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June 3, 2015

Rear Admiral Daniel Abel
Commander
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P.O. Box 25517
Juneau, AK 99802-5517

Submitted online via www.regulations.gov

RE: Recommendations on the Port Access Route Study: In the Chukchi Sea, Bering Strait and Bering Sea, Docket ID: USCG-2014-0941.

Rear Admiral Abel,

Thank you for conducting this Port Access Route Study (PARS) in the Chukchi Sea, Bering Strait and Bering Sea, and for the opportunity to provide comments on the Coast Guard's potential vessel routing system for the area. The PARS study area has tremendous ecological significance, and is vital for the food security and subsistence way of life practiced by residents of communities in the region for millennia. While much of this region remains poorly charted, vessel traffic has increased significantly—a trend that is expected to continue. In this context, an integrated system of routing and other mitigation measures is necessary to enhance vessel safety and preserve ecosystem health. The undersigned groups urge the Coast Guard to include or support the following measures when the agency publishes results of the PARS:

- Two-way route: The Coast Guard's proposed route is well-balanced for vessel safety and steering traffic away from important areas; however, the Coast Guard should consider the possibility of an alternative route that could provide a greater buffer for ecological and cultural values.
- Precautionary areas: We support the Coast Guard's proposed precautionary areas.
- Areas to be avoided (ATBAs): We recommend designation of ATBAs in waters around King Island, St. Lawrence Island, and Nunivak Island. In addition, we recommend an ATBA around Little Diomede Island in a portion of the Bering Strait, located such that it would not impair transit passage.
- Speed limits: To protect vulnerable marine life and enhance safety, we recommend a 10 knot speed limit in the area of the Bering Strait and in the Southeastern Bering Sea.
- Vessel safety communications system: To increase the likelihood of preventing a shipping incident, such as grounding or whale strike, we recommend the implementation of a communication system under which traffic is monitored and real-time weather and other information can be transmitted easily between ships, communities, and the shore.
- Discharge limitations: We recommend that the Coast Guard work with the National Oceanic and Atmospheric Administration (NOAA), United States Fish and Wildlife Service (USFWS) and the

Environmental Protection Agency (EPA) to facilitate more stringent limitations on discharges for vessels transiting the ecologically significant Bering Strait region.

By including the foregoing suite of strong, integrated routing and mitigation measures, the Coast Guard can lay the foundation for a protective legacy for the Bering Strait region. The sections that follow explain these recommendations in more detail.

INTRODUCTION

With its seasonal ice cover, currents, and shallow continental shelf, the Bering Strait region is one of the world's most productive marine ecosystems.[1] It is used by an array of marine mammals including bowhead, beluga and gray whales; ice seals; walruses; and polar bears. The region hosts one of the largest marine mammal and bird migrations on the planet.[2] Almost the entire western Arctic population of bowhead whales and Pacific walruses migrate through the Bering Strait each year. An estimated 12 million seabirds nest or forage in the area each year, including globally significant populations of spectacled eiders; crested, parakeet, and least auklets; pelagic cormorants; and black-legged kittiwakes.[3]

Vessel traffic is anticipated to increase through the PARS study area.[4] Increasing commercial vessel traffic brings new risks and potential impacts to the region. Risks can include vessel collisions, conflicts with hunters in small boats; disturbance of hunting efforts; ship strikes of marine mammals; and impacts on marine life from ocean noise, oil spills, and discharges such as ballast, grey and black water.

Though the volume of transits is still relatively low compared to some other waterways, the risk of an accident in the Bering Strait region is compounded by the presence of seasonal sea ice, strong currents, adverse weather conditions, and inadequate charting. Also, given the region's ecological and cultural importance, remoteness, and lack of response resources, the consequence of an accident in the study area could be catastrophic. In this context, it is prudent to adopt a proactive and protective approach.

Our organizations urge the Coast Guard to establish a strong suite of routing and mitigation measures to improve maritime safety and minimize the impacts of growing ship traffic in the PARS study area. Taking a stewardship approach will involve recommending and implementing measures that reinforce the need for transiting vessels to maintain a high standard of care, one that is commensurate to the ecological and cultural importance of the region.

The Coast Guard should consult with and incorporate the recommendations of residents in the PARS study area as it considers its final recommendations. Indigenous communities of the Bering Strait region have lived a traditional way of life for untold generations. This history gives them great knowledge of the region and its ecosystem. The continued health of the marine ecosystem and a subsistence way of life

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[1] Grebmeier, J.M., Cooper, L.W., Feder, H.M., Sirenko, B.I., 2006. Ecosystem dynamics of the Pacific-influenced northern Bering and Chukchi Seas in the Amerasian Arctic. Progress in Oceanography 71, 331-361. *See also* Springer, A. M., McRoy, C. P., & Flint, M. V. (1996). The Bering Sea Green Belt: shelf-edge processes and ecosystem production. Fisheries Oceanography, 5(3-4), 205-223.
[2] Arctic Council, 2009. Arctic Marine Shipping Assessment.
[3] Smith, M.A., Walker, N.J., Free, C.M., Kirchhoff, M.J., Drew, G.S., Warnock, N., Stenhouse, I.J., 2014. Identifying marine Important Bird Areas using at-sea survey data. Biological Conservation 172, 180-189.
[4] International Council on Clean Transportation, 10-Year Projection of Maritime Activity in the U.S. Arctic Region (2015) Prepared for the U.S. Committee on the Marine Transportation System. www.cmts.gov

are inextricably connected. The Coast Guard should weigh residents' knowledge and concerns for the area with the greatest significance.

Since the Bering Strait is an international strait, the United States and Russia should develop a joint proposal to the International Maritime Organization (IMO) with agreed-upon shipping routes and measures. To be successful at the IMO, we recommend that the Coast Guard re-engage Russia to attempt to get its support for the proposed PARS recommendations. However, we ask that this diplomacy not delay the original timeline of getting interagency approvals and submitting recommendations to the IMO.

The sections below set forth our recommendations in more detail. These recommendations are supported by additional analysis and information in three appendices:

Appendix A – Maps with References
Appendix B – Supporting Scientific Information for Recommendations
Appendix C – Ship Routing Analysis

RECOMMENDATIONS

1. **Routes**

In its December 5, 2014 Federal Register notice, the Coast Guard proposed two, 4-nautical-mile (nm) wide, two-way routes in the PARS study area: a main north-south route that extends from the southern Bering Sea to the southern Chukchi Sea to the east of St. Lawrence Island, and a shorter "spur" route that is located north of St. Lawrence Island and extends west of the main route.

The Coast Guard's proposed routes do an admirable job of balancing a host of competing concerns, including providing mariners with relatively direct and efficient routes, minimizing the number of turns and intersections, maximizing distance from land, and avoiding important ecological and cultural areas. However, we encourage the Coast Guard to give great weight to community concerns and to consider diverting the routes further west from King Island due to the island's ecological and cultural significance.

We conducted a ship routing analysis (see Appendix C) using criteria that weighted such elements as distance from land (with greater weight for St. Lawrence Island and King Island), depth of water, and presence of important ecological and subsistence use areas. The results of this analysis show that while the Coast Guard's main proposed route is a solid option, there are other plausible routes that may better incorporate ecological and cultural values. One such alternative route is presented in Appendix A and further explained in Appendix C. Ultimately, the Coast Guard should consult with tribes and communities directly to determine whether and how to adjust the proposed routes in the area west of King Island.

If the Coast Guard decides against changing the currently proposed route, then the agency should work with area residents to establish additional protections that address tribal and community concerns.

2. **Precautionary Areas**

The Coast Guard's proposed routing measures include four circular precautionary areas, each 8 nautical miles in diameter. Three of the precautionary areas are located at the end points of the proposed two-way routes, and the fourth is located at the intersection of the proposed routes to the west of King Island. Locating precautionary areas at the end-points and intersections of routes is consistent with IMO recommendations and will help "emphasize the need for care in navigation" at these critical points.[5] Our organizations support the proposed precautionary areas and encourage the Coast Guard to include them among the agency's recommendations when the results of the PARS are published.

3. Areas to be Avoided

ATBAs are not included among the routing measures proposed in the Coast Guard's December 5, 2014 Federal Register notice. Designation of specific ATBAs would help protect key places that are highly important to marine wildlife in the region. In addition to protecting important habitat, establishing ATBAs in these areas will also improve safety of navigation by keeping vessels clear of the coast. This will give vessel operators and/or response crews more time in the event that a vessel becomes disabled. Designation of ATBAs will also help highlight the importance of these areas to mariners.

For these reasons, our organizations strongly urge the Coast Guard to include the following specific ATBAs among the recommended routing measures when the results of the PARS are published:

- Bering Strait
- King Island
- St. Lawrence Island
- Nunivak Island

The location of these recommended ATBAs is depicted in maps included in Appendix A.

Both the IMO and the U.S. Coast Guard define an ATBA as "a routeing measure comprising an area within defined limits in which either navigation is particularly hazardous or it is exceptionally important to avoid casualties and which should be avoided by all ships, or certain classes of ship."[6] This broad definition allows the Coast Guard to designate ATBAs designed to help protect the marine environment or marine wildlife from impacts associated with shipping. In fact, IMO guidance expressly provides for establishment of an ATBA "where there is the possibility that unacceptable damage to the environment could result from a casualty."[7]

IMO has already adopted a number of ATBAs for the primary purpose of protecting the marine environment and marine wildlife. For example, the IMO adopted ATBAs off the coast of Florida "to avoid risk of pollution and damage to the environment of these sensitive areas,"[8] and off the coast of California to avoid the risk of pollution in the Channel Islands National Marine Sanctuary.[9] On the northeast coast of North America, the IMO has adopted seasonal ATBAs to reduce North Atlantic right

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[5] IMO, General Provisions on Ships' Routeing (2013 ed.) § 4.5.3.

[6] IMO, General Provisions on Ships' Routeing (2013 ed.) § 2.13; 33 C.F.R. § 167.5(a).

[7] IMO, General Provisions on Ships' Routeing (2013 ed.) § 5.5. *See also id.* § 1.2 (noting that "the organization of safe traffic flow in or around or at a safe distance from environmentally sensitive areas" is one of many legitimate objectives of a routing system).

[8] *See* IMO, Ships' Routeing, Part D, Sec. II (Off the Florida Coast). These ATBAs apply to ships carrying cargoes of oil or hazardous materials and all ships over 50 meters in length. *Id.*

[9] *Id.* (Off the California Coast). These ATBAs apply to all cargo ships, except those bound to and from ports on one of the islands within the area. *Id.*

whale ship strikes.[10] The IMO adopted an ATBA near the ports of Matanzas and Cardenas (Cuba) "for reasons of conservation of unique biodiversity, nature and beautiful scenery."[11] Similarly, an ATBA off the coast of New Zealand was created to "avoid risk of pollution and damage to the environment."[12] In another example, an ATBA off of Cape Terpeniya (Sakhalin Island, Russia) was established "for reasons of conservation of unique wildlife in the area and of inadequate survey."[13]

Beyond these established ATBAs, IMO's Subcommittee on Navigation, Communication and Search and Rescue has already approved a series of five ATBAs in the Aleutian Islands designed "to reduce the risk of marine casualty and resulting pollution, protect the fragile and unique environment of the Aleutian Islands, and facilitate the ability to respond to maritime emergencies."[14] IMO's Maritime Safety Committee will consider the Aleutian Islands ATBAs in June of this year.

The foregoing examples provide ample precedent for the establishment of ATBAs designed to protect particularly important or sensitive places. For this process, our organizations used the best available information to identify important or sensitive places in the PARS study area that should be designated as ATBAs. In addition to recommending designation of the ATBAs described below, we urge the Coast Guard to consult with tribes and communities to determine additional areas important for community and subsistence use that should be designated as ATBAs.

Appendix A shows our recommended ATBAs on a map of the study area. Appendix B explains our data collection and mapping methods in more detail and provides documentation of important ecological values with related scientific studies referenced. The descriptions below are a summarized version of information that can be found in greater detail in Appendix B. Our analysis indicates that the following key places in the Bering Strait and Bering Sea merit heightened protection in the form of an ATBA:

Bering Strait

The Bering Strait serves as the only marine migratory passageway for species that travel to the Arctic Ocean from the Pacific Ocean each spring, with most returning again in the fall ahead of the advancement of seasonal sea ice into the Bering Sea. This means that within a mere 44 nm, hundreds of thousands, if not millions, of individual animals must travel this passageway in both directions each year. Little Diomede Island is located in the middle of the narrow strait on the U.S. side of the shared waters with Russia. Located in the midst of one of the most prodigious migrations on the planet, Little Diomede and its nearshore waters provide important habitat not only for resting and feeding transients, but for resident species that take advantage of the seasonal

[10] *See* Ships' Routeing, Part D, Sec. II (In Roseway Basin, South of Nova Scotia); *id.* ("In the Great South Channel", Off the East Coast of the United States).
[11] *Id.* (In the Access Routes to the Ports of Matanzas and Cardenas). This ATBA applies to all ships over 150 gross tons. *Id.*
[12] *See* Ships' Routeing, Part D, Sec. III (Off the North-East Coast of the North Island of New Zealand). This ATBA generally applies to all vessels greater than 45 meters in length, but there are exceptions for certain vessels including vessels of the Royal New Zealand Navy and fishing vessels engaged in fishing operations. *Id.*
[13] *Id*. (In the Region of Cape Terpeniya (Sakhalin)). The Cape Terpeniya ATBA applies to ships over 1,000 gross tons carrying oil or hazardous cargoes. *Id.*
[14] *See* Routeing Measures and Mandatory Ship Reporting Systems: Establishment of Five Areas to be Avoided in the Region of the Aleutian Islands, submitted by the United States to Sub-Committee on Navigation, Communications and Search and Rescue, 2nd session, Agenda item 3 NCSR 2/3/X (04 December 2014).

productivity. The biological and ecological values associated with the Bering Strait proposed ATBA include:

- An important migratory corridor for belugas, walruses, bowhead whales, and gray whales in spring and fall.
- High spring concentration area for Pacific walrus. Large haulout sites greater than 1,000 walrus on Little Diomede and Fairway Rock.
- Concentration area for bowhead whales in the fall.
- Biologically Important Area for migrating gray whales between June and December.
- High spring concentration area for foraging bearded seals. Spring, summer, and fall concentration area for bearded seals on Little Diomede and Fairway Rock.
- Spring, summer, and fall concentration area for ringed seals.
- Spring concentration area for spotted seals. Important haulout substrate for spotted seals on Fairway Rock. Concentration area during summer and fall on Little Diomede and Fairway Rock.
- Globally significant Important Bird Area (IBA) for marine bird nesting colonies on the Diomede Islands for nearly 7 million least, crested, and parakeet auklets and other species which forage in waters surrounding the islands. Including birds nesting on both Big and Little Diomede islands, this is the largest bird concentration area in Alaska.
- Globally significant pelagic IBA in the Bering Strait for congregations of parakeet, crested, and least auklets, and red phalaropes.
- Marine bird nesting colony on Fairway Rock for 55,000 auklets, puffins, murres, and kittiwakes.
- Polar bear concentration area for feeding during winter, spring and early summer.
- Subsistence hunting area for the Inupiaq people of the Native village of Diomede, located on Little Diomede.

King Island

King Island is located 40 miles offshore from Wales, and about 90 miles to the west of Nome. It is about a mile wide with steep cliffs on all sides. It is historically home to Inupiat residents who were forced to relocate to the mainland in the 1960s. To this day, the King Island community maintains traditional customs, linguistics, and hunting practices tied to the island and its resources. King Island contains important marine bird nesting habitat and marine mammal haulout habitat. The values associated with the King Island proposed ATBA include:

- Subsistence hunting area for the the King Island Tribe.
- Spring concentration area for Pacific walrus.
- Historic and occasional haulout site for Pacific walrus during summer.
- High concentration area for Pacific walrus during fall.
- Bearded seal, spotted seal, and ringed seal concentration area during spring and early summer.
- Marine bird nesting colonies for nearly 250,000 birds including murres, puffins, auklets, and kittiwakes.
- Globally significant IBA for parakeet auklets, with continental- and state-level significance to populations of murres and auklets.

St. Lawrence Island

St. Lawrence Island is situated just south of the Bering Strait in the northern Bering Sea closest to the border with Russia, abutting the Anadyr Strait. It is the sixth largest island in the United States, and is about 90 miles long and varies between 8 and 22 miles wide. The island's marine life is heavily influenced by its surrounding oceanography. Cold, nutrient rich waters that originate from the deep Bering Sea shelf edge are carried by the Anadyr current eastward. Immediately south of the island is a polynya, an area of persistent open water, which provides important habitat during the winter months when the Bering Sea is mostly covered in seasonal sea ice. The values associated with St. Lawrence Island include:

- High concentrations of Pacific walrus in the winter both north and south of the island. A particularly important hotspot is located in the polynya immediately south of the island that provides important foraging habitat.
- Calving and breeding habitat in the polynya south of St. Lawrence Island.
- High concentrations of Pacific walrus in the spring both to the east and northwest of the island with a particularly important staging area to the northwest of Gambell in the Anadyr Strait.
- Annual summer haulout for Pacific walrus on Southwest Cape; and an annual high concentration haulout near the Punuk Islands to the southeast of the island.
- Winter concentration of bearded seals and ringed seals to the south of the island.
- High concentration of bearded seals to the east and northwest of the island with a hotspot just north of Gambell in the Anadyr Strait, overlapping the staging area for Pacific walrus.
- Ringed seal and spotted seal summer and fall concentrations between Gambell and Savoonga.
- High concentration of spotted seals surrounding the island in spring and early summer.
- High concentration of hauled out spotted seals on Southeast Cape during fall.
- Winter concentration of bowhead whales to the north and west of the island, with a high concentration area to the north of Gambell in Anadyr Strait.
- Subsistence hunting area for the St. Lawrence Island Yup'ik that reside in the Native villages of Gambell and Savoonga.
- Important bowhead spring and fall migration corridors in Anadyr Strait.
- Bowhead whale, gray whale, and humpback whale Biologically Important Areas.
- Spectacled eider critical habitat to the south of St. Lawrence Island in the polynya that encompasses a globally significant IBA thought to host the entire world's population (~350,000 birds) during winter.
- Steller sea lion critical habitat on the east by Punuk Islands and the southwest of the island.
- Four globally significant IBAs for populations of auklets, spectacled eiders, and pelagic cormorants, along with continental- and state-significant populations of murres and other species.
- Marine bird nesting colonies for nearly 4 million birds, including populations of murres, kittiwakes, auklets, puffins, and other species.

Nunivak Island

The second largest island in the Bering Sea, Nunivak Island is located about 30 miles offshore from the Yukon and Kuskokwim delta. The island is tundra-covered, about 47 miles long and 66 miles wide, and provides important bird habitat as well as shoreline used by marine mammals that rest from foraging trips. Nunivak Island is located in close proximity to important benthic habitat for birds and marine mammals as it is situated between the Kuskokwim and Yukon Rivers along the Alaska coastal current. There is a persistent area of open water immediately south of the island that provides important habitat for Pacific walrus during their breeding season. The values associated with Nunivak Island include:

- Pacific walrus winter breeding habitat.
- Important Pacific walrus haulout area with greater than 100 individuals.
- Gray whale Biologically Important Area.
- Marine bird colonies with ~325,000 nesting auklets, murres, cormorants, kittiwakes, puffins, and other species.
- Globally significant IBA for Steller's eider during the non-breeding season, along with state-significant populations of brant, Aleutian tern, common eider, and other species.
- Subsistence hunting area for the Central Yup'ik people from the Native village of Mekoryuk, located on the north side of Nunivak Island.

The foregoing areas are well-suited for ATBA designation because they are highly important to marine wildlife and easily avoided by vessels transiting the region. Other areas—such as North Pacific Right Whale critical habitat in the southern portion of the PARS study area, or the bottleneck of the Bering Strait proper—are highly important to marine life, but are impossible for transiting vessels to avoid (Bering Strait) or may not be adhered to and put other sensitive areas at risk (southern portion of the PARS study area). ATBA designation may not be appropriate for these hard-to-avoid areas. Nonetheless, the ecological importance of these waters merits heightened protection. To that end, we urge the Coast Guard to work with NOAA to impose vessel speed restrictions in these areas, as discussed in the section below.

4. Speed Limits

The Coast Guard's area of interest encompasses two important marine ecoregions that have been repeatedly recognized globally for their ecological significance.[15] The entire area under consideration in the PARS is part of an important migratory corridor. The Bering Strait serves as the Pacific gateway to the Arctic Ocean for species of marine mammals, including endangered bowhead whales and ice-dependent seals, and Pacific walruses (a candidate species under the Endangered Species Act). Portions of the study area are designated critical habitat for the endangered eastern population of North Pacific right whale—one of the most imperiled marine mammal species on the planet. The loss of a single whale from this population, especially a female, could result in the extinction of this population. It is incumbent on the Coast Guard to reduce the potential for ship strikes. One way to do this is through the imposition of vessel speed restrictions.

The Ports and Waterways Safety Act gives the Coast Guard authority to control vessel traffic in areas subject to the jurisdiction of the United States determined to be hazardous or under hazardous circumstances.[16] The Coast Guard may exercise this authority by, among other things, "establishing vessel…speed…limitations."[17] In addition, the Endangered Species Act (ESA) and the Marine Mammal

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[15] Wilkinson, T., E. Wiken, J. Bezaury-Creel, T. Hourigan, T. Agardy, H. Herrmann, L. Janishevski, C. Madden, L. Morgan, and M. Padilla. 2009. Marine Ecoregions of North America. Commission for Environmental Cooperation. Montreal, Canada. 200pp.

[16] 33 U.S.C. § 1223(a)(4).

[17] *Id.* § 1223(a)(4)(C). *See also* 33 C.F.R. § 165.11.

Protection Act (MMPA) provide broad authority to federal agencies to promulgate regulations designed to carry out the purposes of those Acts.[18] The Coast Guard could work with NOAA to promulgate regulations limiting vessel speed pursuant to these authorities, as has been done on the East Coast of the United States.

Appendix A depicts our speed restriction recommendations on a map of the study area. Appendix B explains our data collection and mapping methods in more detail. Our analysis indicates that the Bering Strait and North Pacific right whale population in the Southeastern Bering Sea merit heightened protection in the form of speed limits.

Bering Strait

The Bering Strait, as previously mentioned, is an important migratory corridor for a number of species that make the journey between the North Pacific and Bering Sea to the Arctic Ocean twice each year. The bottleneck at the Bering Strait connects the shallow continental shelf that extends from the Bering Sea to the Chukchi Sea. Almost all of the western Arctic population of bowhead whales and North Pacific walruses journey through this region twice a year as they travel from the Bering Sea to the Arctic Ocean. Gray whales make a remarkable ten thousand mile journey from their calving grounds in Mexico to feed in the productive northern Bering and southern Chukchi seas. Increasingly, other whale species including humpback whales, orca whales, and other cetacean species are traveling to the Arctic Ocean via the Bering Strait.[19]

Implementing speed restrictions to protect important migratory routes in the Bering Strait will help protect slow moving marine mammals from ship strikes. Speed restrictions should be applied in areas with increased risk of ship strikes of slow-moving marine mammals for several reasons. Slower vessel speed will allow whales more time to respond to an approaching vessel. If a whale were struck at slower speeds, it would also be less likely to be seriously injured.[20] Based on several studies that showed the reduction of vessel speed decreased mortality of North Atlantic right whales,[21] NOAA adopted a rule for certain areas in the Atlantic Ocean; the rule is designed to reduce the risk of vessel strike by requiring all vessels 65 feet or longer to use speeds of 10 knots or less in important North Atlantic right whale habitat. Given the effectiveness of the rule in preventing right

[18] *See, e.g.,* 16 U.S.C. §1540(f) (authorizing promulgation of regulations "necessary and appropriate" to carry out the purposes of the MMPA; 16 U.S.C. §1540(f) (authorizing promulgation of regulations "as may be appropriate to enforce" the ESA).

[19] Allen, B. M., and R. P. Angliss. Alaska marine mammal stock assessments, 2013. U.S. Dep. Commer., NOAA Tech. Memo. NMFSAFSC-277, 294 p.

[20] Vanderlaan, A.S.M., C. T. Taggart. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Marine Mammal Science 23:144−156

[21] Vanderlaan, A.S.M., C. T. Taggart. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Marine Mammal Science 23:144−156; Russell, B.A., A.R. Knowlton, B. Zoodsma. 2001. Recommended measures to reduce ship strikes of North Atlantic right whales. Report submitted to the National Marine Fisheries Service in partial fulfillment of NMFS Contract 40EMF9000223. National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD. Available at: www.nero.noaa.gov/shipstrike/subinfo/final report.pdf.; Laist D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17:35−75.; Knowlton A.R., F.T. Korsmeyer, J.E. Kerwin, H.Y. Wu, B. Haynes. 1995. The hydrodynamic effects of large vessels on right whales. Contract No. 40ANFF400534, final report to the National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA.

whale deaths,[22] we believe similar speed restrictions can help prevent ship strikes of slow-moving species (e.g., bowhead whale, gray whale, humpback whale) in important migratory corridors in the Bering Strait region. Bowhead whales have many similarities to North Atlantic right whales that make them susceptible to vessel strike,[23] including a slow swimming speed. Bowhead whales seasonally congregate in the Bering Sea and the entire population of the Bering/Chukchi stock transits the Bering Strait twice a year. The period of greatest concern is in the fall (October through November) as bowheads move south along the Chukotka coast into the Strait at a time when vessel traffic remains high.[24] There is some evidence that they are feeding in the area[25] and likely concentrated in areas of high productivity.

Southeastern Bering Sea / Right Whale Critical Habitat

The southeastern Bering Sea portion of the Coast Guard's proposed route passes directly through the western portion of ESA designated critical habitat for the endangered North Pacific right whale. The eastern North Pacific right whale population is listed as "endangered" under the ESA and may be the most endangered stock of large whales in the world with a population estimate of approximately 30 whales.[26]

The designated critical habitat area in the southeastern Bering Sea was identified as a summer and fall feeding area based on repeated aerial and ship-based sightings of right whales, acoustic detection and satellite tracking of individual whales. Repeated identification of individual whales based on photo identification and genetic sampling indicates repeated use of this area and site fidelity on the part of individual whales. Utilization of the area appears to be highest in summer and fall, but whales have been detected in the southeastern Bering Sea critical habitat area in all seasons.

Although information on vessel interactions with North Pacific right whales is lacking due to the small population size and remote habitat, the risk of ship strikes is rated as potentially high for the eastern population in the *Recovery Plan for the North Pacific Right Whale*.[27] Given the small population size, the loss of a single whale to a ship strike could seriously impact the recovery of this critically endangered population. Ship strikes have been documented as a major source of mortality for the critically endangered North Atlantic right whale and vessel speed restrictions have been successful in reducing the risk of ship strikes.

As noted above, all vessels 65 feet or longer must travel at 10 knots or less in certain locations along the U.S. east coast at certain times of the year to reduce the threat of ship collisions. The Coast Guard has an obligation to consult with the NOAA's National Marine Fisheries Service regarding

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[22] Laist, D.W., A.R. Knowlton, and D. Pendelton. 2014. Effectiveness of mandatory vessel speed limits for protecting North Atlantic right whales. Endangered Species Research 23:133-147.

[23] Allen, A.S. 2014. The development of ships' routeing measures in the Bering Strait: Lessons learned from the North Atlantic right whale to protect local whale populations. Marine Policy 50:215-226.

[24] Quakenbush, L.T., R.J. Small, and J.J. Citta. 2013. Satellite tracking of bowhead whales: movements and analysis from 2006 to 2012. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region, Anchorage, AK. OCS Study BOEM 2013-01110. 60 pp +appendices.

[25] Moore, S.E., J.C. George, K.O. Coyle, and T.J. Weingartner. 1995. Bowhead whales along the Chukotka coast in autumn. Arctic 48:155-160.

[26] 73 Fed. Reg. 12,024 (March 6, 2008).

[27] NOAA Fisheries, Final Recovery Plan for the North Pacific Right Whale (June 3, 2013), at I-19.

potential effects on designated North Pacific right whale critical habitat. If the final Coast Guard recommended route crosses North Pacific right whale critical habitat, we recommend that, in consultation with NOAA, the Coast Guard should implement a 10 knot speed restriction for this area at minimum during the summer and fall period when right whales are known to be present.

5. Vessel Safety Communication System

One important component of successful accident prevention, in addition to routing measures, is the ability to view vessel movements and communicate real-time and developing safety information with vessels. Whether it is relaying important environmental data, identifying a vessel in distress or alerting vessels to a concentration of marine mammals, communication brings greater domain awareness and time to react and avert a potential incident or find nearby vessels to assist in an emergency.

The Coast Guard should establish a safety communication system for vessels over 65 feet in length[28] that, in addition to monitoring vessels operating in the Arctic, includes the ability to transmit safety information, real-time weather and other real-time critical information such as the presence of ice, marine mammals, or hunters far from shore. The Coast Guard should work with stakeholders to develop protocols to communicate with regional communities so that they may incorporate the transmission of local real-time information.

The Coast Guard has recognized the risk reduction benefits of seeing and communicating with vessels. Recently the Coast Guard expanded the Automatic Identification System carriage requirements for many vessels, citing its use as one of the most effective ways to increase each vessel's situational awareness, as well as the Coast Guard's maritime domain awareness.[29] Additionally, in 2014 the Coast Guard released guidelines for alternative compliance to spill response requirements for vessels transiting Western Alaska. One prevention measure included was the expectation that program administrators would have 24/7 visibility and the ability to communicate with vessels as needed to aid compliance with risk mitigation measures.[30] Marine Exchanges and Vessel Traffic Service areas have been useful to help guide vessels entering a specific port area and have been an asset to safer navigation and environmental protection; however, the Coast Guard lacks a unified system to oversee all vessel traffic. Rather than allowing multiple systems to oversee the vessel traffic of only certain vessels, we recommend the Coast Guard establish a unified system for vessels of 65 feet or more and under U.S. jurisdiction to ensure that, like the important routing measures, vessels have a common communication and monitoring system.

There is a record of support for this type of system. In 2009, the Arctic Council working group, Protection of the Marine Environment, produced the Arctic Marine Shipping Assessment which recommends an Arctic Marine Traffic System to enhance marine traffic awareness, monitoring and tracking, and near real-time data sharing in order to reduce the risk of accidents and improve response.[31] To reduce ship strikes of the endangered North Atlantic right whale, the Coast Guard

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[28] This is consistent with the Coast Guard's Automatic Identification System carriage requirements at 33 CFR §164.46(b).
[29] U.S. Coast Guard, "Vessel Requirements for Notices of Arrival and Departure, and Automatic Identification System, Final Rule" *Federal Register 80* (January 30, 2015): 5282-5337.
[30] U.S. Coast Guard, "Nontank Vessel Alternative Planning Criteria (APC) Requirements for Western Alaska" *Marine Safety Information Bulletin 03-14* (April 28, 2014).
[31] Arctic Council, 2009. Arctic Marine Shipping Assessment.

worked with NOAA to develop and implement a mandatory ship reporting system; a model that may be useful in developing the system recommended above.[32] And, in the first round of PARS comments, the Alaska Department of Environmental Conservation expressed interest in more accurate vessel tracking[33] and the U.S. Arctic Research Commission supported the idea of enhancing vessel tracking and communication.[34]

6. Discharge Limits

The Bering Strait region is marked by an abundance of marine and coastal wildlife—including many species listed under the ESA—high primary productivity, and traditional subsistence activities. Routine operational discharges from vessels, which can include sewage, graywater, ballast water, food waste (garbage) and oily bilge water,[35] among others,[36] present a real threat to the food web[37] and ecological integrity of the area. These waste streams contain microorganisms (including pathogens), organics, detergents, nutrients, metals, oil and grease,[38] which can result in fish and shellfish contamination,[39] eutrophication, and invasive species introduction.[40]

Generation and discharge quantities of wastewater, particularly for certain types of vessels, are not trivial. For example, the average cruise ship, on a daily basis, produces 21,000 gallons of sewage,[41] 170,000 gallons of graywater,[42] and substantial quantities of sewage sludge (biosolids).[43]

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[32] http://www.nmfs.noaa.gov/pr/shipstrike/msr.htm

[33] State of Alaska, Department of Environmental Conservation, Division of Spill Prevention and Response, Letter to the U.S. Coast Guard on the Bering Strait Port Access Route Study, Docket ID: USCG-2010-083, May 6, 2011.

[34] United States Arctic Research Commission, Letter to the U.S. Coast Guard on the Bering Strait Port Access Route Study, Docket ID: USCG-2010-083, May 9, 2011.

[35] Beginning in 2017, the IMO's Polar Code will prohibit the discharge of oil and oily wastes by vessels into Arctic waters extending northwards from 60° north latitude. *See* http://www.imo.org/MediaCentre/PressBriefings/Pages/17-MEPC-68-preview.aspx#.VWOSJkYbFaY.

[36] U.S. EPA, Vessel General Permit for Discharges Incidental to the Normal Operations of Vessels (VGP)(2013), *available at* http://water.epa.gov/polwaste/npdes/vessels/upload/vgp_permit2013.pdf [hereinafter "2013 VGP"].

[37] Food security concerns, in large measure, have prompted certain Southeast Alaska tribes to call for a prohibition on all discharges from cruise lines within 12 miles of shore (Central Council of the Tlingit and Haida Indian Tribes of Alaska, Resolution EC/00-06, Object to Cruise Ship Dumping of Pollutants in Southeast Alaska Waters (March 4, 2000)) and for the Arctic Marine Mammal Coalition (letter sent Sept. 20, 2012 to dockets USCG-2012-0720 and USCG-2010-0833) to request no vessel discharge zones for the Bering, Chukchi, and Beaufort Seas.

[38] U.S. EPA, Cruise Ship Discharge Assessment Report (2008), *available at* http://water.epa.gov/polwaste/vwd/cruise_ship_disch_assess_report.cfm [hereinafter "EPA 2008 Cruise Ship Assessment"]; U.S. EPA, Graywater Discharges from Vessels (2011), *available at* http://www.epa.gov/npdes/pubs/vgp_graywater.pdf.

[39] Washington State Department of Health, Report to the Legislature Assessment of Potential Health Impacts of Virus Discharge from Cruise Ships to Shellfish Growing Areas in Puget Sound 1, 5, A1-A5 (2007); John Scott Meschke and John C. Kissel, Quantitative Assessment of Acceptable Levels of Virus Discharge from Cruise Ships in Puget Sound, Department of Environmental and Occupational Health Sciences, School of Public Health and Community Medicine 5 (2007).

[40] Congressional Research Service, Cruise Ship Pollution: Background, Laws and Regulations, and Key Issues 5 (updated Dec. 15, 2010), *available at* http://www.eoearth.org/files/169101_169200/169169/rl32450.pdf [hereinafter "CRS Report"].

[41] EPA 2008 Cruise Ship Assessment, *supra* note 4, at 2-1.

[42] *Id.* at 3-2.

Federal and state standards that address various ship discharges into Alaskan Arctic marine waters often can be limited in terms of stringency,[44] spatial extent,[45] and enforcement.[46] Therefore, their efficacy—from the standpoint of public health, ecological, and subsistence use protection—is largely unknown. Due to the extremely important natural resource, economic, and socio-cultural values at issue in the Bering Strait region, we believe a robust, precautionary approach to limiting vessel discharge is needed. We recommend, therefore, that the Coast Guard cooperate with NOAA, USFWS and EPA to facilitate the establishment of greater discharge limitations—including possible discharge bans—for ships operating in the area.

7. Endangered Species Act Consultation

The area under consideration in this PARS, as noted above, is used by multiple species listed as threatened or endangered under the Endangered Species Act. The study area also includes designated critical habitat for listed species, and is used by ESA-candidate species (e.g., Pacific walrus). These species and designated critical habitat may be affected by the establishment of vessel routing measures or other vessel traffic management measures in the region. As a result, the Coast Guard has an obligation to consult with the National Marine Fisheries Service and U.S. Fish and Wildlife Service regarding potential effects on listed species and designated critical habitat, and should consult regarding potential effects on candidate species.[47]

If the Coast Guard has not yet engaged in informal consultation with the Services, we urge it to do so at the earliest possible time. If the Coast Guard has already engaged in consultation with the Services, we urge it to continue consultation as the PARS moves forward. Early consultation will help inform the Coast Guard as to the potential effects of various routing measures and other vessel traffic management measures on listed species, designated critical habitat, and candidate species. It will also help ensure that Coast Guard actions in the region will not have unintended adverse consequences and ensure that recommendations of the PARS will be consistent with these statutes.

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[43] *See* Avellaneda, P.M., Englehardt, J.D., Olascoaga, J., Babcock, E.A., Brand, L., Lirman, D., Rogge, W.F., Solo-Gabriele, H., and G. Tchobanoglous. 2011. Relative risk assessment of cruise ships biosolids disposal alternatives. Marine Pollution Bulletin 62(10): 2157-2169.

[44] *See* Cohen, A.N. and Dobb, F.C. 2015. Failure of the Public Health Testing Program for Ballast Water Treatment Systems. Marine Pollution Bulletin 91(1): 29-34; U.S. EPA, Cruise Ship White Paper 16 (2000), *available at* http://water.epa.gov/polwaste/vwd/upload/2004_10_12_oceans_cruise_ships_white_paper.pdf.

[45] *See* U.S. GAO, Marine Pollution: Progress Made to Reduce Marine Pollution by Cruise Ships, but Important Issues Remain, 7, 20 (2000), *available at* http://www.gao.gov/assets/230/228813.pdf.

[46] *See* CRS Report, *supra* note 6, at 25. For example, with regard to wastewater treatment, relevant state law (AS 46.03.460-AS 46.03.490) and federal statutes—such as the Clean Water Act (which undergirds the Vessel General Permit) and Title XIV of the Miscellaneous Appropriations Bill (2001)—essentially only apply out to 3 miles from the Alaska coastline, leaving large swathes of U.S Arctic waters unprotected.

[47] 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(a).

Conclusion:

Thank you for this opportunity to comment on the PARS for the Bering Sea, Bering Strait, and Chukchi Sea. Our organizations appreciate the Coast Guard's commitment to this process—and we look forward to further commitments to expand needed PARS processes into the northern Chukchi Sea and Beaufort Sea as far as the Canadian border. We urge the agency to include or support the suite of routing and mitigation measures detailed in the foregoing sections when it publishes the results of this PARS. In doing so, the Coast Guard will lay a strong foundation for a system that reduces conflict among waterway users, enhances vessel safety and communities' continued well-being, and strengthens protection of the marine environment.

Respectfully,

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CC: VADM Charles Michel, USCG Deputy Commandant for Operations
Gary Rasicot, Director, Marine Transportation Systems
Dr. Kathryn Sullivan, NOAA Administrator
Admiral Robert Papp, U.S. Special Representative for the Arctic
Craig Fleener, Arctic Advisor, State of Alaska

APPENDIX A

MAPS OF THE BERING STRAIT REGION

Map 1. Proposed Conservation Measures

Map 2. Areas of Concern and Proposed Measures

1. Audubon Alaska (2014b)
2. World Seabird Union (2011)
3. Robards et al. (2007)
4. NOAA (1988)
5. USFWS (2015)
6. NOAA Fisheries (2014)
7. Clarke et al. (2015b)
8. Clarke et al. (2015a)
9. Oceana and Kawerak (2014)

Map 3. Shipping: Relative Density

1. Audubon Alaska (2014a), based on:
    a. Marine Exchange of Alaska (2013)

Map 4. Shipping: Speed > 7 Knots

1. Audubon Alaska (2014a), based on:
    a. Marine Exchange of Alaska (2013)

Map 5. Shipping: Speed > 11 Knots

1. Audubon Alaska (2014a), based on:
    a. Marine Exchange of Alaska (2013)

Map 6. Shipping: Speed > 13 Knots

1. Audubon Alaska (2014a), based on:
    a. Marine Exchange of Alaska (2013)

Map 7. Navigational Features

1. NOAA Office of Coast Survey (2013)
2. Danielson et al. (2013)
3. Marine Exchange of Alaska (2013)
4. Alaska Department of Natural Resources (2010)
5. NOAA Office of Coast Survey (2015)

Map 8. Subsistence Composite

1. Oceana and Kawerak (2014)

Map 9. Bathymetry

1. Danielson et al. (2013)

Maps 10, 11. Sea Ice

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

Map 12. Primary Productivity

1. Oceana and Audubon Alaska (2014), based on:
    a. Dunton et al. (2005)
    b. Grebmeier et al. (2014), updated data from:
        i. Grebmeier et al. (2006)

Map 13. Seafloor Biomass

1. Oceana and Audubon Alaska (2014), based on:
    a. Dunton et al. (2005)
    b. Grebmeier et al. (2014), updated data from:
        i. Grebmeier et al. (2006)

Map 14. Fish Composite

1. Oceana and Kawerak (2014)

Map 15. Marine Bird Nesting Colonies

1. World Seabird Union (2011)

Map 16. Marine Bird Concentration Areas

1. Audubon Alaska (2014b), based on methods in:
    a. Smith et al. (2014b)
    b. Smith et al. (2014a)
2. BirdLife International (2014)
3. World Seabird Union (2011)
4. Audubon Alaska (2014c), based on data from:
    a. Drew and Piatt (2013)
    b. Walker and Smith (2014)

Map 17. Important Bird Areas

1. Audubon Alaska (2015b), based on data from:
    a. Drew and Piatt (2013)

    b. Walker and Smith (2014)
2. Audubon Alaska (2014b), based on methods in:
    a. Smith et al. (2014b)
    b. Smith et al. (2014a)
3. BirdLife International (2014)

Map 18. Spectacled Eider

1. Audubon Alaska (2014b), based on methods in:
    a. Smith et al. (2014b)
    b. Smith et al. (2014a)
2. BirdLife International (2014)
3. Petersen et al. (1999)
4. Audubon Alaska (2015b), based on data from:
    a. Drew and Piatt (2013)
    b. Walker and Smith (2014)

Map 19. King Eider

1. Audubon Alaska (2014b), based on methods in:
    a. Smith et al. (2014b)
    b. Smith et al. (2014a)
2. BirdLife International (2014)
3. Audubon Alaska (2009), based on data from:
    a. Oppel et al. (2009)
4. NOAA (1988)

Map 20. Pelagic Cormorant

1. Audubon Alaska (2014b), based on methods in:
    a. Smith et al. (2014b)
    b. Smith et al. (2014a)
2. BirdLife International (2014)
3. World Seabird Union (2011)
4. Audubon Alaska (2014c), based on data from:
    a. Drew and Piatt (2013)
    b. Walker and Smith (2014)

Map 21. Black-legged Kittiwake

1. Audubon Alaska (2014b), based on methods in:
    a. Smith et al. (2014b)
    b. Smith et al. (2014a)
2. BirdLife International (2014)
3. World Seabird Union (2011)
4. Audubon Alaska (2014c), based on data from:
    a. Drew and Piatt (2013)
    b. Walker and Smith (2014)

Map 22. Thick-billed and Common Murres

1. Audubon Alaska (2014b), based on methods in:
    a. Smith et al. (2014b)
    b. Smith et al. (2014a)
2. BirdLife International (2014)
3. World Seabird Union (2011)
4. Audubon Alaska (2014c), based on data from:
    a. Drew and Piatt (2013)
    b. Walker and Smith (2014)

Maps 23, 24, 25. Least, Parakeet, and Crested Auklets

1. Audubon Alaska (2014b), based on methods in:
    a. Smith et al. (2014b)
    b. Smith et al. (2014a)
2. BirdLife International (2014)
3. World Seabird Union (2011)
4. Audubon Alaska (2014c), based on data from:
    a. Drew and Piatt (2013)
    b. Walker and Smith (2014)

Map 26. Horned Puffin

1. Audubon Alaska (2014b), based on methods in:
    a. Smith et al. (2014b)
    b. Smith et al. (2014a)

2. BirdLife International (2014)
3. World Seabird Union (2011)
4. Audubon Alaska (2014c), based on data from:
    a. Drew and Piatt (2013)
    b. Walker and Smith (2014)

Map 27. Pacific Walrus
1. Robards et al. (2007)
2. Oceana and Kawerak (2014)
3. Jay et al. (2012)
4. US Fish and Wildlife Service (2002)

Map 28. Bearded Seal
1. Oceana and Kawerak (2014)

Map 29. Ringed Seal
1. Oceana and Kawerak (2014)

Map 30. Spotted Seal
1. Oceana and Kawerak (2014)

Maps 31, 32. Bowhead Whale
1. Oceana and Kawerak (2014), based on:
    a. Noongwook et al. (2007)
    b. Citta et al. (2012)
    c. Quakenbush et al. (2013)

Map 33. Gray Whale
1. Oceana and Kawerak (2014)
2. Clarke et al. (2015a)
3. Clarke et al. (2015b)

Map 34. Beluga Whale
1. Clarke et al. (2015a)
2. Clarke et al. (2015b)

Map 35. Polar Bear
1. Audubon Alaska (2014d), using resource selection models from:
    a. Durner et al. (2009)
2. Kalxdorff (1997)

Map 36. Marine Mammal Composite
1. Oceana and Kawerak (2014)

Map 37. Important Marine Mammal Areas
1. Robards et al. (2007)
2. NOAA (1988)
3. US Fish and Wildlife Service (2002)
4. Oceana and Kawerak (2014)
5. NOAA Fisheries (2014)
6. Clarke et al. (2015a)
7. Clarke et al. (2015b)

Map 38. Ecosystem Composite
1. Oceana and Kawerak (2014)

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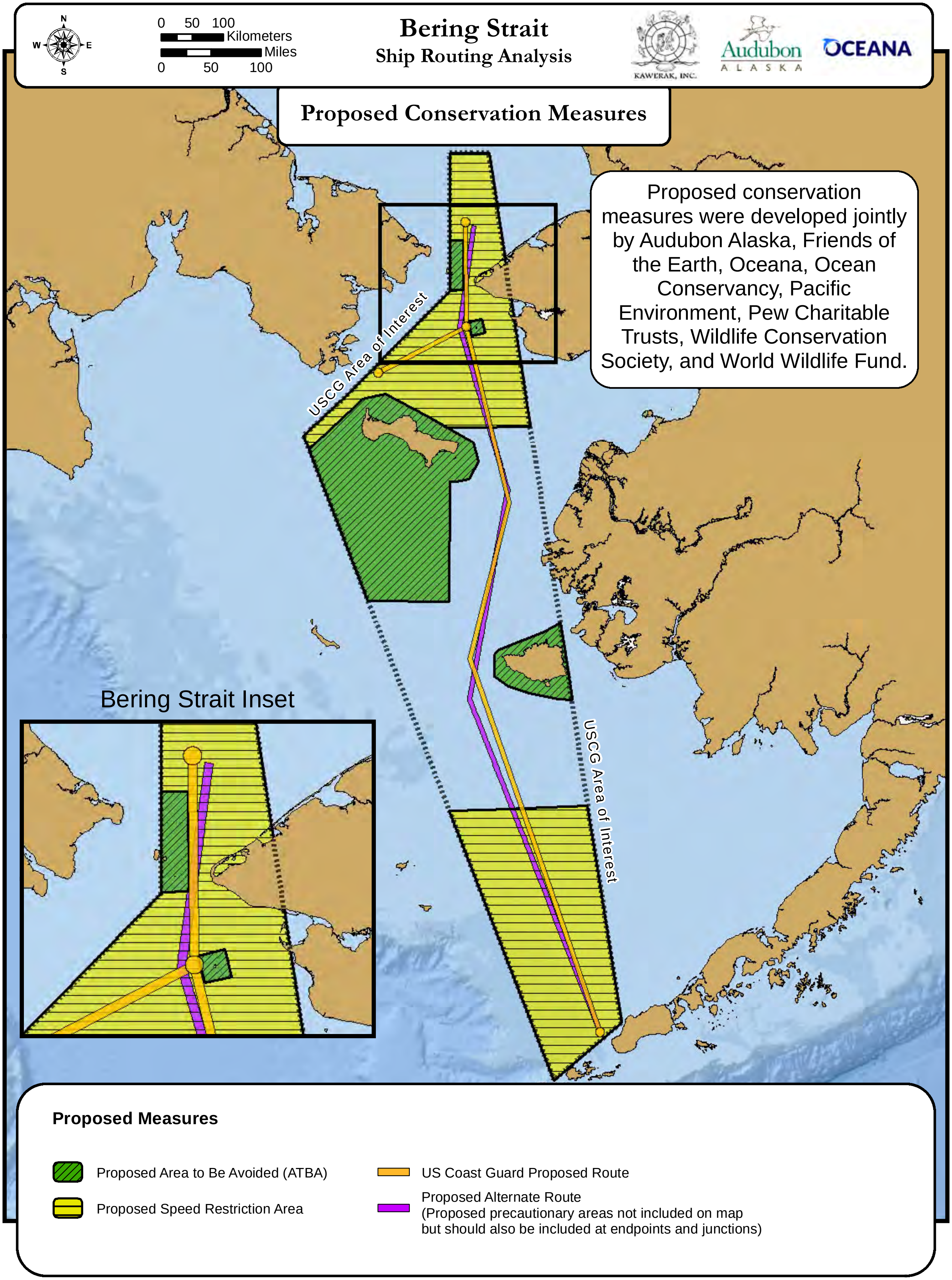
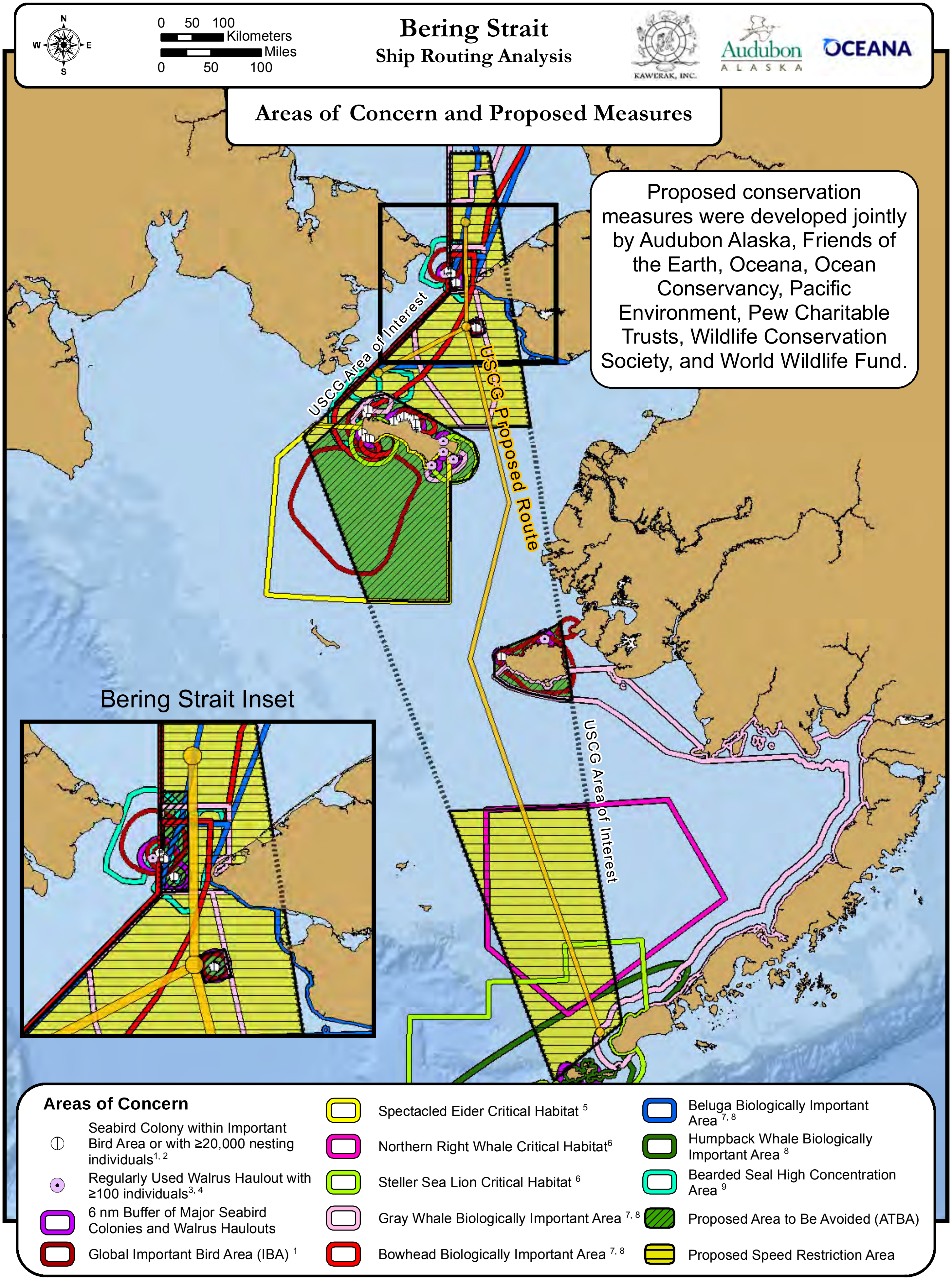
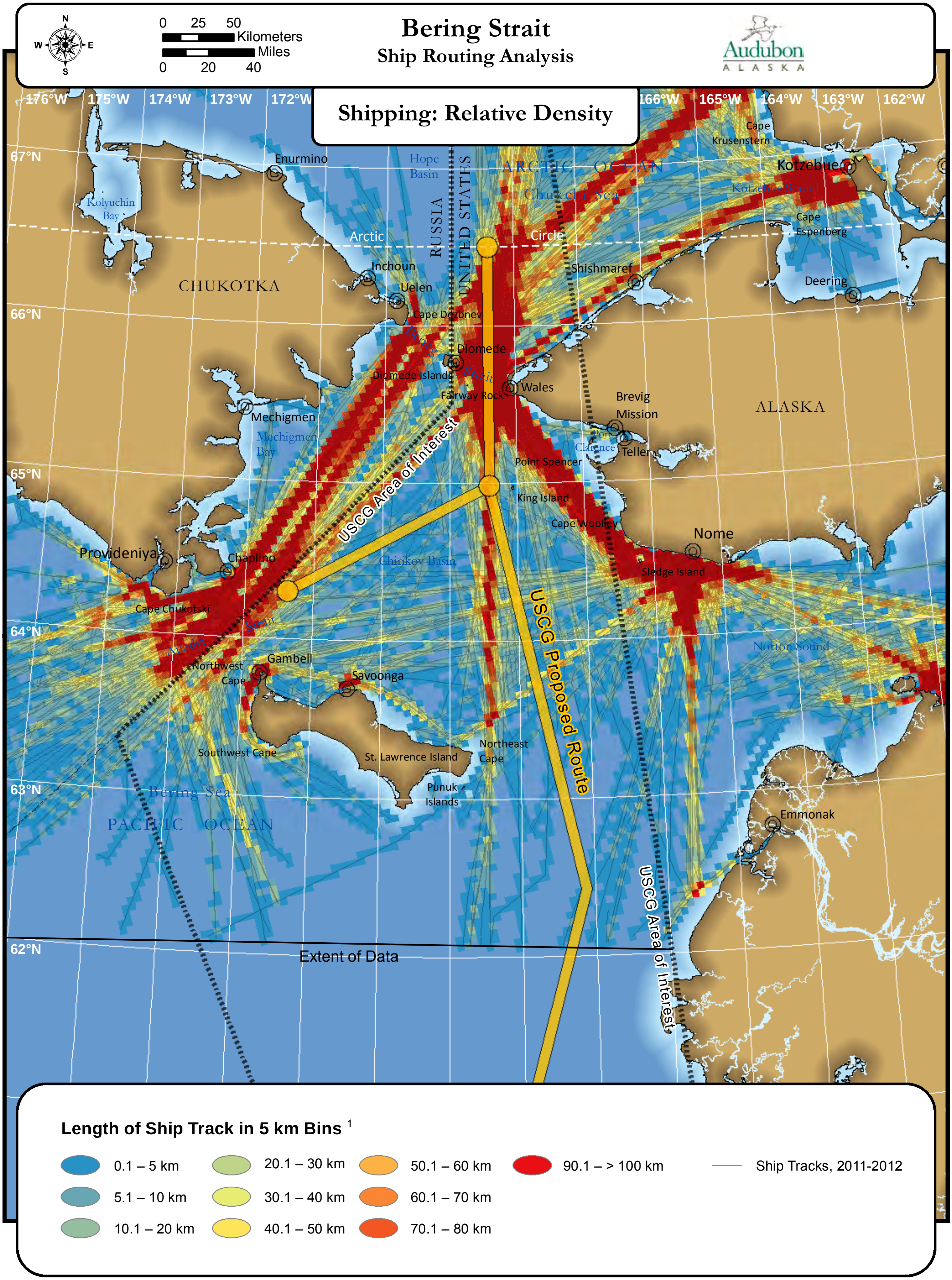


Map last updated: 6/3/2015. Map created by Audubon Alaska.



Data provided by: (1) Smith et al. 2014c. (2) World Seabird Union 2011. (3) Robards et al. 2007. (4) NOAA 1988. (5) USFWS 2015. (6) NOAA Fisheries 2014. (7) Clarke et al. 2015b. (8) Clarke et al. 2015a. (9) Oceana and Kawerak 2014. Map last updated: 6/3/2015. Map created by Audubon Alaska.

Map 3



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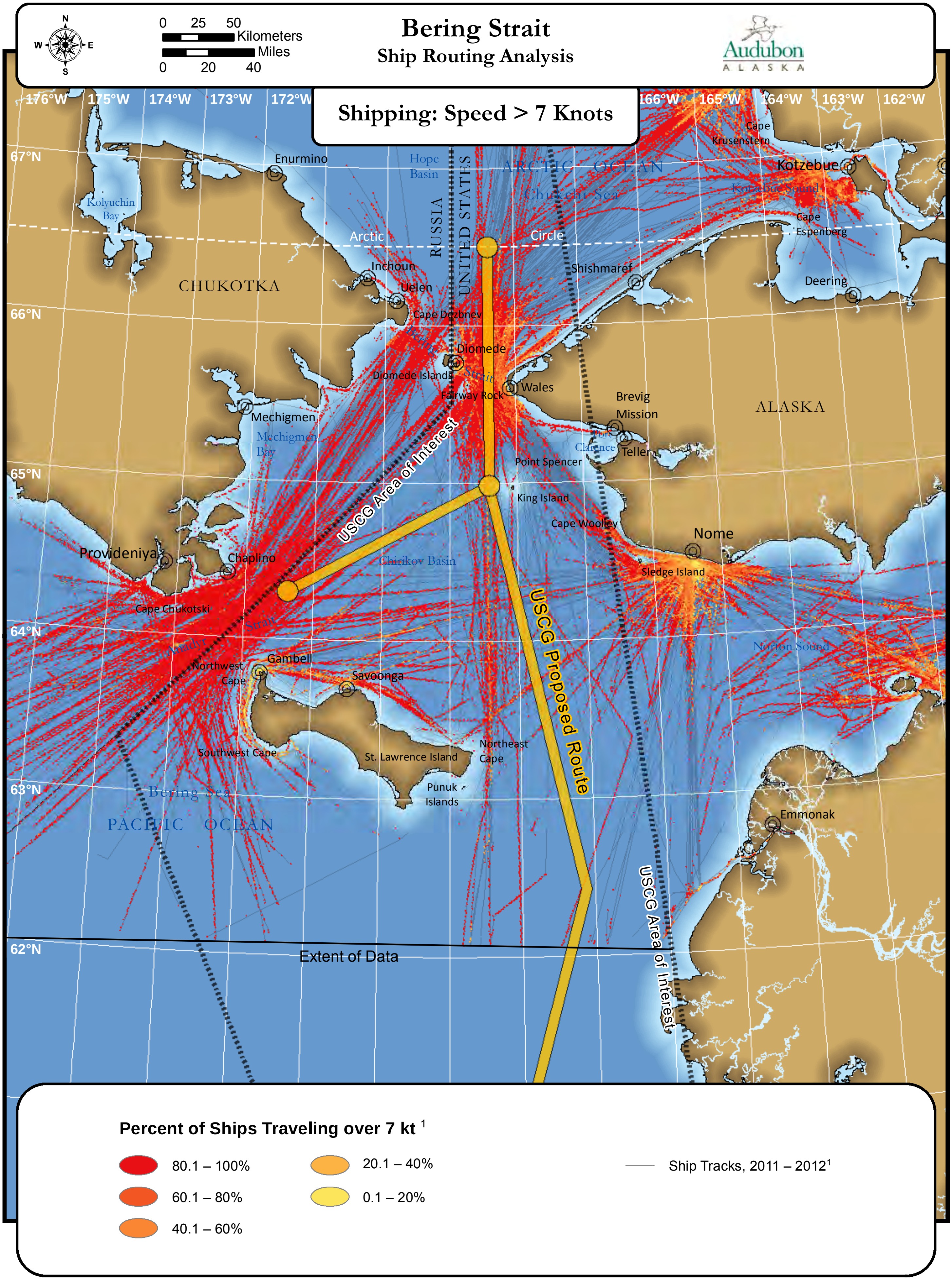
Map 4



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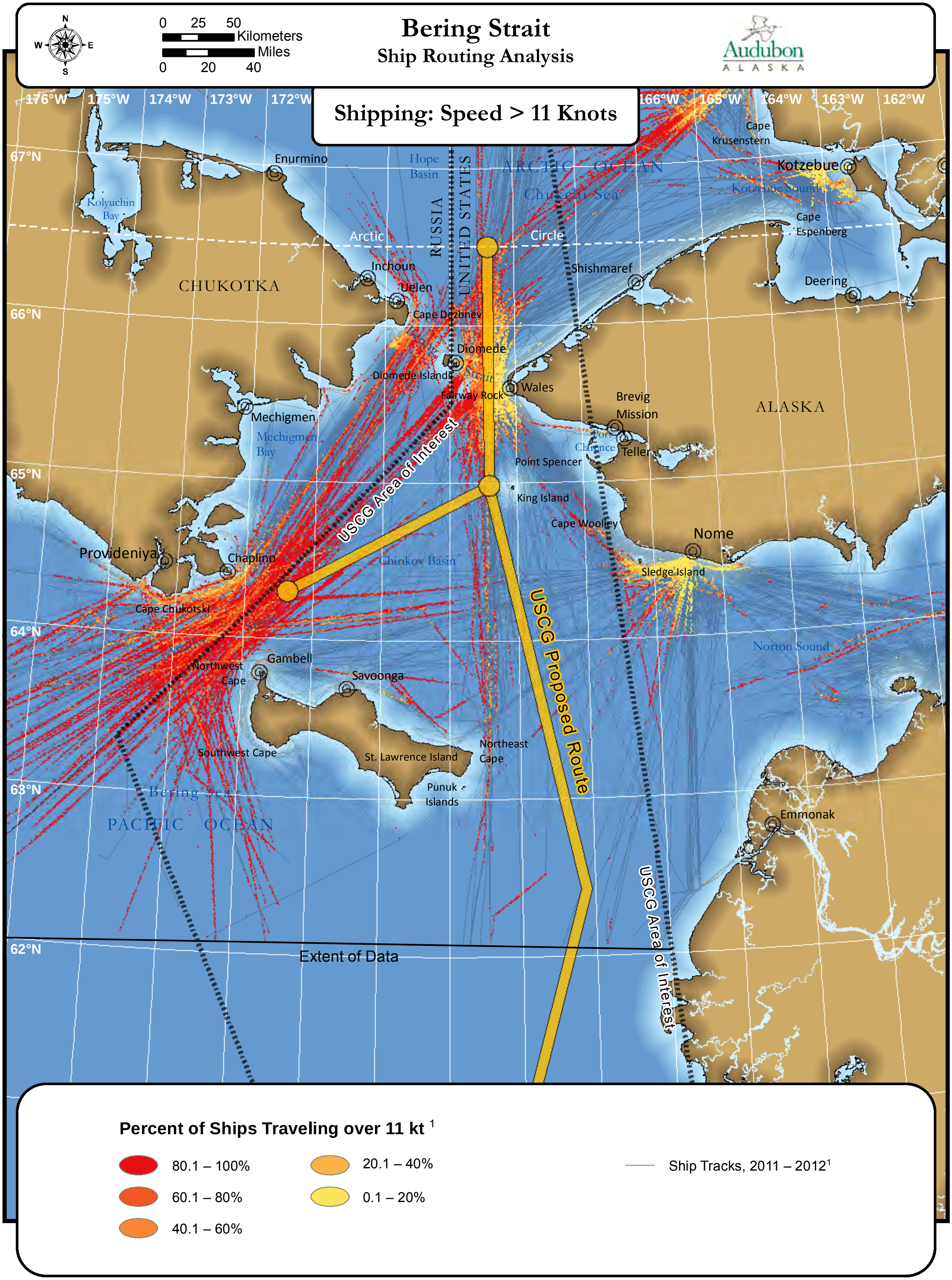
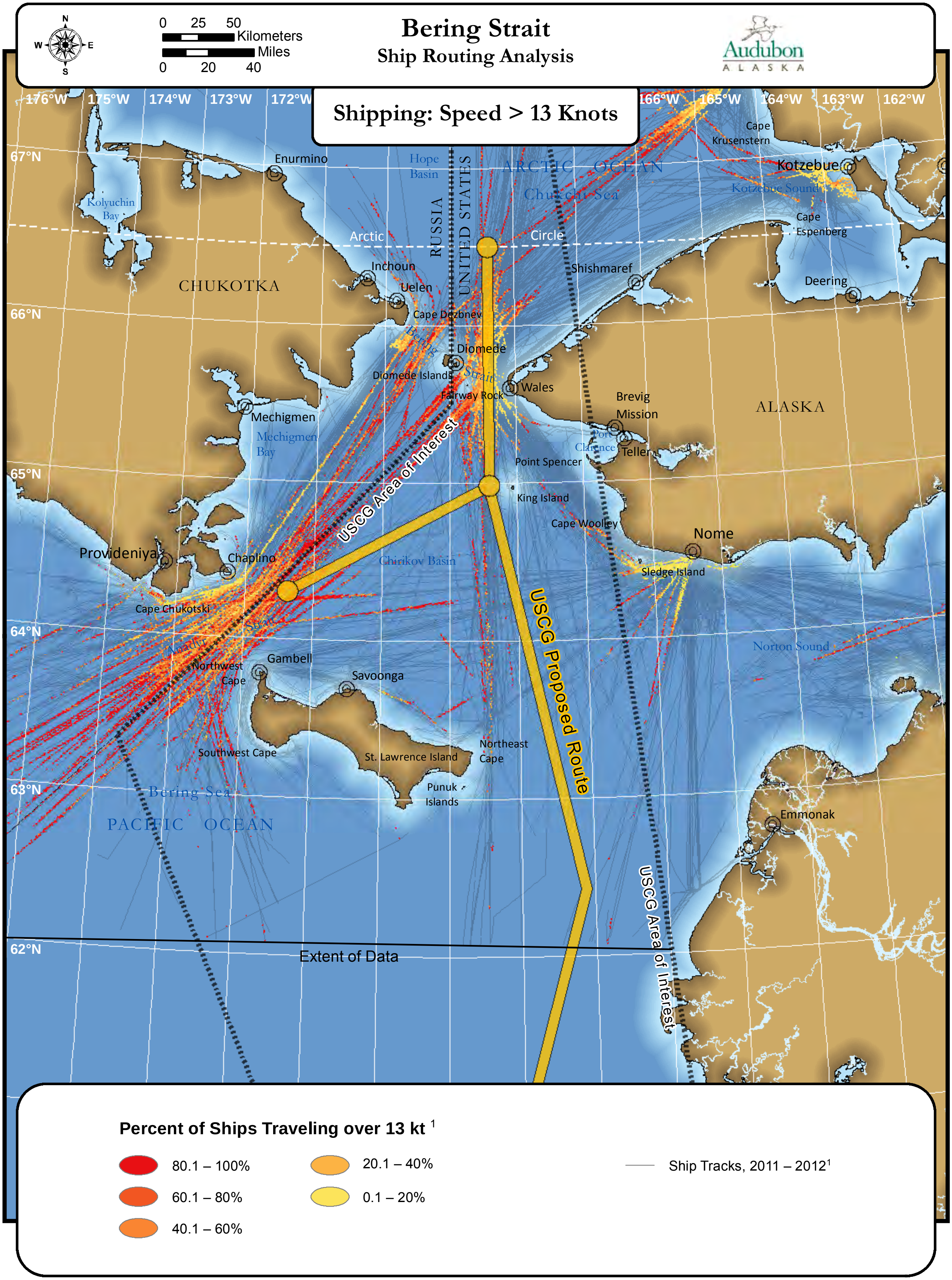
Map 5



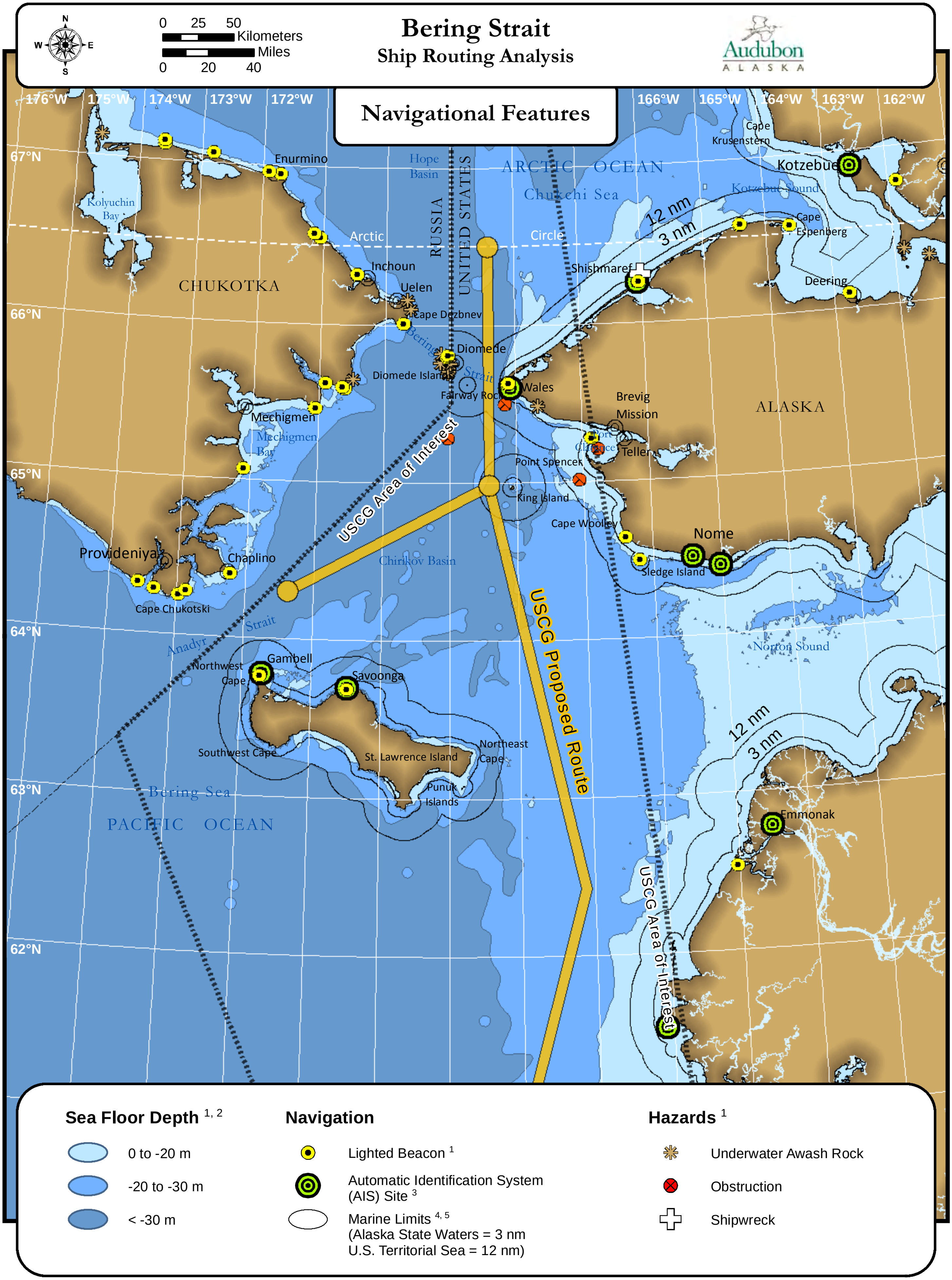
Data provided by: (1) Audubon Alaska 2014a, based on data from: (a) Marine Exchange of Alaska 2013. Map last updated: 5/26/2015. Map created by Audubon Alaska.

Map 6



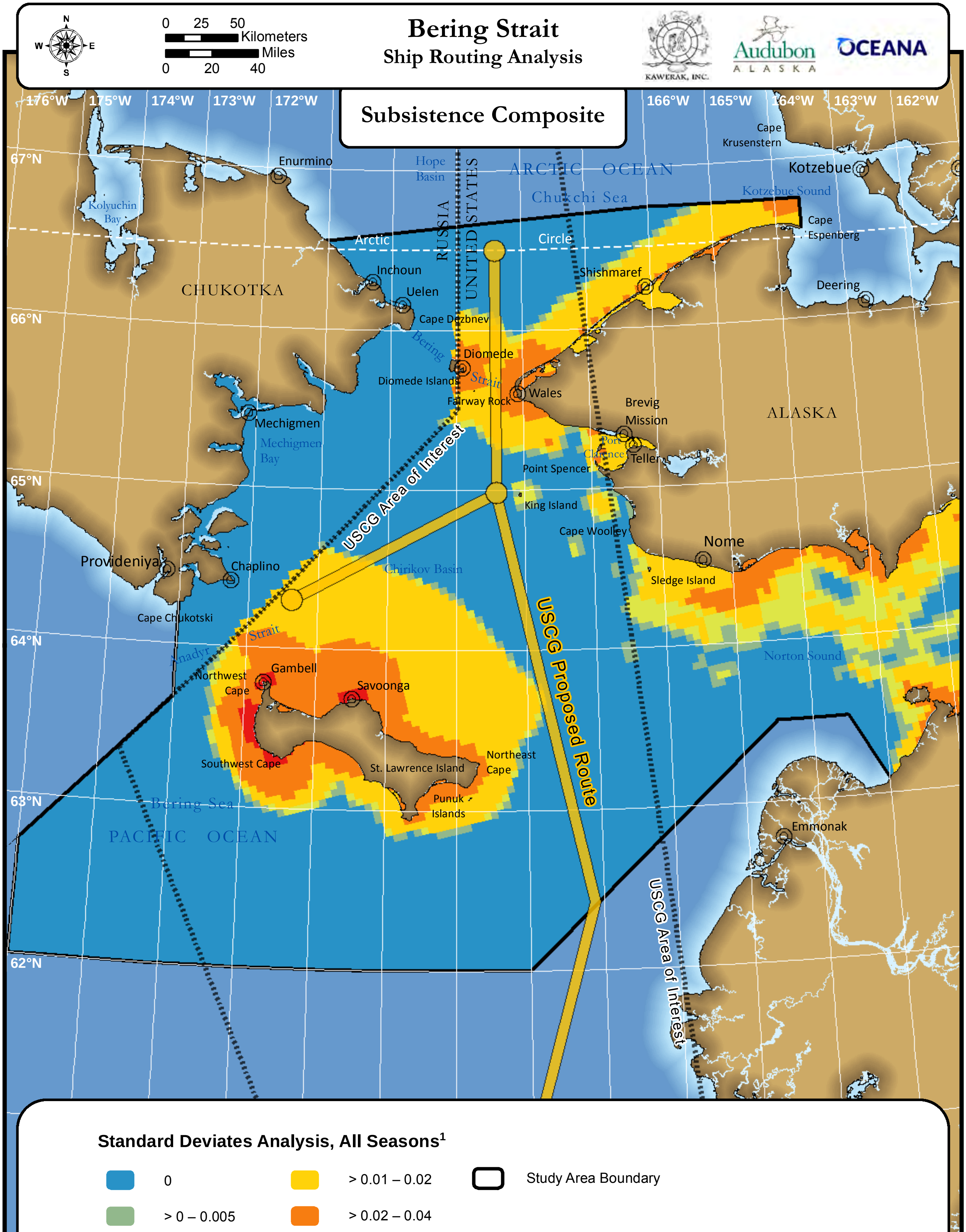
Data provided by: (1) Audubon Alaska 2014a, based on data from: (a) Marine Exchange of Alaska 2013. Map last updated: 5/26/2015. Map created by Audubon Alaska.

Map 7



Data provided by: (1) NOAA Office of Coast Survey 2013; (2) Danielson et al. 2013; (3) Marine Exchange of Alaska 2014; (4) Alaska Department of Natural Resources 2010; (5) NOAA Office of Coast Survey 2015. Map last updated: 5/28/2015. Map created by Audubon Alaska.

Map 8



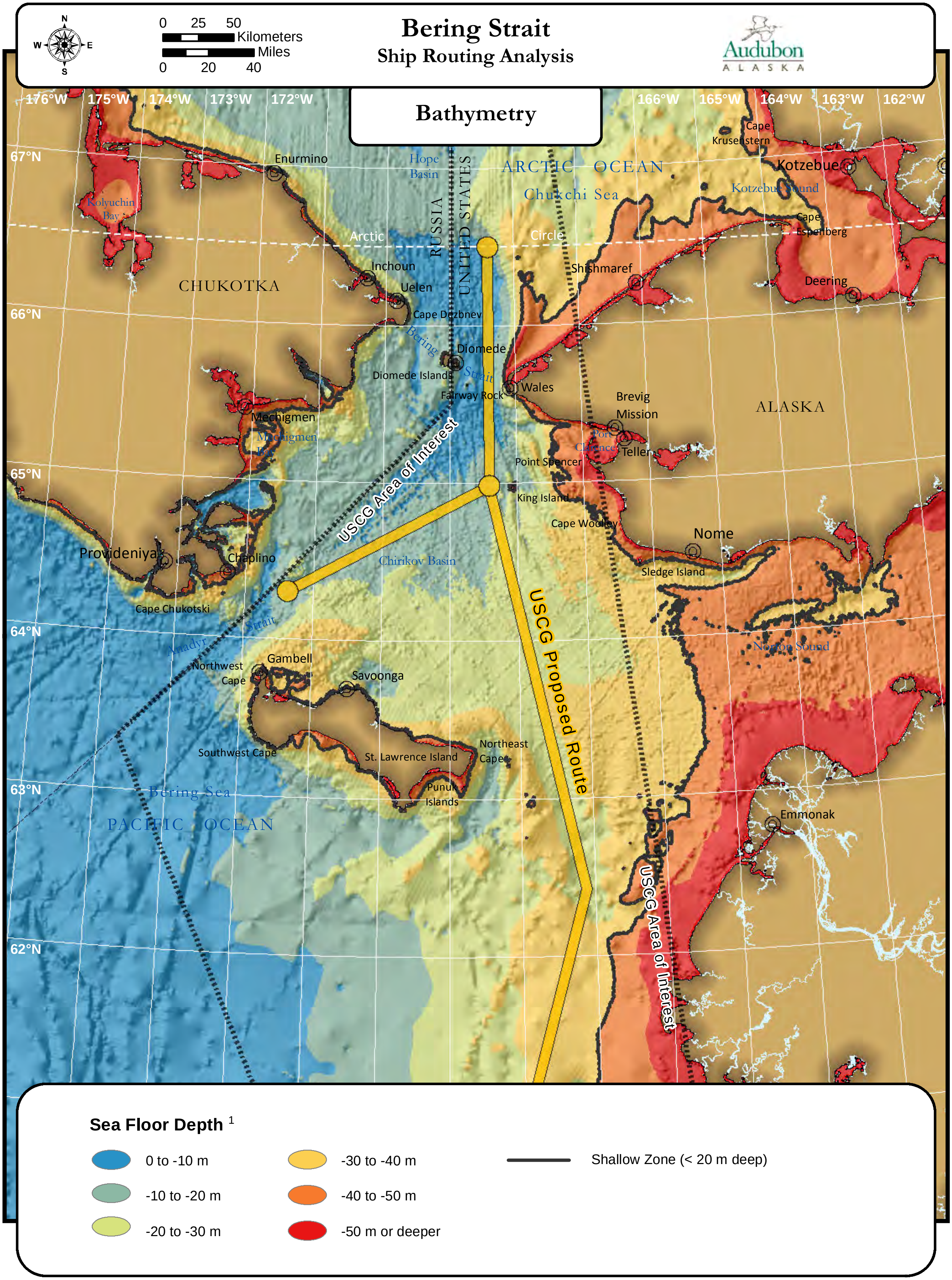
Standard Deviates Analysis, All Seasons[1]

0	> 0.01 – 0.02
> 0 – 0.005	> 0.02 – 0.04
> 0.005 – 0.01	> 0.04

Study Area Boundary

Data provided by: (1) Oceana and Kawerak 2014. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Map 9



Data provided by: (1) Danielson et al. 2013. Map last updated: 5/26/2015. Map created by Audubon Alaska.

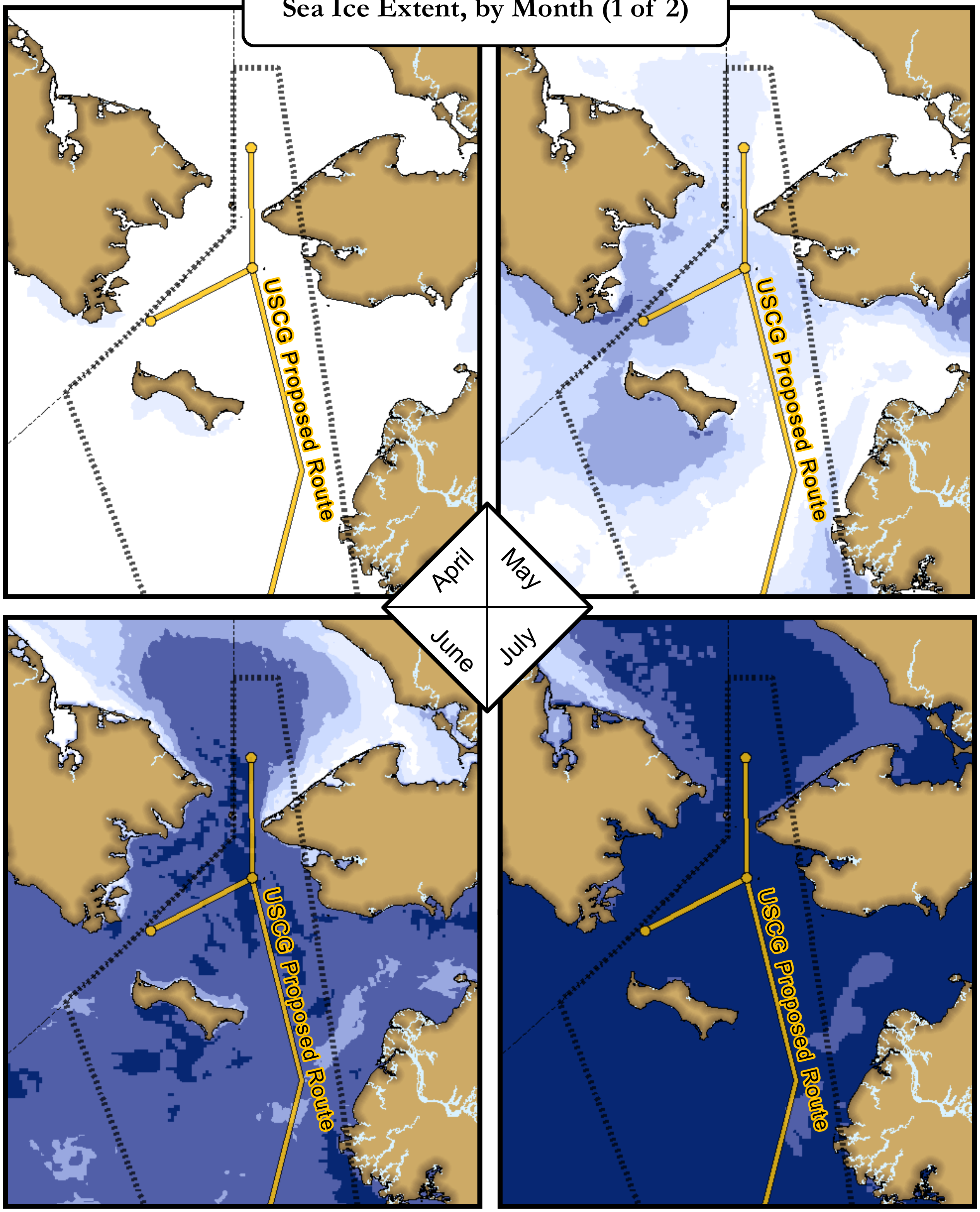
N
S
W
E

0 50 100 Kilometers
Miles
0 50 100

Bering Strait
Ship Routing Analysis

Audubon
ALASKA

Sea Ice Extent, by Month (1 of 2)



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

- 0%
- 0.1 – 20%
- 20.1 – 40%
- 40.1 – 60%
- 60.1 – 80%
- 80.1 – 100%

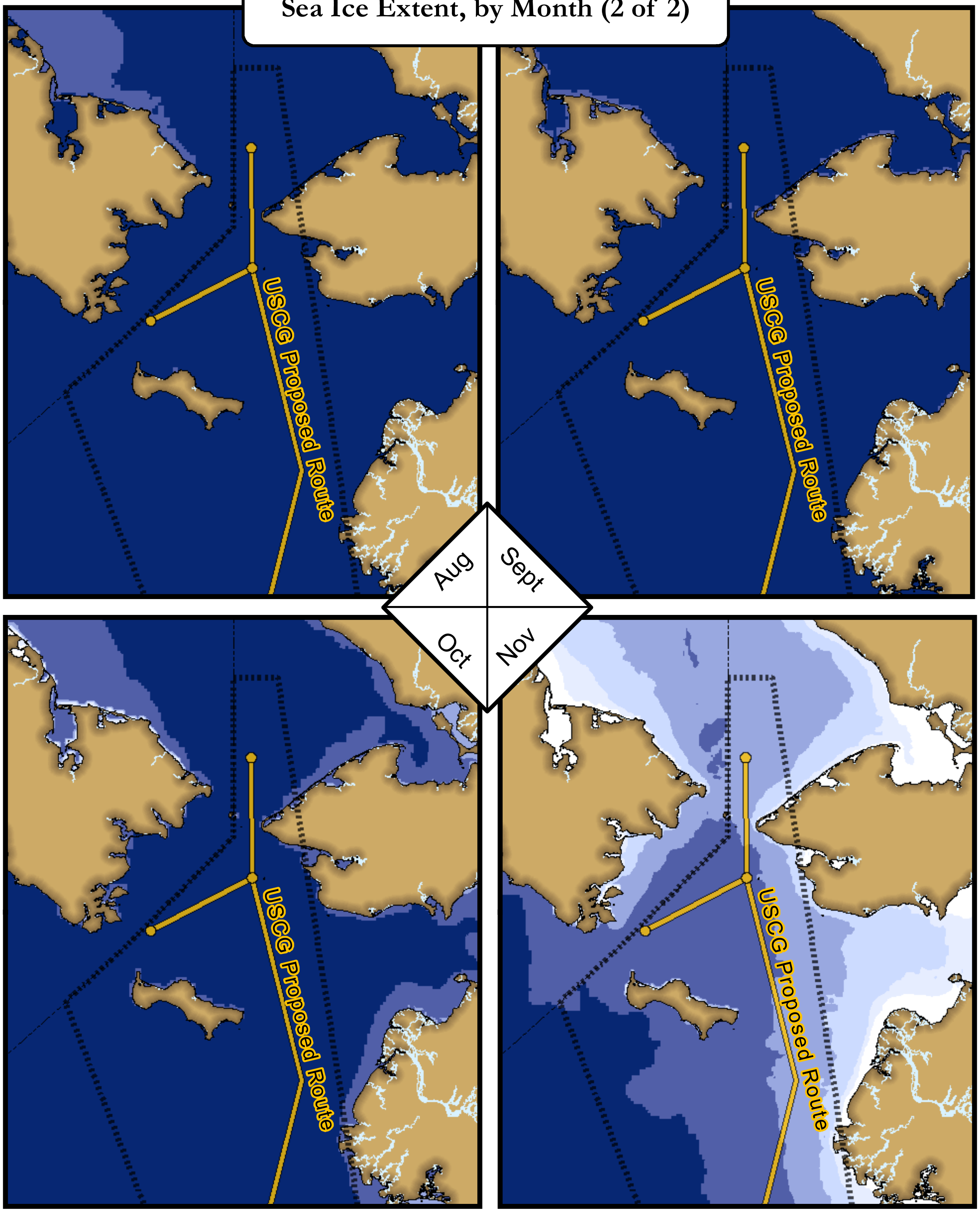
Data provided by: (1) Audubon Alaska 2013, based on data from: (a) National Snow and Ice Data Center 2013. Map last updated: 5/26/2015.
Map created by Audubon Alaska.

0 50 100 Kilometers
Miles
0 50 100

Bering Strait
Ship Routing Analysis

Audubon ALASKA

Sea Ice Extent, by Month (2 of 2)



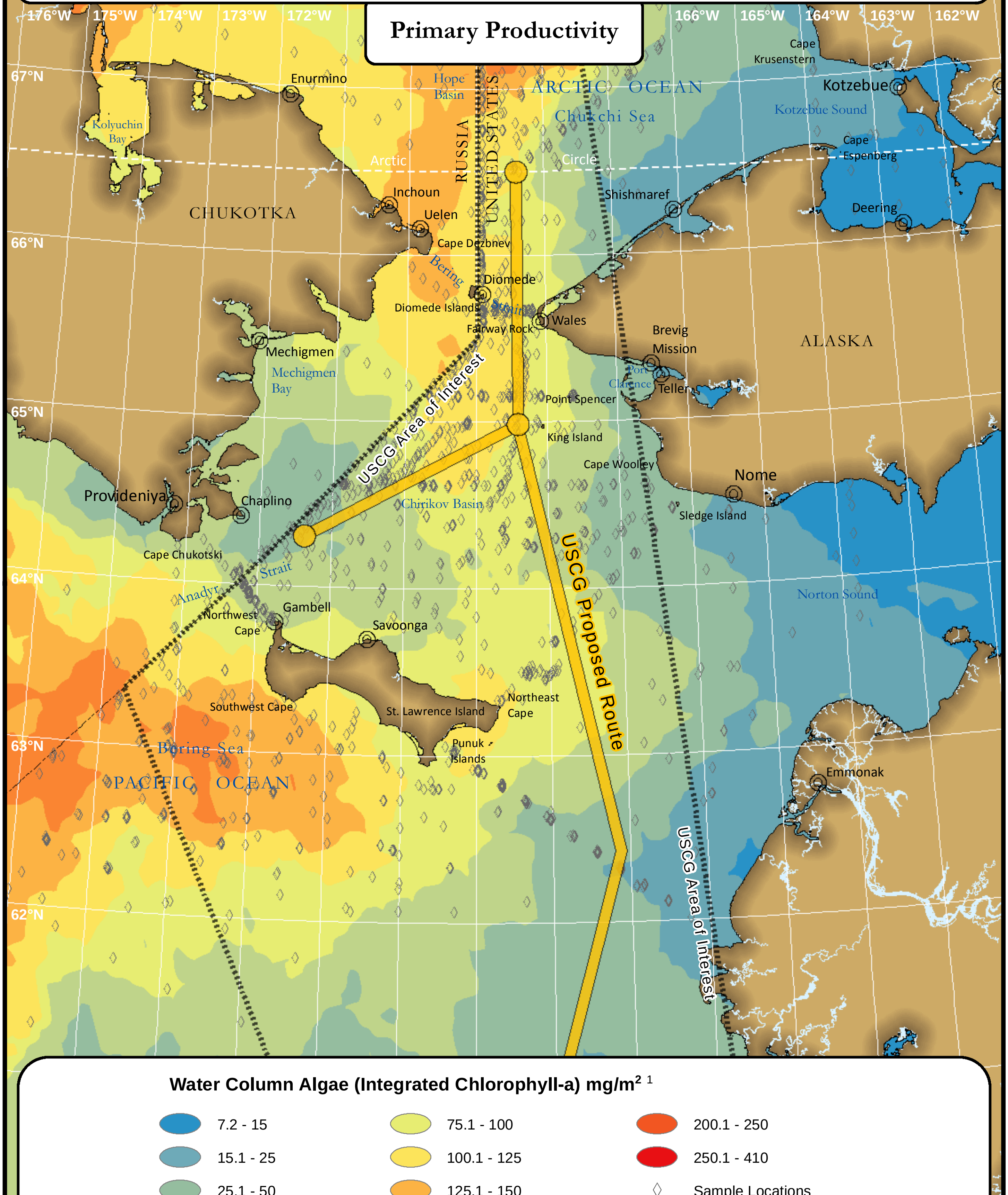
Percent of Days with Ice Present, Monthly Average (2008 – 2012) [1]

- 0%
- 0.1 – 20%
- 20.1 – 40%
- 40.1 – 60%
- 60.1 – 80%
- 80.1 – 100%

Data provided by: (1) Audubon Alaska 2013, based on data from: (a) National Snow and Ice Data Center 2013. Map last updated: 5/26/2015.
Map created by Audubon Alaska.

Bering Strait
Ship Routing Analysis

Primary Productivity

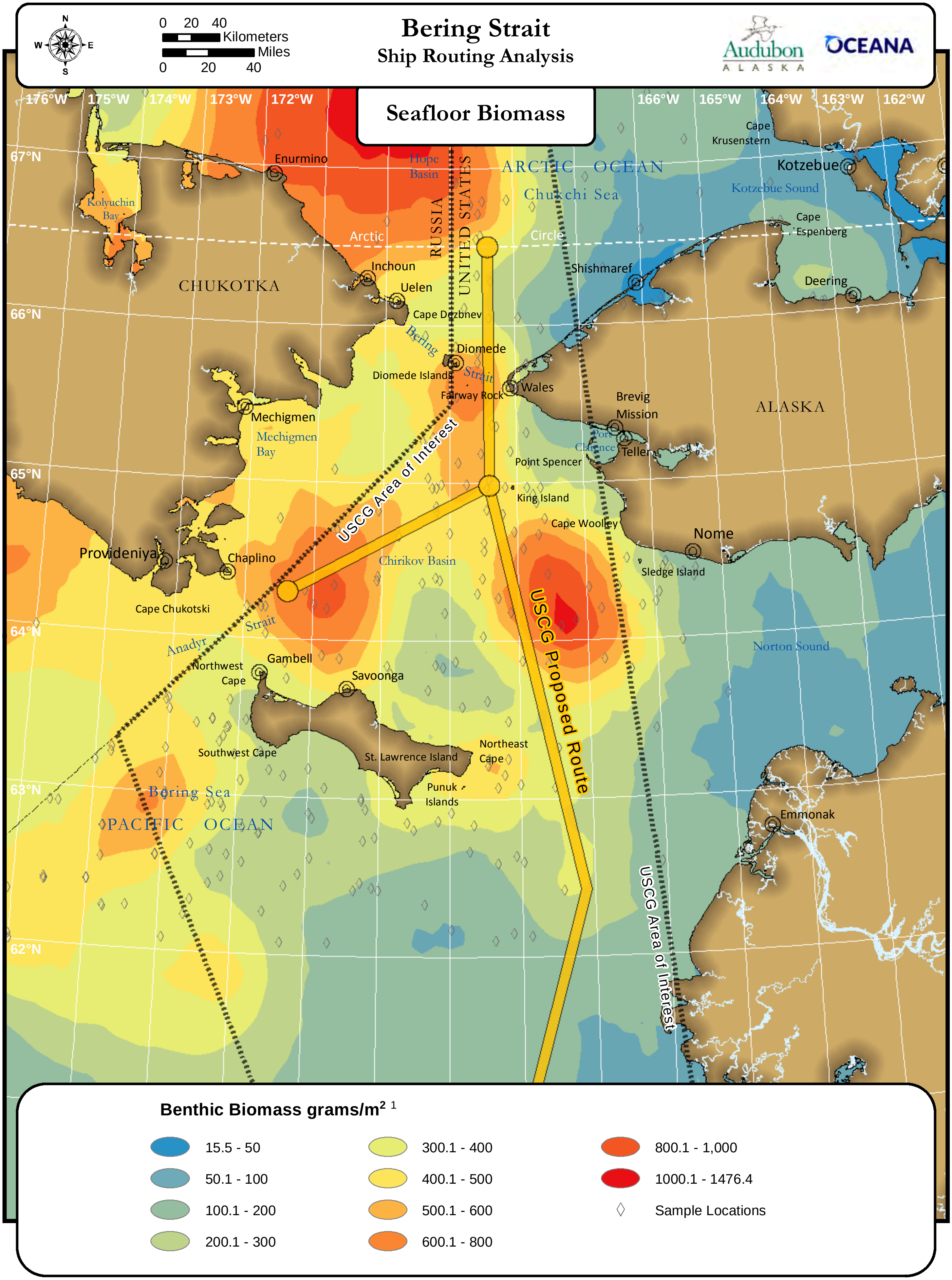


Water Column Algae (Integrated Chlorophyll-a) mg/m^2 [1]

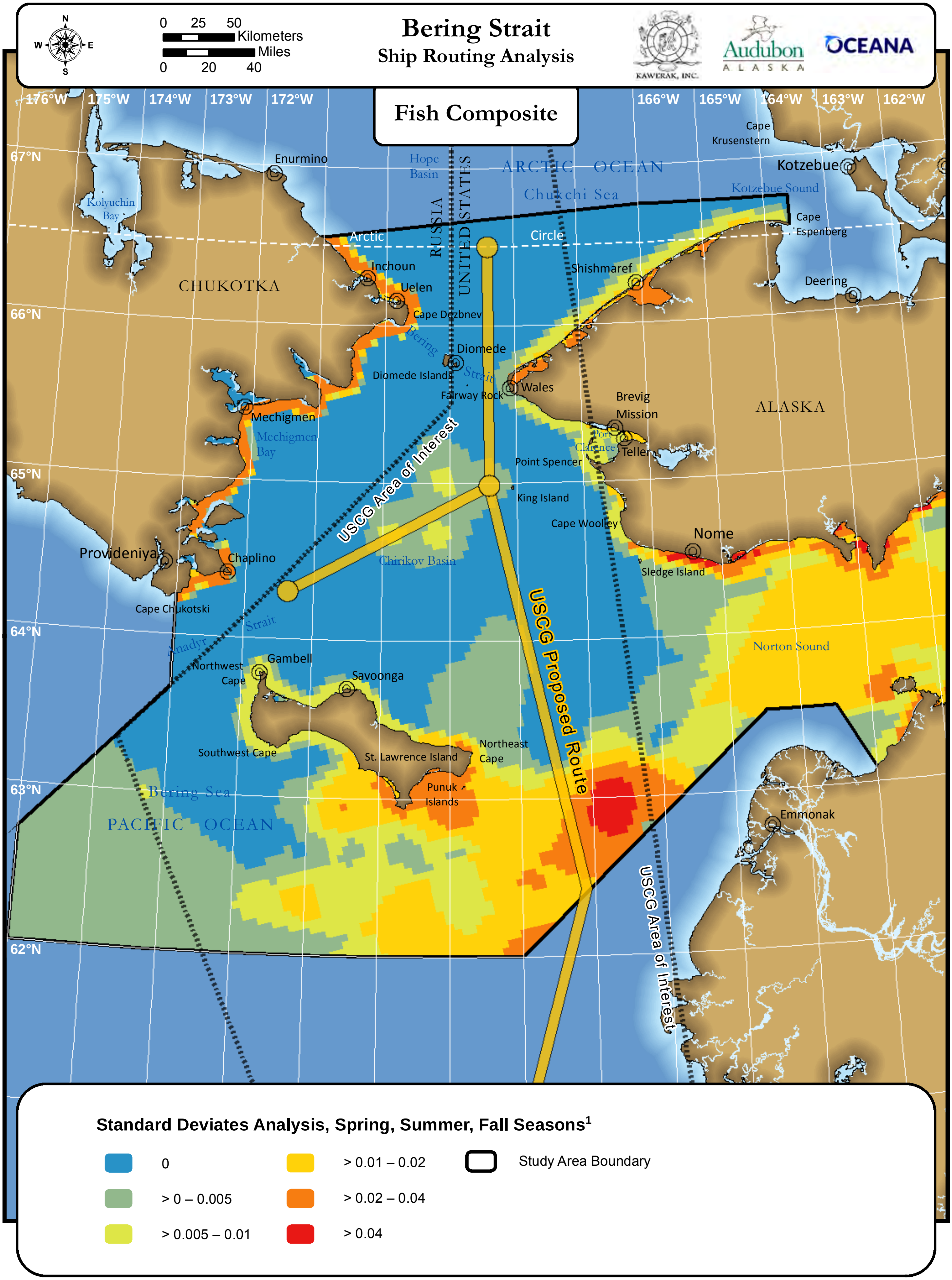
7.2 - 15	75.1 - 100	200.1 - 250
15.1 - 25	100.1 - 125	250.1 - 410
25.1 - 50	125.1 - 150	◊ Sample Locations
50.1 - 75	150.1 - 200	

Data provided by: (1) Oceana and Audubon Alaska 2014, based on data from: (a) Dunton et al. 2005; (b) Grebmeier et al. 2014, updated data from (i) Grebmeier et al. 2006. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Map 13



Data provided by: (1) Oceana and Audubon Alaska 2014, based on data from: (a) Dunton et al. 2005; (b) Grebmeier et al. 2014, updated data from (i) Grebmeier et al. 2006. Map last updated: 6/2/2015. Map created by Audubon Alaska.



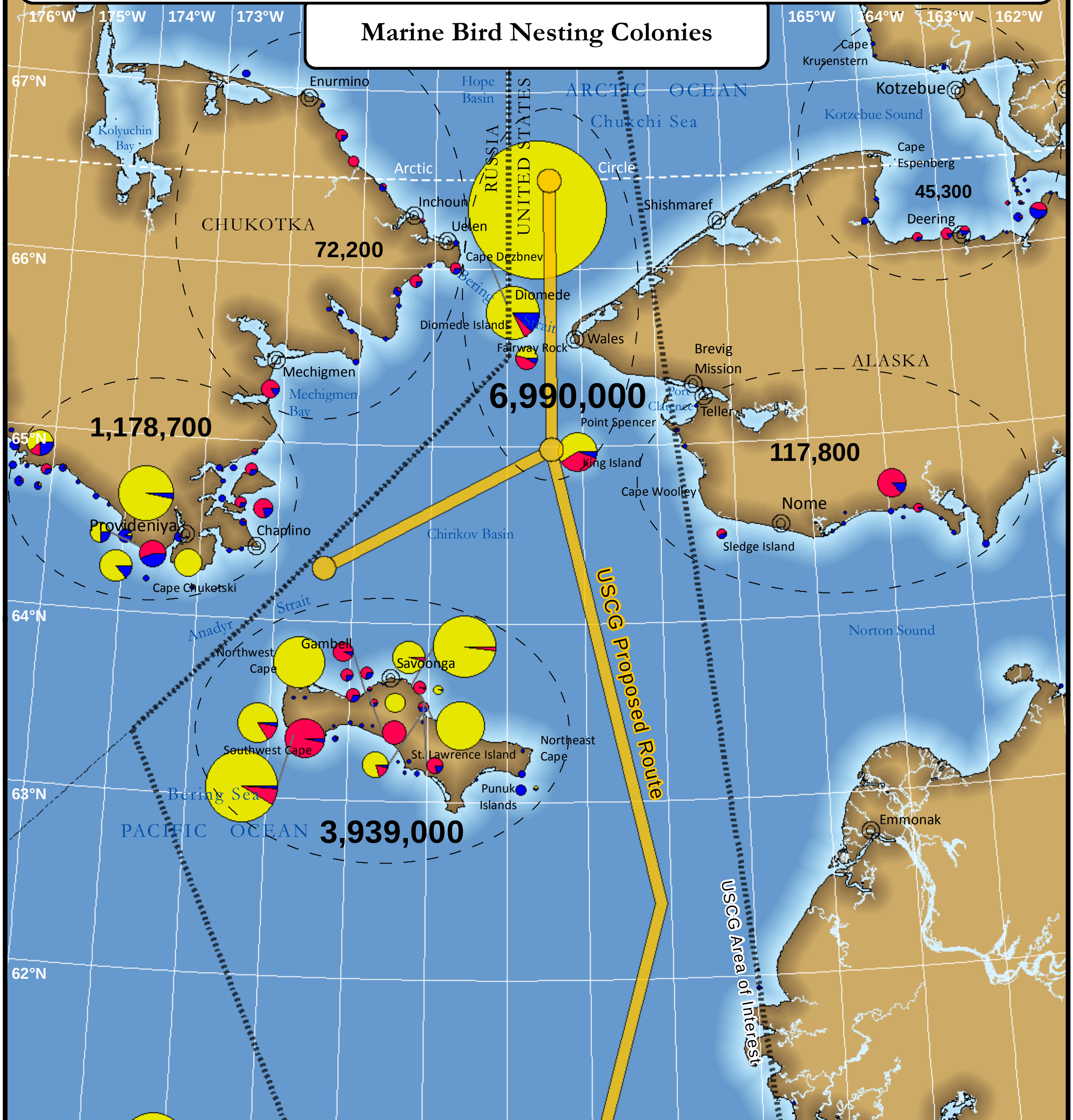
Data provided by: (1) Oceana and Kawerak 2014. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Map 15

Bering Strait
Ship Routing Analysis

Audubon ALASKA

0 25 50 Kilometers
0 20 40 Miles



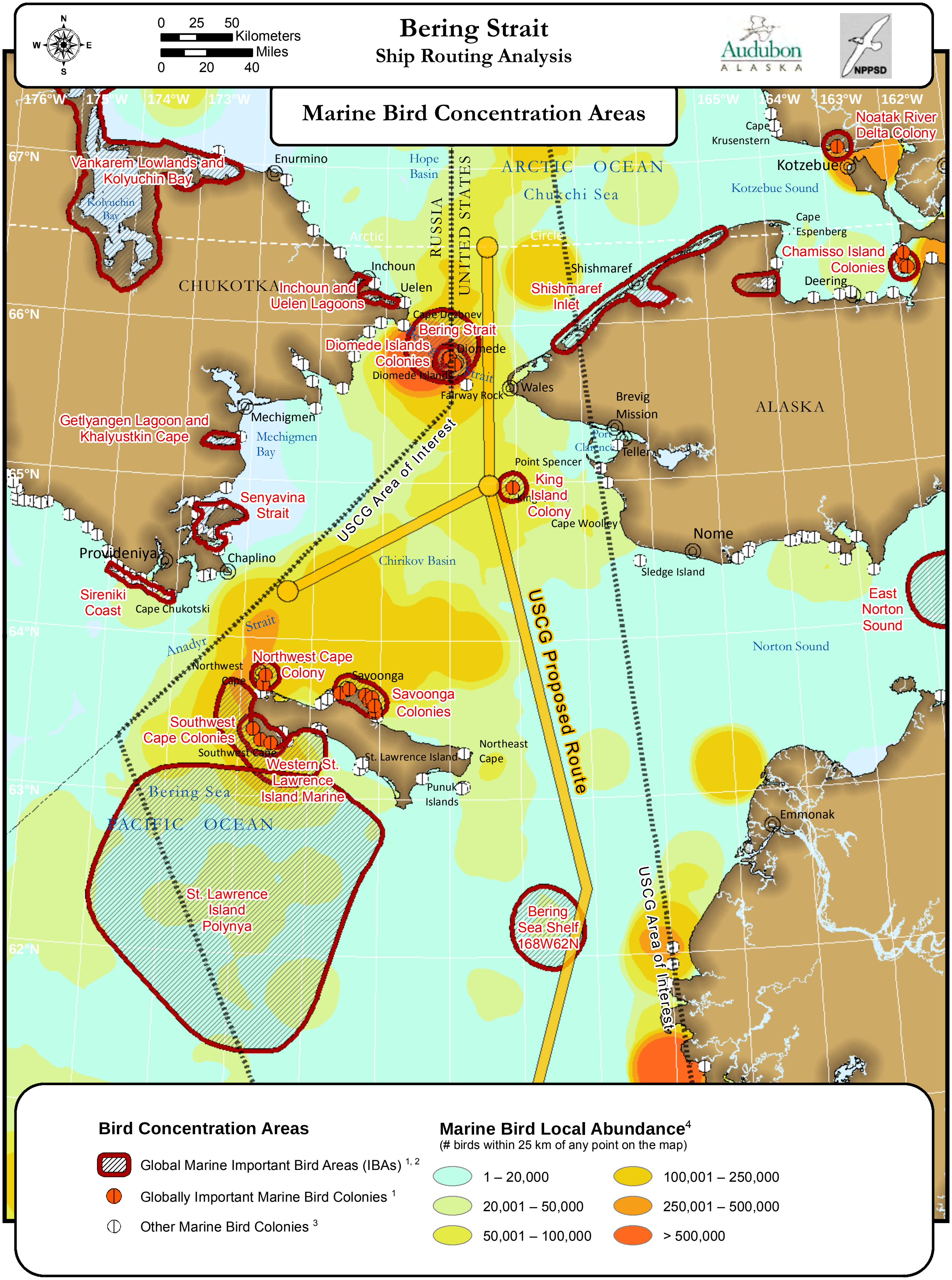
Marine Bird Colonies (Scaled by total number of birds; species listed from most to least abundant) [1]

Auklet: Least Auklet, Unknown Auklet, Crested Auklet, Parakeet Auklet (11 Million Total)

Murre: Unknown Murre, Thick-billed Murre, Common Murre (1 Million Total)

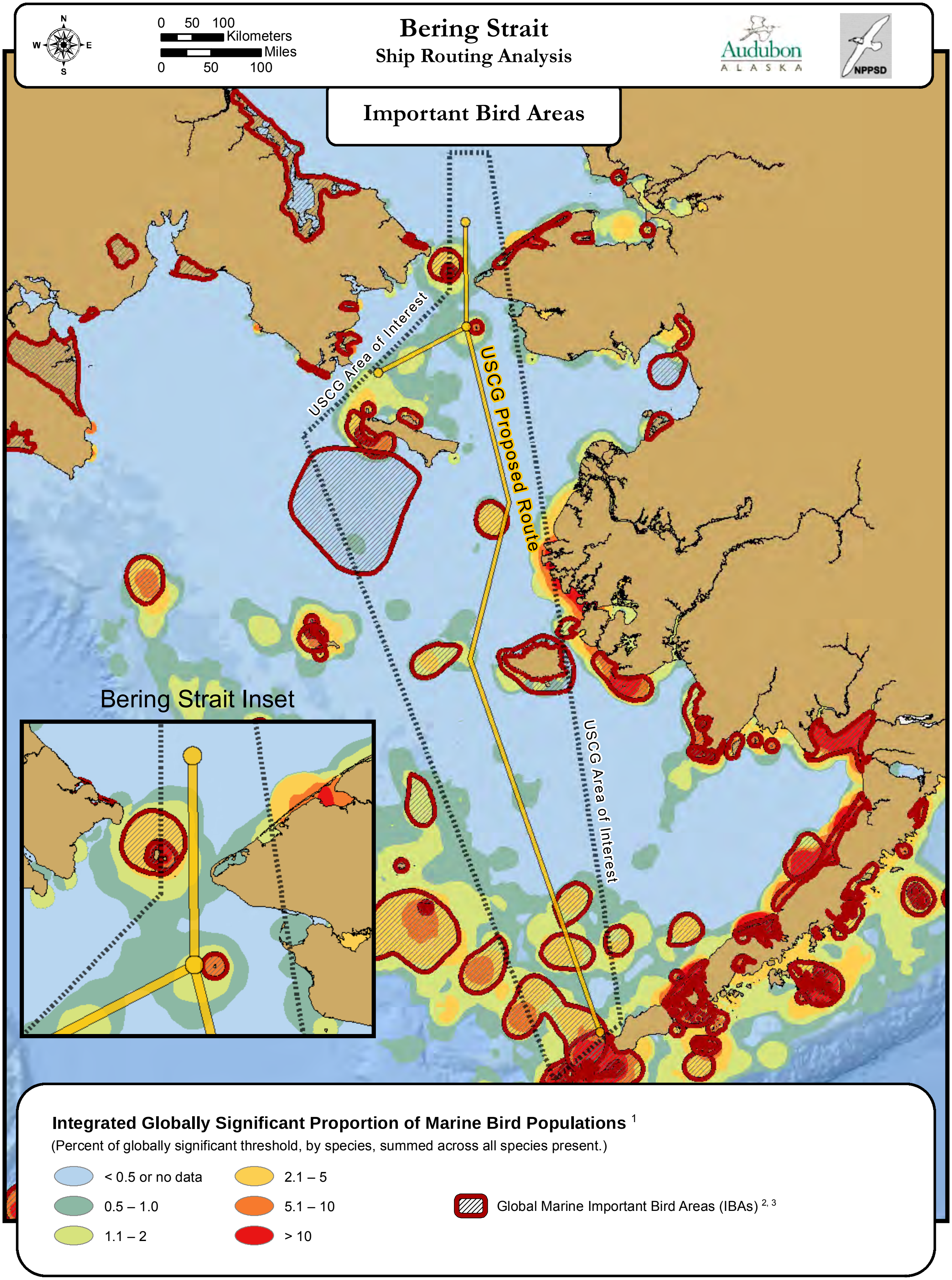
Other: Northern Fulmar, Black-legged Kittiwake, Horned Puffin, Tufted Puffin, Pelagic Cormorant, Pigeon Guillemot, Glaucous Gull, Herring Gull, Common Eider, Arctic Tern, Aleutian Tern, Glaucous-winged Gull, Black Guillemot, Unknown Cormorant, Unknown Tern, Caspian Tern, Dovekie, Slaty-backed Gull (400,000 Total)

Data provided by: (1) World Seabird Union 2011. Map last updated: 5/28/2015. Map created by Audubon Alaska.



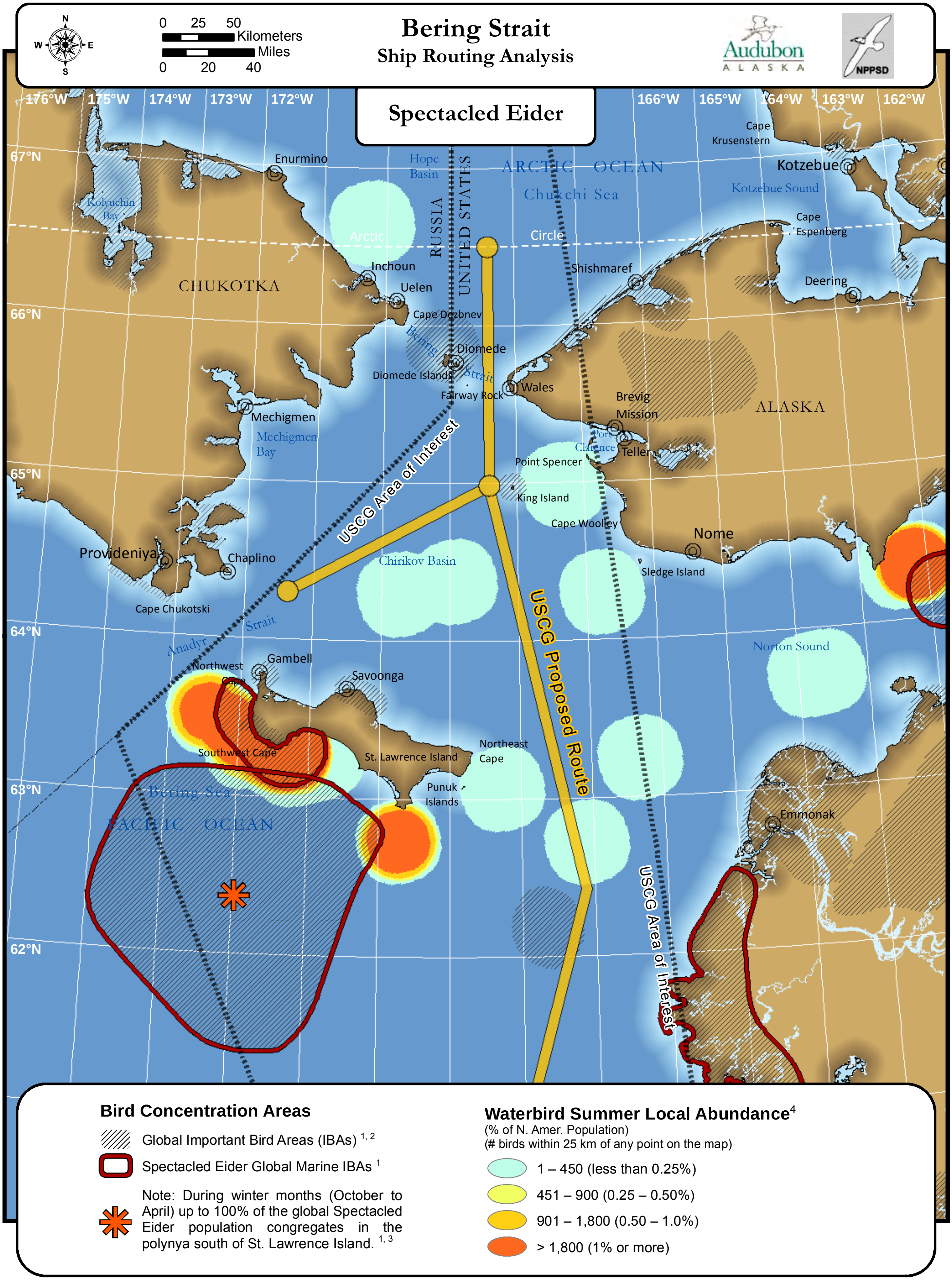
Data provided by: (1) Audubon Alaska 2014b, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (2) BirdLife International 2014. (3) World Seabird Union 2011. (4) Audubon Alaska 2014c, based on data in: (a) Drew and Piatt 2013. (b) Walker and Smith 2014b. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Map 17



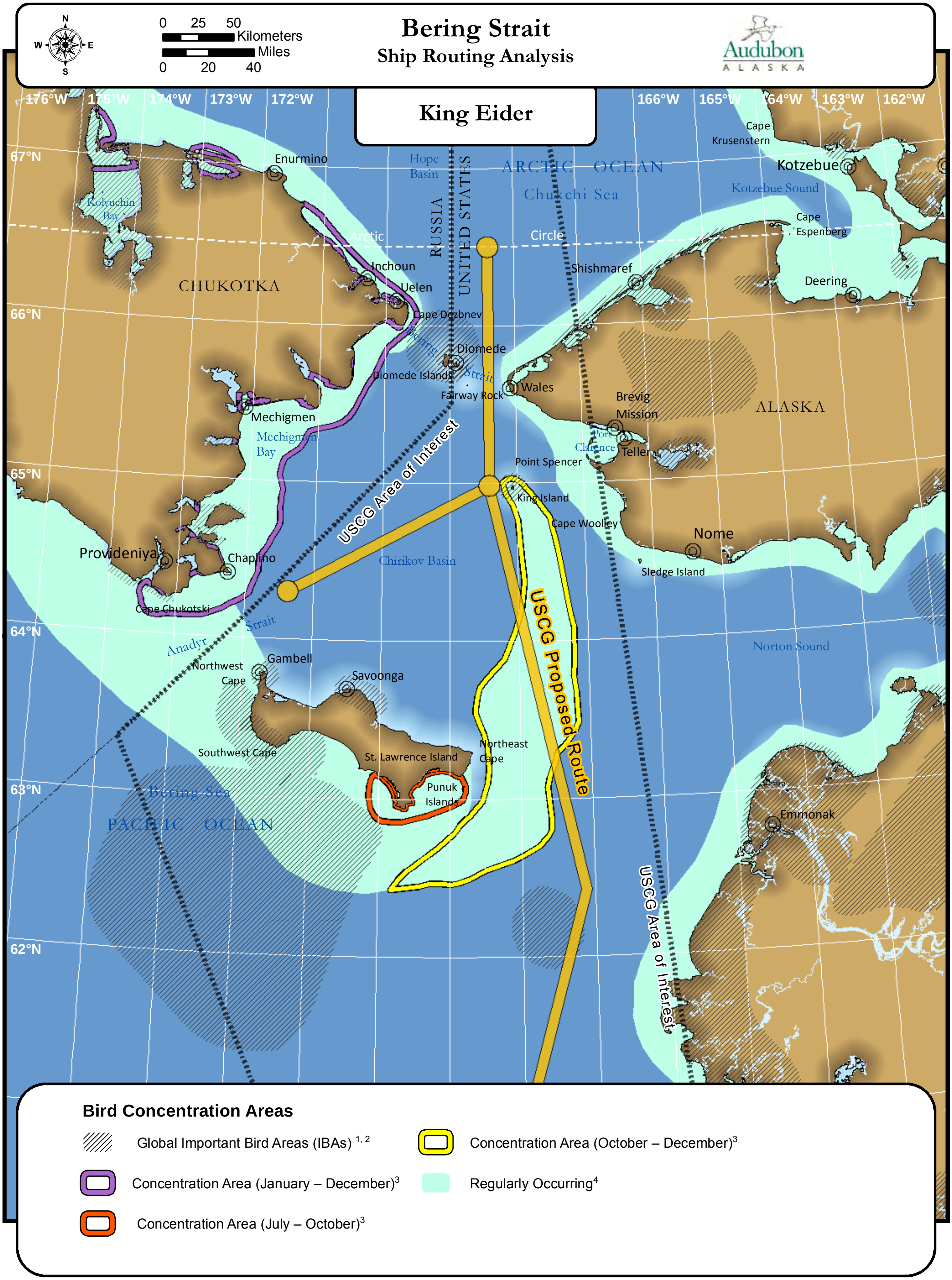
Data provided by: (1) Audubon Alaska 2015, based on data from: (a) Drew and Piatt 2013. (b) Walker and Smith 2014b. (2) Audubon Alaska 2014c, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (3) BirdLife International 2014. (3) World Seabird Union 2011. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Map 18



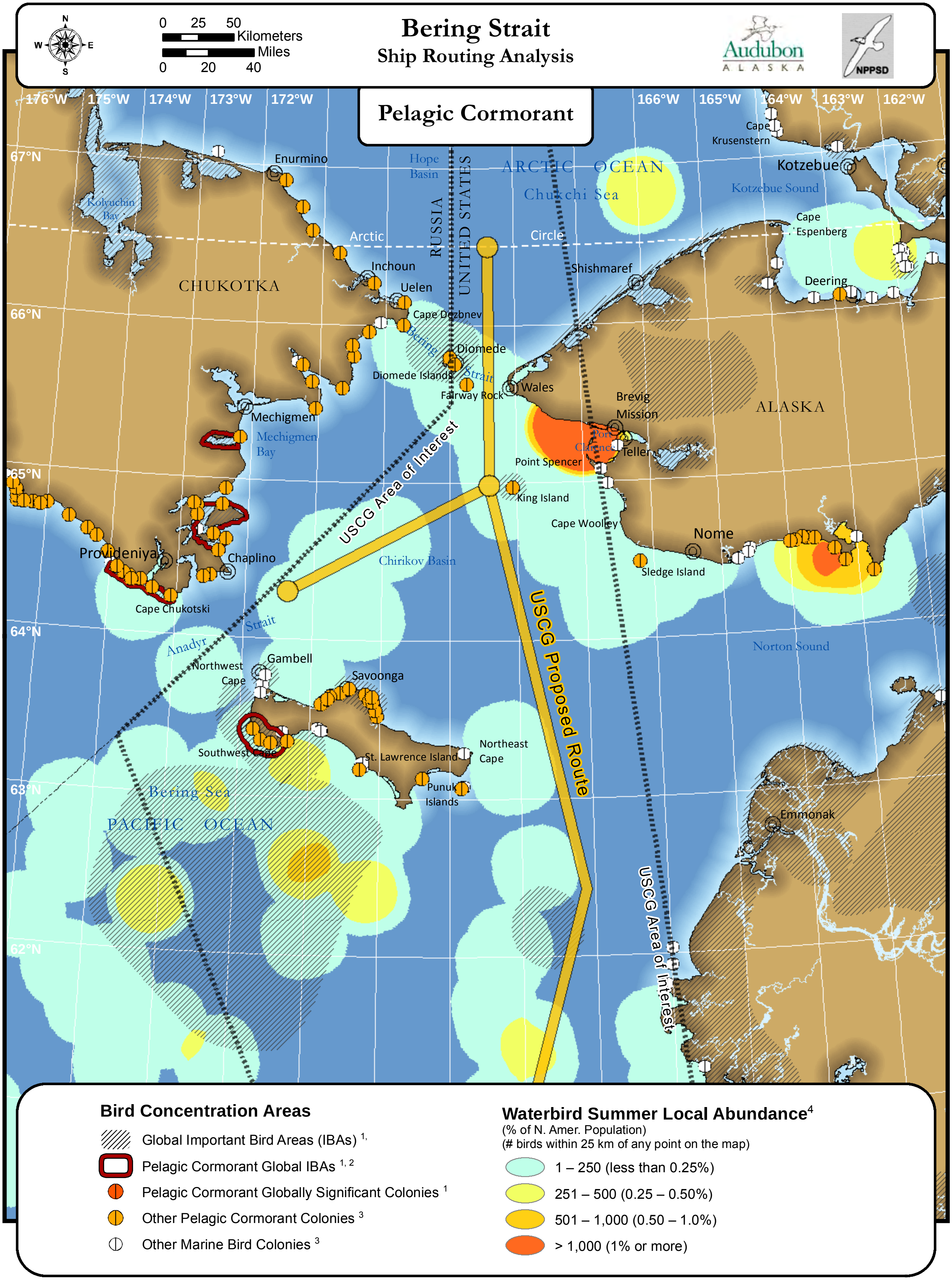
Data provided by: (1) Audubon Alaska 2014b, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (2) BirdLife International 2014. (3) Petersen et al. 1999. (4) Audubon Alaska 2015b, based on data from: (a) Drew and Piatt 2013. (b) Walker and Smith 2014b. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Map 19



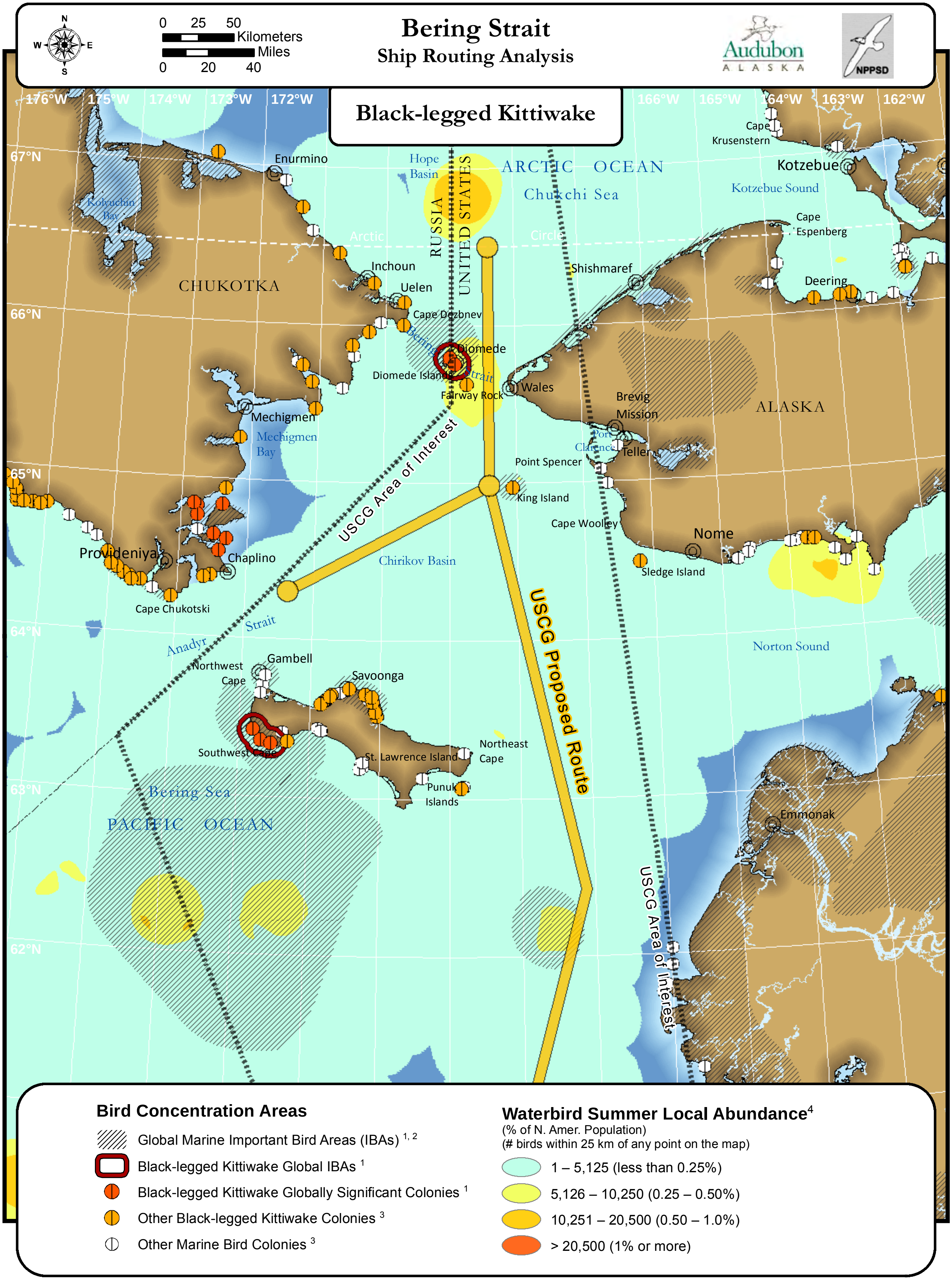
Data provided by: (1) Audubon Alaska 2014b, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (2) BirdLife International 2014. (3) Audubon Alaska 2009, based on data from: (a) Oppel et al. 2009. (4) NOAA 1988. Map last updated: 5/27/2015. Map created by Audubon Alaska.

Map 20



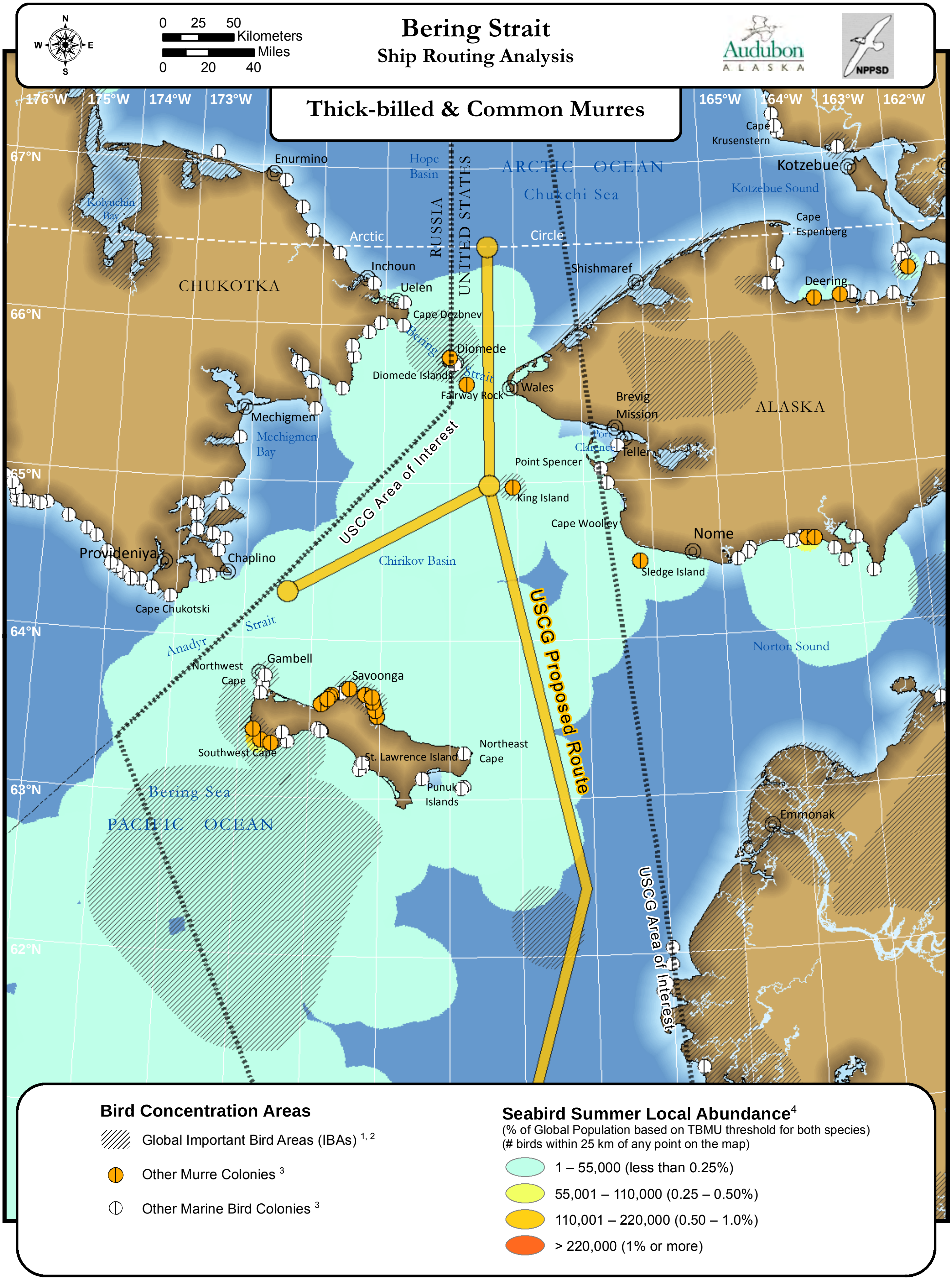
Data provided by: (1) Audubon Alaska 2014b, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (2) BirdLife International 2014. (3) World Seabird Union 2011. (4) Audubon Alaska 2014c, based on data from: (a) Drew and Piatt 2013. (b) Walker and Smith 2014b. Map last updated: 5/28/2015. Map created by Audubon Alaska.

Map 21

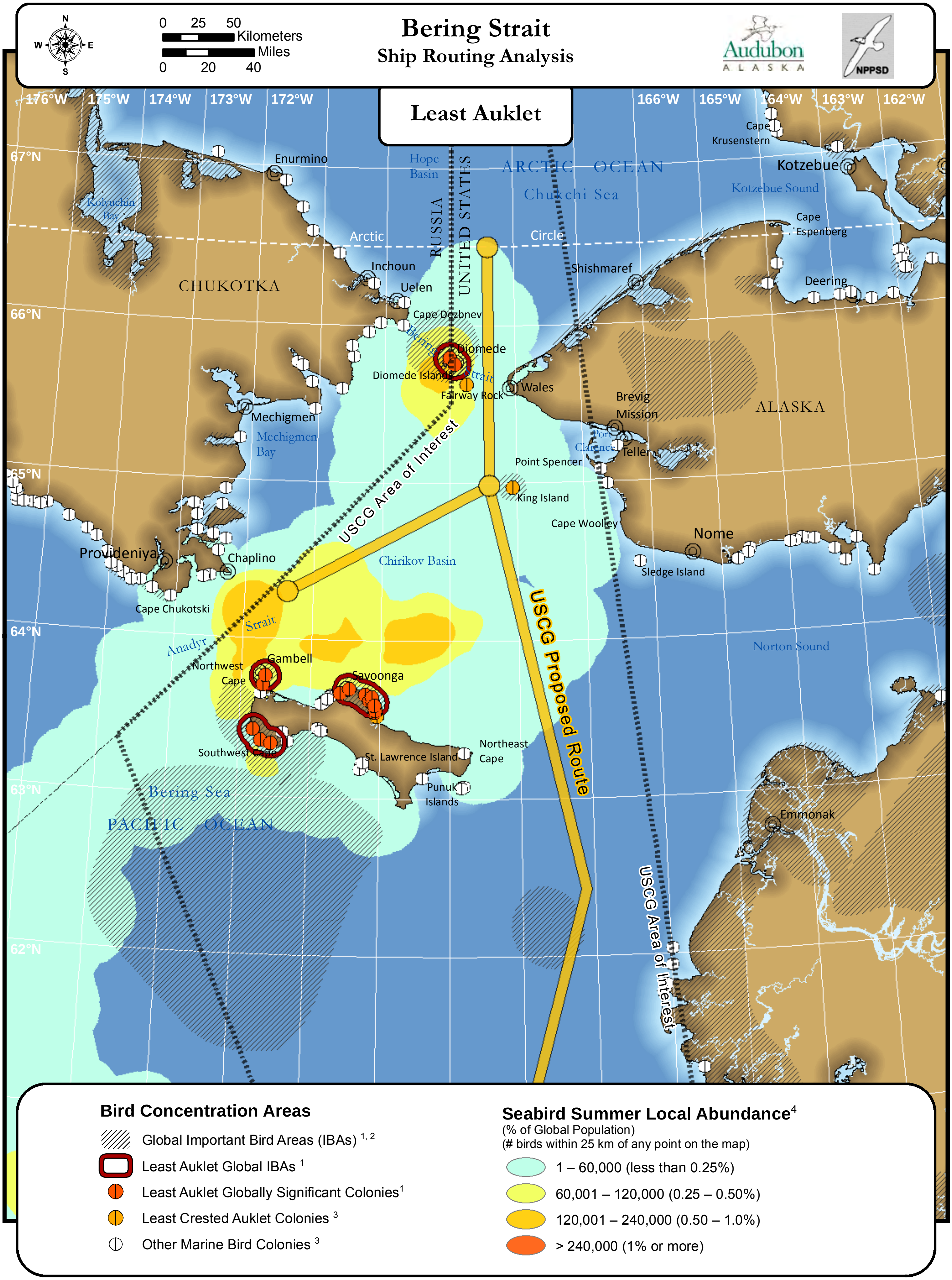


Sources: (1) Audubon Alaska 2014b, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (2) BirdLife International 2014. (3) World Seabird Union 2011. (4) Audubon Alaska 2014c, based on data in: (a) Drew and Piatt 2013. (b) Walker and Smith 2014b. Map last updated: 5/27/2015. Map created by Audubon Alaska.

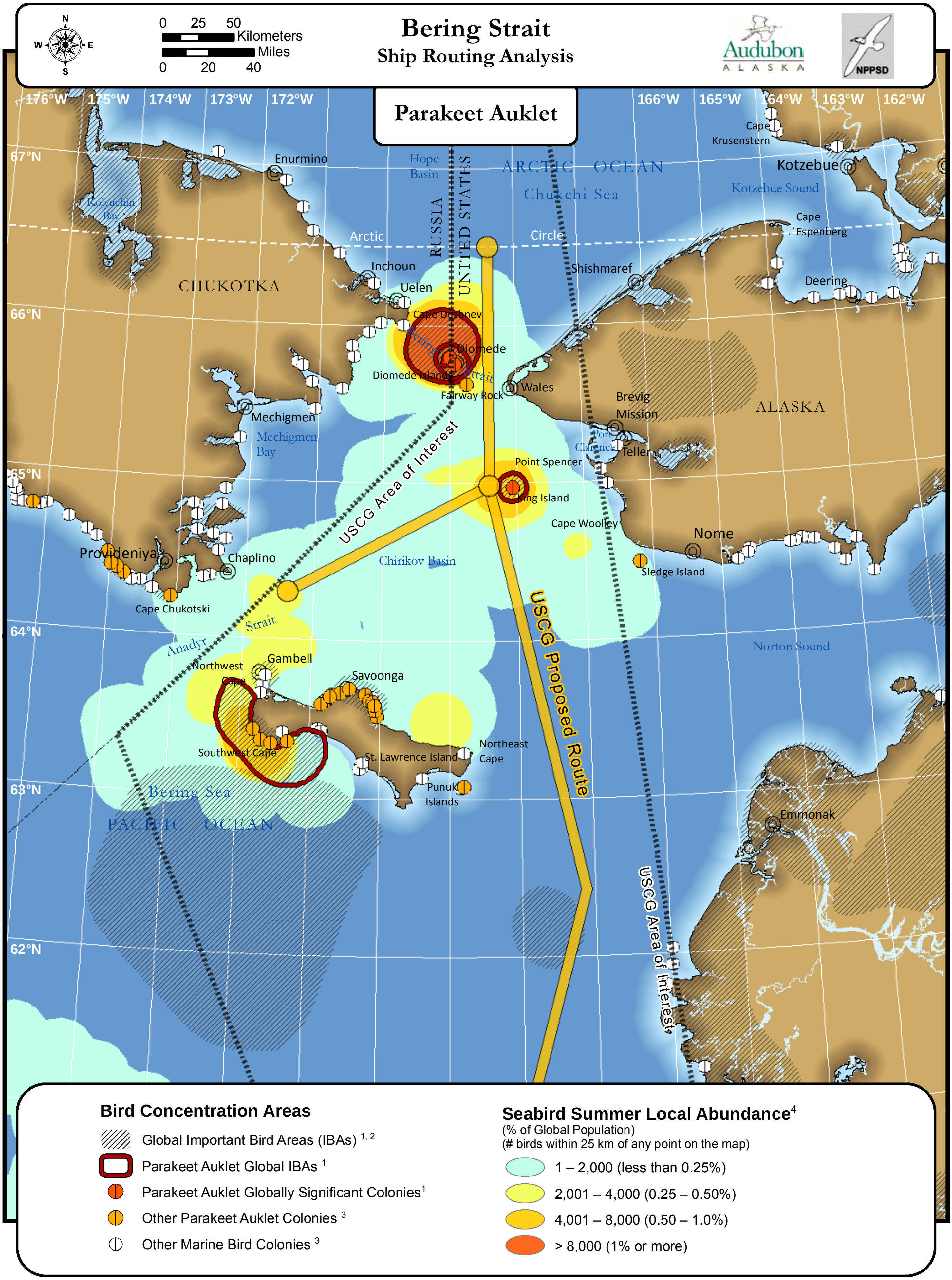
Map 22



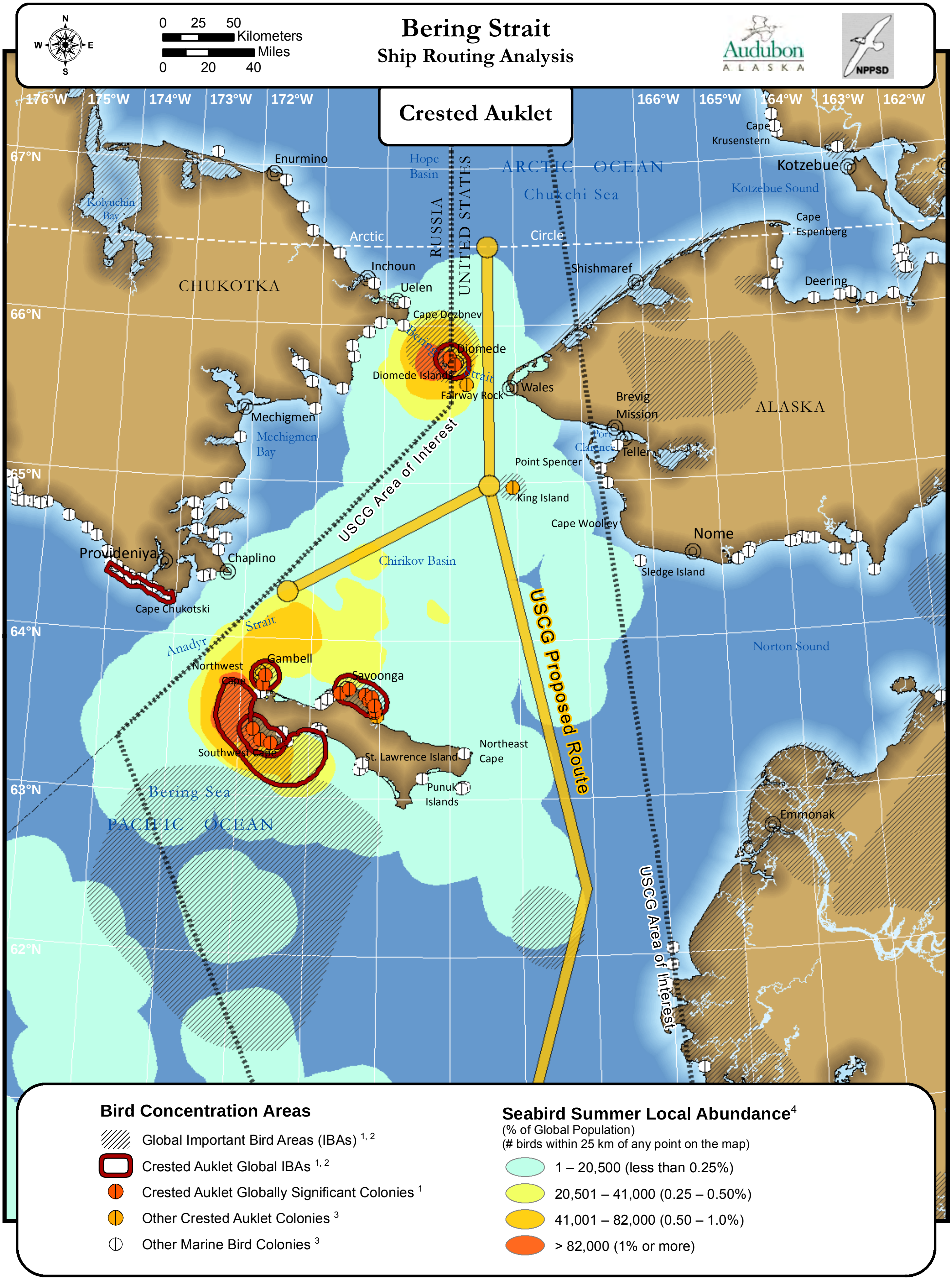
Data provided by: (1) Audubon Alaska 2014b, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (2) BirdLife International 2014. (3) World Seabird Union 2011. (4) Audubon Alaska 2014c, based on data from: (a) Drew and Piatt 2013. (b) Walker and Smith 2014b. Map last updated: 5/28/2015. Map created by Audubon Alaska.



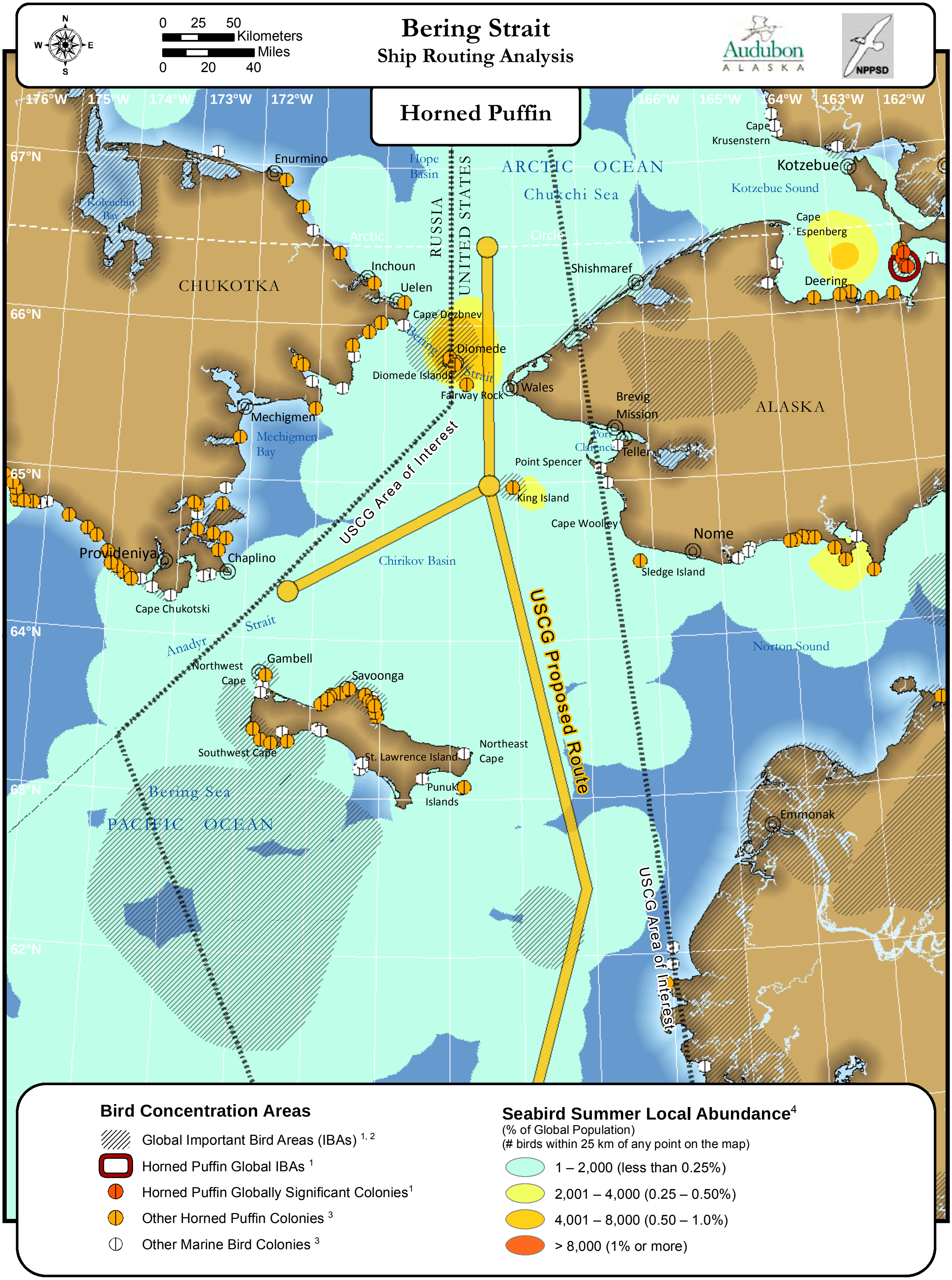
Data provided by: (1) Audubon Alaska 2014b, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (2) BirdLife International 2014. (3) World Seabird Union 2011. (4) Audubon Alaska 2014c, based on data from: (a) Drew and Piatt 2013. (b) Walker and Smith 2014b. Map last updated: 5/27/2015. Map created by Audubon Alaska.



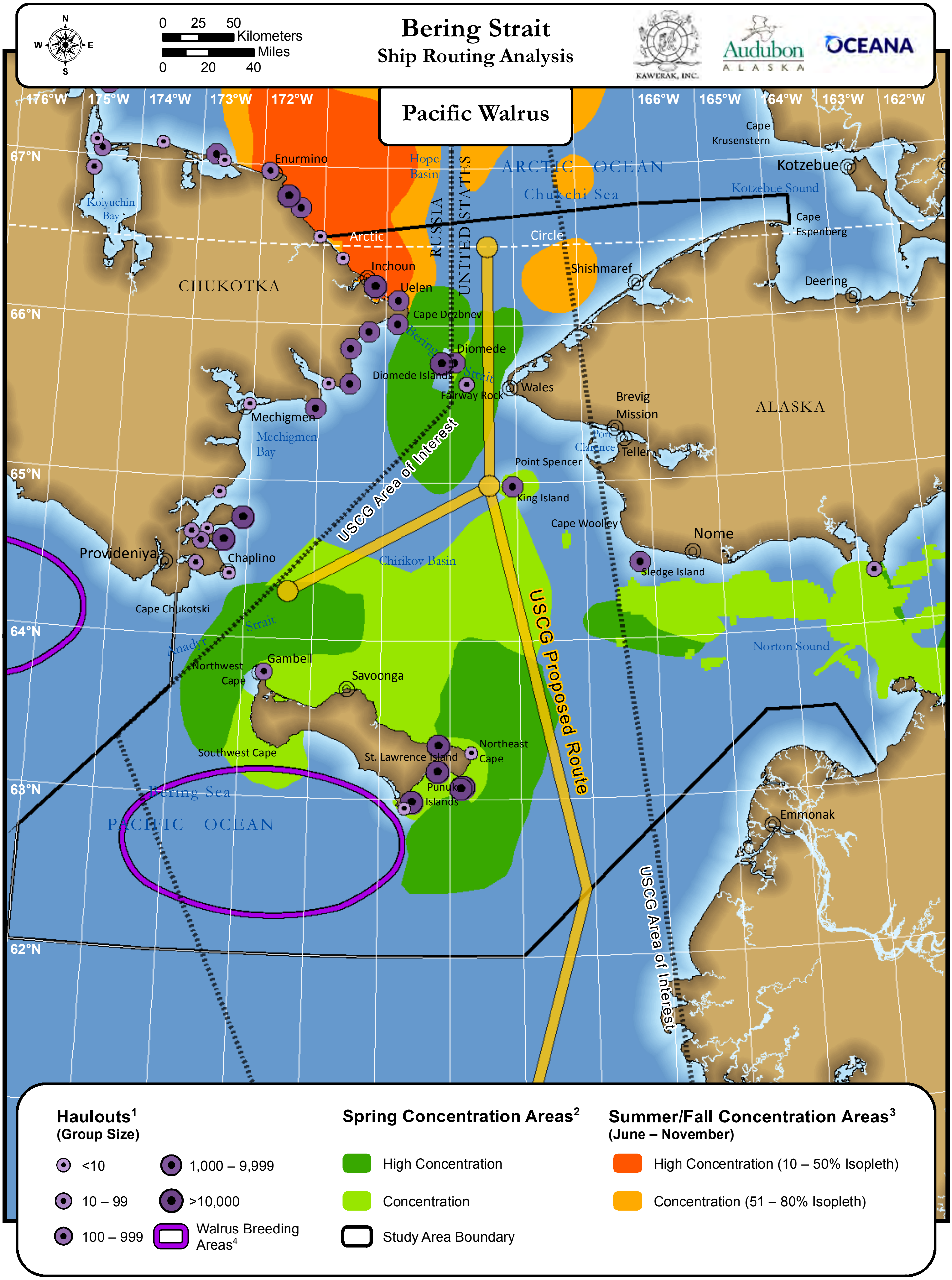
Data provided by: (1) Audubon Alaska 2014b, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (2) BirdLife International 2014. (3) World Seabird Union 2011. (4) Audubon Alaska 2014c, based on data from: (a) Drew and Piatt 2013. (b) Walker and Smith 2014b. Map last updated: 5/27/2015. Map created by Audubon Alaska.



Data provided by: (1) Audubon Alaska 2014b, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (2) BirdLife International 2014. (3) World Seabird Union 2011. (4) Audubon Alaska 2014c, based on data from: (a) Drew and Piatt 2013. (b) Walker and Smith 2014b. Map last updated: 5/27/2015. Map created by Audubon Alaska.

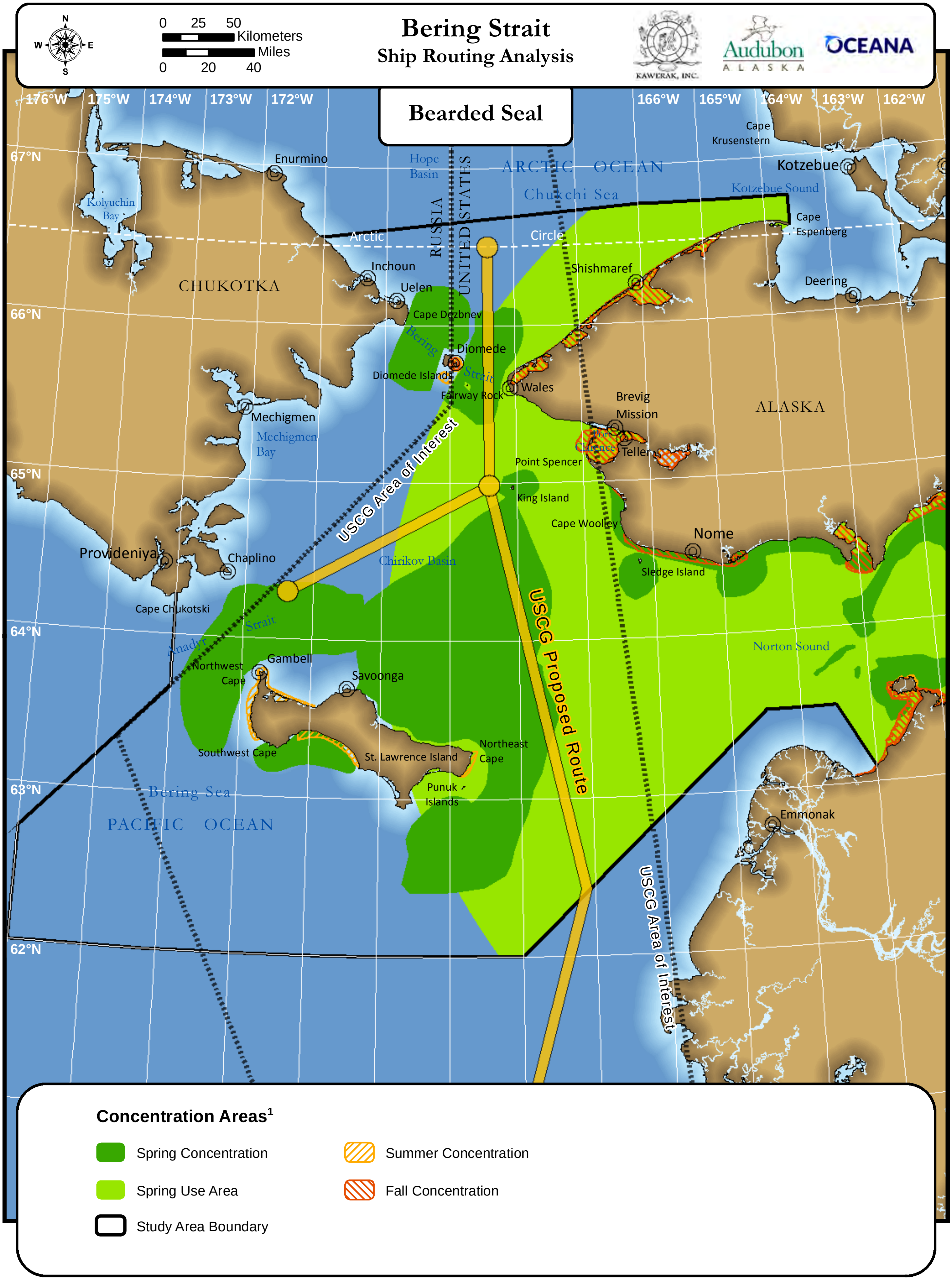


Data provided by: (1) Audubon Alaska 2014b, based on methods in: (a) Smith et al. 2014b. (b) Smith et al. 2014a. (2) BirdLife International 2014. (3) World Seabird Union 2011. (4) Audubon Alaska 2014c, based on data from: (a) Drew and Piatt 2013. (b) Walker and Smith 2014b. Map last updated: 5/27/2015. Map created by Audubon Alaska.



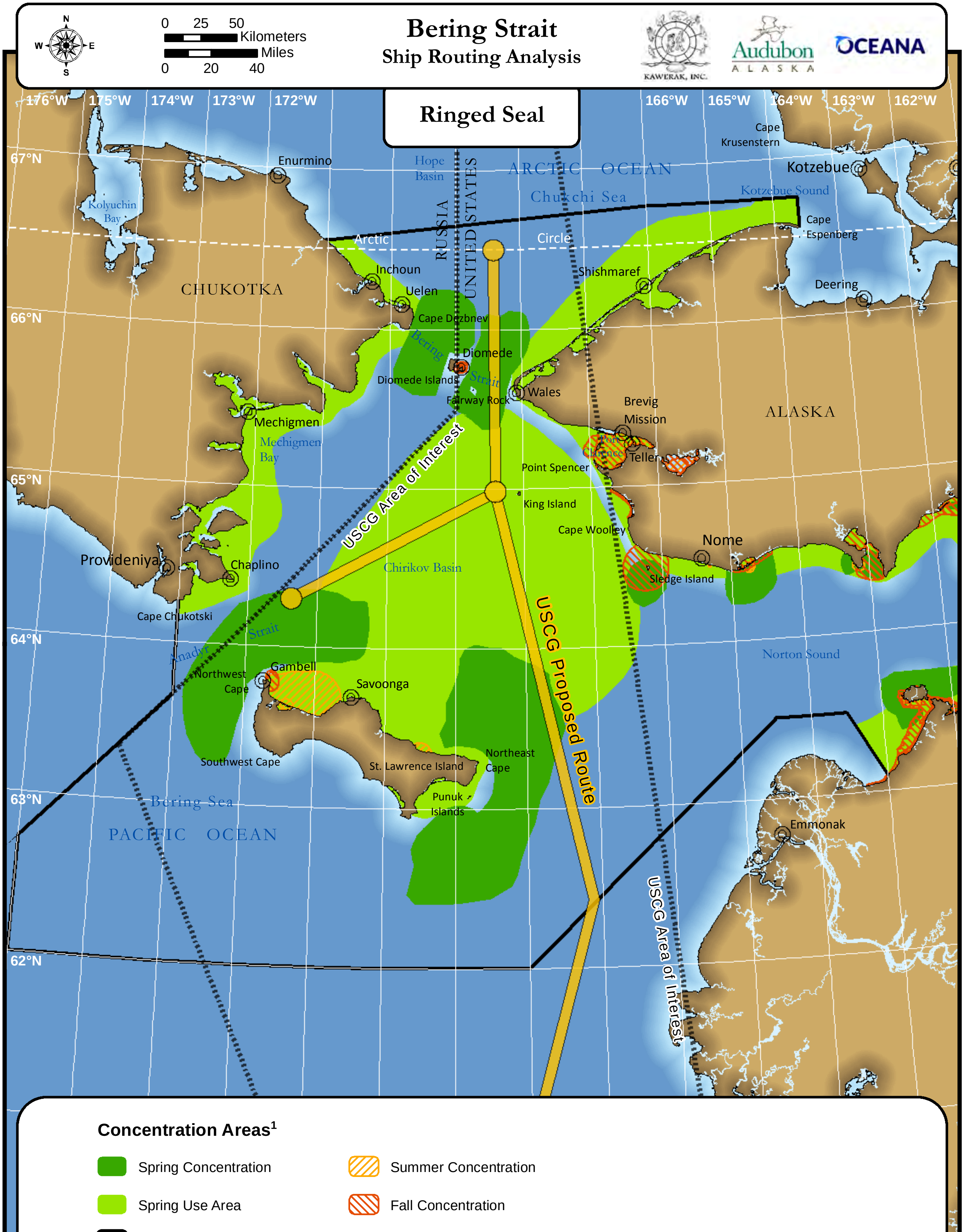
Data provided by: (1) Robards et al. 2007. (2) Oceana and Kawerak 2014. (3) Jay et al. 2012. (4) USFWS 2002. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Map 28



Data provided by: (1) Oceana and Kawerak 2014. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Map 29



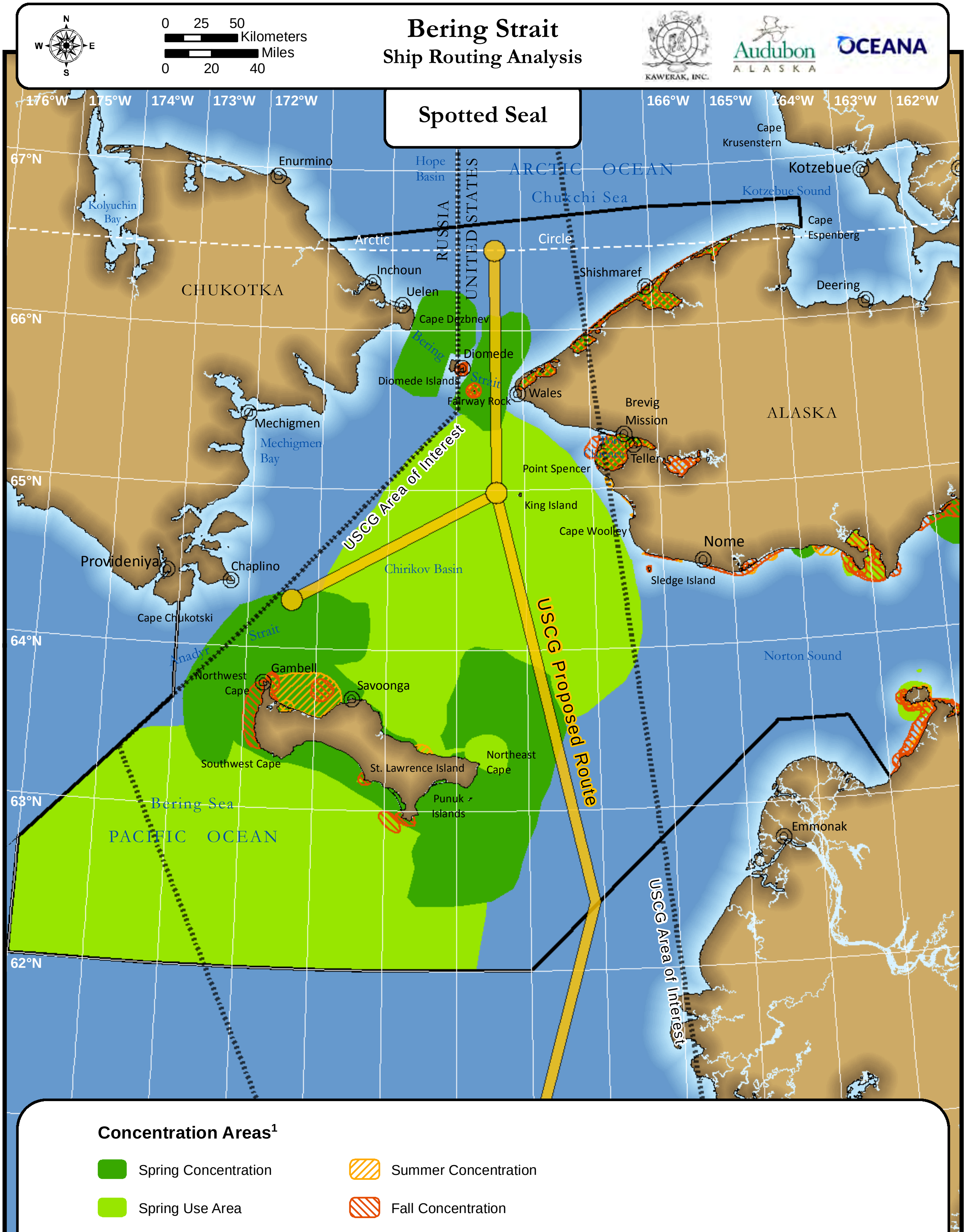
Concentration Areas[1]

- Spring Concentration
- Spring Use Area
- Study Area Boundary
- Summer Concentration
- Fall Concentration

Data provided by: (1) Oceana and Kawerak 2014. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Map 30

Bering Strait
Ship Routing Analysis



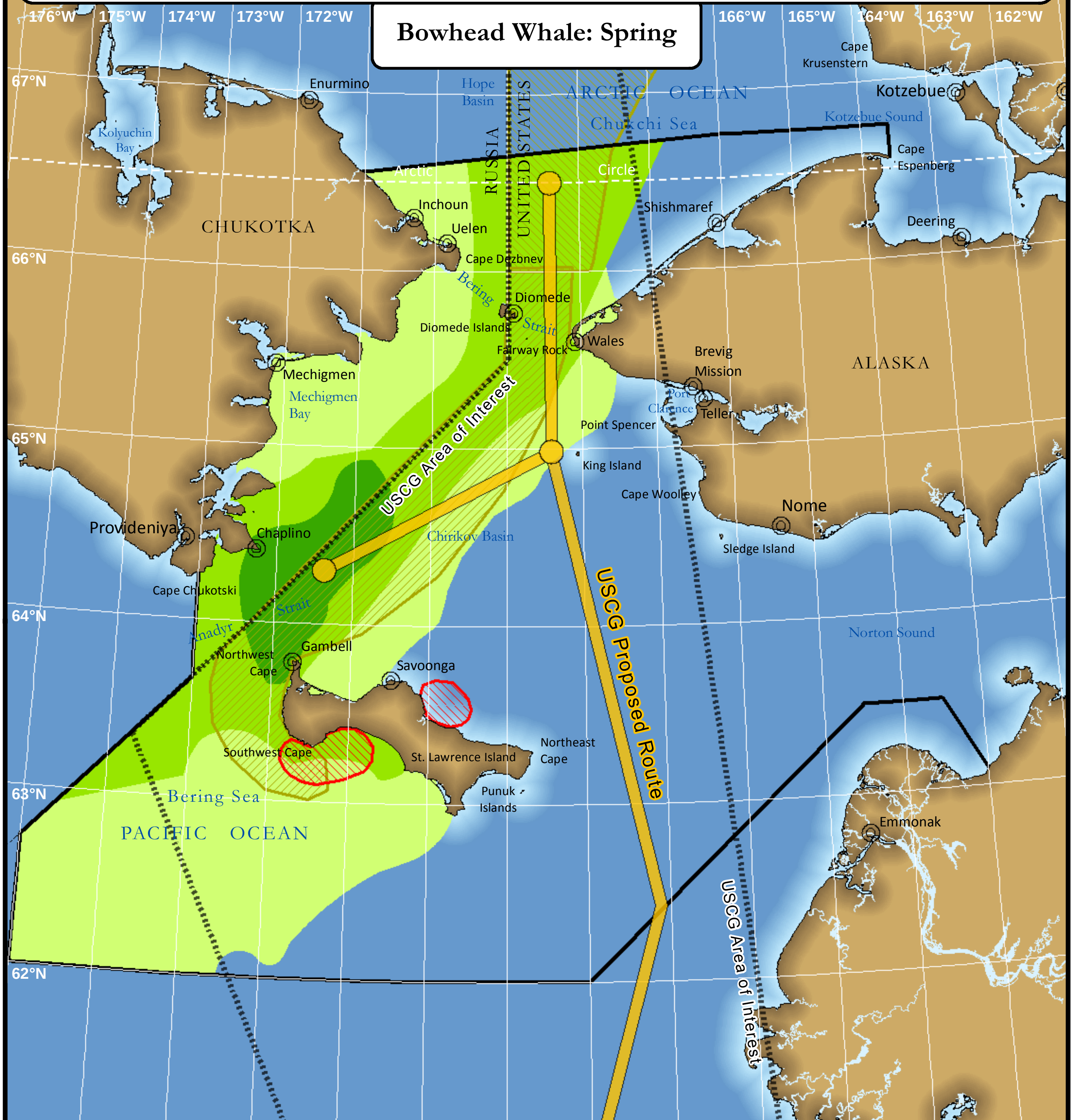
Concentration Areas[1]

- Spring Concentration
- Spring Use Area
- Study Area Boundary
- Summer Concentration
- Fall Concentration

Data provided by: (1) Oceana and Kawerak 2014. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Bering Strait
Ship Routing Analysis

Bowhead Whale: Spring



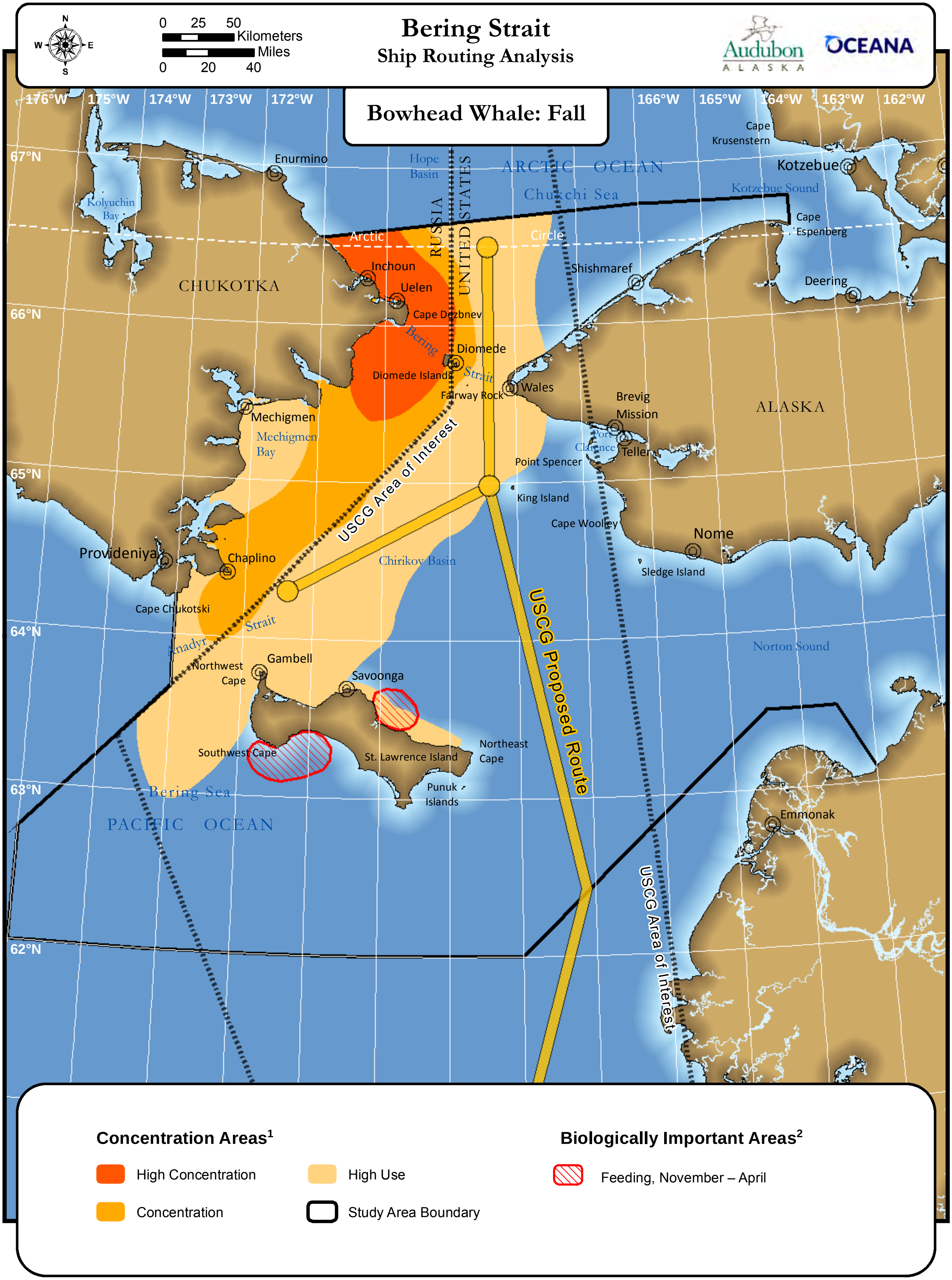
Concentration Areas[1]

- High Concentration
- Concentration
- High Use
- Study Area Boundary

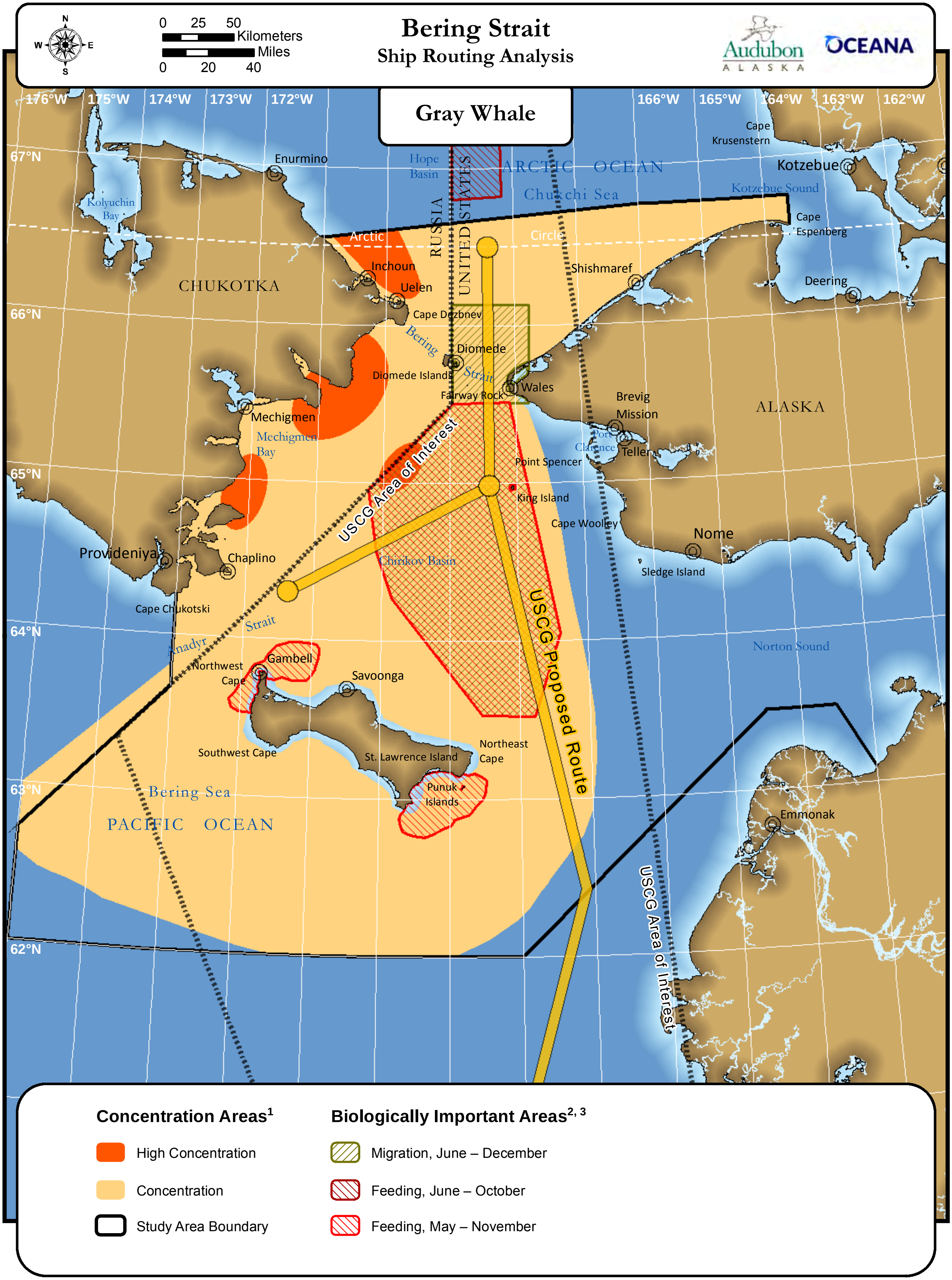
Biologically Important Areas[2, 3]

- Feeding, November – April
- Migration, April – May
- Migration, March – June

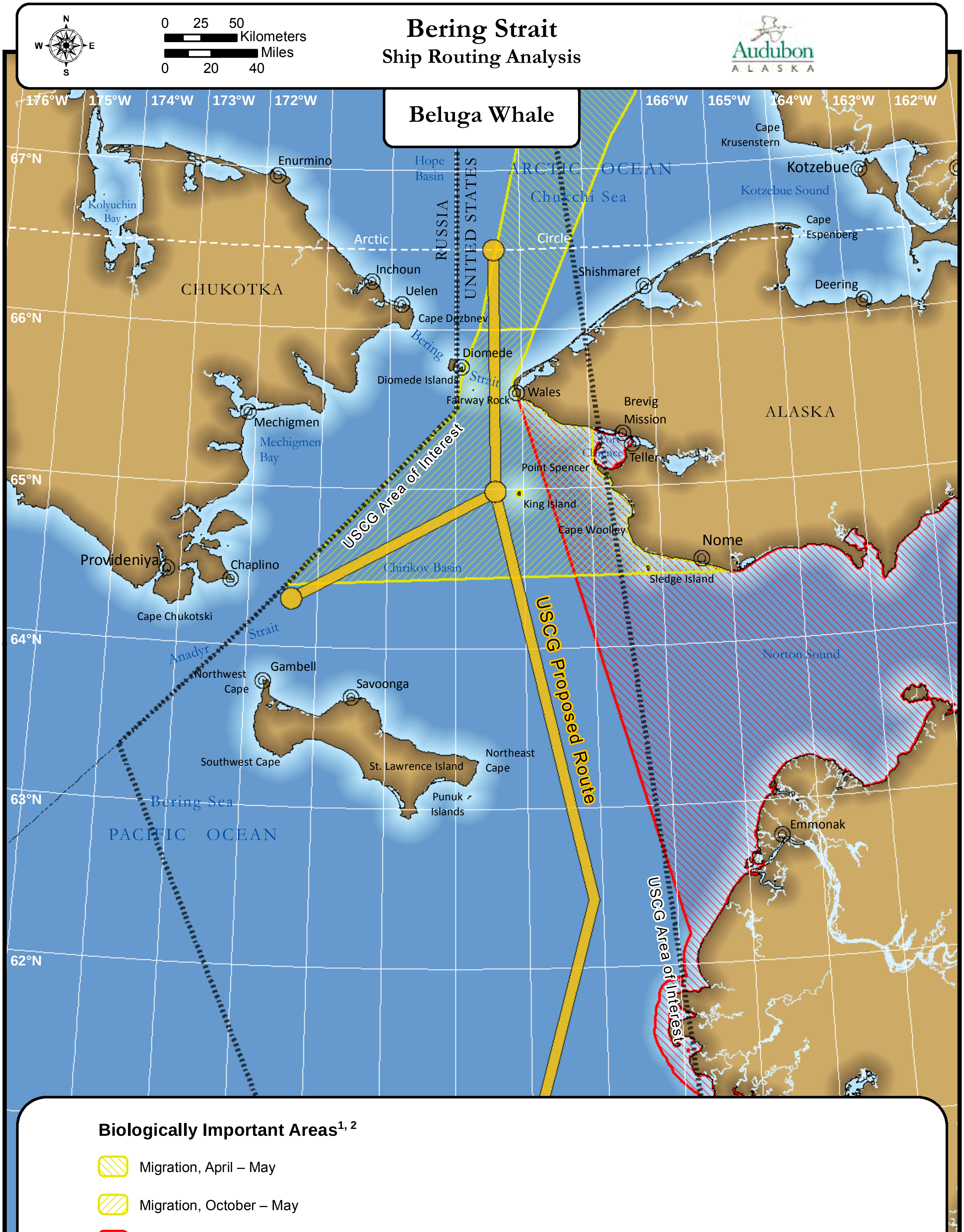
Data provided by: (1) Oceana and Kawerak 2014, based on data from: (a) Noongwook et al. 2007; (b) Citta et al. 2012; (c) Quakenbush et al. 2013. (2) Clarke et al. 2015a. (3) Clarke et al. 2015b. Map last updated: 6/2/2015. Map created by Audubon Alaska.



Data provided by: (1) Oceana and Kawerak 2014, based on data from: (a) Noongwook et al. 2007; (b) Citta et al. 2012; (c) Quakenbush et al. 2013. (2) Clarke et al. 2015a. Map last updated: 6/2/2015. Map created by Audubon Alaska.



Data provided by: (1) Oceana and Kawerak 2014. (2) Clarke et al. 2015a. (3) Clarke et al. 2015b. Map last updated: 6/2/2015. Map created by Audubon Alaska.



Biologically Important Areas[1, 2]

- Migration, April – May
- Migration, October – May
- Feeding, May – November

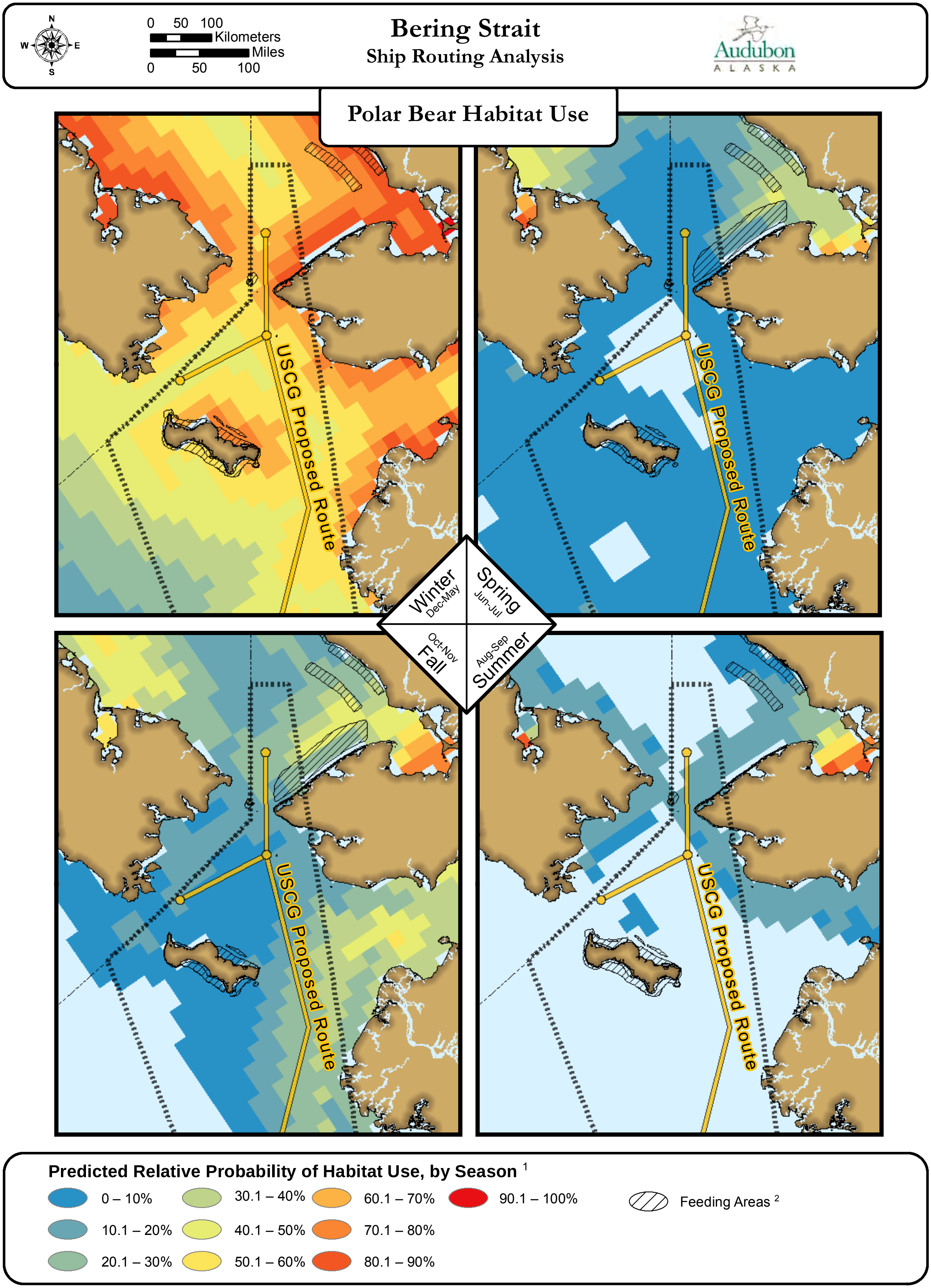
Data provided by: (1) Clarke et al. 2015a. (2) Clarke et al. 2015b. Map last updated: 5/26/2015. Map created by Audubon Alaska.

Map 35

Bering Strait
Ship Routing Analysis

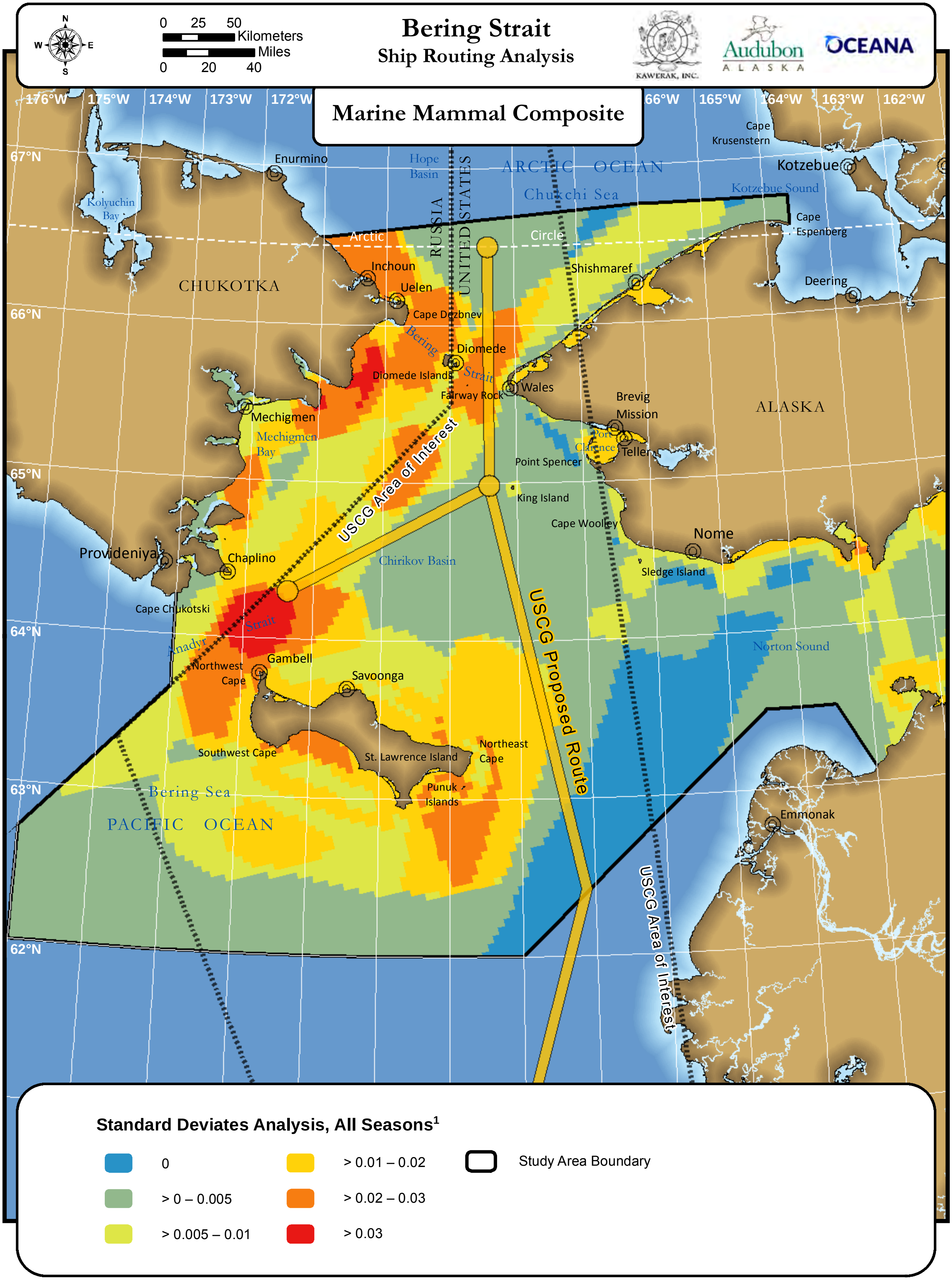
Audubon ALASKA

Polar Bear Habitat Use

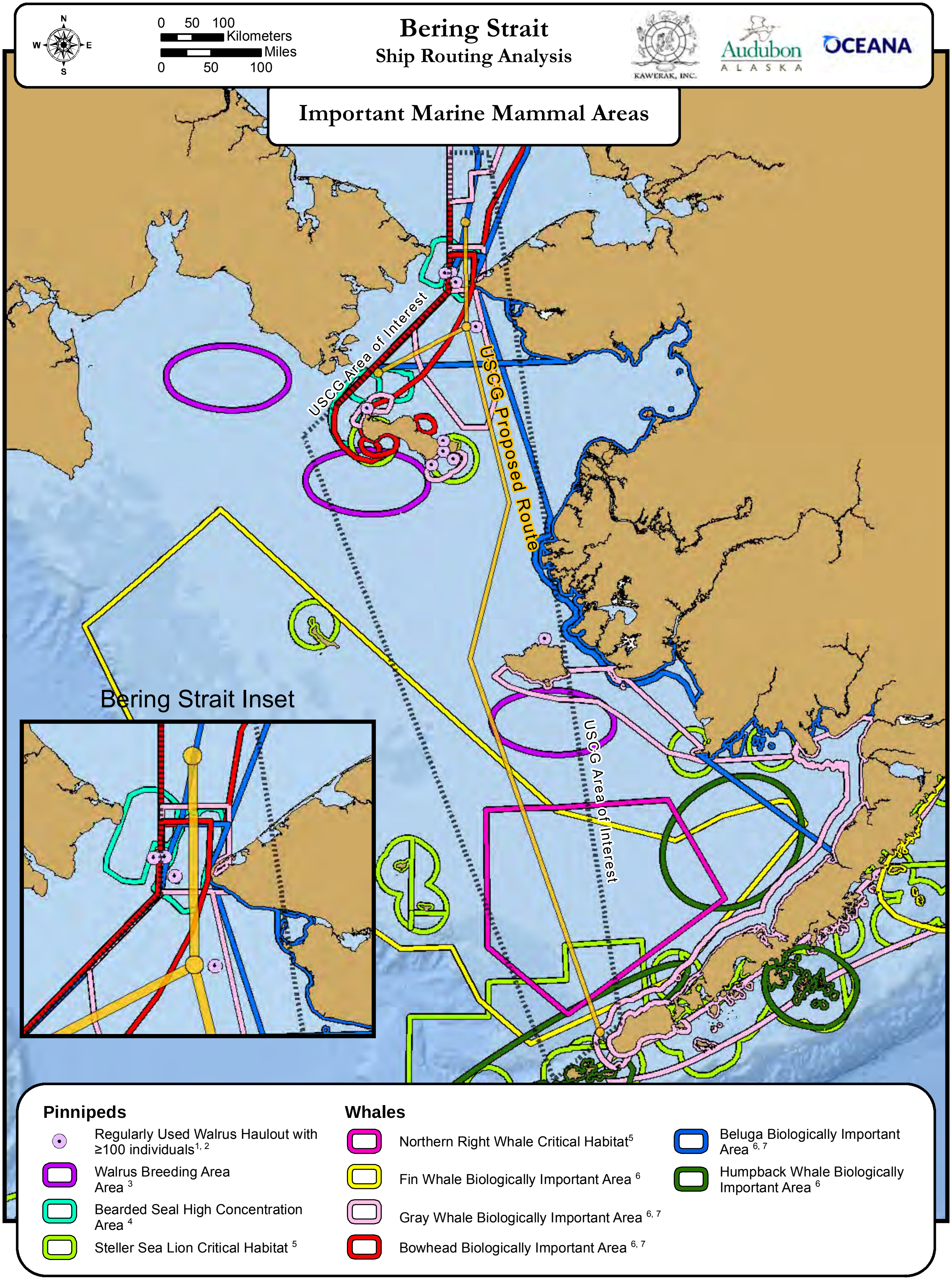


Data provided by: (1) Audubon Alaska 2014, based on data from: (a) Durner et al. 2009. (2) Kalxdorff 1997. Map last updated: 5/27/2015. Map created by Audubon Alaska.

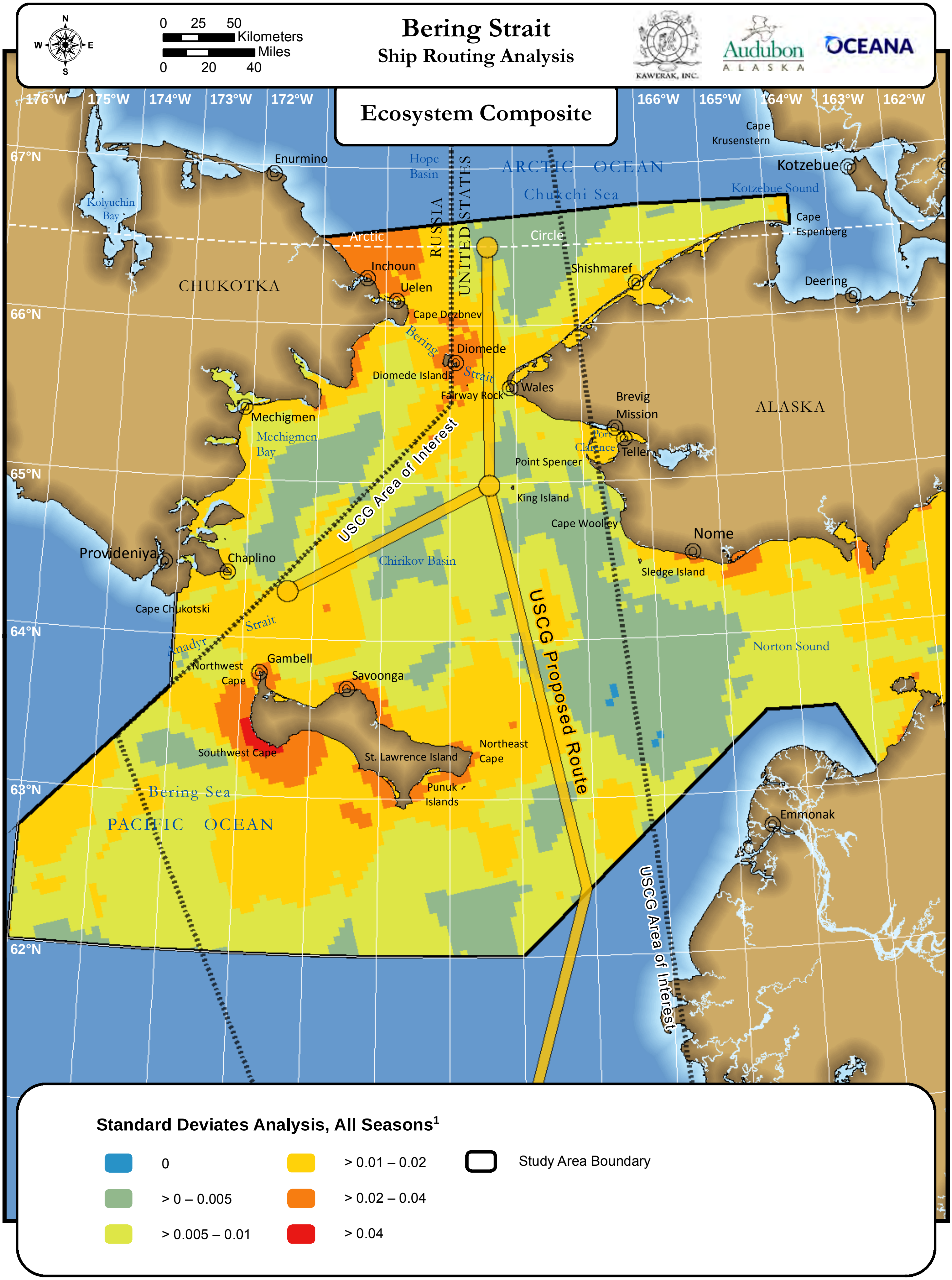
Map 36



Data provided by: (1) Oceana and Kawerak 2014. Map last updated: 6/2/2015. Map created by Audubon Alaska.



Data provided by: (1) Robards et al. 2007. (2) NOAA 1988. (3) USFWS 2002. (4) Oceana and Kawerak 2014 (5) NOAA Fisheries 2014. (6) Clarke et al. 2015a. (7) Clarke et al. 2015b. Map last updated: 6/2/2015. Map created by Audubon Alaska.



Data provided by: (1) Oceana and Kawerak 2014. Map last updated: 6/2/2015. Map created by Audubon Alaska.

APPENDIX B

SUPPORTING SCIENTIFIC INFORMATION FOR RECOMMENDATIONS

The associated maps in Appendix A draw on a thorough examination of the ecological and human use patterns of the region, including a literature and data review, mapping of local and traditional knowledge of wildlife patterns, mapping subsistence use areas, analysis of areas important to birds, and collecting datasets for important marine mammal areas. Many of our maps focus on known concentration areas for species that rely on the Bering Strait Region for their livelihood and for which there was adequate data to be considered for decision-making purposes. Other maps include information relevant to the PARS such as shipping patterns, sea ice, or bathymetry. We strived to make our work objective and transparent. The sources for each data layer are identified on maps and in our comments to link the reader back to the original source information.

Some of the information in this letter's appendices is drawn from the Bering Strait Marine Life and Subsistence Use Data Synthesis which was the product of collaboration between Oceana and Kawerak to better document and map the marine ecosystem of the Bering Strait region. The synthesis gathered much of the available studies, data, and information on subsistence, marine mammals, seabirds, fish, zooplankton, seafloor life, primary production, and sea ice for the region. Kawerak also shared documented local and traditional knowledge of their region's people on ice seals and walrus, hunting areas for those species, and sea ice that was incorporated into the synthesis. That synthesis includes seasonal maps and written information for different species and species groups, as well as analyses conducted by Oceana to identify areas of higher abundance for species groups and the ecosystem.

A number of maps are drawn from Audubon's multi-year effort to identify globally significant coastal and marine Important Bird Areas through spatial analysis of at-sea and aerial survey data. And yet others are based on Biologically Important Areas identified by NOAA, or agency-designated critical habitat for birds and marine mammals.

Omission from our maps did not necessarily indicate that an area was considered unimportant; additional data collection and analysis could reveal ecological patterns that were not apparent in our effort. There are many data gaps in the scientific understanding of the Bering Strait Region; for example, consistent aerial surveys for cetaceans have not occurred in the region since the early 1980s.

Note: This appendix cites information collected by Kawerak from traditional ecological knowledge-holders in the Bering Strait Region. We recognize that our approach to the PARS may not be the same that the traditional ecological knowledge holders would take. We respect their concerns for the region. Thank you to Kawerak and the traditional ecological knowledge holders for allowing us to utilize their information toward the goal of protecting the Bering Strait from impacts of increasing anthropogenic activity.

More detailed information for the mapped species/resources of concern is described in the following sections.

1. Bowhead Whale

The bowhead whale (*Balaena mysticetus*) population that uses the USCG Area of Interest 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 their summertime foraging grounds. In the fall (October through December) they migrate back to the Bering Sea (Moore and Reeves 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. Within the Bering and southern Chukchi Sea, their spring migration route generally travels from the region south and southwest of Saint Lawrence Island to the area off of Point Hope. The route passes on the western side of Saint Lawrence Island and up through the Bering Strait with most whales passing to the east of Little Diomede Island (Quakenbush et al. 2013, Clarke et al. 2015, Ferguson et al. 2015). From off of Point Hope the route travels along the shear zone between the shorefast and pack ice along the Alaska coast to Point Barrow where whales follow offshore leads across the Beaufort Sea (Quakenbush et al. 2013). 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 feeding areas along the Russian coastline and then eventually toward the Bering Strait and St. Lawrence Island (Quakenbush et al. 2013, Citta et al. 2014a). During the fall migration to wintering grounds most but not all bowhead whales pass through the Bering Strait on the Russian side (Citta et al. 2012). 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 described and mapped areas of concern for bowhead whales are based on the following scientific source materials:

- **Spring migration corridor from south and southwest of Saint Lawrence Island through the eastern side of the Bering Strait to off of Point Hope.**
    - Spring migration routes for bowhead whales through this region are known from satellite tagging data.
        - Figure 5 in Citta et al. (2012) found on page 22 depicts the tracks of 14 satellite tagged bowhead whales transiting during spring from the Bering Sea

through the Bering Strait and moving towards Point Hope. Most of the whales passed through the straight during April.

    - Figure 19 in Quakenbush et al. (2013) found on page 28 depicts the tracks of the same 14 satellite tagged whales transiting from the Bering Strait to Point Hope and continuing along the Alaska coast through the Chukchi Sea.

  - Spring migration routes for bowhead whales around Saint Lawrence Island are known from documented local and traditional ecological knowledge published by Noongwook et al. (2007).
    - Figure 3 on page 50 depicts migrations paths around the island at different times of year. The authors describe the different spring migration routes "*In spring, bowhead whales follow two paths past St. Lawrence Island (Fig. 3). One path goes westward past Kiyalighaq (Southeast Cape), remains offshore of Pugughileq (Southwest Cape), and then is seen again at Gambell (Northwest Cape) heading to the northeast. The other path comes near land to the east of Pugughileq, follows the coast past Southwest Cape, but then turns offshore in a northwestward direction towards the coast of Chukotka.*"
  - Recent synthesis studies have also helped document the spring migration corridor for bowhead whales.
    - Figure 7.2 in Ferguson et al. (2015) on page 81 and Figure 8.3 in Clarke et al. (2015) on page 98 depict a biologically important migration area for bowhead whales through the U.S. portion of the Bering Strait region (studies included only U.S. EEZ areas).
    - Map 4.18 in Oceana and Kawerak (2014) shows the spring migration corridor depicted as use and concentration areas.

- **The Anadyr Strait is a winter and spring core use area for bowhead whales that is likely an important feeding area.**
  - Citta et al. (2014b) Figure 2 on page 5 depicts the location of the Anadyr Strait core use area based on satellite telemetry, and Figure 9a on page 12 depicts when satellite tagged bowhead whales used the area. The authors also provide considerable evidence that the Anadyr Strait core use area is likely an important feeding area.
  - Noongwook et al. (2007) documented the knowledge of hunters on Saint Lawrence Island who regularly see whales gathering in this area in May and June (see Figure 3 on page 50 and text on page 51).

- **On the north and south sides of Saint Lawrence Island there are important feeding areas for Bowhead whales between November and April.**
  - Noongwook et al. (2007) documented the knowledge of hunters from Savoonga who regularly see whales in spring lingering near Pugughileq where they are feeding and mating.
  - Noongwook et al. (2007) also documented hunters knowledge that whales will feed along the north coast of Saint Lawrence Island off of the shorefast sea ice in early winter.
  - Figure 7.1 in Ferguson et al. (2015) on page 81 shows the location of feeding Important Biological Areas for bowhead whales between November and April along the north and south side of Saint Lawrence Island, which the authors note, on page 81 as well, is supported by evidence from local and traditional ecological knowledge, stomach contents analysis, and satellite tagging data.

2. North Pacific Right Whale

The eastern population of the North Pacific right whale uses the USCG Area of Interest, especially the portion of the area of interest that lies in the southern Bering Sea. The eastern population is listed as “endangered” under the Endangered Species Act (73 FR 12024, 06 March 2008) and may be the most endangered stock of large whales in the world with a population estimate of about 30 whales (Allen and Angliss 2014). Whaling records show that prior to the decimation of the stock by whaling, the North Pacific right whale had an extensive offshore distribution across the North Pacific Ocean and Bering Sea with evidence of north-south seasonal movements (Clapham et al. 2004). Information about the species current distribution and seasonal movement patterns is limited given the low population size and lack of research on the species. Although there is limited information the available sighting and acoustic data is compelling evidence that the majority of whales remaining in the population utilize the southern Bering Sea, which was the impetus for the area being designated as critical habitat (Clapham et al. 2006, Wade et al. 2011, Allen and Angliss 2014). Utilization of the area appears to be highest in summer and fall, but whales have been detected in the southern Bering Sea critical habitat area in all seasons (Ferguson et al. 2015). Given the very small population size of the North Pacific right whale the incidental loss of even one whale from human activities (e.g., ship strike) could drive the species to extinction (Allen and Angliss 2014).

- **The designated Critical Habitat Area in the southern Bering Sea under the Endangered Species Act is an important area for eastern population of North Pacific right whales.**
  - As described in the text on page 212 of Allen and Angliss (2014), the majority of eastern population North Pacific right whales that have been spotted within the critical habitat area.

- Of the North Pacific right whales that have been sighted within the critical habitat area many of them have been re-sighted within the area, which indicates regular use of the area (Clapham et al. 2006, Wade et al. 2011).
- Figure 7.6 of on page 89 of Ferguson et al. (2015) shows the critical habitat area for the eastern population of North Pacific right whales, which the authors identify as a feeding Biologically Important Area. The text on page 88-89 describes evidence for feeding, including the high abundance of the right whale's copepod prey within the region.
- Clapham et al. (2012) recently published a report on a multi-year study of the eastern population of North Pacific right whale's use of the southeastern Bering Sea.
  - They summarized the use of the southeastern Bering Sea by right whales including their own research in the following text found on page 2. "*There is an increasing body of evidence suggesting that the SEBS middle shelf constitutes the primary habitat of NPRWs in the SEBS during the summer. Acoustic surveys (Munger et al., 2008; Mellinger et al., 2009; Stafford et al., 2010) have shown that the only region in the Bering Sea where NPRWs have been consistently seen is the middle shelf (LeDuc et al., 2001; Shelden et al., 2005). Occasional sightings and acoustic detections have been observed in other areas (e.g. near the Pribilof Islands, National Marine Mammal Laboratory, unpublished data), but these occurrences appear rarer. This study is consistent with the existing information on NPRW occurrence in the SEBS, and underscores the theory that whales spend extended periods of time in the region.*"
  - Figure 4 on page 10 shows the historical sightings of North Pacific right whales along with survey effort and sightings in 2009 with numerous sightings within the critical habitat area.
  - Figure 15 on page 25 shows aerial and vessel based survey sightings of North Pacific right whales, with sightings general occurring in the eastern portion of critical habitat.
  - Figure 18 on page 30 shows tracks of four satellite tagged whales. These data provide strong evidence that whales are utilizing the critical habitat area and not just transiting through the area.
  - Figure 24 on page 37 shows sonobuoy detections of right whales, which primarily occurred within the critical habitat area. This is yet another measure that demonstrates strong evidence for the use of the southeastern Bering Sea by right whales.

- The authors summarized their results on right whales on page 57-58 with the following. "*The results of this study show that whales monitored via satellite telemetry remained inside the NPRW Critical Habitat in the Bering Sea (Figures 18-19). This has provided additional evidence that the Critical Habitat encompasses an important range of the population during their feeding season. Analysis of sonobuoy recordings from the 2008-2011 summer field surveys revealed a high site fidelity in the northeastern portion of the Critical Habitat as well (Figures 29-30). Furthermore, long-term recorders located throughout the BS shelf not only confirm this northeastern site fidelity within the Critical Habitat, but have expanded seasonal presence to encompass the months of July through January.*"
- The authors conclude with the following on page 58 in their discussion of their study results on right whales. "*Finally, the continued loss of sea ice in the Arctic brings with it the certainty that shipping through the Northwest Passage and Northern Sea Route will increase dramatically in future years. The potential for impact on right whales in the Bering Sea through increased noise and collision risk cannot be overestimated.*"

3. GRAY WHALE

The gray whales (*Eschrichtius robustus*) found within the USCG Area of Interest 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. Grey whales are generalist feeders and employ a few feeding methods, including benthic foraging, surface skimming, and engulfing prey. Their primary foraging is believed to be 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 typically occupy shallow coastal areas. Most of the stock summers in the Chukchi Sea and northern and western Bering Sea with important concentration areas within the Coast Guard area of interest.

- **The Chirikov Basin is an important feeding area for gray whales.**
    - While there have been decadal shifts in the size of the feeding area in the Chirikov Basin, the region has remained important for gray whales (Moore et al. 2003, Ferguson et al. 2015). Recent evidence suggest that gray whales may once again be utilizing a broader area in the Chirikov Basin for feeding (Ferguson et al. 2015).

- Oceana and Kawerak (2014) described the location and fluctuations in the feeding area on page 196 and showed the location of concentrated gray whale feeding documented in 2002 in Map 4.24. "*Surveys in the 1980s clearly documented a broad concentration area for gray whales covering much of the Chirikov Basin,*[9, 13, 96] *which is the general area between the Bering Strait and Saint Lawrence Island. During that time period, benthic surveys documented an exceptionally high biomass of gray whale's preferred prey in the region, amphipods, which mirrored the distribution of gray whales in the basin.*[13, 90] *However, repeated surveys over a decade later documented that the gray whale concentration area and high density forage area had both contracted.*[13, 91] *The generalized area of the contracted concentration area is presented in the map and used in the analyses, but given the ongoing changes occurring in the region*[90] *and limited surveying that documented the contraction, this area may no longer be accurate.*"
- A recent synthesis of Biologically Important Areas for cetaceans by Ferguson et al. (2015) show the Chirikov Basin feeding Biologically Important Area in Figure 7.4.(a) on page 86 and describe the location and fluctuations in the following text from page 84-85. "*Within the Aleutian Islands and Bering Sea region, feeding gray whales were found in high densities in the Chirikov Basin and along the northwest and southeast coasts of St. Lawrence Island during aerial surveys conducted in October and November 1980, May through August 1981, and July 1982 through 1985 (Moore et al., 1986, 2003; Figure 7.4; Table S7.4). However, in July 2002, similar aerial surveys detected a 3- to 17-fold decrease in gray whale sighting rates in the Chirikov Basin (Moore et al., 2003). Concurrently, from the 1980s to the early 2000s, ampeliscid amphipod biomass declined by 60 to 90% in the Chirikov Basin (this species is thought to be an important gray whale prey resource) (Moore et al., 2003; Grebmeier et al., 2006; Coyle et al., 2007). These amphipod declines were mainly due to the absence of larger age classes based on changes in measured amphipod length (Coyle et al., 2007).*" … "*The sighting of a large aggregation of gray whales during cetacean line-transect shipboard surveys in the northeastern Bering Sea in September 2014 provides evidence that the Chirikov Basin remains an important feeding area for this species. Specifically, on one day, visual observers confirmed 31 sightings of 50 total gray whales and detected an additional 18 sightings of 19 total large whales that could not be identified to species but were most likely gray whales (NMML, unpub. data, 20 September 2014). The Chirikov Basin and the northwestern and southeastern coasts of St. Lawrence Island are considered BIAs for gray whale feeding, given the high regional densities, which occurred from May through November (Moore et al., 2003; NMML, unpub. data, 20 September 2014). Boundaries for these BIAs were based on the extent of gray whale sightings shown in*

Moore et al. (2003) and encompass the sightings made by shipboard observers in 2014 (NMML, unpub. data, 20 September 2014)."

- Moore et al. (2003) reported on the contraction of gray whale use of Chirikov Basin between the early 1980s and 2002.
  - Figures 2 and 3 on page 738 show sightings and sighting rates of grey whales in the Chirikov Basin and around Saint Lawrence Island from aerial surveys in the early 1980s. Gray whales were very abundant throughout much of the U.S. portion of the Chirikov Basin.
  - Figure 5 on page 740 shows sightings of grey whales during aerial surveys over a few days in 2002. The densities of grey whales in the Chirikov Basin were concentrated, based on survey effort, along the International Date Line in a relatively small area. For minimal survey effort a fair number of gray whales were still seen on the east and west sides of Saint Lawrence Island.
  - Their findings were summarized in their abstract: "*In the 1980s, the Chirikov Basin was considered a prime gray whale feeding area, but there has been no recent comprehensive assessment of whale or prey distribution and abundance. In 2002, a 5-day survey for gray whales revealed restricted distribution in the basin and a 3- to 17-fold decline in sighting rates. To put these data in context, a retrospective summary of gray whale and benthic fauna distribution and abundance was undertaken. During the 1980s, gray whale sighting rates in the Chirikov Basin were highly variable. Ampeliscid amphipods dominated the benthos where gray whale sighting rates were highest. Available measures of biomass suggest a downturn in amphipod productivity from 1983 to 2000, when estimates of gray whale population size were increasing, suggesting that the whales simply expanded their foraging range.*"

- **The east and west sides of Saint Lawrence Island are important feeding areas for gray whales.**
  - Gray whales were sighted in relatively high abundances on the east and west sides of Saint Lawrence Island during aerial survey in the early 1980s and 2002 (Moore et al. 2006, Ferguson et al. 2015). See the referenced figures, text, and information from Moore et al. (2003) and Ferguson et al. (2015) in the previous section.

- **Unimak Pass, the south coast of Nunivak Island, the Chirikov Basin, and the Bering Strait are important migration corridor areas for gray whales in the USCG Area of Interest.**

- A recent synthesis of Biologically Important Areas for cetaceans by Ferguson et al. (2015) identifies these areas as important for the gray whale migration. Figure 7.5 on page 87 shows a map of the migration Biologically Important Areas for gray whales and the text on page 85-87 describes the information used to identify these areas, which includes aerial, vessel, and shore based surveys and sightings. This information is summarized with the following text from page 87. "*Due to the lack of information regarding exact migration routes that gray whales follow throughout the region, delineation of gray whale migratory corridor BIAs was limited to the following three areas: (1) the northbound (March through June) migration from Unimak Pass to Nunivak Island in the southern Bering Sea (Braham, 1984; Barrett-Lennard et al., 2011; Figure 7.5a; Table S7.5), (2) the geographically constricted northbound migration corridor in the Chirikov Basin and Bering Strait (applicable June through December) (Ljungblad et al., 1985, 1986; Rugh et al., 2001; Moore et al., 2003; Figure 7.5a; Table S7.5), and (3) the southbound migration through Unimak Pass (November through January, to account for the shift in migration timing that occurred around 1980) (Rugh et al., 2001; Figure 7.5b; Table S7.5). The boundaries for the first migratory corridor BIA are similar to the feeding BIA described above, although it extends northward to Nunivak Island. The boundaries for the Chirikov Basin migratory corridor BIA are based on the extent of the gray whale sightings shown in Moore et al. (2003). The boundaries for the southbound migratory corridor were defined to extend 3.7 km from shore, based on the offshore limits of sightings from Rugh (1984).*"

4. Beluga Whale

Four populations of beluga whales (*Delphinapterus leucas*) use the U.S. portion of the Bering Sea (Allen and Angliss 2014). 1) The Beaufort Sea population overwinters in the Bering Sea and migrates through the Bering Strait in the spring. 2) The eastern Chukchi Sea population also overwinters in the Bering Sea and moves through the Bering Strait in spring. 3) The eastern Bering Sea population of Beluga Whales utilizes the Norton Sound region, including the mouth of the Yukon River, during summer (Frost and Lowry 1990, Lowry et al. 1999, Oceana and Kawerak 2014, Ferguson et al. 2015). 4) The Bristol Bay population primarily utilizes the Bristol Bay area (ABWC 2012, Allen and Angliss 2014). Based on very limited unpublished satellite tagging information, some whales from the eastern Bering Sea population may overwinter in the marginal pack ice within the USCG Area of Interest (ABWC 2013). During the summer this population is primarily within Norton Sound and outside the area of interest. The Beaufort Sea and eastern Chukchi Sea populations both migrate through the Bering Strait to reach summer foraging grounds (Allen and Angliss 2014).

- **The Bering Strait is an important migratory corridor for beluga whales.**
  - A recent synthesis of Biologically Important Areas for cetaceans by Ferguson et al. (2015) identifies the Bering Strait as a migration Biologically Important Area for beluga whales. Figure 7.9 on page 92 shows this Biologically Important Area. The authors summarize the information supporting their identification on page 92. "*Bering Strait is a narrow passageway (82 km wide at its narrowest point) that all cetaceans migrating between the Bering Sea and northern latitudes of the Chukchi Sea, Beaufort Sea, and Arctic Ocean must transit twice yearly. Belugas begin migrating northward through Bering Strait in March or April and continue into May, based on aerial surveys (Moore et al., 1993), opportunistic sightings, and traditional ecological knowledge (Seaman et al., 1985). Belugas occur in the area in June, July, and August, although most of the Eastern Beaufort Sea and Eastern Chukchi Sea Stocks have migrated to more northerly waters by June (Seaman et al., 1985; Clarke et al., 2015). Coastal residents of Bering Strait have reported belugas migrating south in advance of sea ice in October, with sightings peaking in November and December and continuing into midwinter (Seaman et al., 1985). Satellite-tagging data show belugas from both the Eastern Chukchi Sea and Eastern Beaufort Sea Stocks migrating southward through the area in November (Richard et al., 2001; Suydam et al., 2005; Hauser et al., 2014). Belugas from the Eastern Beaufort Sea Stock appear to cross on the western side of the Strait, whereas the Eastern Chukchi Sea Stock crosses on the eastern side, although sample sizes are small (Citta et al., 2013; Hauser et al., 2014). Belugas have been sighted in the area from January through April (Seaman et al., 1985).*"

5. Humpback Whale

Two populations of humpback whales (*Megaptera novaeangliae*), the western North Pacific stock and the central North Pacific (Hawaii) stock, use the area of the PARS study (Allen and Angliss 2013). The western North Pacific stock winters off of Asia and summers in feeding areas the along the Russian coast, northern North Pacific, Aleutian Islands, Bering Sea, and southern Chukchi Sea. The central North Pacific stock winters in the Hawaiian Islands and summers in feeding areas in Alaska coastal waters from the central Aleutians to Southeast Alaska. Humpback whales are listed as endangered under the Endangered Species Act. The National Marine Fisheries Service (NMFS) is currently proposing to divide the globally listed endangered species into 14 distinct population segments (DPSs), remove the current species-level listing, and in its place list 2 DPSs as endangered and 2 DPSs as threatened (Department of Commerce 2015). If NMFS moves forward with this action, the western North Pacific stock will be listed as threatened under the Endangered Species Act while the central North Pacific stock whales will no longer be listed under the act.

The described and mapped areas of concern for humpback whales are based on the following scientific source materials:

- **From June through September high densities of humpback whales are seen in the eastern Aleutian Islands and along the northern side of the Alaska Peninsula.**
  - Summer feeding Biologically Important Areas for humpback whales were delineated in a recent synthesis for cetaceans in the Aleutian Islands and Bering Sea (Ferguson et al. 2015).
    - Figure 7.7 on page 90 delineates the boundaries of the feeding Biologically Important Area substantiated through satellite-tagging data, aerial and vessel based surveys, acoustic recordings, and photo identification.
    - The text on page 89 describes the high density feeding area. "*Since at least the early 1900s, large aggregations of feeding humpback whales have been seen along the northern side of the eastern Aleutian Islands and Alaska Peninsula, where they were hunted commercially (Reeves et al., 1985). In more recent years, high densities were again seen in these historically high-density areas from June through September during aerial (2008 to 2009) and shipboard (1999 to 2004, 2007 to 2011) visual and acoustic surveys.*"

6. PACIFIC WALRUS

The Pacific walrus (*Odobenus rosmarus divergens*) ranges across the shallow continental shelf waters of the Bering and Chukchi Seas (Smith 2010, Department of the Interior 2013, USFWS Marine Mammals Management 2014). Walrus are among the most important cultural and subsistence resources in the Bering Strait region (Kawerak 2013, Raymond-Yakoubian et al. 2015). Walrus is a mainstay for the continued livelihood of many communities. The body of knowledge on Pacific walrus ecology and biology; however, could not be possible without the traditional ecological knowledge that walrus hunters have shared with governmental agencies, researchers and social scientists.

The entire population of the Pacific walrus overwinters in the Bering Sea at the sea ice edge or in areas of persistent open water, with a portion of the population overwintering in the far western side of the Bering Sea south of St. Lawrence Island, and another portion overwintering on the eastern side closer to Nunivak Island and the mouth of the Kuskokwim River. Winter breeding occurs between January and February, usually in areas of open water that includes recurring polynyas near Nunivak Island, St. Lawrence Island, and the Gulf of Anadyr (Smith 2010, USFWS Marine Mammals Management 2014). As the seasonal Bering Sea ice melts and recedes north, males and females usually segregate. Males use land-based haul out sites and females following the receding ice to the Chukchi Sea. During the summer months, female walrus (and calves) generally 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, USFWS Marine Mammals Management 2014). The primary prey of walrus is benthic invertebrates (Fay 1982, Sheffield and Grebmeier 2009, USFWS 2011); however, other taxa are occasionally consumed.

Walrus distribution is determined by a number of factors. Walrus radio and satellite tagging studies suggest that most areas occupied by walrus are correlated with foraging habitat, and that the most concentrated foraging areas likely correspond with high benthic biomass (Jay et al. 2012). In the Bering Strait region, seasonal movements and distribution are influenced heavily by the movement, quality and type of sea ice (Kawerak 2013, Robards et al. 2013). The dynamic nature of the seasonal sea and the rapidly changing sea ice conditions due to climate change both make predicting concentration areas more difficult (e.g., Robards et al. 2013)

The following source materials describe and document important concentration areas for walrus.

- **Winter concentration area: polynya south of St. Lawrence Island**
    - The Oceana and Kawerak (2014) synthesis of traditional ecological knowledge and western science documents walrus winter habitat. Winter concentration areas for Pacific walrus are located in areas with persistent open water that allows for easy movement. The polynya to the south of St. Lawrence Island provides important winter, foraging habitat. This area associated with walrus activity and movement has been documented by traditional ecological knowledge from Gambell and Savoonga hunters. Walrus distribution in winter depends on the type of sea ice, and where the polynya forms.
        - Winter concentration shown in Map 4.1.
    - Jay et al. (2014) estimated foraging site selection of tagged walruses relative to the benthic infauna and sea ice concentration. The study found that the walrus selected lower sea ice concentrations relative to higher ice concentrations, likely to find both adequate sized sea ice from which to haul out to rest and for better maneuverability. They also found that walrus were feeding from sites south of St. Lawrence Island associated with high productivity coming from organic carbon originating from the Anadyr current. The authors point out that the type of sea ice associated with more concentrations of walrus depends on a number of factors that, recently, have been variable from year to year.
        - Figure 6 shows the average probability of walrus resource selection within benthic sampling areas in 2006, 2008-9. This figure shows the difference over years where you may expect to find foraging walrus; however, given the

difference in concentration areas of preferred prey, it points towards the overall importance of the polynya.

- Fay (1982) synthesized the historical distribution and seasonal abundance of Pacific walrus from field notes and other observations from scientists and naturalists. This contains information from a historical perspective and is included to show the relative importance of the polynya south of St. Lawrence Island for walrus.
    - Winter concentrations are shown in Figure 4 on page 8.
- Calving and breeding areas identified by Fish and Wildlife Service (USFWS Marine Mammals Management 2014).
    - Figure 1 on Page 2 shows breeding areas for Pacific walrus immediately south of St. Lawrence island in the polynya as well as immediately south of Nunivak Island at the mouth of the Kuskokwim River.

- **Northward migration – spring and early summer: Bering Strait and Strait of Anadyr**.
    - The Kawerak/Oceana Bering Strait Synthesis (2014) describe the northward migration of walrus. The northward migration of walrus occurs across the Bering Strait region with the sea ice retreat. The northward migration can depend on the winds, sea ice retreat, and currents. However, it has been occurring earlier than normal. Walrus use both sides of the strait on either side of the Diomede Islands as they move north. The Strait of Anadyr is an important staging area for a number of marine mammal species, including walrus.
        - Figure 4.1 illustrates the expanse of the migration from the eastern and western portion of the Bering Sea as documented by elders and hunters. Note the bottleneck between the narrowest portion of the Bering Strait that separates Russia and Alaska, that most of the female and young in the population of Pacific walrus travel through.
        - Map 4.2 illustrates the concentration areas for walrus during the spring migration.
    - Noongwook et al. (2007) documented the traditional ecological knowledge of the bowhead whale around St. Lawrence Island, in particular documenting descriptions about the movements, distribution and abundance around St. Lawrence Island. Included in the study were the place and timing relative to other important species such as walrus and bearded seal. They documented one such place identified as a concentration area for walrus in spring and early summer north of Gambell.
        - Page 51: "*In May and June, bowheads and gray whales (*Eschrichtius robustus*) are seen in the same areas. In June, when most of the ice is gone,*

bowhead whales have been seen in an area about 40 km north of Gambell. From here, they typically head to the coast of Chukotka. After the ice is gone, there can be large aggregations of walrus and bearded seals moving through the area, a pattern known as qavreq.*"*

  - Map of the area is indicated in Figure 3, on page 50.

- Robards et al. (2013) documented the seasonality of walrus in association with sea ice for three communities (Gambell, Savoonga and Little Diomede). They found that the timing of walrus moving into the Anadyr Strait has been consistent since the 1930s. That strong currents west of St. Lawrence island traveling through the Anadyr Strait keep open water with favorable sea ice conditions for walrus concentrations.

➢ **Southward migration – fall: Bering Strait and Strait of Anadyr.**

- The Kawerak/Oceana synthesis (2014) describes the fall migration for Pacific walrus. The fall migration of walrus, in recent years, has occurred ahead of the formation of seasonal sea ice. In particular, female walruses generally arrive earlier to St. Lawrence Island than males. Females often travel with young-of-the-year and yearlings that do not swim very fast. The Strait of Anadyr is an important migratory corridor for walrus and other marine mammals.
- Robards et al. (2007) compiled a map for walrus haulout sites from traditional ecological 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 in the Bering Sea.
- Noongwook et al. (2007) documented the traditional ecological knowledge of the bowhead whale around St. Lawrence Island, in particular documenting descriptions about the movements, distribution and abundance around St. Lawrence Island. Included in the study were the place and timing relative to other important species such as walrus and bearded seal.

  - Page 51: "*In fall, the movements of walrus and bearded seals mirror the spring pattern. These animals may arrive ahead of the ice. This movement is known as* anleghaq *or, if the movement involves large numbers of animals traveling together, as* unegyuuq *or* qiighqaghsiiq *('like an island') because the group is so large*."

➢ **Land-based haulouts**

- Land-based haul out sites have long been documented by traditional ecological knowledge from the Bering Strait Region, and were included in the Kawerak/Oceana (2014).

        - Map 4.3 shows the summer haul out sites for Pacific walrus.
        - Map 4.4 shows the fall haul out sites for Pacific walrus.
    - Robards et al. (2007) compiled a map for walrus haulout sites from traditional ecological 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 in the Bering Sea.
    - Important haul out sites identified by Fish and Wildlife Service (USFWS Marine Mammals Management 2014).
        - Figure 1 on Page 2 shows the major haul out sites during summer and fall.

7. Spotted Seal

Spotted seals (*Phoca largha*) in Alaska, including those that occur within the USCG Area of Interest, 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 the distribution of 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 recedes northward during the springtime, spotted seals move north through the Bering Strait into Arctic Ocean waters and regularly use barrier islands and coastal haulout sites in the Bering Strait region and along the Chukchi coast. During the open water period animals frequently haul out on land, presumably in proximity to areas with dense aggregations of prey (Frost et al. 1983, Burns 2002) or as resting bouts in between long-distance foraging trips offshore (Lowry et al. 1998). Land-based haulout sites have been identified on both the U.S. and Russian coasts of the Bering Strait region (Lowry et al. 1998, Oceana and Kawerak 2014).

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 (Quakenbush 1988, Johnson et al. 1992, Frost et al. 1993). With increasing duration of late summer ice-free periods, the time seals spend hauled-out on land may be critical for animals molting later in the season (Boveng et al. 2009). The need to minimize disturbance to important spotted seal habitat is identified in the NOAA Stock Assessment Reports for spotted seals, especially the need to minimize disturbance from OCS exploration and development in the form of "*disturbance from 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 on the Chukchi coast 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 sites in these areas will help ensure that communities where spotted seals are 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**
  - Satellite tracking of spotted seals has provided information about spotted seal movements and habitat selection in the Bering and Chukchi Seas (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, in the Bering Strait region and on the Chukchi Peninsula (Fig. 1, Table 2).*
    - 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 3 on page 227 shows a map of Bering and Chukchi Seas showing average daily at-sea locations of satellite-tagged spotted seals, October to December 1991–1993. This figure shows concentration areas in the Bering Strait region and northern Bering Sea.
    - 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*."
  - Recent data for 10 spotted seals tracked by satellite during 2014-15 is available in regularly updated maps provided by the North Slope Borough Department of Wildlife Management. Although the data have not yet been analyzed, movements and haulout locations are similar to those reported by Lowry et al. (1998).
    - Maps of satellite tracked seals are available at: http://www.north-slope.org/departments/wildlife-management/studies-and-research-projects/ice-seals/ringed-seal-research/ringed-seal-research-results-2014.

- Oceana and Kawerak (2014) described haulout sites and concentration areas for spotted seals during spring and fall in the Bering Strait and St. Lawrence Island region. Summer and fall haulouts and concentration areas are shown on maps 4.14 and 4.15.
    - Spotted seals arrive in the Bering Strait region on the northward spring migration during the break up of sea ice (p. 177). Seals congregate near Northeast Cape on St. Lawrence Island and are seen from early springtime from Diomede.
    - Large spotted seal haulouts are described on page 178 at Cape Darby, Atmaq, Carolyn Island, around Rocky Point. A haulout where 50 to 100 seals are commonly found is described on the north side of Besboro Island. Additional haulouts are described at Point Romanoff, Twin Islands near St Michael and on Fairway Rock near Diomede.
- Environmental Sensitivity Index (NOAA: Office of Response and Restoration 2005)
    - The NOAA Environmental Sensitivity Index indicates high concentration areas for spotted seals in the waters around St. Lawrence Island during the months April through December. Areas of importance for spotted seals in the St. Lawrence Island Region are included on Maps 31-34 which indicate the following sites and corresponding locations as being specific concentration areas for spotted seals: #113, 115, and 116. High concentration areas for spotted seals are also documented on the Seward Peninsula in maps 13-15 on the northwest coast and in maps 18, 19 and 21 the southwest coast. These areas include: Cowpack and Shishmaref Inlets (Area 52); Ipek and Lopp Lagoons (Area 59); and Port Clarence, Cape Woodley and Safety Sound (Area 6).
- Most Environmentally Sensitive Areas (MESA) (Alaska Department of Fish and Game Habitat and Restoration Division 2001).
    - The ADFG MESA database identifies the southern coast of St. Lawrence Island as a concentration area for spotted seals.

8. 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 USCG Area of Interest including the Bering Strait Region. 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 (Bengtson et al. 2005, Allen and Angliss 2013). 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 from the Yukon-Kuskokwim delta all the way to Beaufort Sea communities. A significant portion of the Beringia DPS migrates through the Bering Strait in the spring and fall and as a result, decisions affecting bearded seals in the USCG Area of Interest may impact communities throughout these regions, where bearded seals are an important subsistence resource.

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 the northern end of the Bering Strait to Pt. Barrow.
        - 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).
- **Seasonal movements of bearded seals in the Bering and Chukchi Seas**
    - Movement and behavior methodology to identify marine habitats of importance to bearded seals using locations from satellite tracking and dive data (Boveng and Cameron 2013).

        - Boveng and Cameron (2013) identified seasonal movements and dive behavior of bearded seals as determined by satellite-linked time-depth recorders.
        - To identify specific marine habitats 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 northern Bering and Chukchi Seas in all behavioral categories.
        - In the fall all seals moved south with the advancing sea ice and by December had passed through the Bering Strait into the northern Bering Sea where they remained for winter and early-spring.
        - In spring all seals returned north through the Bering Strait into the Chukchi Sea.
            - Figures 6.1 – 6.35 show monthly maps of the sea ice distribution and seasonal movements of bearded seals captured and tagged in Kotzebue Sound.
            - 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.
        - There are some limitations as to the extent that bearded seal tracking results can be extrapolated for the Bering Sea DPS, as the sample size is limited to five subadult and two adult bearded seals.
    - Oceana and Kawerak (2014) described seasonal concentration areas for bearded seals in the Bering Strait and St. Lawrence Island region based on hunter observations and western science. Seasonal concentration areas are shown on maps 4.5 through 4.9.
        - In winter bearded seals are found in coastal areas throughout the Bering Strait and St. Lawrence Island region in areas of open water and loose floating ice (p. 158). High concentration areas occur near Sledge Island, Cape Nome and Stuart Island in Norton Sound (Maps 4.5 and 4.9).
        - During the spring and early summer period high concentration areas occur on the south and eastern sides of St. Lawrence Island and a hotspot is located in the Anadyr Strait on the northwest side of the island. Other

documented high concentration areas are located in the Bering Strait surrounding Diomede and Fairway Rock and along the southern coast of the Seward Peninsula (Map 4.6).

  - During the summer and fall open water period high concentration areas are found in coastal areas of the Seward Penninsula (Maps 4.7 and 4.8).

- NOAA: Office of Response and Restoration (2005) documents highly concentrated bearded seal habitat for spring and summer.
  - The NOAA Environmental Sensitivity Index indicates high concentration areas for bearded seals in the waters around St. Lawrence Island during the months April through June. Areas of importance for bearded seals are included on Maps 31, 32 and 34 which indicate the following sites and corresponding locations as being specific concentration areas for bearded seals: #113. High concentration areas for bearded seals are also documented on the Seward Peninsula in maps 13-15 on the northwest coast and in maps 18, 19 and 21 the southwest coast. These areas include: Cowpack and Shishmaref Inlets (Area 52) and Ipek and Lopp Lagoons (Area 59).
- NOAA (1988) documents highly concentrated bearded seal habitat for spring and summer.
  - In the map included in Section 3.74, the NOAA atlas identifies much of the Chukchi coastal lead system area as a “Major Adult Area” for the months of March and April.

9. 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). 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. 2010). 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. 2010). 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. 2010). 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. 2010).

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

- **Highly concentrated ringed seal fast ice habitat in the Bering and Chukchi Seas**
  - 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 just 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.
  - Oceana and Kawerak (2014) described seasonal concentration areas for ringed seals in the Bering Strait and St. Lawrence Island region based on hunter observations and western science. Seasonal concentration areas are shown on maps 4.10 through 4.12.
    - In winter ringed seals are found in coastal areas throughout the Bering Strait and St. Lawrence Island region in areas of open water and loose floating ice (p. 168). High concentration areas occur on the north side of St. Lawrence Island and in Norton Sound.
    - During the spring high concentration areas occur on the eastern side of St. Lawrence Island and in the Anadyr Strait on the northwest side of the island. Other documented high concentration areas are located in the Bering Strait surrounding Diomede and Fairway Rock and along the southern coast of the Seward Peninsula (Map 4.10).

    - During the summer and fall period high concentration areas are found in Port Clarance, Cape Nome and Cape Darby on the Seward Penninsula (Maps 4.11 and 4.12).
  - 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.
  - NOAA: Office of Response and Restoration (2005) documents highly concentrated ringed seal fast ice habitat.
    - The NOAA Environmental Sensitivity Index indicates concentration areas for ringed seals in the waters around St. Lawrence Island during the months October through June. Areas of importance for ringed seals are included on Maps 31-34.
  - Harwood (2012) identified seasonal movements and dive behavior of seven ringed seals (one adult female, three subadult males, two subadult females and one male pup) instrumented with satellite-linked transmitters, and released at Cape Parry, Northwest Territories, Canada in 2001 and 2002.
    - Figure 1 on page 36 shows the tracks of ringed seals during the fall migration period with some deployments lasting into the winter (January-April) period.
    - All ringed seals tracked in this study migrated westward across the Beaufort Sea Planning Area into areas in the Chukchi Sea. Two seals migrated as far south as the Bering Strait region with one seal moving south into the Bering Sea at the end of the tracking period.

10. Steller Sea Lion

The Steller sea lion (*Eumetopias jubatus*) is distributed around the North Pacific Ocean rim from northern Japan through the Okhotsk Sea, Aleutian Islands and central Bering Sea, southern coast of Alaska and south to California. The Alaskan population is comprised of the Western and Eastern Stocks which are separated at 144° W longitude in the eastern Gulf of Alaska. Steller sea lions breed at coastal rookeries located throughout the range during May-to-July. During the non-breeding season Steller sea lions continue to use both rookeries and haul-out sites throughout their range to rest between foraging trips at sea. The western stock of Steller sea lions declined by 75% between 1976 and 1990 and was listed as threatened range-wide under the Endangered Species Act in 1990 (NMFS 2008). The continued decline of the western stock in Alaska throughout the 1990s led to its listing as endangered in 1997. In 1993 the National Marine Fisheries Service designated all rookeries, major haul-out sites, and a series of aquatic feeding areas as Critical Habitat under the ESA (50 CFR part 226.202). The aquatic zones around rookeries and major haul-out sites extend 20 nm seaward from the basepoint of each rookery and major haul-out site. Special aquatic feeding areas were also designated as critical habitat based on at-sea observations, records of incidental take in fisheries, prey distribution and foraging studies (NMFS 2008).

The USCG Area of Interest intersects with Steller sea lion critical habitat in both the southeastern and northern Bering Sea (50 CFR part 226.202). The southern section of the proposed route passes directly through the Bogoslof foraging area north of Unimak Pass and is in close proximity to several rookeries and major haul-out areas. In the northern portion of the area of interest, two major haul-out sites designated as critical habitat are located on St. Lawrence Island; South Punuk Island and Southwest Cape. Just outside the western boundary of the area of interest four additional critical habitat haul-out sites and one rookery are located in the Pribilof Islands archipelago in the central Bering Sea and one haul-out site is located on Hall Island near St. Matthew Island.

11. 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 subpopulations (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 2013a). 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 2013b). 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 scavenge walrus and bowhead whale (*Balaena mysticetus*) carcasses.

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 (Durner et al. 2009, 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). 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).

As stated in the Federal Register notice designating critical sea-ice habitat (USFWS 2010a), the main problem in identifying important areas for polar bears 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. 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)[1].

The map showing polar bear sea ice habitat selection by season is based on resource selection models published in Durner et al. (2009).

- On the advice of George Durner at USGS, our team mapped polar bear sea ice habitat selection by applying seasonal resource selection coefficients presented in Durner et al. (2009) to the last five years of available sea ice data. Average sea ice concentration data were acquired as 25-km monthly grids from the National Snow and Ice Data Center (2014) for each month from October 2008 through September 2013. Durner et al. presented four seasonal models. We assigned months to season based on the most common assignment in their analysis: winter—December through May, spring—June through July, summer—

[1] See also http://alaska.usgs.gov/science/biology/polar_bears/tracking.html)

August through September, and autumn—October through November. The models were run for each of the 60 months, then monthly results were grouped by season and averaged into a four final seasonal layers representing mean habitat selection value over the most recent five-year period.

12. Marine Birds

The Bering Strait Region hosts one of the highest densities of nesting seabirds in the world. The region from St. Lawrence Island north through Bering Strait includes over 12 million colonial nesting birds, and very high pelagic concentrations of marine birds. In addition to being the destination of millions of birds, the Strait is a highly important migration bottleneck for millions more birds traveling to the Arctic Ocean for summer breeding and foraging.

The maps for marine birds are based on the following scientific source materials.

- **Marine Bird Nesting 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).
    - Our map shows 134 nesting colonies with approximately 12.4 million birds present. Species include (listed from most to least abundant):
      - Auklets: least auklet, unidentified auklet, crested auklet, parakeet auklet (11 million)
      - Murres: unidentified murre, thick-billed murre, common murre (1 million)
      - Other: northern fulmar, black-legged kittiwake, horned puffin, tufted puffin, pelagic cormorant, pigeon guillemot, glaucous gull, herring gull, common eider, Arctic tern, Aleutian tern, glaucous-winged gull, black guillemot, unknown cormorant, unknown tern, caspian tern, dovekie, slaty-backed gull (400,000)

        - Diomede Islands Colonies IBA includes nearly 7 million birds. This IBA spans the international border. Big Diomede Island on the Russian side is a nesting colony for approximately 6,146,000 birds, and Little Diomede Island on the U.S. side is a nesting colony for 543,000 birds, mostly auklets, murres, puffins, and gulls.
        - Birds at the Diomede Islands rest and forage in the surrounding waters of the Bering Strait IBA, designated for a globally significant population of 20,000 parakeet auklets, but with a total estimated abundance of all birds of 635,000 birds of 26 species.
        - Four IBAs along the St. Lawrence Island coast include 4,000,000 nesting and foraging auklets, eiders, cormorants, and kittiwakes.

- **Seabird marine hotspots**
    - Audubon Alaska analyzed globally significant coastal and marine IBAs through spatial analysis of at-sea survey data and aerial survey data.
        - The analysis was based on Drew and Piatt (2013) version 2 of the North Pacific Pelagic Seabird Database (NPPSD), a compilation of at-sea survey transect data that documents seabird densities in the Arctic Ocean and the North Pacific; as well as the Alaska Waterbird Database (AWD) version 1 which is a compilation of aerial survey data across the state of Alaska (Walker and Smith 2014).
        - 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. (2014) 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 12-1 summarizes the globally significant IBAs in the Bering Strait Region shown on Map 19 in Appendix A, for both U.S. and Russian waters. Table 12-2 summarizes IBAs within the USCG PARS Area of Interest shown on Map 20 in Appendix A.

- Using data generated for the IBA analysis, Audubon Alaska (2014) created a new product: the integrated globally significant proportion of birds, which provides a measure of importance by looking at a combination of both species abundance and species rarity, integrated over multiple species.

    - The data indicates relative importance using abundance normalized by population size, integrated for multiple species. It is the % of IBA threshold achieved, summed for all regularly occurring species.

    - The IBA threshold is 1% of the population, based on global population numbers for seabirds or on continental population numbers for waterbirds (BirdLife International 2012).

Table 12-1 Globally significant marine Important Bird Areas in the Bering Strait Region.

Site Name	Global Trigger Species	Continental Trigger Species	State Trigger Species	Country
Bering Sea Shelf 168W62N	Pomarine jaeger			United States
Bering Strait	Parakeet auklet	Crested auklet; least auklet; red phalarope		United States & Russia
Chamisso Island Colonies	Horned puffin			United States
Diomede Islands Colonies	Black-legged kittiwake; crested auklet; least auklet; parakeet auklet		Pelagic cormorant	United States & Russia
East Norton Sound	Spectacled eider			United States
Getlyangen Lagoon and Khalyustkin Cape	Pelagic cormorant			Russia
Inchoun and Uelen Lagoons	Common eider; spectacled eider; long-tailed duck			Russia
King Island Colony	Parakeet auklet	Common murre	Crested auklet; least auklet; thick-billed murre	United States
Mechigmen Bay	Common eider; spectacled eider			Russia
Mechigmen Lagoon	Emperor goose; spoon-billed sandpiper			Russia
Noatak River Delta Colony	Aleutian tern			United States
Northwest Cape Colony	Crested auklet; least auklet			United States

Site Name	Global Trigger Species	Continental Trigger Species	State Trigger Species	Country
Savoonga Colonies	Crested auklet; least auklet	Pigeon guillemot		United States
Senyavina Strait	Pelagic cormorant			Russia
Shishmaref Inlet	Mew gull; black scoter		Common eider; glaucous gull; Pacific golden plover; red-throated loon; spectacled eider	United States
Sireniki Coast	Common eider; spectacled eider; pelagic cormorant; Ross's gull; crested auklet			Russia
St. Lawrence Island Polynya	Spectacled eider		Black-legged kittiwake; crested auklet; glaucous gull	United States
Vankarem Lowlands and Kolyuchin Bay	Steller's eider; emperor goose; yellow-billed loon, spoon-billed sandpiper			Russia
Western St. Lawrence Island Marine	Crested auklet; parakeet auklet; spectacled eider	Least auklet		United States

Table 12-2 Globally significant marine Important Bird Areas in the USCG PARS Area of Interest.

Site Name	Global Trigger Species	Continental Trigger Species	State Trigger Species
Baby Islands & Akutan Pass Colonies	Fork-tailed storm petrel; red-faced cormorant; tufted puffin		Cassin's auklet; double-crested cormorant; Leach's storm petrel
Bering Sea Shelf 165W56N	Glaucous-winged gull		
Bering Sea Shelf 166W56N	Glaucous-winged gull; red-legged kittiwake	Northern fulmar	Glaucous gull

Site Name	Global Trigger Species	Continental Trigger Species	State Trigger Species
Bering Sea Shelf 166W57N	Glaucous-winged gull		
Bering Sea Shelf 168W62N	Pomarine jaeger		
Bering Sea Shelf 169W60N	Pomarine jaeger		
Bering Sea Shelf Edge 166W55N	Black-legged kittiwake; glaucous-winged gull; northern fulmar; short-tailed shearwater; tufted puffin	Red phalarope; sooty shearwater	Fork-tailed storm petrel
Bering Sea Shelf Edge 168W56N	Glaucous-winged gull; red-legged kittiwake	Northern fulmar	Fork-tailed storm petrel
Bering Strait	Parakeet auklet	Crested auklet; least auklet; red phalarope	
Cape Vancouver Marine	King eider; Steller's eider		
Diomede Islands Colonies	Black-legged kittiwake; crested auklet; least auklet; parakeet auklet		Pelagic cormorant
King Island Colony	Parakeet auklet	Common murre	Crested auklet; least auklet; thick-billed murre
Northwest Cape Colony	Crested auklet; least auklet		
Nunivak Island Coastal	Steller's eider		Aleutian tern; black brant; common eider; common murre; rock sandpiper; Steller's eider
Savoonga Colonies	Crested auklet; least auklet	Pigeon guillemot	
Shishmaref Inlet	Mew gull; black scoter		Common eider; glaucous gull; Pacific golden plover; red-throated loon;

Site Name	Global Trigger Species	Continental Trigger Species	State Trigger Species
			spectacled eider
Southwest Cape Colonies	Black-legged kittiwake; crested auklet; least auklet; pelagic cormorant	Common murre; pigeon guillemot	Thick-billed murre
St. Lawrence Island Polynya	Spectacled eider		Black-legged kittiwake; crested auklet; glaucous gull
Western St. Lawrence Island Marine	Crested auklet; parakeet auklet; Spectacled eider	Least auklet	
Unimak & Akutan Passes	Ancient murrelet; black-legged kittiwake; crested auklet; glaucous-winged gull; Kittlitz's murrelet; northern fulmar; red phalarope; sooty shearwater; short-tailed shearwater; tufted puffin; whiskered auklet; black-footed albatross; laysan albatross; marbled murrelet	Black-legged kittiwake; pigeon guillemot	Long-tailed duck; northern fulmar; red-faced cormorant

13. LOWER TROPIC LEVELS

Productivity and production at lower trophic levels can shape Arctic ecosystems, especially considering the relatively short food chains that occur in the Arctic (Grebmeier et al. 2006a, Grebmeier 2012). 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 (Hunt et al. 2002, Grebmeier et al. 2006b). 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, Suydam 2000, Moore et al. 2003, Petersen and Douglas 2004, Cameron et al. 2010, Jay et al. 2012, Boveng and Cameron 2013).

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 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 and Bering seas ecosystems. 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.

12.1 Primary Productivity

To produce the map of primary productivity (integrated water column algae) in Appendix A we interpolated data values from Dunton et al. (2005), Grebmeier et al. (2014). For the analysis we:

- Established a 25×25km grid over the Beaufort Sea Planning Area;
- Calculated the average value for each grid cell;
- Smoothed grid cell values by first converting the grid cell values into point data with one point per grid cell at the centroid, and then running a simple kriging function with ESRI's Geostatistical 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 (Krembs et al. 2000, Hill and Cota 2005, Arrigo et al. 2012, Frey et al. 2012, Boetius et al.

2013). 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).

12.2 Seafloor (Benthic) Biomass

The Bering Strait region has high levels of benthic biomass which are key foraging resources for benthic feeders. To develop the map in Appendix A, we used the same methods as used for primary productivity data.

While some of the data are relatively old, the patterns are at least a gross reflection of the distribution of hot spots of benthic biomass.

12.3 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 75° N 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 (Stringer and Groves 1991, Stirling 1997). 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.

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 (Homer and Schrader 1982, Gradinger 2008, Laidre et al. 2008).

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 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.

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APPENDIX C

BERING STRAIT SHIP ROUTING ANALYSIS

1. Introduction

We conducted a ship routing analysis to assess the environmental and socio-cultural impacts of the USCG proposed route compared to numerous plausible alternate routes. The routing analysis was conducted using GIS to generate and score a set of routes meeting certain minimum criteria set forth by the USCG. Those criteria included 1) routes that do not come within 6 nm of land, 2) routes that have only three turns between Unimak Pass and Bering Strait, and 3) routes that are not substantially longer than the proposed route (which we defined as not more than 5% longer).

This analysis was conducted by Audubon Alaska, with data from multiple sources, primarily Oceana and Kawerak's (2014) published atlas of ecosystem values in the Bering Strait region and Audubon's analysis of Important Bird Areas (Audubon Alaska 2014). Additional review and feedback was provided by Marine Exchange of Alaska, Ocean Conservancy, Pew Charitable Trusts, and World Wildlife Fund.

2. Methods

For the analyses described below, we generated a set of random lines that met the USCG minimum criteria, then assessed the "cost" of traveling those routes using a set of spatial data layers. Each layer was scaled from 0–100 representing a relative impact score, also known as a cost surface. Although all routes analyzed result in three turns between Unimak Pass and Bering Strait, we analyzed two scenarios that varied the number of turns that were altered from the USCG proposed route.

2.1 2-turn Analysis

Based on input from the USCG that the turn near King Island is important to line up a 000° transit of the Strait, our first analysis kept the Unimak Pass start point, the King Island turn, and Bering Strait end points stationary, allowing two turns to be altered (near Nunivak Island and St. Lawrence Island). We generated 2 million random data points within the USCG PARS Area of Interest. We then connected those points into alternate route lines and eliminated all non-plausible routes (e.g. crossing land, more than 5% longer than the Coast Guard route, crossing into Russian waters). After that we were left with 60,430 alternate lines for analysis. See Map 1 in this appendix.

2.2 3-turn Analysis

Next, based on input from local communities that the area near King Island is highly important for subsistence hunting and cultural values, this analysis kept only the Unimak Pass start point stationary, allowing three turns to be altered (those near Nunivak Island, St. Lawrence Island, and King Island), and allowed the end of the line north of Bering Strait to vary from 000°. We generated 4 million random data points within the USCG PARS Area of Interest. We then connected those points into alternate routes and eliminated all non-plausible routes, leaving 1,672 alternate lines for analysis. See Map 2 in this appendix.

2.3 Scoring Routes

Next, we scored all lines in order to rank and identify the "least cost" routes. Note that in this context the cost represents relative impact scores. As an example, each cell has a higher value, or cost, when closer to land and a lower cost when farther away.

The value of all 1-km cells that the route passes through were summed for each variable, giving a cost score. Longer routes pass through more cells, and tend to have higher scores than shorter routes in similar habitat. The best routes have lower total cost scores for each variable. We analyzed each route, for both scenarios, for each environmental variable. All input data layers were scaled linearly from 0–100.

2.3.1 Score 1

We scored the routes using the following variables:

1. Inverse distance to land (inverse calculated using cell value minus project area maximum value)
2. Percent shallow (percent of area less than 60 m deep within a 3 nm buffer of the cell), using data from Danielson et al. (2013)
3. Relative importance to marine birds (a calculation of the "integrated globally significant proportion" of birds) (Audubon Alaska 2015)
4. Standard deviates score for subsistence, all seasons combined (Oceana and Kawerak 2014)
5. Standard deviates score for marine mammals, all seasons combined (Oceana and Kawerak 2014)
6. Standard deviates score for fish, all seasons combined (Oceana and Kawerak 2014)

2.3.2 Score 2

We scored routes a second time, adding an additional variable to reflect areas of additional significance based on local feedback:

7. Inverse distance to St. Lawrence Island and King Island (to give extra weight to pushing the route farther away)

2.3.3 Other Variables

Several other variables were analyzed for informational purposes, but not used to score and rank the set of routes. Those included:

- Annual percent of days with sea ice present
- Inverse distance to seabird colonies
- Inverse distance to walrus haulouts
- Inverse distance to designated Important Bird Areas
- Inverse distance to shallow areas (<60m depth)

2.3.4 Ranking Routes

After calculating the total cost score for each variable for each route, the raw scores were converted to standard deviate values to put variable scores onto a comparable scale ((cell value- mean)/standard deviation). The standard deviates were linearly binned to a scale of 1–10, then summed across variables to score routes.

Routes were scored based on the sum of the binned scores. For Score 1, the minimum/best score possible was a 6, if a route scored in the lowest cost bin for all variables, and the maximum/worst possible score was a 60, if the route was in the highest cost bin for all variables. For Score 2, the best possible score was a 7 and the worst possible score was a 70.

Routes were also ranked, from least to most cost based on the summed standard deviates scores, and top 10 routes were identified and mapped as plausible alternate routes.

3. Results and Discussion

Taking this broad-scale approach provided an objective analytical framework for assessing least cost shipping routes. This allowed us to assess the performance of the USCG-proposed route compared to a large number of plausible alternate routes. A summary of route scores is presented below.

3.1 2-turn Analysis

Score 1: Route scores ranged from 8 to 36, with a mean of 23 and a mode of 24. The USCG route scored 14. The USCG route was in the top 6% of all routes analyzed.

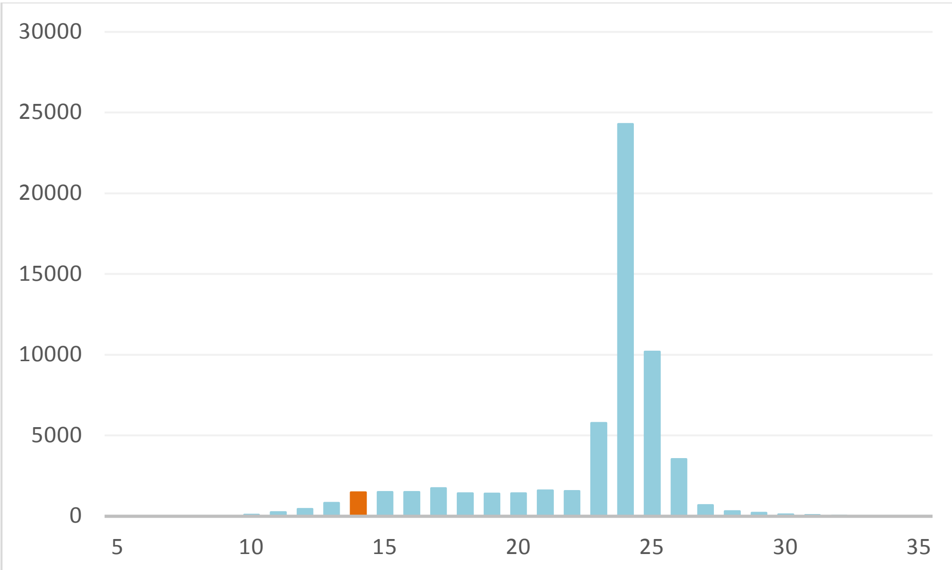

Figure 1. Summary of Score 1 for 2-turn analysis. USCG route in orange and alternate routes in blue.

Score 2: Route scores ranged from 12 to 46, with a mean of 24 and a mode of 25. The USCG route scored 15. The USCG route was in the top 4% of routes analyzed.

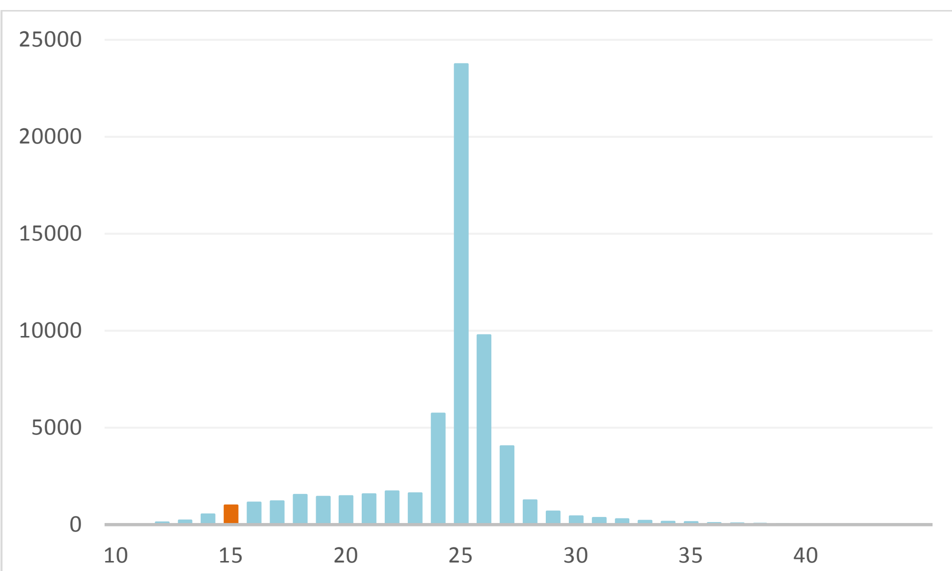

Figure 2. Summary of Score 2 for 2-turn analysis. USCG route in orange and alternate routes in blue.

3.2 3-turn Analysis

Score 1: Route scores ranged from 11 to 39, with a mean of 24 and a mode of 24. The USCG route scored 15. The USCG route was in the top 1% of routes analyzed.

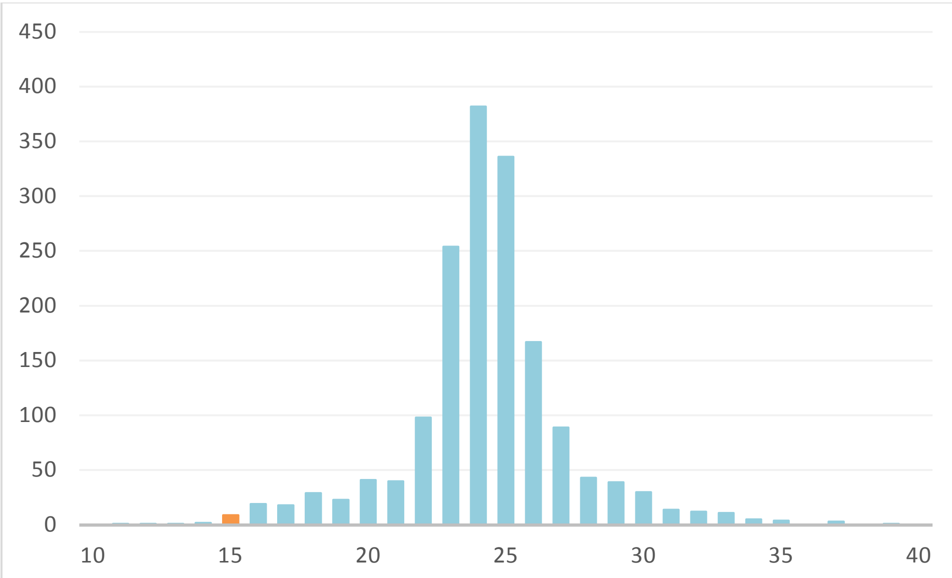

Figure 3. Summary of Score 1 for 3-turn analysis. USCG route in orange and alternate routes in blue.

Score 2: Route scores ranged from 15 to 45, with a mean of 26 and a mode of 25. The USCG route scored 16. The USCG route was in the top 1% of routes analyzed.

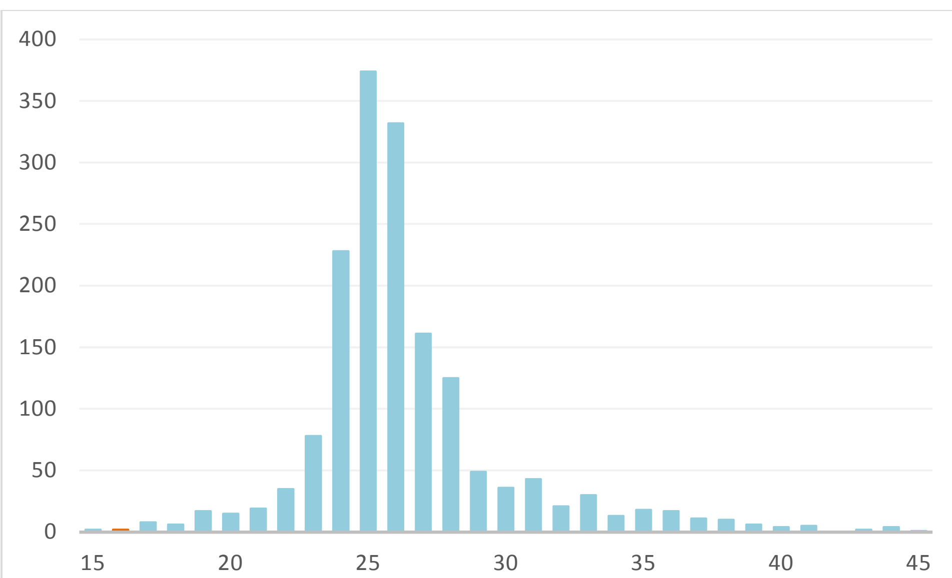

Figure 4. Summary of Score 2 for 3-turn analysis. USCG route in orange and alternate routes in blue.

Table 1. Summary of Alternate Routes and Scores Compared to USCG proposed route.

# of Turns Altered	# of Alternate Routes	Max Length (km)	Score Method	Min Score	Max Score	Mean Score	Mode Score	USCG Score	USCG Percentile
2	60,430	1,244	1	8	36	23	24	14	6%
			2	12	46	24	25	15	4%
3	1,672	1,415	1	11	39	24	24	15	1%
			2	15	45	26	25	16	1%

Best-scoring routes in the 2-turn analysis were very similar to the USCG route between the St. Lawrence Island turn and King Island, but varied substantially from the Nunivak Island turn, generally farther west and south, closer to the Pribilof Islands. Moving the route this direction would better avoid bird concentration areas and designated Important Bird Areas as well as move ships to the outer areas of northern right whale critical habitat. Alternate routes also score better for avoidance of sea ice, distance to land, and shallows.

Best-scoring routes in the 3-turn analysis did not follow one single pattern. This reveals two considerations. First, the number of random plausible routes generated that could meet all criteria for three turns was much smaller (~1700 lines) which indicates that it is difficult to find a satisfactory line through the entire area of interest. Second, the fact that some lines have turns east of the USCG route and some have turns west of the USCG route indicates that finding the right route is a balance, where the position of one point influences the position of the next, and there is no one ideal answer. Although all top ten routes are plausible, one in particular (highlighted in dark purple) seems to better meet criteria desired by local stakeholders, which includes staying far offshore of Nunivak, St. Lawrence, and King islands, and best avoiding bird, mammal, and subsistence use areas. This "proposed alternate route" is a very good and plausible alternative to the USCG route that better accounts for socio-cultural concerns—in particular the edge of the route is 12 nm offshore of King Island.

In summary, the USCG route scored very well in both scenarios analyzed. In all analyses, the USCG route performed much better than most routes, with a score lower than both the mean and mode scores, and only 1 to 6 points higher than the best-performing routes. Some routes did score better than the USCG route, implying that there is some room for improvement from an environmental and social perspective.

We conclude that the USCG should consider the proposed alternate route presented in Map 2 during their decision-making process, and consider how changes to the first leg between Unimak Pass and Nunivak Island can be improved for bird, northern right whale, and other values as shown in Map 1.

4. References

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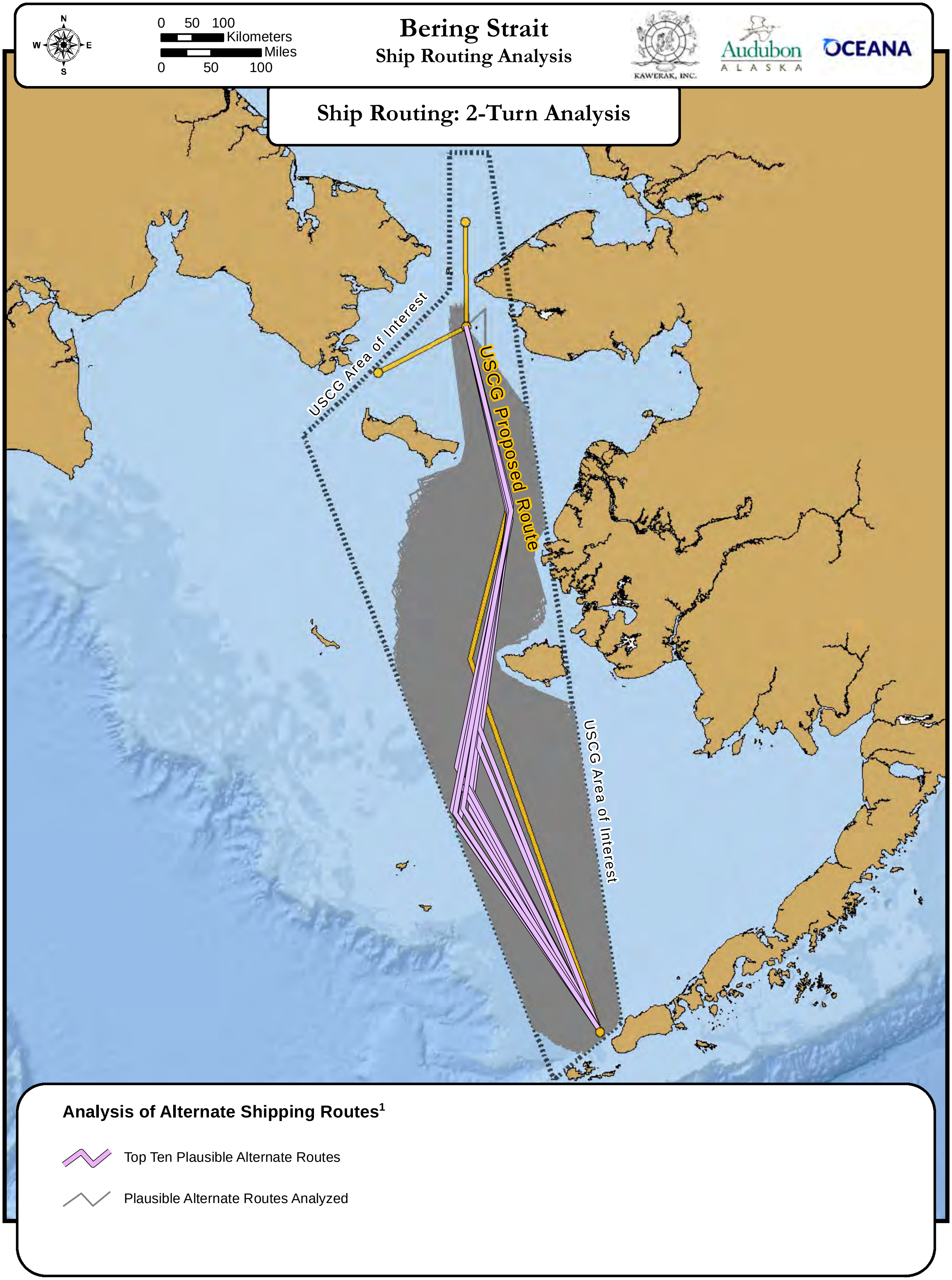
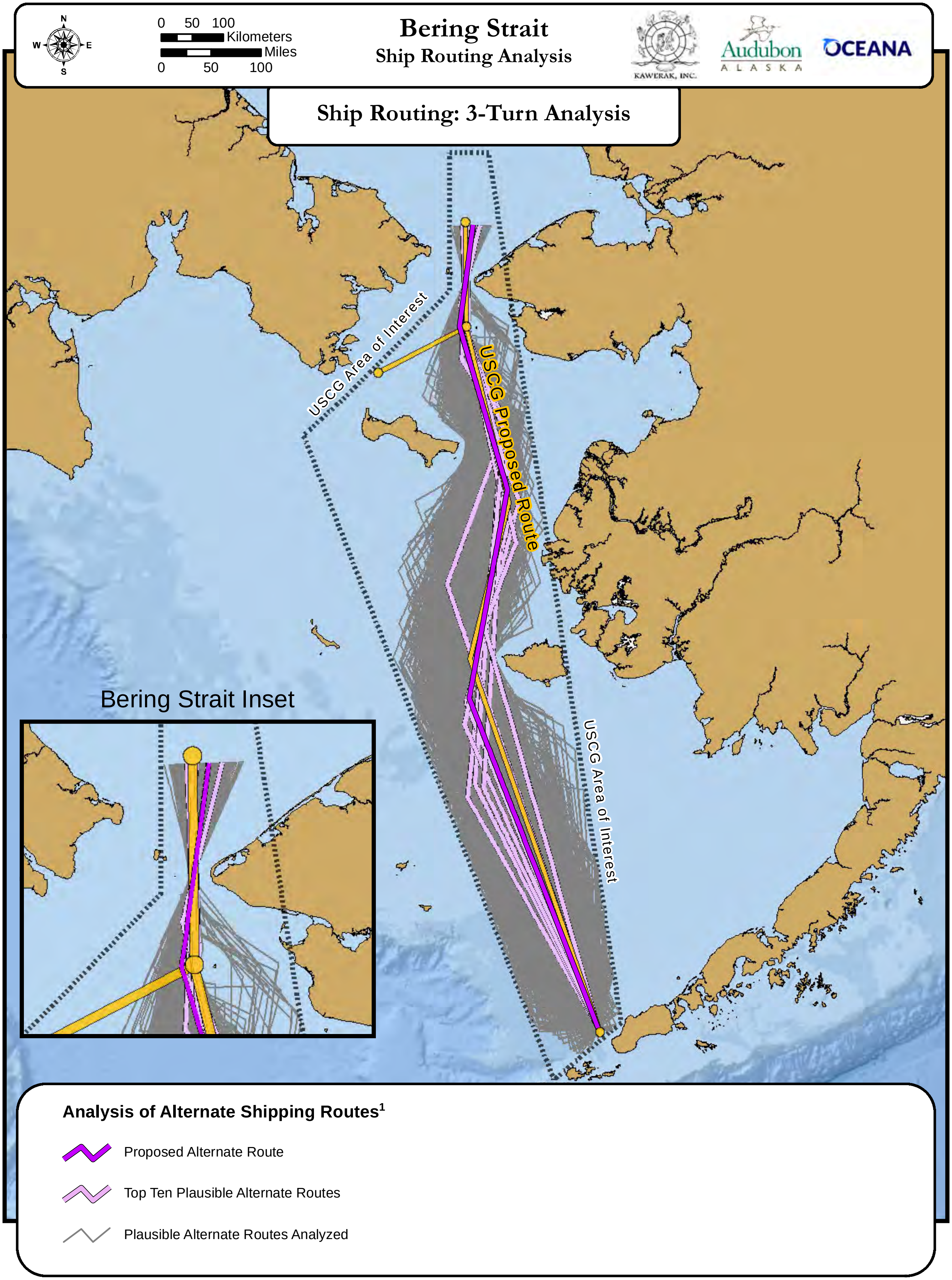
Map 1



Data provided by: (1) Audubon Alaska 2015. Based on data from: (a) Oceana and Kawerak 2014. (b) Audubon Alaska 2014 (c) Danielson et al. 2014. Map last updated: 6/2/2015. Map created by Audubon Alaska.

Map 2



Data provided by: (1) Audubon Alaska 2015. Based on data from: (a) Oceana and Kawerak 2014. (b) Audubon Alaska 2014 (c) Danielson et al. 2014. Map last updated: 6/2/2015. Map created by Audubon Alaska.