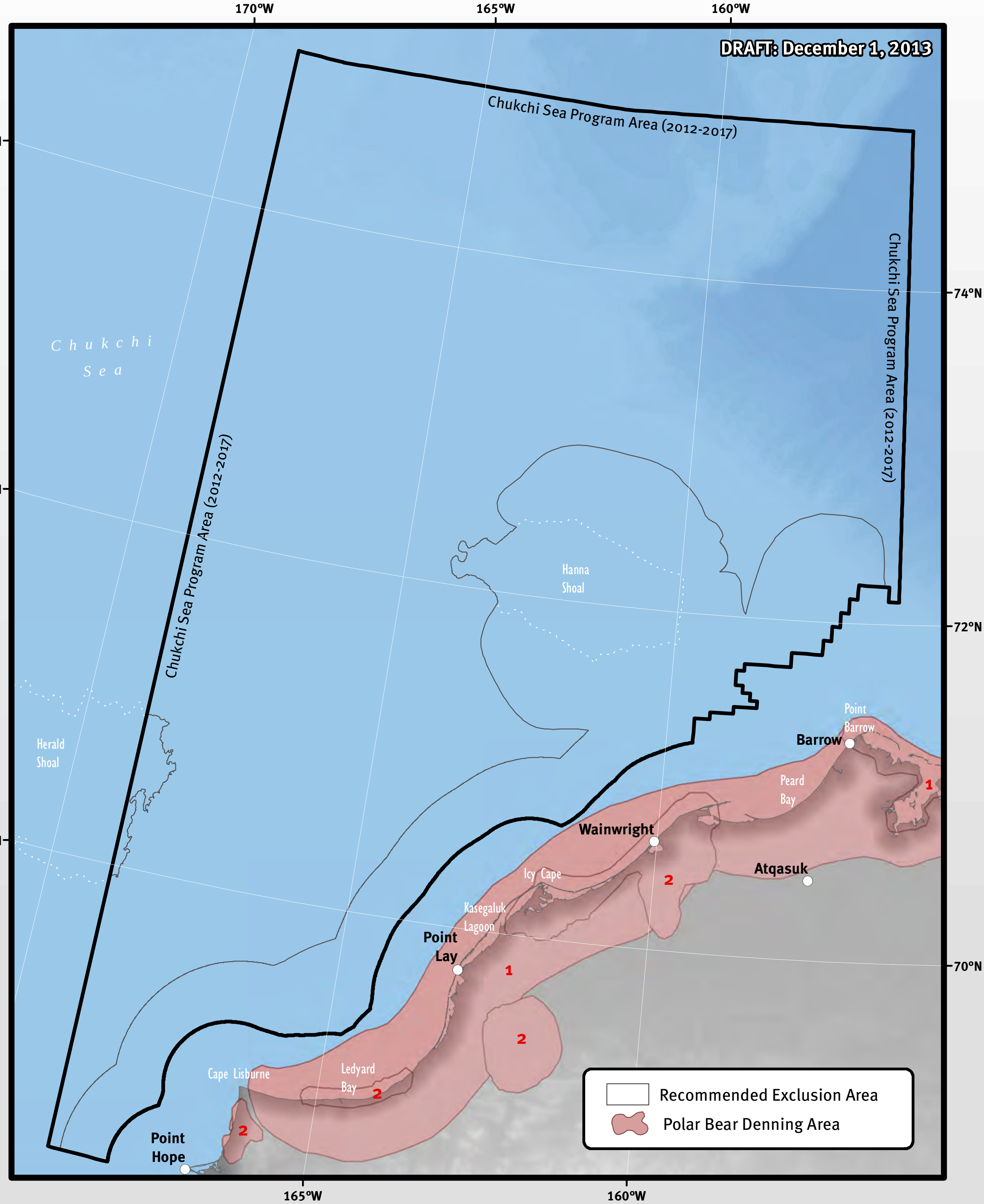
0 20 40 60 80 Kilometers

Polar Bear Denning And Feeding Areas



Principal Sources: (1) NOAA 1988. (2) USFWS 1995. (3) USFWS 2010. (4) Amstrup et al. 2005.

Polar Bear Denning Area Data Sources

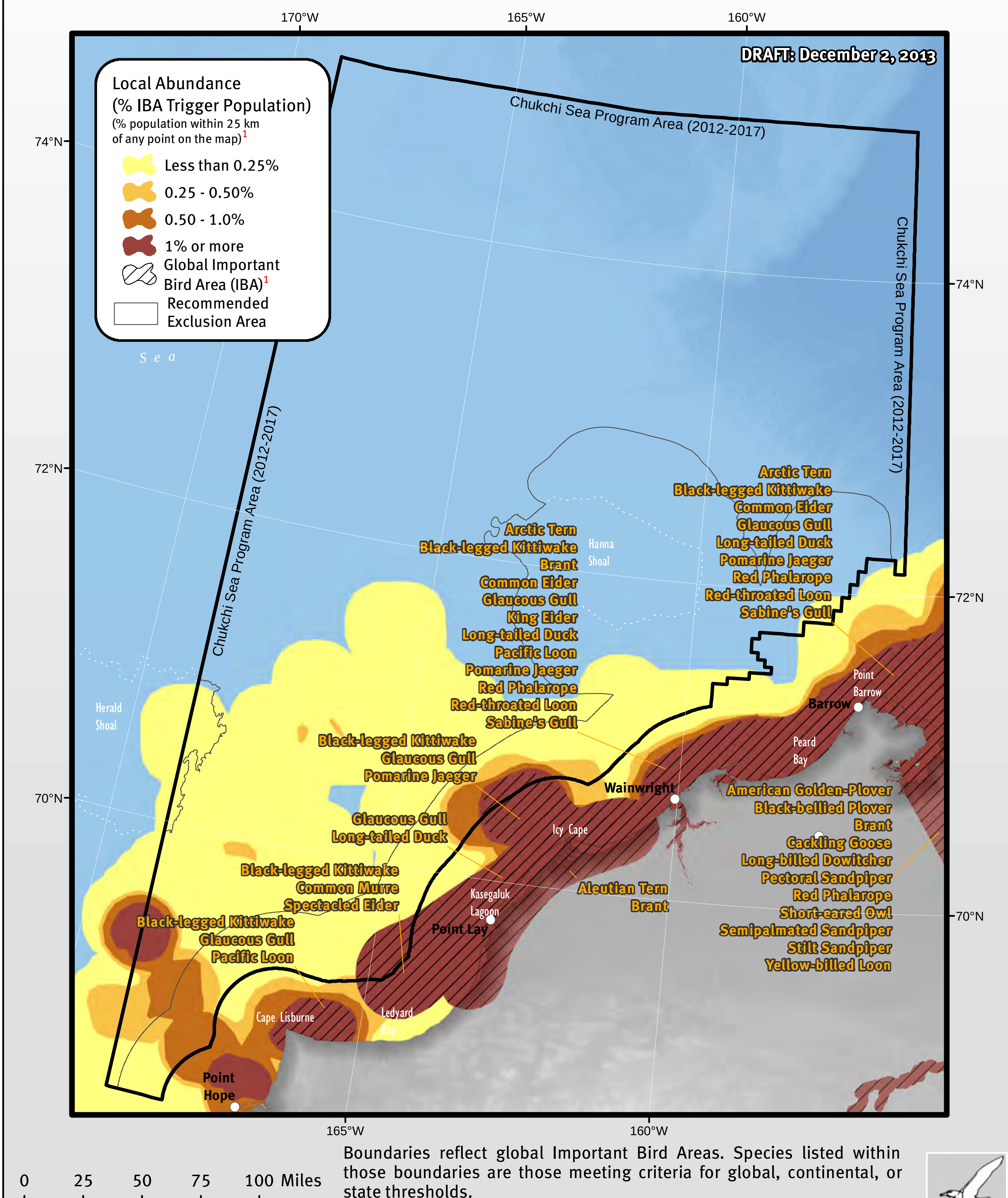


Principal Sources: (1) NOAA 1988. (2) USFWS 1995.

0 25 50 75 100 Miles

0 25 50 75 100 Kilometers

Important Bird Areas

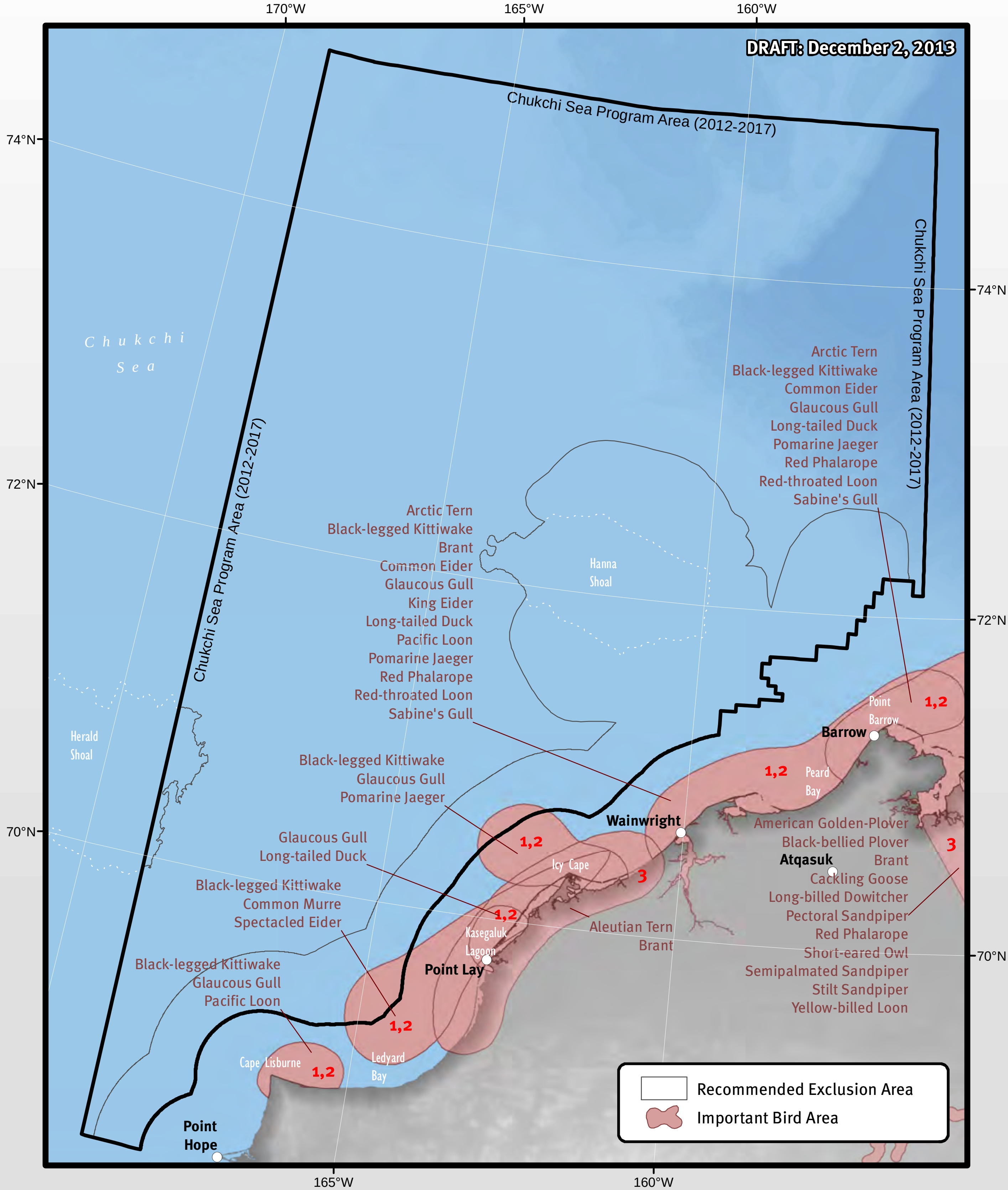


Boundaries reflect global Important Bird Areas. Species listed within those boundaries are those meeting criteria for global, continental, or state thresholds.

Principal Sources: (1) Smith et al. 2012. (2) Smith et al. in review. (3) Audubon Alaska 2008.

NPPSD

Important Bird Area Data Sources



0 25 50 75 100 Miles

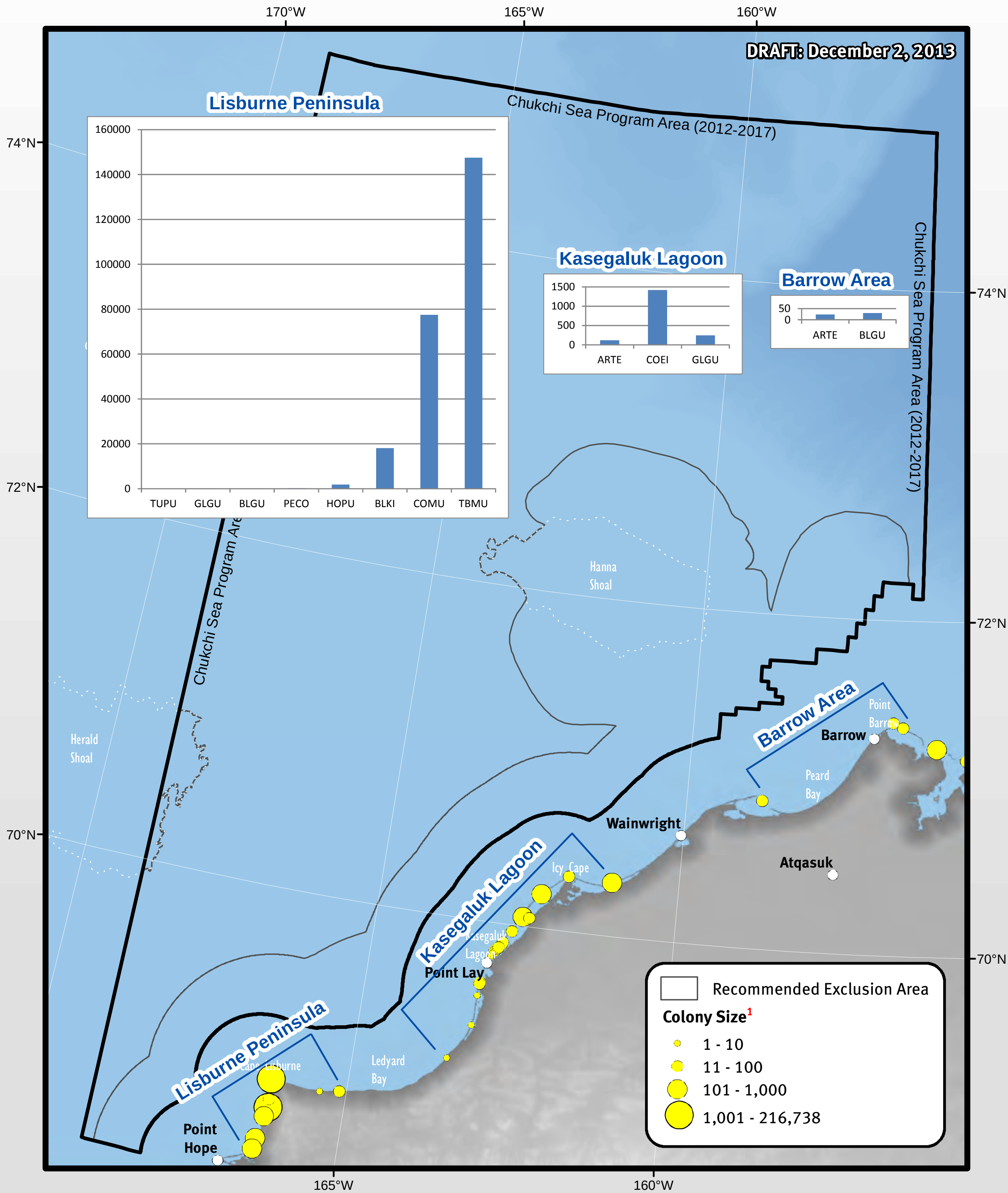
0 25 50 75 100 Kilometers

Species listed are those meeting criteria for global, continental, and state Important Bird Areas.

Principal Sources: (1) Smith et al. 2012. (2) Smith et al. in review. (3) Audubon Alaska 2008.

NPPSD

Bird Colonies



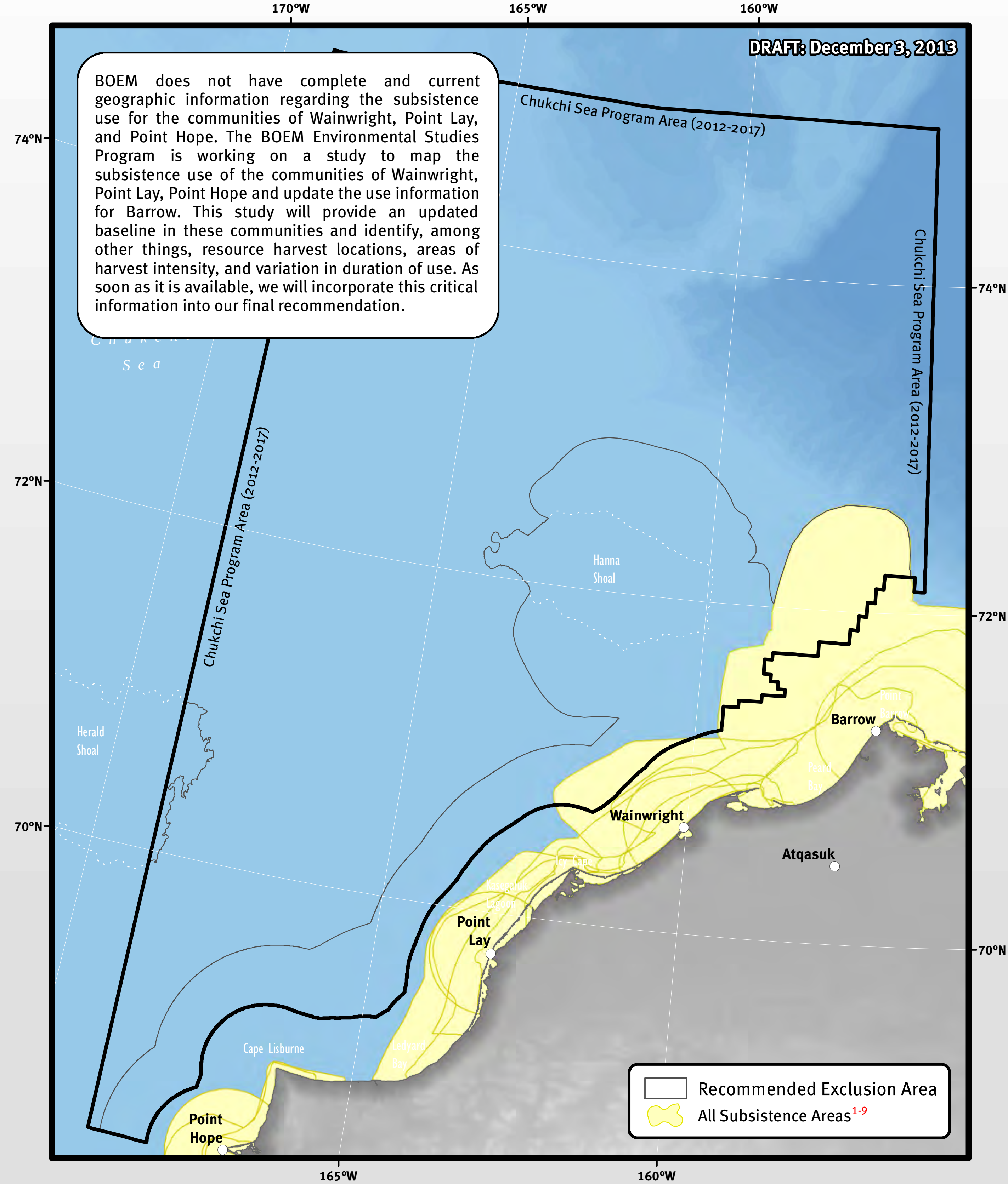
0 25 50 75 100 Miles

0 25 50 75 100 Kilometers

Principal Sources: (1) World Seabird Union 2011.

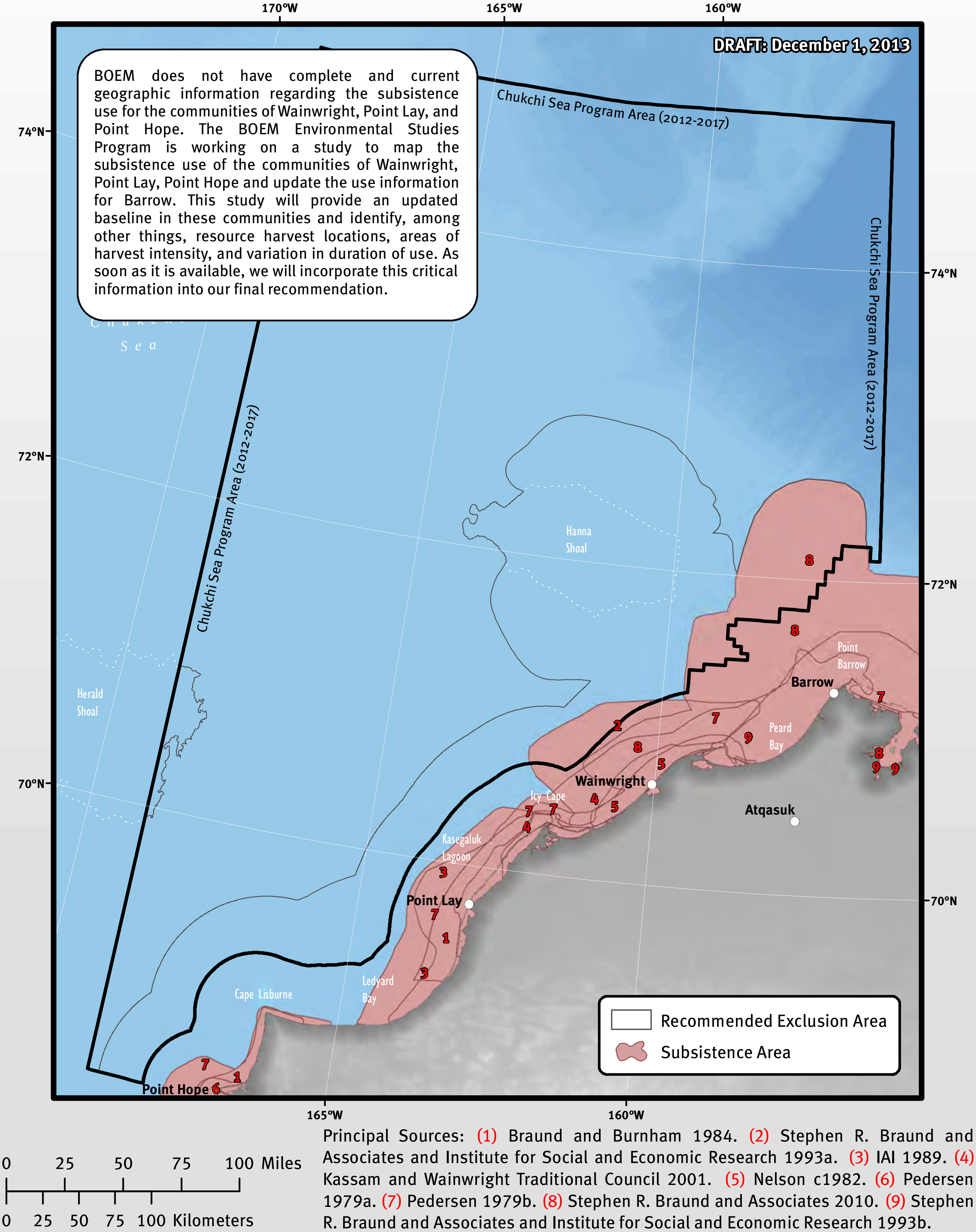
ARTE: Arctic tern; BLGU: black guillemot; BLKI: black-legged kittiwake; COEI: common eider; COMU: common murre; GLGU: glaucous gull; HOPU: horned puffin; PECO: pelagic cormorant; TBMU: thick-billed murre; TUPU: tufted puffin.

Summary of Subsistence Studies Publicly Available to Date of Publication



Principal Sources: (1) Braund and Burnham 1984. (2) Stephen R. Braund and Associates and Institute for Social and Economic Research 1993a. (3) IAI 1989. (4) Kassam and Wainwright Traditional Council 2001. (5) Nelson c1982. (6) Pedersen 1979a. (7) Pedersen 1979b. (8) Stephen R. Braund and Associates 2010. (9) Stephen R. Braund and Associates and Institute for Social and Economic Research 1993b.

Subsistence Area Data Sources



Principal Sources: (1) Braund and Burnham 1984. (2) Stephen R. Braund and Associates and Institute for Social and Economic Research 1993a. (3) IAI 1989. (4) Kassam and Wainwright Traditional Council 2001. (5) Nelson c1982. (6) Pedersen 1979a. (7) Pedersen 1979b. (8) Stephen R. Braund and Associates 2010. (9) Stephen R. Braund and Associates and Institute for Social and Economic Research 1993b.

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Recommended Exclusion Areas

a) Braund and Burnham (1984)
b) Stephen R. Braund and Associates and Institute of Social and Economic Research (1993b)
c) Impact Assessment Inc. (1989)
d) Kassam and Wainwright Traditional Council (2001)
e) Nelson (c1982)
f) Pedersen (1979a)
g) Pedersen (1979b)
h) Stephen R. Braund and Associates (2010)
i) Stephen R. Braund and Associates and Institute of Social and Economic Research (1993a)
j) Jay et al. (2012)
k) Smith et al. (2012)
l) Smith et al. (in review)

Petroleum Potential

1. BOEM (2012)

Seafloor Depth

1. Audubon Alaska (2009a), based on:
    a. Alaska Ocean Observing System (2009)

Important Ecological Area – Ecosystem Analysis

1. Oceana (2013d)

Primary Productivity

1. Oceana (2013c), based on:
    a. Grebmeier et al. (2006)

Seafloor Biomass

1. Audubon Alaska (2009c), based on:
    a. Grebmeier et al. (2006)

Sea Ice Extent (2008-2012)

1. Audubon Alaska (2013c), based on:
    a. National Snow and Ice Data Center (2013)

Marine Mammal Observations (1979-2011)

1. NOAA Fisheries (2013)

Marine Bird Observations (1974-2009)

1. Drew and Piatt (2011)

Marine Bird Observations (1974-2009): Survey Effort

1. (Audubon Alaska 2013a), based on:
    a. Drew and Piatt (2011)

Bowhead Whale Fall Feeding and Migration Concentration Areas

1. Quakenbush et al. (2010)
2. Angliss and Outlaw (2008)
3. Audubon Alaska (2009b), based on:
    a. ADFG (2009)

Bowhead Whale Spring Feeding and Migration Concentration Areas

1. Oceana (2013b), based on:
    a. NOAA (1988)
    b. Quakenbush et al. (2013)
    c. Kassam and Wainwright Traditional Council (2001)
    d. Quakenbush and Huntington (2010)
    e. Angliss and Outlaw (2008)
2. Quakenbush et al. (2012)
3. Angliss and Outlaw (2008)
4. Audubon Alaska (2009b), based on:
    a. ADFG (2009)

Beluga Feeding, Calving and Migration Concentration Areas

1. Oceana and Audubon Alaska (2013), based on:
    a. Moore et al. (1993)
    b. Kassam and Wainwright Traditional Council (2001)
    c. NOAA (1988)
    d. Moore et al. (2000)
    e. Huntington et al. (1999)
    f. Frost et al. (1993)
    g. NOAA Office of Response and Restoration (2005)
    h. Suydam and Alaska Department of Fish and Game (2004)

i. Bureau of Land Management (2003)
j. Frost and Lowry (1990)
k. Suydam et al. (2001)
l. Suydam et al. (2005)
m. Richard et al. (2001)
n. Moore and Clarke (1991)
o. Clarke et al. (1993)
2. Angliss and Outlaw (2008)
3. NOAA (1988)

Marine Mammal Observations (1979-2011): Survey Effort

1. Audubon Alaska (2013b), based on:
    a. NOAA Fisheries (2013)

Gray Whale Concentration Areas

1. Audubon Alaska and Oceana (2013), based on:
    a. NOAA Fisheries (2013)
    b. Clarke et al. (1989)
    c. Moore (2000)
    d. Moore and Clarke (1992)
    e. Moore et al. (2000)
    f. Clarke et al. (2011a)
    g. Clarke et al. (2011b)
    h. Clarke and Ferguson (2010)
2. Angliss and Outlaw (2008)

Bearded Seal Spring Concentration Areas

1. Oceana (2013a), based on:
    a. NOAA (1988)
    b. Bengtson et al. (2005)
    c. R. Suydam, personal communication
    d. NOAA Office of Response and Restoration (2005)
2. Cameron et al. (2010)

Ringed Seal Concentration Areas

1. NOAA (1988)
2. Bengtson et al. (2005)
3. Frost et al. (2004)
4. Kelly et al. (2010)

Spotted Seal Concentration Areas

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2. NOAA Office of Response and Restoration (2005)
3. Rugh et al. (1997)
4. Alaska Department of Fish and Game Habitat and Restoration Division (2001)
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6. Boveng et al. (2009)
7. Huntington et al. (2012)

Combined Walrus Summer Foraging and Haulout Areas

1. Robards et al. (2007)
2. Huntington et al. (2012)
3. Jay et al. (2012)
4. NOAA (1988)

Polar Bear Denning and Feeding Areas

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APPENDIX B

BIOLOGICAL VALUES AND SUPPORTING SCIENCE FOR PROPOSED EXCLUSION AREAS

This appendix describes the data sources and spatial information cited on our maps and used in our spatial analyses. It provides information relating to:

- Cetaceans (bowhead whales, beluga whales, and gray whales);
- Pinnipeds (walrus, ringed seal, spotted seal, and bearded seal);
- Polar bears;
- Marine birds;
- Lower trophic levels and physical features (primary productivity, benthic biomass, sea ice);
- Subsistence; and
- Important ecological areas (IEAs).

We begin with a brief introduction of each topic, focusing on the key features relative to the Chukchi Sea Planning Area. Then, we list and explain the principal data sources that informed our GIS analyses. We summarize the key information from each source, and document with reference to specific page and figure numbers the text or maps that describe concentration areas or other relevant data.

1. CETACEANS

1.1 Bowhead Whale

The bowhead whale (*Balaena mysticetus*) population that uses the Chukchi Sea Planning Area is the Western Arctic Stock (Allen and Angliss 2013). The Western Arctic Stock winters (December to March) in the Bering Sea, and migrates to the Beaufort Sea in spring (April through May) to summertime foraging grounds. In the fall (October through December) they migrate back to the Bering Sea (Moore et al. 1993). Bowhead whales are closely associated with sea ice for much of the year, with the exception of their time at summering grounds, particularly in recent years. Their spring migration route travels along the shear zone between the shorefast and pack ice. In the Chukchi Sea, their route passes the coastal communities of Point Hope, Point Lay, Wainwright, and Barrow. During the fall migration, bowhead whales follow continental slope habitat along the Beaufort Sea coast (Moore 2000). After passing Point Barrow, they move across the Chukchi Sea toward the Russian coastline toward the Bering Strait and St. Lawrence Island. There is high variability from year to year in how they cross the northeastern Chukchi Sea shelf; however, there is evidence that their migration route is influenced by feeding hotspots (Quakenbush et al. 2013). Along these migratory pathways are important areas for foraging and resting, known both by systematic surveys and traditional knowledge of hunters. The bowhead whale subsistence hunt has a central cultural role in the subsistence way of life of some coastal communities, and it plays an important role in the health and well-being of many Arctic peoples, from communities in the Bering Strait region to the Beaufort Sea.

The mapped concentration areas for bowhead whales are based on the following scientific source materials.

- **Spring migration corridor following the Chukchi nearshore lead system**
  - Spring migration routes for bowhead whales in the Chukchi Sea are known from traditional knowledge documentation (Kassam and Wainwright Traditional Council 2001).
    - Figure 17, found on page 35, depicts a generalized map showing bowhead whale hunting sites along the Chukchi Sea nearshore lead system.
    - Page 61 describes the importance of bowhead whales to the community and the sensitivity of bowhead whales to disturbance during the spring migration. "*Spring bowhead hunting is essential to the community of Wainwright from both a dietary and a cultural point of view. Preparation for the hunt is undertaken at both household and community levels…. Bowhead hunting is very sensitive to sea ice conditions and seismic activities by the oil and gas sector.*"
  - Spring migration movements of bowhead whales relative to shoreline points in the Chukchi Sea are known from recent traditional knowledge documentation (Quakenbush and Huntington 2010).
    - Quakenbush and Huntington (2010) conducted semi-directed interviews with a single group discussion consisting of seven bowhead whaling captains with 35 years of combined whaling experience.
    - Page 7 describes seasonal spring movements. "*The movements of bowhead whales near Wainwright are determined primarily by ice conditions. Leads in the local area affect local distribution, whereas the condition of leads to the south influences the timing of the migration as a whole. The prevailing east-northeast winds tend to open the leads near Wainwright, with currents playing a role, too. West winds tend to close the lead, making whaling impossible. When the lead is closed, the whales travel farther from the shorefast ice. Currents are stronger by Point Belcher, and there is a strong current near the Kuk River mouth by Wainwright in late May and early June (Fig. 1). The whales often follow the shorefast ice edge, but may also travel directly from the Icy Cape area to the Point Belcher area, staying farther offshore as they pass the village. Wainwright whalers hear from St. Lawrence Island whalers and from Point Hope whalers that bowheads are migrating. They expect bowhead whales to reach the Wainwright area about a week after they reach Point Hope, depending on ice conditions in between.*"
    - Figure 2, found on page 17, shows the migration path, feeding areas and calving areas relative to the shoreline features of the Chukchi Sea coastline.

    - Page 12 discusses the sensitivity to disturbance of bowhead whales during spring migration: "*The whalers are concerned about how seismic operations may affect whaling and recalled an event in 1968 where they believe seismic activity on the ice in the spring affected their whaling success. Information about seismic testing in the 1960s is difficult to obtain. Federal records at the MMS office in Anchorage show permits were issued for open water seismic in 1968 for fall only. We have no information about such activities in state waters. The best available harvest records show that Wainwright landed two bowhead whales in 1968 and none in 1967 (Marquette and Bockstoce 1980) indicating that the year of the event may have been different. Regardless of the specific details of what occurred in the late 1960s, the whalers base their concerns about seismic activity on their past experiences as well as available information about current and planned activities.*"

- Satellite tracking results from 2006–2010 document bowhead whales migrating during spring along the nearshore Chukchi Sea lead system (Quakenbush et al. 2012).
    - Between the years 2006 and 2010, 57 satellite transmitters were deployed primarily by subsistence hunters. Thirty-seven transmitters were deployed near Barrow, Alaska with seven of these during the spring migration and 30 during the fall migration. Twenty were deployed near the Mackenzie River delta, all during the fall migration.
    - Areas of concentrated use were determined by kernel density estimation. Quakenbush et al. (2010a) page 293 describes the methodology. "*Kernel density estimation is a non-parametric method for calculating the probability that an animal occurs within a defined area. Such probability distributions are also known as utilization distributions (e.g., Kernohan et al., 2002); however, we use the term "kernel density" because it describes the method used to generate the probability distribution of animal locations.*"
    - While this method may help identify where tagged bowhead whales may have spent more time where their signal may be picked up at the surface, it may underestimate the importance of areas where tagged bowhead whales may spend less time at the surface of the water.
    - In 2009 the tagged bowhead whales departed the Bering Sea between 31 March and 27 April beginning their annual spring migration to the Arctic Ocean. In 2010, 5 of 6 tagged bowhead whales left the Bering Sea between 10 and 22 April.
    - Page 9 describes the timing of the migration at Point Barrow, where the migrating bowhead whales move from the Chukchi Sea into the Beaufort Sea. "*The tracks northward to Point Barrow varied in distance from shore but most traveled on the U.S. side of the International Dateline (Fig. 9). A total of 12 tagged bowhead whales passed the spring bowhead survey station (i.e., "the observation perch") near Point Barrow; five bowhead whales passed between 16 April and 7 May in 2009, four passed between 23 April and 1 May in 2010, and three passed between 19 April and 5 May in 2011. Half of the tagged whales (6 of 12) passed the observation perch when leads were closed and whales could*

not be visually counted by observers. Leads were closed when one whale passed in 2009 (Fig 10a), when three passed in 2010 (Fig. 10b), and when two passed in 2011… However, it was clear that all tagged whales migrated within 20 km of the observation perch (Citta et al. In prep.)."

  - Page 9 describes both the distance from shore and the routing animals traveled past Point Barrow, where the migrating bowhead whales move from the Chukchi Sea into the Beaufort Sea. "*Bowhead whales traveled 6–18 km north of Point Barrow before turning east to cross the Beaufort Sea. The route used by a whale in 2006 was farther north than that used by seven whales in 2009 (Fig. 11). In 2009, all whales used a similar route, despite not traveling together. In 2010, however, two of eight whales used a similar route to the 2006 whale while the other six used a route similar to the 2009 whales.*"

- Satellite tracking results from 2010-2012 document bowhead whales migrating during spring along the nearshore Chukchi Sea lead system (Quakenbush et al. 2013).
  - Page 26 describes the route that satellite tagged bowhead whales traveled along the nearshore Chukchi Sea lead system and use of the northeastern Chukchi Sea during the spring migration. "*Until 2010, tagged whales traveled north along the Alaska coast mostly east of the eastern boundary of the Chukchi lease sale area (Fig. 19) towards Point Barrow then on to Amundsen Gulf, Canada (Fig. 20). Whale B09-09, however, migrated later in the spring than the other tagged whales, leaving the Bering Sea ~26 May and traveled up the west side of the Chukchi Sea instead of the east side (Fig. 21). By 14 June 2010 this whale was west of Wrangel Island (Fig. 8) (Quakenbush et al. 2010b, 2012). Between mid June and 21 August 2010, B09-09 remained in the Chukchi Sea (Fig. 8) and this is the only whale tagged during the spring in any year that has not passed Barrow and entered the Beaufort Sea.*"
  - Page 30 describes the migratory pathway of satellite tagged bowhead whales in the nearshore Chukchi Sea lead system. "*Chukchi Sea Lease Area 193. The route of the spring migration follows the Alaska coast to Point Barrow and few whales entered Area 193 or the leased blocks (Fig. 19). During the spring migration, whales transmitted within Area 193 between 16 April and 5 May (Fig. 23).*"
- Spring migration routes from NOAA (1988).
  - Section 3.75 of the NOAA atlas (1988) states that in "April-June: occur mostly from vicinity of St. Lawrence Island through Bering Strait to vicinity of Pt. Hope, then along eastern Chukchi flaw zone to Pt. Barrow, and via offshore leads to Banks Island." In addition, the accompanying map therein includes the Chukchi lead system as a "Major Adult Area" for the month of May.

- **Fall migration corridor through the central Chukchi Sea from Barrow Canyon across Hanna Shoal**
  - Bowhead whale feeding areas during the fall migration have been identified from satellite telemetry tracking (Quakenbush et al. 2010a).
    - Areas of concentrated use were determined by kernel density estimation.
    - Figure 4, page 297, depicts important areas used by bowhead whales. These areas are determined from contours showing probability of use by tagged bowhead whales, from September 2006–2008.
    - Page 302 describes the usefulness of kernel density maps for determining foraging hot spots, but how they may not adequately document important migratory corridors. "*Hence, on the basis of areas identified as important by our kernel density maps, substantial observations from the early 1970s to the present, and oceanographic characteristics (i.e., features favoring advection and trapping of zooplankton), we suspect that the areas where tagged bowhead whales spent more time are important for feeding. Although areas of high probability of use are likely important to bowhead whales, areas of low probability of use may also be important. For example, kernel density maps are not useful for identifying migratory corridors. Kernel densities are based upon the number of satellite locations per whale per month. Because whales moved quickly between areas of concentrated use, migratory corridors contained few locations and therefore exhibited a low probability of use.*"
  - Bowhead whale migration pathways and potential feeding areas during the fall migration have been identified from satellite telemetry tracking results between 2006 and 2010 (Quakenbush et al. 2012).
    - Between the years 2006 and 2010 57 satellite transmitters were deployed primarily by subsistence hunters. Thirty-seven transmitters were deployed near Barrow, Alaska with seven of these during the spring migration and 30 during the fall migration. Twenty were deployed near the Mackenzie River delta, all during the fall migration.
    - Areas of concentrated use were determined by kernel density estimation.
    - Page 16 describes the timing of the fall migration for tagged bowhead whales at Point Barrow. "*Whales passed Point Barrow during the fall migration between 21 July and 2 November.*"
    - Page 16 describes the routing of the fall migration for tagged bowhead whales across the Chukchi Sea. "*Once past Barrow, most tagged bowhead whales traveled across the Chukchi Sea to Wrangel Island, and then south to the Chukotka coast (Fig. 19).*"
    - Figure 19, found on page 16, shows the tracks of 33 satellite tagged bowhead whales migrating through the Chukchi Sea Planning Area from August through December for the time period 2006-2010.

- Figure 20, found on page 17, illustrates the "*kernel density contours showing the probability of use (%) by bowhead whales in October, 2006–2008*." The region around Barrow and moving towards Hanna Shoal and the area from Point Barrow moving towards Peard Bay show high probability of use that corresponds with our depiction for fall concentration areas for bowhead whales.

- Bowhead whale migration pathways and potential feeding areas during the fall migration have been identified from satellite telemetry tracking results between 2010 and 2012 (Quakenbush et al. 2013).
    - This is the second report on long-term study of bowhead whale satellite telemetry. The first report covered the time period from 2006 to 2010 (Quakenbush et al. 2012). Quakenbush et al. (2013) report on animals tagged between the years 2010–2013; however, the movement analyses covers bowhead whales tagged between 2006 and 2012.
    - 17 bowhead whales were tagged between June 2010 and December 2012 for a total of 41 bowhead whales tagged over the duration of the longer-term study. 26 of the 41 tagged bowhead whales were immature.
    - The results from this study suggest that there is high interannual variability with respect to where and when bowhead whales migrate through the northeastern Chukchi Sea. The authors propose that the high variability is dependent upon where and when prey aggregates.
    - Page 23 summarizes the general use of the northeastern Chukchi Sea. "*General Use of Chukchi Lease Sale Area including during drilling. Prior to 2012, virtually all whales (33 of 34) crossed the lease sale area, but no whales spent significant time within the sale area (Fig. 12). Whales typically crossed the Chukchi Sea quickly and then traveled slowly southward along the Chukotka coast, eventually into the Bering Sea. In contrast to this, most whales in 2012 lingered within the Chukchi Sea lease sale area (Fig. 13), co-occurring with drilling operations by Shell at the Burger Prospect (Fig. 14). Whales remained in the central Chukchi Sea until sea ice formed along the northwestern coast of Chukotka. Whales then traveled to the coast of Chukotka near Bering Strait and entered the Bering Sea in early December (Fig. 13).*"
    - Page 30 describes the timing that tagged bowhead whales were typically found within the Chukchi Sea Lease Area 193. "*Chukchi Lease Area 193: …The main period that tagged whales were present within Area 193 was in fall from approximately 28 August to 26 November, although some whales were sporadically present from 6 July to 25 December. On average, tagged whales were present within Area 193 for 10 days (range = 1 to 36 days, n = 45 whales).*"
    - Page 31 describes the residency patterns of tagged bowhead whales within the Chukchi Sea Lease Area 193. "*Residence patterns within the leased blocks were similar to*

those within the larger area (Fig. 23). Because the leased blocks represent a small area, fewer whales were found within the block boundaries….Tagged whales were present within the leased blocks on most days between 3 September and 25 November. A single whale tagged in 2010 was present within the leased blocks on 23 and 24 July. Because the leased blocks are relatively small, residence times in the greater lease area are probably more representative of when whales might be found within leased blocks than the data from leased blocks alone. During the fall migration, 40 of 41 tagged whales (97.6%) entered the lease area (Table 4)."

  - Page 55 describes the fall migratory pathway from Point Barrow to the Bering Strait. "*The fall migratory corridor between Barrow and the Bering Strait, however, is more variable. We think this is related to prey availability, which is also related to the timing of whale movements. Krill is concentrated by oceanographic factors, which vary in space and time. This results in complex movement patterns as individual whales travel to different feeding areas at different times.*"

- COMIDA/ASAMM aerial surveys document the presence of bowhead whales in the Chukchi Sea (Clarke et al. 2013).

  - The Chukchi Sea Offshore Monitoring in Drilling Area (COMIDA) aerial surveys were conducted by the Minerals Management Service, now the Bureau of Ocean Energy Management (MMS/BOEM), and NOAA from 2008 through present (now called Aerial Surveys of Arctic Marine Mammals). MMS surveyed Chukchi Sea Planning Area from 1979 through 1991. COMIDA surveys marine mammal distribution, relative density and behavior during the open water period, mid-June or early July through October.
  - Clarke et al. (2013) summarizes aerial surveys conducted from 30 June through 28 October, 2012. A total of 132 flights were flown with 433 sightings of 648 bowhead whales.
  - COMIDA/ASAMM survey block 14 in the northeastern Chukchi Sea had the highest overall sighting rate in the entire study area (Beaufort and Chukchi Seas) for the COMIDA/ASAMM 2012 study period. Figure 7, on page 39, shows the ASAMM bowhead whale sightings plotted by month, with transect, search and circling effort for 2012. Survey block 14 is depicted on Figure 1, on page 6, and is generally north of Wainwright where depth of 36-50m changes into the 51-200m depth zone, which is presented in Figure 3, page 16.
  - Sightings of bowhead whales in September and October were an order of magnitude higher compared with same time periods in 2011, with similar effort.
  - Page v describes the predominant trends for bowhead whale sightings in 2012. "*In the northeastern Chukchi Sea, bowhead whales were scattered near shore in July and were not sighted in August, with the majority of sightings occurring in fall west of Barrow between 71°N and 72°N. Fall sighting rates (number of whales per km surveyed) of bowhead whales on transect in the western Beaufort Sea were comparable to sighting rates in recent years. The*

survey block with the highest overall sighting rate in the entire study area was block 14 in the northeastern Chukchi Sea. Sighting rate per depth zone between 140°W and 154°W in the western Beaufort Sea was highest in the 51-200 m depth zone in summer and the 21-50 m depth zone in fall. Sighting rates in summer and fall were highest in the ≤20 m depth zone in the Barrow Canyon area (154°W to 157°W) and in the 51-200 m North depth zone in the northeastern Chukchi Sea."

- **Fall feeding area near Barrow Canyon**
  - Satellite telemetry of bowhead whales documents the importance of feeding areas near Barrow Canyon (Quakenbush et al. 2010a).
    - Quakenbush et al. (2010a) used Kernel Density Estimation to identify areas of concentrated use. Page 293 describes the methodology. "*Kernel density estimation is a non-parametric method for calculating the probability that an animal occurs within a defined area. Such probability distributions are also known as utilization distributions (e.g., Kernohan et al., 2002); however, we use the term "kernel density" because it describes the method used to generate the probability distribution of animal locations.*"
    - While this method may help identify where tagged bowhead whales may have spent more time where their signal may be picked up at the surface, it may underestimate the importance of areas where tagged bowhead whales may spend less time at the surface of the water.
    - Figure 4 on page 297 illustrates contours showing probability of use by bowhead whale, September 2006–2008. "*In September, the highest probability of use was concentrated northeast of Point Barrow and extended to the east and west, south of the shelf break and the 200 m isobaths (Fig. 4).*"
  - Satellite telemetry of bowhead whales documents importance of feeding areas from tagging conducted from 2006 to 2010 (Quakenbush et al. 2012).
    - Between the years 2006 and 2010, 57 satellite transmitters were deployed primarily by subsistence hunters. Thirty-seven transmitters were deployed near Barrow, Alaska with seven of these during the spring migration and 30 during the fall migration. Twenty were deployed near the Mackenzie River delta, all during the fall migration.
    - Areas of concentrated use were determined by kernel density estimation. Quakenbush et al. (2010a) page 293 describes the methodology. "*Kernel density estimation is a non-parametric method for calculating the probability that an animal occurs within a defined area. Such probability distributions are also known as utilization distributions (e.g., Kernohan et al., 2002); however, we use the term "kernel density" because it describes the method used to generate the probability distribution of animal locations.*"
    - While this method may help identify where tagged bowhead whales may have spent more time where their signal may be picked up at the surface, it may

underestimate the importance of areas where tagged bowhead whales may spend less time at the surface of the water.

    - Barrow Canyon was identified as an important area, overall, on page 17. "*Areas where tagged bowhead whales spent the most time during the fall migration included Point Barrow, Wrangel Island, and along the northern coast of Chukotka, from Cape Schmidt to Uelen (Fig. 20). These areas should be considered important habitats for feeding given our data (Quakenbush et al. 2010a) and the observations of others (Moore et al. 1995, Zelensky et al. 1995).*"
    - Figure 20, on page 17, shows the kernel density contours showing the probability of use (%) by bowhead whales in October, 2006–2008. The region around Barrow and toward Hanna Shoal shows a high probability of use.

- Satellite telemetry tracking results from 2006–2012 show the importance of Barrow Canyon for tagged bowhead whales (Quakenbush et al. 2013).
    - Figure 30, on page 47, shows "*tagged bowhead locations by density using pooled location data (2006–2012). The highest density areas are in red.*" In Alaska the key core area for bowhead whales is the region in both the Chukchi and Beaufort Sea around Point Barrow.
- COMIDA/ASAMM aerial survey sighting (Clarke et al. 2013).
    - Sighting rates in summer and fall were highest in the ≤20 m depth zone in the Barrow Canyon area (154°W to 157°W).
    - Page v describes the predominant trends for bowhead whale sightings in 2012, and highlights importance of Barrow Canyon. "*In the northeastern Chukchi Sea, bowhead whales were scattered near shore in July and were not sighted in August, with the majority of sightings occurring in fall west of Barrow between 71°N and 72°N. Fall sighting rates (number of whales per km surveyed) of bowhead whales on transect in the western Beaufort Sea were comparable to sighting rates in recent years. The survey block with the highest overall sighting rate in the entire study area was block 14 in the northeastern Chukchi Sea. Sighting rate per depth zone between 140°W and 154°W in the western Beaufort Sea was highest in the 51-200 m depth zone in summer and the 21-50 m depth zone in fall. Sighting rates in summer and fall were highest in the ≤20 m depth zone in the Barrow Canyon area (154°W to 157°W) and in the 51-200 m North depth zone in the northeastern Chukchi Sea.*"

1.2 Beluga Whale

Two populations of beluga whales (*Delphinapterus leucas*) use the Chukchi Sea Planning Area: the Eastern Chukchi Stock (ECS) of beluga whales, which is estimated to have approximately 4,000 whales; and the Beaufort Sea Stock (BSS), which is estimated to have approximately 40,000 whales (Allen and Angliss 2013). Beluga whales usually spend the winter in the Bering Sea pack ice (Frost and Lowry 1990; NOAA 1988). In spring they migrate to their summering grounds (Frost and Lowry 1990; Moore et al. 1993; NOAA 1988), where the whales congregate in shallow waters in specific locations along the coast in late June to July (Frost and Lowry 1990; Frost et al. 1993; Huntington et al. 1999; Richard et al. 2001). These congregation areas are stock-specific (ABWC 2011, 2013; Allen and Angliss 2013). The whales disperse from the congregation sites, apparently following one of two strategies. Some tagged whales have been found to head far offshore into the ice pack, while others spend time in areas closer to shore with more open water (NOAA 1988; Richard et al. 2001; Suydam et al. 2005; Suydam et al. 2001). In the fall the whales migrate back toward and into the Bering Sea (Richard et al. 2001; Suydam et al. 2005).

The mapped concentration areas for beluga whales are based on the following scientific source materials.

- **The spring migration corridor for the BSS**
    - The BSS of beluga whales migrates along the Chukchi coast in April and May.
    - Aerial surveys were conducted along much of the northwest Alaskan coast in the spring during the years 1980–84. The surveys conducted in the early 1980s suggest that the BSS beluga whales migrate to the Beaufort Sea from the Bering Sea by following a path through the Bering Strait, following the coastal Chukchi Sea lead system along the Alaska coast, and turning east around a degree north of Point Barrow in offshore leads. (Moore et al. 1993).
    - Hunters and elders from Wainwright note that there are two migrations of beluga whales, one in spring and one in summer, that pass by their community (page 29, 2001). The first migration of beluga whales comes with the spring bowhead whale migration. The hunters observe these whales from the edge of the landfast sea ice, which provides additional evidence of the location of the migration.
    - NOAA (1988) atlas summarizes the movements of beluga whales along the Chukchi Sea lead system. "*Some [belugas] continue to the Beaufort Sea via eastern Chukchi flaw zone to Pt. Barrow and via offshore leads to Banks Island and Amundsen Gulf*".
    - Moore et al. (2000) summarize the BS beluga stock along the Chukchi Sea lead system. "*The BS beluga stock follows a migration cycle similar to bowheads. In spring, white whales are often seen along the same route as bowheads*".
    - The Alaska Department of Fish and Game (ADFG) has conducted research on bowhead whales and documented their spring migration route, shared by beluga whales.
        - The summary of the spring bowhead whale migration from the Bering Sea to the Beaufort Sea is described in its entirety on Figures 21-23, and within the text found on pages 29–32 (Quakenbush et al. 2010b). On page 29 the description of the transit through the Chukchi Sea. "*On average, whales took 11 days to travel from St. Lawrence Island to Point Hope (sd=2.3, n=6), six days to travel from Point Hope to Wainwright (sd=0.4, n=5), and one day to travel from Wainwright to Barrow (sd=0.5, n=5). Bowhead whales traveled mostly parallel and within 40 km of the Alaskan coast during the spring migration. There was little use of Chukchi Sea Lease Sale Area 193 during spring*

migration with only one of the six tracks skirting the eastern boundary (Fig. 21). Six whales were tracked past Barrow, the earliest passing ~16 April and the latest was ~6 May."

    - Alaska Department of Fish and Game (2010) illustrates the tagged bowhead whale tracks from 2006-2010.

  - Figure 1 shows the bowhead whale and beluga whale spring migration route through the Chukchi Sea (Moore and Laidre 2006).

- **Timing of the ECS migration to the Chukchi Sea Planning Area**
  - Of the nearly 30 ECS beluga whales that have been satellite tagged, only one tag lasted through an entire year (see tag 22149). Information from that tag suggests the ECS of beluga whales may not enter the Chukchi Sea Planning Area until summer. These whales may remain in the Bering Sea or southern Chukchi Sea until June. The tagged beluga whale moved into the Chukchi Sea Planning Area in June and moved to the Kasegaluk Lagoon area in late June (NMFS 2013).
  - Prior work suggested that beluga whales in Kotzebue Sound in late May and early June were part of ECS (Frost and Lowry 1990). However, recent genetic-based research indicates that those beluga whales may actually be from a different stock (ABWC 2011, 2013).
  - Documented knowledge from Point Lay beluga whale hunters describes that the ECS whales congregate south of Kaseagaluk Lagoon in late June or early July (Huntington et al. 1999).

- **ECS Kasegaluk Lagoon high concentration area**
  - Kasegaluk Lagoon and the Kuk River estuary "*are important seasonal summer habitats of beluga whales*" (Bureau of Land Management 2003). Belugas are sensitive to human disturbance; airborne and waterborne noise may influence their distribution (Frost and Lowry 1990) and drive them from important habitats. Subsistence hunters have reported concerns that if the first returning belugas are disturbed as they move along the coast in the spring, succeeding groups of whales may not come within hunting range (Bureau of Land Management 2003; Huntington and Mymrin 1996).
  - Although there are notes on the occurrence of belugas in the region from the 1950s and 1960s (Bee and Hall 1956; Childs 1969), studies in the area did not begin until 1978 "*when observations and conversations with residents indicated that at least several hundred belugas occurred in the area each year*" (Frost and Lowry 1990).
  - Huntington et al. (1999) describe the general patterns and variability in beluga use of the Kasegaluk Lagoon hotspot (see Figure 5). The whales come into the coastal region generally around Omalik Lagoon. After congregating there for a period of time, groups of whales move north along the coast.
  - Aerial surveys of the region have occurred sporadically since the late 1970s, which have consistently documented the region as an important area for Beluga whales.

        - Surveys flown in the late 1970s and early 1980s with results displayed on Figure 6 on page 439 (Frost et al. 1983), and on Figure 8 on page 52 (Frost and Lowry 1990).
        - Surveys flown in 1981, with survey results documenting Kasegaluk lagoon as a concentration area in Appendix 3, on the first set of maps on page 384 (Moore et al. 1993).
        - Surveys flown in 1987 (and prior years) depict the importance of Kasegaluk Lagoon, in Figure 8 on page 52 (Frost and Lowry 1990).
        - Surveys flown in 1990 and 1991 document the importance of Kasegaluk Lagoon as a concentration area for beluga whales (Frost et al. 1993). Frost et al. (1993) is specific to the use of Kasegaluk Lagoon by the ECS.
    - Given the consistent high use of the Kasegaluk Lagoon area and the regular subsistence hunt that is conducted there, the area was chosen as the location to satellite tag beluga whales (Suydam et al. 2005).
    - NOAA bases their minimum population estimates for the beluga whale ECS on aerial survey data for the region (Allen and Angliss 2013), which indicates that at least most of the ECS is believed to congregate in this area. NOAA surveys may not accurately estimate beluga population size, but point to the importance of the region for this population.

- **Summer ECS concentration area**
    - After gathering at the Kasegaluk Lagoon hotspot, beluga whales from the ECS move northward along the northern Alaskan Chukchi Sea coastline (Huntington et al. 1999). During this time and through the rest of the summer the ECS is concentrated in Barrow Canyon and the shelf break off Point Barrow. The evidence for this concentration area is derived primarily from satellite tagging data as well as from aerial surveys.
    - Most (but not all) whales move northeastward from the Kasegaluk Lagoon hotspot in a band that stretches from the coast out 50-100 km offshore. The few tagged whales that do not follow this pattern moved further offshore into the middle of the Chukchi Sea (Suydam et al. 2005; Suydam 2009).
    - Aerial surveys have noted whales along the coast and out to the edge of the ice pack north of Kasegaluk Lagoon (see aerial survey references in ECS – Kasegaluk Lagoon hotspot section). Repeated sampling corroborates that the whales move from south to north along the coast (Clarke et al. 2012; Clarke et al. 2013; Clarke et al. 2011; Frost et al. 1993).
    - While some whales continue into Barrow Canyon and keep going north into the central Arctic basin (AFSC ; Suydam et al. 2001)), a large number of whales spend considerable time along the coast, in Barrow Canyon, and along the shelf break in the vicinity of Barrow Canyon (Suydam 2009). See Figures 1 and 2 in Suydam et al. (2001) and Figures 2-12 in NMFS (ND).
        - More recent beluga whale satellite tagging data corroborates these patterns (NMFS 2013).

- **BSS fall migration corridor**
  - In the fall, the beluga whale BSS crosses the Beaufort Sea and passes through the Chukchi Sea into to the Bering Sea to overwinter (NOAA 1988; Richard et al. 2001). Figure 6 in Richard et al. (2001) depicts this migration route.
  - Of the BSS satellite tagged beluga whales that were captured during the fall migration (Richard et al. 2001), all whales crossed the northern Chukchi Sea to the region around Wrangel Island (see Figure 6). However, just nine of the thirty tags originally deployed lasted long enough to show this trek. Based on large sightings of animals in the Wrangel Island area (NOAA 1988), the authors believe this migration represents a "*large segment of the population*" (page 232 in Richard et al. 2001). All tags that made it to Wrangel Island traveled above 72 degrees north latitude through the Chukchi Sea (see Figure 6 in Richard et al. 2001).
  - From 1988 to 1991 a concerted effort was made to survey Chukchi Sea waters north of 72 degrees latitude, but even those aerial surveys did not extend beyond 73 degrees for the most part (Clarke et al. 1993; Moore and Clarke 1991). Figure 2 in Clarke et al. 1993 and Figure 4 in Moore and Clarke 1991 show this effort. In those surveys, a large number of beluga whales were found migrating above 72 degrees north latitude (Figures 2, 3 and 5 in Clarke et al. 1993; Figures 8 and 19 in Moore and Clarke 1991). Clarke et al. (1993) concluded in their abstract: "*There appears to be a nearshore migration route roughly following the axis of Barrow Canyon, and an offshore route north of 72 degrees in the northeastern Chukchi Sea*." Given the information in these figures as well as in Richard et al. (2001), there appears to be a migration route across the northern part of the Chukchi Sea above 72 degrees north latitude. Aerial surveys suggest a fair number of beluga whales observed between 72 and 73 degrees north latitude, but satellite tracking data indicates it is a broader migration path.
  - It is unclear what proportion of the beluga whale BSS travel farther north than are regularly surveyed, but the numbers may be substantial based on the proportion of whales from Figure 6 in Richard et al. (2001) that passed well north of 72 degrees north latitude. ASAMM surveys are rarely flown in this region and there is very little coverage, given the survey tracts for Chukchi Sea surveys (Clarke et al. 2012; Clarke et al. 2013; Clarke et al. 2011). Only one flight track has been flown recently in the region above 72 degrees north latitude in the Chukchi Sea Planning Area, which was on Sept 3, 2012 with a sea state that was primarily poor for spotting animals (Beaufort Sea State Scale 6 to 8). Further, September 3 is early to catch the migration of belugas in the region (see Table 5 Richard et al. 2001).
  - Aerial survey data covering September and October suggests two paths across the Chukchi Sea: a northern (highlighted above) and a southern; Figures 2, 3 and 5 in Clarke et al. 1993, and Figure 19 in Moore and Clarke 1991. It is unclear if the southern route is used by BSS or if those whales are from the ECS (see below).

- **ECS fall migration concentration area and migration corridor**
  - During early fall, many ECS satellite tagged beluga whales are still found in Barrow Canyon as well as the region along the shelf break in the vicinity of Barrow Canyon stretching along the Beaufort shelf break to the (AFSC ; Suydam et al. 2005; Suydam 2009). Figures 1-12 in Suydam et al. (2005) depict this aggregation.
  - More recent ECS satellite tagging data corroborates these patterns (AFSC ; NMFS 2013).
  - In October and November, beluga whales move into the Barrow Canyon area (where it seems a large number of them spend time) and generally head southwest towards the central Chukchi Sea, and eventually to the southern Chukchi Sea (Suydam et al. 2005).
    - Figure 4 on page 39 shows the locations of whales tagged in July 2001 between July 3 and December 5. Note the high use in Barrow Canyon and relative lack of whales locations across and north of the Hanna Shoal region, which indicates that whales entering the Beaufort Sea and Arctic Ocean basin likely return to the southern Chukchi Sea through the Barrow Canyon region.
    - Figure 9 on page 44 shows the location of whales tagged in 1998 and 2001 during October through December.
    - Figure 10 on page 45 shows the location of whales tagged between 1998 and 2002 by age class.
  - More recent tagging data corroborate these patterns, specifically individual whale movements in October and November (AFSC ; NMFS 2013).
  - As the population of ECS is so much lower in numbers than that of the BSS, it is difficult to use aerial survey data to pinpoint ECS use areas when the two stocks may be mixed. However, aerial survey data corroborates the use of Barrow Canyon by beluga whales in the fall generally, which has been presented in several publications
    - On page 437 of Moore et al. (2000), Figure 6 shows autumn beluga whale sightings, which are concentrated in Barrow Canyon as well as the Beaufort Shelf (Moore et al. 2000).
    - On page 45 of Moore and Clarke (1991), Figure 19 shows cumulative beluga whale sightings in the Chukchi Sea during the fall with high numbers of sightings in the Barrow Canyon area (Moore and Clarke 1991).
    - On page 387, in the abstract from their paper on fall migration patterns of beluga whales, Clarke et al. (1993) observe that "[*t*]*here appears to be a nearshore migration route roughly following the axis of Barrow Canyon.*" Figure 2 on pages 389-390 of this paper shows survey effort and beluga sightings for each year between 1982 and 1991 with relatively high numbers of sightings in Barrow Canyon apparent in most years. Figure 3 on page 391 shows the data in terms of relative abundance, and Figure 5 on page 394 shows the swimming direction of Beluga whales with a direction that is parallel to Barrow Canyon in regions B and D, which contain the canyon (Clarke et al. 1993).
    - Additional support for the fall migration route may be found in more recent aerial surveys that cover Barrow Canyon. Figure 27 on page 77 of Clarke et al.

(2012) shows beluga whale sightings in 2011 as compared to other light ice years with surveys (Clarke et al. 2012). Figure 28 on page 87 of Clarke et al. (2013) shows beluga whale sightings in 2012 as compared to other light ice years with surveys (Clarke et al. 2013). Figure 13 on page 22 shows beluga whale sightings during October (as well as other months) for the years 2008-2010 in the Chukchi Sea (Clarke et al. 2011).

1.3 Gray Whale

The gray whales (*Eschrichtius robustus*) found in the Chukchi Sea Planning Area are from the Eastern North Pacific Stock that winters in the waters of Baja, Mexico, where they calve. Gray whales begin their yearly northward migration from February through May to summer feeding grounds located in the northern and western Bering Sea and much of the Chukchi Sea (Allen and Angliss 2013). Gray whales usually travel singly or in small groups. Aggregations may occur on productive feeding grounds. Gray whales prey on benthic infauna – amphipods and mysiids – by filtering food through their baleen while traveling near the seafloor as they suck up sediment. As such they occupy shallow coastal areas. While most of the stock summers in the southern Chukchi and northern Bering Seas, there are some important concentration areas in the northeast Chukchi Sea (Clarke et al. 1989).

The mapped concentration areas for gray whales are based on the following scientific source materials.

- **Highly concentrated gray whale habitat – Wainwright to Barrow region**
  - Data sources from surveys conducted from 1982 through 2011.
    - Gray whale concentration areas in the northeastern Chukchi Sea have shifted from the 1982–1991 and 2008–2010 survey periods, with sightings concentrated closer to shore than the Hanna Shoal region (Clarke et al. 2012). The Hanna Shoal region was an important concentration area in surveys conducted during the 1980s (see below). However, gray whale sightings have been recently moving farther offshore as documented in the 2011 and 2012 surveys (Clarke et al. 2012; Clarke et al. 2013). These increased sightings offshore should be taken into account and the Hanna Shoal region should not be precluded from consideration as important gray whale habitat as whales may return to these foraging hotspots in the future.
    - The highest sighting rate by depth zone (51-200m) has not changed over time, as the highest sightings across years (1892 through 2012) has remained in the 51-200m depth zone (Clarke et al. 2012).
  - COMIDA/ASAMM aerial surveys support the concentrated gray whale habitat in the nearshore Chukchi Sea.
    - COMIDA surveys have been conducted by MMS/BOEM and NOAA from 2008 through present day (now called Aerial Surveys of Arctic Marine Mammals (ASAMM)); prior to that, MMS surveyed the Chukchi Sea Planning Area from

1979 through 1991. COMIDA/ASAMM surveys are designed to document marine mammal distribution, relative density and behavior during the open water period, mid-June or early July through October.

- 2012 survey results are summarized on page vi. "*Gray whales were seen in all months of the study period in the northeastern Chukchi Sea and westernmost Alaskan Beaufort Sea. Gray whale aggregations were observed within ~40 km of the Alaskan coastline between Point Barrow and Wainwright and very nearshore (<5 km) from Icy Cape to Cape Lisburne, particularly in July. Few gray whales were seen on Hanna Shoal (~72°N, 162°W), but sightings were offshore (up to 100 km) between Point Franklin and Icy Cape. Gray whales were also seen in the Barrow Canyon area and very nearshore east of Barrow. Sighting rate per depth zone was highest in the ≤35 m depth zone in the northeastern Chukchi Sea; highest sighting rate per month occurred in July and decreased sharply in August, September and October. Most gray whales (57%) were feeding. Sixty-seven gray whale calves were seen, although some calf sightings may have been repeat sightings*" (Clarke et al. 2013).

- 2012 survey results, displayed and presented on page 66, noted increased sightings offshore: "*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.*"

- 2012 survey results are presented on page 67, Figure 20. Figure 20 shows ASAMM gray whale sightings plotted by month. In particular, note block 13. Gray whale sighting rate is described on page 72: "*In summer and fall 2012, gray whales were seen on transect from 68°N to 72°N and 154°W to 169°W. There were 132 gray whale sightings on transect, ranging from one whale per sighting (n = 70) to eight whales per sighting (n = 2). The greatest number of sightings on transect was in block 13 with 52 sightings, followed by block 17 with 44 sightings. The highest sighting rates per survey block for the entire study period were in block 13 (0.017 WPUE) and block 17 (0.014 WPUE) (Table 10). However, highest sighting rate was in block 12 in August (0.018 WPUE) and block 14 in September (0.006 WPUE), blocks that generally have not had high sighting rates since ASAMM aerial surveys commenced in 2008. The highest monthly sighting rate was in July (0.015 WPUE); monthly sighting rate decreased through August and September and was lowest in October (0.001 WPUE)*" (Clarke et al. 2013).

- 2011 surveys summarized on page vi. "*Similar to previous years, locations where gray whale aggregations were observed continued to be near the Alaska coastline between Point Barrow and Point Franklin. Scattered sightings were observed offshore (>100 km) and very nearshore (<5 km) between Cape Lisburne and Point Hope. Similar to 2008–2010, gray whales were not seen on Hanna Shoal (~72°N, 162°W), but sightings were farther offshore between Point Franklin and Icy Cape than were observed in 2008–2010*" (Clarke et al. 2012).

    - 2011 surveys are summarized on page vi. "*Sighting rate per depth zone was highest in the 51–200 m depth zone, a trend noted since surveys in the Chukchi Sea recommenced in 2008; the highest sighting rate per month was in July, which is earlier than the peak in 2008–2010. Most gray whales (62%) were feeding.*"
    - 2011 survey results are presented and discussed on page 59. "*In summer and fall 2011, gray whales were seen from 68°N to 71.5°N and 156.5°W to 169°W. There were 131 gray whale sightings on transect, ranging from 1 whale per sighting (n = 92) to 5 whales per sighting (n = 2). The greatest number of sightings on transect was in Block 13 with 68 sightings, followed by block 17 with 41 sightings. The highest sighting rates per survey block were in block 13 (0.014 WPUE) and block 17 (0.012 WPUE) (Table 9). The highest monthly sighting rate was in July (0.012 WPUE) and the lowest was in October (0.003 WPUE)*" (Clarke et al. 2012).
  - Clarke and Ferguson (2010) conducted aerial surveys of large whales from 2008-2009 and compared these observations with data collected from 1982-1991.
    - Page 4 discusses the important areas based on sightings. "*Gray whale distribution in 2008-2009 remained primarily nearshore between Pt Lay and Pt Barrow, and underscores the continued importance of that area to gray whales in all months surveyed. Overall sighting rates were lowest in June, increased through August, then decreased through October, reflecting the migration timing of gray whales in Alaskan waters (Rugh et al., 2001). This temporal pattern in sighting rates was repeated in data collected from 1982-1991 and also observed during oil industry-sponsored surveys in 2006-2008 (Thomas et al.,2010).*"
    - The predominant behavior was feeding in 2008-2009.
    - The authors noted a lack of gray whales at Hanna Shoal, as they were observed regularly there engaging in feeding behavior during the 1980s.
    - Data collected from the early years (1982-1991) provide valuable insight for distribution and density patterns relative to sea ice presence/absence.

- **Highly concentrated gray whale habitat – Hanna Shoal Region**
  - Data sources from surveys 1982-1991.
    - Aerial surveys conducted between 1982 and 1987 showed concentrations of Gray whales in the Hanna Shoal region (as defined in the section on walrus). While gray whales were not consistently observed in this area in the surveys conducted between 2008 and 2010, it is important to note that the region was not systematically surveyed between 1991 and 2008. The Hanna Shoal region is not only a potentially important concentration area for gray whales, it is also shows where gaps in the data reflect the need for further study to better understand the migratory patterns and concentrations of these animals.

- Clarke et al. (1989) documents gray whale distribution and relative abundance from July through early September from 1982-1987. "*Feeding whales were seen most often within 40 km of the shore, but also occurred offshore. Thirty-six gray whale calves were seen. Calf abundance (number of calves/survey hour) was significantly higher (p < 0.001) in July, when 92% (n = 33) of all calves were seen, than in any other month. Most cow–calf pairs were seen nearshore between Point Hope and Point Barrow.*"
- Moore (2000) analyzed 1982–1991 autumn sighting data for variability in cetacean distribution and habitat selection.
  - Habitat selection was evaluated by species for selected oceanographic parameters A chi-square analysis was used to calculate habitat selection ratios to investigate cetacean use of shoal and trough features.
  - There were 495 flights conducted between September and October over the period from 1982 to 1991. Sightings of gray whales were made during randomly derived transect legs.
  - Page 453: "*Gray whales were seen more often than expected in coastal/shoal habitat in all ice conditions in the northern Chukchi Sea (Table 4). Distribution during heavy ice conditions was sparse and generally confined to coastal waters near Wainwright, with only three sightings offshore near shoal areas (Fig. 2). Conversely, during light ice years, clusters of gray whale [transect sightings] occurred in coastal and offshore shoal habitat.*"
  - Page 455: "*Gray whales were seen more often than expected in coastal/shoal habitat across all transport conditions in the northern Chukchi Sea (Fig. 2, Table 8). An exceptionally high selection ratio (B4 = 0.93) reflects the strong affinity of gray whales for coastal/shoal habitat in years of high transport (Table 9). Conversely, in years of moderate and low transport, gray whales were more strongly associated with shelf/trough waters (B2 = 0.68 – 0.69). Indeed, standardized ratios suggest that the latter habitat was selected at least twice as frequently as coastal/shoal waters during moderate and low-transport years. Notably, there were no gray whale [transect sightings] in shelf/trough habitat during high transport years.*"
- Moore and Clarke (1992) summarize distribution, abundance, migration timing and habitat relationships from surveys conducted in 1991.
  - Aerial surveys conducted in 1991 from 20 September through 7 November were subsequently compared to surveys flown from 1982–1990. 134 surveys were flown in 1991 with 79% effort in the Chukchi Sea.
  - Page xiii: "*There were 20 sightings for a total of 26 gray whales in the study area in 1991, from 22 September to 7 October. Gray whale distribution along the Chukchi coast was similar to, but not comprehensive of, past years. Although fewer in number, gray whales were seen offshore in the vicinity of Hanna Shoal (GEL 180 to 210 km northwest of Barrow) as in 1986–87 and 1989, and for the first time roughly 95 km northwest of Point Barrow.*"

- Page xiv: "*Over ten survey seasons (1982–91), there were 167 sightings for a total of 424 gray whales in the study area during September and October. Relative abundance was highest in nearshore blocks near Point Hope and Point Barrow. The majority of gray whales (84%, n= 358) seen were feeding, usually in coastal blocks 13, 17 and 24. Offshore, feeding gray whales were seen in blocks 14 and 14N in 1986–87, 1989 and 1991, near the boundary of Hanna Shoal. Gray whales were usually (93%, n =394) in open water (O-1 0% ice cover), although gray whales were seen in ice cover up to 90%.*" Note, Figure 2, found on page 7, shows the location of the blocks, and the line separating blocks 14 and 14N approximately bisects Hanna Shoal.
- Page 88: "*There were 167 sightings for a total of 424 gray whales over nine survey seasons.*"
- Page 94: "*Gray whale distribution was limited to three areas in the latter half of September: nearshore between Point Barrow and Point Franklin (ca. 70" 55'N, 155" W); offshore northwest of Point Franklin from 71030' to 72.30'N between 160"30' and 1620 30'W (sic); and along the coast at Point Hope (Fig. 29). Gray whale distribution during the first half of October was more widespread. Whales were seen along the coast between Point Barrow south to Icy Cape, northwest of Point Franklin (as in late September) and west of Icy Cape, and along the coast at Point Hope and Cape Lisburne. During the latter half of October, gray whale distribution was limited to nearshore waters between Point Barrow and Point Franklin, and the south-central Chukchi Sea southwest of Point Hope. Waters south of Point Hope were surveyed only in late October and November 1989–91, and high sea states often curtailed surveys in this area. Gray whales were seen in the southernmost Chukchi Sea, and between the Bering Strait and St. Lawrence Island in the northern Bering Sea, in late October and November 1980 (Clarke and Moore in press) suggesting that whales continue to feed in this area even as the southbound migration is underway in the southeastern Bering Sea (Rugh 1984).*"
- Page 94: "*The overall pattern of gray whale distribution highlights the importance of nearshore waters between Point Barrow and Point Franklin and offshore areas in the north-central Chukchi Sea. Gray whale distribution in offshore areas appears related to prey availability near Hanna Shoal. As elsewhere, most of the gray whales seen in the north-central Chukchi Sea were associated with mud plumes, which indicate foraging on benthic invertebrates (Nerini 1984). Although Hanna Shoal has not been sampled for potential gray whale prey, the occurrence of feeding whales there and not elsewhere in the northern Chukchi Sea indicate that these waters represent a feeding area that the whales move into when receding ice cover permits.*"

o Moore et al. (2000) analyzed 1982–1991 aerial survey data for seasonal variability in summer cetacean habitat selection.
  - 634 flights were flown in total, with 139 flights flown between July and August and 495 flown between September and October.
  - Water depth and sea ice were the two environmental variables recorded on randomly derived transect legs. Determinations for depth and oceanographic

conditions were made post-survey. Habitat selection was tested with chi-square analyses and calculation of habitat selection ratios.

- Page 438: "*Gray whale summer distribution was concentrated in the northern Bering Sea, with 93% (462 of 496) of all [transect sightings] in the Chirikov Basin (Fig. 7).*"
- Page 438: "*In the Chukchi Sea, gray whale sightings were clustered along the shore, mostly between Cape Lisburne and Point Barrow.*"
- Page 438: "*Gray whales were associated with ice only in the northern Chukchi Sea. During summer surveys, they were seen in ice conditions to 30% surface cover and, more often than expected, in 0 – 20% ice habitat ($\chi 2 = 12.5; p < 0.01$).*"
- Page 439: "*In autumn, gray whale distribution in the Chukchi Sea was clustered near shore at Pt. Hope and between Icy Cape and Pt. Barrow, and in offshore waters northwest of Pt. Barrow (Hanna Shoal) and southwest of Pt. Hope (Fig. 7).*"
- Page 442: "*Gray whale selection of shoal and coastal habitat was strongest in summer. In autumn, gray whales selected trough habitats in the northern Chukchi Sea, a shift possibly coupled with a transition from feeding to migratory behavior.*"

2. PINNIPEDS

2.1 Pacific Walrus

Pacific walrus (*Odobenus rosmarus divergens*) range in the shallow continental shelf waters of the Bering and Chukchi Seas (Department of the Interior 2013; Smith 2010; USFWS 2013a). Winter breeding sites are located by areas of open water near Nunivak Island, St. Lawrence Island, and the Gulf of Anadyr (Smith 2010; USFWS 2013a). During the summer months, walrus typically range widely across the continental shelf on ice floes from which they forage on benthic organisms in water depths up to 100 meters (Smith 2010; USFWS 2011, 2013a). The primary prey of walrus is benthic invertebrates (Fay 1982; Sheffield and Grebmeier 2009; USFWS 2011) however other taxa are consumed infrequently. Large concentrations during the summer are found near Hanna Shoal and Wrangell Island (Smith 2010; USFWS 2013a). In recent years Hanna Shoal has been shown to be a "critical foraging area" (Department of the Interior 2013) for walrus in the summer and fall, in particular for female/calf pairs (Brueggeman et al. 1990; Brueggeman et al. 1991; Jay et al. 2012; MacCracken 2012). Historically, there have been land-based haul-out sites with scant walrus occupancy; however, the land-based haul-out use has increased in recent years likely due to diminishing sea ice cover over shallow continental shelf waters (Clarke et al. 2011; Garlich-Miller et al. 2011; Jay and Fischbach 2008; Jay et al. 2011).

Walrus radio and satellite tagging studies suggest that most areas occupied by walrus will also be foraging habitat, and that the most concentrated foraging areas likely correspond with high benthic biomass (Jay et al. 2012). The exception to the correlation between walrus concentration areas and foraging habitat are the land-based haul out sites along the Chukchi Sea coast. In recent years, tracking studies have shown that walrus travel tens of kilometers to foraging sites offshore from land-based haul-out sites (Jay et al. 2012). Walrus are sensitive to disturbance and are vulnerable to injury and mortality when hauling out in large numbers on land (Huntington et al. 2012; USFWS 2013a)., The use of land-based coastal haul-out sites may increase in coming decades with the predicted declines in sea ice extent (USFWS 2013a).

The mapped concentration areas for walrus are based on the following scientific source materials.

- **Summer foraging concentration areas**
  - Using satellite tagging data, Jay et al. (2012) have estimated walrus foraging and occupancy was in the northeastern Chukchi Sea
    - 251 animals were tagged from June to September in the years 2008–2011.
    - Walrus foraging and occupancy utilization distributions (UDs) were determined. UDs are the probability of animals using an area during the time specified. A UD of 50% was identified as core use area of most concentrated use.
    - Figure 4, page 8 shows UD estimates by month. Earlier in the season (June) walrus foraging occurred in low ice concentration areas along the Chukchi coast. In July the "*area of highest foraging concentration in the eastern Chukchi was restricted to the northeastern sector*," which included parts of Hanna Shoal and the area south of Hanna Shoal. In August, this area extended outward to cover more of Hanna Shoal and the region surrounding the shoal. In September, the foraging area was reduced and closer to shore-based haul-out sites, likely due to lack of sea ice present for animals to haul out and rest upon.
    - Page 10, September in Figure 4: "*Notably, in 2009 and 2010, tagged walruses used the nearshore area immediately surrounding the onshore haul-out, but, in 2011 about half of the tagged walruses made round trips of up to about 200km northward to an area just south of Hanna Shoal (USGS, Alaska Science Center, unpubl. Data; see also September in Fig. 4), an area with high infaunal biomass of bivalves that was used extensively by walruses prior to September*."
  - Aerial Survey data from COMIDA/ASAMM effort from 2012 field surveys published in 2013 corroborate the areas identified in Jay et al. (2012) as being important for walrus (Clarke et al. 2013).
    - COMIDA surveys were conducted by MMS/BOEM and NOAA from 2008 through present day (now called Aerial Surveys of Arctic Marine Mammals (ASAMM)); prior to that MMS surveyed Chukchi Sea Planning Area from 1979 through 1991. COMIDA/ASAMM surveys document marine mammal distribution, relative density and behavior during the open water period, mid-June or early July through October.
    - Walrus were sighted in all months during the 2012 survey in the northeastern Chukchi Sea. Figure 35, found on pages 97–98, shows the ASAMM walrus sightings by month (June–July, August, September, and October) and include

transect, search and circling effort. A total of 470 sightings of 12,892 walruses were recorded (Table 3).

- Walrus were observed in the water and hauled out on ice, particularly near Hanna Shoal during the period from July through August. This was also the time period during which most walrus sightings occurred. Block 14 in the COMIDA/ASAMM surveys is the survey block commonly associated with the area defined as Hanna Shoal (see below for discussion on the delineation of Hanna Shoal).
- ASAMM surveys were conducted on 3 September 2012 specifically to assess walrus use of sea ice habitats. Most sightings on this day occurred near Hanna Shoal, where there were 12 sightings of 50 walruses (Page 96).
- As the sea ice recedes and less sea ice habitat is available for animals to haul out on, they migrate towards the coast closer to Pt. Lay (Figure 35 c/d). As use of land-based haulouts increases, walrus make foraging trips from land-based haulout sites to offshore foraging locations in the Hanna Shoal region. As a result of these foraging trips, these corridors between resting sites and foraging sites should be protected to ensure connectivity.
- Walrus haulout sites on land were not observed during the COMIDA/ASAMM surveys in 2012; however, in years when sea ice recedes to the northern Chukchi shelf (e.g. 2009, 2010, 2011, and 2013), extensive use of land-based haulout sites occurs (Clarke et al. 2012; Clarke et al. 2011).

- COMIDA data published in 2012 from 2011 aerial surveys in the Chukchi Sea corroborate those areas identified in Jay et al. (2012) as being important for walrus (Clarke et al. 2012).
  - Page 84: "*Walruses observed offshore in August and September appeared to show a preference for Hanna Shoal (~72°N, 162°W), presumably using this area as a feeding ground.*"
  - Figure 31, pages 85–87 shows the region of Hanna Shoal as being important for walrus.
  - Page 84: "*In June and July, when sea and shorefast ice were still present in the study area, walruses were either hauled out on ice or swimming in open water; group sizes ranged from single animals to 600, with larger groups hauled out on ice. In early August, when sea ice had receded north and the study area was virtually ice-free (Appendix A), walruses were observed only in open water and were starting to congregate nearshore. On 17 August, the first aggregation of walruses to haul out on the Alaskan coastline during the 2011 field season was observed (Figure 32).*"
- Department of the Interior (2013) delineated the Hanna Shoal region as being important for walrus.
  - Page 35,370: Significant summer concentrations include areas near Wrangel and Herald Islands in Russian waters and at Hanna Shoal (northwest of Point Barrow) in U.S. waters.

        - The Hanna Shoal Use Area was delineated on page 35,371 using Jay et al. (2012) walrus foraging and occupancy utilization distributions (UDs). Figure 2 on page 35,424 shows Hanna Shoal, as well as the combined 50% foraging and occupancy UDs from Jay et al. (2012), from June to September at Hanna Shoal that represents the core use area during the time of most concentrated use by walrus.

- **Fall coastal land-based haul-out sites and associated habitat**.
    - In recent years, land-based walrus haul outs at Icy Cape and Point Lay have increased substantially—a trend that will likely continue as late summer sea ice recedes earlier and further north due to climate warming (USFWS 2013a). When hauled out, walruses are highly sensitive to human disturbance, including aircraft or boat traffic (Garlich-Miller et al. 2011; USFWS 2013a).
    - A buffer for walrus haul out areas, from Icy Cape to Point Franklin and around the coast of Peard Bay, was recommended by Joel Garlich-Miller of the USFWS (personal communication January 2011).
    - Traditional knowledge from Point Lay and Wainwright document recent and historical use of the land-based haulout sites for walrus along the Chukchi Coast (Huntington et al. 2012). Figure 1, page 3 shows the locations for historic sites as well as recent haulout sites near Point Lay. Walrus haulout sites have been seen from Cape Sabine all the way to Point Franklin with the largest sites located at Point Lay, just south of Icy Cape, and at Mitliktavik. In addition, many walrus have been observed in the nearshore waters in the fall months, and a concern identified by the traditional knowledge holders is increased disturbance due to offshore vessel traffic and offshore oil and gas activities during the open water period.
    - Figure 18 from Clarke et al. (2011) illustrates the COMIDA walrus sightings from surveys flown July-October 2010, showing and delineating the concentration near Pt. Lay. The differences in numbers hauled out also corroborate the status review (Garlich-Miller et al. 2011) and draft Stock Assessment Report (USFWS 2013a) assessment of traveling walrus from coastal land-based haul-out sites to offshore benthic feeding areas.
    - Documentation for the Pt. Lay coastal haulout also can be found from COMIDA/ASAMM aerial surveys flown in 2011 (Clarke et al. 2012).
        - Page vi: "*Documentation of a walrus haulout near Point Lay, from mid-August to early October. Unlike the walrus haulout documented near Point Lay in 2010, the 2011 haulout was observed earlier and for a longer period of time. Group size estimates of the haulout throughout the field season ranged from 1,000 to 20,000 walruses.*"
        - Page 84: "*In early August, when sea ice had receded north and the study area was virtually ice-free (Appendix A), walruses were observed only in open water and were starting to*

congregate nearshore. On 17 August, the first aggregation of walruses to haul out on the Alaskan coastline during the 2011 field season was observed (Figure 32)."

    - Page 84: "*The walrus haulout was located approximately 6 km northeast of Point Lay, Alaska, relatively close to where walrus haulouts were documented during 2010 aerial surveys (Clarke et al. 2011d). The aggregation was documented on nine subsequent surveys between mid-August and early October. Group size estimates of the haulout throughout the season ranged from 1,000 to 20,000 individuals (Table 14). The haulout was documented on every survey near Point Lay until it was last observed on 6 October. Additional survey effort near Point Lay was conducted in mid-October (17 October), and no haulouts were observed. Walrus aggregations on land were observed earlier and for a longer period of time in 2011 compared to those observed in 2009 and 2010 (Clarke et al. 2011d).*"

  - Robards et al. (2007)compiled a map for walrus haulout sites from traditional knowledge.
    - Data about coastal haulouts within the range of Pacific walrus were compiled from numerous sources, including community members and researchers. This effort identified several walrus haulout sites along the Chukchi coast.

- **Subsistence hunting areas**
  - While the majority of the walrus subsistence harvest occurs on St. Lawrence Island, walrus are an important subsistence resource for the communities of the North Slope along the Chukchi coast (Alaska Eskimo Whaling Commission et al. 2003; Braund and Burnham 1984; Huntington et al. 2012; Kassam and Wainwright Traditional Council 2001; MMS Alaska OCS Region 1987, 1996; Nelson c1982; Pedersen 1979a; Stephen R. Braund and Associates 2010; United States Army Corps of Engineers: Alaska District 1999).
  - The U.S. Fish and Wildlife Service collected subsistence harvest information, that included timing of hunting, from 2007 through 2011 (Department of the Interior 2013). FWS found the following times for majority of harvests for the following Chukchi communities.
    - Barrow: June and July when land-fast ice breaks up; can range up to 60 miles from shore.
    - Wainwright: most harvests among North Slope communities; up to 40% of the communities' subsistence use; hunt from June through August as sea ice retreats; distances around 20 miles but can range up to 60 miles from shore (Stephen R. Braund and Associates 2012).
    - Point Hope: late May and early June and August through September; distances usually 5 miles

        - Point Lay: hunting timing peaks in June-July; travel usually up to 40 miles offshore; recently land-based haul out hunting only at the beginning and end of herd formation**.**

- **Defining Hanna Shoal**
    - During a time of rapid change, Hanna and Herald shoals appear to be important sea ice areas over the long term. These shallow areas divert warm water masses flowing northward from the Bering Sea, holding colder water long into the summer season (Weingartner et al. 2005). As a result, sea ice persists there longer into the season as well (Martin and Drucker 1997). A pack ice feature near Hanna Shoal called Post Office Point was historically a meeting point known for its reliable ice all summer long. The area was given its name because ships would meet at this dependable location to exchange mail and information at sea (Aldrich 1915). Recent warming has changed the structure of this persistent lobe of ice, and the minimum September sea ice extent has come that far south only once in the last decade (National Snow and Ice Data Center 2010). In comparison, Hanna Shoal and Post Office Point were ice-covered seven out of ten years in the 1980s and four out of ten years in the 1990s. Nonetheless, Post Office Point and Hanna and Herald shoals continue to be areas of persistent ice floes, which are very important for ice-associated wildlife. Although the pack ice is expected to further recede with climate change, the seafloor topography is likely to continue to divert warm waters. Hanna and Herald shoals have the potential to provide substantial lingering ice floes well into the future compared to other areas in the region (Spall 2007), and may become a last stronghold for some ice-associated species such as the walrus.
    - Foraging depth of walrus is an important delineator for Hanna Shoal. The FWS status review (Garlich-Miller et al. 2011), on page 6 provides support for walrus foraging depth. "*Although walruses are capable of diving to depths of more than 250 m (820 ft) (Born et al. 2005), they usually forage in waters of 80 m (262 ft) or less (Fay and Burns 1988; Born et al.2003; Kovacs and Lydersen 2008), presumably because of higher productivity of their benthic foods in shallow waters (Fay and Burns 1988; Carey 1991; Jay et al. 2001; Grebmeier et al. 2006 a,b)*."
    - Hanna Shoal Use Area (HSUA) as described in Incidental Take Letter of Authorization (LOA) by the Department of Interior U.S. Fish and Wildlife Service (Department of the Interior 2013) on page 35371: "*To delineate the HSWUA, we overlaid the 50 percent UDs for both foraging and occupancy in Jay et al. (2012) in the Hanna Shoal area, as defined bathymetrically by Smith (2011), for the months of June through September. The combined area of those 50 percent UDs produced two adjacent polygons, one on the north slope of the bathymetrically defined shoal and one on the south slope of the bathymetrically defined shoal. We recognize that animals using the areas delineated by those two polygons would be frequently crossing back and forth between those areas and, therefore, joined the two polygons at the closest point on the west and east ends. The final HSWUA totals approximately 24,600 km2 (9,500 mi2) (Figure 2; see Final Regulation Promulgation section)*."
    - NOAA and BOEM have also recognized and identified the importance of Hanna Shoal (Department of the Interior 2013). "*For example, the Audubon Society (Smith 2011) defined*

Hanna Shoal based on bathymetry, delineating an area of approximately 5,700 km^2 (2,200 mi^2). The National Marine Fisheries Service (NMFS) (2013) defined Hanna Shoal as an area of high biological productivity and a feeding area for various marine mammals, including bearded seals (Erignathus barbatus) and ringed seals (Pusa hispida). Their maps delineate an area of approximately 7,876 km^2 (3,041 mi^2). The BOEM Environmental Studies Program reflects both a Hanna Shoal Regional Study Area and a Hanna Shoal Core Study Area of about 720,000 km^2 (278,000 mi^2) and 150,000 km^2 (58,000 mi^2), respectively (BOEM 2013)."

2.2 Spotted Seal

Spotted seals (*Phoca largha*) in Alaska, including those that utilize the Chukchi Sea Planning Area, belong to the Bering Distinct Population Segment (DPS) (Allen and Angliss 2013). They are widely distributed along the Bering, Chukchi and Beaufort continental shelves. Their distribution is determined both by seasonal sea ice and life history events (Boveng et al. 2009). Pupping, breeding and molting usually occur in association with the movement of seasonal sea ice from late fall through spring, which is when seals are primarily in the Bering Sea. As the sea ice diminishes each year, spotted seals move north into Arctic Ocean waters and regularly use barrier islands and coastal haulout sites. During the open water period animals are hauling out on land, presumably closer to areas with dense aggregations of prey (Burns 2002; Frost et al. 1983) or as resting bouts in between long-distance foraging trips offshore (Lowry et al. 1998). These land-based haulout sites have been identified by the community of Pt. Lay in their traditional knowledge of the region and have also been incorporated into the naming of Kasegaluk Lagoon.

The Outer-Continental Shelf Environmental Assessment Program (OCSEAP) conducted large-scale aerial surveys of land-based haulout sites for pinnipeds in the Bering Sea and Arctic Ocean, including the Chukchi coastline during the late 1980s. These surveys determined that for spotted seals, one of the most utilized sites was Kasegaluk Lagoon (Frost et al. 1983). Of fourteen known spotted seal haulout sites in Western Alaska and Eastern Russia, four are located in the vicinity of Kasegaluk Lagoon (Lowry et al. 1998). Kasegaluk Lagoon haul outs are used from mid-July through early September, and over 1,000 spotted seals have been observed on many occasions (Frost et al. 1993). Kaseaguluk Lagoon is one of the few areas where over 1,000 seals may haul out regularly and is the most significant site in the Chukchi Sea. Other large haulout sites for spotted seals are located in the Bering Sea (Frost et al. 1993).

Spotted seals are considered among the most wary of seals, exhibiting high sensitivity to aircraft within 1.25 miles, and sensitivity to human disturbances at their haul-out sites (Frost et al. 1993; Johnson et al. 1992; Quakenbush 1988). Minimizing disturbance to seals at Kasegaluk Lagoon is a conservation priority. Furthermore, with increasing periods of late summer ice-free periods, the time seals spend hauled-out on land may be critical to animals molting later in the season, such as later molting males and maturing pups (Boveng et al. 2009). This need to minimize disturbance to important spotted seal habitat is identified in the Stock Assessment Reports for spotted seals, especially the need to minimize disturbance from OCS exploration and development in the form of "*disturbance form vessel traffic, seismic exploration noise, or the potential for oil spills*" (Allen and Angliss 2013).

Spotted seals are an important subsistence resource for communities along the coast from the Beaufort Sea to Bristol Bay. Animals that have been satellite tagged from haul-out sites at Kasegaluk Lagoon have spent significant time in Kotzebue Sound, the Bering Strait, and in the Yukon-Kuskokwim delta region (Lowry et al. 1998). Minimizing disturbance at important land-based haul-out site like Kasegaluk lagoon will help ensure that communities outside the Chukchi Sea program area, where spotted seal is an important subsistence resource, will have continued access to subsistence hunting of spotted seals.

The mapped concentration areas for spotted seals are based on the following scientific source materials.

- **Highly concentrated spotted seal haulout areas**
  - Information for the location of important land-based haulout sites during the open water season for spotted seals comes from surveys conducted in the 1980s and 1990s (Frost et al. 1993).
    - Aerial surveys were conducted in 1989, 1990 and 1991 to document distribution, abundance and habitat use of spotted seals during July, August, and September, with surveys extended in 1991 until November.
    - Spotted seals were observed hauled out near Utukok Pass, Akoliakatat Pass and Avak Inlet. See Figures 1 and 2 (pages 9 and 10, respectively) for place name locations.
    - In 1989, the highest count was approximately 1800 spotted seals on September 1st with equal numbers at Utukok and Akoliakatat passes (Table 1, page 11). In 1990 the highest count was approximately 2100 seals on July 28 with over 1,000 animals observed in late August and early September (Table 2, page 11). Utukok Pass had higher numbers of animals observed earlier and Akoliakatat Pass had higher numbers of animals observed later. In 1991, approximately 2200 seals were observed on 29 September with equal numbers of seals observed at Utukok and Akoliakatat passes (Table 3, page 11). In 1991 the highest counts at Utukok Pass occurred in late September and Akoliakatat occurred periodically from late July through late September.
    - Page 13: "*There was no obvious seasonal pattern in the total number of seals hauled out in Kasegaluk Lagoon during July-September (Fig. 3). During 1989–91, counts of over l000 seals occurred any time from late July through late September, and similar large counts have been reported as early as 10 July (Frost et al., 1983). Maximum yearly counts occurred on 1 September 1989, 28 July 1990, and 29 September 1991.*"
  - Satellite tracking provided context about spotted seal movement in the Chukchi Sea (Lowry et al. 1998).
    - Movement and behavior of 12 spotted seals (8 males and four females) captured from Kaseagaluk Lagoon were tracked using satellite tags from 1991–1993.

        - Open water season (August–November) movements: "*During August-November, satellite-tagged seals alternated haul-outs at coastal sites with trips to sea. Seals hauled out at four areas in Kasegaluk Lagoon and at ten other locations along the coast of northwestern Alaska and the Chukchi Peninsula (Fig. 1, Table 2). The most frequently used haul-out area was Akoliakatat Pass…*"
        - Table 2 on page 224 shows the number, characteristic and location of spotted seal haulouts on land in Beaufort, Chukchi and Bering Seas, August to October 1991–1993.
        - Figure 2 on page 225 shows a map of Bering, Chukchi, and Beaufort Seas showing average daily at-sea locations of satellite-tagged spotted seals, August to November 1991–1993. This figure shows the concentration area by Kasegaluk Lagoon to Icy Cape.
        - Page 224: "*When they were away from haul-outs, seals were located in both coastal and offshore areas (Fig. 2). The most heavily used region was the eastern Chukchi Sea within about 120 km of the Alaskan coast.*"
    - Concentration of spotted seals at Kasegaluk Lagoon from other studies.
        - Concentrations around Kasegaluk Lagoon identified in aerial surveys conducted from 1992–1993 (Rugh et al. 1997)
            - Page 12: "*The principal locations with seal concentrations were (ordered from south to north) Kuskokwim Bay, … Good Hope Bay, and Kasegaluk Lagoon.*"
        - A traditional knowledge study conducted on walrus in Point Lay and Wainwright noted the importance of Kasegaluk Lagoon and other rivers for feeding seals throughout the summer months (Huntington et al. 2012). Hunters in Point Lay identified the region north of Point Lay as being important haulout area for spotted seals. They also identified (Figure 1, page 3) spotted seal haulout sites on small islands on the north side of Utuqqaq Pass and at the entrance to Avvaq Bay. Traditional knowledge holders further discuss the productivity that supports foraging habitat in the nearshore for marine mammals and fish about 10–15 miles offshore.
    - Environmental Sensitivity Index (NOAA Office of Response and Restoration 2005)
        - The NOAA Environmental Sensitivity Index indicates a high level of concentration (greater than 1000) potentially present in Kasegaluk Lagoon during the months June through November. Areas of importance nearshore for spotted seal are included on Map 17 and Map 18. Map 17 indicates the following sites and corresponding locations as being specific concentration areas for spotted seals: #75, 78, and 80.

2.3 Bearded Seal

Bearded seals (*Erignathus barbatus nauticus*) are circumpolar in their distribution; in Alaska they inhabit the shallow continental shelves of the Bering, Chukchi, and Beaufort Seas in waters less than 200m where they feed primarily on benthic organisms (Boveng and Cameron 2013). The Beringia Distinct Population Segment (DPS) occupies these general areas and thus the Chukchi Planning Area. In general, bearded seals are closely associated with sea ice, in particular offshore pack ice between 70-90% coverage about 20–100 nautical miles offshore (Allen and Angliss 2013; Bengtson et al. 2005). Sea ice is important during critical life history events such as pupping and molting when hauling out of the water may be important for thermoregulation or resting. It is during these critical time periods that bearded seals are known to concentrate in specific areas (Boveng and Cameron 2013). As such, bearded seals follow the seasonal movements of the pack ice. The Bering and Chukchi Seas contain some of the most continuous habitat across their circumpolar range and it is here that the longest migrations occur (Cameron et al. 2010).

Bearded seals are an important subsistence resource for communities in the Yukon-Kuskokwim delta all the way to Beaufort Sea communities. Some bearded seals that use the Chukchi Sea Planning Area also use areas in the Bering Sea. As a result, decisions affecting bearded seals in the Chukchi Sea OCS Planning Area may impact communities in the Yukon-Kuskokwim and Bering Strait regions, where bearded seals are an important subsistence resource (Boveng and Cameron 2013).

The mapped concentration areas for bearded seals are based on the following scientific source materials:

- **Highly concentrated bearded seal habitat – spring**
  - Bengtson et al. (2005) determined density and population estimates for bearded seals.
    - Aerial surveys were conducted primarily along the coastal zone (within 37 km of the shoreline) with a few surveys between 148 and 185 km from the shoreline from north of the Bering Strait to Pt. Barrow.
    - Detection probabilities were estimated for each observer based on recorded sighting data (versus proxy-density values). Bearded seals were not observed as frequently as ringed seals in this study to estimate separate detection probabilities for each ice type, so all observations were used to estimate a global detection probability. Densities were based on sighting recorded for all observers. Bearded sighting densities were not adjusted due to insufficient information about haulout patterns. Abundance of seals in each stratum were calculated as sum of abundance estimates for each line multiplied by ratio of stratum area to survey effort within the stratum. Density of seals in each stratum was the abundance estimate divided by the stratum area. Uncorrected densities for bearded seals likely underestimated the actual densities of bearded seals as those animals in the water were not accounted for. Traditional knowledge from hunters in the region

indicates that during this time period there may be many animals present in the water.

- The highest density of bearded seals in May–June was located in offshore pack ice with high benthic productivity, and thus a preferred food source. Figure 4b on page 839.
- Figure 6 on page 841 illustrates for the Chukchi coastline, the estimated densities of bearded seals from May–June. The actual densities of bearded seals along this region may be under-represented as they are presented with unadjusted survey timing and seal haulout behavior for both 1999 and 2000. Additionally, the open lead was excluded from density calculation further underestimating density of bearded seals (which is likely an area of high use – see next section).

- **Highly concentrated bearded seal habitat – spring and summer**
  - Movement and behavior and methodology to identify marine habitats of importance to bearded seals using movement and dive data (Boveng and Cameron 2013).
    - Boveng and Cameron (2013) identified seasonal movements and dive behavior of bearded seals as determined by satellite and time-depth transmitters.
    - To identify specific marine habitats in the Chukchi Sea Planning Area they fit movement and diving data to multi-state random walk model that allows for transitions between states of movement behavior for: foraging, transit and resting. Figure 5, page 20 depicts the model.
    - Bearded seals in this study utilized the Chukchi Sea Planning Area in all behavioral categories.
      - Page 64: "*All seven of the bearded seals tracked in this study moved through the Chukchi Sea Planning Area (CSPA) and two of the seven also used the Beaufort Sea Planning Area (BSPA) (Figure 8). The tagged bearded seals' use of the habitat within the planning areas was a mix of transit, foraging, and resting, as determined by the multi-state movement and behavior modeling (see next section).*"
      - Figure 11 on page 68 shows the modeled tracks of bearded seals for the summer period (June-September), fall (October-December) and winter (January-April) periods.
      - Two tagged bearded seals traveled offshore into the Chukchi planning area and engaged in foraging behavior, (see Figure 11, page 68).
    - The Chukchi nearshore corridor is an important area for bearded seals.
      - Seals captured in Kotzebue Sound traveled north in spring and were usually located within 50 km of the shoreline.

        - Page 64: "*The majority of the locations in the planning areas were in a corridor relatively near the Alaska coast (Figure 9). Of all the locations obtained from bearded seals in the CSPA, 70.8% were within 50 km of the coast.*"
      - There are some limitations as to the extent that bearded seal tracking results can be extrapolated from the Bering Sea DPS, as the sample size is limited to five subadult and two adult bearded seals.
  - A traditional knowledge study conducted on walrus in Point Lay and Wainwright noted that there were abundant bearded and ringed seals basking visible from shore (Huntington et al. 2012). Traditional knowledge holders further discuss the productivity that supports foraging habitat in the nearshore for marine mammals and fish about 10–15 miles offshore.
  - NOAA Office of Response and Restoration (2005) documents highly concentrated bearded seal habitat for spring and summer.
      - Chukchi Sea waters were included as being important for bearded seals from Barrow to Point Hope, offshore. Bearded seals were identified specifically in waters for maps 13-24 to the extent of the Chukchi waters represented by the maps.
  - NOAA (1988) documents highly concentrated bearded seal habitat for spring and summer.
      - In the map included in Section 3.74, the NOAA atlas (1988) identifies much of the Chukchi coastal lead system area as a "Major Adult Area" for the months of March and April.

2.4 Ringed Seal

Ringed seals (*Phoca hispida*) have a circumpolar distribution, and in the U.S. are found in the Bering, Chukchi and Beaufort Seas (Allen and Angliss 2013). In Alaska, they are considered one stock, and regional migratory patterns and movements are not well-known. Ringed seals are closely associated with sea ice and adapted to both pack ice and shorefast ice (Kelly 1988). In the Beaufort and Chukchi Seas, as the pack ice retreats, they generally follow the ice edge; however, some animals may remain near their fast ice habitats during the open water period (Kelly et al. 2010b). In the winter months, ringed seals in the Beaufort and Chukchi Seas remain in Arctic waters near landfast ice as well as leads and areas of open waters. Relative to other pinnipeds, they are among the most well-adapted to shorefast ice; they return to nearshore habitats prior to freeze-up and their densities tend to be the highest in fast ice regions (Frost et al. 2004). As water freezes, they maintain breathing holes in the ice, and as snow accumulates they excavate snow caves and maintain lairs for resting and pupping (Kelly et al. 2010b). As spring warms and melts snow accumulated over breathing holes, seals begin their annual molting cycle and will bask on top of ice for longer periods of time. Molting in adults may extend into July in the U.S. Arctic (Kelly et al. 2010b). Increasingly, there are concerns about the impacts as a result of climate change on ringed seals. In particular, the loss of sea ice and changes in snow cover may impact the timing and quality of lairs (Kelly et al. 2010b).

The mapped concentration areas for ringed seals are based on the following scientific source materials.

- **Highly concentrated ringed seal fast ice habitat**
  - Density and population estimates of ringed seals in the Chukchi Sea (Bengtson et al. 2005).
    - Aerial surveys were conducted primarily along the coastal zone (within 37 km of the shoreline) with a few surveys between 148 and 185 km from the shoreline from north of the Bering Strait to Pt. Barrow.
    - Density and population estimates were derived from aerial surveys and a correction factor to account for those seals not visible that may be in the water. The correction factor was determined using a model of the proportion of time out of the water for seals caught in Kotzebue Sound and Prudhoe Bay.
    - Average density of ringed seals was estimated as: 1.91 seals/km^2 and 1.62 seals/km^2, respectively for 1999 and 2000. Estimated densities of ringed seals in the eastern Chukchi May–June in 1999 and 2000 found are depicted in Figure 3 on page 838. Note that the open water lead was excluded from surveys and from density estimates as the surveys were counting those animals hauled out on ice.
    - The greatest density of ringed seals occurred south of Kivalina. However, there was still a relatively high density of ringed seals in the nearshore Chukchi in 1999 (again, refer to Figure 3 on page 838).
    - Page 842: "*Ringed seals were four to ten times more abundant in nearshore fast and pack ice environments than in offshore pack ice. This distribution is consistent with the pattern reported by other authors such as Smith (1973), who reported that densities of ringed seals were much lower beyond 29 km from shore. The higher densities of ringed seals in the coastal areas was not surprising, given the importance of shorefast ice for ringed seal lairs and breeding habitat (Burns 1970; Smith and Stirling 1975; Smith and Hammill 1981; Lydersen and Gjertz 1986; Hammill and Smith 1989; Lydersen et al. 1990; Lydersen and Ryg 1991; Smith et al. 1991; Furgal et al. 1996).*"
  - Information about key environmental correlates to determine density of ringed seals (Frost et al. 2004). Both water depth and location relative to fast ice edge are both factors that could be applied in identifying areas in the Chukchi as being important habitat for ringed seals.
    - Aerial surveys were conducted in the Beaufort Sea from late May through early June 1996–1999 using strip-transect methodology. They examined the effects of habitat, weather, and time of day on observed seal densities using univariate chi-

square goodness-of-fit tests, and a multivariate generalized linear model to estimate the relationship between seal counts and covariates.

- Observed densities ranged from 0.81 seals/km^2 in 1996 to 1.17 seals/km^2 in 1999. Water depth and location relative to fast ice edge and ice deformation were important determinants for higher densities.
- Highest densities occurred at depths between 5–35m. Densities were also high in relatively flat ice and near fast ice edge, declining both shoreward and seaward.
- Seals may return to shorefast regions before freeze-up as food resources in those regions may be plentiful and in the case of males, may start defending home ranges (Kelly et al. 2010a).

- A traditional knowledge study conducted on walrus in Point Lay and Wainwright noted that there were abundant bearded and ringed seals basking visible from shore (Huntington et al. 2012). Traditional knowledge holders also discuss the productivity that supports foraging habitat in the nearshore for marine mammals and fish about 10–15 miles offshore. They further note that while the other species of seals regularly haul out onto land, ringed seals never haul out onto land.
- NOAA (1988) documents highly concentrated ringed seal fast ice habitat.
  - In Section 3.72 with regards to ringed seal movements it states "Seals wintering in Bering Sea apparently move to Chukchi in May-June, return October-November. Others nonmigratory, except for incshore-offshore movements. <u>Fast ice mainly inhabitated by adults in winter-spring</u>; immatures reside offshore, moving to fast and remnant ice for molt, late spring-early summer" with emphasis added. In addition, the associated map identifies the region of shorefast ice as a "Major Adult Area" for the months of February to June.
- NOAA Office of Response and Restoration (2005) documents highly concentrated ringed seal fast ice habiatat.
  - The NOAA Environmental Sensitivity Index indicates that ringed seals are present in concentrations throughout the Chukchi in coastal waters and shorefast ice from October through July, engaging in pupping from March to May and molting from March to July. Maps 19-24 indicate particularly high concentration areas for ringed seals.

3. Polar Bear

Polar bears (*Ursus maritimus*) occur throughout the Arctic in close association with the seasonal ice pack. The worldwide population of polar bears is estimated to be approximately 20,000–25,000 individuals distributed among 19 subpopulaitons (Schliebe et al. 2008). Within the United States portion of the range, polar bears most commonly occur at low densities over shallow continental shelf waters (<300 meters) within 180 miles of the Alaskan coast (USFWS 2013b). Polar bears from two separate sub-populations or stocks occur in Alaska: (1) the Chukchi-Bering Seas' stock (CS); and (2) the Southern Beaufort Sea stock (SBS) (USFWS 2013c). The SBS population is estimated to contain approximately 1,500 polar bears that range between Icy Cape on the Northwest coast of Alaska and Pearce Point in Canada. The distribution of the CS stock extends westward into the eastern portion of the Eastern Siberian Sea, Russia Federation, east past Point Barrow, Alaska, and southward into the Bering Sea, where the southern boundary is determined by the extent of annual ice. The size of the CS population is estimated at approximately 2000 individuals and may be declining, however there is a low level of confidence in the current population estimate (Evans et al. 2003).

Polar bears utilize sea ice habitat for foraging, and are most often concentrated near the ice edge, leads, or polynas over shallow continental shelf waters (Durner et al. 2004). The primary prey of polar bears in most areas of the arctic are ringed seals (*Pusa hispida*), and bearded seals (*Erignathus barbatus*) are also a common prey. Pacific walrus (*Odobenus rosmarus divergens*) calves are taken occasionally and polar bears will also scavange walrus and bowhead whale (*Balaena mysticetus*) carcasses. Changes in the concentration and distribution of arctic sea ice that reduce access to prey may have a negative effect on polar bear growth and survival (Schliebe et al. 2008). Sea ice is also important for pregnant females to access denning sites. Pregnant females enter maternity dens by late November, and give birth in late December or early January. Changing sea ice patterns may negatively impact polar bear reproductive success and may also reduce foraging opportunities for females and cubs after they emerge from maternal dens. Based on recent satellite tracking studies, denning of pregnant females from the Chukchi Sea population occurs primarily on Wrangel and Herald Islands, and on the Chukotka coast in the Russian Federation (USFWS 2010a). Denning on the northwest coast of Alaska has decreased in recent decades, likely due to reduced sea ice connectivity with the Chukchi coastline during the late-fall (Fischbach et al. 2007; USFWS 2010a).

The polar bear was listed as a threatened species under the Endangered Species Act (ESA) on May 15, 2008 and is listed as vulnerable in the IUCN Red List of Threatened Species (Schliebe et al. 2008). The USFWS designated critical habitat for polar bear populations in the United States effective January 6, 2011 (USFWS 2010a). In the Federal Register listing, USFWS designated three separate units as components of polar bear critical habitat: (1) Sea-ice Habitat; (2) Terrestrial Denning Habitat; and (3) Barrier Island Habitat. The designation of critical habitat was challenged in Federal Court by several parties, including the State of Alaska and the Alaska Oil and Gas Association. On January 11, 2013, the District Court for the District of Alaska, issued an order vacating and remanding to the Service specific sections of this rule (United States District Court For the District of Alaska 2013). As a result there is no legally designated critical habitat for the polar bear at this time.

The primary threat to the survival of threatened polar bear populations is the loss of sea-ice habitat throughout the species range (USFWS 2010a). If current trends of sea-ice loss due to climate change continue, polar bears may decrease by 30-50% in the next 50 years and may become extirpated from most of their range within 100 years (Schliebe et al. 2008). Other anthropogenic threats including oil and gas exploration and development, shipping, over-harvesting and the effects of toxic contaminants may also impact recruitment and survival (Schliebe et al. 2008). The potential effects of human activities are much greater in areas where there is a high concentration of dens (USFWS 2010a). Low-level negative impacts on polar bears due to oil and gas exploration and development include disturbance due to noise and human interaction and toxic effects from chronic releases of contaminants. The greatest threat to polar bears and their habitat from future oil and gas development is the potential effect of an oil spill or discharges into the marine environment (USFWS 2010a). (Amstrup et al. 2006) estimated that "*the numbers of bears potentially oiled by a hypothetical 5912 barrel spill (the largest spill thought probable from a pipeline breach) ranged from 0 to 27 polar bears for September open water conditions, and from 0 to 74 polar bears in October mixed ice conditions.*" If a spill of the magnitude of the Deepwater Horizon in the Gulf of Mexico were to occur, the effects could be catastrophic, especially if oil persisted in the marine environment over the winter and entered the coastal sea-ice lead systems where polar bears, the ice seals they prey upon and other marine life would be severely impacted.

The mapped concentration areas for polar bears submitted in this package are based on the best available scientific source materials. At present the available scientific data are not adequate to identify additional deferral areas to protect polar bears and their essential habitat in the Chukchi Program Area. As stated in the Federal Register notice designating critical sea-ice habitat (USFWS 2010a), the main problem lies in identifying specific areas that are spatially and temporally consistent given the variability in sea ice extent and seasonal location within and between years. Accordingly, we have included the USFWS Sea-Ice Habitat layer in our map and chosen not to include additional specific deferral recommendations for sea-ice habitat at this time. However we note that there is an extensive history of radio and satellite tracking of polar bears and habitat utilization information and data layers exist from previous studies (e.g.(Amstrup et al. 2006; Durner et al. 2009)). USFWS and USGS are conducting new satellite tracking studies on bears from the Chukchi Sea population (USFWS 2010a); see also http://alaska.usgs.gov/science/biology/polar_bears/tracking.html). Analysis of data from new studies in conjunction with previously collected information may address this data gap for both the Chukchi Sea and Southern Beaufort Sea populations. We will continue to monitor the results of this research to determine whether further deferral recommendations to protect important polar bear habitat areas are warranted in the future.

The map showing polar bear denning and feeding areas contains three data layers from three primary sources.

- **Polar Bear sea ice habitat (ESA Critical Habitat Unit 1)**
  - The key reference for polar bear sea ice habitat is the 2010 Federal Register notice associated with the U.S. Fish and Wildlife Service's designation of critical habitat for the polar bear (USFWS 2010a).
    - The USFWS determined that one of the primary constituent elements (PCEs) polar bear for polar bear critical habitat in the United States is: "*Sea ice habitat used for feeding, breeding, denning, and movements, which is sea ice over waters 300 m (984.2 ft) or less in depth that occurs over the continental shelf with adequate prey resources (primarily ringed*

and bearded seals) to support polar bears" (USFWS 2010a). Although polar bears do range farther north and over deeper water than the designated sea ice CH would indicate (Amstrup et al. 2006), the habitat selection analysis by (Durner et al. 2004) demonstrates that polar bears remain almost entirely over the continental shelf indicating that this is the habitat with the biological features essential to the conservation of the species.

- In the 2010 Final Rule designating polar bear critical habitat (CH) the USFWS summarized the rational for designating sea ice habitat for polar bears as a broad continental shelf area as follows (page 76,119): "*Mapping specific sea-ice habitat is impracticable because it is dynamic and highly variable on both temporal and spatial scales. Sea-ice distribution and composition vary within and among years. For example, sea-ice conditions that are characteristic of polar bear optimal feeding habitat vary depending on the wind, currents, weather, location, and season. Therefore, sea ice that was optimal at one time may not be at another, nor will it necessarily be the same from year-to-year during the same month.*"
- Although the Alaska District Court has vacated specific components of the designation of critical habitat units 2 (denning habitat) and 3 (barrier islands habitat), the court upheld the rationale for designation of Sea Ice CH (Unit 1). The court stated that *"[T]he Service successfully shows that the sea ice habitat PCE may require special management considerations or protection now or in the future and does not violate the Administrative Procedures Act*" (page 21 in the court record).

- **Major denning area**
  - The 1988 NOAA Bering, Chukchi, and Beaufort Seas Coastal and Ocean Zones Strategic Assessment Data Atlas delineated the boundaries within which major polar bear denning areas are located . Within the Chukchi Program Area the major denning area is coincident with the western extent of the area that was designated as ESA critical habitat. Within the Chukchi Sea Program Area these boundaries are consistent with recent studies of maternal denning habitat in Alaska (e.g. Fischbach et al. 2007).
  - We chose not to use the USFWS Critical Habitat (Unit 2) for Terrestrial Denning Habitat because was a part of the rationale for this designation was vacated by the Alaska US District Court in January 2013 and remanded to the USFWS.
- **Lower density denning area**
  - Key references that we used for lower density denning for polar bear included: (Fischbach et al. 2007; NOAA 1988; USFWS 1995). This map layer is derived from the 1988 NOAA Bering, Chukchi, and Beaufort Seas Coastal and Ocean Zones Strategic Assessment Data Atlas in combination with the USFWS Habitat conservation strategy for polar bears in Alaska (USFWS 1995). Use of the area west of Point Barrow by polar bears for denning has historically been lower than the Southern Beaufort Sea coast and may be decreasing due to the loss of late-fall sea ice connectivity. Conversely however,

the importance of terrestrial denning habitat may be increasing due to the decline in multi-year sea ice. Radio and satellite telemetry studies elsewhere indicate that denning can occur in multi-year pack ice and on land. Recent studies of the SBS indicate that the proportion of dens on pack ice have declined from approximately 62% in 1985–1994 to 37% in 1998–2004 (Fischbach et al. 2007).

- In the 2010 Final Rule designating polar bear critical habitat (CH) the USFWS noted that denning habitat west of Pt. Barrow lacks the required primary constituent element (PCE) of "*sea ice in proximity of terrestrial denning habitat prior to the onset of denning during the fall to provide access to terrestrial den sites.*" The USFWS cites radio tracking data indicating that historically, few bears denned in this region and that it is not accessible to pregnant females from the Chukchi/Bering Sea population in the fall. This view is also consistent with the data and findings presented in (Fischbach et al. 2007).

4. MARINE BIRDS

The Chukchi Sea is an important region for marine birds migrating, nesting, foraging, and staging through spring, summer, and fall. Multiple IBAs line the Chukchi Sea coast stretching into the offshore waters out to about 40 miles. One area of high abundance reaches 100 miles offshore off the Lisburne Peninsula where nearly 250,000 colonial nesting seabirds forage during the breeding season.

The mapped concentration areas for marine birds are based on the following scientific source materials.

- **Seabird Colonies**
  - The World Seabird Union, on behalf of the U.S. Fish and Wildlife Service and other entities, manages the North Pacific Seabird Data Portal, formerly the Beringian Seabird Colony Catalog. This extensive dataset includes ~1700 nesting colonies in Alaska World Seabird Union (2011).
    - The abundance of each species present at each colony was recorded by surveyors counting the number of individuals, nests, or pairs over the last few decades. The database reports the best estimate made for that colony based on one or more site visits.
    - We eliminated records that were more than four decades old (pre-1971), rated as a poor quality estimate, or were otherwise questionable (Smith et al. 2012).
    - Based on this information, there are 30 nesting colonies on the Chukchi coast adjacent to the program area, which are home to 10 breeding species. The largest colony, Cape Lisburne, has an estimated 216,000 nesting birds in summer. There are approximately one quarter million seabirds nesting in coastal areas adjacent to the program area. These seabirds forage in the offshore waters of the Chukchi Sea.

Table 4-1. Estimate of breeding birds present at nesting colonies near the Chukchi Sea Program Area[1].

Location	ARTE	BLGU	BLKI	COEI	COMU	GLGU	HOPU	PECO	TBMU	TUPU	Total
Lisburne Peninsula											
Cape Dyer						48	24	26		4	**102**
Cape Lewis		28	3,000		7,500	50	300	58	17,500	4	**28,440**
Cape Lisburne		170	15,000		70,000	20	1,450	78	130,000	20	**216,738**
Corwin Creek								33		3	**36**
Kilikralik Pass						50	60	40			**150**
Kowtuk Point			100					30			**130**
Noyalik Peak							35	4		12	**51**
Sapumik Ridge		9									**9**
Subtotal		**207**	**18,100**		**77,500**	**168**	**1,869**	**269**	**147,500**	**43**	**245,656**
Kasegaluk Lagoon											
E. Akoliakatat Pass	42			442		10					**49**
Icy Cape Spit	6			62		2					**470**
Kasegaluk Lagoon 1				2		6					**8**
Kasegaluk Lagoon 2	4			2		4					**10**
Kasegaluk Lagoon 3				6		36					**42**
Kasegaluk Lagoon 4	2			18		14					**34**
Kasegaluk Lagoon 5				12		12					**24**
Kasegaluk Lagoon 6				6		14					**20**
Kasegaluk Lagoon 7				46		36					**82**
Kasegaluk Lagoon 8				50							**50**
Kasegaluk Lagoon 9				34		36					**70**
Kasegaluk Lagoon 10	2			102		8					**112**
Kasegaluk Lagoon 11	8			20		12					**40**
Kasegaluk Lagoon 12	4			8		10					**22**
Omalik Spit	10										**10**
Point Lay Barrier Is.				4		4					**8**
S. Kasegaluk Spit	2			6							**8**
S. Utukok Pass Is.				56		2					**58**
Sikok Point Barrier Is.	4			4							**8**
Solivik Island	36			538		40					**614**
Subtotal	**120**			**1,418**		**246**					**1,739**
Barrow Area											
Deadman's Island		30									**30**
Point Barrow Spit		14									**14**
Seahorse Island	24										**24**
Subtotal	**24**	**44**									**68**
Total	**144**	**281**	**18,100**	**1,418**	**77,500**	**414**	**1,869**	**269**	**147,500**	**43**	**247,508**

[1]ARTE = Arctic tern; BLGU = black guillemot; BLKI = black-legged kittiwake; COEI = common eider; COMU = common murre; GLGU = glaucous gull; HOPU = horned puffin; PECO = pelagic cormorant; TBMU = thick-billed murre; TUPU = tufted puffin.

- **Global IBAs**
    - Smith et al. (2012; in review) analyzed globally significant marine IBAs through spatial analysis of at-sea survey data.
        - The analysis was based on Drew and Piatt's (2011) version 2 of the North Pacific Pelagic Seabird Database, a compilation of at-sea survey transect data that documents seabird densities in the Arctic Ocean and the North Pacific.
        - The IBAs are based on BirdLife International's A4 criteria: places that regularly hold more than 1% of the North American population of a congregatory waterbird species (A4i), or more than 1% of the global population of a congregatory seabird species (A4ii) (National Audubon Society 2012).
        - Smith et al. (2012; in review) developed a standardized and data-driven spatial method for identifying globally significant marine IBAs using six primary steps: accounting for unequal survey effort, filtering input data for persistence, producing maps representing a gradient from low to high abundance, drawing core area boundaries around major concentrations, validating the results, and combining overlapping boundaries into important areas for multiple species.
        - The authors "*tried to minimize uncertainty and leaned toward decisions that could potentially increase Type II error (false negatives, or failure to identify an area that is truly important) but decrease Type I error (false positives, or identifying an area as important that truly is not). This approach, along with survey coverage gaps in the available data, likely means that important areas exist in places not identified. Therefore, failure to identify an IBA did not necessarily mean that a particular area was unimportant (Rocchini et al. 2011).*"

Table 4-2 Globally significant IBAs overlapping the Chukchi Program Area (Smith et al. 2012).

IBA Name	Global Trigger Species[1,2]	Continental Trigger Species	State Trigger Species	Estimated Abundance for Assessed Species	Species Richness
Barrow Canyon & Smith Bay	ARTE; BLKI; GLGU; KIEI; LTDU; POJA; REPH; RTLO; SAGU	BRAN; COEI	PALO	725,467	38
Chukchi Sea Nearshore	ARTE; BLKI; GLGU; LTDU; POJA; REPH; SAGU		COEI; RTLO	698,091	33
Icy Cape Marine	BLKI; GLGU; POJA			185,449	32
Kasegaluk Lagoon[3]	BRAN; SPEI		ALTE	>40,100	unknown
Ledyard Bay[3]	SPEI; BLKI; COMU	COMU	BLKI	>143,000	unknown
Lisburne Peninsula Marine	BLKI		GLGU; PALO	104,504	33
Point Lay Marine	LTDU		GLGU	32,088	24

[1]ALTE = Aleutian tern; ARTE = Arctic tern; BLKI = black-legged kittiwake; BRAN = brant; COEI = common eider; COMU = common murre; GLGU = glaucous gull; KIEI = king eider; LTDU = long-tailed duck; POJA = pomerine

jaeger; PALO = Pacific loon; REPH = red phalarope; RTLO = red-throated loon; SAGU = Sabine's gull; SPEI = spectacled eider.

[2]Trigger species are those that met the global criteria, for which the IBA was recognized.

[3]Ledyard Bay and Kasegaluk Lagoon IBAs were based on different methods (satellite telemetry and expert assessment); abundance was estimated for the trigger species only and total species richness was not assessed.

5. Lower Trophic Levels and Physical Features

Productivity and production at lower trophic levels can shape Arctic ecosystems, especially considering the relatively short food chains that occur in the Arctic (Grebmeier 2012; Grebmeier et al. 2006a). Primary production is ultimately the foundation of any ecosystem. In the northern Bering and Chukchi sea ecosystems, a greater proportion of primary productivity moves through the benthic portion of the food web compared to more southern regions, such as the southern Bering Sea (Grebmeier et al. 2006b; Hunt et al. 2002). This makes productivity of seafloor communities particularly important. Seafloor communities are an important prey resource in the Arctic for species at higher trophic levels, such as walrus, gray whales, bearded seals, and diving sea ducks (Bogoslovskaya et al. 1981; Boveng and Cameron 2013; Cameron et al. 2010; Jay et al. 2012; Moore et al. 2003; Petersen and Douglas 2004; Suydam 2000).

Complete data are not available on primary production or movement of production through the food web. However, there are good data sets on the distribution of patterns of water column algae during the open water period, as well as patterns of benthic biomass across the region—specifically the review put together by Grebmeier and colleagues in 2006 (Grebmeier et al. 2006a). These are proxies that can be used to delineate areas that may be productive spots at lower trophic levels that are important to the productivity and structure of the Chukchi Sea ecosystem. The synthesis compiled by Grebmeier and colleagues in 2006 (Grebmeier et al. 2006a) will soon be updated by the PacMARS project, but those data have not been made readily available to the public yet. The areas that generally have high concentrations of water column algae or benthic biomass, are likely important to the health of Arctic ecosystems.

Grebmeier et al. (2006a) generously shared their synthesis data sets for water column algae and benthic biomass with us. Specific methods they used to produce these data sets are described in their methods.

5.1 Primary Productivity

Areas that tend to have high concentrations of water column algae are Barrow Canyon, parts of Hanna Shoal, and the waters south of Hanna Shoal. To produce the map of integrated water column algae we interpolated data values from Grebmeier et al. (2006a) using the natural neighbor methodology available in ESRI's Spatial Analyst extension.

Integrated water column algae are likely the best proxy available for the region. The open water season is an important time for production, as sea ice cover does not limit light penetration into the water column. While algal growth at the ice edge, in polynyas, in and under the ice, and in melt ponds may be significant, accurate measurements are not available for the Chukchi Sea area (Arrigo et al. 2012; Boetius et al. 2013; Frey et al. 2012; Hill and Cota 2005; Krembs et al. 2000). While there are satellite data available for the region, these data may not reflect biomass accurately because of subsurface plumes of phytoplankton; and satellite measurements need to be calibrated to account for sediments in coastal waters, which is ongoing (Lee Cooper personal communication with C. Krenz).

5.2 Benthic Biomass

The Chukchi Sea has high levels of benthic biomass compared to the Beaufort Sea. Areas with especially high levels of benthic biomass include the head of Barrow Canyon and the region South of Hanna Shoal. Hanna Shoal also has relatively high levels of benthic biomass, too. To develop the map, benthic biomass samples were interpolated using the natural neighbor methodology available in ESRI's Spatial Analyst extension.

While some of the data are relatively old—and sparse in some areas of the areas of the Chukchi Sea Planning Area—the patterns are at least a gross reflection of the distribution of hot spots of benthic biomass. The more recent information being synthesized as a part of the PacMARS project will undoubtedly clarify the patterns. Once available, that information should be used to delineate high benthic biomass areas.

5.3 Sea Ice

Sea ice is a defining ecosystem characteristic which consists of multiple types of features that influence the distribution of marine productivity and wildlife, such as pack ice, ice floes, leads, polynyas, landfast ice, river overflood, and under-ice freshwater pooling. In the Arctic, ice reaches it maximum extent in March, reaching in some years nearly to the Aleutian Islands in the eastern Bering Sea. In September each year, sea ice reaches its minimum extent, receding past the U.S. Exclusive Economic Zone, more than 200 miles offshore, north of 75º latitude. This constantly changing, essential feature is a key to why the Arctic marine environment is so dynamic. Although the minimum sea ice extent varies significantly from year to year, the trend is an annually receding ice edge in all months of the year (Comiso 2002; Comiso et al. 2008). It is not known exactly how these dynamic sea ice features will change in a warming climate. Predictions of future sea ice conditions include earlier melting, later freeze-up, an increase in open water, retraction of sea ice from the productive continental shelf, declining multi-year ice, and less stability in landfast ice (USFWS 2010b). Wang and Overland (2009) predict a nearly sea ice-free Arctic summer in approximately 20 years, and more recent papers acknowledge that state could occur considerably sooner (Maslowski et al. 2012; Overland and Wang 2013).

Polynyas (recurrent, predictable open water areas in the sea ice) and open leads are important congregation and feeding areas for mammals and birds (Stirling 1997; Stringer and Groves 1991). Polynyas are continually changing in size and shifting position, which can make them difficult to map (Eicken et al. 2005). However, these openings are found consistently in some areas that are adjacent to land or grounded pack ice where the ice is blown offshore by the prevailing wind or pulled away by currents. Although summer ice pack has changed dramatically over the last four decades, winter ice openings have stayed fairly consistent (Eicken et al. 2005), indicating that areas important now and in the past are likely to persist into the future. In the Chukchi and Bering seas, there are two distinct classes of polynyas: persistent open areas off south-facing coasts and less frequently occurring wind-driven openings that occur off north-facing coasts (Stringer and Groves 1991).

Another important sea ice feature is landfast ice, which is stable ice that is fastened to the shore and remains much of the year. This feature provides an important platform for wildlife and subsistence hunters. In the Alaskan Beaufort Sea, landfast ice "*first forms in October and is anchored to the coast. It then rapidly extends some 20-40 km offshore to eventually cover ~25% of the shelf area and remains in place through June*" (Gradinger 2008). Landfast ice in this area has not changed in extent, although formation and breakup are occurring later and earlier compared to data from the 1970s; the ice is also less stable, with impacts on local hunting (Gradinger 2008).

Variation in ice cover is the dominant factor in the spatial pattern of primary productivity from phytoplankton (Wang et al. 2005). Many of the phytoplankton blooms and much of the wildlife activity occurring in the Arctic environment is concentrated at the ice edge. The sea ice is very important to primary productivity as a platform for large algal blooms happening on the bottom of the sea ice in spring and summer (Gradinger 2008; Homer and Schrader 1982; Laidre et al. 2008). Production associated with the sea ice is the base of an ice-associated food web that includes amphipods, Arctic cod, seabirds, and seals. "*It remains unresolved how changes in the diversity and productivity of the ice related biota combined with changes of the timing and regions of ice melt and formation will impact the ice itself and the tight sea ice-pelagic-benthic couplings in the arctic shelf seas*" (Gradinger 2008). Complicated by climate warming, baseline biophysical processes are difficult to measure. Nonetheless, an effort should be made to better understand sea ice dynamics in relation to climate change, which has the potential to significantly change the Arctic marine ecosystem as we currently know it.

The sea ice maps are based on the following scientific source materials:

- **Sea ice concentration**
    - National Snow and Ice Data Center (2013) distributes daily sea ice extent data, which is a product of the National Ice Center. Derived from satellite imagery, these data are the most current and complete resource for examining sea ice patterns in the Northern Hemisphere.
        - The National Environmental Satellite, Data, and Information Service (NESDIS), part of the National Oceanic and Atmospheric Administration (NOAA), has an extensive history of monitoring snow and ice coverage. Accurate monitoring of global snow and ice cover is a key component in the study of climate and global change as well as daily weather forecasting. By inspecting environmental satellite imagery, analysts from the Satellite Analysis Branch (SAB) at the Office of Satellite Data Processing and Distribution (OSDPD), Satellite Services Division (SSD), created a Northern Hemisphere snow and ice map from November 1966 until the National Ice Center (NIC)

took over production in 2008.

    - Beginning in February 2004, further improvements in computer speed and imagery resolution allowed for the production of a higher resolution daily product with a nominal resolution of 4 km. NSIDC distributes the 24-km and the 4-km IMS product for February 2004 to present. In 2006, NSIDC started distributing 4-km GeoTIFF files for use with GIS applications.

- Audubon Alaska (2013) collected five years of daily sea ice extent data, using spatial analysis to derive grids of the percent of days with sea ice by month for the Northern Hemisphere from 2008 through 2012.

    - Daily sea ice extent data for the circumpolar north were collected for five years from January 1, 2008 to December 31, 2012 at a 4 km resolution (National Snow and Ice Data Center 2013). These data define sea ice presence as areas with greater than 15% ice concentration.

    - The data layers were summed by month then divided by the total number of days of data available for that month (occasionally a daily grid was unavailable from NSIDC due to processing error). The resulting statistic represented the percent of days with sea ice for each of 60 months (12 months over 5 years). Next, five grids for each month (2008 to 2012) were averaged, resulting in one grid each for the months of January through December representing the average percent of days with sea ice. Finally, months were combined into seasons by averaging three months together, as shown on the map.

6. SUBSISTENCE

Subsistence use area data have been collected on the North Slope since at least the 1970s (Pedersen 1979a, b). Until recently, these data have been based primarily on recall interviews, in which hunters are asked after the fact where they have traveled and hunted. Some studies document lifetime use areas (e.g., (Pedersen 1979a, b), whereas others have looked at specific years (e.g. Stephen R. Braund and Associates and Institute of Social and Economic Research 1993a). While such data have been repeatedly shown to be reliable in providing a broad picture of subsistence patterns, there has always been a degree of uncertainty associated with the maximum extent, especially offshore where there are no landmarks by which hunters can connect their memories with a map. Widespread use of GPS by hunters has provided a much higher degree of certainty for hunting routes and harvest locations, whether by hunters noting where they are and reporting that information in interviews, or by hunters providing GPS data to researchers (e.g., the results of the Braund study that are being reviewed by BOEM at present). The combination of GPS, taking uncertainty out of navigation, and larger boats with more powerful engines has given hunters the ability to travel farther offshore. Recent studies (e.g., as reported in Stephen R. Braund and Associates 2010) document subsistence activities farther offshore than have been documented previously. The areas recorded in previous studies are thus confirmed as still being used, with the addition of more distant areas, up to 90 miles offshore in some cases.

More recent studies have also differentiated use areas by season. Not surprisingly, the greatest extent of offshore use is during summer, when hunters can travel by boat. Typically, such trips are in search of pack ice where hunters can find walrus and bearded seals. If animals can be found close to the community, hunters will not travel far. But with the rapid retreat of sea ice in recent summers, hunters often have to travel great distances, especially as the period between break up of shorefast ice (allowing boat launch and travel) and the disappearance of pack ice within boating range (ending the opportunity to get ice-associated animals) appears to be getting shorter.

Harvest areas can vary considerably from one year to the next, depending on environmental conditions and also the degree to which subsistence needs have been filled already. In years with poor spring bowhead whale harvests, for example, hunters may have greater incentive to find walrus and bearded seals in summer. In years with ice staying near shore, hunters may not have to travel far to find bearded seals needed for, among other things, making covers for skin boats (*umiaq*s) used the following spring during whaling.

Thus, studies that document harvest areas in a given year cannot be interpreted as representing the full use area over the course of many years. Even lifetime subsistence use areas, which in principle reflect the degree of spatial flexibility required for a hunter to continue to provide for his family and community over a long period, cannot be taken as indications of what will be required in future. Use areas can grow (e.g., as implied in Stephen R. Braund and Associates 2010) for offshore areas, assuming the areas farther offshore are in fact new use areas rather than areas that were inaccurately documented before), and they can also shrink due to environmental, social, and technological changes (e.g. Fienup-Riordan et al. 2013 for seal hunting in Emmonak). The essential feature is flexibility, so that hunters can adjust and adapt as needed, without unnecessary constraints. For example, the ability of bowhead whale hunters in Savoonga to hunt in fall (from the north side of St. Lawrence Island) as well as in spring (when they hunt from the south side of the island) was the result of changing ice conditions together with the lack of a restricted hunting season and the lack of any impediments or conflicting uses in what is now the fall whaling use area (Noongwook et al. 2007).

Recent subsistence use area studies have also estimated intensity of use (e.g. as shown in Stephen R. Braund and Associates 2010) in addition to aggregate spatial extent. Intensity can be a useful indicator of areas where conflicting uses would cause maximum disruption, but should not be over-interpreted to mean that areas of less intense use are unimportant or that activities in those areas would have minimal impact on harvests and food security. First, intensity of use can vary extensively from year to year, as noted earlier for annual use areas as a whole. Second, intensity of use for a community may not match intensity of use for individuals or households, some of whom may use different areas from the majority. Third, areas of lower use intensity may still be important at certain times or for procuring a full harvest. Thus, maps of intensity of harvest effort may be valuable for deciding the locations or routes of transitory phenomena (e.g., a barge bringing supplies to a village), but long-term facilities or impacts anywhere within the subsistence use area should be treated with great caution.

Finally, it is important to note that hunting areas are only one of the spatial aspects of successful hunting. The animals, too, need to thrive throughout their range in order to arrive in the hunting area healthy and in sufficient numbers to support an adequate harvest to meet local needs. Thus, protecting only the subsistence use area is unlikely to be adequate to protect food security of Chukchi coast villages. Disturbances within hunting areas are of most concern, because such disturbances can reduce the local availability of otherwise abundant animals or force hunters to travel farther, with greater risk, to have a successful hunt. Disturbances outside the hunting areas may not have as rapid or direct an effect on hunting success, unless they cause major changes in migratory routes, but they can affect the health and abundance of a population and thus lead to long-term impacts on subsistence harvests. A range of geographic characterizations of subsistence use areas, up to the "calorie-shed" (area from which one's food comes) are described in Huntington et al. (2013), emphasizing that long-term activities need to be evaluated at the largest spatial scales.

With these considerations in mind, we recommend that the entire documented aggregate subsistence use area for the Chukchi coast villages be excluded from leasing. We note that this area includes the spring migratory corridor for bowhead whales and other species, reducing the risk of major disruption to migratory pathways or to concentrations of animals during migration.

Table 6-1 Summary of subsistence studies in the U.S. Chukchi Sea

Study	Period	Village(s)	Recall/Real time	Species specific?	Seasonal/ annual	GPS?
Pedersen (1979a)	Lifetime	Point Hope	Recall	Yes	Annual	No
Pedersen (1979b)	Lifetime	All North Slope	Recall	Yes	Annual	No
Nelson (c1982)	Lifetime	Wainwright	Recall	Yes	Annual	No
Braund and Burnham (1984)	1979-1983	Barrow, Point Hope, Point Lay, Wainwright	Recall	Yes	Annual	No
Impact Assessment Inc. (1989)	Lifetime	Point Lay	Recall	Yes	Annual	No
Stephen R. Braund and Associates and Institute of Social and Economic Research (1993b)	1988-1989	Wainwright	Real time	Yes	Seasonal	No
Stephen R. Braund and Associates and Institute of Social and Economic Research (1993a)	1987-89	Barrow	Real time	Yes	Seasonal	No
Kassam and Wainwright Traditional Council (2001)	Not specified	Wainwright	Recall	Yes	Annual	No
Stephen R. Braund and Associates (2010)	1997-2006, 2006	Barrow, Kaktovik, Nuiqsut	Recall	Yes	Annual	No

7. IEAs

Identification of Important Ecological Areas (IEAs) provides a way to prioritize spatial conservation, response, and restoration efforts. We define Important Ecological Areas as geographically delineated areas which by themselves or in a network have distinguishing ecological characteristics, are important for maintaining habitat heterogeneity or the viability of a species, or contribute disproportionately to an ecosystem's health, including its productivity, biodiversity, functioning, structure, or resilience. For example, IEAs may encompass migration routes, subsistence areas, sensitive seafloor habitats, breeding and spawning areas, foraging areas, or areas of high primary productivity. As an exercise in valuation, determining "relative importance" requires a process for establishing and comparing values of individual or multiple ecological features on a similar scale. This can be accomplished using standard deviates, as described below.

The results we incorporate in our comments were based on an analysis in a 400,000 square kilometer area in the Beaufort and Chukchi seas off the north slope of Alaska. Ecological features used in the analysis were primary productivity, benthic biomass, sea ice, seabirds, marine mammals, and subsistence for which datasets were available or could be compiled. The study region was divided into a 10x10 km grid of study units. Spatial data for each ecological feature were overlaid on the grid and values for each study unit calculated. This created a distribution of study unit values for an ecological feature and values were then converted to standard deviates. Positive standard deviates from the different ecological features were added to provide a landscape of relative importance. Variability in the relative importance of planning units was found across the study region with Barrow Canyon, coastal areas, and the greater Hanna Shoal region (including areas to the south of the shoal) having high relative importance values.

Descriptions of the data layers used and the methods used to combine information are provided in a draft Atlas of Important Ecological Areas submitted during prior comment periods. That draft is available at: http://www.regulations.gov/#!documentDetail;D=NOAA-NMFS-2013-0054-0070.

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