BIRDS

Milo Burcham

BIRDS MAP INDEX

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Marine Bird Colonies

Melanie Smith

Marine birds sustain themselves by utilizing ocean resources during their annual cycle. The term "marine birds" refers to both seabirds and marine-associated waterbirds. Seabirds almost exclusively rely on the marine environment, with the exception of breeding terrestrially in colonies. Seabirds very rarely, if ever, venture inland or utilize freshwater environments. Waterbirds are those that make use of either or both freshwater and saltwater environments and spend a much greater length of time on land throughout their annual cycle. Colonial-nesting waterbirds that often utilize marine resources include gulls, terns, and cormorants. Shorebirds are also considered marine waterbirds; in Alaska they do not nest colonially.

The dramatic, rocky coast of Alaska provides excellent habitat for colony-nesting birds: 865 colonies are mapped throughout the Bering, Chukchi, and Beaufort Seas, including parts of Russia and Arctic Canada, and provide nesting habitat for nearly 34 million birds. Different species prefer different nesting habitats, resulting in several species sharing the same area, but utilizing different niches. For example, Horned Puffins (*Fratercula corniculata*) nest in rock crevices in talus and between boulders below 300 feet (100 m), while their next closest relative, Tufted Puffins (*Fratercula cirrhata*), prefer earthen burrows high up along cliff edges and steep slopes covered with dense vegetation (Piatt and Kitaysky 2002a, b). Common and Thick-billed Murres (*Uria aalge* and *U. lomvia)* nest on ledges along cliff walls in very dense concentrations, with Thick-billed Murres selecting narrower ledges (Squibb and Hunt 1983, Gaston and Hipfner 2000, Ainley et al. 2002). Red-legged and Black-legged Kittiwakes (*Rissa brevirostris* and *R. tridactyla*) nest on ledges so small that often they face the cliff wall with their tails hanging over the edge, with Red-legged Kittiwakes more tolerant of nesting below overhangs (Byrd and Williams 1993a). Common Eiders (*Somateria mollissima*) are semi-colonial nesting sea ducks that select sites on the ground along sandy, low-lying barrier islands and spits amongst the cover of driftwood, rocks, or vegetation (Goudie et al. 2000).

DISTRIBUTION

The four most numerous categories of marine birds, from highest to lowest across the region, are auklets (16.1 million), murres (7.1 million), storm-petrels (4.4 million), and puffins (2.8 million). Ten species (including one group identified only to genus) total over one million birds across the project area. The most abundant species is the Least Auklet (*Aethia pusilla*), which nests in the largest colonies of any seabirds in this region, estimated at 7.8 million birds distributed across only 35 colonies. The next most abundant species in this region are: Crested Auklet (*A. cristatella*; 4.6 million), unidentified murres (*Uria* spp.; 2.9 million), Leach's Storm-Petrel (*Oceanodroma leucorhoa*; 2.3 million), Thick-billed Murre (2.2 million), Fork-tailed Storm-Petrel (*O. furcatea*; 2.2 million), Common Murre (2.0 million), Tufted Puffin (1.9 million), Black-legged Kittiwake (1.8 million), and Northern Fulmar (*Fulmarus glacialis*; 1.1 million).

Roy W. Lowe / USFWS

Murre colony.

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Seven multi-species nesting colonies support over one million nesting birds. The largest nesting colony in the Bering, Chukchi, and Beaufort Seas is on Big Diomede Island, Russia, which is home to an approximated 5.1 million birds—primarily Least Auklets. The second-largest colony, and the largest in Alaska, is on Buldir Island where 3.5 million birds gather—primarily Leach's and Fork-tailed Storm-Petrels. St. George Island comes in at third with 2.1 million, half of which are Thick-billed Murres. In fourth place is Kiska Island (Sirius Point) with 1.8 million birds, mostly Least Auklets. Cape Yagnochymlo is the fifth largest colony, with 1.2 million birds, half of which are Crested Auklets. Ivekan Mountain on St. Lawrence Island comes in at sixth, with 1.2 million birds, of which two-thirds are Crested Auklets. Finally, the seventh-largest colony is on Hall Island with one million birds—a mix of Least Auklets, Thick-billed Murres, Northern Fulmars, and Crested Auklets.

Red-faced Cormorants (*Phalacrocorax urile*), Whiskered Auklets (*Aethia pygmaea*), and Red-legged Kittiwakes are endemic to the project area. All of their breeding colonies occur in the mapped region, with the exception of a small number of individuals that may breed along the adjacent margins of the area depicted. Tufted Puffins are present at the greatest number of colonies (398), followed by Horned Puffins (383), Pigeon Guillemots (*Cepphus columba*; 349), Pelagic Cormorants (*Phalacrocorax pelagicus*; 328), and Glaucous-winged Gulls (*Larus glaucescens;* 301). Table 5.1-1 shows the estimated abundance and number of colonies for marine birds in the region. (Note that the species abundances cited throughout this summary and on the associated map represent the best available count, but vary in degree of certainty and precision. They are best regarded as general estimates.)

LIFE CYCLE

Globally, about 13% of all bird species nest in colonies (Gill 1995), although when it comes to seabirds, about 98% of species breed colonially (Hamer et al. 2002). Seabirds are long-lived (20–60 years), balancing their late onset of breeding (up to 10 years) and generally low reproductive rates (often a single egg) with extended chick-rearing (up to 6 months) and high survival rates (Schreiber and Burger 2002). One popular illustration of the life history of seabirds comes from a monitoring site on Midway Atoll, where a Laysan Albatross (*Phoebastria immutabilis*) named Wisdom, the oldest known banded bird in the wild, continues to hatch a chick every year at 65+ years of age.

In the Bering, Chukchi, and Beaufort Seas, marine birds tend to migrate from March to May, and September to November, and lay eggs and rear chicks from May to August, with some notable differences between species/guilds. Auklets generally migrate to their breeding colonies in April and lay eggs in mid-May. Chicks hatch in late June and fledge by the end of August. From July through October they molt, and from August through October adults and juveniles leave the nesting colony to fly to their wintering areas (Byrd and Williams 1993b, Jones 1993, Jones et al. 2001, Bond et al. 2013).

Leach's Storm-Petrels, which winter farther south in sub-tropical and tropical waters, begin heading north earlier, in early March, arriving by late April. Eggs are laid in early June, hatching by mid-August. The young fledge late—by mid-October—when the adults and juveniles depart south, making it to wintering areas by late November (Huntington et al. 2013). In contrast, Fork-tailed Storm-Petrels tend to wander during winter months (November–March), arriving back at breeding colonies by mid-March. The early arrivals may lay eggs as soon as early April, but most do not lay until mid-May. In early August, chicks are hatched, then fledged by early November. These birds molt on their wintering grounds between November and February (Boersma and Silva 2001).

Typically, life cycles for Common Murres vary with the latitude of their breeding colony. These birds migrate to the Semidi Islands (just south of the Alaska Peninsula in the Gulf of Alaska) from mid-March to mid-May, with most arriving throughout April and early May. However, in the Chukchi Sea, Common Murres are migrating in mid-April to late May, with most arriving in the first half of May. At both sites, birds are laying eggs in June and early July and hatching chicks in July and August, although the Chukchi Sea birds tend to be a week or two behind the Semidi Island birds. September through mid-October (but as late as mid-November), the murres are migrating back to wintering grounds, where they finish out their annual molt by the end of November (Ainley et al. 2002).

The timing of spring molt and migration is speculative for Horned Puffins, but is believed to occur between early March and mid-June, with most birds molting in March and April and migrating in April and May. The majority of the birds lay eggs in late June through July, with hatching, rearing, and fledging taking place late July through mid-September. Both the fall molt (again, not well understood) and the migration happen in mid-September through November, and for some birds, as late as December. Horned Puffins are stationary during January and February on wintering grounds, then begin the cycle all over again. The annual cycle for Tufted Puffins is very similar to Horned Puffins, although the timing of migration, egg-laying, and chick-rearing tends to occur about two weeks earlier.

Diet

Colonial breeding is a survival strategy that helps species avoid predators. Seabirds do this by gathering in large, raucous groups, by locating their nests in hard-to-access cliffside areas, and by breeding synchronously so that predators are swamped with an overabundance of prey and can only take a limited number of eggs or chicks at any one time (Coulson 2002). One of the drawbacks of breeding among thousands of other individuals is the competition for food. Seabirds ameliorate this issue by selecting colonies near highly productive at-sea foraging hotspots, where ocean conditions tend to aggregate prey (such as are found in the highly productive Bering Sea ecosystem), and by regularly flying great distances (often over 30 miles [50 km]) from the colony to locate food. While many colonies are located near marine hotspots and heavily utilized foraging areas, others are located far from the nearest upwelling, requiring seabirds to travel. An example of this is the heavy use of the Bering Sea shelf break region by marine birds, especially surface-feeding birds, even though the nearest islands may be quite some distance away. Situated nearest to the shelf break, the Pribilof Islands, St. Matthew and Hall Islands, and St. Lawrence Island attract hundreds of thousands to millions of nesting seabirds.

Marine birds may be opportunistic surface-feeders (e.g., storm-petrels), or divers in pursuit of underwater prey (e.g., alcids), or in some cases bottom-feeders searching for bivalves on the ocean floor (e.g., eiders). Most colonial marine birds can be generalized into categories of planktivores (zooplankton-eaters) or piscivores (fish-eaters); however, many species utilize both types of food. Categorizing colonial birds into foraging guilds by combining foraging strategy (surface vs. diving) with primary forage type (planktivore vs. piscivore) reveals interesting patterns of habitat use (e.g. Wong et al. 2014). Surface-feeding colonial birds gather in the highest concentrations along areas influenced by upwelling from the Bering Sea shelf break, as well as along the Aleutian chain. Surface-feeding planktivores and piscivores form very similar concentration patterns, with the notable exception of the higher density of surface-feeding planktivores in the southern Chukchi Sea. Colonial diving birds have their highest concentrations on the Bering Sea shelf (especially near offshore islands), along the Aleutian chain, and in the Bering Strait. The distribution of diving piscivores is higher in the southeastern Bering Sea and northern Gulf of Alaska, while the diving planktivores have additional high-concentration areas in the Bering Strait and western Aleutians.

CONSERVATION ISSUES

Alaska bears a great responsibility for conserving seabird habitat as it is home to a significant proportion of the world's seabird abundance and diversity. The US, and particularly Alaska, supports the largest number of breeding seabird species of any nation, as well as the second-highest number of endemic breeding seabird species, and the third highest number of species of conservation concern (Croxall et al. 2012). Seabirds nesting at colonies can be severely impacted by natural disasters such as volcanic eruption (US Fish and Wildlife Service 2008c), and human-induced factors such as introduced species (e.g., eggs taken by foxes and rats on Aleutian Islands) (Byrd et al. 2005). Other disturbances at colonies may include hunting and the

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TABLE 5.1-1. Species composition and estimated abundance for bird colonies in the project area.

	Composition	Abundance	# Colonies	% of Total Birds
< 20,000	Auklets: 3% Murres: 24% Puffins: 29% Storm-Petrels: 2% Other: 42%	1,282,886	731	4%
20,000–49,999	Auklets: 10% Murres: 31% Puffins: 28% Storm-Petrels: 6% Other: 25%	1,813,555	55	5%
50,000–99,999	Auklets: 21% Murres: 35% Puffins: 18% Storm-Petrels: 1% Other: 26%	1,696,155	23	5%
100,000–249,999	Auklets: 17% Murres: 43% Puffins: 13% Storm-Petrels: 8% Other: 19%	4,623,259	29	13%
250,000–499,999	Auklets: 35% Murres: 17% Puffins: 15% Storm-Petrels: 18% Other: 15%	4,103,467	12	12%
500,000+	Auklets: 65% Murres: 14% Puffins: 2% Storm-Petrels: 15% Other: 4%	20,754,236	15	61%
Total	Auklets: 47% Murres: 21% Puffins: 8% Storm-Petrels: 13% Other: 11%	34,273,558	865	100%

Table sources listed in Map Data Sources section.

collection of eggs by subsistence users, noise from aerial or vessel traffic, nearby development, or disruption by birdwatchers or other recreational visitors. In the ocean, colonial seabirds are exposed to a number of other stressors, among those underwater noise, shipping traffic (Humphries and Huettmann 2014), overfishing (Ainley et al. 1994, Cury et al. 2011), or climate-induced changes in forage productivity and availability (Meehan et al. 1998, Piatt et al. 2007, Koeppen et al. 2016). Other threats include fishing bycatch, ingestion of plastics (Causey and Padula 2015), and oil-and-gas activity and spills (O'Hara and Morandin 2010).

Although colonies with large bird populations are obvious conservation targets, others with only several hundred birds can also be a priority, depending upon the sensitivity of the species. Habitat for endemic species, those with low total abundance, few breeding colonies, and/or species of concern should be given special consideration. All colony sites depicted on this map should be protected from direct human disturbance and development, with the exception of allowable hunting and the gathering of eggs for subsistence. The Alaska Maritime National Wildlife Refuge currently owns and manages a majority of the colonies in Alaska. Conserving only 27 of the 865 colonies would protect three-quarters of all colonial nesting seabirds shown on this map—about 25 million individuals (see Table 5.1-1). Those sites, in particular, should receive the highest possible protection from harm.

MAPPING METHODS (MAPS 5.1.1–5.1.2d)

The North Pacific Seabird Data Portal (NPSDP) is part of the Seabird Information Network (SIN) (Seabird Information Network 2011). The NPSDP contains data depicting seabird colony locations, species, and populations across Alaska, as well as parts of eastern Russia and western Canada. These colonies range in size from a few individuals to several million birds. Surveyors recorded the abundance of each species present at each colony location by counting or estimating (or in some cases very roughly estimating) the number of individuals, nests, or pairs. The database reports the best estimate made for that colony based on one or more site visits. Smith et al. (2012) eliminated older (pre-1971), poor, or questionable records, and compiled a multi-species colony data layer from the SIN database.

In addition, Audubon Alaska updated colony data records for eight species. In Alaska, we added new information on Aleutian Terns (*Onychoprion aleuticus*), which represents the most recent or otherwise best estimate available for each colony location. This resulted in updated abundance estimates for some colonies, as well as the addition of new colony locations. Aleutian Tern colony data were provided by Seabird Information Network (2017) and the authors of Renner et al. (2015). Additional colony locations for Common Eiders, as well as one colony for Thick-billed Murres, were provided from unpublished nesting colony data collected by the Canadian Wildlife Service (2013). These data depicted nesting sites along the Canadian Beaufort coast—an

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TABLE 5.1-2. Classification of foraging guilds for colonial nesting marine birds that regularly forage in the Bering, Chukchi, and Beaufort Seas.

Species	Surface	Diving[1]	Planktivorous	Piscivorous
Aleutian Tern	x		x	x
Arctic Tern	x			x
Black-legged Kittiwake	x		x	x
Fork-tailed Storm-Petrel	x		x	x
Glaucous Gull	x		x	x
Glaucous-winged Gull	x			x
Herring Gull	x		x	x
Ivory Gull	x		x	x
Leach's Storm-Petrel	x		x	x
Northern Fulmar	x		x	x
Red Phalarope	x		x	
Red-legged Kittiwake	x			x
Red-necked Phalarope	x		x	
Ross's Gull	x		x	x
Sabine's Gull	x		x	x
Unidentified Gull	x		x	x
Unidentified Kittiwake	x			x
Unidentified Phalarope	x		x	
Unidentified Storm-Petrel	x		x	x
Unidentified Tern	x			x
Ancient Murrelet		x	x	x
Black Guillemot		x		x
Cassin's Auklet		x	x	
Common Murre		x	x	x
Crested Auklet		x	x	
Double-crested Cormorant		x		x
Dovekie		x	x	
Horned Puffin		x		x
Least Auklet		x	x	
Parakeet Auklet		x	x	
Pelagic Cormorant		x		x
Pigeon Guillemot		x	x	x
Red-faced Cormorant		x		x
Short-tailed Shearwater		x	x	x
Sooty Shearwater		x	x	x
Thick-billed Murre		x	x	x
Tufted Puffin		x		x
Whiskered Auklet		x	x	
Unidentified Auklet		x	x	
Unidentified Cormorant		x		x
Unidentified Murre		x	x	x
Unidentified Puffin		x		x
Unidentified Shearwater		x	x	x

[1] The diving category included deep plungers such as shearwaters.

area not included in SIN. We also updated count data for Red-faced Cormorants in the Pribilof Islands based on Romano and Thomson (2016), and count data for larger Red-faced Cormorant colonies in the Aleutian Islands based on Alaska Maritime National Wildlife Refuge (2009), Byrd et al. (2001b), and Byrd and Williams (2004). Red-legged Kittiwake colony data were updated based on Byrd et al. (1997), Byrd et al. (2001a), Byrd et al. (2001b), Byrd et al. (2004), Thomson et al. (2014), and Williams (2017). Data for Crested, Least, and Parakeet Auklets were updated based on Artukhin et al. (2016), Konyukhov et al. (1998), and Vyatkin (2000).

Species were classified into foraging guilds (Table 5.1-2) based on diet information in the Birds of North America Online (Cornell Lab of Ornithology and American Ornithologists' Union 2016) and personal communication with George Hunt (University of Washington) and Brie Drummond (Alaska Maritime National Wildlife Refuge). Species that utilize both zooplankton and fish as primary food sources (depending on season, location, etc.) were added to both categories. We analyzed annual average density using data from Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), with data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Survey data for summer and fall (June–November) were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We then ran a 31-mile (50-km) kernel density analysis to convert binned data into smoothed distribution data.

Data Quality

The colony data are available throughout the US and Russian portions of the project area, with the addition of some Canadian data, but data quality—survey dates and techniques—varies substantially among colonies. Very large colonies, such as those of auklets or storm-petrels, are the hardest to estimate and are likely to have the greatest uncertainty. As a result, species abundances presented on this and other maps in this chapter represent the best estimate available, but that estimate may be highly uncertain or imprecise.

The at-sea survey data used in the foraging guild maps have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting maps. There is little to no survey coverage in the Canadian and Russian portions of the project area, potentially leaving major data gaps for these species. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of these maps.

Reviewer

- Robb Kaler

MAP DATA SOURCES

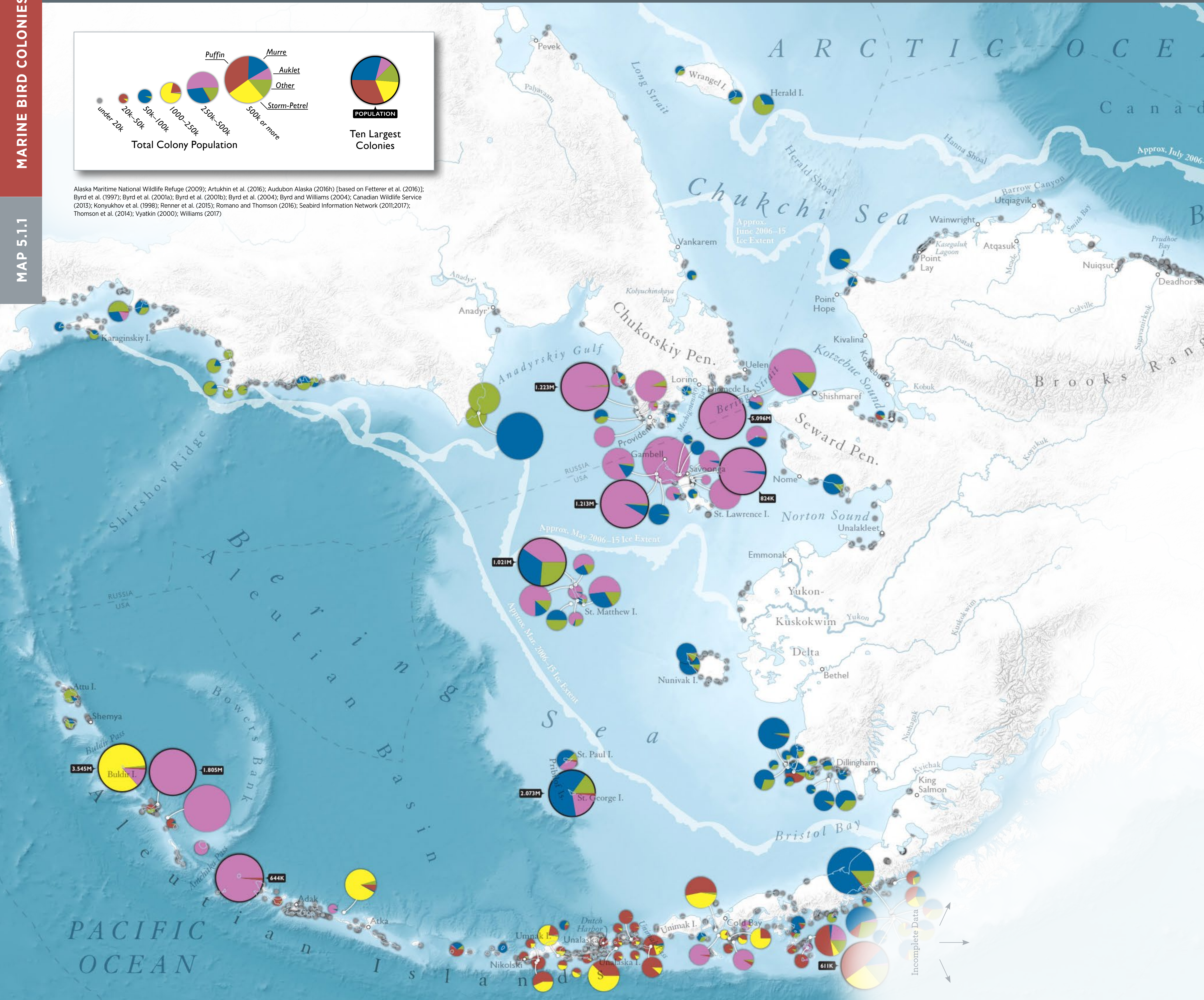
Marine Bird Colonies Map: Alaska Maritime National Wildlife Refuge (2009); Artukhin et al. (2016); Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Byrd et al. (1997, 2001a, 2001b, 2004); Byrd and Williams (2004); Canadian Wildlife Service (2013); Konyukhov et al. (1998); Renner et al. (2015); Romano and Thomson (2016); Seabird Information Network (2011; 2017); Thomson et al. (2014); Vyatkin (2000); Williams (2017)

Foraging Guilds Maps: Audubon Alaska (2017e) based on Audubon Alaska (2016a)

Marine Bird Colonies

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman

Audubon ALASKA



Alaska Maritime National Wildlife Refuge (2009); Artukhin et al. (2016); Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Byrd et al. (1997); Byrd et al. (2001a); Byrd et al. (2001b); Byrd et al. (2004); Byrd and Williams (2004); Canadian Wildlife Service (2013); Konyukhov et al. (1998); Renner et al. (2015); Romano and Thomson (2016); Seabird Information Network (2011;2017); Thomson et al. (2014); Vyatkin (2000); Williams (2017)

Gary Drew / USGS

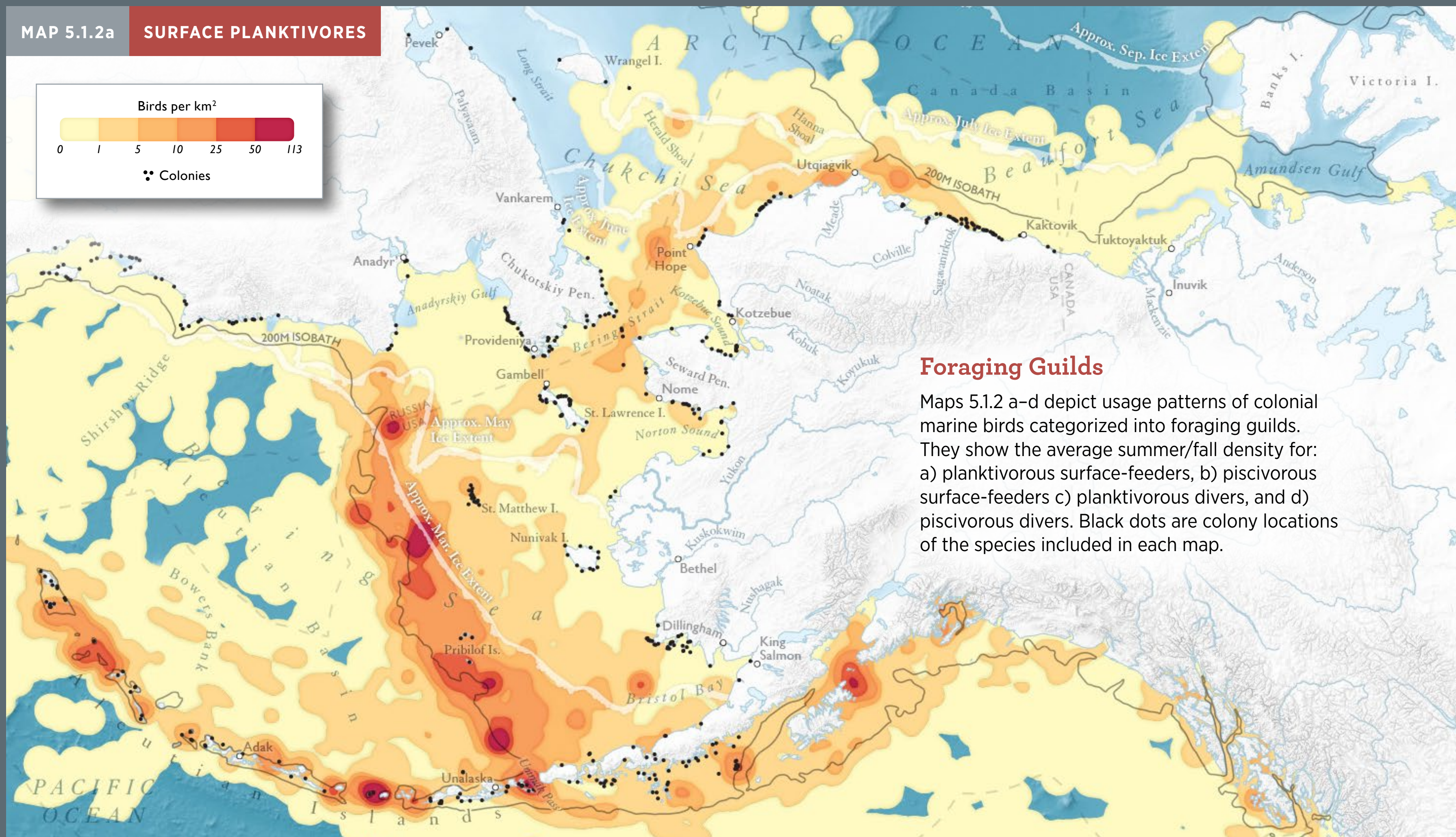
Marine Bird Colonies

Globally, about 13% of all bird species nest in colonies (Gill 1995), although when it comes to seabirds, about 98% of species breed colonially (Hamer et al. 2002). The term marine birds refers to both seabirds and marine-associated waterbirds. This region provides excellent habitat for colony-nesting marine birds: 865 colonies are mapped throughout the project area, providing nesting habitat for nearly 34 million birds. The four most numerous categories of birds, from highest to lowest across the region, are auklets (16.1 million), murres (7.1 million), storm-petrels (4.4 million), and puffins (2.8 million). Ten species (including one group identified only to genus) total over one million birds across the project area. The most abundant species is the Least Auklet (*Aethia pusilla*), which nests in the largest colonies of any seabirds in this region, estimated at 7.8 million birds distributed across only 35 colonies. The largest nesting colony in the project area is on Big Diomede Island, Russia, which is home to an approximated 5.1 million birds. The second-largest colony, and the largest in Alaska, is on Buldir Island where 3.5 million birds gather. Three-quarters of all colonial nesting birds, about 25 million individuals, nest in only 27 colonies.

Foraging Guilds

Map Author: Melanie Smith
Cartographer: Daniel P. Huffman

MAP 5.1.2a SURFACE PLANKTIVORES

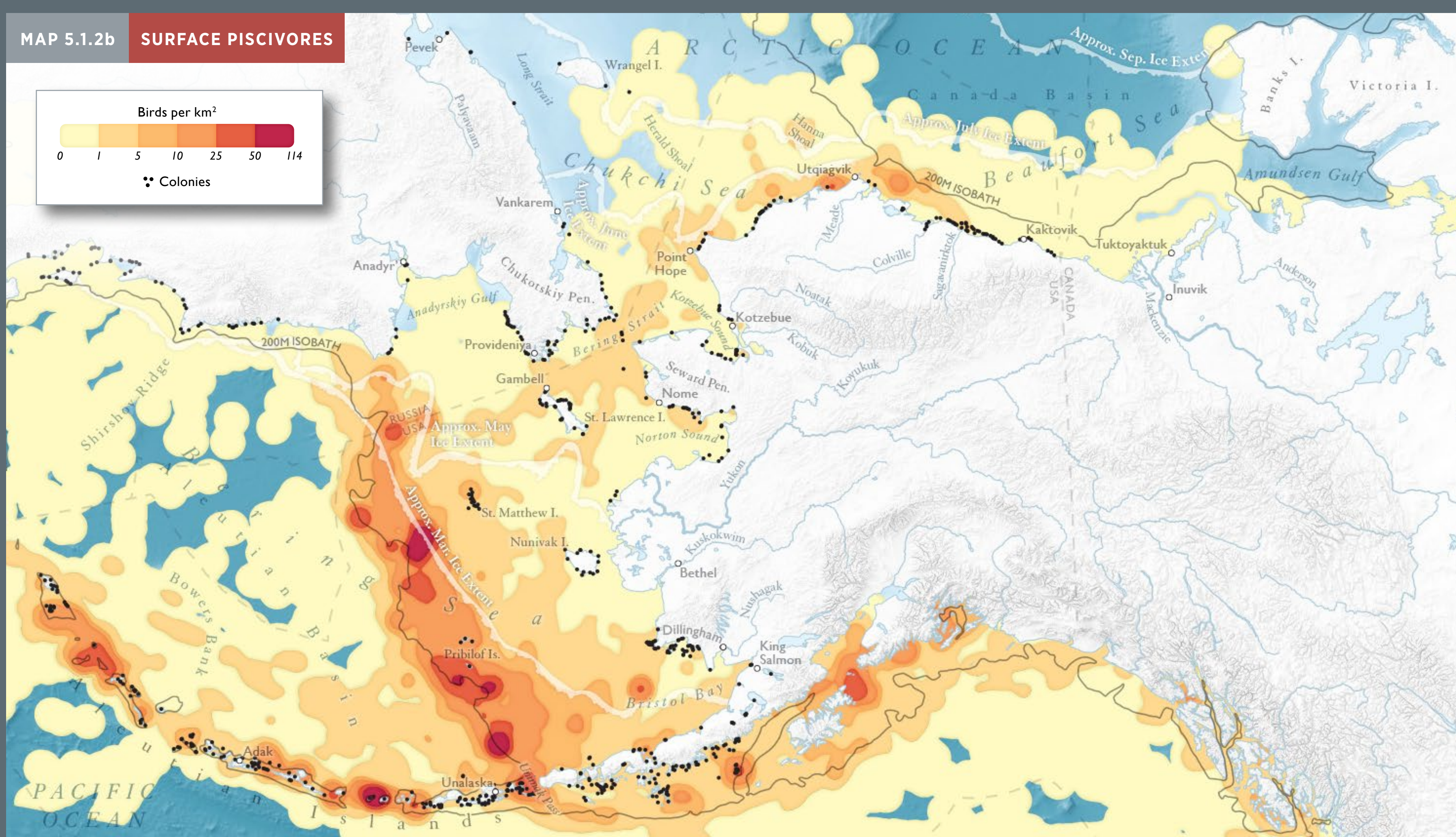


Foraging Guilds

Maps 5.1.2 a–d depict usage patterns of colonial marine birds categorized into foraging guilds. They show the average summer/fall density for: a) planktivorous surface-feeders, b) piscivorous surface-feeders c) planktivorous divers, and d) piscivorous divers. Black dots are colony locations of the species included in each map.

Audubon Alaska (2017e) based on Audubon Alaska (2016a)

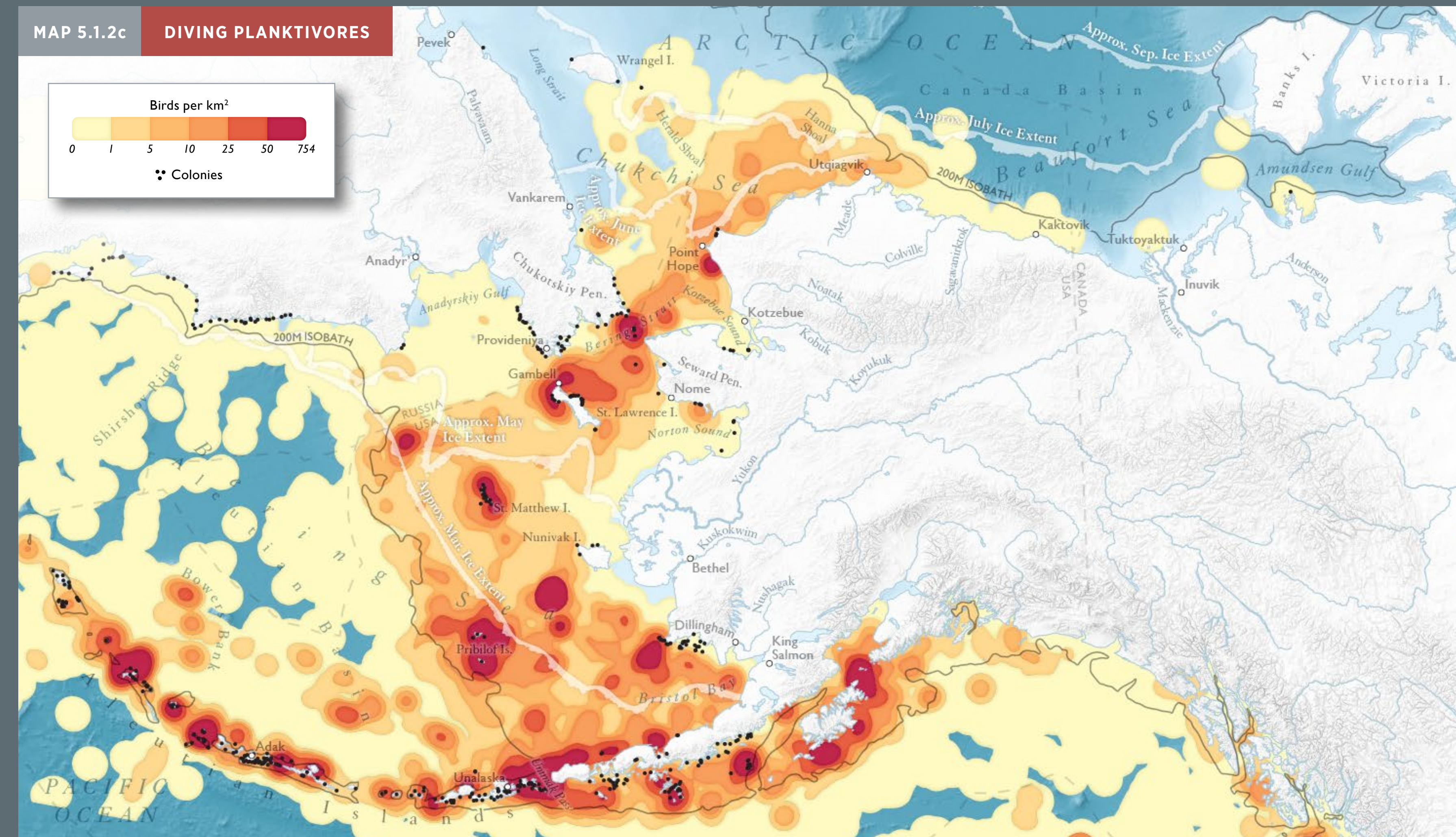
MAP 5.1.2b SURFACE PISCIVORES



Audubon Alaska (2017e) based on Audubon Alaska (2016a)

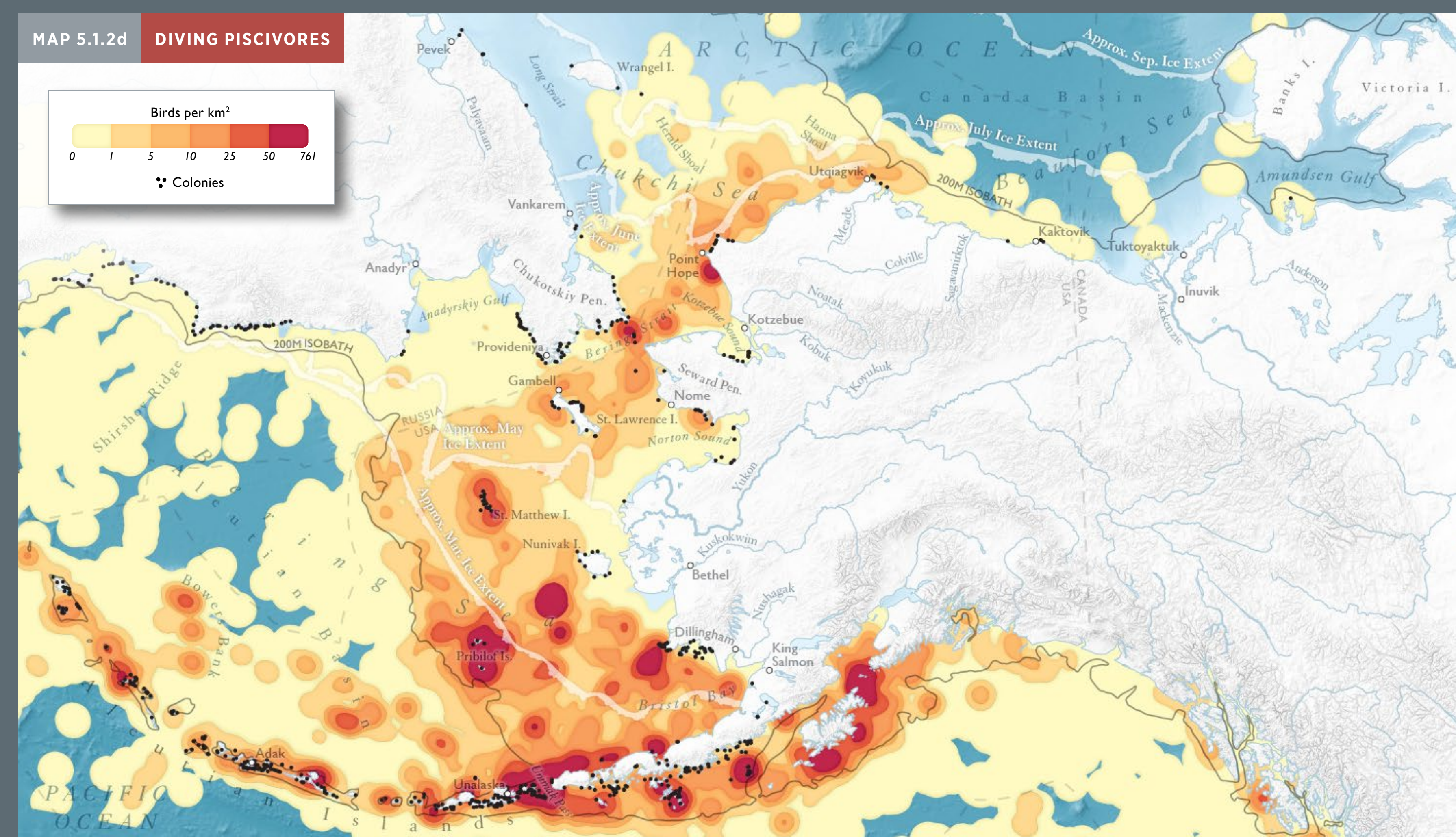
NPPSD Audubon ALASKA

MAP 5.1.2c DIVING PLANKTIVORES



Audubon Alaska (2017e) based on Audubon Alaska (2016a)

MAP 5.1.2d DIVING PISCIVORES



Audubon Alaska (2017e) based on Audubon Alaska (2016a)

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Important Bird Areas

Melanie Smith

Effective bird conservation requires the identification of areas used by populations for key life-history events including breeding, foraging, staging, molting, and migration. Important Bird Areas (IBAs) are based on an established program that identifies these essential habitats for birds (National Audubon Society 2012, BirdLife International 2017a). IBAs are designated using a set of scientific criteria that trigger the nomination of sites, which are reviewed by local and national committees of leading bird experts convened by Audubon and BirdLife International. The global network of more than 1,200 IBAs around the world continues to grow.

Marine IBAs are sites that are delineated from the surrounding seascape due to specific criteria. For an area to qualify as an IBA, it must support a high concentration of birds, provide habitat for a threatened or rare species, or provide habitat for a bird with a very limited or restricted range. In the US, sites are ranked as significant at the state, continental, or global level, based on the estimated population abundance. The majority of Alaska's IBAs are recognized at the global level for including 1% or more of the global population of seabirds (the A4ii criterion), or 1% or more of the North American population of waterbirds (waterfowl and shorebirds; the A4i criterion)—both of which qualify for global status. Audubon Alaska has identified 208 IBAs in the state, more than three-quarters of which are globally significant. Alaska has more globally significant IBAs than any other state, and almost half of all of the globally significant IBAs identified in the US.

DISTRIBUTION

Marine birds in Alaska (> 50 million) far outnumber the human population of the state (~740,000 in 2016), and marine bird densities across the Bering Sea are of global significance; the US Fish and Wildlife Service (2008b) estimates that seabird nesting along the Bering Sea coast accounts for 87% of the seabirds in the US. Accordingly, our project area includes many notable IBAs (Audubon Alaska 2014).

The Northern Alaska Peninsula Coastal IBA (see Map 5.2) has the largest number of recorded species, with 69. This IBA is globally significant for Black Scoter (*Melanitta americana*), Emperor Goose (*Chen canagica*), Glaucous-winged Gull, (*Larus glaucescens*) King Eider (*Somateria spectabilis*), Steller's Eider (*Polysticta stelleri*)), and White-winged Scoter (*Melanitta fusca*).

The Teshekpuk Lake Area IBA is especially significant for waterfowl and shorebirds, such as Red and Red-necked Phalaropes (*Phalaropus fulicarius* and *P. lobatus*), Northern Pintails (*Anas acuta*), Long-tailed Ducks (*Clangula hyemalis*), and Yellow-billed Loons (*Gavia adamsii*). It has the largest number of species triggering IBA status, at 31, and 15 of those are at the A4i level, indicating 1% or more of the North American population are present.

The greatest abundance of birds in any IBA is in Unimak and Akutan Passes, with an estimate of over 7 million birds, of which about 4.5 million are Short-tailed and Sooty Shearwaters (*Puffinus tenuirostris* and *P. griseus*), accompanied by hundreds of thousands of Black-legged Kittiwakes (*Rissa tridactyla*), Northern Fulmars (*Fulmarus glacialis*), Tufted Puffins (*Fratercula cirrhata*), Whiskered Auklets (*Aethia pygmaea*), and Crested Auklets (*A. cristatella*).

The Buldir Island Colony IBA is the single largest colony in Alaska, with 3.5 million birds, primarily nesting Leach's and Fork-tailed Storm-Petrels (*Oceanodroma leucorhoa* and *O. furcata*). However, the prize for the largest colony in the project area goes to Big Diomede Island, Russia. The Diomede Islands Colonies IBA (Big and Little Diomede Islands combined) is home to 5.1 million Least (*A. pusilla*), Crested, and Parakeet Auklets (*A. psittacula*) Auklets.

In addition, several other marine IBAs encompass over one million birds (Audubon Alaska 2014): Bering Sea Shelf Edge 166W55N (4.3 million); Semidi Islands Colonies (2.4 million); St. George Island Colony (2.1 million); Kiska Island Colonies (1.8 million); Southwest Cape Colonies (1.7 million); St. Matthew and Hall Islands Colonies (1.6 million); Savoonga Colonies (1.5 million); Kiska Island Marine (1.4 million); St. George Island Marine (1.3 million); Buldir & Near Islands Marine (1.1 million); and Fenimore Pass & Atka Island Marine (1.1 million).

LIFE CYCLE

Breeding areas, including places for courting, mating, nesting, and raising young, make up many of the IBAs identified throughout the Bering Sea, Arctic Ocean, and Interior. Several of the largest seabird congregation areas in the world are found at seabird colonies along cliffs and island shores in the Bering Sea. Many marine IBAs near the western Alaska coast are places that birds migrate through in spring, then molt, stage, and/or migrate through in the fall. Millions of birds stay in Alaska in the winter, most often concentrated in the southern Bering Sea and Aleutian Islands, or the northern Gulf of Alaska. Other IBAs often encompass foraging hotspots found at eddies, shelf breaks, and upwelling sites along the Bering Sea shelf, Bering Strait, Chukchi Sea, nearshore waters in the Beaufort Sea, and the Aleutian Islands.

CONSERVATION ISSUES

Ever-increasing human demands on marine resources have intensified the need to identify and conserve important ecosystem functions and habitat for birds. Globally, seabird numbers are thought to be in steep decline, down 70% since 1950 among the world's monitored populations, likely due to a combination of factors (Paleczny et al. 2015). Habitat loss (including impacts on marine forage resources) is a serious threat facing bird species around the world. In the marine realm, habitat can be lost to a number of stressors, such as underwater noise, shipping traffic (Humphries and Huettmann 2014), overfishing (Ainley et al. 1994, Cury et al. 2011), or climate-induced changes in forage productivity and availability (Meehan et al. 1998, Piatt et al. 2007, Koeppen et al. 2016). Other threats include natural disasters (US Fish and Wildlife Service 2008c), fishing bycatch (particularly relevant to the Short-tailed Albatross [*Phoebastria albatrus*]) (US Fish and Wildlife Service 2014a), ingestion of plastics (Causey and Padula 2015), oil-and-gas activity and spills (O'Hara and Morandin 2010), and introduced species (e.g. eggs taken by foxes and rats on Aleutian Islands) (Byrd et al. 2005).

Recognition of IBA status does not automatically impose any type of regulation or management guidelines. However, IBAs are often the focus of conservation efforts, and many of them have been subsequently protected under various conservation designations. In addition to providing a starting point for establishing legal protections, IBA information can be utilized in regional to global applications, such as environmental assessments, the design of best management practices, or broad-scale integrative spatial planning. Globally, thousands of IBAs and millions of acres of avian habitat have received recognition and better protection as a result of the IBA program. In the marine environment, IBAs make good candidates for Marine Protected Areas (MPAs) (Lascelles et al. 2012, Ronconi et al. 2012), because places where seabirds forage are often indicative of productivity hotspots for lower trophic organisms, fishes, and marine mammals (Piatt and Springer 2003, Piatt et al. 2007, Parsons et al. 2008, Suryan et al. 2012).

Audubon's Alaska IBA program is an initiative to address conservation issues through place-based assessments of threats and protections necessary for the long-term health of bird populations. The US, primarily Alaska, supports the largest number of breeding seabird species of any nation, as well as the second-highest number of endemic breeding species, and the third highest number of species of conservation concern (Croxall et al. 2012). Having a significant proportion of the world's seabird abundance and diversity, Alaska bears a great responsibility for the stewardship of seabird habitat and conservation.

5.2 IMPORTANT BIRD AREAS

MAP ON PAGES 122–123

Aaron Lang / USFWS

In winter, the global population of over 350,000 Spectacled Eiders uses the perennial polynya south of St. Lawrence Island in the northern Bering Sea. Because of this level of aggregation, these birds are particularly vulnerable to disease, spills, or habitat degradation.

Three species of seabirds on the Endangered Species List are of particular concern: Short-tailed Albatross (endangered), Steller's Eider (threatened), and Spectacled Eider (*Somateria fischeri*; threatened), all of which use the Bering, Chukchi, and Beaufort Seas. Currently, there are no IBAs designated for Short-tailed Albatross. There are 20 globally significant IBAs for Steller's Eiders, 10 of which regularly have 1% or more of the North American population present. There are four globally significant IBAs for Spectacled Eider, which regularly have 1% or more of the North American population present.

Presently, several IBAs are within areas permanently withdrawn from offshore oil-and-gas development in Bristol Bay. Recently recommended by the US Coast Guard, shipping Areas to be Avoided would keep transiting vessels of 400 gross tons or more out of significant marine areas such as the St. Lawrence Island Polynya IBA, where the entire world's population of 350,000 Spectacled Eiders spends their winters. Many other colony IBAs are protected as part of the Alaska Maritime National Wildlife Refuge. IBAs are invaluable in the life histories of many species that live in the Bering, Chukchi, and Beaufort Seas, and should be regarded as having high conservation priority.

MAPPING METHODS (MAP 5.2)

Alaska's IBA network is a compilation of areas identified using at-sea surveys, colony data, and expert opinion. At-sea IBAs were established from an extensive database of at-sea survey data spanning 37 years, the North Pacific Pelagic Seabird Database, or NPPSD (US Geological Survey–Alaska Science Center 2015). Audubon Alaska developed a standardized and data-driven spatial method for identifying globally significant marine IBAs across Alaska, in a six-step process: 1) spatially binning data, and accounting for unequal survey effort; 2) filtering input data for persistence of species use; 3) analyzing data to produce data layers representing a gradient from low to high abundance; 4) drawing single-species core area boundaries around major concentrations based on abundance thresholds; 5) validating the results; and 6) combining overlapping boundaries into important areas for multiple species (Smith et al. 2014c).

Smith et al. (2012) identified globally significant colony IBAs by analyzing an extensive colony catalog put together by the US Fish and Wildlife Service (Seabird Information Network 2011). Spatial analysis was used to group nearby colonies in "metacolonies" (e.g. on adjoining cliffs or islets). Alaska's IBAs also include coastal and interior IBAs identified through GIS analysis of aerial survey data, employing similar methods to those described above using at-sea surveys (Smith et al. 2014b).

Finally, some IBAs were derived using boundaries drawn by experts to delineate areas of known high concentration. Expert opinion was used in areas where spatial data were insufficient to create GIS-derived boundaries. Together, these various IBA-identification methods make up the Alaska IBA network. IBAs from Canada and Russia were acquired from BirdLife International and delineated using similar methods with an emphasis on expert-derived IBAs.

Data Quality

The at-sea survey data used to identify IBAs in Alaska, the NPPSD, has variable coverage across the project area. Areas of Alaska vary greatly in survey coverage and effort, influencing identification of IBAs. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of these maps. In Alaska, Smith et al. (2014c) developed methods that conservatively identified IBAs so that results minimized Type I errors (false positives), while recognizing that other areas of importance likely exist that were not identified. Therefore, areas not shown as IBAs on this map are not necessarily unimportant.

Reviewer

- Gary Drew

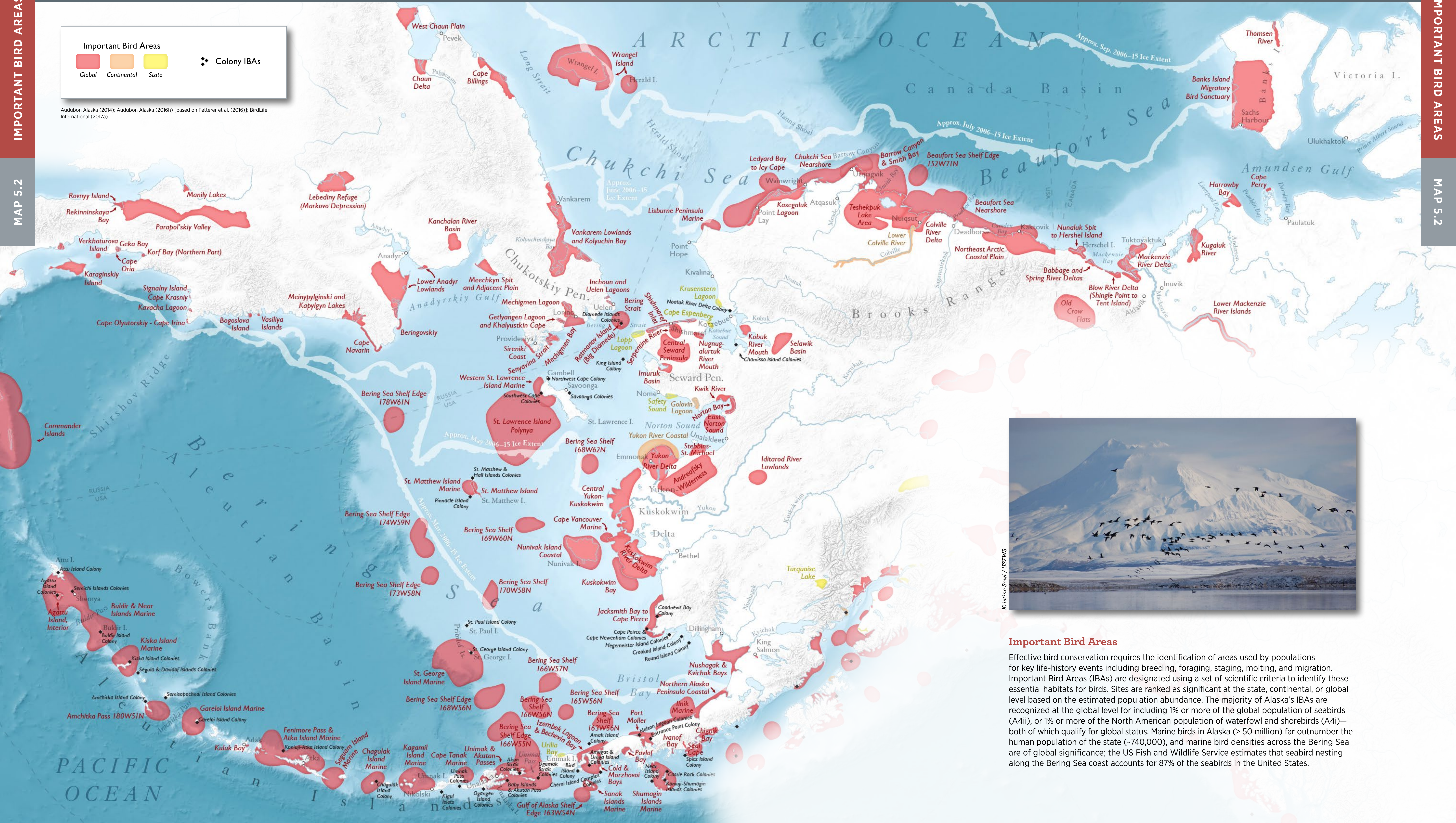
MAP DATA SOURCES

Important Bird Areas: Audubon Alaska (2014); BirdLife International (2017a)

Important Bird Areas

Map Author: Melanie Smith
Cartographer: Daniel P. Huffman

NPPSD
Audubon ALASKA



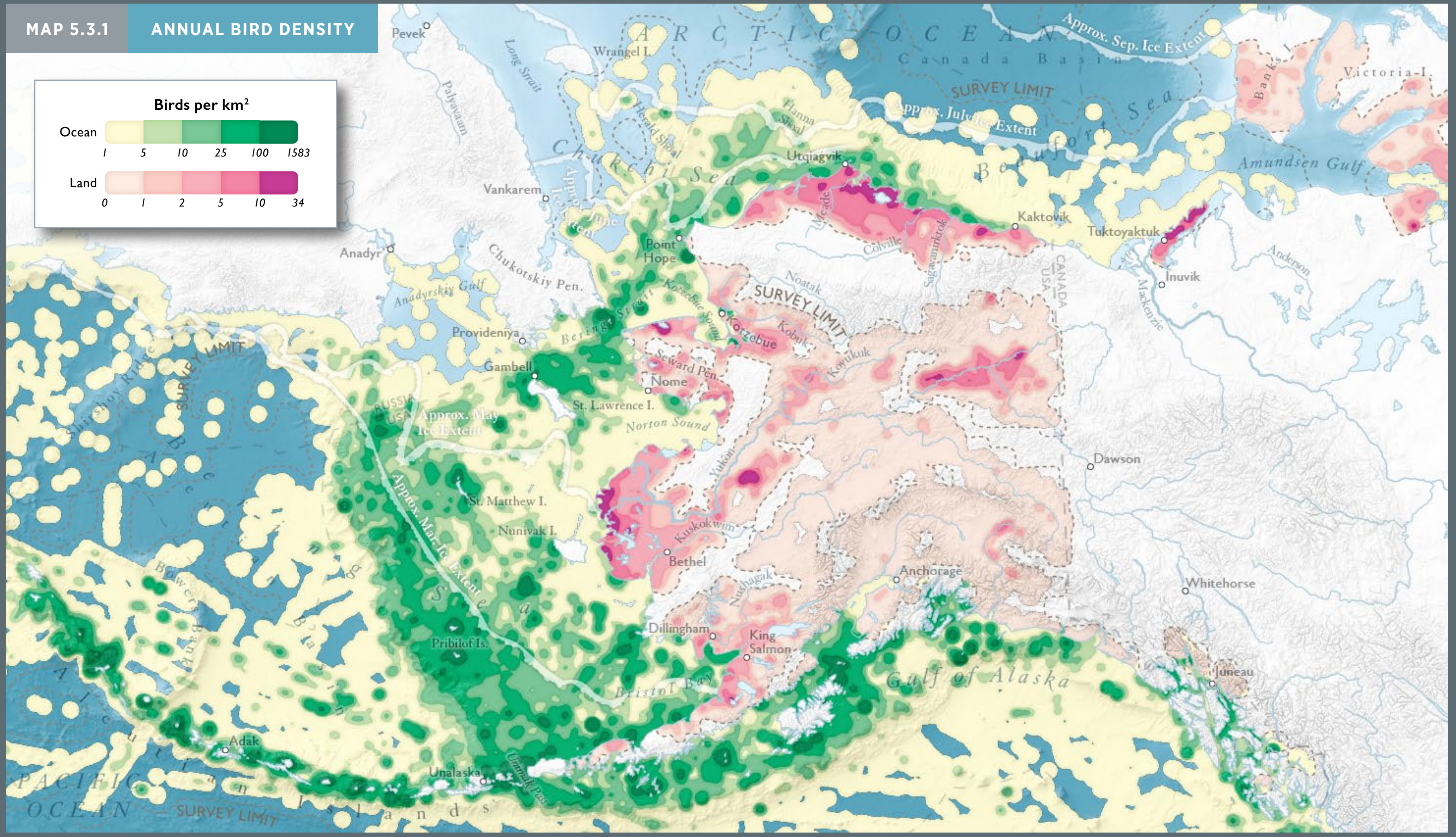
Kristine Sowl / USFWS

Important Bird Areas

Effective bird conservation requires the identification of areas used by populations for key life-history events including breeding, foraging, staging, molting, and migration. Important Bird Areas (IBAs) are designated using a set of scientific criteria to identify these essential habitats for birds. Sites are ranked as significant at the state, continental, or global level based on the estimated population abundance. The majority of Alaska's IBAs are recognized at the global level for including 1% or more of the global population of seabirds (A4ii), or 1% or more of the North American population of waterfowl and shorebirds (A4i)—both of which qualify for global status. Marine birds in Alaska (> 50 million) far outnumber the human population of the state (~740,000), and marine bird densities across the Bering Sea are of global significance; the US Fish and Wildlife Service estimates that seabird nesting along the Bering Sea coast accounts for 87% of the seabirds in the United States.

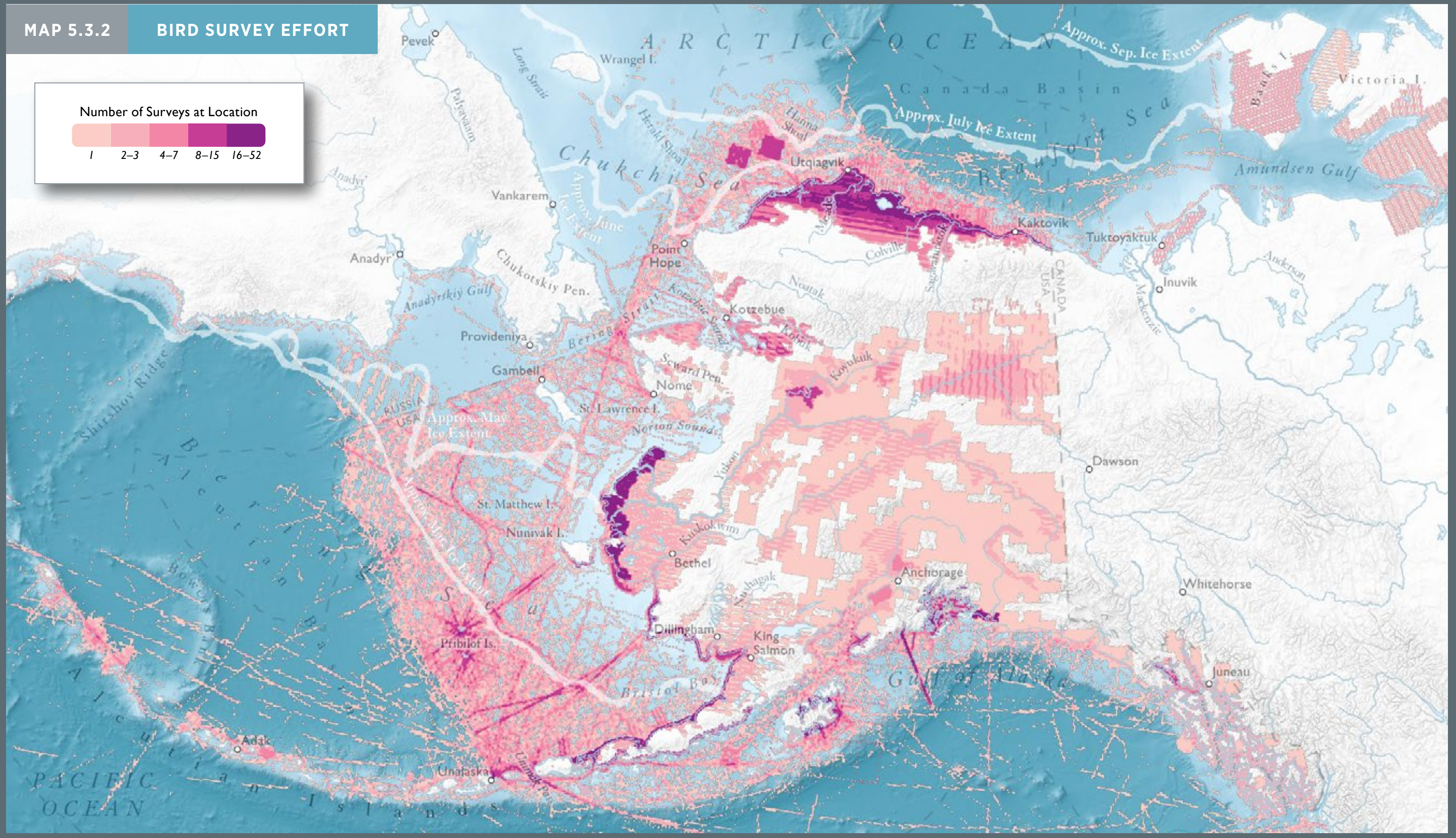
A Closer Look: Bird Density and Survey Effort

MAP 5.3.1 ANNUAL BIRD DENSITY



Map Authors: Melanie Smith, Erika Knight, and Benjamin Sullender
Cartographer: Daniel P. Huffman

MAP 5.3.2 BIRD SURVEY EFFORT



Melanie Smith

MAPPING METHODS

Audubon Alaska collected the available bird survey databases for this region and compiled them into a single dataset called the Alaska Geospatial Bird Database (AGBD) in order to seamlessly analyze bird distribution and concentration (Audubon Alaska 2016a). The AGBD combines and integrates survey locations from available aerial and at-sea bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) compiled by the US Geological Survey (USGS). Surveys included in the AGBD were conducted between 1973 and 2014.

We processed each incoming dataset across a standard fishnet of 3.1-mile (5-km) bins, calculating average species density within each bin summarized by year and survey, and merged all results into a single dataset. We then dissolved that dataset to create a single value for each species in each bin representing the average density across all surveys and years, as well as the total average density of birds within each bin.

Bird survey effort (Audubon Alaska 2017a) was calculated by counting the number of surveys within each 3.1-mile (5-km) bin. Seasonal bird density was calculated using kernel density analysis with a 31-mile (50-km) search radius by breaking the species records out by season before dissolving and averaging density: winter (December–February), spring (March–May), summer (June–August), and fall (September–November). Annual bird density was calculated using kernel density analysis with a 15.5-mile (25-km) search radius based on the total average density of all species detected.

Data Quality

The AGBD survey data have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas delineated using this dataset may be biased toward US waters. Additionally, within Alaska, survey coverage and effort vary greatly, influencing overall accuracy of the resulting densities and mapped distribution patterns. Little to no survey coverage in the Canadian and Russian portions of the project area potentially result in major data gaps for total bird density and for species distributions depicted throughout this chapter.

MAP DATA SOURCES

These maps are based on the AGBD (Audubon Alaska 2016a). The AGBD is a compilation of many major survey efforts and compiled databases. The data included were:

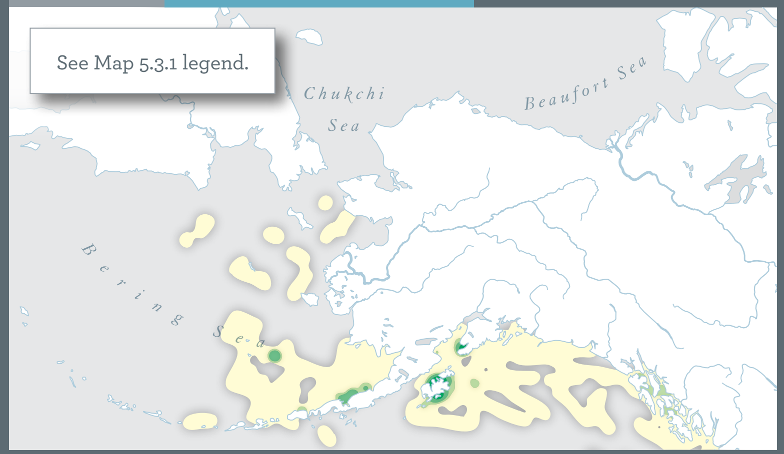
Manomet, Inc.: PRISM Shorebird (2002–2008)

NPS: Nearshore Survey (2006–2013), Wrangell Aerial Waterfowl Surveys (2007)

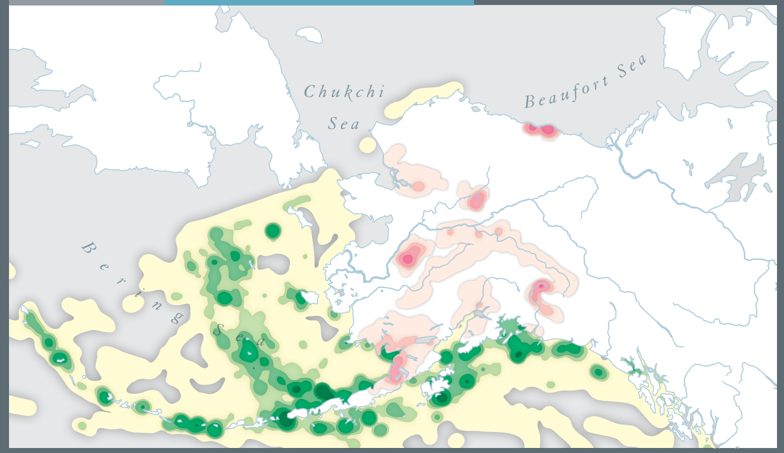
USGS: NPPSD v2

USFWS: Alaska Expanded (1989–2008), Arctic Coastal Plain (ACP) Breeding Pair (1992–2006), ACP Common Eider Shoreline Survey (1999–2009), ACP Waterbird (2007–2010), ACP Yellow-Billed Loon (2003–2004), Arctic Nearshore (1998–2003), Beaufort Nearshore (1999–2000), Beaufort Offshore (1999–2001), Black Scoter (2004–2008), Cook Inlet Steller's Eider (2004–2005), Copper River Dusky Canada Goose (1986–2009), Kodiak Steller's Eider (2001–2010), North Slope Eider (1992–2006), North Slope Shorebird Survey (2005–2007), PRISM Shorebird (2002–2008), Seward Peninsula Yellow-billed Loon (2005–2007), South-central Loon (2001–2003), Southeast Alaska (1997–2002), Southwest Alaska Emperor Goose (1999–2012), Southwest Alaska Steller's Eider (1997–2012), Teshekpuk Lake Goose Molting (1997–2006), Trumpeter Swan (2005), Central Arctic (2005–2011), At-Sea (2013–2014), Western Greater White-fronted Goose (1994–2008), Yukon Delta Goose Swan Crane (1985–2008), Yukon Delta Waterbird (1988–2008)

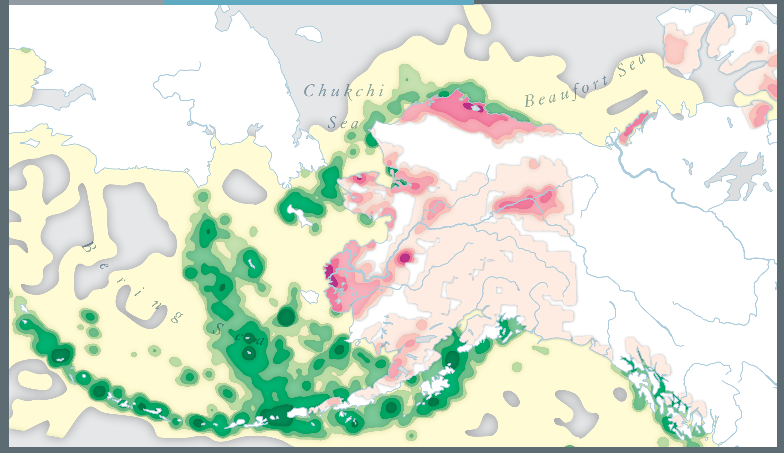
MAP 5.3.3a WINTER BIRD DENSITY



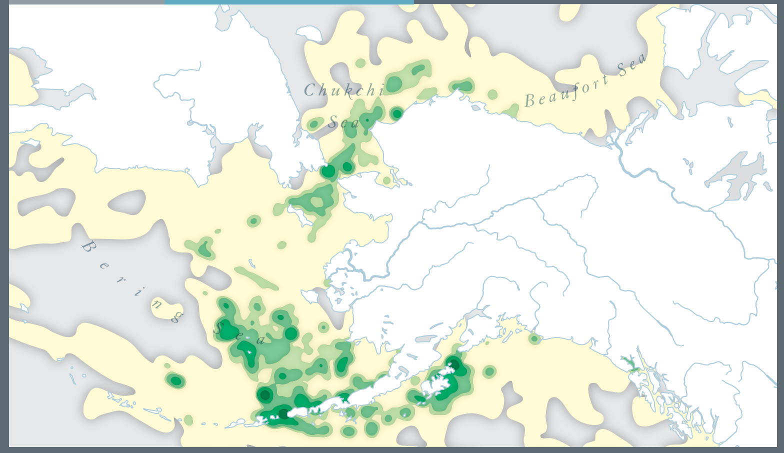
MAP 5.3.3b SPRING BIRD DENSITY



MAP 5.3.3c SUMMER BIRD DENSITY



MAP 5.3.3d FALL BIRD DENSITY



Eiders

Max Goldman, Erika Knight, and Melanie Smith

King Eider *Somateria spectabilis* | **Spectacled Eider** *S. fischeri* | **Common Eider** *S. mollissima* | **Steller's Eider** *Polysticta stelleri*

Eiders are especially well-adapted to the Arctic climate, spending their entire lives within a few hundred miles of the sea-ice edge (Frimer 1994a, Oppel et al. 2011). These hardy Arctic and subarctic birds are among the northernmost nesters on the planet. The four eider species make up two distinct genera, *Somateria,* and *Polysticta,* within the sea ducks subfamily Meringae. As such, they spend the majority of their lives at sea, returning to shore only to breed (Johnsgard 1964, Lamothe 1973, Oppel et al. 2009a). Eiders are among the deepest diving of the more than 20 extant sea duck species, often reaching depths of more than 100 feet (30 m) while foraging for mollusks and crustaceans from the ocean floor. Differences mainly in size allow the four eider species to utilize similar habitats without directly competing for resources (Fox and Mitchell 1997, Merkel et al. 2007a, Merkel et al. 2007b). Because they feed on the ocean floor, they are generally found within 9 miles (15 km) of the shore, or where the shelf is not too deep to be accessible or productive (Oppel et al. 2009b, Oppel and Powell 2010b).

Eiders are deep divers, reaching depths of up to 165 feet (50 m) and averaging dives of 33–66 feet (10–20 m) (Frimer 1994b). They are covered in especially dense down, which contributes to their ability to withstand the brutal temperatures of the Arctic and subarctic. Male eiders have ornate plumage on their heads during breeding season, which they display to females with head-turning behavior, enticing them to copulate. Their webbed feet allow them to swim and dive extremely well, while the claws they have on each toe enable them to grip the icy substrate often present when they arrive at their breeding grounds (Bent 1925). While diving, eiders use their feet and wings to propel themselves forward. After each dive, they preen their feathers to promote drying and to redistribute the oil from their oil gland to protect their feathers from saturation in preparation for the next dive (Johnsgard 1964, Frimer 1994b).

DISTRIBUTION

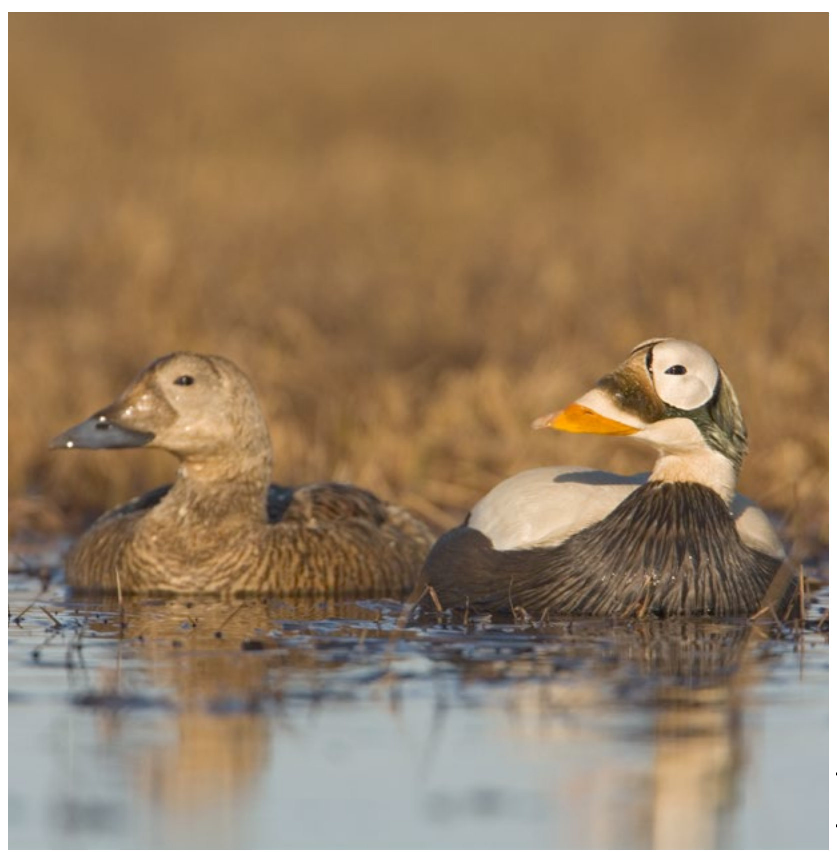
Eiders spend the vast majority of their time at sea. Males spend 11 months a year there, coming ashore only to breed. Females are on land for approximately three months for breeding, but spend the rest of the year in open water. When eiders migrate north during the spring, they often arrive before the thaw. They likely choose their nest sites based on which areas thaw and dry first. As sea ice marches south during the fall and winter, many eiders will follow the ice edge as it continues south, feeding at the productive ice margin. When the ice margin begins to retreat north in the spring, eiders again prepare to migrate to their breeding grounds.

Migration

In the spring, eiders of all species form flocks of 10,000–15,000, and up to 100,000, and migrate from staging and wintering areas to their breeding grounds. They are among the first birds to return to northern breeding grounds, flying at all hours and traveling thousands of miles north over sea ice at speeds of approximately 40 miles/hour (60 km/h) to get there (Phillips et al. 2006a, Phillips et al. 2006b, Oppel et al. 2008, Dickson 2012d, Dickson 2012c, Dickson 2012a). Soon after breeding, male eiders leave their mates and eggs for staging areas near breeding grounds to prepare for molt migration (Lamothe 1973, Cotter et al. 1997). They then depart in relatively small groups for molting areas further south. Females follow just after, or sometimes just before, the chicks fledge (Powell and Suydam 2012). The young often migrate on their own, as sea-ice formation forces them south (Frimer 1993). After molting, many eiders will over-winter in or near their molting areas, or until the advancing sea-ice edge forces them south (Oppel et al. 2008). Others will actively migrate to wintering areas. The fall migration takes place in small groups throughout the fall and early winter (Oppel et al. 2008, Dickson 2012d, Dickson 2012c).

Milo Burcham

King Eider male.



Milo Burcham

Spectacled Eider female and male.

Wintering

Most Pacific-breeding eiders winter in the Bering Sea, seeking out the sea-ice margins of polynyas or the advancing ice edge. All of the approximately 70,000 Pacific-breeding Steller's Eiders (*Polysticta stelleri*) winter near the Alaska Peninsula, Kodiak Island, eastern Aleutian Islands, and lower Cook Inlet. While only 10% of Spectacled Eiders (*Somateria fischeri*) breed in Alaska, the entire population can be found wintering in a perennial polynya southwest of St. Lawrence Island. Eiders are often not sedentary during winter; some King Eiders (*S. spectabilis*) will travel up to 1,000 miles (1,600 km) among 3 or more wintering sites, while some eiders will remain at a single site throughout the winter months. Sea-ice concentration and food availability are the likely causes for winter movements (Oppel et al. 2008, Oppel and Powell 2009). As food availability fluctuates greatly throughout the winter, starvation becomes a grave and common threat to eiders when they begin their spring migration. In 1964, an estimated 10% (100,000 birds) of the global population of King Eiders died from exposure because of a lack of open water in staging areas in the Beaufort Sea due to a particularly harsh winter (Barry 1968). There are many other examples of mass starvation events, ice-fog related mass death, and records of large numbers of flightless, molting birds succumbing to exposure due to late season storms (Barry 1968, Myres 1958, Fournier and Hines 1994, Mallory et al. 2001).

Species Description

King Eider. The most conspicuous of the eiders, King Eiders are some of the northernmost breeding birds on the planet. They have a tendency to forage farther offshore, and in deeper water than the other eider species (Frimer 1995a, Bustnes and Lonne 1997, Fox and Mitchell 1997). King Eiders breed on the North Slope of Alaska, along the Beaufort Sea coast of Canada, and in coastal Northern Chukotka, Russia. They winter throughout the shallow waters of the Bering Sea shelf.

Spectacled Eider. Spectacled Eiders are the least colonial of the eiders, with many fewer nests per square mile than their cousins. They are listed as threatened under the Endangered Species Act (ESA). In Alaska, 5% of the global population of 363,000 Spectacled Eiders breed in coastal habitats along the Beaufort Sea and 5% of the population breed in the Yukon-Kuskokwim Delta, while the remaining 90% of the global population of this species breed on the northern coast of eastern Russia (D. Safine pers. comm.). They winter exclusively in the Bering Sea (Petersen et al. 1999).

Common Eider. The largest of the eider species, there are six to seven different subspecies of Common Eider (*Somateria mollissima*), each occupying a different geographic area of the Arctic (Mendall 1987). Common Eiders are distributed throughout high-northern latitudes, breeding in many regions of the Northern Hemisphere (Goudie et al 2000). In Alaska, Common Eiders are found in the Bering, Chukchi, and Beaufort Seas. In Canada, they breed terrestrially near Amundsen Gulf, and east into the Hudson Bay region and Nova Scotia. In Europe, Common Eiders breed along the Barents Sea, Baltic Sea, North Sea, and into France. They commonly winter in Iceland, Greenland, and Siberia and are found in the continental US as far south as Florida (Goudie et al 2000).

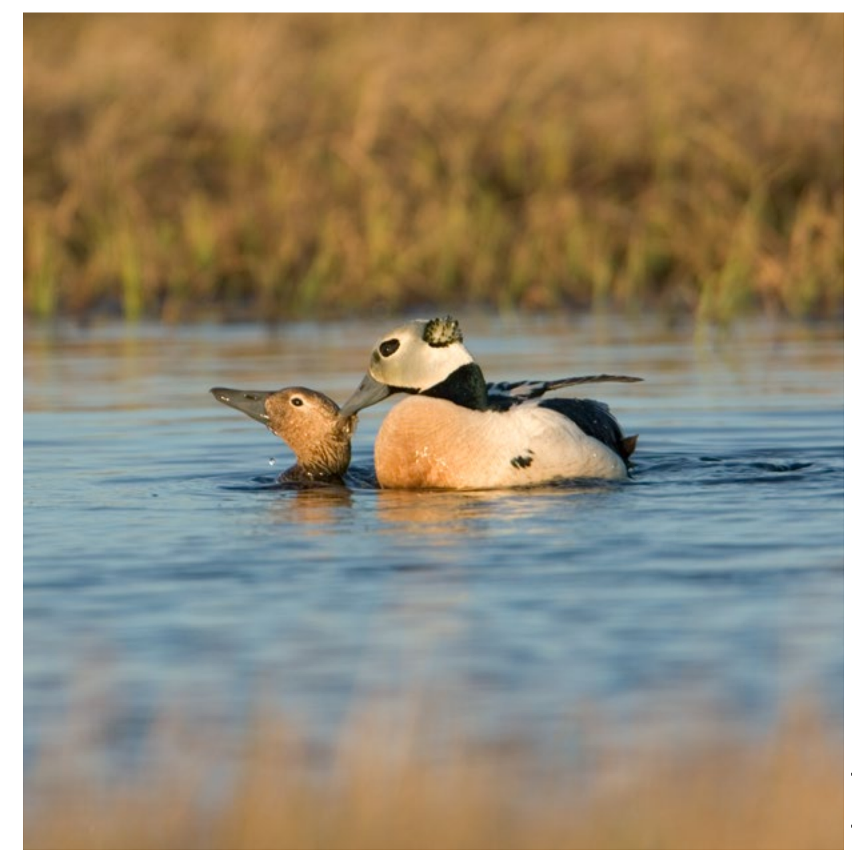
Steller's Eider. The smallest of the eider species, Steller's Eiders utilize freshwater tundra ponds during the breeding season. While the larger eider species are often found in deeper water during winter, Steller's Eiders occupy the shallow coastal waters throughout the Arctic and subarctic, rarely traveling south of Alaska waters (Fredrickson 2001). They are listed as threatened under the ESA and vulnerable on the International Union for the Conservation of Nature's (IUCN's) Redlist. Steller's Eiders are split into two populations: the Pacific-breeding population and the Atlantic-breeding population. Pacific-breeding Steller's Eiders most commonly breed on the northeastern coast of Russia, with less than 1% of the Pacific breeding population utilizing the North Slope of Alaska (D. Safine pers. comm.). They winter along the Alaska Peninsula and the Aleutian Islands, as well as along the eastern coast of the Anadyr Peninsula (Fredrickson 2001).

LIFE CYCLE

Pair bonds are formed on wintering grounds, or during spring migration (Johnsgard 1964, Lamothe 1973, Oppel and Powell 2010a). Males display to females in many ways, including head-turning to show off the ornate plumage possessed by the males of all four species, pushing (holding tip of bill close to water, chin held close to breast, head angled downward), cooing, and wing-flapping. Eider wing-flapping consists of a male facing a female, with body and head vertical, exposing the black V on its throat, and flapping twice (Johnsgard 1964). Eiders are often seasonally monogamous, although males may breed with more than one female in the same five-minute period (Lamothe 1973).

Dave Shaw

Common Eider male.



Milo Burcham

Steller's Eider female and male courtship.

Female eiders exhibit natal site fidelity, with 88% of King Eider females returning to within 15 miles (25 km) of their birth site the following year (Oppel and Powell 2010a). Nest sites are chosen as they become available, with island sites often the first to thaw and dry, followed by terrestrial sites near water (Cramp and Simmons 1977, Kondratyev 1992). The female eider chooses a location, accompanied by, but without influence from, her male counterpart. The female selects the site by probing with her bill. If the location is suitable, she settles in by moving side to side to depress the grass into a shallow bowl, which she further defines by removing vegetation (Lamothe 1973). After laying the third egg, she will begin to preen the down from her belly, adding it to the grasses that line the nest as an insulative layer. If the initial clutch fails or is predated, they may lay a second, but eiders are not known to have two successful clutches in a single season (Palmer 1976). Nest sites are often chosen in areas with an abundance of lemmings, likely to reduce predatory pressure from Arctic foxes (*Vulpes lagopus*).

Common Eiders utilize a semi-colonial breeding strategy, sometimes grouping together in the hundreds and thousands to breed. The natal-site fidelity present in all female eiders perpetuates an added benefit with Common Eiders, as their colonies are subsequently made up of closely related females, which may be the mechanism driving some of the Common Eider's uniquely cooperative behavior, such as egg-laying in nests of related individuals and communal chick-rearing, or creching (Anderson and Alisauskas 2001;2002, Ost et al. 2007).

Diet
Eiders are diving feeders, with each species hunting at different depths for prey of different sizes, likely due to the general size differences between the four species. Benthic invertebrates are the main food source for all eiders, consisting specifically of mollusks, crustaceans, echinoderms, and polychaete worms (Frimer 1995b;1997, Bustnes and Systad 2001, Lovvorn et al. 2003, Merkel et al. 2007a, Merkel et al. 2007b, Oppel et al. 2009c, Kristjansson et al. 2013). Some algae and marine vegetation are consumed as well as some fish and fish eggs. While in their breeding area, eiders are known to consume insects, including flies, midges, beetles, and larvae as well (Kistchinski and Flint 1974, Kondrat'ev 1992). The majority of food is eaten whole while submerged, with very few, larger items that require more manipulation consumed on the surface (Beauchamp et al. 1992, Bustnes and Lonne 1995).

CONSERVATION ISSUES

The Spectacled Eider and the Steller's Eider (US Fish and Wildlife Service 1997, 2001) are listed as threatened under the ESA due to substantial, unexplained decreases in population. Critical Habitat was proposed and accepted, but eider numbers continue to decline.

Since 2004, the IUCN Redlist has considered the Steller's Eider to be vulnerable because it is undergoing a rapid population reduction of 46% over 20 years (Larned et al. 2012), particularly in Alaska populations. In 2015, the IUCN deemed the Common Eider to be near threatened due to declines likely driven by overharvesting of aquatic resources, pollution, disturbance, and hunting.

Eiders are vulnerable to oil spills due to large flock sizes, distance from shore, and use of moderate-ice areas. A model of a possible oil spill on a primary staging area that would kill 1,000–5,000 breeding-age females showed that the population of King Eiders breeding in northern Alaska would decline to 1,500–3,500 females in 50 years (Bentzen and Powell 2012). Chronic oil contamination is also a serious problem in areas near international shipping lanes, such as the Aleutian Islands, the Bering Sea, the Bering Strait, and increasingly the Chukchi and Beaufort Seas.

Eiderdown is commonly used in quilts and bedding due to its insulative properties. Before eiders were given special protection under the Migratory Bird Treaty (1916, Article IV), eiderdown was collected through the indiscriminate killing of eiders. Today, eiderdown is still collected, but from nests of human-habituated eiders (female eiders line their nests with their down) and in much smaller quantities. Native subsistence hunters in Alaska and Canada harvest down, meat, and eggs from eiders.

Sport hunting of Common Eiders is becoming increasingly common, likely due to extremely liberal hunting regulations and an increase in restrictiveness over other waterfowl seasons. The impact of this increase is not well measured, but reported harvests of greater than 100,000 Common Eiders exceed sustainable levels of known breeding stocks by magnitudes of 5 to 10 (Reed and Erskine 1986).

TABLE 5.4-1. Eider life history characteristics and conservation status. Sources: Goudie et al. (2000), Fredrickson (2001), Petersen and Flint (2002), Powell and Suydam (2012), Warnock (2017).

	King Eider *Somateria spectabilis*	Spectacled Eider *S. fischeri*	Common Eider *S. mollissima*	Steller's Eider *Polysticta stelleri*
Body Size Mass Length Wingspan	**M** 2.5–4.5 pounds (200–2,100 g) **L** 19–28 inches (50–70 cm) **W** 34–40 inches (86–102 cm)	**M** 3–4 pounds (1,275–1,750 g) **L** 20 inches (53 cm) **W** 37 inches (95 cm)	**M** 3–6.5 pounds (1,300–3,040 g) **L** 19.5–28 inches (50–70 cm) **W** 31–43 inches (80–110 cm)	**M** 1.5–2 pounds (720–970 g) **L** 17–18 inches (43–46 cm) **W** 27 inches (69 cm)
Maximum Life Span (wild)	15 years	11 years	21 years	21 years
Clutch Size Range Average	**R** 1–16 eggs **A** 5 eggs	**R** 1–11 eggs **A** 4 eggs	**R** 1–14 eggs **A** 4 eggs	**R** 1–7 eggs **A** 4 eggs
Nest-Water Proximity	80% <100 feet (<30 m)	76% <3 feet (< 1 m)	Unknown	Avg. 10 feet (3 m)
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	**ESA:** No Status **IUCN:** Least Concern **WL:** Yellow List (Alaska NW Canada population)	**ESA:** Threatened **IUCN:** Least Concern **WL:** Red List	**ESA:** No Status **IUCN:** Near Threatened **WL:** Not Listed	**ESA:** Threatened **IUCN:** Vulnerable **WL:** Red List
Population Global Alaska	**G** 860,000 **A** 470,000	**G** 363,000 **A** 363,000	**G** 3.3–4 million **A** 170,000	**G** 117,500 **A** 82,000
Breeding Season Eggs Young	**E** June to late July **Y** July to late September	**E** Mid-March to mid-July **Y** Mid-June to early August	**E** June to late July **Y** July to October	**E** Early June to mid-July **Y** Early July to late August
Migration Spring Molt Fall	**S** April to late July **M** Early June to mid-September **F** Mid-October to mid-January	**S** Mid-April to mid-June **M** Mid-June to mid-September **F** Early Oct to mid-November	**S** Mid-March to June **M** Late June to late July **F** Mid-October to January	**S** Mid-April to early July **M** Late June to mid-October **F** Late July to December

TABLE 5.4-2. Data sources for eider maps (5.4.1–5.4.4), complied by layer.

	King Eider *Somateria spectabilis*	Spectacled Eider *S. fischeri*	Common Eider *S. mollissima*	Steller's Eider *Polysticta stelleri*
Range	• Audubon Alaska (2015) • Audubon Alaska (2016a) • BirdLife International (2017a) • Dickson et al. (1997) • eBird (2015) • National Oceanic and Atmospheric Administration (1988) • Powell and Suydam (2012) • Sea Duck Joint Venture (2016) • T. Bowman (pers. comm.)	• Audubon Alaska (2015) • Audubon Alaska (2016a) • BirdLife International (2017a) • D. Safine (pers. comm.) • eBird (2015) • Petersen et al. (1999) • Sea Duck Joint Venture (2016) • US Fish and Wildlife Service (2016b)	• Audubon Alaska (2015) • Audubon Alaska (2016a) • BirdLife International (2017a) • Dickson (2012b) • eBird (2015) • Petersen and Flint (2002) • Sea Duck Joint Venture (2016)	• Audubon Alaska (2015) • Audubon Alaska (2016a) • BirdLife International (2017a) • eBird (2015) • Martin et al. (2015) • Rosenberg et al. (2016) • Sea Duck Joint Venture (2016) • US Fish and Wildlife Service (2016b)
Breeding	• Audubon Alaska (2016b) based on > Audubon Alaska (2016a) > Dickson et al. (1997) > National Oceanic and Atmospheric Administration (1988) > Powell and Suydam (2012) > Sea Duck Joint Venture (2016) • Solovyeva and Kokhanova (2017) based on > Arkhipov et al. (2014) > Krechmar and Kondratyev (2006) > Solovyeva (2011)	• Audubon Alaska (2016b) based on Audubon Alaska (2016a) • Solovyeva and Kokhanova (2017) based on > Arkhipov et al. (2014) > Krechmar and Kondratyev (2006) > Solovyeva (2011)	• Audubon Alaska (2016b) based on Audubon Alaska (2016a) • BirdLife International (2017a) • Bollinger and Platte (2012) • Canadian Wildlife Service (2013) • D. Solovyeva (pers. comm.) • Sea Duck Joint Venture (2016) • Seabird Information Network (2011) • T. Bowman (pers. comm.) • US Fish and Wildlife Service (2008a)	• Arctic Landscape Conservation Cooperative (2012) • D. Safine (pers. comm.) • Sea Duck Joint Venture (2016) • Stehn and Platte (2009)
Wintering	• Dickson (2012a) • Oppel (2008) • Phillips et al. (2006b) • Sea Duck Joint Venture (2016) • T. Bowman and J. Fischer (pers. comm.)	• Audubon Alaska (2015) • Sexson et al. (2012)	• Dickson (2012b) • Petersen and Flint (2002) • Sea Duck Joint Venture (2016) • T. Bowman (pers. comm.) • T. Bowman and J. Fischer (pers. comm.) • US Fish and Wildlife Service (2008a)	• Kingsbery (2010) • Sea Duck Joint Venture (2016) • Sowls (1993)
Staging	• Audubon Alaska (2009b) • Dickson (2012c) • Oppel (2008) • Oppel et al. (2009a) • Phillips et al. (2007)	• Audubon Alaska (2015) • Sexson et al. (2012) • Sexson et al. (2016)	• Dickson (2012b) • Petersen and Flint (2002)	• D. Safine (pers. comm.) • Larned (2012) • Martin et al. (2015) • Rosenberg et al. (2016) • US Fish and Wildlife Service (2016a)
Molting	• Dickson (2012a) • National Oceanic and Atmospheric Administration (1988) • Oppel (2008) • Phillips et al. (2006b)	• Audubon Alaska (2015) • Sexson et al. (2012) • Sexson et al. (2016)	• D. Solovyeva (pers. comm.) • Dickson (2012b)	• D. Safine (pers. comm.) • US Fish and Wildlife Service (2016a)
Marine Regular Use	• Audubon Alaska (2017d) based on National Oceanic and Atmospheric Administration (1988)	• Audubon Alaska (2017d) based on > Audubon Alaska (2014) > BirdLife International (2017a)	• Audubon Alaska (2017d) based on National Oceanic and Atmospheric Administration (1988)	• Audubon Alaska (2017d) based on > Audubon Alaska (2014) > BirdLife International (2017a)
IBAs and IBA Core Areas	• Audubon Alaska (2014) • Audubon Alaska (2015) • BirdLife International (2017a)	• Audubon Alaska (2014) • Audubon Alaska (2015) • BirdLife International (2017a)	• Audubon Alaska (2014) • BirdLife International (2017a)	• Audubon Alaska (2014) • Audubon Alaska (2015) • BirdLife International (2017a)
Critical Habitat	Not applicable	• US Fish and Wildlife Service (2016b)	Not applicable	• US Fish and Wildlife Service (2016b)
Migration	• National Oceanic and Atmospheric Administration (1988) • Oppel et al. (2009a) • Powell and Suydam (2012)	• D. Solovyeva (pers. comm.) • Petersen et al. (1999) • Sexson et al. (2014)	• D. Solovyeva (pers. comm.) • Dickson (2012b) • National Oceanic and Atmospheric Administration (1988)	• Martin et al. (2015) • Rosenberg et al. (2016)

MAPPING METHODS (MAPS 5.4.1–5.4.4)

We categorized distribution and activity of eiders into four main categories of intensity: extent of range, regular use, concentration, and high concentration. Where possible, we analyzed survey data to draw boundaries and assess intensity of use. However, survey data alone did not provide adequate coverage of the project area. Therefore, the eider maps are a composite of both survey-derived polygons and polygons from other sources. Regular use and concentration areas are based on either a) isopleths resulting from spatial analysis, or b) information presented in reports and literature.

The mapped eider ranges were analyzed by Audubon Alaska (2016e) using species-specific observation points from eBird (2015) and Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a), which combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). To assess range, we buffered all known occurrences of eiders, by species, using a 62-mile (100-km) radius, and merged polygons. Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. For each species of eider, the survey-derived range polygon was merged with the additional data listed in Table 5.4-2. Inconsistencies in the resulting polygons were manually edited and smoothed.

Breeding areas and breeding concentration areas were delineated by Audubon Alaska (2016b) based on multiple data sources. With the exception of Steller's Eiders, for which there were not enough observational data for analysis, breeding area data for mainland Alaska are based on Audubon Alaska's analysis of the AGBD (Audubon Alaska 2016a). From this database, those species-specific observation points recorded on land during the breeding season (as documented in Cornell Lab of Ornithology and American Ornithologists' Union (2016)) were processed using a kernel density analysis with a 15.5-mile (25-km) search radius. For eiders, the data generally encompass surveys conducted from the late 1980s to 2012. The 99% isopleth of the kernel density analysis was used to represent breeding regular use areas, and the 50% isopleth was used to represent breeding concentration areas. In Canada, Russia, and on St. Lawrence Island, survey data are spatially incomplete or unavailable; therefore, breeding areas in these regions are represented by merging available breeding polygons from several sources, as listed below. For Steller's Eiders, the breeding area is based on Sea Duck Joint Venture (2016) and Stehn and Platte (2009). The breeding concentration area is based on observations documented in Arctic Landscape Conservation Cooperative (2012) and Stehn and Platte (2009), with input from USFWS biologist David Safine.

For each species, wintering, molting, and staging data were composited from spatial data provided in several sources. In some cases, concentration information was available for wintering, staging, or molting. Data sources are listed together by activity, regardless of intensity (i.e. regular use or concentration), in Table 5.4-2. For more specific layer information, refer to the Map Data Sources section.

Areas of the ocean that are regularly used by each species but that cannot be assigned to a primary activity such as staging, molting, or wintering are shown as marine regular use. Marine regular use for King and Common Eiders is based on National Oceanic and Atmospheric Administration (1988) marine use areas, which were merged with a 6.2-mile (10-km) buffer of coastal areas within the species' range (Audubon Alaska 2017d). For Spectacled and Steller's Eiders, marine regular use is based on marine portions of Important Bird Areas (IBAs) in which activity-specific information is unknown.

High-concentration areas were represented using global IBAs. In Russia and Canada, we used IBA data from BirdLife International (2017a) while IBAs in Alaska were from Audubon Alaska (2014). Because IBA boundaries often encompass multiple species hotspots, in Alaska we also used available single-species IBA core areas (Audubon Alaska 2015) to show high concentration (see Smith et al. 2014c). IBA core areas do not exist for Common Eider.

Migration arrows were drawn by Audubon Alaska (2016d) based on several sources including satellite telemetry data, previously drawn migration arrows shown in National Oceanic and Atmospheric Administration (1988), and textual descriptions of migration.

The sea-ice data shown on these maps approximate median monthly sea-ice extent. The monthly sea-ice lines are based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

Eider data exist across much of the project area. The observation data used to generate range polygons are generally available across the project area, although sparser in Russia and Canada than in Alaska. Many of the migration, wintering, staging, and molting areas are based on data from satellite telemetry studies. For all of these studies, individuals were tagged in Alaska and Canada only; we were unable to find telemetry data for eiders tagged in the Russian Far East.

As with telemetry data, the AGBD used to analyze breeding regular-use and breeding concentration areas is most robust in Alaska. However, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting maps. There is little to no survey coverage across the Canadian and Russian portions of the project area, potentially leaving major data gaps in the mapped distribution and concentration of these species. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of these maps.

Reviewers

- Tim Bowman
- Julian Fischer
- David Safine

Common Eider female on nest.

USFWS

MAP DATA SOURCES

KING EIDER MAP

Extent of Range: Audubon Alaska (2016e) based on Audubon Alaska (2015), Audubon Alaska (2016a), Dickson et al. (1997), eBird (2015), National Oceanic and Atmospheric Administration (1988), Powell and Suydam (2012), Sea Duck Joint Venture (2016), and T. Bowman (pers. comm.)

Breeding: Audubon Alaska (2016b) based on Audubon Alaska (2016a), Dickson et al. (1997), National Oceanic and Atmospheric Administration (1988), Powell and Suydam (2012), and Sea Duck Joint Venture (2016); Solovyeva and Kokhanova (2017) based on Arkhipov et al. (2014), Krechmar and Kondratyev (2006), and Solovyeva (2011)

Breeding Concentration: Audubon Alaska (2016b) based on Audubon Alaska (2016a)

Wintering: Dickson (2012a); Kingsbery (2010); Oppel (2008); Phillips et al. (2006b); Sea Duck Joint Venture (2016); Sowls (1993); T. Bowman and J. Fischer (pers. comm.)

Staging: Audubon Alaska (2009b); Dickson (2012c); Oppel (2008); Oppel et al. (2009a); Phillips et al. (2007)

Molting: Dickson (2012a); National Oceanic and Atmospheric Administration (1988); Oppel (2008); Phillips et al. (2006b)

Marine Regular Use: Audubon Alaska (2017d) based on National Oceanic and Atmospheric Administration (1988)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Migration: Audubon Alaska (2016d) based on National Oceanic and Atmospheric Administration (1988), Oppel (2009), and Powell and Suydam (2012)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

SPECTACLED EIDER MAP

Extent of Range: Audubon Alaska (2017l) based on Audubon Alaska (2015), Audubon Alaska (2016a), BirdLife International (2017a), D. Safine (pers. comm.), eBird (2015), Petersen et al. (1999), Sea Duck Joint Venture (2016), and US Fish and Wildlife Service (2016b)

Breeding: Audubon Alaska (2017j) based on Audubon Alaska (2016a); Solovyeva and Kokhanova (2017) based on Arkhipov et al. (2014), Krechmar and Kondratyev (2006), and Solovyeva (2011)

Breeding Concentration: Audubon Alaska (2017j) based on Audubon Alaska (2016a)

Wintering: Audubon Alaska (2015); Sexson et al. (2012)

Wintering Concentration: Sexson et al. (2012)

Staging: Sexson et al. (2012); Sexson et al. (2016)

Staging Concentration: Audubon Alaska (2015); Sexson et al. (2016)

Molting: Sexson et al. (2012); Sexson et al. (2016)

Molting Concentration: Audubon Alaska (2015); Sexson et al. (2016)

Marine Regular Use: Audubon Alaska (2017d) based on Audubon Alaska (2014) and BirdLife International (2017a)

Critical Habitat: US Fish and Wildlife Service (2016b)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Migration: Audubon Alaska (2017k) based on Petersen et al. (1999) and Sexson et al. (2014); D. Solovyeva (pers. comm.)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

COMMON EIDER MAP

Extent of Range: Audubon Alaska (2017c) based on Audubon Alaska (2014), Audubon Alaska (2016a), BirdLife International (2017a), Dickson (2012b), eBird (2015), Petersen and Flint (2002), and Sea Duck Joint Venture (2016)

Breeding: Audubon Alaska (2017b) based on Audubon Alaska (2016a), Bollinger and Platte (2012), D. Solovyeva (pers. comm.), Sea Duck Joint Venture (2016), T. Bowman (pers. comm.), and US Fish and Wildlife Service (2008a)

Breeding Concentration: Audubon Alaska (2017b) based on Audubon Alaska (2016a), Bollinger and Platte (2012), Canadian Wildlife Service (2013), Seabird Information Network (2011), T. Bowman (pers. comm.), and US Fish and Wildlife Service (2008a)

Wintering: Dickson (2012b); Petersen and Flint (2002); Sea Duck Joint Venture (2016); T. Bowman (pers. comm.); T. Bowman and J. Fischer (pers. comm.); US Fish and Wildlife Service (2008a)

Wintering Concentration: Dickson (2012b); Petersen and Flint (2002)

Staging: Dickson (2012b); Petersen and Flint (2002)

Staging Concentration: Dickson (2012b)

Molting: D. Solovyeva (pers. comm.); Dickson (2012b)

Marine Regular Use: Audubon Alaska (2017d) based on National Oceanic and Atmospheric Administration (1988)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

Migration: D. Solovyeva (pers. comm.); Dickson (2012b); National Oceanic and Atmospheric Administration (1988)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

STELLER'S EIDER MAP

Extent of Range: Audubon Alaska (2016k) based on Audubon Alaska (2015), BirdLife International (2017a), eBird (2015), Martin et al. (2015), Rosenberg et al. (2016), Sea Duck Joint Venture (2016), US Fish and Wildlife Service (2016b), and US Geological Survey–Alaska Science Center (2015)

Breeding: D. Safine (pers. comm.); Sea Duck Joint Venture (2016); Stehn and Platte (2009)

Breeding Concentration: Audubon Alaska (2016i) based on Arctic Landscape Conservation Cooperative (2012) and D. Safine (pers. comm.)

Wintering: Kingsbery (2010); Sea Duck Joint Venture (2016); Sowls (1993)

Staging: D. Safine (pers. comm.); Larned (2012); Martin et al. (2015); Rosenberg et al. (2016); US Fish and Wildlife Service (2016a)

Molting: D. Safine (pers. comm.); US Fish and Wildlife Service (2016a)

Marine Regular Use: Audubon Alaska (2017d) based on Audubon Alaska (2014) and BirdLife International (2017a)

Critical Habitat: US Fish and Wildlife Service (2016b)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

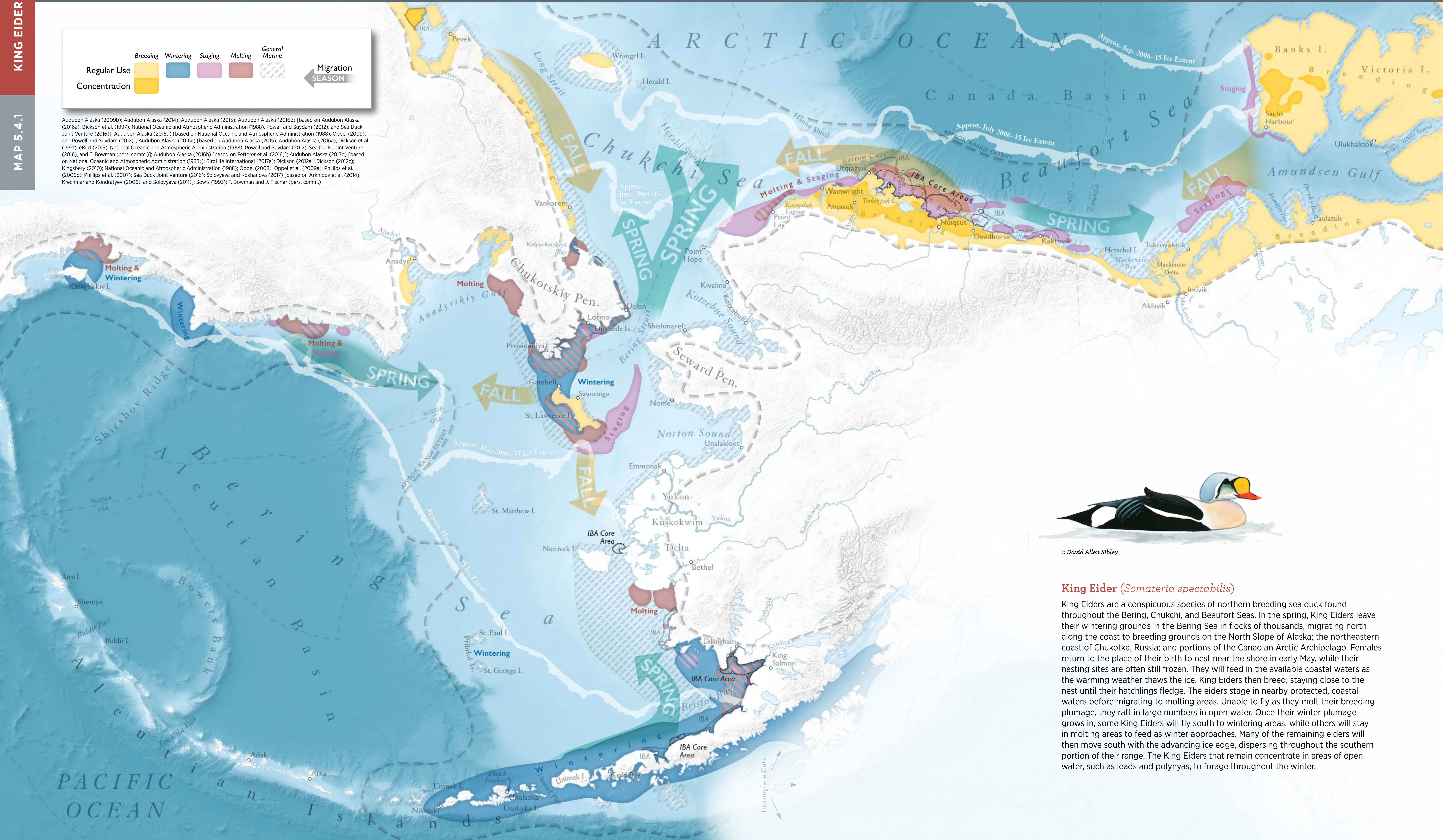
Migration: Audubon Alaska (2016j) based on Martin et al. (2015) and Rosenberg et al. (2016)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

5.4 EIDERS MAPS ON PAGES 132–139

King Eider

Map Authors: Erika Knight, Max Goldman, and Melanie Smith
Cartographer: Daniel P. Huffman



Audubon Alaska (2009b); Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016b) [based on Audubon Alaska (2016a), Dickson et al. (1997), National Oceanic and Atmospheric Administration (1988), Powell and Suydam (2012), and Sea Duck Joint Venture (2016)]; Audubon Alaska (2016d) [based on National Oceanic and Atmospheric Administration (1988), Oppel (2009), and Powell and Suydam (2012)]; Audubon Alaska (2016e) [based on Audubon Alaska (2015), Audubon Alaska (2016a), Dickson et al. (1997), eBird (2015), National Oceanic and Atmospheric Administration (1988), Powell and Suydam (2012), Sea Duck Joint Venture (2016), and T. Bowman (pers. comm.)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Audubon Alaska (2017d) [based on National Oceanic and Atmospheric Administration (1988)]; BirdLife International (2017a); Dickson (2012a); Dickson (2012c); Kingsbery (2010); National Oceanic and Atmospheric Administration (1988); Oppel (2008); Oppel et al. (2009a); Phillips et al. (2006b); Phillips et al. (2007); Sea Duck Joint Venture (2016); Solovyeva and Kokhanova (2017) [based on Arkhipov et al. (2014), Krechmar and Kondratyev (2006), and Solovyeva (2011)]; Sowls (1993); T. Bowman and J. Fischer (pers. comm.)

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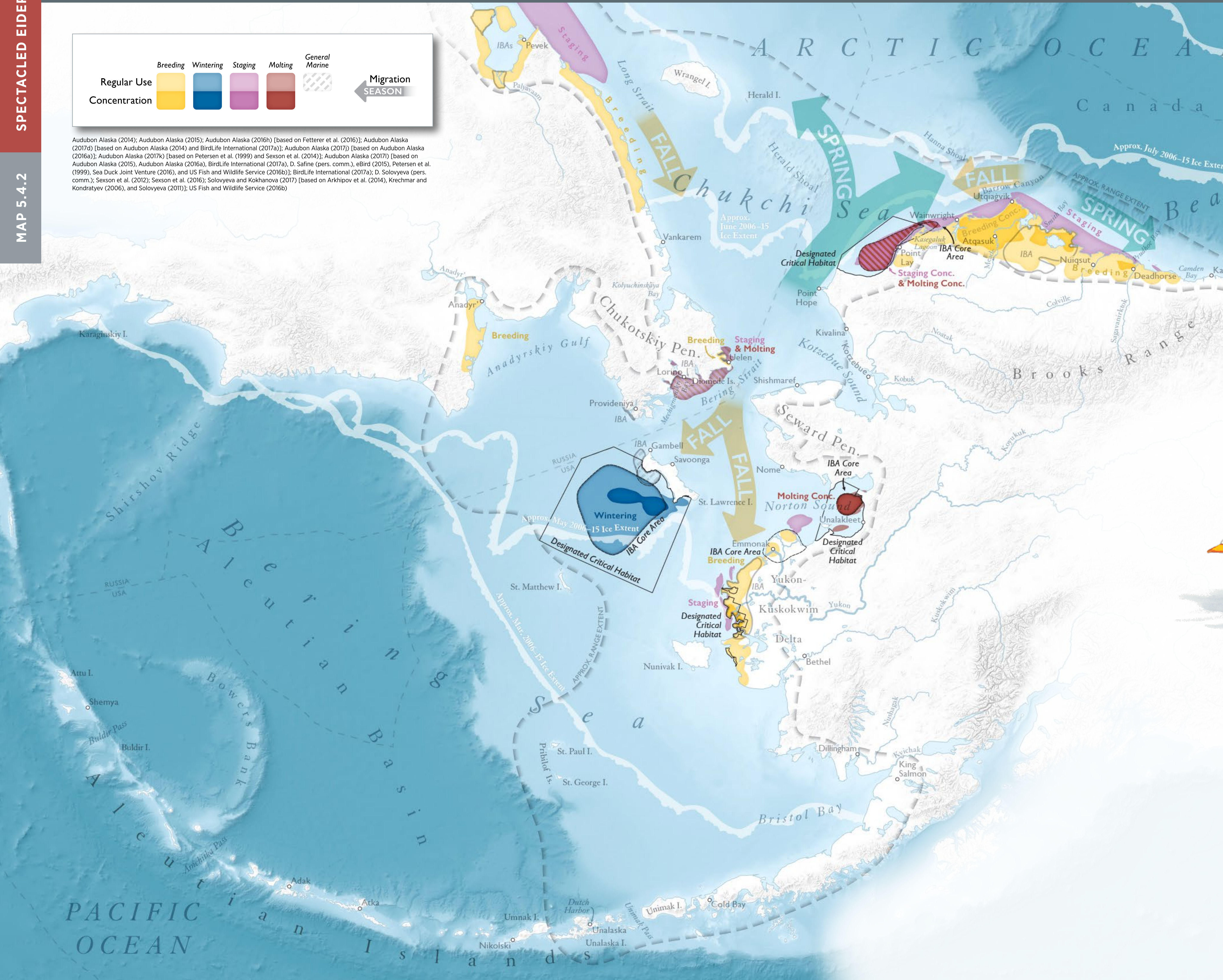
King Eider (*Somateria spectabilis*)

King Eiders are a conspicuous species of northern breeding sea duck found throughout the Bering, Chukchi, and Beaufort Seas. In the spring, King Eiders leave their wintering grounds in the Bering Sea in flocks of thousands, migrating north along the coast to breeding grounds on the North Slope of Alaska; the northeastern coast of Chukotka, Russia; and portions of the Canadian Arctic Archipelago. Females return to the place of their birth to nest near the shore in early May, while their nesting sites are often still frozen. They will feed in the available coastal waters as the warming weather thaws the ice. King Eiders then breed, staying close to the nest until their hatchlings fledge. The eiders stage in nearby protected, coastal waters before migrating to molting areas. Unable to fly as they molt their breeding plumage, they raft in large numbers in open water. Once their winter plumage grows in, some King Eiders will fly south to wintering areas, while others will stay in molting areas to feed as winter approaches. Many of the remaining eiders will then move south with the advancing ice edge, dispersing throughout the southern portion of their range. The King Eiders that remain concentrate in areas of open water, such as leads and polynyas, to forage throughout the winter.

Spectacled Eider

Map Authors: Melanie Smith, Erika Knight, and Max Goldman
Cartographer: Daniel P. Huffman

Audubon ALASKA



Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Audubon Alaska (2017d) [based on Audubon Alaska (2014) and BirdLife International (2017a)]; Audubon Alaska (2017j) [based on Audubon Alaska (2016a)]; Audubon Alaska (2017k) [based on Petersen et al. (1999) and Sexson et al. (2014)]; Audubon Alaska (2017l) [based on Audubon Alaska (2015), Audubon Alaska (2016a), BirdLife International (2017a), D. Safine (pers. comm.), eBird (2015), Petersen et al. (1999), Sea Duck Joint Venture (2016), and US Fish and Wildlife Service (2016b)]; BirdLife International (2017a); D. Solovyeva (pers. comm.); Sexson et al. (2012); Sexson et al. (2016); Solovyeva and Kokhanova (2017) [based on Arkhipov et al. (2014), Krechmar and Kondratyev (2006), and Solovyeva (2011)]; US Fish and Wildlife Service (2016b)

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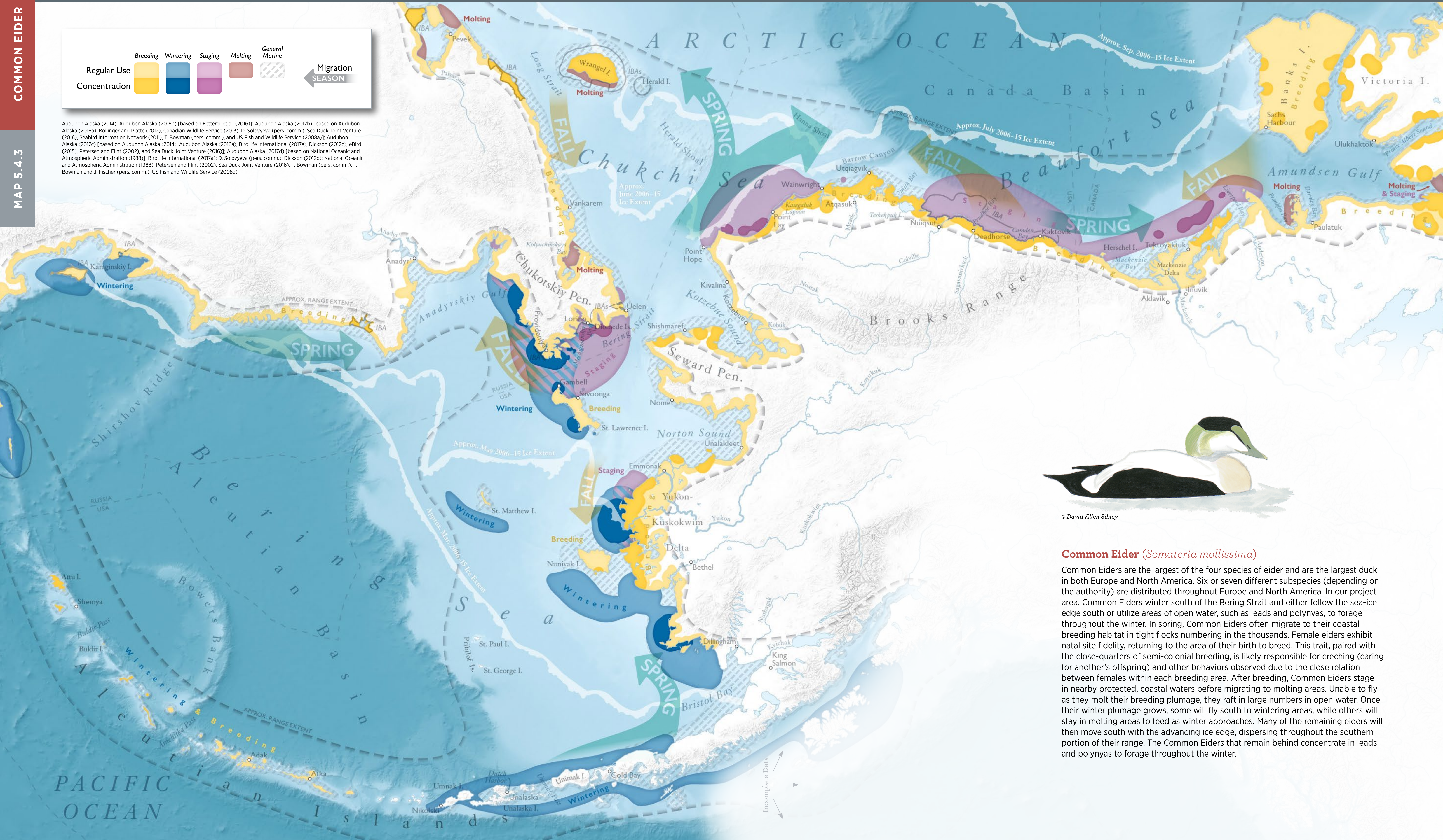
Spectacled Eider (*Somateria fischeri*)

Spectacled Eiders are Arctic-dwelling sea ducks that breed in coastal areas of Alaska and Russia. Of the three distinct breeding populations of Spectacled Eider, one uses the Yukon-Kuskokwim (Y-K) Delta, another nests on the North Slope of Alaska, and a third breeds along the northern coast of eastern Arctic Russia. The entire global Spectacled Eider population of around 363,000 sea ducks winters in a perennial polynya southwest of St. Lawrence Island, and around 90–95% of these breed in Russia, while the remaining 5–10% breed in western or northern Alaska. After breeding, Spectacled Eiders stage offshore before moving to molting areas to molt and regrow their flight feathers, after which they migrate to their wintering grounds. The Spectacled Eider was listed as threatened under the Endangered Species Act in 1993 due to a rapid decline in population on the Y-K Delta. The population breeding in western Alaska declined more than 90% from the 1970s to the 1990s. As a result of the listing, critical habitat was designated for Spectacled Eiders in four areas: staging and molting grounds in Ledyard Bay off the coast of the North Slope, molting grounds in Norton Sound, breeding grounds on the Y-K Delta, and the wintering area south of St. Lawrence Island. Since these steps were taken, the western Alaska breeding population numbers have been increasing.

Common Eider

Map Authors: Erika Knight, Max Goldman, and Melanie Smith
Cartographer: Daniel P. Huffman

Audubon ALASKA



Audubon Alaska (2014); Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Audubon Alaska (2017b) [based on Audubon Alaska (2016a), Bollinger and Platte (2012), Canadian Wildlife Service (2013), D. Solovyeva (pers. comm.), Sea Duck Joint Venture (2016), Seabird Information Network (2011), T. Bowman (pers. comm.), and US Fish and Wildlife Service (2008a)]; Audubon Alaska (2017c) [based on Audubon Alaska (2014), Audubon Alaska (2016a), BirdLife International (2017a), Dickson (2012b), eBird (2015), Petersen and Flint (2002), and Sea Duck Joint Venture (2016)]; Audubon Alaska (2017d) [based on National Oceanic and Atmospheric Administration (1988)]; BirdLife International (2017a); D. Solovyeva (pers. comm.); Dickson (2012b); National Oceanic and Atmospheric Administration (1988); Petersen and Flint (2002); Sea Duck Joint Venture (2016); T. Bowman (pers. comm.); T. Bowman and J. Fischer (pers. comm.); US Fish and Wildlife Service (2008a)

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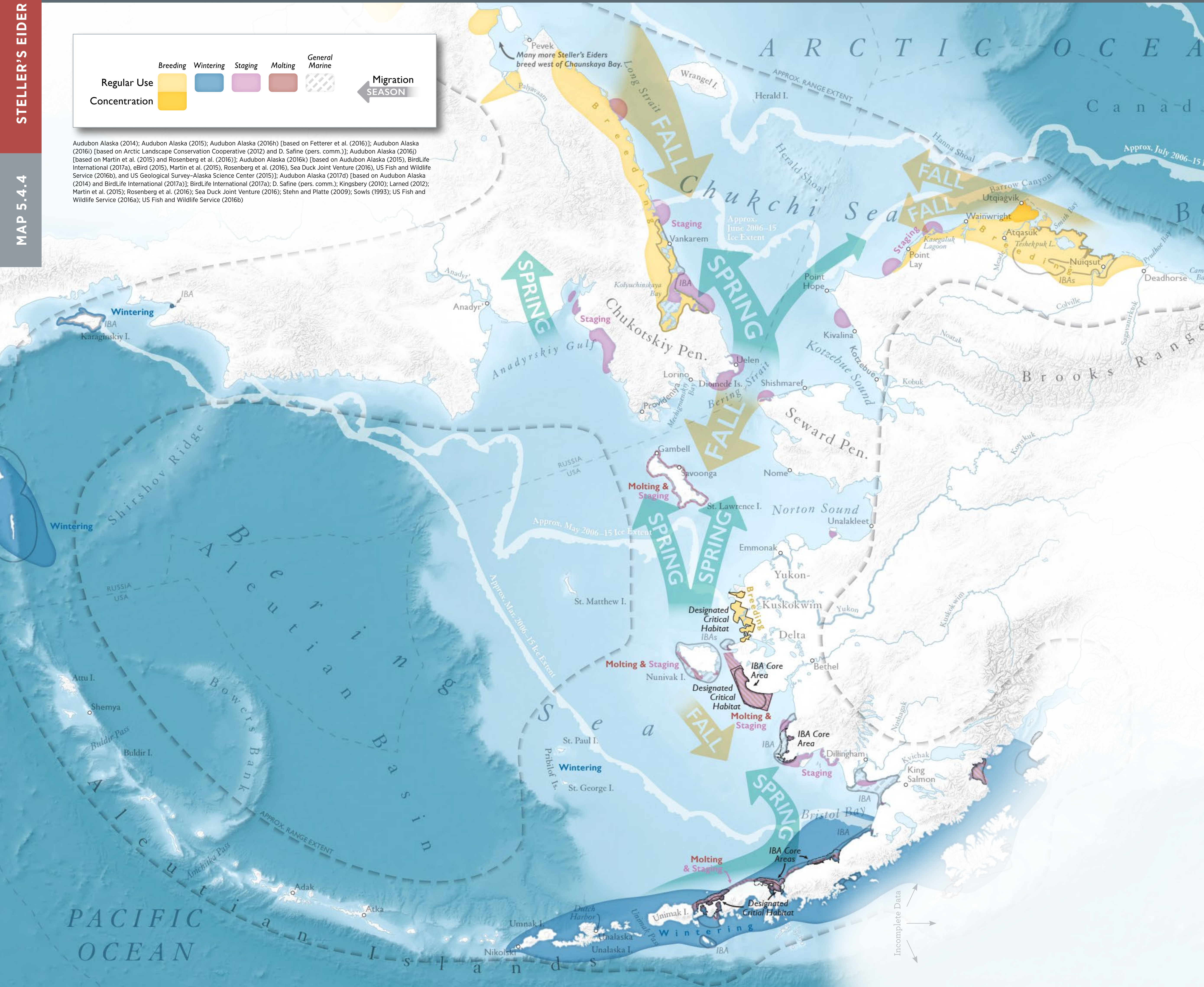
Common Eider (*Somateria mollissima*)

Common Eiders are the largest of the four species of eider and are the largest duck in both Europe and North America. Six or seven different subspecies (depending on the authority) are distributed throughout Europe and North America. In our project area, Common Eiders winter south of the Bering Strait and either follow the sea-ice edge south or utilize areas of open water, such as leads and polynyas, to forage throughout the winter. In spring, Common Eiders often migrate to their coastal breeding habitat in tight flocks numbering in the thousands. Female eiders exhibit natal site fidelity, returning to the area of their birth to breed. This trait, paired with the close-quarters of semi-colonial breeding, is likely responsible for creching (caring for another's offspring) and other behaviors observed due to the close relation between females within each breeding area. After breeding, Common Eiders stage in nearby protected, coastal waters before migrating to molting areas. Unable to fly as they molt their breeding plumage, they raft in large numbers in open water. Once their winter plumage grows, some will fly south to wintering areas, while others will stay in molting areas to feed as winter approaches. Many of the remaining eiders will then move south with the advancing ice edge, dispersing throughout the southern portion of their range. The Common Eiders that remain behind concentrate in leads and polynyas to forage throughout the winter.

Steller's Eider

Map Authors: Erika Knight, Max Goldman, and Melanie Smith
Cartographer: Daniel P. Huffman

Audubon ALASKA



Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Audubon Alaska (2016i) [based on Arctic Landscape Conservation Cooperative (2012) and D. Safine (pers. comm.)]; Audubon Alaska (2016j) [based on Martin et al. (2015) and Rosenberg et al. (2016)]; Audubon Alaska (2016k) [based on Audubon Alaska (2015), BirdLife International (2017a), eBird (2015), Martin et al. (2015), Rosenberg et al. (2016), Sea Duck Joint Venture (2016), US Fish and Wildlife Service (2016b), and US Geological Survey–Alaska Science Center (2015)]; Audubon Alaska (2017d) [based on Audubon Alaska (2014) and BirdLife International (2017a)]; BirdLife International (2017a); D. Safine (pers. comm.); Kingsbery (2010); Larned (2012); Martin et al. (2015); Rosenberg et al. (2016); Sea Duck Joint Venture (2016); Stehn and Platte (2009); Sowls (1993); US Fish and Wildlife Service (2016a); US Fish and Wildlife Service (2016b)

Steller's Eider (*Polysticta stelleri*)

Steller's Eiders are Arctic-dwelling sea ducks that breed in coastal areas of Alaska and Russia. There are three distinct breeding populations of Steller's Eider: one very small breeding population uses the Yukon-Kuskokwim (Y-K) Delta, another population breeds on the North Slope, and a third population breeds along the northern coast of eastern Arctic Russia. The entire Pacific population of Steller's Eiders winters in the ice-free coastal areas of the Alaska Peninsula, the Aleutian Islands, and the northwestern portion of the Gulf of Alaska. Of these 70,000 eiders, around 1% breed on the North Slope of Alaska, an unknown but very small population breeds on the Y-K Delta, and the remaining 99% of the global population migrates from their wintering grounds to breed in northern Russia. After breeding, Steller's Eiders stage offshore before moving to molting areas to molt their flight feathers, and then migrate to their wintering grounds. Steller's Eiders were listed as threatened under the Endangered Species Act in 1997 due to a rapid decline in population. As a result, critical habitat was designated for Steller's Eiders in four areas: staging and molting grounds off the coast of the Y-K Delta; breeding grounds on the Y-K Delta; and two areas of molting, wintering, and staging grounds off the northern shores of the Alaska Peninsula. Although there is evidence that the Steller's Eider population is stabilizing, the last estimate (2012) noted a 2% decrease in the global population.

MAP ON PAGES 144–145

Long-tailed Duck

Clangula hyemalis

Max Goldman, Erika Knight, and Melanie Smith

Long-tailed Ducks (*Clangula hyemalis*) are distinct Arctic sea ducks with smallish bodies and eponymous slim, elongated tail feathers. Once commonly referred to in North America as Oldsquaw, Long-tailed Ducks breed in tundra and taiga regions of far-northern latitudes.

Small for a sea duck, this plump, black-and-gray duck is in a near constant state of plumage change, with three molts per annum, instead of the much more common two molts each year (Salomonsen 1949). The namesake elongated tail feathers are displayed by males year-round. During winter, the Long-tailed Duck's head is white, with a gray patch around the eye and a black patch extending down the neck to its black back and rump. In summer, as breeding season approaches, the male's head turns from white to black, but the gray eyepatch remains. As the summer turns to fall, its head and neck turn white, and its breast and flanks turn gray (Palmer 1976, Payne et al. 2015). Females undergo three molts also, though they are more nuanced than the male's. Male Long-tailed Ducks are slightly larger than females, although there is substantial overlap between the two sexes. While Long-tailed Ducks are distinct, when silhouetted they are sometimes confused with Northern Pintails due to the accentuated tail-feathers each species possesses. However, the erratic flight pattern of the Long-tailed Duck is unique.

These ducks are highly vocal, with a distinctive, nasal call that carries widely. The call of the Long-tailed Duck can be heard throughout the treeless areas where these ducks spend their lives. Males are the most common caller, using their vocality during courtship, although they will also call during the winter (Palmer 1976, Robertson and Savard 2002).

DISTRIBUTION

Long-tailed Ducks are an Arctic- and subarctic-breeding species with a Holarctic distribution. They typically nest at low densities in tundra and taiga habitats, with higher densities sometimes seen on islands (Robertson and Savard 2002). Sea ice and its accompanying features are integral components of Long-tailed Duck ecology (Gilchrist and Robertson 2000).

Wintering

These small, hardy ducks will remain at the northern extent of their range until ice necessitates a move further south to their wintering grounds. They spend the winter on both coasts of North America and on the Great Lakes, sometimes using other large freshwater bodies throughout the continent. In other parts of their range, Long-tailed Ducks spend the winter in southwestern Greenland and throughout most of Iceland (Scott and Rose 1996), as well as ice-free coastal areas of the North and Baltic Seas such as Denmark, Germany, Poland, Finland, Sweden, and Norway (Mathiasson 1970, Laursen 1989). In the North Pacific and Arctic Oceans, Long-tailed Ducks congregate during winter in coastal or protected waters of the Bering Sea, and south as far as the Sea of Okhotsk near Hokkaido, Japan (Dement'ev 1966, Kistchinski 1973, Brazil and Yabuuchi 1991).

Migration

Long-tailed Ducks often gather at distinct, traditional, coastal areas in the thousands before beginning the journey north (Palmer 1976, Woodby and Divoky 1982, Veit and Petersen 1993). As with other Arctic sea ducks, many Long-tailed Ducks begin their northward migration in late winter, while the sea-ice margin is still near its maximum annual extent (Bergman 1974, Campbell et al. 2007a). Most migrate north along offshore leads from their temperate and subarctic wintering grounds in spring, preferring not to stray from open water and food sources (Johnson 1985, Ader and Kespaik 1996).

As they migrate along coastal areas, they can often be identified by their distinct, erratic flight patterns (Palmer 1976). They generally travel in small groups, flying close to the water's surface. Some birds are known to take an overland route in years of especially heavy ice coverage, even crossing the Brooks Range on the way to their coastal breeding habitat (Richardson and Johnson 1981, Woodby and Divoky 1982, Johnson et al. 2005). Upon arrival, flocks of Long-tailed Ducks will congregate in leads or polynyas as they wait for their inland breeding habitat to thaw (McLaren and Alliston 1985).

After breeding, male Long-tailed Ducks migrate to molting areas in small groups beginning in late June, and juveniles and some females join them in July (Johnson and Richardson 1982, Johnson 1985, Petersen et al. 2003). Molting groups of 30,000–40,000 individuals are found in protected coastal waters along the Beaufort and Chukchi coasts and the Chukotka and Seward Peninsulas, although smaller molting groups are likely present throughout the Arctic, including some that molt on breeding areas (e.g. females with broods) (Howell et al. 2003, Flint et al. 2004, Derksen 2015, Payne et al. 2015, Viain and Guillemette 2016). After molting, many Long-tailed Ducks spend September and early October staging in the Canadian Beaufort Sea before migrating to wintering areas in October to December (Ader and Kespaik 1996, Campbell et al. 2007a, Bartzen et al. 2017).

LIFE CYCLE

Long-tailed Ducks do not reach sexual maturity until their third year (Robertson and Savard 2002). Females exhibit a high rate of natal site fidelity, returning year after year to the breeding area of their birth, regardless of success (Alison 1975b, Robertson and Savard 2002). Long-tailed Duck females choose a nest site and begin nest-building after the first egg is laid (Alison 1975b). Females lay six to eight eggs and line the nest with grasses, sedges, heathers, willow leaves, and a sparse amount of down (Drury 1961, Alison 1975b). Eggs hatch after three to four weeks of incubation, and ducklings are able to feed immediately. As early as a single day after hatching, ducklings are led to open water by their mothers (Alison 1975b). While they are poor divers at first, they learn quickly and must be taken to new ponds regularly as

TABLE 5.5-1. Long-tailed Duck life history characteristics and conservation status. Sources: Robertson and Savard (2002), Warnock (2017).

	Long-tailed Duck *Clangula hyemalis*
Body Size Mass Length Wingspan	 **M** 1–2.5 pounds (500–1,100 g) **L** 15–19 inches (40–50 cm) **W** 70–95 inches (190–240 cm)
Maximum Life Span (wild)	Unknown
Clutch Size Range Average	 **R** 6–8 eggs **A** 7 eggs
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	 **ESA:** Not Listed **IUCN:** Vulnerable **WL:** Not Listed
Population Global Alaska	 **G** 6,500,000 **A** 200,000
Breeding Season Eggs Young	 **E** Late May–Early July **Y** Early July–Late August
Migration Spring Molt Fall	 **S** Early April to Late May **M** Late June to August **F** Late October to Late December

MAP ON PAGES 144–145

The Long-tailed Duck undergoes three distinct molts per year. The male Long-tailed Duck (shown here in winter plumage) has two distinct, elongated tail feathers, for which the species is named.

Milo Burcham

food resources become depleted (Alison 1976, Pehrsson and Nystrom 1988). While many large sea ducks require eight weeks or more to fledge, Long-tailed Ducks can take flight after only six weeks (Alison 1975a, Alison 1976).

Diet

Long-tailed Ducks are likely the most adept divers of all sea ducks, regularly gathering food at depths of 15–50 feet (5–15 m), and as deep as 230 feet (70 m) (Schorger 1947;1951, Bustnes and Systad 2001). They feed primarily on epibenthic prey found among the rocks and kelp along the ocean floor, consuming their prey underwater unless the food item is especially large (Peterson and Ellarson 1977, White et al. 2009). On breeding grounds, Long-tailed Ducks eat larval and adult aquatic insects, crustaceans, small fishes, fish roe, and vegetable matter (Cottam 1939, Pehrsson and Nystrom 1988, Sellin 1990). When wintering on salt water, they tend to eat epibenthic amphipods, mysids, bivalves, gastropods, and isopods (Cottam 1939, Johnson 1984, Sanger and Jones 1984) and abundant herring eggs when available. On freshwater wintering grounds, they tend to feed more heavily on amphipods, fish, oligochaete worms, and mollusks (Peterson and Ellarson 1977, Rofritz 1977).

CONSERVATION ISSUES

There is evidence of a decline in the worldwide population of Long-tailed Ducks, but regional trends vary (Schamber et al. 2009, Bellebaum et al. 2014, Bowman 2015). The International Union for the Conservation of Nature (IUCN) lists the worldwide population of Long-tailed Ducks as vulnerable. In North America, they are protected by the Migratory Bird Treaty Act of 1918, but legally hunted for both sport and subsistence. In North America, the Long-tailed Duck population apparently declined substantially from the 1970s to the 1990s, but has since stabilized, although the species is poorly monitored (Robertson and Savard 2002). Elsewhere, these ducks are one of the species protected by the Agreement on the Conservation of African-Eurasian Migratory Waterbirds. In 2008, the US Fish and Wildlife Service (USFWS) rejected an Endangered Species Act petition to list them as endangered. They are not listed on Audubon Alaska's WatchList.

Long-tailed Ducks are responding to increased and persistent threats with declines in numbers in many parts of their circumpolar range, although actual causes of decline are difficult to ascertain. Flint et al. (2012) provided evidence suggesting that changes in abundance of some sea duck species, including Long-tailed Ducks, were strongly influenced by changes in the oceanic environment, although multiple causes are likely responsible. While lead shot has been a consistent source of contamination, it was outlawed in the US in 1998, Canada in 1999, and again briefly in the US in 2016, although the ban was lifted by the US Department of the Interior in March of 2017. Waterfowl and other birds are known to ingest lead shot (Pattee and Hennes 1983, Schummer et al. 2011). In Alaska, especially high lead-exposure levels in nesting female Long-tailed Ducks has been proposed as a cause of nest declines of more than 20% in the Yukon-Kuskokwim Delta population (Flint et al. 1997, Schamber et al. 2009).

Long-tailed Duck mortality due to gill-net entanglement has historically been a common occurrence and substantial source of mortality throughout their global range (Scott 1938, Ellarson 1956, Zydelis et al. 2009). Changes in fisheries management in the US and Canada have abated much of the local concern, although international fisheries in

MAP ON PAGES 144–145

much of the Long-tailed Duck's range have not adopted safer practices, and bycatch is possibly still an important source of mortality in the Baltic Sea (Žydelis et al. 2013).

MAPPING METHODS (MAP 5.5)

We categorized Long-tailed Duck distribution and activity into three main categories of intensity: extent of range, regular use, and concentration. Where possible, we analyzed survey data to draw boundaries and assess intensity of use. However, survey data alone did not provide adequate coverage of the project area. Therefore, the Long-tailed Duck map is a composite of both survey-derived polygons and polygons from other sources. Regular-use and concentration areas are based on either a) isopleths resulting from spatial analysis, or b) information presented in reports and literature.

The mapped Long-tailed Duck range was analyzed by Audubon Alaska (2016g) using observation points from eBird (2015) and Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a). The AGBD combines and integrates point locations from available bird surveys conducted by the USFWS, the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). To assess range, we buffered all known occurrences of Long-tailed Ducks using a 62-mile (100-km) radius, and merged polygons. Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. The survey-derived range polygon was merged with Long-tailed Duck data from Audubon Alaska (2015), Bartzen et al. (2017), BirdLife International (2017a), Sea Duck Joint Venture (2016), Petersen et al. (2003), and Portenko (1972). Inconsistencies in the resulting polygons were manually edited and smoothed.

Breeding regular-use and concentration areas were delineated by Audubon Alaska (2017f) by merging and smoothing breeding data from BirdLife International (2017a), personal communication with USFWS biologist Marc Romano, National Oceanic and Atmospheric Administration (1988), Dickson et al. (1997), Portenko (1972), Sea Duck Joint Venture (2016), and Audubon Alaska's analysis of the AGBD (Audubon Alaska 2016a). For our analysis, Long-tailed Duck observation points recorded on land during the breeding season (May–September, as documented in Cornell Lab of Ornithology and American Ornithologists' Union (2016)) were processed using a kernel density analysis with a 15.5-mile (25-km) search radius. For Long-tailed Duck, the data encompass surveys conducted from 1988 to 2013. The 99% isopleth of this analysis was incorporated into the merged breeding regular-use polygon. Breeding concentration areas were represented by the 50% isopleth from the kernel density analysis.

Wintering areas were compiled by Audubon Alaska based on wintering information provided in Bartzen et al. (2017), Kingsbery (2010), Sea Duck Joint Venture (2016), and Sowls (1993).

Staging areas were compiled by Audubon Alaska based on staging information provided in Bartzen et al. (2017) and Petersen et al. (2003).

Molting areas were compiled by Audubon Alaska based on molting information provided in National Oceanic and Atmospheric Administration (1988), National Oceanic and Atmospheric Administration (2005), Portenko (1972), and Dickson and Gilchrist (2002). In addition, we delineated molting areas along the North Slope coast of Alaska based on aerial survey data recorded in Fischer et al. (2002) and Lysne et al. (2004), and in personal communication with Paul Flint, whose research on Long-tailed Duck molting areas is documented in Flint et al. (2016).

Areas of the ocean that are regularly used by Long-tailed Ducks but that cannot be assigned to a primary activity such as staging, molting, or wintering are shown based on National Oceanic and Atmospheric Administration (1988), merged with a 6.2-mile (10-km) buffer of the coastal areas within the species' range.

High-concentration areas were represented using global Important Bird Areas (IBAs). In Russia and Canada, IBAs for Long-tailed Ducks are based on data from BirdLife International (2017a), while IBAs in Alaska are from Audubon Alaska (2014). Because IBA boundaries often encompass multiple-species hotspots, in Alaska we also show single-species IBA core areas to indicate high concentrations specific to Long-tailed Ducks (see Smith et al. 2014c).

Migration arrows were published in Bartzen et al. (2017).

The sea-ice data shown on this map approximate median monthly sea ice extent. The monthly sea-ice lines were based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

Various forms of Long-tailed Duck data exist across much of the project area. The observation data used to generate range polygons are available across the project area, although they are sparser in Russia and Canada than in Alaska. Molting data are also sparser in Russia. Migration, wintering, and staging data are largely based on one satellite telemetry study of 57 Long-tailed Ducks tagged in the western Canadian Arctic (Bartzen et al. 2017), although the wintering and staging areas incorporate data from additional publications as well.

As with telemetry data, the AGBD used to analyze breeding regular-use and breeding concentration areas is most robust in Alaska. However, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting map. There is little to no survey coverage in the Canadian and Russian portions of the project area, potentially leaving major data gaps in the mapped distribution and concentration of this species. Refer to Map 5.3.1 of Bird Survey Effort in this chapter for more insight into the relative accuracy of these maps.

Reviewers

- Tim Bowman
- Julian Fischer

MAP DATA SOURCES

Extent of Range: Audubon Alaska (2016g) based on Audubon Alaska (2015), Audubon Alaska (2016a), Bartzen et al. (2017), BirdLife International (2017a), eBird (2015), Petersen et al. (2003), Portenko (1972), and Sea Duck Joint Venture (2016)

Breeding: Audubon Alaska (2017f) based on Audubon Alaska (2016a) and Sea Duck Joint Venture (2016); BirdLife International (2017a); Dickson et al. (1997); M. Romano (pers. comm.); National Oceanic and Atmospheric Administration (1988); Portenko (1972)

Breeding Concentration: Audubon Alaska (2017f) based on Audubon Alaska (2016a)

Wintering: Bartzen et al. (2017); Kingsbery (2010); Sea Duck Joint Venture (2016); Sowls (1993)

Staging: Bartzen et al. (2017); Petersen et al. (2003)

Molting: Audubon Alaska (2016f) based on Fischer et al. (2002), Lysne et al. (2004) and P. Flint (pers. comm.); Dickson and Gilchrist (2002); National Oceanic and Atmospheric Administration (1988); National Oceanic and Atmospheric Administration (2005); Portenko (1972)

Marine Regular Use: Audubon Alaska (2017g) based on National Oceanic and Atmospheric Administration (1988)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Migration: Bartzen et al. (2017)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

5.5 LONG-TAILED DUCK
MAP ON PAGES 144–145

Long-tailed Duck nests are composed of grasses and leaves, and lined with down. Females incubate six to eight eggs for nearly a month before their ducklings hatch. These precocious ducklings leave the nest to feed with their parents within a day of hatching, and fledge when only a month and a half old. A female Long-tailed Duck is pictured on a downy nest.

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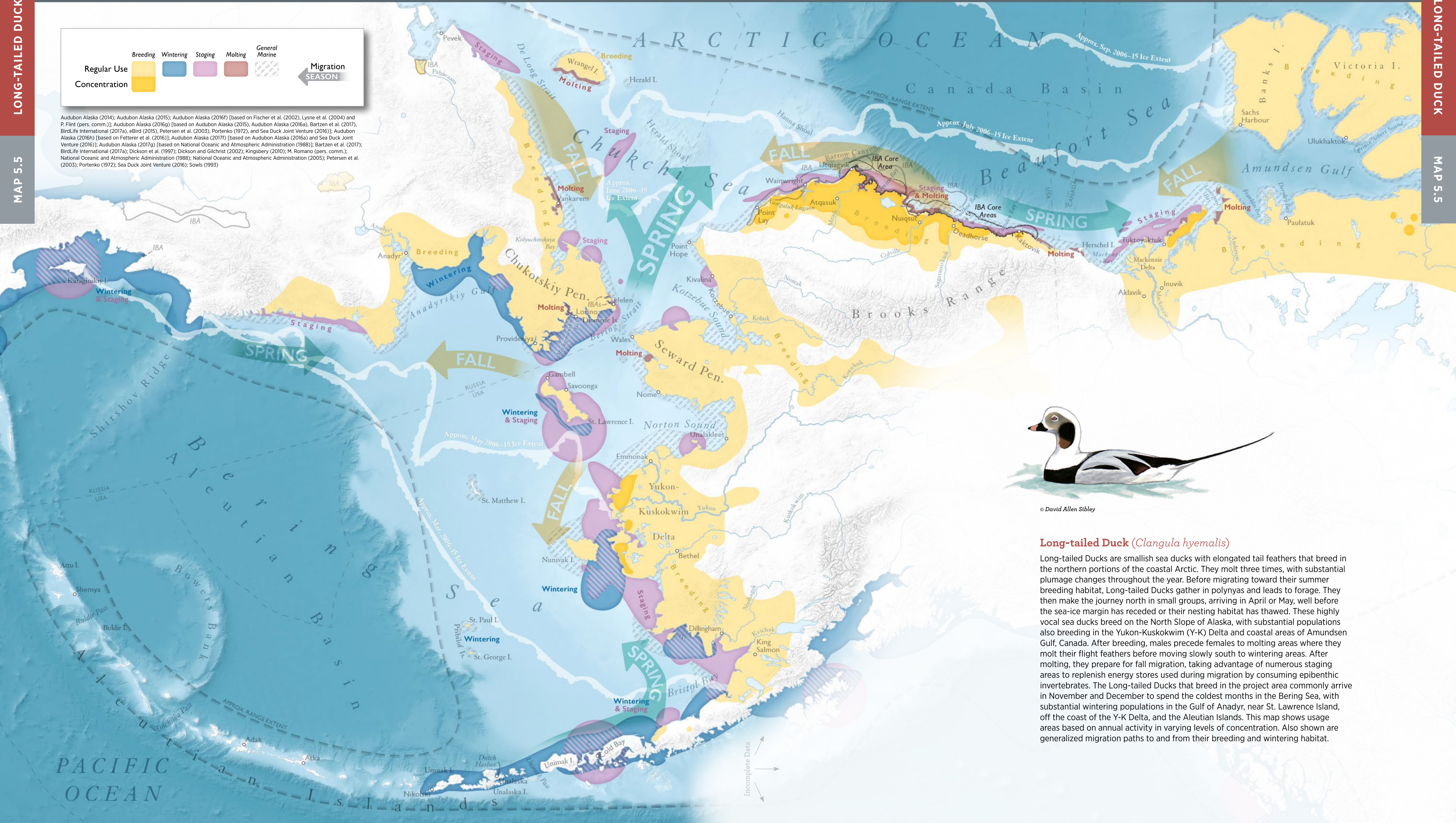
Long-tailed Duck

Map Authors: Erika Knight, Max Goldman, and Melanie Smith
Cartographer: Daniel P. Huffman

Audubon ALASKA



Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016f) [based on Fischer et al. (2002), Lysne et al. (2004) and P. Flint (pers. comm.)]; Audubon Alaska (2016g) [based on Audubon Alaska (2015), Audubon Alaska (2016a), Bartzen et al. (2017), BirdLife International (2017a), eBird (2015), Petersen et al. (2003), Portenko (1972), and Sea Duck Joint Venture (2016)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Audubon Alaska (2017f) [based on Audubon Alaska (2016a) and Sea Duck Joint Venture (2016)]; Audubon Alaska (2017g) [based on National Oceanic and Atmospheric Administration (1988)]; Bartzen et al. (2017); BirdLife International (2017a); Dickson et al. (1997); Dickson and Gilchrist (2002); Kingsbery (2010); M. Romano (pers. comm.); National Oceanic and Atmospheric Administration (1988); National Oceanic and Atmospheric Administration (2005); Petersen et al. (2003); Portenko (1972); Sea Duck Joint Venture (2016); Sowls (1993)

Long-tailed Duck *(Clangula hyemalis)*

Long-tailed Ducks are smallish sea ducks with elongated tail feathers that breed in the northern portions of the coastal Arctic. They molt three times, with substantial plumage changes throughout the year. Before migrating toward their summer breeding habitat, Long-tailed Ducks gather in polynyas and leads to forage. They then make the journey north in small groups, arriving in April or May, well before the sea-ice margin has receded or their nesting habitat has thawed. These highly vocal sea ducks breed on the North Slope of Alaska, with substantial populations also breeding in the Yukon-Kuskokwim (Y-K) Delta and coastal areas of Amundsen Gulf, Canada. After breeding, males precede females to molting areas where they molt their flight feathers before moving slowly south to wintering areas. After molting, they prepare for fall migration, taking advantage of numerous staging areas to replenish energy stores used during migration by consuming epibenthic invertebrates. The Long-tailed Ducks that breed in the project area commonly arrive in November and December to spend the coldest months in the Bering Sea, with substantial wintering populations in the Gulf of Anadyr, near St. Lawrence Island, off the coast of the Y-K Delta, and the Aleutian Islands. This map shows usage areas based on annual activity in varying levels of concentration. Also shown are generalized migration paths to and from their breeding and wintering habitat.

Loons

Max Goldman, Erika Knight, and Melanie Smith

Yellow-billed Loon

Gavia adamsii

Red-throated Loon

G. stellata

The Yellow-billed Loon (*Gavia adamsii*) and the Red-throated Loon (*G. stellata*) are migratory diving birds that nest in the lakes of northern North America and Eurasia. These subarctic and Arctic species hunt fish in nearshore marine habitats or large, clear, freshwater lakes. A close relative of the Common Loon (*G. immer*), the Yellow-billed Loon is distinct because of its namesake yellow bill and its northerly range, although the two species are often mistaken for each other (Phillips 1990). This confusion stems not only from their physical appearance but also from obvious similarities in behavior and call, which has likely resulted in incorrect estimates of population size and range for the Yellow-billed Loon in the past (North 1994). As a result, there are very few long-term data regarding this species, and the only monitored population is the Alaska—Arctic Coastal Plain (Alaska—ACP) breeding population, which is often used as an indicator of the species as a whole (Schmutz and Rizzolo 2012, US Fish and Wildlife Service 2014b, J. Schmutz 2017). The Red-throated Loon is distinctly smaller than the five other extant loons (*Gavia* spp.) and is rarely mistaken for any other species, although winter plumage of the Red-throated Loon and the Pacific Loon are similar.

Red-throated and Yellow-billed Loons are distinguished from each other by a number of characteristics. The Red-throated Loon is substantially smaller and slighter, with finer features and unique markings, such as a dark, brownish-red throat patch, and pale-gray head and neck. They lack the distinctive black back markings of other loons in breeding plumage and can be as little as one-third the size of the much bulkier Yellow-billed Loon. The slender neck and fine, pointed, upturned bill of the Red-throated Loon give it a quintessential loon profile.

Among the largest of the five extant species of loon, the Yellow-billed Loon is very similar in appearance to its similarly sized sister taxon, the Common Loon (Evers et al. 2010). In breeding plumage, both species have black heads and black backs spotted with white. Each has a "necklace" of white stripes as well, although the number of stripes differs between species, with the Yellow-billed Loon having more than 12 and the Common Loon having fewer than 12 stripes (North 1994). The differences in their bills give the clearest way to identify the two species. The Yellow-billed Loon's yellow- to ivory-colored bill is often held in an uptilted position, while the Common Loon holds its bluish-black bill closer to parallel with the water (Binford and Remsen 1974, Burn and Mather 1974, Evers et al. 2010).

Yellow-billed Loons, Red-throated Loons, and their cousins are well-suited to foraging under water. Their streamlined shape allows them to efficiently move through their aquatic habitat to pursue prey. They propel themselves with their feet, keeping their wings pinned closely to their bodies. Their aptness in water does not translate to land, however, as they often have difficulty walking, and are only able to initiate flight from water (US Fish and Wildlife Service 2014b). When they take to the air, loons fly with their necks outstretched and their feet trailing behind (Andres 1993).

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Red-throated Loon adult in breeding plumage.

TABLE 5.6-1. Loon life-history characteristics and conservation status. Sources: North (1994), Barr et al. (2000), Warnock (2017).

	Yellow-billed Loon *Gavia adamsii*	Red-throated Loon *G. stellata*
Body Size Mass Length	**M** 10–13 pounds (4.5–6 kg) **L** 30–36 inches (75–90 cm)	**M** 3–5 pounds (1.5–2.5 kg) **L** 20–27 inches (50–70 cm)
Maximum Life Span (wild)	Unknown	Unknown
Clutch Size Range	1–2 eggs	1–2 eggs
Nest-Water Proximity	<6.5 feet (<2 m)	<6.5 feet (<2 m)
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	**ESA:** Not Warranted **IUCN:** Near Threatened **WL:** Red List	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Red List
Population Global Alaska	**G** 24,000 **A** 3,500	**G** 400,000 **A** 15,000
Breeding Season Eggs Young	**E** May to August **Y** Mid-July to October	**E** May to August **Y** Mid-July to October
Migration Spring Fall	**S** April to July **F** Mid-August to November	**S** April to July **F** Mid-August to November

DISTRIBUTION

The Yellow-billed Loon and Red-throated Loon are the rarest and the most widely distributed of the five extant loons, respectively.

Migration

Starting in April, Yellow-billed and Red-throated Loons migrate from wintering grounds to breeding grounds, and return after breeding each fall, usually arriving at wintering areas by mid-November (North 1994, Barr et al. 2000). They mainly utilize coastal marine resources when migrating, although some western Canada breeding Yellow-billed Loons follow an overland migration route from Southeast Alaska, likely foraging in large lakes along the way (Schmutz 2017). Traveling singly or in pairs, Arctic-breeding loons congregate in leads and polynyas near their breeding territory before beginning the nesting process (Barr et al. 2000, Mallory and Fontaine 2004). After breeding, males, females, and juveniles will migrate independently to wintering grounds beginning in early September. Failed breeders may leave as early as July (North 1994, Barr et al. 2000). Juvenile loons are known to stay in wintering areas until sexually mature, will not migrate to breeding areas until the age of three, and are not likely to successfully breed until they are six (Evers et al. 2010).

Wintering

The wintering range of Yellow-billed Loons includes coastal waters of the Aleutians through Southeast Alaska, south to Puget Sound; the Pacific Coast of Asia from the Sea of Okhotsk to the Yellow Sea; the Barents Sea to the Norwegian coast; and likely the British coast. Red-throated Loons winter in the Aleutian Islands, Southeast Alaska, Asia and Russia, but their winter range also extends along the east coast of the US, the western US south to Baja, Mexico, and portions of coastal Europe including Scandinavia, the UK, Portugal, Spain, and Italy, among others (Gibson and Byrd 2007, Strann and Østnes 2007, US Fish and Wildlife Service 2014b, Gibson et al. 2015). They prefer sheltered marine coastal areas with moderately shallow water, presumably for prey selection.

LIFE CYCLE

Yellow-billed and Red-throated Loons generally form pair bonds once they arrive at their breeding territory in June. Loons are monogamous each breeding season, although death or eviction from their territory will immediately prompt a new pair bond to form. Yellow-billed and Red-throated Loons are especially territorial, evicting any other loons and diving ducks from their territory, which is comprised of 1–2 lakes ranging in size from 30 to more than 250 acres (13–100 ha). They avoid lakes that are associated with rivers and have fluctuating seasonal water levels (North and Ryan 1986, 1989).

After the bond has been established and their territory has been defended, the pair will begin building a nest or improving on a previous year's nest (Davis 1972, Dickson 1993, Eberl and Picman 1993, US Fish and Wildlife Service 2014b). Loon nests are most often located on islands or peninsulas within 3 feet (1 m) of the water's edge (North 1994). They are simple nests, comprised of a depression in shoreline vegetation, peat, or mud that is intermittently reinforced with grass and moss throughout habitation (North and Ryan 1989, Barr et al. 2000).

Nest building is immediately followed by the laying of usually two, 3.5-inch (9-cm) long, brownish, elliptical eggs. The pair divides the task of incubation, splitting time between sitting on eggs and foraging for themselves and their mate. About 28 days later, the eggs will hatch. Chicks leave the nest with their parents soon after hatching, moving between natal and brood-rearing lakes until fledging at about ten weeks (North 1994, Earnst et al. 2005, Earnst et al. 2006). Survival rates from hatching to fledging are approximately 50%, with late ice melt contributing to especially low chick survival in some years (US Fish and Wildlife Service 2014b).

Diet

Loons pursue prey underwater, and often under ice, by propelling themselves forward with their rear-facing feet to catch a variety of small fishes, such as ninespine sticklebacks (*Pungitius pungitius*), least cisco (*Coregonus sardinella*), Alaska blackfish (*Dallia pectoralis*), and slimy sculpin (*Cottus cognatus*) (US Fish and Wildlife Service 2014b, Haynes et al. 2015). In wintering ranges, they will consume a more varied diet, including fishes, crustaceans, and worms (Bailey 1922, Cottam 1939, North 1994, Barr et al. 2000, US Fish and Wildlife Service 2014b).

CONSERVATION ISSUES

Loons are protected in the US by the Migratory Bird Treaty Act of 1918, and the Agreement on the Conservation of African-Eurasian Waterbirds. The Yellow-billed Loon was designated as a candidate for listing under the Endangered Species Act (ESA) in March of 2009, after a petition to the US Fish and Wildlife Service (USFWS) to list them as an endangered or threatened species was received in April of 2004. After publishing a 12-month finding in the Federal Register in 2007, USFWS concluded that listing the Yellow-billed Loon as an endangered or threatened species under the ESA was "warranted, but precluded by higher listing priorities," and was thereby added to the list of species annually reviewed by USFWS. In 2010, the International Union for the Conservation of Nature (IUCN) classified the Yellow-billed Loon as near-threatened due to "a moderately rapid population decline owing to unsustainable subsistence harvest" (IUCN 2016). In October of 2014, after further study into the population status within Alaska, the USFWS found that listing the Yellow-billed Loon was not warranted.

The Red-throated Loon is not listed by the ESA, and is considered a species of least concern by the IUCN (BirdLife International 2016a), although conservative estimates show that the Alaska population likely dropped by over 50% (Groves et al. 1996). Audubon Alaska includes both species on the Red List of its WatchList, indicating that each species is experiencing declines (Warnock 2017).

Human activity and climate change are the most pressing management concerns regarding Yellow-billed Loons. In the Yellow Sea portion of their wintering range, intertidal reclamation for industrial and agriculture development has resulted in the destruction of as much as 60% of the area's tidal wetlands over the last half-century

Bob Wick / Bureau of Land Management

Yellow-billed Loons, among the largest of the loon species, breed on the banks of freshwater ponds in the far northern portions of Alaska in the US, the Chukotka Peninsula in Russia, and the Canadian Arctic.

(Murray et al. 2014). Red-throated Loons have been especially hard hit by this habitat loss and the resulting concentration of environmental toxins, such as polychlorinated biphenyl (PCB), as they rely on shallow waters to feed during the winter (Schmutz et al. 2009). As with many Arctic-breeding species, infrastructure development and spill potential related to hydrocarbon extraction pose imminent threats. Oil and gas exploration is prevalent in the breeding and nearshore marine regular-use and concentration areas for both the Yellow-billed and Red-throated Loons in Alaska (Bart et al. 2013). Oil spills, infrastructure, vehicle and aircraft disturbance, lake pollution, and increased predation are issues that may affect them. Additionally, the sustained warming of the Arctic, and sea-level rise due to global climate change threatens to inundate their Arctic coastal tundra breeding habitats with fresh water, destroying the saline sensitive environment that sustains adult loons and their young through the breeding season (Schoen et al. 2013). Subsistence harvest of loons continues but is not considered to be a serious threat, as take numbers are low, and unlikely to impact populations (Naves and Zeller 2017). These concerns, along with commercial fishing bycatch and the potential for an increase in novel pathogens as the climate becomes more temperate, pose the most pressing threats to the survival of the Yellow-billed and Red-throated Loons in the Arctic (Groves et al. 1996, Agler et al. 1999, Hodges et al. 2002).

MAPPING METHODS (MAPS 5.6.1–5.6.2)

For the loon maps, we categorized distribution and activity into four main categories of intensity: extent of range, regular use, and concentration. Where possible, we analyzed survey data to draw boundaries and assess intensity of use. However, survey data alone did not provide adequate coverage of the project area. Therefore, the loon maps are a composite of both survey-derived polygons and polygons from other sources. Regular-use and concentration areas are based on either a) boundaries based on spatial analysis, or b) information presented in reports and literature.

The mapped range extents for each species were analyzed by Audubon Alaska (2016m) using observation points from eBird (2015), Schmutz (2017), Arctic Landscape Conservation Cooperative (2013) (for Yellow-billed Loons only), and Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). To assess range, we buffered all known occurrences of each species using a 62-mile (100-km) radius, and merged polygons. Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. For Yellow-billed Loons, the survey-derived range polygon was merged with range data from Alaska Department of Fish and Game (2016). Inconsistencies in the resulting polygons were manually edited and smoothed.

For Yellow-billed Loons, breeding regular-use and concentration areas were delineated by Audubon Alaska (2017m) by merging and smoothing breeding data from US Fish and Wildlife Service (2014b), Audubon Alaska (2009d), and Audubon Alaska's analysis of the AGBD (Audubon Alaska 2016a). For our analysis, Yellow-billed Loon observation points recorded on land during the breeding season (as documented in Cornell Lab of Ornithology and American Ornithologists' Union (2016)) were processed using a kernel density analysis with a 15.5-mile (25-km) search radius. The data encompass surveys conducted from 1992 to 2011. The 99% isopleth of this analysis was incorporated into the merged breeding regular-use polygon. Breeding concentration areas were represented by the 50% isopleth from the kernel density analysis.

For Red-throated Loons, breeding regular-use and concentration areas were compiled by Audubon Alaska (2009c) based on data from several sources, including Portenko (1972), Flint et al. (1984), Walker and Smith (2014), and Drew and Piatt (2005). The breeding regular-use area also incorporated data from Cornell Lab of Ornithology and American Ornithologists' Union (2016).

To delineate general marine regular-use areas, we used a combination of telemetry data (Schmutz 2017) and at-sea surveys (Audubon Alaska 2016a). To delineate areas from telemetry data, location classes with the highest spatial certainty were utilized (LC 0–3), and we removed points that intersected land. To discriminate points where loons were stopped on the water or moving slowly through an area (i.e. not migrating), we selected only locations with a movement rate of 3.1 miles (5 km) per hour or less. Next, we converted points to a raster grid with a 3.1-mile (5-km) cell size, counting the number of unique individuals occurring in each bin. We then converted raster cells back to points resulting in one point at the centroid of each bin. To remove spatial outliers, we ran a nearest neighbor analysis to identify points within 31 miles (50 km) of another occurrence, from either the telemetry or at-sea survey data. Next we ran a 78-mile (125-km) kernel density analysis, and calculated the 99% isopleth. We then reverse-buffered the isopleth line to trim back toward the buffered point locations. Next, we analyzed the at-sea survey data using nearly the same process: removed points on land, utilized locations within 31 miles (50 km) of each other, averaged reported densities across 3.1-mile (5-km) cells, ran a 78-mile (125-km) kernel density analysis, calculated the 99% isopleth, and trimmed the result. Due to many overlaps and inconsistencies between the results of the telemetry and at-sea analyses, GIS analysis alone was not a sufficient delineator—the final boundaries were hand-drawn to incorporate the results of the two analyses while referring back to the original point data, including the timing and density of birds reported. After that, we ran a 31-mile (50-km) kernel density analysis for each of the datasets (telemetry and at-sea) using the same methods as used for the previous (marine regular-use) analyses. We then delineated the areas with a density of 1 or more standard deviations above the mean regional density. The resulting polygons were classified into regular-use staging or regular-use wintering based on timing of use and geographic location. Areas with density of 3 or more standard deviations above the mean density were mapped as staging and wintering concentration areas.

High-concentration areas were represented using global Important Bird Areas (IBAs). In Russia and Canada, IBAs are shown based on data from BirdLife International (2017a) while IBAs in Alaska are from Audubon Alaska (2014). Because IBA boundaries often encompass multiple-species hotspots, in Alaska we also show single-species IBA core areas to indicate high concentrations specific to each species (see Smith et al. 2014c).

Migration arrows were drawn by Audubon Alaska (2016d) based on satellite telemetry data from Schmutz (2017).

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines are based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

By combining telemetry, at-sea, and aerial surveys, data for Yellow-billed and Red-throated Loons exist across much of the project area, although data are sparser in Russia and Canada than in Alaska. Migration and wintering data are based on one satellite telemetry study (Schmutz 2017) in which over 50 birds of each species were tagged in Alaska between 2000 and 2010.

The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Arctic Canada. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Areas of little to no survey coverage in the Canadian and Russian portions of the project area potentially resulted in data gaps for these species, although telemetry data were used to fill gaps in many locations. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of these maps.

Reviewer

- Joel Schmutz

MAP DATA SOURCES

YELLOW-BILLED LOON MAP

Extent of Range: Audubon Alaska (2016m) based on Alaska Department of Fish and Game (2016), Arctic Landscape Conservation Cooperative (2013), Audubon Alaska (2016a), eBird (2015), and Schmutz (2017)

Breeding: Audubon Alaska (2017m) based on Audubon Alaska (2009d), Audubon Alaska (2016a), and US Fish and Wildlife Service (2014b)

Breeding Concentration: Audubon Alaska (2017m) based on Audubon Alaska (2016a)

Wintering: Audubon Alaska (2016n) based on Audubon Alaska (2016a) and Schmutz (2017)

Wintering Concentration: Audubon Alaska (2016n) based on Audubon Alaska (2016a) and Schmutz (2017)

Staging: Audubon Alaska (2016n) based on Audubon Alaska (2016a) and Schmutz (2017)

Staging Concentration: Audubon Alaska (2016n) based on Audubon Alaska (2016a) and Schmutz (2017); BirdLife International (2017a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Migration: Audubon Alaska (2016l) based on Schmutz (2017)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

RED-THROATED LOON MAP

Extent of Range: Audubon Alaska (2016m) based on Audubon Alaska (2016a), eBird (2015), and Schmutz (2017)

Breeding: Audubon Alaska (2009c) based on Flint et al. (1984), Portenko (1972), US Geological Survey–Alaska Science Center (2015), and Walker and Smith (2014); Cornell Lab of Ornithology and American Ornithologists' Union (2016); Portenko (1972)

Breeding Concentration: Audubon Alaska (2009c) based on Flint et al. (1984), Portenko (1972), US Geological Survey–Alaska Science Center (2015), and Walker and Smith (2014)

Wintering: Audubon Alaska (2016n) based on Audubon Alaska (2016a) and Schmutz (2017)

Wintering Concentration: Audubon Alaska (2016n) based on Audubon Alaska (2016a) and Schmutz (2017)

Staging: Audubon Alaska (2016n) based on Audubon Alaska (2016a) and Schmutz (2017)

Staging Concentration: Audubon Alaska (2016n) based on Audubon Alaska (2016a) and Schmutz (2017)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

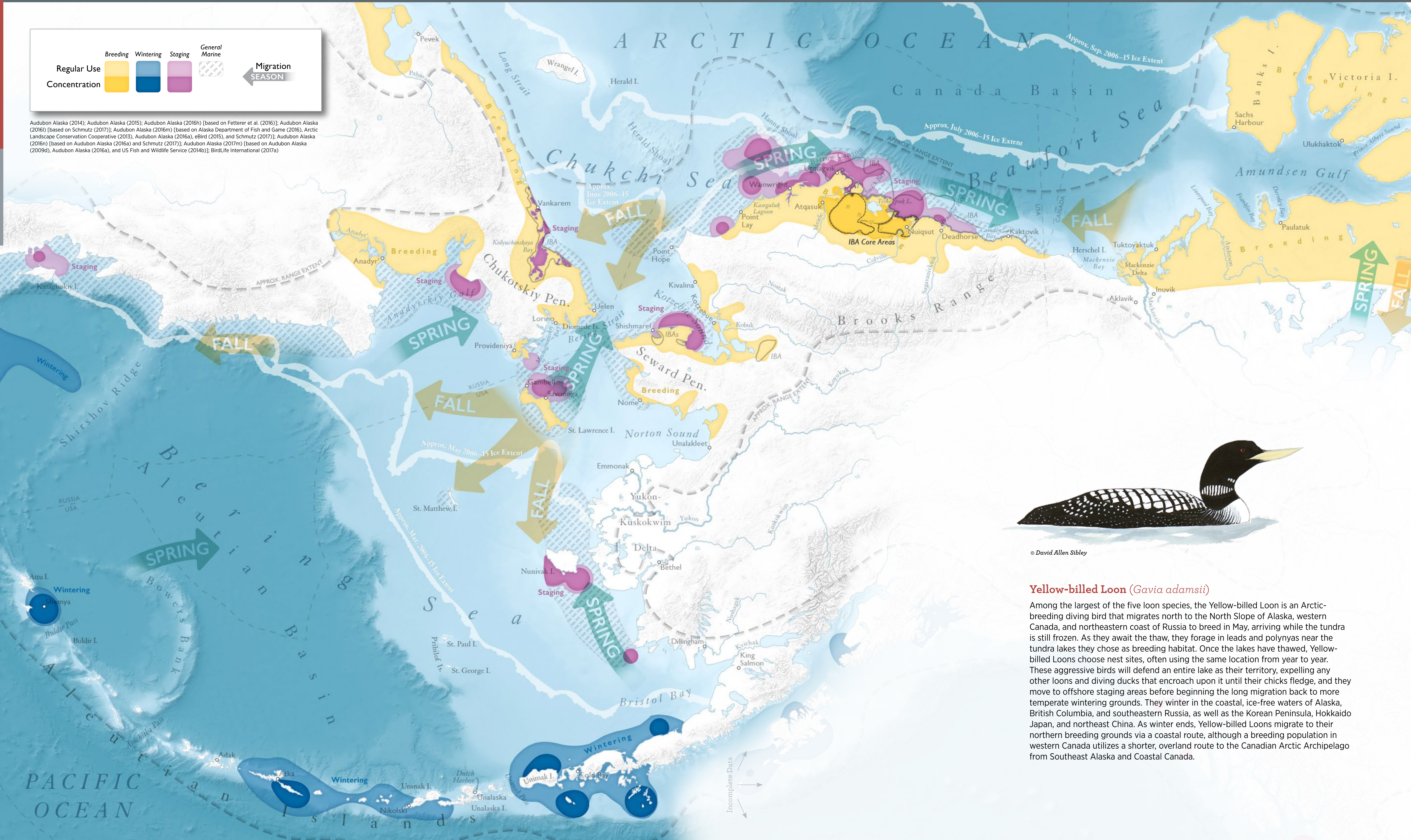
Migration: Audubon Alaska (2016l) based on Schmutz (2017)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

Yellow-billed Loon

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman

Audubon ALASKA



Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Audubon Alaska (2016l) [based on Schmutz (2017)]; Audubon Alaska (2016m) [based on Alaska Department of Fish and Game (2016), Arctic Landscape Conservation Cooperative (2013), Audubon Alaska (2016a), eBird (2015), and Schmutz (2017)]; Audubon Alaska (2016n) [based on Audubon Alaska (2016a) and Schmutz (2017)]; Audubon Alaska (2017m) [based on Audubon Alaska (2009d), Audubon Alaska (2016a), and US Fish and Wildlife Service (2014b)]; BirdLife International (2017a)

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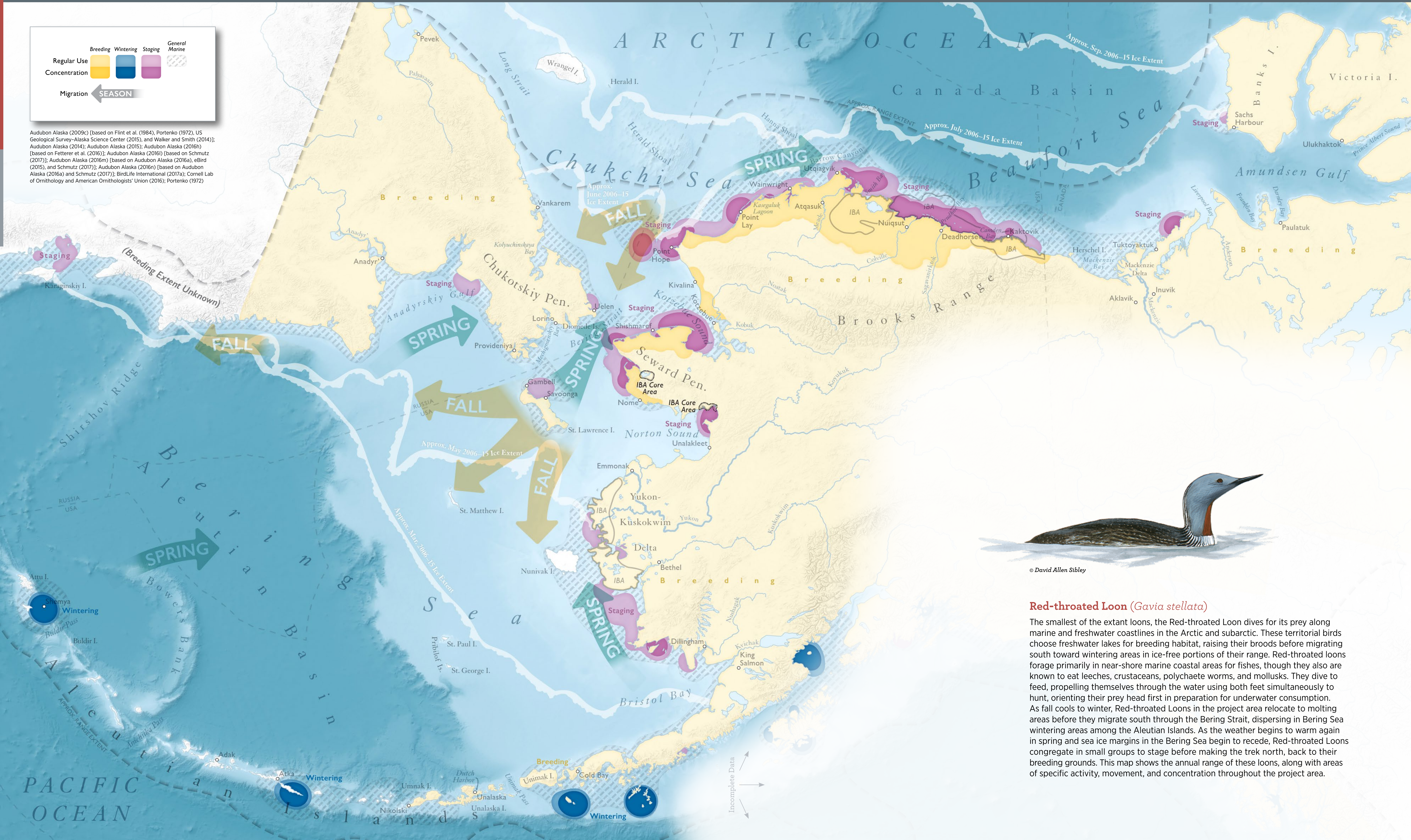
Yellow-billed Loon (*Gavia adamsii*)

Among the largest of the five loon species, the Yellow-billed Loon is an Arctic-breeding diving bird that migrates north to the North Slope of Alaska, western Canada, and northeastern coast of Russia to breed in May, arriving while the tundra is still frozen. As they await the thaw, they forage in leads and polynyas near the tundra lakes they chose as breeding habitat. Once the lakes have thawed, Yellow-billed Loons choose nest sites, often using the same location from year to year. These aggressive birds will defend an entire lake as their territory, expelling any other loons and diving ducks that encroach upon it until their chicks fledge, and they move to offshore staging areas before beginning the long migration back to more temperate wintering grounds. They winter in the coastal, ice-free waters of Alaska, British Columbia, and southeastern Russia, as well as the Korean Peninsula, Hokkaido Japan, and northeast China. As winter ends, Yellow-billed Loons migrate to their northern breeding grounds via a coastal route, although a breeding population in western Canada utilizes a shorter, overland route to the Canadian Arctic Archipelago from Southeast Alaska and Coastal Canada.

Red-throated Loon

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman

Audubon ALASKA



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Red-throated Loon (*Gavia stellata*)

The smallest of the extant loons, the Red-throated Loon dives for its prey along marine and freshwater coastlines in the Arctic and subarctic. These territorial birds choose freshwater lakes for breeding habitat, raising their broods before migrating south toward wintering areas in ice-free portions of their range. Red-throated loons forage primarily in near-shore marine coastal areas for fishes, though they also are known to eat leeches, crustaceans, polychaete worms, and mollusks. They dive to feed, propelling themselves through the water using both feet simultaneously to hunt, orienting their prey head first in preparation for underwater consumption. As fall cools to winter, Red-throated Loons in the project area relocate to molting areas before they migrate south through the Bering Strait, dispersing in Bering Sea wintering areas among the Aleutian Islands. As the weather begins to warm again in spring and sea ice margins in the Bering Sea begin to recede, Red-throated Loons congregate in small groups to stage before making the trek north, back to their breeding grounds. This map shows the annual range of these loons, along with areas of specific activity, movement, and concentration throughout the project area.

Audubon Alaska (2009c) [based on Flint et al. (1984), Portenko (1972), US Geological Survey–Alaska Science Center (2015), and Walker and Smith (2014)]; Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Audubon Alaska (2016l) [based on Schmutz (2017)]; Audubon Alaska (2016m) [based on Audubon Alaska (2016a), eBird (2015), and Schmutz (2017)]; Audubon Alaska (2016n) [based on Audubon Alaska (2016a) and Schmutz (2017)]; BirdLife International (2017a); Cornell Lab of Ornithology and American Ornithologists' Union (2016); Portenko (1972)

5.7 RED-FACED CORMORANT MAP ON PAGE 156

Red-faced Cormorant

Phalacrocorax urile

Max Goldman, Erika Knight, and Melanie Smith

Among the least known and understood species in the Northern Hemisphere, the Red-faced Cormorant (*Phalacrocorax urile*) is a medium to large, colonial-nesting seabird that utilizes coastal waters, islands, and continental shelves in the North Pacific. They are similar in both appearance and range to the Pelagic Cormorant (*P. pelagicus*). Red-faced Cormorants are exclusively marine, spending their entire lives in, above, or within a few feet of the water.

As their name suggests, Red-faced Cormorants are distinguished by the red facial skin that is prominent in breeding adults. It is often paired with a yellowish bill and a pale-blue gape. Also, while in breeding plumage, adult birds display a single crest of feathers on their crown, or sometimes double crests on their crown and nape, and a conspicuous white patch on their flank (Causey 2002). They are, in general, approximately 25% larger than Pelagic Cormorants. Male and female Red-faced Cormorants exhibit dimorphism in size alone, with identical plumage through all stages of life (Causey 2002). They have a well-developed uropygial gland, which they use to oil their wet feathers by first rubbing it with their bill, and then preening their feathers, in order to reduce saturation in subsequent dives.

DISTRIBUTION

The range of the Red-faced Cormorant extends, in a latitudinally narrow band, from the Kenai Peninsula west through the Aleutian Islands and the Commander Islands to the Kuril Islands, the Kamchatka Peninsula, and Northern Japan. They rarely range south of the Aleutians or the Alaska Peninsula; some colonies are found north into Bristol Bay and the Pribilof Islands (Gabrielson and Lincoln 1959, Siegel-Causey and Litvinenko 1993).

Migration and Wintering

Red-faced Cormorants are not migratory—instead, they may disperse within nearshore areas of their year-round range after breeding. In years of heavy sea-ice coverage in the Bering Sea, their northern winter range extent will be constrained by the ice (Siegel-Causey and Litvinenko 1993). High levels of winter mortality are regularly recorded based on carcasses uncovered by melting snow (Causey 2002).

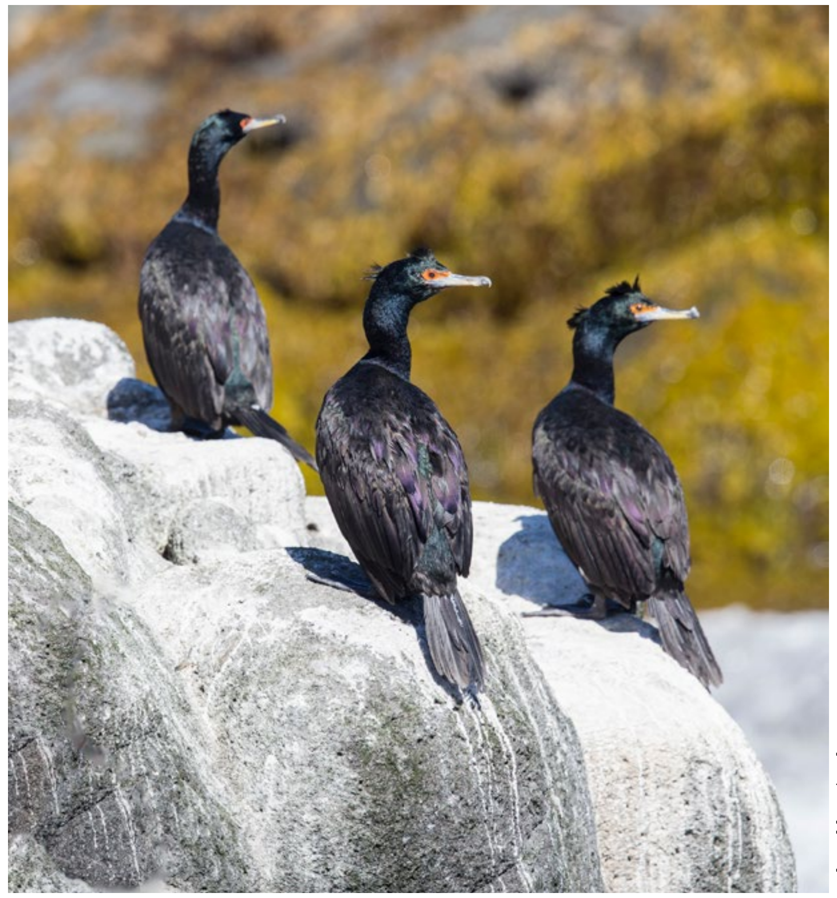
LIFE CYCLE

Pair bonding begins in early May, and by mid-May, breeding birds have found a mate, and the males have initiated the process of building a trial nest to strengthen their bond, in a location that the male will often use year after year. The trial nest is rarely used for incubation (Wright et al. 2013).

Red-faced Cormorants nest in relatively small colonies, generally consisting of less than 50 nests (Siegel-Causey 1988). Most of their nests are found in the steep, rocky cliffs of the islands in the southern Bering Sea. In Alaska, they often nest among cliff-nesting seabirds, such as puffins, murres, and kittiwakes. Red-faced Cormorants are among the first to arrive at the nesting site and defend their preferred locations (the least accessible portion of the seaside cliffs) from other incoming nesters (Nysewander 1983b).

Although male Red-faced Cormorants initiate nest-building as a component of pair bonding, both sexes participate in nest construction by gathering mainly grasses, seaweeds, sticks, and guano to create a 14–15 inch (40–50 cm) wide nest; the size of the nest is often constrained by the available surface on the cliff-faces they prefer (Bent 1922).

Once the nest is completed, Red-faced Cormorants will lay 2–4 greenish to pale-blue eggs, each 2–2.5 inches (6–6.5 cm) long and covered in chalky white deposits. The female cormorant lays an egg every two days (Wehle 1978, Hunt et al. 1981, Nysewander 1983b, Wright et al. 2013). Both parents will incubate the eggs until hatching, usually after 31–34 days. The clutch will never be left alone, as there are often egg-eating predatory birds and Arctic foxes (*Vulpes lagopus*) in the vicinity of the nesting sites (Hunt et al. 1981, Nysewander 1983b, Wright et al. 2013).



Bob Waldrop / RedPoint Images

Red-faced Cormorants tend to nest in relatively small colonies (less than 50 nests) on steep, rocky, island cliffs in the southern Bering Sea.

Chicks hatch featherless, with their eyes closed. Red-faced Cormorant parents share the brooding duties, never leaving the nestlings alone for the first four weeks of life (Palmer 1962, Palmer 1976). As is the case with many seabirds, the survival rate of the brood is approximately 50%, and they are not known to produce a second clutch even when the first is completely lost (Hunt et al. 1981, Wright et al. 2013). After 40–50 days, the chicks will fledge, but will continue to accompany their parents for food for several weeks (Robertson 1971, Wright et al. 2013).

Diet

Red-faced Cormorants subsist on fishes that live on the ocean floor, such as smelt, sand lances, flounder, and sculpin, as well as some bottom-dwelling macroinvertebrates, including amphipods, euphausiids, decapods, polychaete worms, and pelagic mollusks (Palmer 1962, Hunt et al. 1981). They generally hunt in inshore areas with rocky bottoms, pursuing their prey by diving from the water's surface, propelling themselves with their feet, and swallowing their prey underwater, except when it is large or difficult to swallow (Hoffman et al. 1981, Causey 2002).

CONSERVATION ISSUES

The Red-faced Cormorant is not protected under the Endangered Species Act (ESA) and is listed as a species of least concern by the International Union for the Conservation of Nature (IUCN). However, substantial declines in population have been noted, and the US Fish and Wildlife Service (USFWS) considers Red-faced Cormorants a species of conservation concern (BirdLife International 2012). While data on population size are not strong as very little research has been done specific to these birds, the perceived declines could be substantial for an endemic species with a limited range. The Red-faced Cormorant is listed as declining in Audubon Alaska's 2017 WatchList (Warnock 2017).

5.7 RED-FACED CORMORANT MAP ON PAGE 156

TABLE 5.7-1. Red-faced Cormorant characteristics and conservation status. Sources: Causey (2002), Warnock (2017).

	Red-faced Cormorant *Phalacrocorax urile*
Body Size Mass Length Wingspan	 **M** 4–5.5 pounds (1,850–2,400 g) **L** 30–39 inches (75–100 cm) **W** Unknown
Maximum Life Span (wild)	Unknown
Clutch Size Range Average	 **R** 2–4 eggs **A** 2.5 eggs
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	 **ESA:** Not Listed **IUCN:** Least Concern **WL:** Red List
Population Global Alaska	 **G** 200,000 **A** 20,000
Breeding Season Eggs Hatch Fledge	 **E** Late May **H** June **F** Late July to Early August

According to the Alaska Seabird Information Series (2006), there are many steps that should be taken in order to restore the Red-faced Cormorant to an Alaska population of 50,000 individuals. A comprehensive monitoring program should be established to identify and survey populations at key index locations, and to measure changes in mortality, nesting, and reproductive success. Prey availability should also be monitored, including continued research into the commercially viable fishes upon which Red-faced Cormorants rely. Human disturbance is a constant concern, with the repercussions of fuel spills and fisheries infringement at the forefront of this issue.

MAPPING METHODS (MAP 5.7)

We categorized distribution into four main categories of intensity: extent of range, regular use, concentration, and high concentration. The extent of range was drawn by buffering all known occurrences of Red-faced Cormorant using data from Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a), eBird (2015), and the Seabird Information Network (2011). The AGBD combines and integrates point locations from available bird surveys conducted by the USFWS, the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. Red-faced Cormorant observations from these data sources were then buffered with a 62-mile (100-km) radius and merged. In some cases, inconsistencies were manually edited and smoothed.

To determine regular-use and concentration areas, survey data were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We ran kernel density analyses to convert binned data into smoothed distribution data, then selected areas of repeated occurrence. In Alaska, the regular-use areas represent the 99% isopleth from a kernel density raster, using a search radius of 78 miles (125 km). For the concentration areas, we ran a 31-mile (50-km) kernel density analysis, then delineated density values that are 1 or more standard deviations above the project area mean density.

Because of the relative lack of survey data in Russia, concentration areas in Russia are often not known or depicted. Where there were gaps in survey coverage, we buffered species' colony locations, using a buffer radius equal to the species' average maximum foraging distance (12.4 miles [20 km] (Cornell Lab of Ornithology and American Ornithologists' Union 2016)). These two types of boundaries were combined to represent regular use across the project area.

High concentration areas were represented using global Important Bird Areas (IBAs). In Russia and Canada, we used IBA data from BirdLife International (2017a) while IBAs in Alaska are from Audubon Alaska (2014). Because IBA boundaries often encompass multiple-species hotspots, in Alaska we also used single-species IBA core areas (Audubon Alaska 2015) to show high concentration for Red-faced Cormorants (see Smith et al. 2014c).

Red-faced Cormorant colony data were downloaded from the Seabird Information Network (2011). The colony count data for the Pribilof Islands were updated based on Romano and Thomson (2016), and count data for larger colonies in the Aleutian Islands were updated based on Alaska Maritime National Wildlife Refuge (2009), Byrd et al. (2001b), and Byrd and Williams (2004). This map represents the most recent or otherwise best estimate available for each colony location (see Smith et al. 2012). On the map, the size of each colony point represents the percent of the total population present at that colony. Total population was the sum of the abundance of the species across all colonies within the project area.

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines are based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of this map. The colony data are available throughout the US and Russia portions of the project area, but data quality—survey dates and techniques—varies greatly among colonies. Colony sizes should be interpreted as estimates rather than precise counts.

Reviewer

- Marc Romano

MAP DATA SOURCES

Extent of Range: Audubon Alaska (2016e) based on Audubon Alaska (2016a), eBird (2015), Romano and Thomson (2016), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Alaska Maritime National Wildlife Refuge (2009), Audubon Alaska (2016a), Byrd et al. (2001b), Byrd and Williams (2004), Romano and Thomson (2016), and Seabird Information Network (2011)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

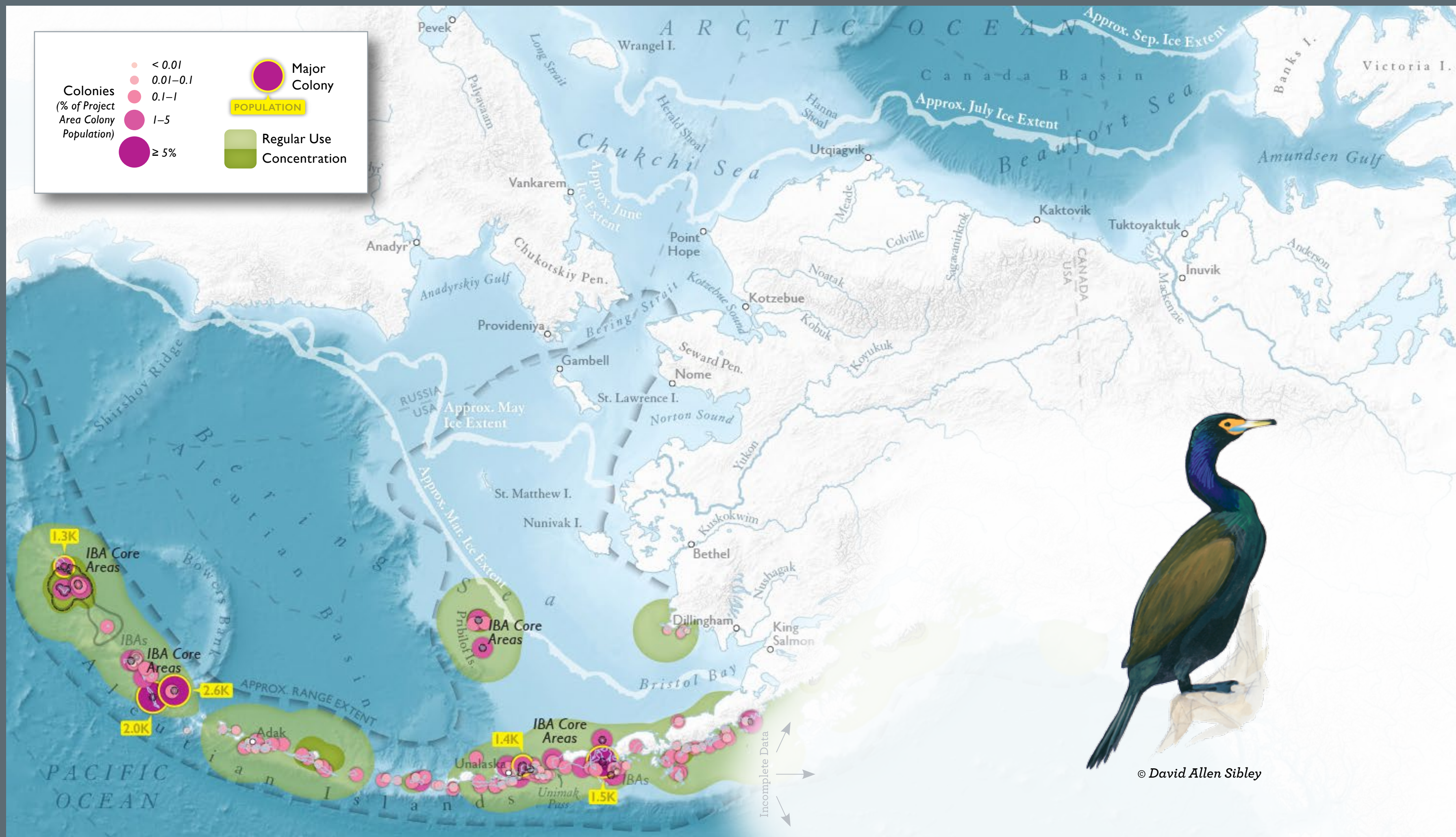
IBA Core Areas: Audubon Alaska (2015)

Colonies: Alaska Maritime National Wildlife Refuge (2009); Byrd et al. (2001b); Byrd and Williams (2004); Romano and Thomson (2016); Seabird Information Network (2011)

Sea Ice Extent: Audubon Alaska (2016h) based on Fetterer et al. (2016)

Red-faced Cormorant

Audubon ALASKA



Alaska Maritime National Wildlife Refuge (2009); Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Alaska Maritime National Wildlife Refuge (2009), Audubon Alaska (2016a), Byrd et al. (2001b), Byrd and Williams (2004), Romano and Thomson (2016), and Seabird Information Network (2011)]; Audubon Alaska (2016e) [based on Audubon Alaska (2016a), eBird (2015), Romano and Thomson (2016), and Seabird Information Network (2011)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Byrd et al. (2001b); Byrd and Williams (2004); Romano and Thomson (2016); Seabird Information Network (2011)

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman

Red-faced Cormorant (*Phalacrocorax urile*)

Red-faced Cormorants are cliff-nesting, colonial-breeding seabirds found in the Aleutian Islands in the southern Bering Sea. They nest among Pelagic Cormorants (*P. pelagicus*), Horned and Tufted Puffins (*Fratercula corniculata, F. cirrhata*), Thick-billed and Common Murres (*Uria lomvia, U. aalge*), and Red-legged and Black-legged Kittiwakes (*Rissa brevirostris, R. tridactyla*), selecting the least accessible seaside cliffs as nesting habitat. They are often the first to arrive during breeding season, and aggressively defend their nest sites from other nesting birds. While some colonies may be home to nearly 3,000 birds, the majority of colonies are much smaller, often containing 50 or fewer nests.

Each year, breeding Red-faced Cormorants lay two to four eggs each, of which half the chicks will survive. The others fall victim to starvation or predation by other birds and Arctic foxes. Historically, Red-faced Cormorant numbers have been difficult to ascertain, as this species has been (and often still is) regularly confused with its closely related cousin, the much more prolific and gregarious Pelagic Cormorant. When breeding season is over and cooler weather moves in, Red-faced Cormorants take to the sea, foraging in the nearshore areas surrounding the Aleutians and the western coast of Alaska, sometimes making it as far north as the Bering Strait. Sea-ice extent generally constrains winter movements of Red-faced Cormorants, and exposure and starvation are likely culprits of winter mortality.

MAPS ON PAGE 160

Phalaropes

Nils Warnock, Erika Knight, and Melanie Smith

Red-necked Phalarope

Phalaropus lobatus

Red Phalarope

P. fulicarius

While technically these shorebirds belong to the family *Scolopacidae*, Red-necked and Red Phalaropes (*Phalaropus lobatus* and *P. fulicarius*) act more like seabirds, spending 9–11 months of the year on open waters (Tracy et al. 2002, Warnock et al. 2002). Both species breed in Alaska, with Red Phalaropes being a coastal breeder from Western Alaska north and eastward into Canada, while Red-necked Phalaropes breed at both coastal and interior sites throughout much of Alaska (Rubega et al. 2000, Tracy et al. 2002, Armstrong 2015). Another phalarope, Wilson's Phalarope (*P. tricolor*) is a rare local breeder in interior Alaska, infrequently seen in the marine realm (Armstrong 2015). Hereafter, phalarope refers to Red-necked and Red Phalaropes unless otherwise stated. Phalaropes are known for their characteristic spinning motion while feeding in water, a technique that generates a micro water vortex that spins their invertebrate prey to the surface (Obst et al. 1996, Prakash et al. 2008). In the marine realm, phalaropes are denizens of areas where different types of marine waters come together (upwelling areas, drift lines, thermal gradients, ice edges, etc.) and concentrate food, making it more accessible (Briggs et al. 1984, Brown and Gaskin 1988, Tyler et al. 1993, Wahl et al. 1993, Warnock et al. 2002). Whalers of the past called Red Phalaropes "bowhead birds" because of their propensity to be found with feeding bowhead whales (*Balaena mysticetus*) (Nelson 1983). Unlike the majority of sexually dimorphic shorebirds, the larger and more colorful breeding phalaropes are female, with role reversals attributed to their sometimes polyandrous lifestyle, in which females mate with more than one male (Emlen and Oring 1977).

In contrast to other shorebirds, phalaropes are uniquely adapted for life at sea. Phalaropes appear to have more feathers in the breast and belly region than most shorebirds, which gives them extra waterproofing and added buoyancy on the water (Warnock et al. 2002). They possess laterally flattened legs with lobed toes, allowing them to readily swim and spin in the water in search of food (Obst et al. 1996). Their feeding mode is also adapted to life around water, using the surface tension of water to rapidly transport tiny invertebrate prey items in small water droplets between their mandibles to the back of the jaw to be swallowed (Rubega and Obst 1993, Rubega 1997).

DISTRIBUTION

In the late 1880s in the Arctic Ocean, Nelson (1883) noted that Red Phalaropes were often found along the edge of the ice pack feeding on invertebrates (Orr et al. 1982, Johnson and Herter 1989). Red Phalaropes are known to feed on ice-associated amphipods, *Apherusa glacialis* (Divoky 1984, Tracy et al. 2002).

Direct evidence of where phalaropes from Alaska spend their non-breeding season is lacking. It is likely that these birds spend the non-breeding season off the western coast of South America, after migrating south along the Pacific Flyway (Nisbet and Veit 2015). In South America, both species are common in non-breeding months in the productive Peru Current System (a.k.a. the Humboldt Current) offshore of Peru and Northern Chile, where Red Phalaropes, in particular, are found in less-stratified water near the shelf break (Rubega et al. 2000, Tracy et al. 2002, Spear and Ainley 2008).

Spending the majority of their lives at sea, phalaropes are highly pelagic shorebirds, unique in many ways. An example is the plumage difference between male and female phalaropes. While most sexually dimorphic avian pairs consist of a more distinctly plumed male, female phalarope plumage is brighter and more colorful than their smaller male counterparts. Pictured is a female Red Phalarope in breeding plumage.

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Migration
Direct evidence (via tagging studies) of migration routes used by either species is lacking for Alaska breeding phalaropes. The only tracking study of either species is based on the 13,700-mile (22,000- km) movement of one geolocator-tagged Red-necked Phalarope tracked from breeding grounds in Scotland across the Gulf of Mexico to non-breeding grounds between the Galapagos Islands and the South American coast in the Pacific Ocean (Smith et al. 2014a).

In Alaska, phalaropes appear to head to coastal lagoons and marine waters after breeding (Gabrielson and Lincoln 1959, Johnson and Herter 1989, Kessel 1989). Red Phalaropes typically become strictly pelagic after breeding, and migrate and feed farther offshore than Red-necked Phalaropes (Johnson and Herter 1989). During their fall migration, Red-necked Phalaropes follow coastal, pelagic, and interior routes, staging in the west at places such as Lake Abert, OR; Mono Lake, CA; and Great Salt Lake, UT (Rubega et al. 2000, Oring et al. 2013). Smith et al. (2014b) identified four pelagic areas in Alaska with predictable, globally important numbers with at least 1% of the global population of Red Phalaropes. These include a region in the Beaufort Sea 11 miles (18 km) offshore encompassing parts of Barrow Canyon and Smith Bay; a region (152°W 71°N) 42 miles (68 km) from land along the Beaufort–Chukchi Seas shelf edge; a marine region between Seguam and Amlia islands in the Aleutian chain; and a region (178°W 61°N) over 125 miles (200 km) from land in the eastern Bering Sea along the shelf edge. Red-necked Phalaropes do not typically concentrate in large numbers offshore in Alaska waters during migration, although large passages of these birds have been observed at inshore areas such as the Wrangell Narrows in Southeast Alaska during fall and spring migration (Gabrielson and Lincoln 1959, also N. Warnock, pers. obs.).

Species Description
Red-necked Phalarope. Red-necked Phalaropes are circumpolar breeders in subarctic and Arctic regions. In Alaska, breeding birds have been found in coastal areas from the Copper River Delta north through the Alaska Peninsula and parts of the Aleutians to the North Slope into Canada. Interior Alaska breeding birds mainly occur across a swath of the central part of the state along the Yukon River (Cramp et al. 1983, Rubega et al. 2000).

Red Phalarope. Like Red-necked Phalaropes, Red Phalaropes are circumpolar breeders in subarctic and Arctic regions, but generally breed farther north and are more coastal than Red-necked Phalaropes. In Alaska, breeding birds have been found in coastal areas from Bristol Bay to St. Lawrence Island to the North Slope into Canada (Cramp et al. 1983, Tracy et al. 2002).

LIFE CYCLE
Phalaropes typically breed in moist to wet tundra areas and around other wetlands in subarctic and Arctic regions (Kessel 1989, Piersma et al. 1996, Rubega et al. 2000, Tracy et al. 2002). Pair bonding appears to occur either shortly before arrival, or on the breeding grounds (Rubega et al. 2000, Tracy et al. 2002). Both species are known for their polyandrous mating systems, yet the third phalarope species, Wilson's Phalaropes, are more typically monogamous. The percentage of polyandrous Red Phalaropes ranges from 36 to 50% (Tracy et al. (2002) and references therein), while for Red-necked Phalaropes, the range is from 0 to 14% (Rubega et al. (2000) and references therein). Males incubate the typical four-egg clutches and rear the chicks.

TABLE 5.8-1. Phalarope life history characteristics and conservation status. Sources: Rubega et al. (2000), Tracy et al. (2002), Warnock (2017).

	Red-necked Phalarope *Phalaropus lobatus*	Red Phalarope *P. fulicarius*
Body Size Mass Length Wingspan	**M** 0.7–1.7 ounces (20–48 g) **L** 7–7.4 inches (18–19 cm) **W** 12.2–13.4 inches (31–34 cm)	**M** M 1.3–2.7 ounces (37–77 g) **L** 7.9–8.7 inches (20–22 cm) **W** 14.6–15.7 inches (37–40 cm)
Maximum Life Span (wild)	10+	6+
Clutch Size Range Average	**R** 1–6 eggs **A** 4 eggs	**R** 1–6 eggs **A** 4 eggs
Nest-Water Proximity	< 330 feet (< 100 m) from water	< 330 feet (< 100 m) from water
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Not Listed	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Not Listed
Population Global Alaska	**G** 4,050,000 **A** 1,250,000	**G** 2,165,000 **A** 590,000
Breeding Season Eggs Young	**E** June to July **Y** June to August	**E** June to July **Y** June to August
Migration Spring Molt Fall	**S** April to May **M** October to March **F** July to October	**S** May to June **M** August to September **F** July to November

Diet
Phalaropes commonly feed on terrestrial and marine invertebrates (Rubega et al. 2000, Tracy et al. 2002). At breeding sites, phalarope diets are often dominated by crane flies (*Tipulidae*), mosquitos, and midges (*Chironomidae*). In the marine environment, phalaropes frequently rely on amphipods and copepods (Rubega et al. 2000, Tracy et al. 2002). Red-necked Phalaropes at interior saline lakes predominately eat brine flies (*Ephydra hians*), and to a much lesser degree, brine shrimp (*Artemia salina*) (Rubega et al. 2000).

CONSERVATION ISSUES
Phalaropes are protected under the US Migratory Bird Treaty Act of 1918, but neither phalarope has any other special protected status in the US. The International Union for Conservation of Nature (IUCN) lists both phalaropes as species of least concern (BirdLife International 2016c), although Red-necked and possibly Red Phalarope populations have undergone declines (Rubega et al. 2000, Tracy et al. 2002, Andres et al. 2012). Both populations seem especially vulnerable to declines in their prey on South American non-breeding grounds caused by El Niño–Southern Oscillation (ENSO) events (Nisbet and Veit 2015). Declines in breeding phalaropes on the North Slope of Alaska in the early to mid-1980s were attributed to the massive ENSO event of 1982–83 (Troy 1996). Phalaropes have also been identified as vulnerable to being caught as bycatch in gill nets at sea (Žydelis et al. 2013, BirdLife International 2016c).

MAPPING METHODS MAPS (5.8.1–5.8.2)
We categorized distribution into four main categories of intensity: extent of range, regular use, concentration, and high concentration. Where possible, we analyzed survey data to draw boundaries and assess intensity of use. However, survey data alone did not provide adequate coverage of the project area. Therefore, the phalarope maps are a composite of both survey-derived polygons and polygons from other sources. Regular-use and concentration areas are based on either a) boundaries resulting from spatial analysis, or b) information presented in reports and literature.

The extent of range was drawn by buffering all known occurrences of each species using data from Audubon's Alaska Geospatial Bird

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Database (AGBD) (Audubon Alaska 2016a) and eBird (2015). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. For each species, observations from these data sources were then buffered with a 62-mile (100-km) radius and merged. The survey-derived range polygon for each species was merged with range data from Cornell Lab of Ornithology and American Ornithologists' Union (2016), BirdLife International (2017c), BirdLife International (2017a), Audubon Alaska (2015) and/or National Oceanic and Atmospheric Administration (1988). Inconsistencies in the resulting polygons were manually edited and smoothed.

To determine regular-use and concentration areas, survey data were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We ran kernel density analyses to convert binned data into smoothed distribution data, then selected areas of repeated occurrence. In Alaska, the regular-use areas represent the 99% isopleth from a kernel density raster, using a search radius of 78 miles (125 km). For the concentration areas, we ran a 31-miles (50-km) kernel density analysis, then delineated density values that are 1 or more standard deviations above the project area mean density.

High-concentration areas were represented using global Important Bird Areas (IBAs). In Russia and Canada, we used IBA data from BirdLife International (2017a) while IBAs in Alaska were from Audubon Alaska (2014). Because IBA boundaries often encompass multiple-species hotspots, in Alaska, we also show single-species IBA core areas (Audubon Alaska 2015) to indicate high concentrations specific to Red Phalaropes (see Smith et al. 2014c). For Red-necked Phalaropes, no single-species IBA core areas are known in the project area.

Breeding habitat suitability data on the Arctic Coastal Plain are displayed. These data were modeled by Saalfeld et al. (2013b) based on data from 767 plots surveyed as part of PRISM. For Red Phalarope, breeding and breeding-concentration areas from National Oceanic and Atmospheric Administration (1988) are shown in addition to the modeled data. For Red-necked Phalarope, breeding areas from Cornell Lab of Ornithology and American Ornithologists' Union (2016) and BirdLife International (2017c) are shown in addition to the modeled data.

The migration data shown for Red Phalarope are from National Oceanic and Atmospheric Administration (1988).

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines were based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality
The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting maps. There is little to no survey coverage in the Canadian and Russian portions of the project area, potentially leaving major data gaps for these species. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of these maps.

Reviewer
• Dan Ruthrauff

MAP DATA SOURCES
RED-NECKED PHALAROPE MAP
Extent of Range: Audubon Alaska (2017h) based on Audubon Alaska (2016a), BirdLife International (2017c), Cornell Lab of Ornithology and American Ornithologists' Union (2016), eBird (2015), and Northwest Territories (2017)

Regular Use: Audubon Alaska (2017i) based on Audubon Alaska (2016a)

Concentration: Audubon Alaska (2017i) based on Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

Breeding Habitat Suitability: Saalfeld et al. (2013b; 2013a)

Breeding Area: BirdLife International (2017c); Cornell Lab of Ornithology and American Ornithologists' Union (2016)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

RED PHALAROPE MAP
Extent of Range: Audubon Alaska (2017h) based on Audubon Alaska (2015), Audubon Alaska (2016a), BirdLife International (2017a), Cornell Lab of Ornithology and American Ornithologists' Union (2016), eBird (2015), and National Oceanic and Atmospheric Administration (1988)

Regular Use: Audubon Alaska (2017i) based on Audubon Alaska (2016a)

Concentration: Audubon Alaska (2017i) based on Audubon Alaska (2015) and Audubon Alaska (2016a)

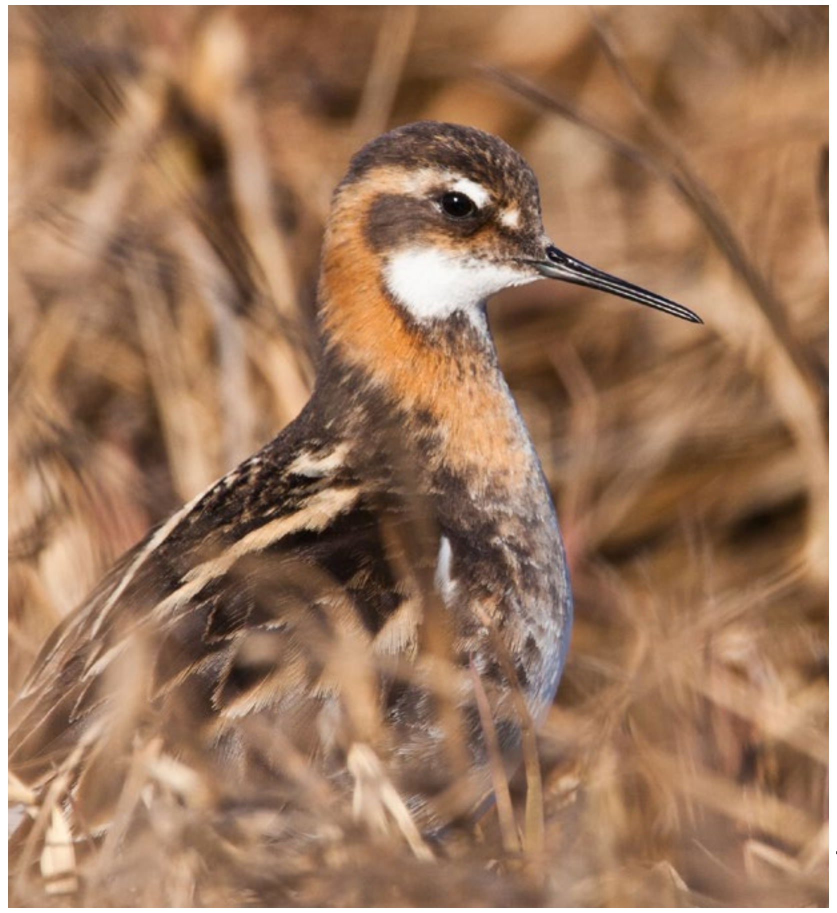
IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Breeding Habitat Suitability: Saalfeld et al. (2013b; 2013a)

Migration: National Oceanic and Atmospheric Administration (1988)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

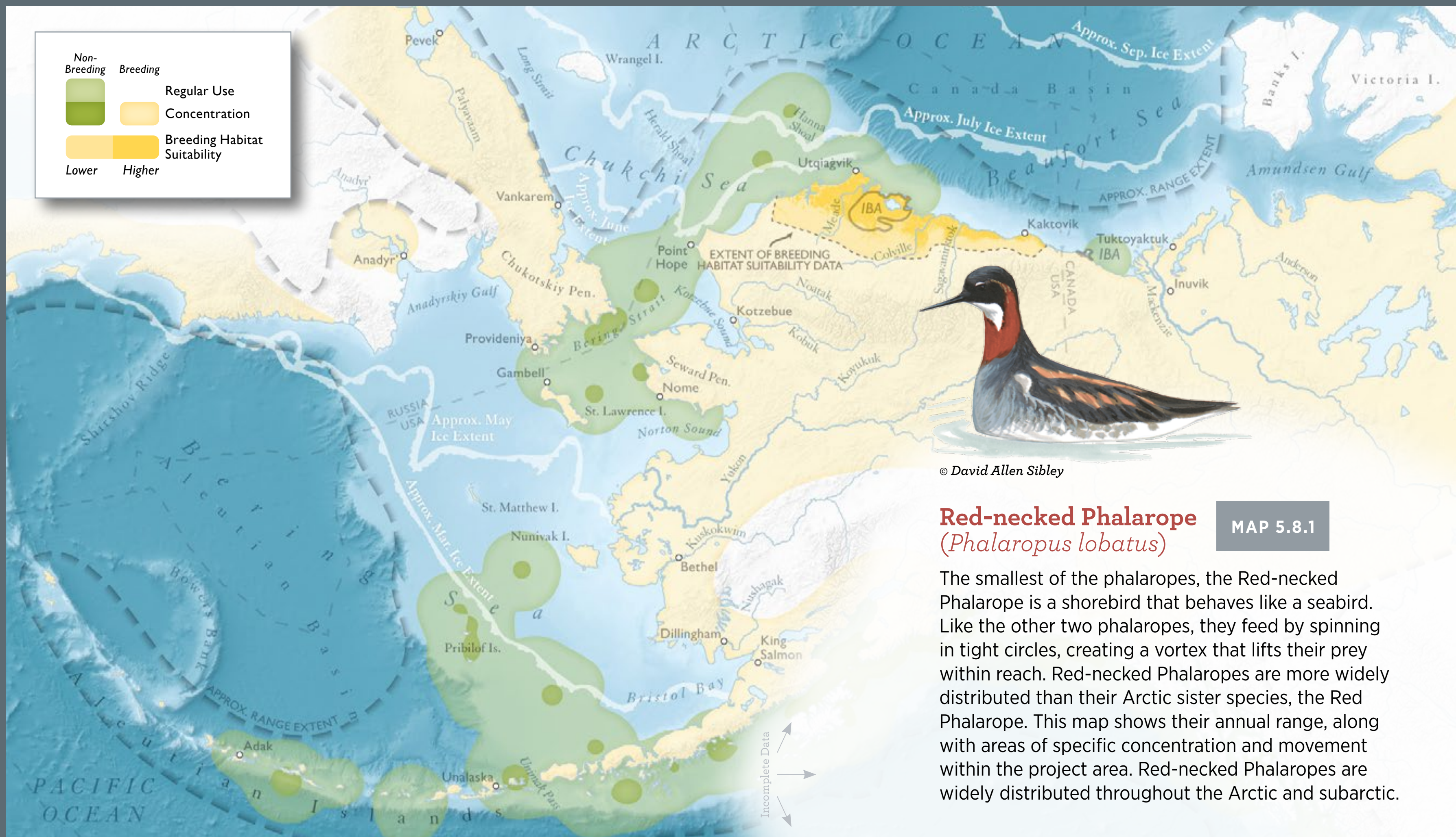


Dave Shaw

Red-necked Phalarope.

Phalaropes

Audubon ALASKA



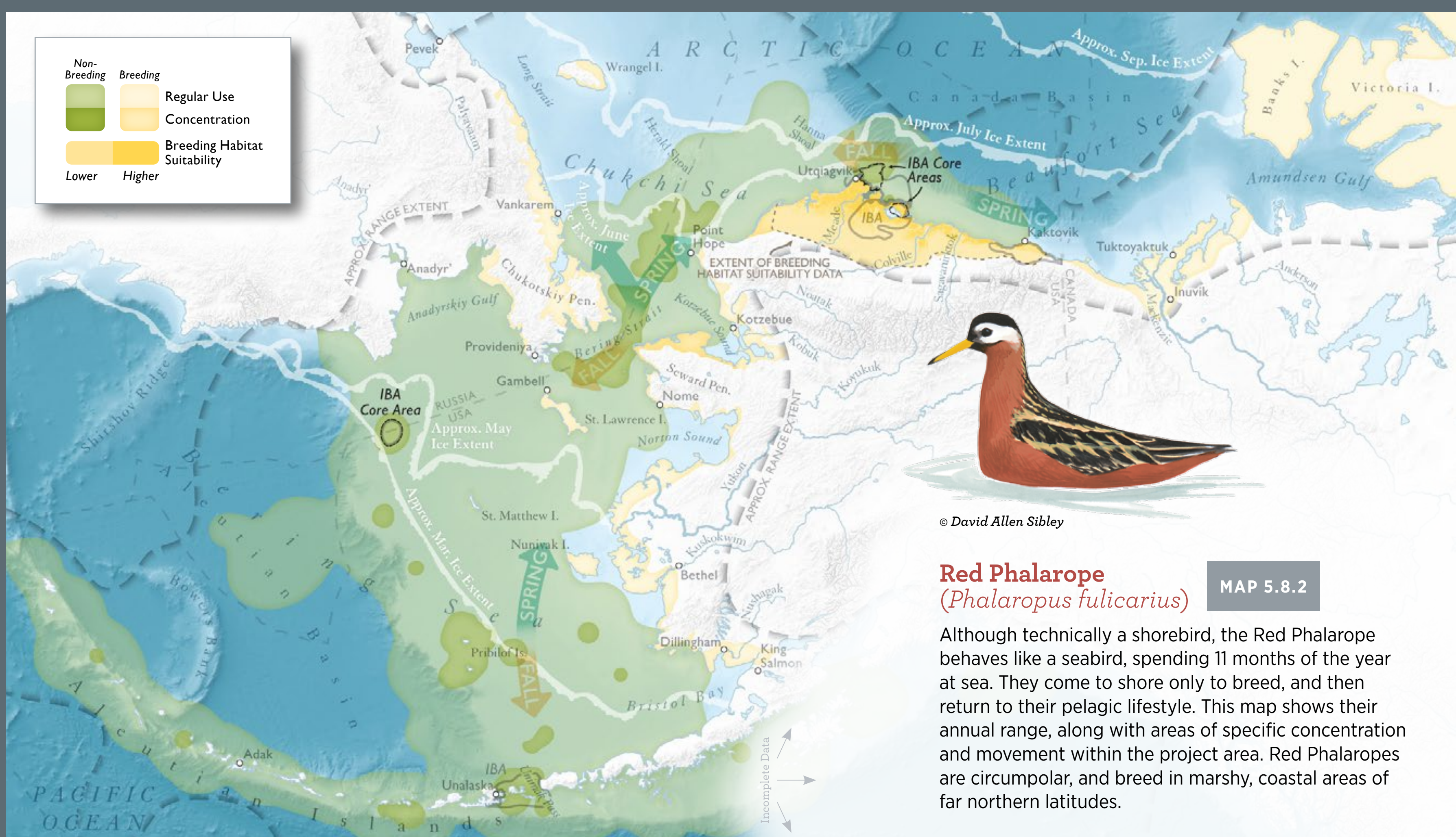
Red-necked Phalarope
(Phalaropus lobatus)

MAP 5.8.1

The smallest of the phalaropes, the Red-necked Phalarope is a shorebird that behaves like a seabird. Like the other two phalaropes, they feed by spinning in tight circles, creating a vortex that lifts their prey within reach. Red-necked Phalaropes are more widely distributed than their Arctic sister species, the Red Phalarope. This map shows their annual range, along with areas of specific concentration and movement within the project area. Red-necked Phalaropes are widely distributed throughout the Arctic and subarctic.

Audubon Alaska (2014); Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Audubon Alaska (2017h) [based on Audubon Alaska (2016a), BirdLife International (2017c), Cornell Lab of Ornithology and American Ornithologists' Union (2016), eBird (2015), and Northwest Territories (2017)]; Audubon Alaska (2017i) [based on Audubon Alaska (2016a)]; BirdLife International (2017a); BirdLife International (2017c); Cornell Lab of Ornithology and American Ornithologists' Union (2016); Saalfeld et al. (2013b;2013a)

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman



Red Phalarope
(Phalaropus fulicarius)

MAP 5.8.2

Although technically a shorebird, the Red Phalarope behaves like a seabird, spending 11 months of the year at sea. They come to shore only to breed, and then return to their pelagic lifestyle. This map shows their annual range, along with areas of specific concentration and movement within the project area. Red Phalaropes are circumpolar, and breed in marshy, coastal areas of far northern latitudes.

Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Audubon Alaska (2017h) [based on Audubon Alaska (2015), Audubon Alaska (2016a), BirdLife International (2017a), Cornell Lab of Ornithology and American Ornithologists' Union (2016), eBird (2015), and National Oceanic and Atmospheric Administration (1988)]; Audubon Alaska (2017i) [based on Audubon Alaska (2015) and Audubon Alaska (2016a)]; BirdLife International (2017a); National Oceanic and Atmospheric Administration (1988); Saalfeld et al. (2013b;2013a)

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Aleutian Tern

Onychoprion aleuticus

Nils Warnock, Erika Knight, and Melanie Smith

Overall, this is a rather mysterious bird whose wintering distribution and population dynamics are poorly understood. The type specimen and egg were collected by Ferdinand Bischoff as part of an expedition led by the Smithsonian Institution and the Chicago Academy of Sciences in June of 1868 on Kodiak Island (Gabrielson and Lincoln 1959), and the species was described by Spencer Baird in 1869 (Dixey et al. 1981). Aleutian Terns (*Onychoprion aleuticus*) are now known to have a breeding distribution in eastern Russia and in coastal Alaska; populations in Alaska at least appear to be in steep decline, or individuals from known breeding colonies are redistributing (Renner et al. 2015). Compared to its cousin, the Arctic Tern (*Sterna paradisaea*), a bird with which it often nests and feeds (Holtan 1980), Aleutian Terns are relatively non-aggressive (Baird et al. 1983).

Like most terns, the Aleutian Tern is adapted to life in the air and water (Gochfeld and Burger 1996). They have long, pointed wings, relatively small, streamlined bodies, and small legs and feet that are awkward for serious walking or swimming (Gochfeld and Burger 1996, North 2013). They are strong fliers and generally feed by hovering and snatching prey from the water surface or by plunge-diving (Gochfeld and Burger 1996, North 2013).

Aleutian Tern adult in breeding plumage.

DISTRIBUTION

Aleutian Terns are not known to associate with sea ice. In the southeastern Bering Sea, Aleutian Tern densities were slightly higher in years with early spring ice retreat and they foraged in shallower waters in those years (Renner et al. 2016).

Migration

Migration routes of Aleutian Terns are still largely unknown, although limited tracking and presence/absence data offer clues (Pyare et al. 2013, Renner et al. 2015). Based on eBird records (eBird 2017), after the breeding season ends in August, terns begin to decline quickly in Alaska, with a few sightings in September. Sites offshore from South Korea and Taiwan have August records. In September, Aleutian Terns are seen offshore from Taiwan down into Southeast Asia including the Philippines, Indonesia, and Malaysia (see also Hill and Bishop (1999), Poole et al. (2011)). However, based on eBird records, sightings of Aleutian Terns in much of Southeast Asia begin to decline and mostly disappear by January through February. It is not clear if this is because of a lack of observations during this period or that the terns move on to other unknown areas. Understanding the migration and wintering areas will allow for more specific conservation actions. Spring migration appears to begin in March stretching into April with records of Aleutian Terns from the western coast of the Malaysian Peninsula across Southeast Asia to Taiwan. By May, Aleutian Terns appear to mostly be gone from Southeast Asia (but see Lee (1992)) and are recorded along the coast from Hong Kong north to Russian and Alaska (Hill and Bishop 1999).

Wintering

The non-breeding distribution of Aleutian Terns is still poorly understood. At least part of their wintering season is spent in Southeast Asia (see discussion below, Hill and Bishop (1999), Poole et al. (2011), North (2013), Pyare et al. (2013), and Goldstein et al. (in review)). In *Onychoprion* terns in general, pre-alternate molt occurs on the non-breeding grounds (Howell 2010). It has been noted that Aleutian Terns are unusual among these terns in that they drop four to five inner primaries at once, suggesting that they molt in non-breeding areas with rich food resources (Howell 2010, North 2013).

LIFE CYCLE

Arrival of Aleutian Terns to the breeding grounds occurs from April to June, depending on location and latitude (North 2013). They nest on the ground in relatively small colonies, sometimes with Arctic Terns, and they tend to nest along the coastline strips between intertidal flats and more vegetated uplands (Holtan 1980, Baird et al. 1983, Kessel 1989, North 2013). Colonies are more dense on islands with no predators (Baird et al. 1983). Occasionally they nest at more interior sites in bogs and other wetlands. It is speculated that by nesting with more aggressive Arctic Terns, Aleutian Terns gain predator protection (Baird et al. 1983). While Aleutian Terns are some of the last seabirds to arrive on their breeding grounds, they are among the first to lay eggs (end of May into June), fledge chicks (mid-July through August), and then leave the breeding grounds (Baird et al. 1983).

Diet

Like many terns, this species appears to mainly feed on small fishes and crustaceans such as euphausiids (Holtan 1980, Kessel 1989, Gochfeld and Burger 1996, North 2013). On the Alaska Peninsula, in the Kodiak Archipelago, breeding Aleutian Terns fed mainly on capelin (*Mallotus villosus*), sculpins (*Enophrys bison*), and sand lance (*Ammodytes hexapterus*), as well as other small fishes and occasionally euphausiids (Baird et al. 1983). On the Copper River Delta, Alaska, three-spined stickleback (*Gasterosteus aculeatus*) was commonly eaten as well as salmon smolt (Holtan 1980).

CONSERVATION ISSUES

Aleutian Terns are protected under the US Migratory Bird Treaty Act of 1918, but they do not have any other special protection status. Aleutian Terns were recently added to Audubon Alaska's Red WatchList because of apparent steep declines in Alaska (Warnock 2017). Renner et al. (2015) calculated a 93% decline in Aleutian Tern numbers at known breeding colonies over the past three decades, but it remains uncertain if this reflects a redistribution of birds (perhaps to Russia where up to 80% of the global population may nest) or an actual decline.

In the Aleutians Islands Aleutian Terns were preyed upon by Peregrine Falcons, and levels of the pesticide dichlorodiphenyldichloroethylene (DDE) in one tern was higher than average levels found in resident birds (White et al. 1973). Likewise, mercury levels have been found to be of concern in the stickleback, a fish species consumed by Aleutian Terns (Kenney et al. 2012); but overall, contaminant loads and links in Aleutian Terns are poorly understood and studied. Introduced predators may be a problem for these ground nesters and they do not nest in any numbers in areas where foxes occur (Bailey and Kaiser 1993). Disturbance of tern colonies by subsistence egg collectors

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TABLE 5.9-1. Aleutian Tern life history characteristics and conservation status. Sources: North (2013), Warnock (2017).

	Aleutian Tern *Onychoprion aleuticus*
Body Size Mass Length Wingspan	 **M** 3–5 ounces (83–140 g) **L** 12.5–13.4 inches (32–34 cm) **W** 29.5–31.5 inches (75–8.0 cm)
Maximum Life Span (wild)	Unknown
Clutch Size Range Average	 **R** 1–3 eggs **A** 2 eggs
Nest-Water Proximity	Mostly coastal near water (within 2 miles [3 km]), but occasionally farther inland
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	 **ESA:** Not Listed **IUCN:** Least Concern (but see discussion above) **WL:** Red List
Population Global Alaska	 **G** 31,000 **G** 5,500
Breeding Season Eggs Young	 **E** June to July **Y** June to August
Migration Spring Fall	 **S** April to May **F** August to September

can be detrimental (Renner et al. 2015). On a larger scale, factors like sea temperature impacting the availability and abundance of prey of Aleutian Terns, and factors potentially impacting terns on their poorly understood wintering grounds, may present significant management issues for which actions are still unidentified (Renner et al. 2015).

MAPPING METHODS (MAP 5.9)

We categorized distribution into four main categories of intensity: extent of range, regular use, concentration, and high concentration. The extent of range was drawn by buffering all known occurrences of Aleutian Terns using data from Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a), eBird (2015), Renner et al. (2015), and Seabird Information Network (2017). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. Aleutian Tern observations from these data sources were then buffered with a 62-mile (100-km) radius and merged. In some cases, inconsistencies were manually edited and smoothed.

To determine regular-use and concentration areas, survey data were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We ran kernel density analyses to convert binned data into smoothed distribution data, then selected areas of repeated occurrence. In Alaska, the regular-use areas represent the 99% isopleth from a kernel density raster, using a search radius of 78 miles (125 km). For the concentration areas, we ran a 31-mile (50-km) kernel density analysis, then delineated density values that are 1 or more standard deviations above the project area mean density.

Because of the relative lack of survey data in Russia, concentration areas in Russia are often not known or depicted. Where there were gaps in survey coverage, such as in Russia, we buffered species' colony locations, using a buffer radius equal to the species' average maximum foraging distance. Because consistent information regarding the average maximum foraging distance for Aleutian Terns was not available, the average maximum foraging radius for Arctic Terns (12 miles [19 km] (Lascelles 2008)) was used. These two types of boundaries were combined to represent regular use across the project area.

High-concentration areas were represented using global Important Bird Areas (IBAs). In Alaska, we used IBA data from Audubon Alaska (2014). Because IBA boundaries often encompass multiple-species hotspots, in Alaska we also show single-species IBA core areas (Audubon Alaska 2015) to indicate high concentrations specific to Aleutian Terns (see Smith et al. 2014c). In Russia and Canada, we accessed IBA data from BirdLife International (2017a); however, no Russian or Canadian Aleutian Tern IBAs are present within the map area.

Aleutian Tern colony data were provided by Seabird Information Network (2017) and the authors of Renner et al. (2015). This map represents the most recent or otherwise best estimate available for each colony location (see Smith et al. 2012). On the map, the size of each colony point represents the percent of the total population present at that colony. Total population was the sum of the abundance of the species across all colonies within the project area.

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines are based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. Aleutian Terns do not use Canadian waters in our project area. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist but fewer Aleutian Terns nest). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting map. There is little to no survey coverage in the Canadian and Russian portions of the project area, potentially leaving major data gaps for this species. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of this map. The colony data are available throughout the US and Russian portions of the project area, but data quality—survey dates and techniques—varies greatly among colonies. Colony sizes should be interpreted as estimates rather than precise counts.

Reviewers

- Pat Baird
- Robin Corcoran
- Michael Goldstein
- Susan Oehlers

MAP DATA SOURCES

Extent of Range: Audubon Alaska (2016e) based on Audubon Alaska (2016a), eBird (2015), Renner et al. (2015), and Seabird Information Network (2017)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a), Renner et al. (2015), and Seabird Information Network (2017)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014)

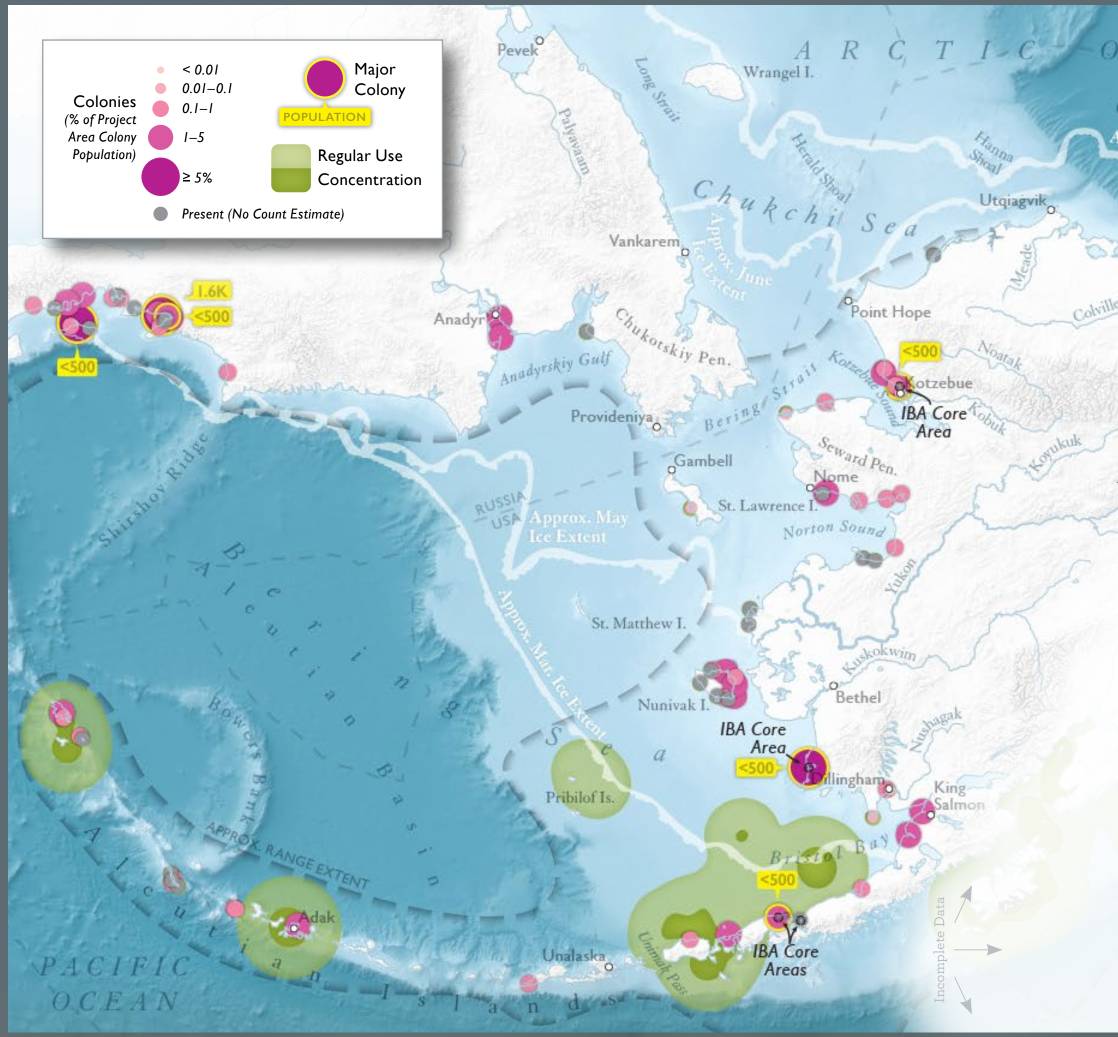
IBA Core Areas: Audubon Alaska (2015)

Colonies: Renner et al. (2015); Seabird Information Network (2017)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

Aleutian Tern

Audubon ALASKA



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Aleutian Tern (*Onychoprion aleuticus*)

Aleutian Terns are small, colonial nesting birds of the Arctic and subarctic. They are well-distributed throughout Kamchatka and Alaska, although they are not common anywhere. This map shows the annual range of these terns within the project area, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial Aleutian Tern population within the project area.

Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2016a)]; Audubon Alaska (2016e) [based on Audubon Alaska (2016a), eBird (2015), Renner et al. (2015), and Seabird Information Network (2017)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Renner et al. (2015); Seabird Information Network (2017)

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman

Adult Aleutian Tern on a nest.

Mike Denega

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Kittiwakes

Max Goldman, Erika Knight, and Melanie Smith

Red-legged Kittiwake

Rissa brevirostris

Black-legged Kittiwake

R. tridactyla

Kittiwakes are small, pelagic gulls belonging to the genus *Rissa*. Both species, the well-studied Black-legged Kittiwake (*Rissa tridactyla*) and the lesser-studied Red-legged Kittiwake (*R. brevirostris*), are distributed in the far northern latitudes of the Arctic and subarctic. The Black-legged Kittiwake boasts a circumpolar distribution in the northern hemisphere, while the Red-legged Kittiwake is less abundant and breeds exclusively in the Bering Sea. The attention given to Black-legged Kittiwakes is likely a result of their relative abundance and the ease of observing their breeding habits in the portions of their range that overlap human population centers, such as northern Europe. Researchers and managers rely upon kittiwake breeding success as an indicator of ecosystem health. Breeding kittiwakes are particularly tolerant of anthropogenic disturbance, and are considered the "white rats" of the seabird world (Hatch et al. 2009).

Kittiwakes are small gulls with forked tails and mostly white plumage, accented by a gray back (darker in the Red-legged Kittiwake) and black-tipped wings. A kittiwake's bill is relatively small, thin, and greenish-yellow in color. The Black-legged Kittiwake has a longer, more pointed bill than its congeneric sister species. Differences in bills and profiles, as well as the namesake differences in leg color, are evident field marks to differentiate between species (Kaufman 1989). The legs of Red-legged Kittiwakes are scarlet red and distinct, although some Black-legged Kittiwakes are known to have a reddish tint to their black legs (Grant 2010). Their short legs and dexterous claws are well suited for nesting on the tenuous substrate of coastal cliffs, yet these same features encumber their ability to walk with agility. They are excellent fliers and can hover on the wing, easily making difficult maneuvers in and out of their precarious nests. The eyes of Red-legged Kittiwakes are larger than those of Black-legged Kittiwakes, a trait that allows Red-legged Kittiwakes to see well in low-light situations, and regularly feed at night (Storer 1987).

Kittiwakes only vocalize in rudimentary ways, using a few simple calls to recognize individuals, warn the colony of danger, and announce themselves when arriving to or leaving the nest (Firsova 1978, Wooller 1978). The calls of Red-legged Kittiwakes are higher in pitch than those of Black-legged Kittiwakes (Firsova 1978).

DISTRIBUTION

Advancing winter sea ice in the Bering Sea displaces kittiwakes that breed in the far north so they are sometimes found at the ice edge. While some kittiwakes (especially Black-legged Kittiwakes) spend the winter south of the Aleutian Islands in the Gulf of Alaska (Kessel and Gibson 1978, Everett et al. 1990), most of the kittiwakes that breed in the Pribilof Islands and the western Aleutians seem to prefer to winter in the western portion of their range (McKnight et al. 2011, Orben et al. 2015a, Orben et al. 2015c), see Figure 5.10-1.

Migration

Not fully migratory, many birds can be found in the vicinity of the breeding colony well into winter if sea ice permits, although the well studied Red-legged Kittiwakes of the Pribilofs are highly migratory (Orben 2017). The majority of kittiwakes do travel away from the breeding colony, generally departing in September and slowly heading west or south to molt and feed in warmer waters through the cold northern winter (Forsell and Gould 1981). They arrive in their wintering areas in late fall or winter (Briggs et al. 1987). In spring, kittiwakes return to their breeding grounds. Unlike other seabirds that move as a flock, kittiwakes migrate in small groups until they congregate in large

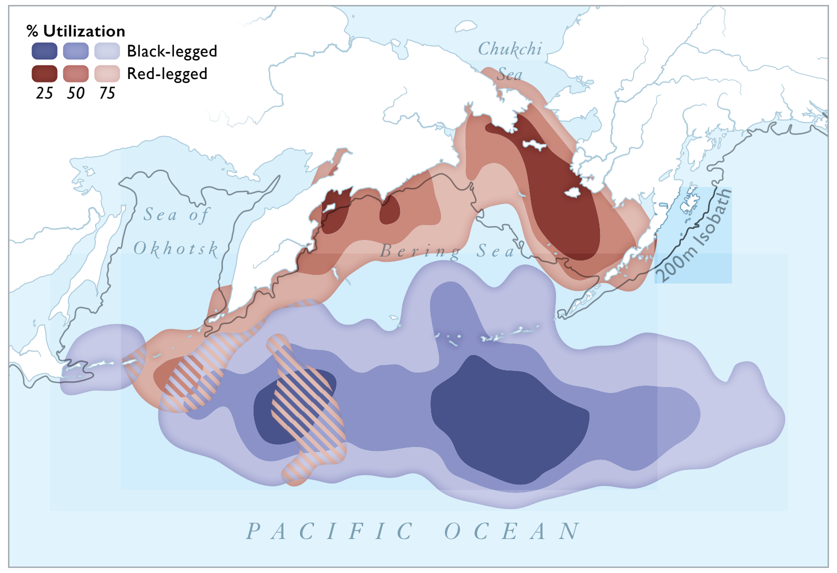

FIGURE 5.10-1. At-sea utilization distributions (UDs) for Red-legged Kittiwakes (n = 17) and Black-legged Kittiwakes (n = 34) in the subarctic North Pacific from October 15, 2010 to February 27, 2011. Adapted from Orben et al. 2015a. Adapted from Orben et al. (2015a).

numbers at the breeding colony. Most Red-legged Kittiwakes likely stay in the Bering Sea to spend the coldest months foraging on the continental shelf, sea-ice margin, and open ocean as daily conditions dictate (Orben et al. 2015a). Many are still found near their breeding colonies at the sea-ice margin (Shuntov 1963, Kessel and Gibson 1978, Everett et al. 1990). Black-legged Kittiwakes also prefer cold, ice-free waters far from shore (Brown 1986) and only low numbers are found in the ice-free portions of the Bering Sea in winter. Most prefer the productive waters of the western subarctic gyre as well as the Gulf of Alaska; and waters off the coasts of British Columbia, Canada; and the western US all the way to Baja, Mexico (Harrington 1975, Gould et al. 1982, Morgan et al. 1991).

Species Description

Red-legged Kittiwake. The Red-legged Kittiwake breeds on a very small number of islands in the southern Bering Sea, the Aleutian Islands, and the Commander Islands in Russia. The islands supporting Red-legged Kittiwake colonies include the Pribilofs; Bogoslof and Fire Islands; Buldir Island; and Bering, Cooper, and Arri Kamen Islands in the Commanders (Stejneger 1885, Preble and McAtee 1923, Kenyon and Phillips 1965, Byrd and Tobish 1978, Firsova 1978). They range from the Gulf of Alaska north through the Bering Sea to the Chukchi Sea, west as far as mainland Chukotka, south as far as Japan, and east to Prince William Sound.

Black-legged Kittiwake. Black-legged Kittiwakes are circumpolar in coastal areas of the Arctic and subarctic. In Alaska, they nest as far north as Cape Lisburne and as far south as Boussole Head near Glacier Bay, with the largest portion of the population breeding in the Gulf of Alaska (Fairchild et al. 2007, Seabird Information Network 2017). Pacific breeding birds travel as far west as the Kolyma River Delta in Russia and are known to utilize Wrangel Island south to the Sea of Okhotsk (Kondratyev et al. 2000). In eastern North America, two areas are widely used by Black-legged Kittiwakes: the Canadian High Arctic and the Gulf of St. Lawrence.

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TABLE 5.10-1. Kittiwake life history characteristics and conservation status. Sources: Byrd and Williams (1993), Hatch et al. (2009), Warnock (2017)

	Red-legged Kittiwake *Rissa brevirostris*	Black-legged Kittiwake *R. tridactyla*
Body Size Mass Length	**M** 10.4–17.2 ounces (296–489 g) **L** 13.8–15.4 inches (35–39 cm)	**M** 11.1–20.5 ounces (316–580 g) **L** 14.9–16.4 inches (38–41 cm)
Maximum Life Span (wild)	Unknown	Avg. 13 years
Clutch Size Range Average	**R** 1–3 eggs **A** 2 eggs	**R** 1–3 eggs **A** 2 eggs
Nest-Water Proximity	Coastal cliff nester	Coastal cliff nester
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	**ESA:** Not Listed **IUCN:** Vulnerable **WL:** Red List	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Red List
Population Global Alaska	**G** 306,000 **A** 209,000	**G** 17,500,000 **A** 1,322,000
Breeding Season Eggs Young	**E** June to mid-August **Y** Mid-July to mid-September	**E** May to July **Y** June to August
Migration Spring Fall	**S** April **F** September	**S** March to May **F** September to December

Red-legged Kittiwake.

Black-legged Kittiwake.

LIFE CYCLE

Kittiwakes form large, dense, noisy colonies upon coastal cliffs, often within 25 miles (40 km) of productive feeding grounds (Biderman and Drury 1978, Hunt et al. 1981, Springer 1991). Red-legged Kittiwakes are known to travel great distances for food; in the Pribilofs they travel up to 60 miles (200 km) to forage (Kokubun et al. 2015).

Kittiwakes prefer nest sites on near-vertical faces up to 1,000 feet (300 m) high, often among murres or other cliff-nesting seabirds (Hickey and Craighead 1977, Hunt et al. 1981). Many form pairs once they have arrived at their breeding grounds in late April or early May, although experienced birds often arrive already paired (Nysewander 1983a, Byrd and Williams 1993a). Kittiwakes are often the first birds to arrive at their breeding colony and use this time to gradually construct their nests out of mud and plants before they begin laying their eggs in June, with both members of the pair constructing the nest (Byrd and Williams 1993a). In June, the female lays a single egg, rarely laying a second (Hunt et al. 1981, Johnson and Baker 1985, Lloyd 1985, Byrd 1989). Both parents participate in incubation and foraging during the approximately four weeks between laying and hatching (Hunt et al. 1981). After hatching, the young stay in the nest for the first two weeks before venturing out to explore the area directly surrounding the nest. They fledge after about five weeks and will return to the nest for food for several weeks (Hunt et al. 1981).

Diet

Kittiwakes feed within the top few feet of the ocean surface (Hunt et al. 1981, Hatch et al. 1993). They are especially buoyant, and are not well adapted to diving, so they forage by pursuit-plunging or dipping after their prey, seeking small fish and marine invertebrates such as sand lance (*Ammodytidae* spp.), capelin (*Mallotus villosus*), Pacific herring (*Clupea pallasii*), Arctic cod (*Arctogadus glacialis*), saffron cod (*Eleginus gracilis*), lanternfishes (*Myctophidae*), northern lampfish (*Stenobrachius leucopsarus*), walleye pollock (*Theragra chalcogramma*), squid (cephalopods), amphipods, and euphausiids (Schneider and Hunt 1984, Bradstreet 1985, Dragoo 1991).

Red-legged and Black-legged Kittiwakes feed both diurnally and nocturnally, but the Red-legged Kittiwake is better adapted to nocturnal feeding, with larger eyes that more easily gather the scarce light available during low-light feeding sessions (Storer 1987). Kittiwakes often forage at nutrient-rich upwelling sites over the continental shelf, where their prey concentrates. They are also known to utilize pelagic waters in areas where the shelf is especially narrow (Hunt et al. 1981, Schneider and Hunt 1984), such as at Buldir Island in Alaska, where they forage over pelagic waters near the colony (Schneider and Hunt 1984). Both species of kittiwake are often seen foraging over large schools of fish among larger gulls, murres, terns, cormorants, and puffins.

CONSERVATION ISSUES

Though Black-legged Kittiwakes have large populations across their circumpolar range they have faced recent declines in Alaska (Goyert et al. 2017). Red-legged Kittiwakes experienced substantial declines in the 1970s and 1980s, leading to an International Union for Conservation of Nature (IUCN) listing of vulnerable in 1994, continuing through their most recent evaluation in 2015 (Renner et al. 2012, International Union for the Conservation of Nature 2014). Red-legged Kittiwakes were designated as a candidate for listing as threatened or endangered under the Endangered Species Act in 1994, though more research was deemed necessary to complete the listing. The species is listed in the Red Book of Russia. The decline at their largest colony on St. George Island in the Pribilofs has stabilized, although their numbers still fluctuate in other portions of their range. These declines may be due to commercial fisheries depleting the forage fish on which kittiwakes rely (Renner et al. 2012). Red-legged and Black-legged Kittiwakes are on the Red List of Audubon Alaska's 2017 WatchList, indicating declines in their population (Warnock 2017).

Climate change appears to be a major contributiong factor to the substantial declines both species of kittiwake continue to experience (Goyert et al. 2017). Kittiwakes are susceptible to many pressures, both natural and anthropogenic. Anthropogenic disturbance is a common concern regarding colonial breeding seabirds, although kittiwakes seem to be affected less by this disturbance than other colonial nesters. The main predator of kittiwake adults, chicks, and eggs is the Arctic fox (*Vulpes lagopus*). Other predators include Glaucous-winged Gulls (*Larus glaucescens*), Glaucous Gulls (*L. hyperboreus*), Common Ravens (*Corvus corax*), Bald Eagles (*Haliaeetus leucocephalus*), and Peregrine Falcons (*Falco peregrinus*) (Nysewander 1983a, Fadely et al. 1989, Suryan et al. 2006a). The Alaska Maritime National Wildlife Refuge conducts an introduced-fox eradication program, which has been successful thus far (Ebbert and Byrd 2002).

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As with many species of seabird, the dependence of kittiwakes on abundant prey brings them into regular contact with commercial fisheries, although their surface-feeding habits do not regularly cause them to be caught in gill nets (Ainley et al. 1981). Commercial fisheries have likely depleted forage fish stocks utilized by kittiwakes, but more data are needed to confirm this theory (Springer 1992, Hatch et al. 1993).

Contact with oil rarely resulted in death for kittiwakes impacted by the *Exxon Valdez* oil spill of 1989 (Piatt et al. 1990a, Piatt et al. 1990b). While long-term effects of oiling events on kittiwakes are unknown, biomagnification and ingestion during preening are likely to have detrimental effects on exposed birds.

The commercial harvest of kittiwake eggs has had past adverse effects on the size and distribution of colonies, and likely caused substantial declines in kittiwake recruitment in colonies of Red-legged Kittiwakes in the Pribilofs in the 1970s (Hunt et al. 1981). In Greenland, hunting and egging continued into the 21st century but has since been forbidden (Nyeland 2004, Merkel and Barry 2008).

MAPPING METHODS (MAPS 5.10.1–5.10.2)

We categorized distribution into four main categories of intensity: extent of range, regular use, concentration, and high concentration. The kittiwake extents of range were drawn by buffering all known occurrences of each species using data from Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a), eBird (2015), and the Seabird Information Network (2011). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. For each species, observations from these data sources were then buffered with a 62-mile (100-km) radius and merged. In some cases, inconsistencies were manually edited and smoothed. The Red-legged Kittiwake range was extended into Anadyrskiy Gulf, where survey data are limited, based on personal communication with Rachael Orben.

To determine regular-use and concentration areas, survey data were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We ran kernel density analyses to convert binned data into smoothed distribution data, then selected areas of repeated occurrence. In Alaska, the regular-use areas represent the 99% isopleth from a kernel density raster, using a search radius of 78 miles (125 km). For the concentration areas, we ran a 31-mile (50-km) kernel density analysis, then delineated density values that are 1 or more standard deviations above the project area mean density.

Because of the relative lack of survey data in Russia, concentration areas in Russia are often not known or depicted. Where there were gaps in survey coverage, such as in Russia, we buffered species' colony locations, using a buffer radius equal to the species' average maximum foraging distance (44 miles [71 km] for Black-legged Kittiwakes (Lascelles 2008) and 75 miles [120 km] for Red-legged Kittiwakes (Cornell Lab of Ornithology and American Ornithologists' Union 2016)). These two types of boundaries were combined to represent regular use across the project area.

High-concentration areas were represented using global Important Bird Areas (IBAs). In Russia and Canada, we used IBA data from BirdLife International (2017a) while IBAs in Alaska are from Audubon Alaska (2014). Because IBA boundaries often encompass multiple-species hotspots, in Alaska we also show single-species IBA core areas (Audubon Alaska 2015) to indicate high concentrations for each species (see Smith et al. 2014c).

Kittiwake colony data were downloaded from the Seabird Information Network (2011). The colony count data for Red-legged Kittiwakes were updated based on Byrd et al. (1997), Byrd et al. (2001a), Byrd et al. (2001b), Byrd et al. (2004), Thomson et al. (2014), and Williams (2017). This map represents the most recent or otherwise best estimate available for each colony location (see Smith et al. 2012). On the map, the size of each colony point represents the percent of the total population present at that colony. Total population was the sum of the abundance of the species across all colonies within the project area.

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines were based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. Kittiwakes generally do not use the areas of Canadian waters in our project area. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting maps. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of these maps. The colony data are available throughout the US and Russian portions of the project area, but data quality—survey dates and techniques—varies greatly among colonies. Colony sizes should be interpreted as estimates rather than precise counts.

Reviewers

- Rachael Orben
- Marc Romano

MAP DATA SOURCES

RED-LEGGED KITTIWAKE MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), eBird (2015), R. Orben (pers. comm.), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a), Byrd et al. (1997), Byrd et al. (2001a), Byrd et al. (2001b), Byrd et al. (2004), Seabird Information Network (2011), Thomson et al. (2014), and Williams (2017)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2015) and Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Colonies: Byrd et al. (1997); Byrd et al. (2001a, b); Byrd et al. (2004); Seabird Information Network (2011); Thomson et al. (2014); Williams (2017)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

BLACK-LEGGED KITTIWAKE MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a) and Seabird Information Network (2011)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2015) and Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

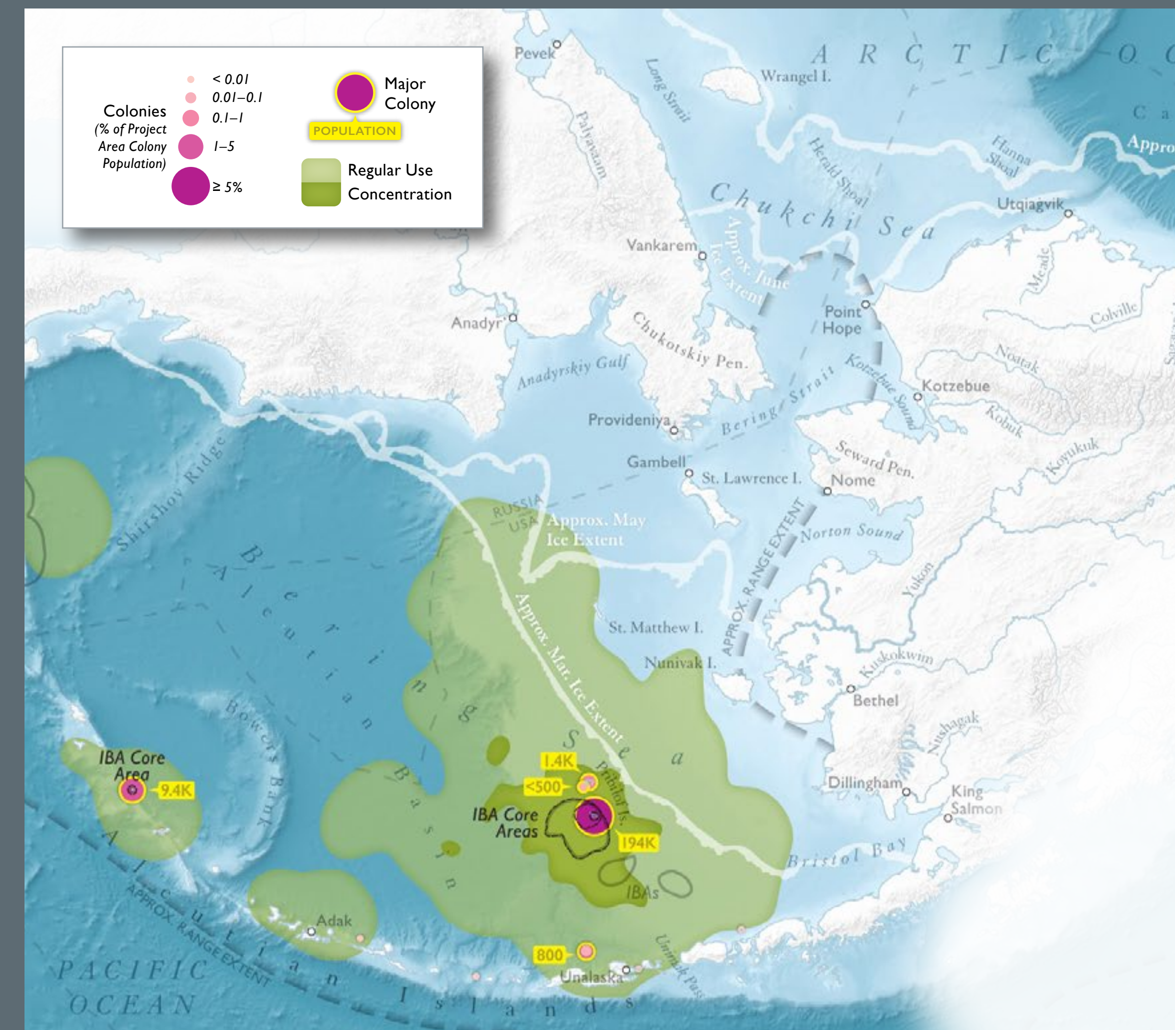
IBA Core Areas: Audubon Alaska (2015)

Colonies: Seabird Information Network (2011)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

Kittiwakes

Audubon ALASKA



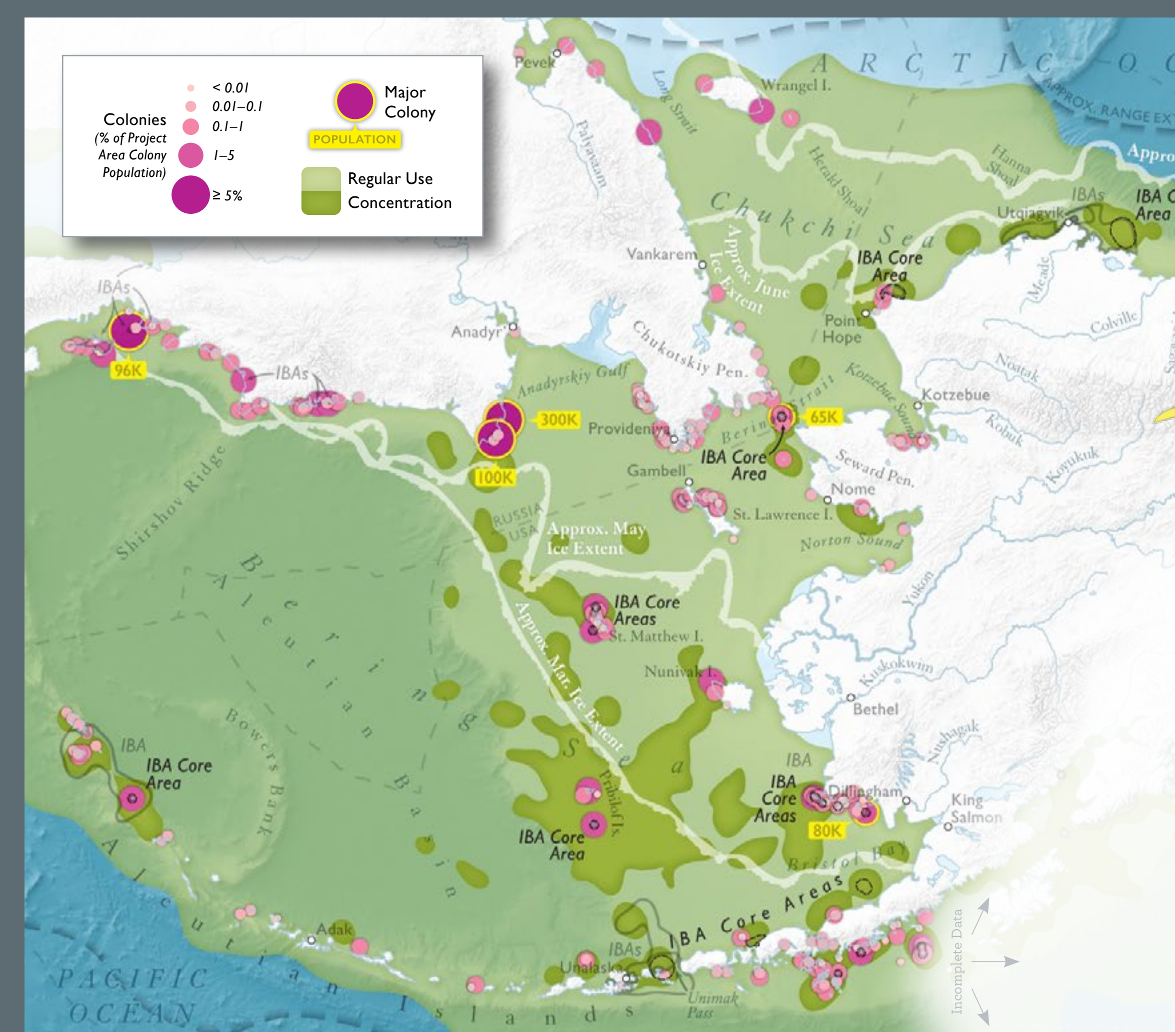
Red-legged Kittiwake MAP 5.10.1

(Rissa brevirostris)

The global population of 300,000 Red-legged Kittiwakes nest only on coastal cliffs in a few small colonies in the southern Bering Sea. This map shows their annual range within the project area, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial Red-legged Kittiwake population within the project area.

Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2015), Audubon Alaska (2016a), Byrd et al. (1997), Byrd et al. (2001a), Byrd et al. (2001b), Byrd et al. (2004), eBird (2015), R. Orben (pers. comm.), Seabird Information Network (2011), Thomson et al. (2014), and Williams (2017)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Byrd et al. (1997); Byrd et al. (2001a); Byrd et al. (2001b); Byrd et al. (2004); Seabird Information Network (2011); Thomson et al. (2014); Williams (2017)

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman



Black-legged Kittiwake MAP 5.10.2

(Rissa tridactyla)

Black-legged Kittiwakes are globally numerous, abundant in the Bering and Chukchi Seas, and adaptable, with thousands breeding as far north as Wrangel Island. This map shows their annual range within the project area, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial Black-legged Kittiwake population within the project area.

Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2015), Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Seabird Information Network (2011)

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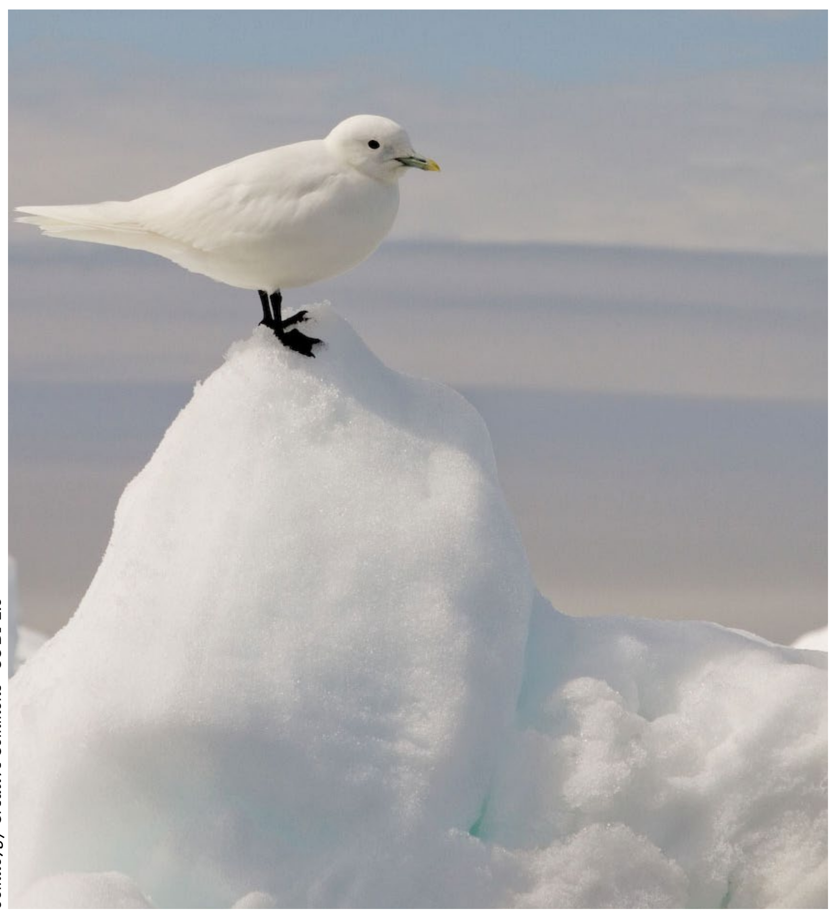
Ivory Gull

Pagophila eburnea

Nils Warnock, Erika Knight, and Melanie Smith

As its genus name implies (*Pagophilia* means "a preference for ice"), the Ivory Gull (*Pagophila eburnea*) is a species that is almost exclusively dependent on sea ice throughout its annual cycle (Cramp et al. 1983, Mallory et al. 2008). During the non-breeding season, these birds move tens of thousands of miles along the ice-edge (Gilg et al. 2010, Spencer et al. 2014a). This medium-sized gull is, in adult plumage, strikingly white with short, black legs and a small, orange-tipped, yellowish-green to greenish-blue bill. Uncommon to rare in Alaskan waters, the Ivory Gull is mainly pelagic and stays near ice, but occasionally shows up at interior sites (Gabrielson and Lincoln 1959, Divoky 1976, eBird 2017). This species is easy to miss, however, because of the extremely remote areas it inhabits. In Alaska's Arctic waters, only single, or as many as tens of birds are seen at a time. These birds may come from the Russian breeding colonies of about 4,000 birds from around Severnaya Zemliya to the west, and possibly from smaller Canadian colonies to the east (Volkov and De Korte 1996, Gilg et al. 2010, I. Stenhouse pers. comm.). While trend data are sparse, the global population is thought to be in decline (Robertson et al. 2007, Gilg et al. 2009, Environment Canada 2014, BirdLife International 2016b).

Little is known about the physical adaptations of Ivory Gulls, but Gabrielsen and Mehlum (1989) found that the resting metabolic rate of the Ivory Gull was about 200% higher than predicted for a relatively small seabird. This may allow Ivory Gulls to increase heat production when stressed by the cold, although this is based on measurements from a single bird. The mean body temperature of this bird was 104.5° F (40.3° C). Ivory Gulls possess short, stout tarsi (Cramp et al. 1983) with strong, claw-like feet, perhaps for gripping on ice (Howell and Dunn 2007).



The Ivory Gull prefers especially remote, icy areas in the circumpolar Northern Hemisphere. Named for their distinct, all-white adult plumage, the Ivory Gull's inaccessible habitat has contributed to the mystery of this species.

DISTRIBUTION

While Ivory Gulls have been spotted as far south as southern California (Mallory et al. 2008), most observations of this ghost-like gull are within sight of Arctic sea ice. Depending upon the location, they associate on the ice with walrus (*Odobenus rosmarus divergens*), ice seals, and polar bears (*Ursus maritimus*), and at sea with kittiwakes, Red Phalaropes (*Phalaropus fulicarius*), and Sabine's Gulls (*Xema sabini*) (Divoky 1976, Cramp et al. 1983). Satellite-tagged, post-breeding Ivory Gulls from the northeast Atlantic generally followed the northern-most edge of sea ice off Canada, Greenland, and Russia during their non-breeding season, although some birds use glacier fronts in open-water areas (Gilg et al. 2010). Likewise, tagged Ivory Gulls from Seymour Island in Arctic Canada showed a strong affinity for edge regions of sea ice and dense pack ice (average of 50% concentration) (Spencer et al. 2014a).

Post-breeding migration has been described as "bi-directional trans-polar migration" (Gilg et al. 2010), with birds heading in both easterly and westerly directions to wintering grounds along ice edges. Ivory Gulls travel an average 4–6 miles (6–10 km) per hour, with highest travel rates during November (Gilg et al. 2010, Spencer et al. 2014a). Like many migratory seabirds, fall migration is more prolonged in Ivory Gulls than their spring migration (Gilg et al. 2010, Spencer et al. 2014a).

Migration

Based on the movements of satellite-tagged individuals, major wintering areas of Ivory Gulls appear to be in the Bering Sea, southeast Greenland, and the Davis Strait/Labrador Sea, with most birds arriving at these wintering areas in November and December (Gilg et al. 2010, Spencer et al. 2014a). Although sample sizes are small, up to 25% of birds that winter in the Bering Sea come from colonies in Franz Joseph Land in Russia, 20% from Svalbard, and 11% from Greenland (Gilg et al. 2010). Genetically, Ivory Gulls collected near Utqiaġvik (formerly Barrow) during the non-breeding season are largely differentiated from breeding birds from Norway, Greenland, and Canada, also suggesting a Russian connection for these birds (Royston and Carr 2016).

LIFE CYCLE

Ivory Gulls nest in Arctic Canada, Greenland, Norway (Svalbard), and Russia at some of the highest latitudes and remotest sites of any bird in the world (Cramp et al. 1983, Volkov and De Korte 1996, Krajick 2003, Mallory et al. 2008). Typically, small nesting colonies (tens to thousands of birds) are found on steep rock cliffs and gravel plateaus 6–31 miles (10–50 km) from the water in places with few predators (particularly Arctic fox [*Volpes lagopus*]) (Robertson et al. 2007, Mallory et al. 2008, Gilg et al. 2009). They will also nest in flat, bare areas near the sea (Cramp et al. 1983, Volkov and De Korte 1996). Rarely, small colonies have been found on floating, gravel, and rock-covered islands in the ice (Boertmann et al. 2010). Ivory Gulls nest on the ground, usually laying two eggs.

Diet

The diet of Ivory Gulls consists mostly of invertebrates and fishes, although the species is omnivorous and highly opportunistic, depending upon location and season (Mallory et al. 2008). In certain seasons and areas, birds are known to feed on placentas and feces of marine mammals, as well as on scraps of kills made by polar bears (Divoky 1976, Gjertz and Lydersen 1986). In Alaska's Chukchi Sea, southwest of Utqiaġvik (formerly Barrow), 13 Ivory Gulls were collected in the month of October and 92% of them had Arctic cod (*Boreogadus saida*) in their stomachs, while 23% had ingested plant material (Divoky 1976). In the Bering Sea, walleye pollock (*Theragra chalcogramma*) are an important prey for Ivory Gulls (Divoky 1981, Mallory et al. 2008)

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CONSERVATION ISSUES

In Canada, the Ivory Gull is listed as endangered under the Species at Risk Act, and a recovery strategy is in place (Environment Canada 2014). It is also listed as a Category 3 (Rare) species in the Red Data Book of the Russian Federation and designated as near threatened on the IUCN Red List of Threatened Species (BirdLife International 2016b). The Conservation of Arctic Flora and Fauna (CAFF)'s Circumpolar Seabird Group has also developed an international conservation strategy (Gilchrist et al. 2008). Since 2010, Audubon Alaska has included the Ivory Gull on its Red List, indicating that the species is declining (Warnock 2017).

Ivory Gulls appear to be declining and thus are of significant management concern (Gilg et al. 2009, Environment Canada 2014). For a species that relies so heavily on sea ice throughout its annual cycle, perhaps the major long-term challenge for Ivory Gulls is the rapid decline of Arctic sea ice due to changing climatic conditions, including rising temperatures (Serreze et al. 2007). The mechanism(s) for how this impacts Ivory Gull populations is unclear; although some suggest changing winter habitat conditions are of particular concern (Krajick 2003). During the breeding season, unusual rainstorm events have caused significant breeding failure with close to 100% chick mortality at Ivory Gull colonies in Greenland (Yannic et al. 2014). Subsistence hunting in Greenland has been documented to be a significant source of mortality for adult Ivory Gulls, but hunting appears to be declining (Stenhouse et al. 2004). Additionally, high loads of environmental contaminants have been measured in these Arctic gulls (Braune et al. 2006, Braune et al. 2007, Verreault et al. 2010). Using feather samples from adult birds collected in Arctic Canada, methylmercury was found to have increased significantly over the past 130 years (Bond et al. 2015). At Seymore Island in Canada, eggs of Ivory Gulls had elevated levels of mercury, in some cases high enough to have negative impacts on reproductive success (Braune et al. 2006).

MAPPING METHODS (MAP 5.11)

We categorized distribution into three main categories of intensity: extent of range, regular use, and concentration. The extent of range was drawn by buffering all known occurrences of Ivory Gulls using data from Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a), eBird (2015), Spencer et al. (2015), and Gilg et al. (2016). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. Ivory Gull observations from these data sources were then buffered with a 62-mile (100-km) radius and merged. In some cases, inconsistencies were manually edited and smoothed.

To determine regular-use and concentration areas, survey data were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We ran kernel density analyses to convert binned data into smoothed distribution data, then selected areas of repeated occurrence. In Alaska, the regular-use areas represent the 99% isopleth from a kernel density raster, using a search radius of 78 miles (125 km). Data from Portenko (1972), indicating regular use of the shorelines around St. Lawrence and Wrangel Islands, is also shown as regular use. For the concentration areas, we ran a 31-mile (50-km) kernel density analysis, then delineated density values that are 1 or more standard deviations above the project area mean density.

Migration arrows were digitized by Audubon Alaska (2009a) based on migration information provided in Mallory et al. (2008).

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines are based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

TABLE 5.11-1. Ivory Gull life history characteristics and conservation status. Sources: Mallory et al. (2008), Warnock (2017).

	Ivory Gull *Pagophila eburnea*
Body Size Mass Length Wingspan	**M** 1–1.5 pounds (465–617 g) **L** 15.7–16.9 inches (40–43 cm) **W** 42.5–47.2 inches (108–120 cm)
Maximum Life Span (wild)	20+ years
Clutch Size Range Average	**R** 1–3 eggs **A** 2.2 eggs
Nest-Water Proximity	9–14 miles (15–22 km) inland (in North America)
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	**ESA:** Not Listed **IUCN:** Near Threatened **WL:** Red List
Population Global Alaska	**G** 19,500 **A** 1,000
Breeding Season Eggs Young	**E** June to August **Y** July to September
Migration Spring Molt Fall	**S** March to May **M** March to July **F** September to November

Data Quality

The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years Survey data is most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting maps. There is little to no survey coverage in the Canadian and Russian portions of the project area, potentially leaving major data gaps for this species. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of this map.

Reviewer

• Iain Stenhouse

MAP DATA SOURCES

Extent of Range: Audubon Alaska (2016e) based on Audubon Alaska (2016a), eBird (2015), Gilg et al. (2016), and Spencer et al. (2014a, b)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a); Portenko (1972)

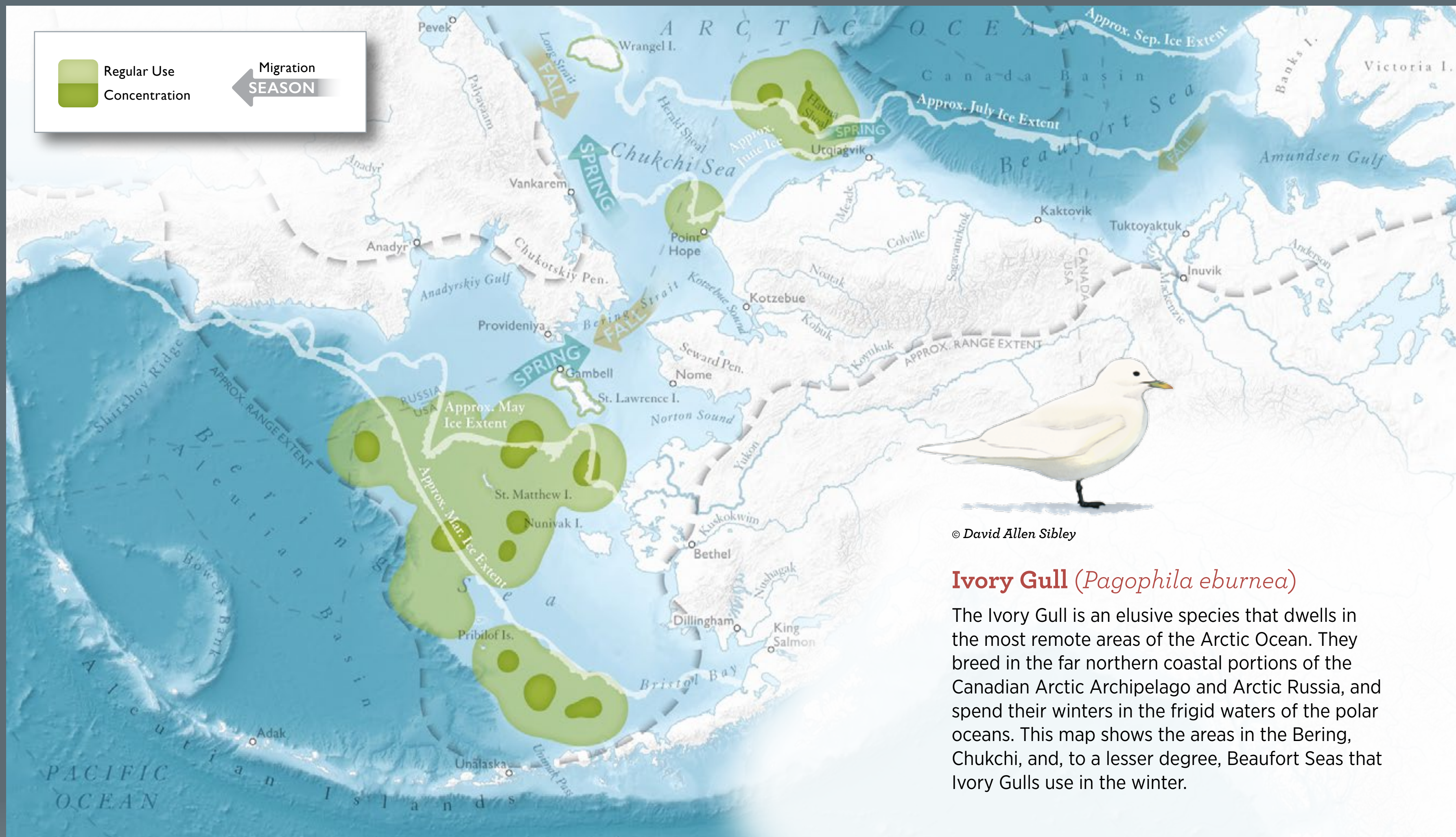
Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2016a)

Migration: Audubon Alaska (2009a) based on Mallory et al. (2008)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

Ivory Gull

Audubon ALASKA



Ivory Gull *(Pagophila eburnea)*

The Ivory Gull is an elusive species that dwells in the most remote areas of the Arctic Ocean. They breed in the far northern coastal portions of the Canadian Arctic Archipelago and Arctic Russia, and spend their winters in the frigid waters of the polar oceans. This map shows the areas in the Bering, Chukchi, and, to a lesser degree, Beaufort Seas that Ivory Gulls use in the winter.

Audubon Alaska (2009a) [based on Mallory et al. (2008)]; Audubon Alaska (2016c) [based on Audubon Alaska (2016a)]; Audubon Alaska (2016e) [based on Audubon Alaska (2016a), eBird (2015), Gilg et al. (2016), Spencer et al. (2014a;2014b)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; Portenko (1972)

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman

Ivory Gull.

Gerrit Vyn

Murres

Max Goldman, Erika Knight, and Melanie Smith

Common Murre

Uria aalge

Thick-billed Murre

U. lomvia

The largest and most well-studied birds in the auk family (*Alcidae*), the two congeneric species of murre, the Common Murre (*Uria aalge*) and Thick-billed Murre (*U. lomvia*), are among the most abundant seabirds in the Northern Hemisphere. They are found in cooler, continental shelf waters of the Arctic and subarctic in North America, Europe, and eastern Asia (Gaston and Hipfner 2000, Wong et al. 2014). A pursuit-diving colonial nester, murres live their entire lives on or very near the ocean, coming ashore only to breed. Common and Thick-billed Murres are very difficult to tell apart at a distance or in low light; and the fact that they often nest in the same areas in colonies numbering in the millions only serves to exacerbate the problem, resulting in many records of unidentified murre species. Raptors, such as the Bald Eagle (*Haliaeetus leucocephalus*), Gyrfalcon (*Falco rusticolus*), and Rough-legged Hawk (*Buteo lagopus*), and mammals, such as the red fox (*Vulpes vulpes*), Arctic fox (*Vulpes lagopus*), and polar bear (*Ursus maritimus*), are the most common natural predators of adult murres, while foxes, corvids, and gulls are common predators of eggs and young (Ainley et al. 2002).

Common and Thick-billed Murres have dark brown or black heads, necks, upper wings, and backs and have white underparts. They use their short tails for propping themselves up when perched on the rocky cliffs on which they breed (Ainley et al. 2002). Both species have long, tapered black bills. The bill of the Common Murre is finer than that of the Thick-billed Murre, which has a noticeable decurve at the tip of the culmen, compared to the subtle taper of the Common Murre's bill. The most distinctive field mark is a diagnostic white line on the bill of the Thick-billed Murre, though this is difficult to observe from a distance. There are also minor differences in plumage between the two murres as well. The Common Murre shows a curved, upside-down "U" on its upper chest at the margin between black and white feathers, while the Thick-billed Murre has a sharper, inverted "V" where black feathers meet white feathers on its chest (Ainley et al. 2002).

Murres have very short wings and a relatively large and heavy body, resulting in the highest wing-load of extant flighted birds (Croll et al. 1991). This high wing-load makes takeoff very difficult, and murres require an especially fast wing beat and flight speed to stay airborne (Croll et al. 1991). They are, however, well-suited for swimming and diving, regularly reaching depths of over 330 feet (100 meters) and dive durations of over 4 minutes (Piatt and Nettleship 1985). The depth and duration of their dives indicate that they employ an unknown mechanism to avoid lung collapse and decompression sickness upon returning to the surface (Piatt and Nettleship 1985).

Murres are known to communicate with a broad variety of sounds (Gaston and Hipfner 2000). Communication is constant and critical within the murres' breeding colonies to help this highly aggressive species maintain order. Murres most commonly communicate as a form of individual recognition between mates and neighbors, so breeding colonies are very noisy. After leaving the colony, murres vocalize to locate each other after dives of over two minutes in foggy and often stormy seas that may separate parent and chick (Gaston and Hipfner 2000, Ainley et al. 2002).

DISTRIBUTION

Thick-billed and Common Murres are true seabirds, spending all of their lives at sea in waters that remain below 46° F (8° C), except during the breeding season, when they leave the water for cliffs for 6–10 weeks. In the Bering Sea, murres often move south with the sea-ice margin and begin to move north again as soon as the sea ice recedes. During the winter, forage-fish assemblages can be highly variable, and mortality is often high, as birds without proper fat stores starve in the snow and ice of the far north (Gaston and Hipfner 2000, Ainley et al. 2002, Orben et al. 2015b).

Migration

The first few weeks of migration for fathers and chicks is strictly in the water, until around six weeks after hatching, when chicks are able to fly (Gaston and Hipfner 2000, Ainley et al. 2002). Arctic-breeding murres in high latitudes move south ahead of the advance of the sea-ice margin through the Chukchi and Bering Seas toward molting areas in the southern Bering Sea. While spring migration is not well understood, movements are likely timed with the northward retreat of the winter sea ice in the Bering Sea (Gaston and Hipfner 2000, Ainley et al. 2002).

Wintering

Both male and female murres migrate to molting areas in the fall after breeding, becoming flightless for one to two months. The Common Murre winter range extends farther south than that of the Thick-billed Murre (Gaston and Hipfner 2000, Ainley et al. 2002). Murres are often found near shore, using open water inlets and coves as feeding refugia during the winter months. The Pacific breeding populations of murres utilize Bristol Bay, the Aleutian Islands, and the continental shelf waters south of the sea-ice margin as wintering grounds (Divoky 1979, Gould et al. 1982, Harrison 1982, Brown 1986, Shuntov 1993). Male and female murres often winter in different areas, returning to the same locations each year (Hatch et al. 2000).

Species Description

Common Murre. Common Murres breed in Arctic and subarctic waters. In the Pacific, they breed on coastal cliffs from 72 to 33°N, specifically Wrangel Island in the northern Beaufort Sea, south through the Bering Strait, St. Lawrence Island, the Pribilofs, Bristol Bay, and the Aleutian Islands, along the shores of the Gulf of Alaska, and south to Monterey, California, including the Farallon Islands (Carter et al. 2001, Ainley et al. 2002). In the Atlantic, they breed in coastal areas from 56 to 43°N, including the southern tip of Greenland, south to Labrador Island and Quebec, Newfoundland, and Nova Scotia in the Bay of Fundy (Nettleship 1980, Cairns et al. 1986, Lock et al. 1994). Their winter range includes offshore portions of the same general area, except where sea ice encroaches.

Thick-billed Murres. Thick-billed Murres utilize similar areas as Common Murres, but with some distinct differences. While Common Murres range as far south as California to breed, Thick-billed Murres do not go farther south than the coast of British Columbia, Canada, staying instead between 72 and 50°N in the Pacific (Campbell et al. 2007b). They also breed farther north in the Atlantic than do Common Murres (between 82 and 46°N), using the cliffs on the coast of Prince Leopold Island, Baffin Island, and Greenland, as well as Labrador, Newfoundland, and Nova Scotia (Nettleship 1980, Cairns et al. 1986). There are breeding populations of Thick-billed Murres that do not interact with Common Murres in northern Hudson Bay and Hudson Strait, and on the Beaufort Sea coast of Canada in the Northwest Territories, near Amundsen Gulf (Johnson and Ward 1985, Gaston and Hipfner 2000).

LIFE CYCLE

Highly social, Common and Thick-billed Murres breed nearly shoulder to shoulder with other murres in colonies often composed of hundreds of thousands of breeding birds. They do not build nests, and instead lay their eggs on the rocky substrate of the island cliff ledges, slopes, and flat surfaces of their breeding habitat (Stephensen and Irons 2003). By breeding in high numbers and high density, they are somewhat protected from large gulls (*Larus* spp.) that attempt to take chicks or steal food brought to chicks (Spear 1993). Murres lay their single, especially hard egg in a highly synchronous manner, with 90% of all eggs in a given colony laid within 15 days of each other (Murphy and Schauer 1996). The long, pointed shape of the egg is an adaptation that keeps it

TABLE 5.12-1. Murre life history characteristics and conservation status. Sources: Gaston and Hipfner (2000), Ainley et al. (2002), Warnock (2017).

	Common Murre *Uria aalge*	Thick-billed Murre *U. lomvia*
Body Size Mass Length Wingspan	**M** 1.8–2.5 pounds (800–1,125 g) **L** 15–17 inches (38–43 cm) **W** 25–28 inches (64–71 cm)	**M** 1.75–3.3 pounds (795–1480 g) **L** 13.7–18.9 inches (35–48 cm) **W** 25–30 inches (64–75 cm)
Maximum Life Span (wild)	26 years	29 years
Clutch Size Range Average	**R** 1 egg **A** 1 egg	**R** 1 egg **A** 1 egg
Nest-Water Proximity	Coastal cliff nester	Coastal cliff nester
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Not Listed	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Not Listed
Population Global Alaska	**G** 18 million **A** 2.8 million	**G** 22 million **A** 2.2 million
Breeding Season Eggs Young	**E** Early June to August **Y** Mid-July to mid-September	**E** Late May to late June **Y** Late June to late July
Migration Spring Molt Fall	**S** April to June **M** Early September to mid-December **F** August to mid-November	**S** March to May **M** Late August to mid-December **F** July to mid-September

from rolling off the cliffside nest, as it instead rolls in a tight circle. Both sexes share equally in incubating the egg (Wanless and Harris 1986, Verspoor et al. 1987). If an egg is lost early in the breeding season, pairs will reclutch, producing another single egg.

Adults share foraging responsibilities as well, and must seek abundant, energy-rich prey within 37–43 miles (60–70 km) of breeding ledges, as chicks are fed a single fish several times a day (Gaston and Hipfner 2000). Chicks leave the nest with their fathers well before they are capable of flight, at only three or four weeks old. This event is also highly synchronous, with large groups of male murres leading their young chicks to the cliff's edge, jumping into the water, then calling for the chicks to join them in the water (Roelke and Hunt 1978). If the chick becomes separated from its father, it is immediately surrounded by other murres until reunited through a duet of calls between the chick and parent. Back together, chicks then begin their first migration, swimming with their fathers until they are able to fly (Roelke and Hunt 1978). The female stays at the nest site for up to two weeks after her mate and chick have left, before flying south with non-breeding subadults (Gaston and Hipfner 2000).

Diet

Pursuit-diving seabirds, murres use their short, powerful wings for propulsion and capture prey in their bills. Unlike puffins, they generally catch a single fish at a time, repositioning the prey for swallowing headfirst while they are still under water (Sanford and Harris 1967, Swennen and Duiven 1977, Raikow et al. 1988). Although they are commonly found hunting by themselves, murres also forage cooperatively in flocks that often consist of thousands of seabirds of many species, such as shearwaters, cormorants, gulls, jaegers, kittiwakes, and other alcids. They are also often joined by marine mammals, including whales and dolphins foraging for fishes and invertebrates, such as Arctic cod (*Boreogadus saida*), saffron cod (*Eleginus gracilis*), pollock (*Pollachius* spp.), sand lance (*Ammodytes* spp.), capelin (*Mallotus villosus*), herring (*Clupea* spp.), euphausiids, large copepods, and squid. They feed mostly in the epibenthic and demersal zones, on or just above the ocean floor. The high energetic requirements of their northern-latitude habitat, poor insulation, and high wing-loading require murres to consume 10–30% of their body mass each day (Johnson and West 1975, Swennen and Duiven 1977).

CONSERVATION ISSUES

While the Common and Thick-billed Murres are protected by the Migratory Bird Treaty Act of 1918, they have no other protections, owing to large, relatively stable populations throughout their global range. They are not listed on Audubon Alaska's WatchList, but Common Murre population numbers have declined in the southeast Bering Sea (Goyert et al. 2017). However, murres are susceptible to many pressures, both natural and anthropogenic. Eggs and chicks are commonly eaten by foxes. In 1976, two red foxes on Shaiak Island in the Aleutians in Alaska caused the loss of nearly all of the eggs of 25,000 breeding pairs of murres due to their own predation and that of large gulls, which preyed on the unprotected eggs after the foxes flushed the murres from their nests (Petersen 1982, Bailey 1993).

As with many species of seabirds, the murres' dependence on abundant prey brings them into regular contact with commercial fisheries. Murres are commonly caught in gill nets throughout their global range (Ainley et al. 1981). Commercial fisheries have also likely depleted forage fish stocks utilized by murres, but few data have been gathered to support this theory (Duffy and Schneider 1994, Gaston and Hipfner 2000).

Murres are regularly susceptible to high mortality due to oil spills (Piatt et al. 1990a). Contact with oil often results in hypothermia and malnutrition due to a loss of the insulative properties of their feathers (Seip et al. 1991). During preening, they also ingest oil, which has longer-term effects (Wiens et al. 1984).

Anthropogenic disturbance is a common concern regarding colonial breeding seabirds. Murres are especially sensitive to human intrusions, such as low-flying aircraft, loud or close watercraft, and the close approach by people on foot or in non-motorized watercraft (Chardine and Mendenhall 1998).

The commercial harvest of murre eggs was responsible for precipitous declines in local breeding populations near the end of the 19th century, but those efforts have ceased under the Migratory Bird Treaty Act of 1918 and other protections. The subsistence harvest of murre eggs is not widespread, and only three communities are known to regularly collect Common or Thick-billed Murre eggs: Pond Inlet in Nunavut and Ivujivik in Quebec in Canada, and Cape Thompson in Alaska in the US. Little is known about the subsistence value of murres to Japanese or Russian communities.

Starvation is a common cause of murre mortality, and dead murres are sometimes found in very large numbers. As recently as the winter of 2015–16, Common Murres in Alaska suffered a large mortality event of ~500,000 birds, likely caused by a combination of climate factors, such as atypically warm weather patterns and water temperatures leading to diminished forage-fish assemblages (Cavole et al. 2016). The competition for insufficient food resources caused the Common Murre population to travel great distances, even to inland locations in search of food. Suffering diminished body condition, many starved. As the climate becomes increasingly variable, mass die-offs will likely become more common (Sydeman et al. 2016).

MAPPING METHODS (MAPS 5.12.1–5.12.3)

Due to the difficulty of identifying murres in many field conditions, much of the data used in these maps are identified only as "unidentified murre" rather than to species level. In order to present information for murres as completely as possible, we have made three maps: one specific to Common Murres, one specific to Thick-billed Murres, and one that incorporates all data regarding murres (Total Murres).

We categorized distribution into four main categories of intensity: extent of range, regular use, concentration, and high concentration. The extent of range was drawn by buffering all known occurrences of Common Murres, Thick-Billed Murres, or Total Murres using data from Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a), eBird (2015), the Seabird Information Network (2011), and Canadian Wildlife Service (2013). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. For each species and for Total Murres, observations from these data sources were then buffered with a 62-mile (100-km) radius and merged. In some cases, inconsistencies were manually edited and smoothed. The Thick-billed Murre range was extended throughout the western Bering Sea, where survey data are limited, based on Orben et al. (2015b).

To determine regular-use and concentration areas, survey data were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We ran kernel density analyses to convert binned data into smoothed distribution data, then selected areas of repeated occurrence. In Alaska, the regular-use areas represent the 99% isopleth from a kernel density raster, using a search radius of 78 miles (125 km). For the concentration areas, we ran a 31-mile (50-km) kernel density analysis, then delineated density values that are 1 or more standard deviations above the project area mean density.

Because of the relative lack of survey data in Russia, concentration areas in Russia are often not known or depicted. Where there were gaps in survey coverage, such as in Russia, we buffered species' colony locations, using a buffer radius equal to the species' average maximum foraging distance (42 miles [68 km] for Common Murres and 66 miles [106 km] for Thick-billed Murres (Lascelles 2008)); for colonies not identified to the species level, the average of Common Murre and Thick-billed Murre foraging radii (54 miles [87 km]) was used). These two types of boundaries were combined to represent regular use across the project area.

High-concentration areas were represented using global Important Bird Areas (IBAs). In Russia and Canada, we used IBA data from BirdLife International (2017a) while IBAs in Alaska are from Audubon Alaska (2014). Because IBA boundaries often encompass multiple-species hotspots, in Alaska we also show single-species IBA core areas (Audubon Alaska 2015) to indicate high concentrations for each species (see Smith et al. 2014c).

Murre colony data were downloaded from the Seabird Information Network (2011) and supplemented with data provided by the Canadian Wildlife Service (Canadian Wildlife Service 2013). These maps represent the most recent or otherwise best estimate available for each colony location (see Smith et al. 2012). On the map, the size of each colony point represents the percent of the total population present at that colony. Total population was the sum of the abundance of the species across all colonies within the project area.

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines are based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

The Common Murre and Thick-billed Murre maps represent only those areas where murres could be identified to the species level; there are areas not shown on each species-specific map where murres are present, but it is unknown which (or if both) species uses these areas. The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting maps. There is little to no survey coverage in the Canadian and Russian portions of the project area, potentially leaving major data gaps for these species. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of these maps. For example, the Common Murre map indicates that there is a colony of approximately 500,000 Common Murres at Cape Navarin; therefore, it seems likely that the species concentrates in marine waters near this colony. However, our concentration analysis did not show a concentration area in this vicinity, perhaps because survey data are limited here. The colony data are available throughout the US and Russian portions of the project area, but data quality—survey dates and techniques—varies greatly between colonies. Colony sizes should be interpreted as estimates rather than precise counts.

Reviewer
• Rachael Orben

MAP DATA SOURCES

COMMON MURRE MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), Canadian Wildlife Service (2013), eBird (2015), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a), Canadian Wildlife Service (2013), and Seabird Information Network (2011)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Colonies: Canadian Wildlife Service (2013); Seabird Information Network (2011)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

THICK-BILLED MURRE MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), Canadian Wildlife Service (2013), eBird (2015), Orben et al. (2015b), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a), Canadian Wildlife Service (2013), and Seabird Information Network (2011)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Colonies: Canadian Wildlife Service (2013); Seabird Information Network (2011)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

TOTAL MURRES MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), Canadian Wildlife Service (2013), eBird (2015), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a), Canadian Wildlife Service (2013), and Seabird Information Network (2011)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

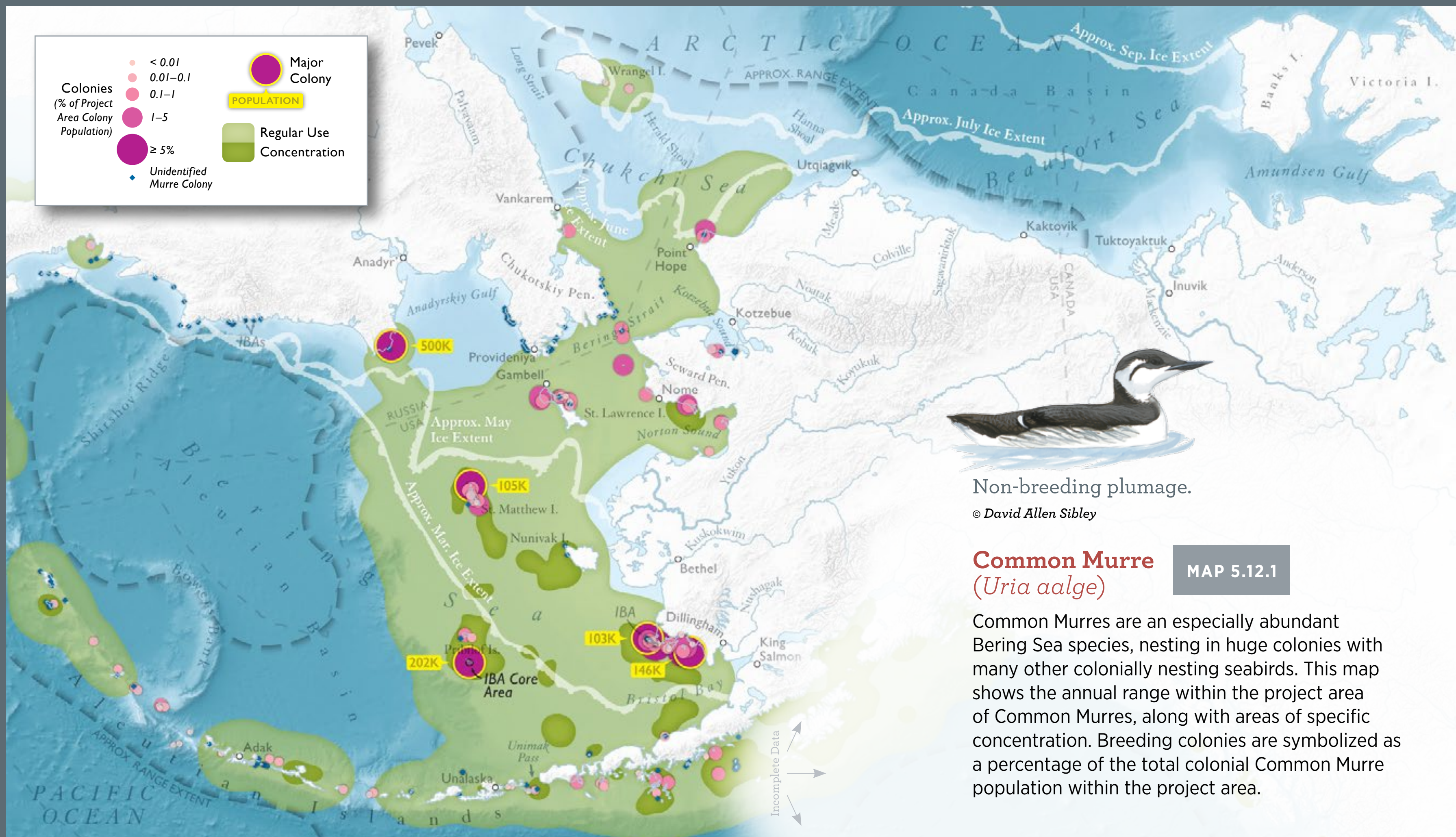
Colonies: Canadian Wildlife Service (2013); Seabird Information Network (2011)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

Murres

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman

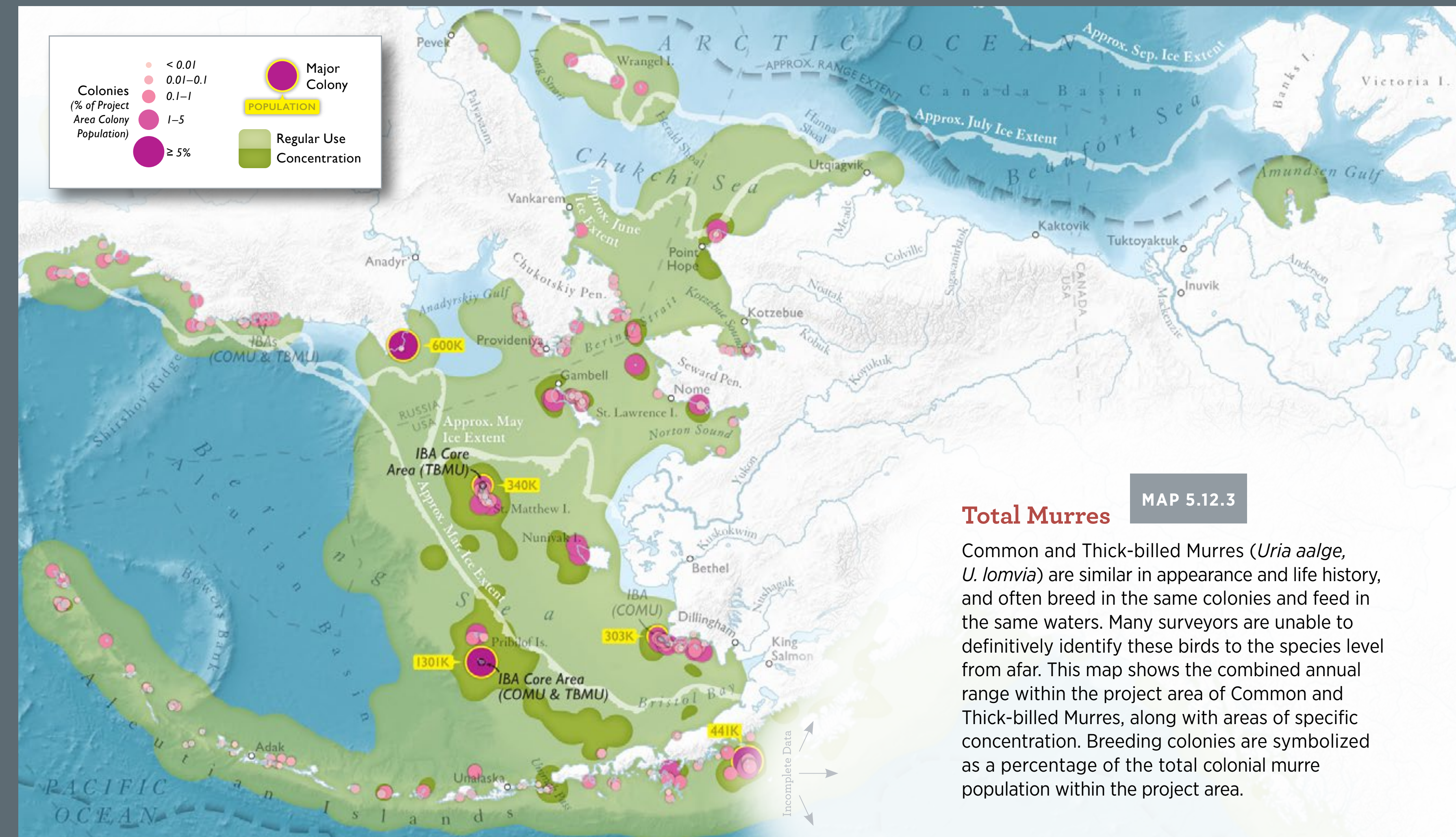
Audubon ALASKA



Common Murre MAP 5.12.1
(Uria aalge)

Common Murres are an especially abundant Bering Sea species, nesting in huge colonies with many other colonially nesting seabirds. This map shows the annual range within the project area of Common Murres, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial Common Murre population within the project area.

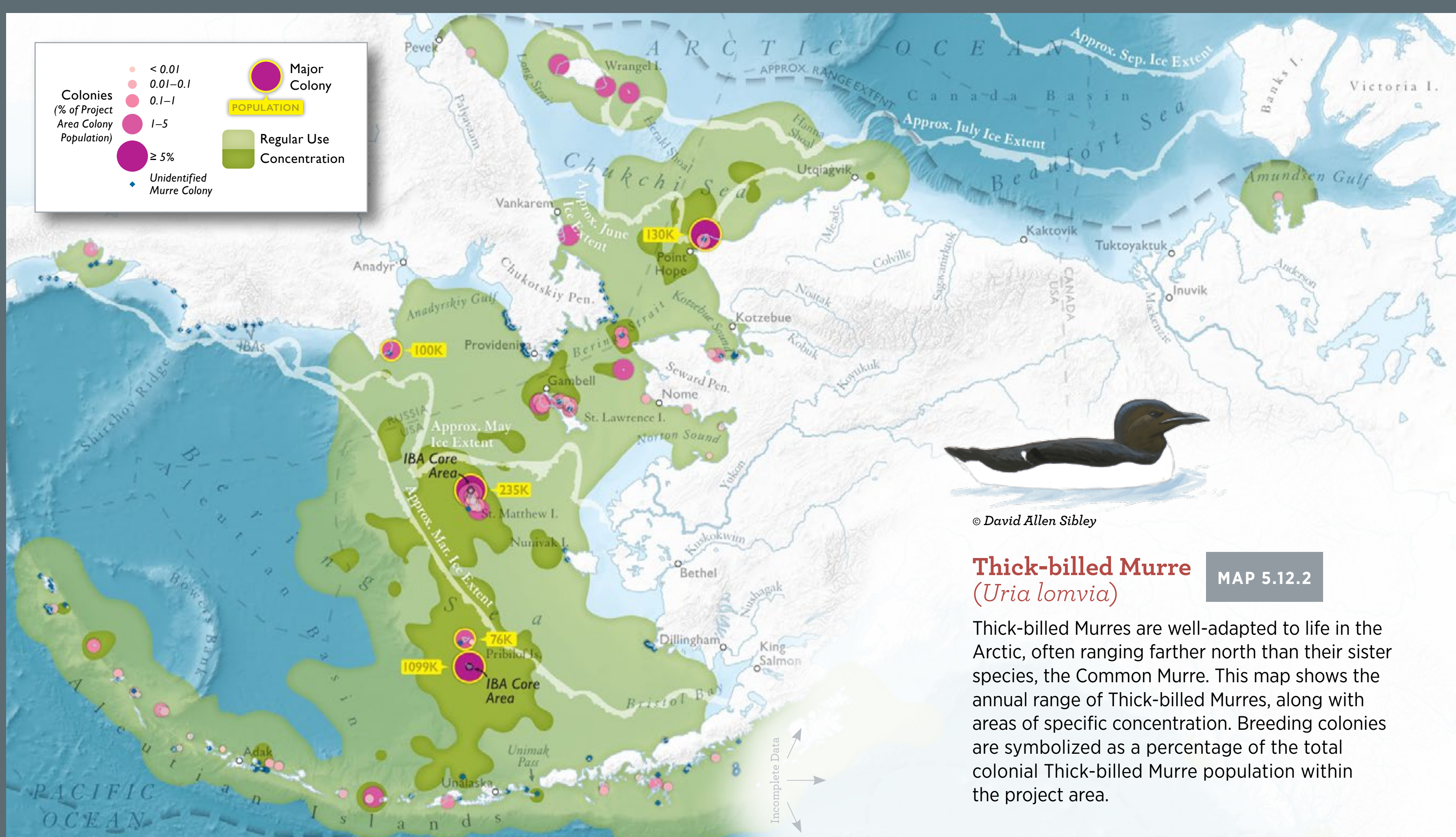
Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2016a), Canadian Wildlife Service (2013), eBird (2015), and Seabird Information Network (2011)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Canadian Wildlife Service (2013); Seabird Information Network (2011)



Total Murres MAP 5.12.3

Common and Thick-billed Murres (*Uria aalge, U. lomvia*) are similar in appearance and life history, and often breed in the same colonies and feed in the same waters. Many surveyors are unable to definitively identify these birds to the species level from afar. This map shows the combined annual range within the project area of Common and Thick-billed Murres, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial murre population within the project area.

Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2016a), Canadian Wildlife Service (2013), eBird (2015), and Seabird Information Network (2011)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Canadian Wildlife Service (2013); Seabird Information Network (2011)



Thick-billed Murre MAP 5.12.2
(Uria lomvia)

Thick-billed Murres are well-adapted to life in the Arctic, often ranging farther north than their sister species, the Common Murre. This map shows the annual range of Thick-billed Murres, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial Thick-billed Murre population within the project area.

Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2016a), Canadian Wildlife Service (2013), eBird (2015), Orben et al. (2015b), and Seabird Information Network (2011)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Canadian Wildlife Service (2013); Seabird Information Network (2011)

Common and Thick-billed Murres at a shared, cliff-side breeding colony. Note the distinguishing white line along the length of Thick-billed Murre's bill in the upper right portion of the photograph.

5.13 PUFFINS MAPS ON PAGE 179

Puffins

Max Goldman, Erika Knight, and Melanie Smith

Horned Puffin

Fratercula corniculata

Tufted Puffin

F. cirrhata

Among the most iconic and well-known species of the Arctic, Horned (*Fratercula corniculata*) and Tufted (*F. cirrhata*) Puffins are ornate, diving seabirds that nest colonially among the numerous coastal cliffs of the Arctic and Subarctic. Closely related to (and in the case of the Horned Puffin, closely resembling) the Atlantic Puffin (*F. arctica*), they are adapted to a plethora of climatic regimes, utilizing the frigid and often ice-covered waters of the Chukchi Sea down to the subtropical currents of the central North Pacific Ocean (Gaston and Jones 1998).

While Horned and Tufted Puffins share many physical traits and adaptations, they are visually distinguishable due to substantial phenotypic differentiation. Adult Tufted Puffins are covered in brownish-black plumage, with a large, white face-mask; a large, grooved, orange bill; and long, golden head-plumes that curve down the neck (Piatt and Kitaysky 2002a, b). Their legs and feet are bright yellowish to almost red, and their short neck becomes shorter during flight when they retract it into their shoulders (Gaston and Jones 1998). In contrast, Horned Puffins have a tall, narrow, deeply curved, bright-yellow bill, with a reddish tip and grooves along its edges for holding fish (Bésdard 1969). They have distinct facial patches: an orange patch at the gape, and a fleshy, black protrusion above their orange eye that earns them their name. The Horned Puffin's legs are also bright yellowish to almost red, and their necks are similarly short. However, they are especially distinct from their Pacific-dwelling congener in flight, as they have a clearly visible white breast which, when paired with their white face and black crown, makes the black band around their necks look like a broad necklace (Gaston and Jones 1998, Piatt and Kitaysky 2002a).

Puffins are excellent swimmers, and regularly dive 180 feet (60 m) or more to capture prey (Bédard 1969). They use their wings to propel themselves through the water. This marine aptitude comes at a cost, however, and puffins are not exceptional fliers. They require a long stretch of water surface to take off, and their rapid wingbeats propel them on an especially direct flight path, without much opportunity for maneuvering (Gaston and Jones 1998). After foraging, they are often too laden to successfully take flight, and instead will dive to evade disturbance. They walk upright, traversing tenuous substrate with ease by clinging to the surface with their large claws. Puffins are not particularly vocal, although they regularly communicate with calls and growls during the breeding season, both on the water and at the colony (Seneviratne et al. 2009, Klenova and Kolesnikova 2013).

DISTRIBUTION

Horned and Tufted Puffins are found in the northern latitudes of the Pacific and Arctic Oceans. After the summer breeding season in the Bering Sea, they are displaced by the advancing winter sea-ice margin. While most appear to seek out the deep, oceanic waters of the central North Pacific at the onset of winter, some are found near the ice edge, preferring passes among the ice-free Aleutian Islands (Gabrielson and Lincoln 1959, Gould and Piatt 1993).

Migration

As is the case with other alcids, puffins are not completely migratory, with many individuals staying near their breeding colonies unless forced to relocate due to sea-ice advance, as happens in both the Bering Sea and the Sea of Okhotsk (Hatch et al. 2000). Most puffins disperse from their breeding habitat by late October, possibly as far south as the Channel Islands in California, although they generally stay far from land at this time and prefer foraging in the open ocean (Ainley et al. 1990, Wahl et al. 1993). After accompanying their parents to the southern wintering areas, juveniles may stay for one or two years as they mature, before returning to the breeding grounds to attempt, but

Horned Puffin taking flight.

Terri Stinnett Photography

5.13 PUFFINS MAPS ON PAGE 179

TABLE 5.13-1. Puffin life history characteristics and conservation status. Sources: Piatt and Kitaysky (2002a, b), Warnock (2017).

	Horned Puffin *Fratercula corniculata*	Tufted Puffin *F. cirrhata*
Body Size		
Mass		
Length	**M** 1–1.4 pounds (483–648 g)	**M** 1.1–2.2 pounds (520–1000 g)
Wingspan	**L** 8–15 inches (20–38 cm)	**L** 14–16 inches (35–40 cm)
Maximum Life Span (wild)	20 years	Unknown
Clutch Size		
Range	**R** 1 egg	**R** 1 egg
Average	**A** 1 egg	**A** 1 egg
Nest-Water Proximity	Coastal cliff nester	Coastal cliff nester
Conservation Status		
Endangered Species Act	**ESA:** Not Listed	**ESA:** Not Listed
IUCN Red List	**IUCN:** Least Concern	**IUCN:** Least Concern
Audubon AK WatchList	**WL:** Red List	**WL:** Red List
Population		
Global	**G** 1,200,000	**G** 3,500,000
Alaska	**A** 921,000	**A** 2,280,000
Breeding Season		
Eggs	**E** June to mid August	**E** May to mid-August
Young	**Y** Mid-July to October	**Y** Mid-June to early October
Migration		
Spring		
Molt	**S** March to mid-June	**S** Mid-February to mid-May
Fall	**F** September to December	**F** September to December

usually fail, to breed (Baird et al. 1983, Gould and Piatt 1993). In the spring, once the weather has begun to warm and the day is sufficiently long (usually near the beginning of April), adults begin to return to their breeding area in flocks (Wehle 1980, Harding 2001).

Species Description

Horned Puffin. Horned Puffins are distributed throughout the North Pacific Ocean, from the subtropical gyre, at approximately 35°N, to the Beaufort Sea. They breed along the coastline and on offshore islands from British Columbia through the Gulf of Alaska, the Aleutians, and the Bering and Chukchi Seas, as far north as Wrangel Island (Wehle 1980). In the western portion of their range, Horned Puffins breed on the Kuril Islands and along the coast of the Sea of Okhotsk (Konyukhov et al. 1998, Golubova 2002). They winter over a broad area of the pelagic North Pacific. About 77% of the world population of Horned Puffins is found in Alaska (Piatt and Kitaysky 2002a).

Tufted Puffins. Similarly, Tufted Puffins are also found from as far south as subtropical Pacific waters off the coast of California, at about 35°N, to the Beaufort Sea (Gould and Piatt 1993). About 65% of the global population of Tufted Puffins is found in the state of Alaska (Piatt and Kitaysky 2002b). The largest colonies are concentrated in the Aleutian Islands and along the Alaska Peninsula in the southern Bering Sea, although they are found to breed on islands throughout the Sea of Okhotsk, the Bering Sea, the Chukchi Sea, and as far north as Cape Lisburne (Golubova 2002).

LIFE CYCLE

In the Bering and Chukchi Seas, resources do not become available until the sea ice has receded and the newly available sunlight catalyzes productivity in the waters beneath. Puffins begin to occupy their steep, cliffside breeding colonies in early May (Hatch and Hatch 1983, Harding 2001). Mates arrive in pairs, or begin forming pairs immediately after arrival at the breeding grounds, and have occupied nesting habitat within one week (Sealy 1973; Wehle 1976, 1980; Harding 2001). These pairs are likely monogamous within each season. They excavate burrows with their claws and bills in the rocky soil on steep slopes well above the shoreline, then line their nests with nearby grasses, feathers, fishing line, or algae. Horned Puffins are more likely to use a crevice to nest than are Tufted Puffins, although both are known to dig burrows (Piatt and Kitaysky 2002a, b). The presence of foxes and other mammalian predators will catalyze a move to crevices or caves or more inaccessible habitat. The male puffin will defend the female at the nest and on the water with aggressive movements and chasing behavior. Within three to four weeks of mating, a single egg is laid, and parents take turns incubating it with their featherless brood patches. Chicks begin to hatch throughout the colony after five or six weeks of incubation, and parents will brood their newly hatched chick for another week after hatching (Harding 2001; Piatt and Kitaysky 2002a, b). As with many colonial-breeding seabirds, their reproductive progression is highly synchronized. Most breeding puffins depart the colony within two to three weeks, once chicks are fledged (Elphick and Hunt 1993, Morrison et al. 2009).

Diet

While wintering in the southern portion of their range, puffins dive to pursue squid, euphausiids, and pelagic fishes in the open ocean—traits that are more similar to other pelagic birds than to other alcids (Baird et al. 1983, Byrd et al. 1993, Piatt and Kitaysky 2002a). The adult puffin diet is made up of mostly soft-bodied organisms, although they predominately feed fish to their young, foraging in bays and along the continental shelf within a broad 60-mile (100-km) range for schooling fishes, such as anchovy (*Engraulis mordax*), capelin (*Mallotus villosus*), lanternfish (especially *Myctophidae*), juvenile pollock (*Theragra chalcogramma*), rockfish (*Sebastes* spp.), greenling (*Hexagrammidae*), and sand lance (*Ammodytes* spp.) (Piatt et al. 1992, Piatt and Kitaysky 2002a, b, Piatt and Springer 2003, Piatt et al. 2006, Golubova and Nazarkin 2009, Sydeman et al. 2016). They capture their prey by diving and propelling themselves through the water with their wings (Bédard 1969). Puffins eat their prey under water, unless they are foraging for their young, in which case they orient their prey perpendicular to their bills, which can hold up to 20 fish at once, a unique quality among seabirds (Bédard 1969). While their maximum dive depth likely reaches over 300 feet (100 m), they usually forage in water less than 200 feet (60 m) deep (Piatt and Nettleship 1985). Puffins are known to forage in relatively low densities and are also commonly found among other species of seabird, foraging in mixed-species flocks of 10–20 individuals (Wehle 1976, Piatt et al. 1992).

CONSERVATION ISSUES

Horned and Tufted Puffins are both protected by the Migratory Bird Treaty Act of 1918. Horned and Tufted Puffins are also both on the Red List of Audubon Alaska's WatchList, owing to declines in recent years, especially in the southeast Bering Sea region (Dragoo et al. 2016, Goyert et al. 2017). Tufted Puffin declines are not as significant or widespread as those suffered by the Horned Puffin (Sydeman et al. 2016).

Puffins are susceptible to predation, and some other birds prey on adults during the breeding season, including Bald Eagles (*Haliaeetus leucocephalus*), Steller's Sea-Eagles (*H. pelagicus*), and Peregrine Falcons (*Falco peregrinus*). Chicks and eggs are at risk as well, with gulls and Common Ravens (*Corvus corax*) the likely culprits. Foxes are especially detrimental to seabird colonies, as they kill and store prey, and are known to decimate colonies when they gain access (Bailey 1993). Brown bears (*Ursus arctos*) destroy nesting burrows and habitat in search of eggs and chicks on the Alaska Peninsula, and in 1992 and 1993, almost 100% of nestlings on Ugaiushak Island and nearby Central Island were eaten by brown bears (Springer et al. 1999, Piatt and Kitaysky 2002a, b). Norway rats (*Rattus norvegicus*) and ground squirrels (*Spermophilus undulatus*) were intentionally or accidentally introduced to many seabird colonies in Alaska during the 1800s and early 1900s, causing precipitous declines in seabird recruitment levels. Affected seabirds rebounded rapidly after rat-eradication efforts (Croll et al. 2016).

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Anthropogenic disturbance is a concern. Investigator and harvester disturbance during hatching or incubation may have led to desertion in the past (Amaral 1977, Wehle 1980). Subsistence harvest of adults and eggs is a common cultural pursuit among most coastal communities in the Bering Strait region of Alaska, although the impact is not likely to affect puffin population sizes (Fall et al. 2003).

As is the case with many seabirds, Horned and Tufted Puffins are especially susceptible to impacts from oil spills. Nearly 600 dead birds were recovered after the *Exxon Valdez* spill in 1989, although estimates of puffin mortality as a result of that spill were likely more than 20,000 birds (Piatt et al. 1990a, b; Glickson et al. 2014).

Bycatch in gill nets is a common and widespread problem. Changes in fishing regulations have abated the issue somewhat. From the 1950s to 1990s, hundreds of thousands of puffins were drowned in the gill nets of offshore fisheries (Ainley et al. 1981; Piatt and Kitaysky 2002a, b). The banning of high driftnet fishing in the late 1980s lowered mortality to less than 1,000 birds per year, although Russian and Japanese fleets still employ those banned methods, likely resulting in high puffin and other seabird mortality (DeGange et al. 1993, Artyukhin and Burkanov 2000, Gjerdrum et al. 2003, Žydelis et al. 2013).

MAPPING METHODS (MAPS 5.13.1–5.13.2)

We categorized distribution into four main categories of intensity: extent of range, regular use, concentration, and high concentration. The Horned Puffin and Tufted Puffin extents of range were drawn by buffering all known occurrences of each species using data from Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a), eBird (2015), and the Seabird Information Network (2011). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. For each species, observations from these data sources were then buffered with a 62-mile (100-km) radius and merged. In some cases, inconsistencies were manually edited and smoothed.

To determine regular-use and concentration areas, survey data were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We ran kernel density analyses to convert binned data into smoothed distribution data, then selected areas of repeated occurrence. In Alaska, the regular-use areas represent the 99% isopleth from a kernel density raster, using a search radius of 78 miles (125 km). For the concentration areas, we ran a 31-mile (50-km) kernel density analysis, then delineated density values that are 1 or more standard deviations above the project area mean density.

Because of the relative lack of survey data in Russia, concentration areas in Russia are often not known or depicted. Where there were gaps in survey coverage, such as in Russia, we buffered species' colony locations, using a buffer radius equal to the species' average maximum foraging distance (58 miles [94 km] for Horned Puffin; 62 miles [100 km] for Tufted Puffin (Lascelles 2008)). These two types of boundaries were combined to represent regular use across the project area.

High-concentration areas were represented using global Important Bird Areas (IBAs). In Russia and Canada, we used IBA data from BirdLife International (2017a) while IBAs in Alaska are from Audubon Alaska (2014). Because IBA boundaries often encompass multiple-species hotspots, in Alaska we also show single-species IBA core areas (Audubon Alaska 2015) to indicate high concentrations for each species (see Smith et al. 2014c).

Puffin colony data were downloaded from the Seabird Information Network (2011). This map represents the most recent or otherwise best estimate available for each colony location (see Smith et al. 2012). On the map, the size of each colony point represents the percent of the total population present at that colony. Total population was the sum of the abundance of the species across all colonies within the project area.

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines were based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. Puffins generally do not use the areas of Canadian waters in our project area. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting maps. There is little to no survey coverage in the Canadian and Russian portions of the project area, potentially leaving major data gaps for these species. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of these maps.

The colony data are available throughout the US and Russian portions of the project area, but data quality—survey dates and techniques—varies greatly between colonies. Colony sizes should be interpreted as estimates rather than precise counts.

Reviewers

- Nora Rojek
- Liz Labunski

MAP DATA SOURCES

HORNED PUFFIN MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a) and Seabird Information Network (2011)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Colonies: Seabird Information Network (2011)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

TUFTED PUFFIN MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a) and Seabird Information Network (2011)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

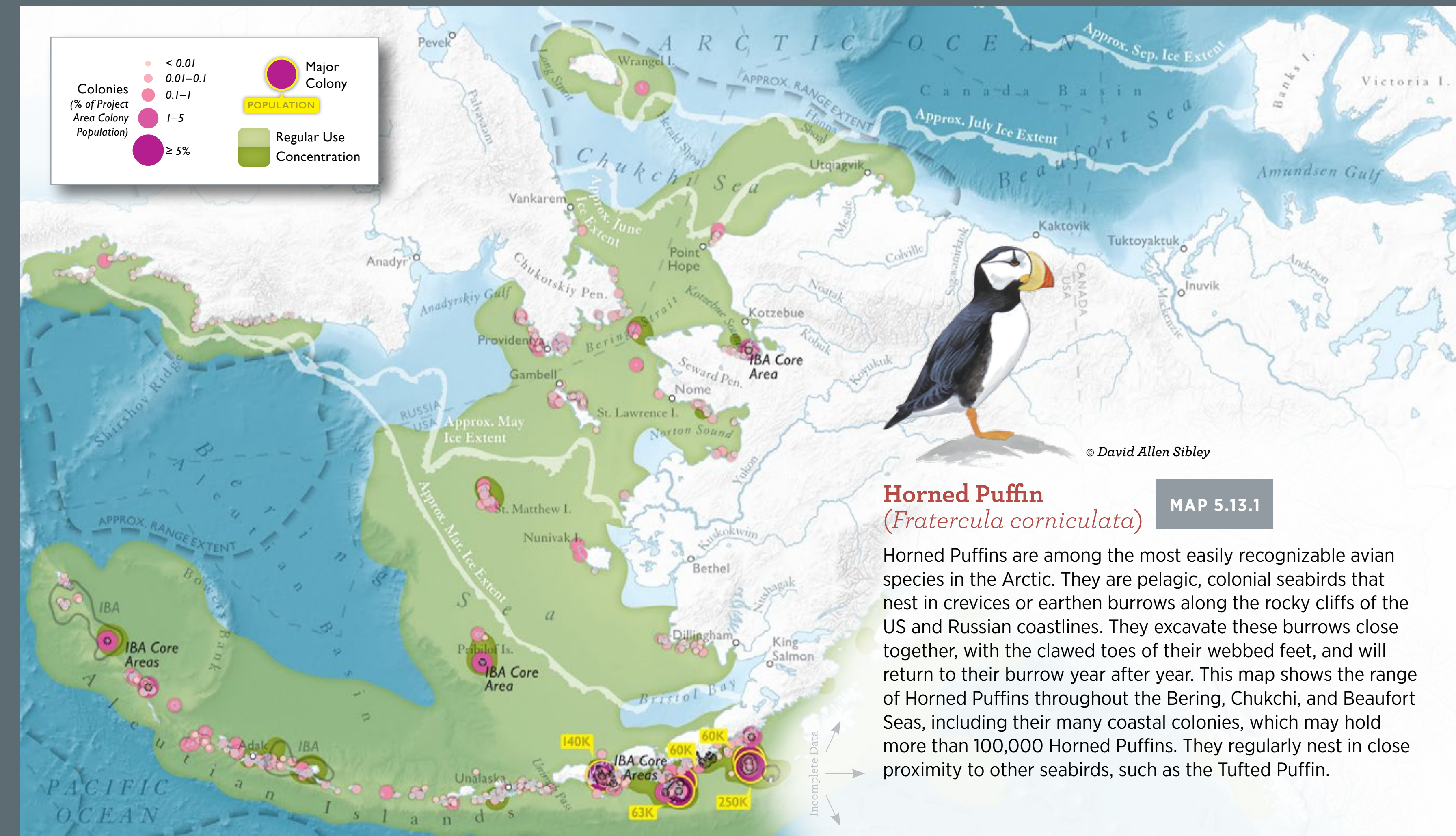
IBA Core Areas: Audubon Alaska (2015)

Colonies: Seabird Information Network (2011)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

Puffins

Audubon ALASKA



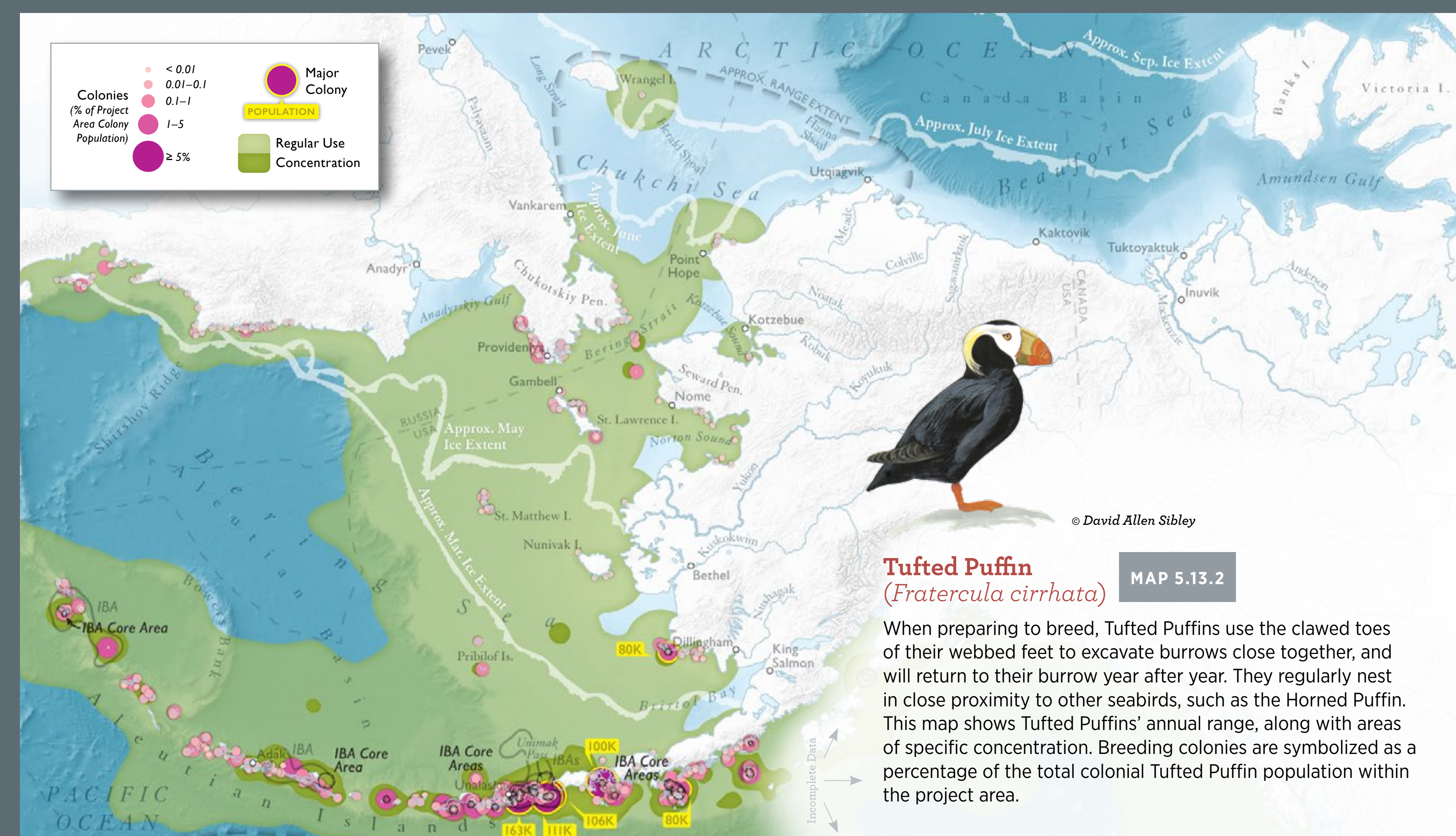
Horned Puffin
(Fratercula corniculata)

MAP 5.13.1

Horned Puffins are among the most easily recognizable avian species in the Arctic. They are pelagic, colonial seabirds that nest in crevices or earthen burrows along the rocky cliffs of the US and Russian coastlines. They excavate these burrows close together, with the clawed toes of their webbed feet, and will return to their burrow year after year. This map shows the range of Horned Puffins throughout the Bering, Chukchi, and Beaufort Seas, including their many coastal colonies, which may hold more than 100,000 Horned Puffins. They regularly nest in close proximity to other seabirds, such as the Tufted Puffin.

Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Seabird Information Network (2011)

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman



Tufted Puffin
(Fratercula cirrhata)

MAP 5.13.2

When preparing to breed, Tufted Puffins use the clawed toes of their webbed feet to excavate burrows close together, and will return to their burrow year after year. They regularly nest in close proximity to other seabirds, such as the Horned Puffin. This map shows Tufted Puffins' annual range, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial Tufted Puffin population within the project area.

Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Seabird Information Network (2011)

Auklets

Susan Culliney, Erika Knight, and Melanie Smith

Parakeet Auklet
Aethia psittacula

Crested Auklet
A. cristatella

Whiskered Auklet
A. pygmaea

Least Auklet
A. pusilla

Auklets are part of the Alcid family, which also includes murres, puffins, guillemots, and murrelets. Among the six species of auklets, the four *Aethia* species are the most closely related and have ranges in the Bering Sea and Arctic Ocean: Parakeet Auklet (*Aethia psittacula*), Crested Auklet (*A. cristatella*), Whiskered Auklet (*A. pygmaea*), and Least Auklet (*A. pusilla*). Of these four, Crested and Whiskered are most closely related, sharing traits such as a pungent citrus-like odor, forehead crests, and similar vocalizations (Jones 1993, Douglas et al. 2004). There are two other auklet species in Alaska: Cassin's Auklet (*Ptychoramphus aleuticus*) is in the same tribe as the *Aethia* species but only has limited breeding ranges in Alaska waters, while Rhinoceros Auklets (*Cerorhinca monocerata*) are actually more closely related to puffins. The remainder of this summary will, therefore, focus on the four closely related *Aethia* species that occupy the Bering, Chukchi, and (to a lesser degree) Beaufort Seas.

Auklets are enigmatic seabirds. They are characterized by elaborate facial feather ornamentation and complex courtship duets and dances, yet their showiness is contrasted by their mystery. Most of the data on auklets come from breeding colonies that congregate on rocky islands and coastlines. However, these are pelagic birds, only coming on land to breed, and quickly returning to their marine habitat following the nesting season. Fledging chicks leap from their natal cliffs and eagerly take to the sea. Much of the data on foraging behavior, migratory movements, and wintering range, therefore, remain poorly known or unknown, yet are critical to conservation of these species.

Males and females appear identical, differentiated primarily by size. Auklets are characterized by generally dark plumages, contrasted with striking white eyes, generally red bills, and conspicuous ornamental facial plumes, which vary by species. The Least Auklet has a knob on its bill and numerous bristly facial plumes that cluster around its auriculars and forehead. The Whiskered Auklet has two bright white facial streaks that form a handsome pattern along with the thin black plumes that curl up and over its bill. The Parakeet Auklet is relatively drab with a single prominent white facial streak extending from just behind its eye to the back of its head. The Crested Auklet is overall very dark, with a white streak extending from its eye toward the back of its head, and a prominent black puff of feathers curling over and beyond its bill.

These elaborate facial patterns and plumes in both sexes are probably the result of sexual selection. Birds with more prominent facial decoration are preferred by both sexes (Jones and Montgomerie 1992, Jones 1993). The particularly protruding feather plumes in Crested and Whiskered Auklets have also been proposed as a sensory adaptation, for navigating tight crevices in dark nesting burrows (Seneviratne and Jones 2008).

DISTRIBUTION

Counting auklets can be difficult and typically relies on estimating colony sizes, but biologists estimate there are about 16.5 million auklets nesting in this region (Seabird Information Network 2011). Even though they are present in the millions in these Arctic seas, they are not sea-ice inhabitants. Auklets shift their distribution during the winter, probably to avoid the advancing ice edge and to seek out winter foraging opportunities.

Migration

Auklet migration is poorly understood, but some movement must occur between terrestrial nesting sites and the species' pelagic lives during winter. Soon after their nesting duties are complete, auklets return to the sea. Jones et al. (2001) posit Parakeet Auklets move southward after the nesting season, where they remain dispersed over winter, and then return north. Recent tagging data appear to confirm this, with Parakeet Auklets moving from clusters around breeding colonies into more open waters of the eastern Bering Sea and North Pacific (Schacter and Robbins 2016). The tracking study also found Crested Auklets following a similar pattern away from breeding colonies during the winter, moving into concentrations in the Sea of Okhotsk, nestled between Japan and Russia, some time spent around Aleutian Islands, and into the Bering Strait and Chukchi Sea (Schacter and Robbins 2016). Whiskered Auklets, by contrast, may linger for a time on breeding islands, perhaps due to their wintering range remaining so close their nesting islands (Zubakin and Konyukhov 2001). Recent tracking data add confirmation, finding Whiskered Auklets remaining generally near their colony year-found (Schacter and Robbins 2016).

Wintering

In winter, the pelagic nature of auklets makes their non-breeding habits difficult to study. After leaving the colony in the fall, their movements in the Arctic Ocean are probably initially dictated by the extent of sea ice. The winter range of Parakeet Auklets is better documented than the others: in the early fall, Parakeet Auklets may roam as far north as Utqiaġvik (formerly Barrow), but overall the species quickly moves down into the Northern Pacific, and may go as far south as waters far offshore from Washington, Oregon, and California (Manning and MacPherson 1952, Gould and Piatt 1993, Rottenborn and Morlan 2000, Jones et al. 2001). Whiskered Auklets, by contrast, stay near breeding colonies in waters remaining free of ice (Troy and Bradstreet 1991, Byrd and Williams 1993b).

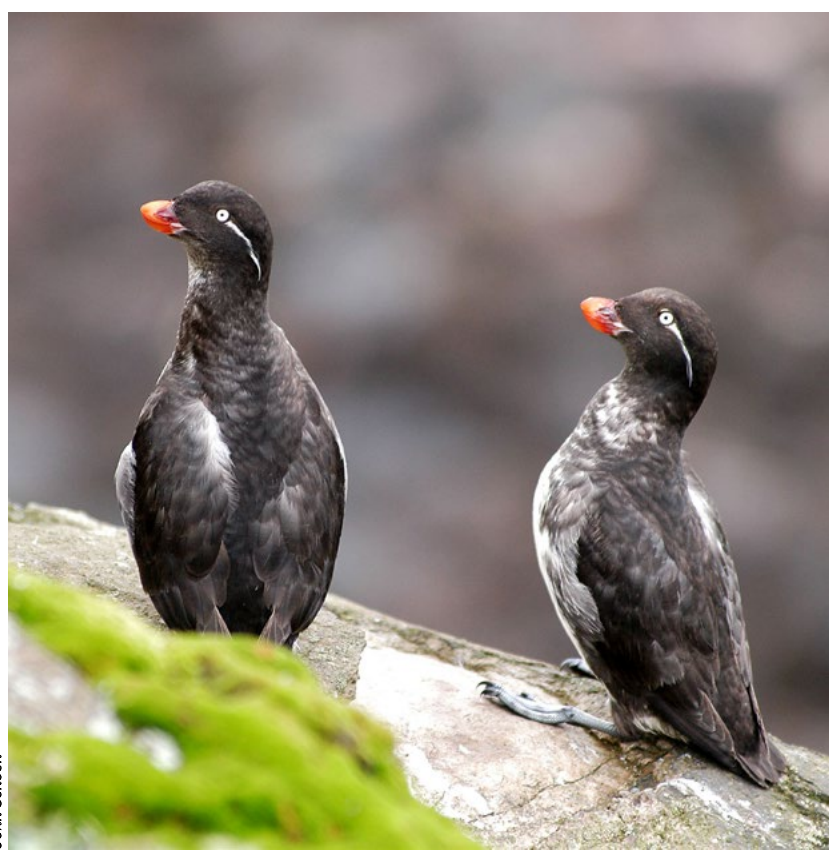
Species Description

Parakeet Auklet. The second largest of the four species considered here, the Parakeet Auklet is more "mild-mannered" and less colonial than other auklets. Compared to other auklet species, Parakeet Auklets have a small population size—500,000 to 1 million nesting across the region (Pollom et al. 2017). This species is the most widely dispersed of the auklets included in this summary. Breeding occurs on islands and rocky mainland coastlines in the Bering Sea, along the Aleutian chain, and in parts of Southeast Alaska (Jones et al. 2001). Presumably from the nearest colonies in the Bering Strait, birds regularly forage as far north as Barrow Canyon, with localized hotspots identified in Hope Basin and the Hanna Shoal region (Kuletz et al. 2015). However, Parakeet Auklets probably vacate the Chukchi and Bering Seas when sea ice forms and they migrate to points south, where they are regularly seen far offshore from Washington, Oregon, and California. Vagrants have even been found in the northwestern Hawaiian Islands.

Crested Auklet. Larger and more aggressive than the others, the Crested Auklet is also much more gregarious, congregating in colonies during the breeding season that can reach nearly a million pairs, and remaining in dense flocks even during the winter (Jones 1993). In total, an estimated 4.6 million Crested Auklets nest here—they are the second most abundant species in this region (Seabird Information Network 2011). They breed on rocky islands and rocky mainland coastlines in the Aleutian chain, the Alaska Peninsula, and as far north as the Bering Strait, including points in Russia (Jones 1993). Following the nesting season, they are found in high densities in the Chukchi Sea, especially the Hanna Shoal region, where they most likely undergo their wing molt in September (Kuletz et al. 2015). Many of these birds may be coming from southern colonies, migrating northward after chick-rearing (Kuletz et al. 2015). After sea ice moves in, their wintering range clusters to the north and south of the Aleutian chain.

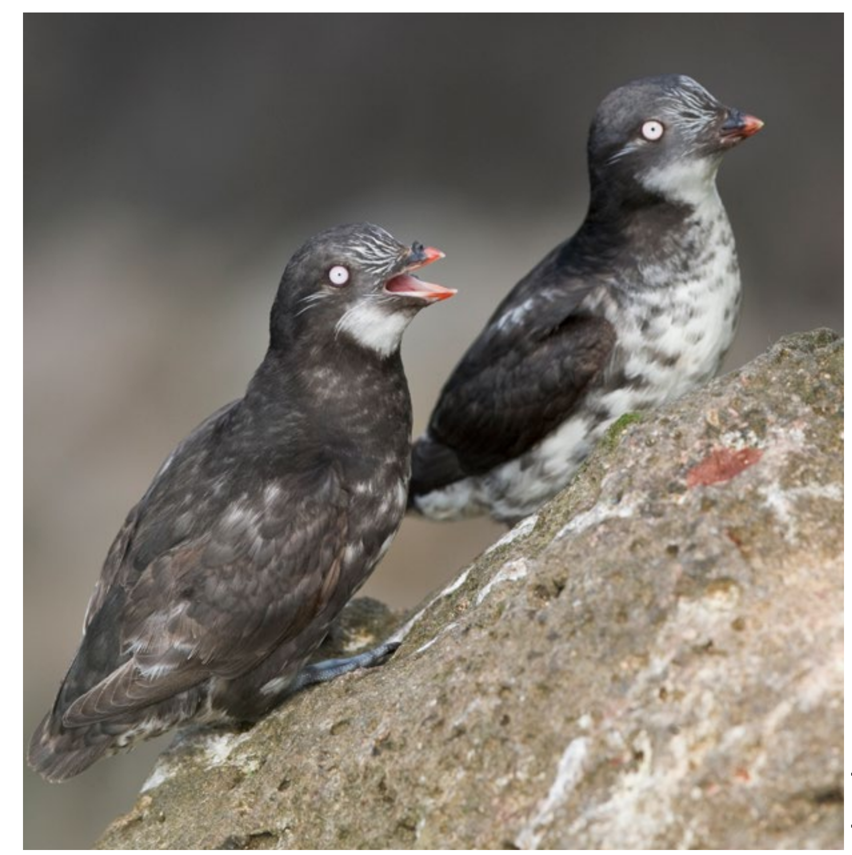
Whiskered Auklet. Secretive and nocturnal in its comings and goings from nest sites (Knudtson and Byrd 1982), the Whiskered Auklet is a less colonial species than its counterparts. Whiskered Auklets are endemic to this region with a total global population of only about 120,000 (Warnock 2017). They have a limited breeding range on select islands in the Aleutian chain, rarely wandering north of the Pribilof Islands (Byrd and Williams 1993b). Their winter range is not much different; they spend winter in waters near their breeding islands, as sea ice allows. Unlike other auklets, some Whiskered Auklet individuals continue to visit nesting habitat and nesting chambers during the wintering season (Zubakin and Konyukhov 2001).

Least Auklet. The smallest member of the Alcid family, the tiny Least Auklet is about the size of a chunky American Robin (*Turdus migratorius*) (Bond et al. 2013). This auklet species exhibits strong colonial and flocking tendencies and may be particularly susceptible to introduced rats, which killed large numbers of Least Auklets in some years on one island in the Aleutian chain (Major et al. 2006). Least Auklets are the most abundant and most densely packed species in this region, with nearly 8 million individuals present in only 35 breeding colonies


John Schoen
Parakeet Auklets.


Milo Burcham
Crested Auklet.


Nature Picture Library / Alamy Stock Photo
Whiskered Auklet.


Milo Burcham
Least Auklets.

5.14 AUKLETS MAPS ON PAGES 186–187

TABLE 5.14-1. Auklet life history characteristics and conservation status. Sources: Byrd and Williams (1993b), Jones (1993), Jones et al. (2001), Bond et al. (2013), Warnock (2017).

	Parakeet Auklet *Aethia psittacula*	Crested Auklet *A. cristatella*	Whiskered Auklet *A. pygmaea*	Least Auklet *A. pusilla*
Body Size Mass Length	**M** 8–12 ounces (230–350 g) **L** 9–10 inches (23–26 cm)	**M** 7–11 ounces (200–325 g) **L** 7–8 inches (18–20 cm)	**M** 3–5 ounces (90–150 g) **L** 6–7 inches (17–19 cm)	**M** 2–3 ounces (60–90 g) **L** 4–5 inches (12–14 cm)
Maximum Life Span (wild)	Unknown	8 years	Unknown	4.5 years
Clutch Size Range Average	**R** 1 egg **A** 1 egg	**R** 1 egg **A** 1 egg	**R** 1 egg **A** 1 egg	**R** 1 egg **A** 1 egg
Nest-Water Proximity	<650–800 feet (200–250 m) above sea level	Colonial cliff nester	Colonial cliff nester	Colonial cliff nester
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Not Listed	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Not Listed	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Yellow List	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Not Listed
Population Global Alaska	**G** 1.2 million **A** 1 million	**G** 8.2 million **A** 2 million	**G** 121,000 **A** 116,000	**G** 30 million **A** 9 million
Breeding Season Eggs Young	**E** Mid-May to July **Y** Mid-June to mid-September	**E** May to July **Y** Late June to early September	**E** May to mid-June **Y** June to early September	**E** May to mid-July **Y** Mid-June to early September
Migration Spring Molt Fall	**S** March to May **M** June to November **F** Mid-August to November	**S** Late March to mid-May **M** June to October **F** August to October	**S** April to May **M** June to October **F** Late July to early September	**S** March to June **M** June to October **F** Mid-July to November

(Seabird Information Network 2011). They breed on rocky coastlines and islets in the Bering Sea and along the Aleutian chain. The largest colony in the project area, Big Diomede Island, Russia, is home to 2 million Least Auklets (Seabird Information Network 2011). From this and other nesting colonies, these birds range into the Chukchi and Beaufort Seas during summer and fall with localized hotspots identified in the Hope Basin and Hanna Shoal in summer and fall (Kuletz et al. 2015). In the winter, some birds remain near breeding sites as sea ice allows, but others may head south into the North Pacific (Sydeman et al. 2010, Bond et al. 2013).

LIFE CYCLE

Auklets are colonial breeders. Crested and Least are more vocal and gregarious than Whiskered and Parakeet. Colonies regularly include mixed *Aethia* and other seabird species. Where *Aethia* species overlap, there can be some competition for nest sites, with Crested and Parakeet both dominant over Whiskered, and with all three usually displacing the relatively tiny Least Auklet (Knudtson and Byrd 1982). However, the variation in sizes between these species also allows for niche differentiation into a range of nest cavity sizes.

Auklets do not build a nest, but instead lay their single egg per season directly on the substrate, in rocky cavities on talus slopes and rocky cliffs, with varying levels of bare and vegetated microterrain (Byrd et al. 1993, Byrd and Williams 1993b, Hipfner and Byrd 1993, Jones 1993, Jones et al. 2001, Bond et al. 2013). The size of the cavity chamber and entrance vary by species size. Colonies of Crested Auklets occur on both islands and mainland coastlines of Alaska and Russia; Parakeet and Least Auklets occur on islands in Alaska and also along certain mainland coastlines in Russia. Whiskered Auklets are limited to islands (Seabird Information Network 2011).

All four of these auklet species exhibit conspicuous visual and vocal displays at nesting colonies, using a variety of chirps, whinnies, and cackles, as well as courtship dance moves (Byrd and Williams 1993b, Jones 1993, Jones et al. 2001, Bond et al. 2013). Particularly large colonies can create a tremendously loud roar (Bond et al. 2013) that can be heard from some distance. Auklet pairs primarily display on land, while copulation takes place on the water (Jones et al. 2001, Bond et al. 2013).

Both Crested and Whiskered Auklets have an unusual citrus-like smell, which is thought to act as a parasite repellant and mate attractant (Beier and Wartzok 1979, Douglas et al. 2001, Douglas et al. 2004, Douglas 2008). During courtship, Crested Auklet pairs anoint each other with this scent, thus transferring ectoparasite repellent between partners (Douglas 2008). Birds that smell more strongly, and therefore have more scent to share, are more sexually attractive to potential partners (Jones 1993, Douglas et al. 2004).

Prior to fledging, chicks will exit their nest chamber to practice flapping and strengthen their new wing muscles; the whirring of thousands of chick wings in a dense Crested Auklet colony has been notably audible to some researchers (Jones 1993). Chicks leaving nests apparently fly directly out to sea and move offshore to begin immediately fending for themselves; those that fall short in the initial flight are susceptible to predation (Jones et al. 2001, Bond et al. 2013).

Diet

Auklets are agile divers that forage on the open ocean, using their wings to propel themselves underwater in pursuit of prey. Crested, Whiskered, and Least Auklets forage on marine zooplankton, with *Neocalanus* copepods and euphausiids being common prey (Bédard 1969, Piatt et al. 1990c, Troy and Bradstreet 1991, Byrd and Williams 1993b, Jones 1993, Bond et al. 2013). The Parakeet Auklet's special conical bill is thought to be adapted to feeding on zooplankton and crustaceans, and even small fishes that cluster around jellyfish tentacles (Jones et al. 2001). However, in using this foraging tactic, Parakeet Auklets are also apparently susceptible to ingesting plastic particles that cluster around jellyfish and mimic prey items (Jones et al. 2001). Auklet diets during the non-breeding season are not well studied.

Auklet foraging focuses on areas where water currents bring prey items into greater concentration, and the four species appear somewhat differentiated in their foraging microhabitats. Parakeet Auklets feed in turbulent tidal areas (Hunt et al. 1993, Hunt et al. 1998). Whiskered Auklets favor well-mixed waters (Haney 1991), where currents converge near islands (Byrd and Gibson 1980). Least and Crested Auklets forage in deeper waters that are stratified, where upwelling brings prey to the surface (Haney 1991, Hunt et al. 1993, Jones 1993, Bond et al. 2013), but Crested Auklets probably seek deeper concentrations of prey (Jones 1993).

Parakeet Auklet in flight.

Milo Burcham

CONSERVATION ISSUES

These auklets are all species of least concern under the International Union for the Conservation of Nature (IUCN) Red List and are not listed under the US Endangered Species Act because of its restricted distribution and reliance on Alaska waters, Whiskered Auklets are on Audubon Alaska's Yellow List, indicating a vulnerable population (Warnock 2017). As migratory birds, auklets are protected in the US by the broad-sweeping Migratory Bird Treaty Act of 1918, which gains its impact through several international treaties between the US and Canada, Russia, and Japan. The remote breeding islands and isolated coastlines favored by auklet breeding colonies afford a de facto measure of protection for these species. The Alaska Maritime National Wildlife Refuge covers much of the auklet breeding range in the US.

The amount of time these birds spend far at sea, coupled with their remote island breeding habitat, means these species are well removed from most direct human impacts. Limited subsistence take of birds and eggs continues to take place today (Jones 1993, Jones et al. 2001, Bond et al. 2013), but with no known impact on populations. Most negative impacts from humans are instead indirect in nature.

Auklets are prey to large falcons, owls, Common Ravens (*Corvus corax*), gull species, and Arctic foxes (*Vulpes lagopus*), with Whiskered Auklets probably particularly vulnerable due to their terrestrial presence during the winter (Williams et al. 2003). Parakeet, Crested, and Least Auklets have even been found in the stomachs of fish such as Pacific halibut (*Hippoglossus stenolepis*) and cod. Where these predators are found naturally, auklet populations can persist (Jones et al. 2001). But introductions of predators to islands where they did not normally occur can devastate or even extirpate the local auklet populations (Murie 1959, Bailey 1993, Bailey and Kaiser 1993, Jones 1993). However, different auklet populations may be able to withstand some introduced predation pressure (Bond et al. 2013). Unlike foxes and avian predators, rats can access nesting chambers within rocky crevices. Introduced Norway rats (*Rattus norvegicus*) killed large numbers of Least Auklets on Kiska Island (Bond et al. 2013). By far, the accidental introduction of Norway rats by humans may represent the biggest threat to breeding auklet populations (Jones 1993, Bond et al. 2013).

Human marine activity can also cause harm to auklets. For instance, the lights of fishing vessels can be fatally attractive (Dick and Donaldson 1978, Byrd and Williams 1993b, Jones 1993, Bond et al. 2013); bright lights of one vessel attracted 6,000 Crested Auklets to the boat, with a high mortality rate (Dick and Donaldson 1978). Auklets also comprise a significant percentage of the drowned seabird bycatch in offshore gillnets and driftnets (DeGange and Day 1991). Commercial fishing may also have trophic impacts, but the exact effects are uncertain (Bond et al. 2013).

Marine pollution is another threat. Oil spills may represent an acute threat to Crested and Whiskered Auklets, due to the dense flocking behavior exhibited by these species (Byrd and Williams 1993b, Jones 1993). Auklets were among those birds oiled and killed by the 1989 *Exxon Valdez* oil spill (Jones et al. 2001). Parakeet Auklets are also susceptible to plastic pollution, as their particular foraging tactic seeks small prey among jellyfish tentacles and may confuse small plastic pieces for prey (Robards et al. 1995, Jones et al. 2001). However, Parakeet Auklet chicks do not appear to be at risk of plastic ingestion, probably because adults feed chicks undigested prey items rather than regurgitated meals (Bond et al. 2010). The long-term population impacts of plastics on auklets are not well understood.

Both climate change and natural variation in breeding and marine habitat could have an impact on auklet populations. Foraging niches, dependent on water columns and currents, could make these species vulnerable to climate change, which may cause dramatic shifts in marine hydrography and productivity (Jones et al. 2002, Bond et al. 2010, Wolf et al. 2010). Populations also appear strongly tied to terrestrial breeding habitat. Auklets' coastal rocky habitat may decline as vegetation takes over talus slopes (Roby and Brink 1986), but erosion and volcanic activity can also create new habitat (Sowls et al. 1978), perhaps setting a basic equilibrium (Jones et al. 2001), although continued conservation of auklets may require ensuring fresh habitat does consistently exist (Stephensen and Irons 2003).

MAPPING METHODS (MAPS 5.14.1–5.14.4)

We categorized distribution into four main categories of intensity: extent of range, regular use, concentration, and high concentration. The extents of range for auklets were drawn by buffering all known occurrences of each species using data from Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a), eBird (2015), and the Seabird Information Network (2011). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. For each species, observations from these data sources were then buffered with a 62-mile (100-km) radius and merged. In some cases, inconsistencies were manually edited and smoothed.

To determine regular-use and concentration areas, survey data were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We ran kernel density analyses to convert binned data into smoothed distribution data, then selected areas of repeated occurrence. In Alaska, the regular-use areas represent the 99% isopleth from a kernel density raster, using a search radius of 78 miles (125 km). For the concentration areas, we ran a 31-mile (50-km) kernel density analysis, then delineated density values that are 1 or more standard deviations above the project area mean density.

Because of the relative lack of survey data in Russia, concentration areas in Russia are often not known or depicted. Where there were gaps in survey coverage, such as in Russia, we buffered species' colony locations, using a buffer radius equal to the species' average maximum foraging distance (58 miles [94 km] for Crested Auklets and 44 miles [71 km] for Least Auklets (Lascelles 2008)); information regarding the average maximum foraging distance for Parakeet Auklets and Whiskered Auklets was not available, so the average of the foraging radii for Crested Auklets and Least Auklets (51 miles [82 km]) was used. These two types of boundaries were combined to represent regular use across the project area.

High-concentration areas were represented using global Important Bird Areas (IBAs). In Russia and Canada, we used IBA data from BirdLife International (2017a) while IBAs in Alaska are from Audubon Alaska (2014). Because IBA boundaries often encompass multiple-species hotspots, in Alaska we also show single-species IBA core areas (Audubon Alaska 2015) to indicate high concentrations for each species (see Smith et al. 2014c).

Auklet colony data were downloaded from the Seabird Information Network (2011) and, where such information was known, updated based on publications by Artukhin et al. (2016), Konyukhov et al. (1998), or Vyatkin (2000). These maps represent the most recent or otherwise best estimate available for each colony location (see Smith et al. 2012). On the map, the size of each colony point represents the percent of the total population present at that colony. Total population was the sum of the abundance of the species across all colonies within the project area.

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines were based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. Auklets generally do not use the areas of Canadian waters in our project area. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting maps. There is little to no survey coverage in the Russian portion of the project area, potentially leaving major data gaps for these species. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of these maps.

The colony data are available throughout the US and Russian portions of the project area, but data quality—survey dates and techniques—varies greatly between colonies. Colony sizes should be interpreted as estimates rather than precise counts. Note that just over 4,000 Whiskered Auklets are accounted for in the breeding colony catalog (Seabird Information Network 2011), out of a total estimated population of approximately 120,000 birds. Therefore, the largest breeding colonies shown may not be the largest that exist for that species.

Reviewer

• Heather Renner

MAP DATA SOURCES

PARAKEET AUKLET MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a), Seabird Information Network (2011), and Vyatkin (2000)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2015) and Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Colonies: Seabird Information Network (2011); Vyatkin (2000)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

CRESTED AUKLET MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Artukhin et al. (2016), Audubon Alaska (2016a), Konyukhov et al. (1998), Seabird Information Network (2011), and Vyatkin (2000)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2015) and Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Colonies: Artukhin et al. (2016); Konyukhov et al. (1998); Seabird Information Network (2011); Vyatkin (2000)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

WHISKERED AUKLET MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a) and Seabird Information Network (2011)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2015) and Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Colonies: Seabird Information Network (2011)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

LEAST AUKLET MAP

Extent of Range: Audubon Alaska (2016c) based on Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)

Regular Use: Audubon Alaska (2016c) based on Artukhin et al. (2016), Audubon Alaska (2016a), Konyukhov et al. (1998), Seabird Information Network (2011), and Vyatkin (2000)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2015) and Audubon Alaska (2016a)

IBAs: Audubon Alaska (2014); BirdLife International (2017a)

IBA Core Areas: Audubon Alaska (2015)

Colonies: Artukhin et al. (2016); Konyukhov et al. (1998); Seabird Information Network (2011); Vyatkin (2000)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

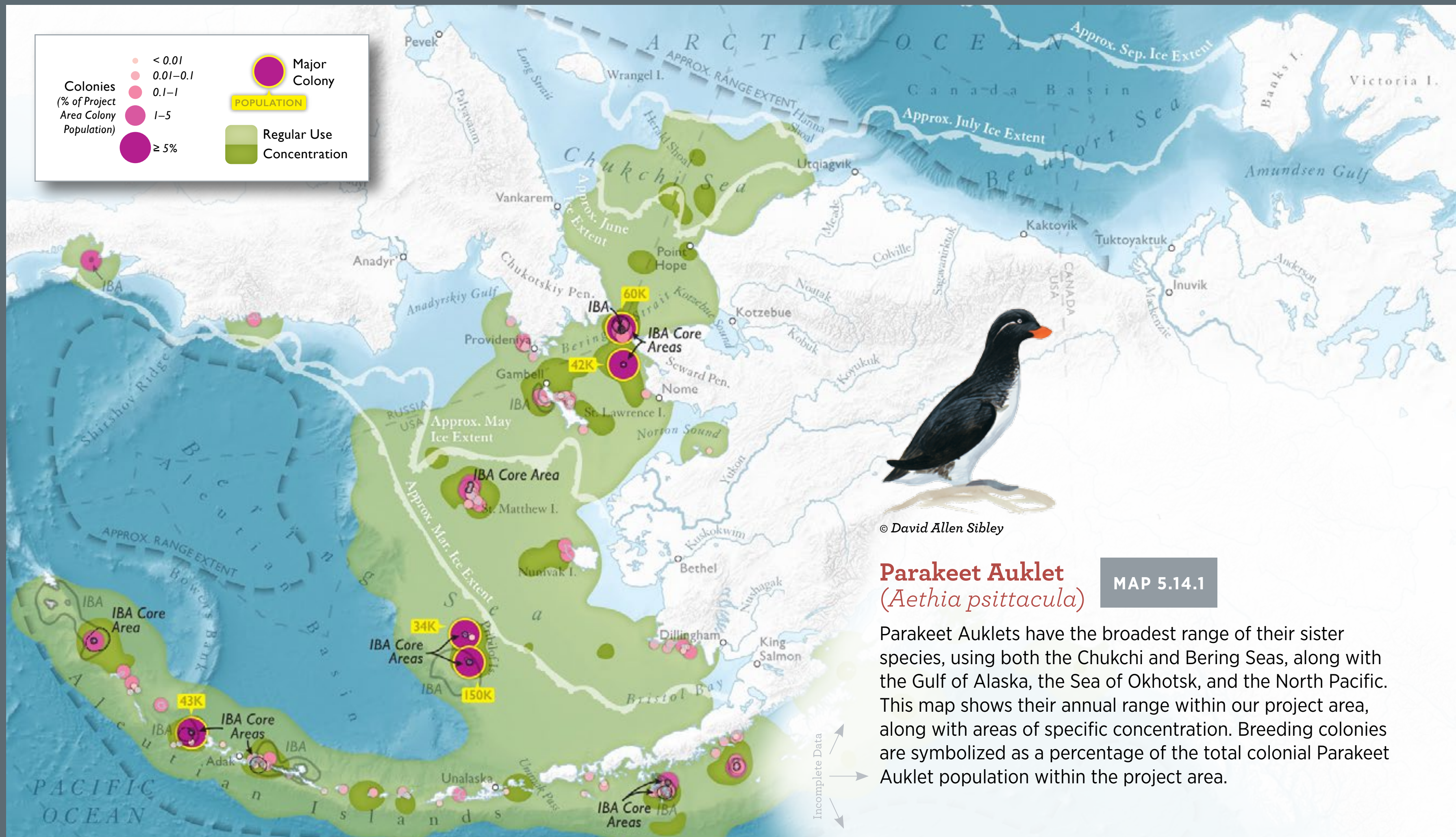
5.14 AUKLETS MAPS ON PAGES 186–187

Auklets, like other Alcids, use their large, webbed feet to propel themselves through the water. When perched on land, they rest on their tarsi instead of on their toes (metatarsi) like other perching birds. Pictured is a perched Crested Auklet.

Milo Burcham

Auklets

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman

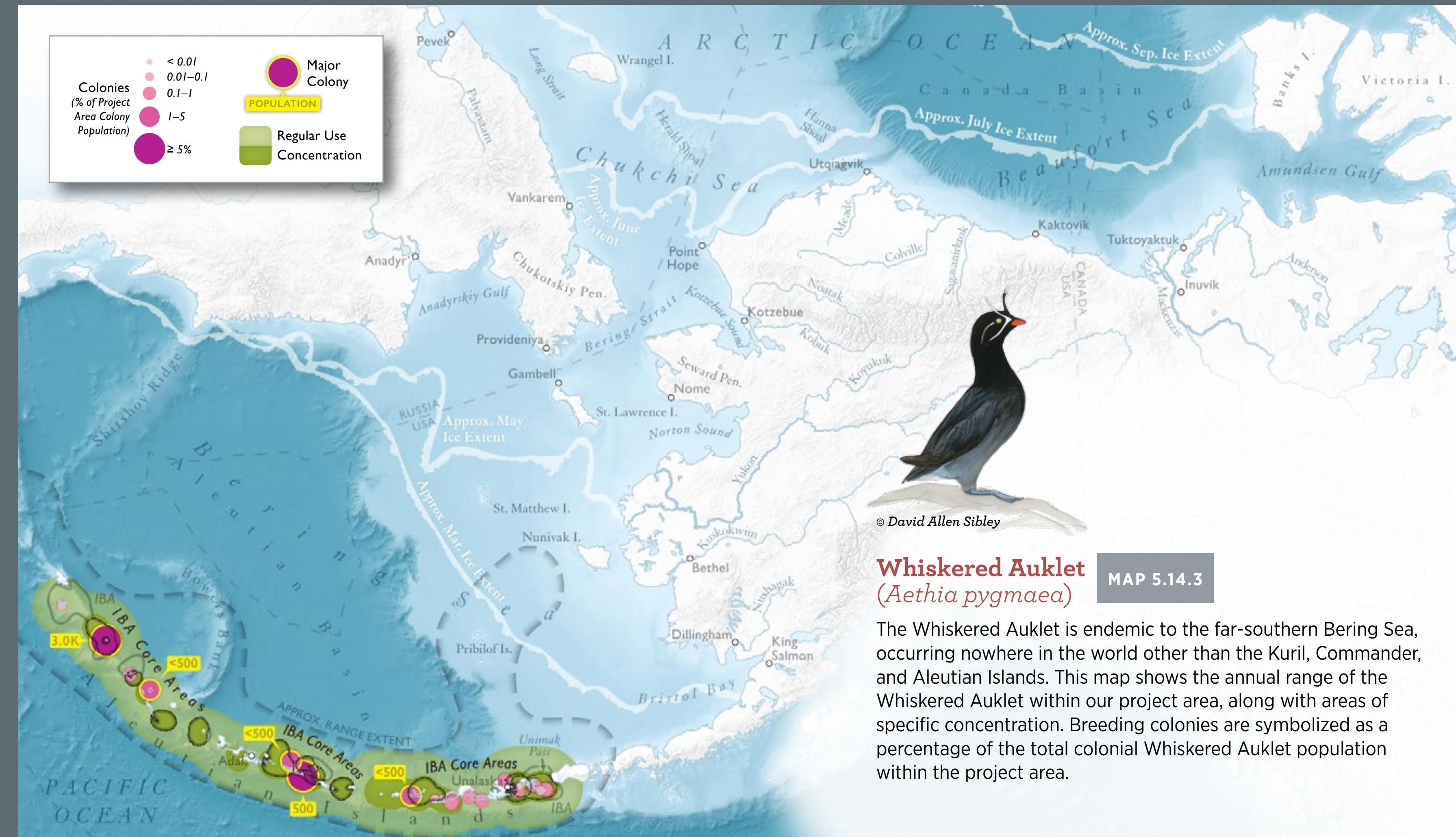


Parakeet Auklet
(Aethia psittacula)

MAP 5.14.1

Parakeet Auklets have the broadest range of their sister species, using both the Chukchi and Bering Seas, along with the Gulf of Alaska, the Sea of Okhotsk, and the North Pacific. This map shows their annual range within our project area, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial Parakeet Auklet population within the project area.

Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2015), Audubon Alaska (2016a), eBird (2015), Seabird Information Network (2011), and Vyatkin (2000)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Seabird Information Network (2011); Vyatkin (2000)



Whiskered Auklet
(Aethia pygmaea)

MAP 5.14.3

The Whiskered Auklet is endemic to the far-southern Bering Sea, occurring nowhere in the world other than the Kuril, Commander, and Aleutian Islands. This map shows the annual range of the Whiskered Auklet within our project area, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial Whiskered Auklet population within the project area.

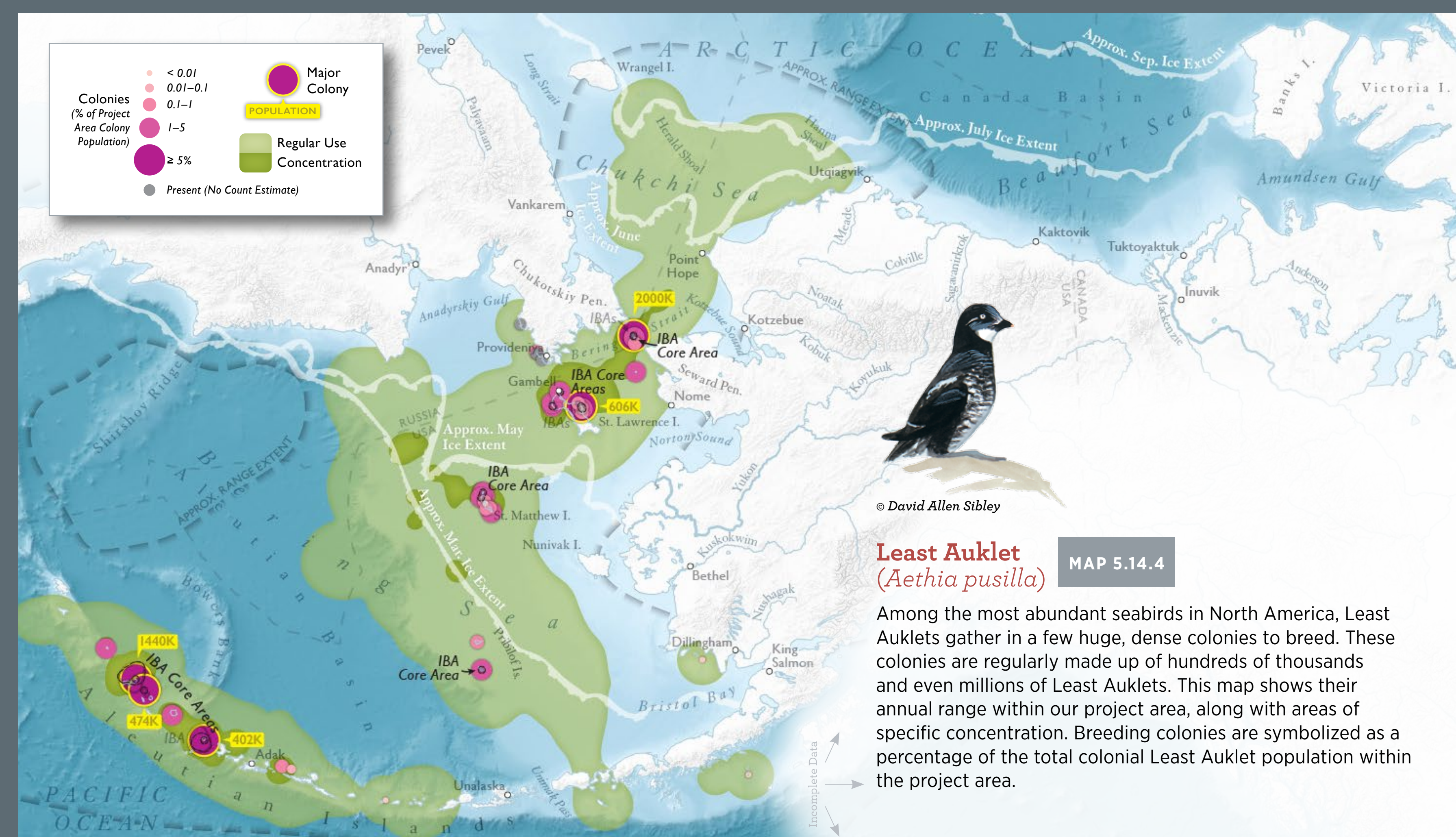
Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2015), Audubon Alaska (2016a), eBird (2015), and Seabird Information Network (2011)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Seabird Information Network (2011)

Crested Auklet
(Aethia cristatella)

MAP 5.14.2

Crested Auklets are colonial-nesting seabirds of the Bering Sea. They engage in intricate and elaborate courtship in their colonies, among hundreds of thousands of other auklet pairs. This map shows their range within our project area, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial Crested Auklet population within the project area.

Artukhin et al. (2016); Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Artukhin et al. (2016), Audubon Alaska (2015), Audubon Alaska (2016a), eBird (2015), Konyukhov et al. (1998), Seabird Information Network (2011), and Vyatkin (2000)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Konyukhov et al. (1998); Seabird Information Network (2011); Vyatkin (2000)



Least Auklet
(Aethia pusilla)

MAP 5.14.4

Among the most abundant seabirds in North America, Least Auklets gather in a few huge, dense colonies to breed. These colonies are regularly made up of hundreds of thousands and even millions of Least Auklets. This map shows their annual range within our project area, along with areas of specific concentration. Breeding colonies are symbolized as a percentage of the total colonial Least Auklet population within the project area.

Artukhin et al. (2016); Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Artukhin et al. (2016), Audubon Alaska (2015), Audubon Alaska (2016a), eBird (2015), Konyukhov et al. (1998), Seabird Information Network (2011), and Vyatkin (2000)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; BirdLife International (2017a); Konyukhov et al. (1998); Seabird Information Network (2011); Vyatkin (2000)

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Short-tailed Albatross

Phoebastria albatrus

Nils Warnock, Erika Knight, and Melanie Smith

As ponderous on land as they are graceful in the air, Short-tailed Albatrosses (*Phoebastria albatrus*) are regular visitors to Alaska waters. In the late 1800s, global populations were estimated to be in the hundreds of thousands to millions (Hasegawa and DeGange 1982), and these global wind travelers were reportedly seen and eaten regularly by local communities in the Bering Sea region (Nelson et al. 1887, Gabrielson and Lincoln 1959, Murie 1959, Yesner and Aigner 1976). However, plumage hunters decimated the breeding colonies in Japan at the turn of the century (Hasegawa and DeGange 1982), and by the 1950s, ornithologists in Alaska were suggesting that the birds were nearly extinct or extinct (Gabrielson and Lincoln 1959, Murie 1959). While still numerically rare, populations are climbing back from the precipitously low number of 50–60 birds (Kuro-o et al. 2010). Since the early 2000s, sightings have been increasing in Alaska, with a population today of nearly 500 birds (Kuletz et al. 2014). Aside from their breeding grounds, few other regions are as important to Short-tailed Albatrosses as the upwelling waters on either side of the Aleutian chain and Alaska Peninsula (Piatt et al. 2006, Suryan et al. 2007).

Like all albatrosses, the Short-tailed Albatross is adapted to life on the wing at sea, with long, slender wings, relatively light bodies, and ability to dynamically soar (Suryan et al. 2008, Sachs et al. 2013). Medium in size and body mass, Short-tailed Albatrosses have especially high wing-loading relative to other albatrosses that may limit their use of the Central Pacific and other open-ocean areas of low wind speed and productivity in favor of more productive coastal upwelling systems (Suryan et al. 2008).

DISTRIBUTION

For seabirds like albatrosses that have a long maturation period and a long breeding season (Weimerskirch 1992, Finkelstein et al. 2010), migration and wintering periods often overlap (Croxall et al. 2005). The non-breeding period for adult Short-tailed Albatrosses may only last for three to four months. Some Short-tailed Albatrosses may not reproduce until they are six years old, spending those years away from the breeding grounds on the open water; some of these non-breeding birds will return to the breeding colony (especially birds four years and older) for periods of time (Hasegawa and DeGange 1982, McDermond and Morgan 1993). Likewise, around 20% of adult birds forgo breeding in any given year (US Fish and Wildlife Service 2008c, Finkelstein et al. 2010, R. Suryan pers. comm.). Short-tailed Albatrosses are not typically known to associate with sea ice, although Murie (1959) cites an early Alaskan explorer who noted that St. Lawrence communities often caught very fat albatross on the sea ice near the island.

LIFE CYCLE

Short-tailed Albatrosses are monogamous with about an eight-month breeding cycle (US Fish and Wildlife Service 2008c). Like all albatrosses, the age of first breeding is quite delayed, and for Short-tailed Albatrosses, the average is six years (Finkelstein et al. 2010). This species breeds on islands in Japan, although in recent years, at least one pair has successfully bred on Midway Atoll (VanderWerf 2012). In Japan, about 80% of all Short-tailed Albatrosses flock to the largest colony on Torishima Island in the Izu Islands, with smaller numbers in the Senkaku Islands (VanderWerf 2012). Birds begin arriving at breeding colonies in early October, and successful breeders and fledglings leave the islands in late May to June (Hasegawa and DeGange 1982, McDermond and Morgan 1993).

Migration

Post-breeding dispersal to non-breeding areas is rapid (McDermond and Morgan 1993, R. Suryan pers. comm.). For birds that move away from the breeding colonies in Japan, the most common destination is Alaska, along continental shelf margins and areas of upwelling in passes among the Aleutian Islands (Piatt et al. 2006, Kuletz et al. 2014). Distribution patterns for different ages and sexes of Short-tailed Albatross are distinct but overlap at times, with post-breeding female adult birds staying longer in Japanese and Russian waters than males. Juveniles and subadults are more likely to occur along the continental shelf off western North America, and rarely as far south as Mexico (Suryan et al. 2007, US Fish and Wildlife Service 2008c, VanderWerf 2012). There are few records of this species north of St. Lawrence Island (US Fish and Wildlife Service 2008c), although they have been documented in the Chukchi Sea (Day et al. 2013). Movements and concentration areas away from the breeding colonies are generally focused on where food, especially squid, is concentrated and accessible (Kuletz et al. 2014).

Diet

In general, albatrosses snatch fish, fish eggs, squid, and occasionally crustaceans ranging in length from <0.1 to 40 inches (0.1 to 100 cm) from the top water layer (Cherel and Klages 1998, US Fish and Wildlife Service 2008c). They closely associate with commercial fishing fleets, where the birds grab fish and offal produced by these fishing activities (Melvin et al. 2001, Dietrich and Melvin 2007, Suryan et al. 2007, US Fish and Wildlife Service 2008c).

Short-tailed Albatrosses have long, slender wings and light bodies which are well-suited for life on the wing.

John Schoen

MAP ON PAGE 190

TABLE 5.15-1. Short-tailed Albatross life history characteristics and conservation status. Sources: Suryan et al. (2007), US Fish and Wildlife Service (2008c), Warnock (2017).

	Short-tailed Albatross *Phoebastria albatrus*
Body Size Mass Length Wingspan	 **M** 9.5–18.7 pounds (4.3–8.5 kg) **L** 37 inches (94 cm) **W** 90 inches (228 cm)
Maximum Life Span (wild)	45+ years
Clutch Size Range Average	 **R** 1 egg **A** 1 egg
Nest-Water Proximity	Nests on ocean islands
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	 **ESA:** Endangered **IUCN:** Vulnerable **WL:** Red List
Population Global Alaska	 **G** 4,350 **A** 500
Breeding Season Eggs Young	 **E** October to December **Y** January to June
Migration Spring Molt Fall	 **S** May to June **M** June to September **F** September to October

CONSERVATION ISSUES

Since July 31, 2000, the Short-tailed Albatross has been federally listed as endangered in the US under the Endangered Species Act and is currently (2014) under a five-year review. Since 2008, there is also a joint US/Japan Recovery Plan and Team (US Fish and Wildlife Service 2008c). In Canada, the species is covered under the Migratory Bird Convention Act and is listed as threatened (Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2013). The Short-tailed Albatross is also a protected species under the 13-country Agreement on the Conservation of Albatrosses and Petrels (ACAP). While the US is an observer nation under ACAP, it is currently not a ratified member (Agreement on the Conservation of Albatrosses and Petrels 2009). The Short-tailed Albatross is on the Red List of Audubon Alaska's WatchList because of its depressed population status (Warnock 2017).

With the majority of the global population of Short-tailed Albatrosses thought to be nesting on Torishima Island (note that the Senkaku Islands breeding population has not been surveyed since 2002), anything that negatively affects that island's ecosystem is of management concern. One major concern is the island's active volcano, which in the past decade has erupted three times (1902, 1939, and 2002), causing loss of breeding habitat due to lava flows in some years (Hasegawa and DeGange 1982, Finkelstein et al. 2010). As a consequence, translocation efforts to other islands have been undertaken with some success (Deguchi et al. 2012, Deguchi et al. 2014). For many albatross species, ingestion of plastics is a problem, and 7 of the 11 Short-tailed Albatross chicks examined in one study had eaten plastic (McDermond and Morgan 1993, H. Hasegawa pers. comm.). In Alaska's waters, a significant management concern has been the bycatch of Short-tailed Albatross by certain commercial fisheries, particularly longline fisheries (Gilman 2003), although the US recovery plan notes only 17 cases of this species taken by commercial fishing activities since 1988 (US Fish and Wildlife Service 2014a). For an extensive list of management concerns, see US Fish and Wildlife Service (2008c) and Phillips et al. (2016).

MAPPING METHODS (MAP 5.15)

We categorized distribution into three main categories of intensity: extent of range, regular use, and concentration. The extent of range was drawn by buffering all known occurrences of Short-tailed Albatross using data from Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a), eBird (2015), and data downloaded from Ocean Biographic Information System-Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) (Geernaert 2004, Halpin et al. 2009, Geernaert 2012, Hyrenbach et al. 2013), and satellite telemetry data (Suryan et al. 2006b, Suryan et al. 2007, Suryan et al. 2008, Suryan and Fischer 2010, Deguchi et al. 2014). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Individual spatial outliers were removed if the observation was not within 62 miles (100 km) of another observation. Short-tailed Albatross observations from these data sources were then buffered with a 62-mile (100-km) radius and merged. In some cases, inconsistencies were manually edited and smoothed.

To determine regular-use and concentration areas, survey data were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We ran kernel density analyses to convert binned data into smoothed distribution data, then selected areas of repeated occurrence. In Alaska, the regular-use areas represent the 99% isopleth from a kernel density raster, using a search radius of 78 miles (125 km), which was then merged with a 50% core area delineated by O'Connor (2013) from satellite telemetry data described in Suryan et al. (2006b), Suryan et al. (2007), Suryan et al. (2008), Suryan and Fischer (2010), and Deguchi et al. (2014). For the concentration areas, we ran a 31-mile (50-km) kernel density analysis, then delineated density values that are 1 or more standard deviations above the project area mean density.

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines are based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. Short-tailed Albatrosses do not use Canadian waters. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting map. There is little to no survey coverage in the Russian portions of the project area, potentially leaving major data gaps for this species. Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of this map. The range and regular-use polygons are based in part on this mostly US observation data, but also incorporate satellite telemetry data from a study of more than 50 birds tagged in Japan.

Reviewer

- Robert Suryan

MAP DATA SOURCES

Extent of Range: Audubon Alaska (2016e) based on Audubon Alaska (2016a), Deguchi et al. (2014), eBird (2015), Geernaert (2004, 2012), Hyrenbach et al. (2013), Suryan et al. (2006b, 2007, 2008), and Suryan and Fischer (2010)

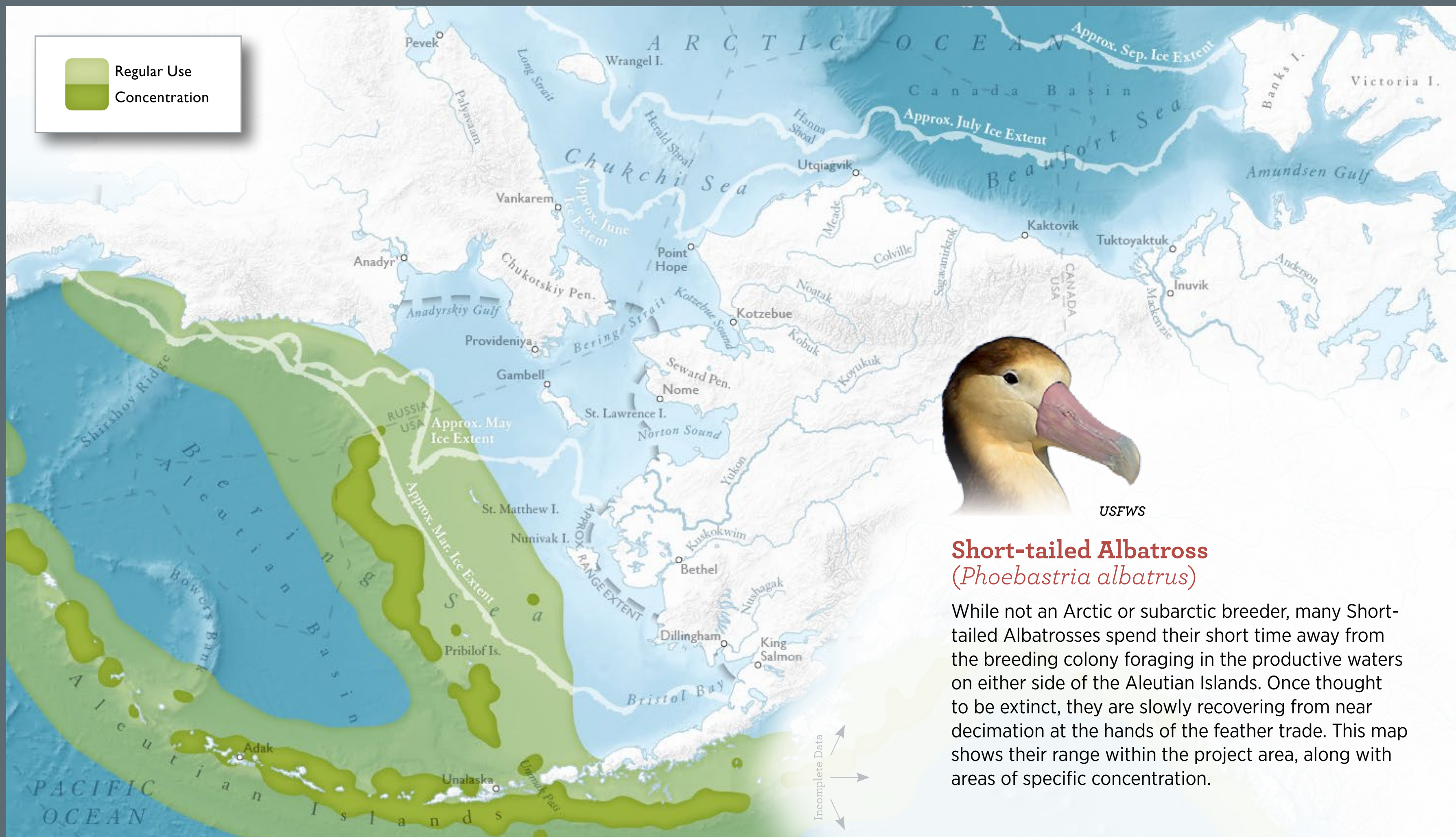
Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a); O'Connor (2013)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2016a), Geernaert (2004, 2012), and Hyrenbach et al. (2013)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

Short-tailed Albatross

Audubon ALASKA



Short-tailed Albatross
(Phoebastria albatrus)

While not an Arctic or subarctic breeder, many Short-tailed Albatrosses spend their short time away from the breeding colony foraging in the productive waters on either side of the Aleutian Islands. Once thought to be extinct, they are slowly recovering from near decimation at the hands of the feather trade. This map shows their range within the project area, along with areas of specific concentration.

Audubon Alaska (2016c) [based on Audubon Alaska (2016a), Geernaert (2004), Geernaert (2012), and Hyrenbach et al. (2013)]; Audubon Alaska (2016e) [based on Audubon Alaska (2016a), Deguchi et al. (2014), eBird (2015), Geernaert (2004), Geernaert (2012), Hyrenbach et al. (2013), Suryan et al. (2006b), Suryan et al. (2007), Suryan et al. (2008), and Suryan and Fischer (2010)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]; O'Connor (2013)

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman

Robin Corcoran/USFWS

Breeding Short-tailed Albatrosses spend at least eight months of the year at their breeding colony: pairing, laying, incubating, hatching, rearing, fledging, and caring for a single chick. Non-breeders will stay at sea or come to the breeding colony for a shorter period of time before returning to the open ocean that they are well adapted to utilize. Juvenile birds (pictured) take 10–12 years to reach sexual maturity.

MAP ON PAGE 194

Shearwaters

Nils Warnock, Max Goldman, Erika Knight, and Melanie Smith

Short-tailed Shearwater
Ardenna tenuirostris

Sooty Shearwater
A. griseus

Formerly of the *Puffinus* genus, Short-tailed (*Ardenna tenuirostris*) and Sooty (*A. griseus*) Shearwaters belong to the family of birds known as *Procellariidae* that includes petrels and fulmars. Combined, Short-tailed and Sooty Shearwaters make up one of the most abundant pelagic bird taxa in North Pacific waters (Schneider and Shuntov 1993, Shuntov 2000). They also travel some of the farthest distances of any bird that comes to Alaska, averaging 36,000–40,000 miles (59,000–64,000 km) per year (Shaffer et al. 2006, Carey et al. 2014). Both shearwater species arrive in Alaska in late April and early May and leave about 150 days later, from mid-September to early October, as they head to their breeding colonies in the Southern Hemisphere (Shaffer et al. 2006, Carey et al. 2014). These global ocean movements allow Sooty and Short-tailed Shearwaters to breed in the Southern Hemisphere when primary productivity is higher than in the Northern Hemisphere, then move to North Pacific waters when primary productivity surpasses productivity in the southern latitudes—a strategy that has been described as "the pursuit of an endless summer" (Shaffer et al. 2006, Carey et al. 2014).

Like albatross and other procellariids, shearwaters are adapted to a life at sea with their long, slender wings and relatively light bodies. In flight, especially when wind speeds are low, both species move along using a series of stiff wingbeats followed by a period of gliding. Aiding procellariids in their ability to find patchy food on the open ocean is a typically large olfactory bulb, which allows them to smell prey and even their nests on their breeding colonies from far away (e.g. Bonadonna et al. (2001), Nevitt et al. (2004)). To catch food, Sooty Shearwaters dive up to 230 feet (70 m) under water, and have been shown to have higher red blood cell counts and hematocrit values compared to other petrel species that do not dive as deep in pursuit of prey (Dunphy et al. 2015).

DISTRIBUTION
Most non-breeding Short-tailed Shearwaters are found in North Pacific waters off of Japan, Russia, and Alaska, from 40°N to over 70°N up in the Chukchi Sea (Minami et al. 1995, Gall et al. 2013, Carey et al. 2014, Yamamoto et al. 2015). In Alaska, the most abundant shearwater in the Bering Sea is the Short-tailed (Schneider and Shuntov 1993). Almost all of this species' individuals breed in large colonies on the Furneaux Group of islands off of southeastern Australia (Carey et al. 2014).

Sooty Shearwaters flock to the same North Pacific waters off of Japan, Russia, and western North America, although between 30°N and 60°N (Minami et al. 1995, Shaffer et al. 2006). Sooty Shearwaters breed in large island colonies off of New Zealand and to a lesser degree in Australia, Chile, and the Falkland Islands (BirdLife International 2017b). Birds from the Falkland Islands travel north and spend the non-breeding season in the North Atlantic Ocean (Hedd et al. 2012).

Migration
While Short-tailed and Sooty Shearwaters from breeding grounds in the Pacific Ocean share an epic migration strategy of moving between the Northern and Southern Hemispheres, how they do it differs. Short-tailed Shearwaters follow a triangular/circular migration route, moving northwest across the Pacific Ocean to coastal waters off Japan and across to Alaska and then back down the central Pacific to their breeding grounds (Carey et al. 2014) (see Figure 5.16-1). New Zealand-breeding Sooty Shearwaters tend to embark on a figure-eight migration, where the birds head northeast to east (as far east as the coast of South America) after which birds head northwest toward Japan or north along the western coast of North America to Alaska before coming back down through the Central Pacific to the breeding gounds (Shaffer et al. 2006).

For adult Short-tailed Shearwaters, average northward migration is rapid, with birds moving about 500 (±75) miles/day (840 [±125] km/day) begininning in mid-April, crossing the equator on 26 April, reaching non-breeding grounds on 2 May (±6 days), with a total transit time of about two weeks (Carey et al. 2014). For the reverse southward migration, the average adult Short-tailed leaves the nonbreeding grounds on 26 September (±7 days), crosses the equator on 7 October and arrives back to the breeding colonies on 13 October (± 6 days), moving 430 miles/day (700 km/day) (Carey et al. 2014).

Rick Hibpshman

Short-tailed Shearwater.

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Sooty Shearwater.

5.16 SHEARWATERS MAP ON PAGE 194

TABLE 5.16-1. Shearwater life history characteristics and conservation status. Sources: Shaffer et al. (2006), Carey et al. (2014), Warnock (2017).

	Short-tailed Shearwater *Ardenna tenuirostris*	Sooty Shearwater *A. grisea*
Body Size Mass Length Wingspan	**M** 19 ounces (550 g) **L** 16.5 inches (42 cm) **W** 36–39 inches (91–99 cm)	**M** 23–33.5 ounces (650–950 g) **L** 15.5–18 inches (40–46 cm) **W** 37–43 inches (94–110 cm)
Maximum Life Span (wild)	40 years	34 years
Clutch Size Range Average	**R** 1 egg **A** 1 egg	**R** 1 egg **A** 1 egg
Nest-Water Proximity	Nest on islands	Nest on islands
Conservation Status Endangered Species Act IUCN Red List Audubon AK WatchList	**ESA:** Not Listed **IUCN:** Least Concern **WL:** Not Listed	**ESA:** Not Listed **IUCN:** Near Threatened **WL:** Not Listed
Population Global Alaska	**G** 23 million **A** >3.4 million	**G** 20 million **A** >1 million
Breeding Season Eggs Young	**E** November–December **Y** January–April	**E** Late November to early December **Y** January to April
Migration Spring Molt Fall	**S** April to early May **M** May to early September (wing) **F** Late September to mid-October	**S** April to early May **M** May to August (wing) **F** Late September to mid-October

New Zealand-breeding Sooty Shearwaters also leave their breeding grounds in early April, on average traveling 325–575 miles/day (550–900 km/day) (depending on prevailing winds) and arriving at North Pacific non-breeding grounds on 4 May (± 13 days) (Shaffer et al. 2006). Reversing direction, Sooty Shearwaters leave northern waters in mid-to late September, cross the equator on average on 7 October (± 5 days), and cover 525 (± 80) miles/day (840 [± 135] km/day), before arriving to the breeding grounds in mid-October (Shaffer et al. 2006).

Wintering

The term "wintering" is a misnomer for these shearwaters since they are Southern Hemisphere breeders that come to the Northern Hemisphere during their "summer" period, hence "non-breeding" is a more apt description. Based on tracking studies of both shearwaters, there are three main non-breeding areas, all in highly productive waters: 1) the California Current region (for Sooty Shearwaters); 2) Alaska waters, especially waters around the Gulf of Alaska (mostly Sooty Shearwaters), the Aleutian Islands, and the southern Bering Sea; and 3) the region where the Kuroshio and Oyashio Currents pass Japan and Russia's Kamchatka Peninsula (Shaffer et al. 2006, Carey et al. 2014). In the Bering Sea, Short-tailed Shearwaters move north later in the non-breeding season in response to changing sea temperature and changing distributions of krill, a major prey item (Yamamoto et al. 2015).

LIFE CYCLE

Both shearwater species nest on the ground surface and in burrows to escape predation (Warham and Wilson 1982); they lay only one egg and once the chick hatches, parents share feeding duties. Short-tailed Shearwaters are intermittent breeders, where on average, 14% of birds are not present at their breeding colony in any given year (Bradley et al. 2000). Perhaps as an adaptation to reduce foraging competition around breeding colonies with huge numbers of birds, these shearwaters will go on extended foraging trips for weeks over 930 miles (1,500 km) from the colony (Weimerskirch 1998, Klomp and Schultz 2000). In both species, adults depart from breeding colonies in March and April, before fledged chicks leave the colonies (Warham and Wilson 1982, Carey et al. 2014). In late March and early April, adult Short-tailed Shearwaters move from breeding colonies south to cold, productive waters along the Antarctic Polar Front and the northwest Ross Sea, where they feed and fatten until mid-April (Carey et al. 2014).

Diet

Major food items for both species include squid, fishes, and various crustaceans (e.g. Schneider and Shuntov (1993), Minami et al. (1995), Weimerskirch and Cherel (1998). In a diet comparison of the two species from the western North Pacific, Sooty Shearwaters ate more fish and squid while Short-tailed Shearwaters fed more at the lower zooplankton level (Minami et al. 1995). In the Bering Sea, euphausiids are a major prey item for Short-tailed Shearwaters (Murie 1959, Schneider and Shuntov 1993, Hunt et al. 1996).

At sea, both species surface-feed and plunge-dive in large flocks numbering in the tens of thousands of birds (Howell et al. 2012, N. Warnock pers. obs.). In the Central Pacific Ocean, Sooty Shearwaters were commonly observed plunge-diving for prey that was being chased by tuna, and eating squid (Spear and Ainley 1999). While chasing food underwater, shearwaters will flap their wings in pursuit (Howell 2010), and Sooty Shearwaters can dive almost to 230 feet (70 m) (average depth is 46 [± 36] feet [14 ± 11 m]); (Shaffer et al. 2006).

CONSERVATION ISSUES

In the US, Sooty and Short-tailed Shearwaters are protected under the US Migratory Bird Treaty Act of 1918, but neither shearwater has any other special protection status. Globally, large-scale changing ocean conditions, especially related to warming water temperatures and the negative impacts on the prey of shearwaters, have caused declines in shearwater populations (Veit et al. 1997, Baduini et al. 2001). More regionally, large-scale pelagic driftnet fishing efforts in the North Pacific, particularly for salmon and squid, negatively affected wintering concentrations of Sooty and particularly Short-tailed Shearwaters, killing thousands to hundreds of thousands of birds per year until this fishery was banned in most regions in the 1980s (DeGange et al. 1993, Uhlmann 2003). Other fisheries, including gillnetting, longlining, and trawling, are known to incidentally take shearwaters but to a lesser extent (Uhlmann 2003). On the breeding grounds, the chicks of both shearwater species have been and continue to be harvested by local subsistence communities (Moller and Kitson 2008); in the Titi Islands of New Zealand an estimated 360,000 Sooty Shearwater chicks (aka "muttonbirds") are harvested each year (ranging from 320,000 to 400,000 birds) (Newman et al. 2009).

MAPPING METHODS (MAP 5.17)

Due to the difficulty of identifying shearwaters in many field conditions, much of the data used in these maps are identified only as "shearwater" rather than specifically as Sooty or Short-tailed Shearwater. The shearwaters map combines all available data regarding shearwaters in this region, whether recorded to the species or genus level.

We categorized distribution into three main categories of intensity: extent of range, regular use, and concentration. The extent of range was drawn by buffering all known occurrences of shearwaters using data from Audubon's Alaska Geospatial Bird Database (AGBD) (Audubon Alaska 2016a) and eBird (2015). The AGBD combines and integrates point locations from available bird surveys conducted by the US Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Program for Regional and International Shorebird Monitoring (PRISM), as well as data from the North Pacific Pelagic Seabird Database (NPPSD) (US Geological Survey–Alaska Science Center 2015). Individual spatial outliers were removed if the observation was not

5.16 SHEARWATERS MAP ON PAGE 194

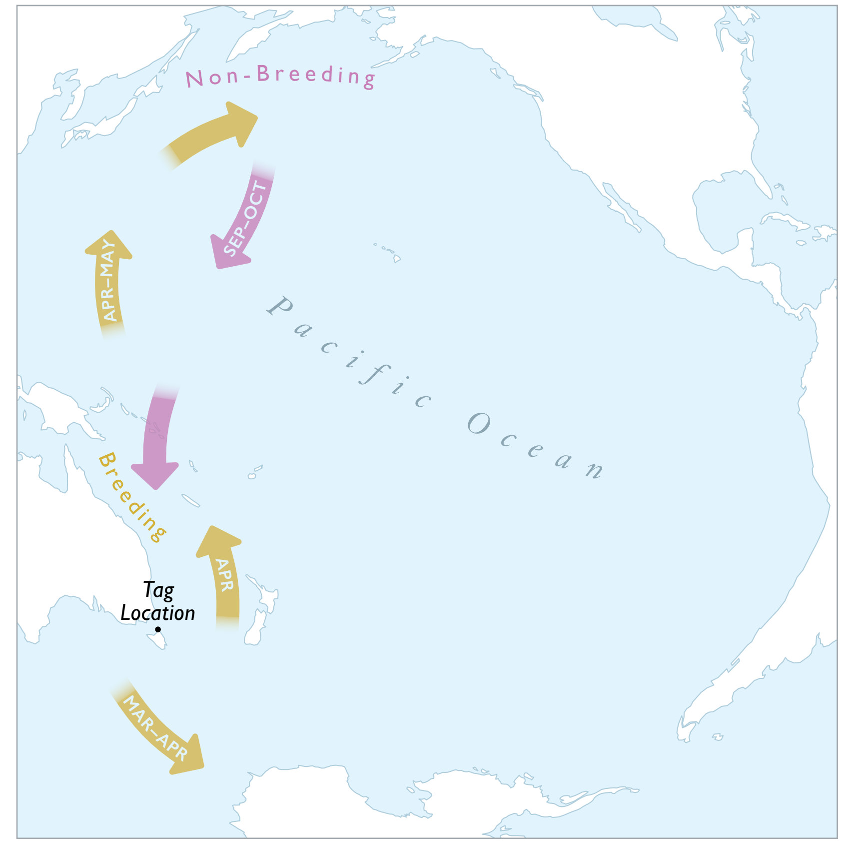


FIGURE 5.16-1. **Short-tailed Shearwater migration:** From Australian breeding grounds (tagging location), Short-tailed Shearwaters head south to stage off the coast of Antarctica before migrating north to Japanese and Alaskan waters, where they spend the Austral winter (Boreal summer). They then return across the Pacific Ocean to breed during the Austral summer (Boreal winter). Source: Carey et al. (2014).

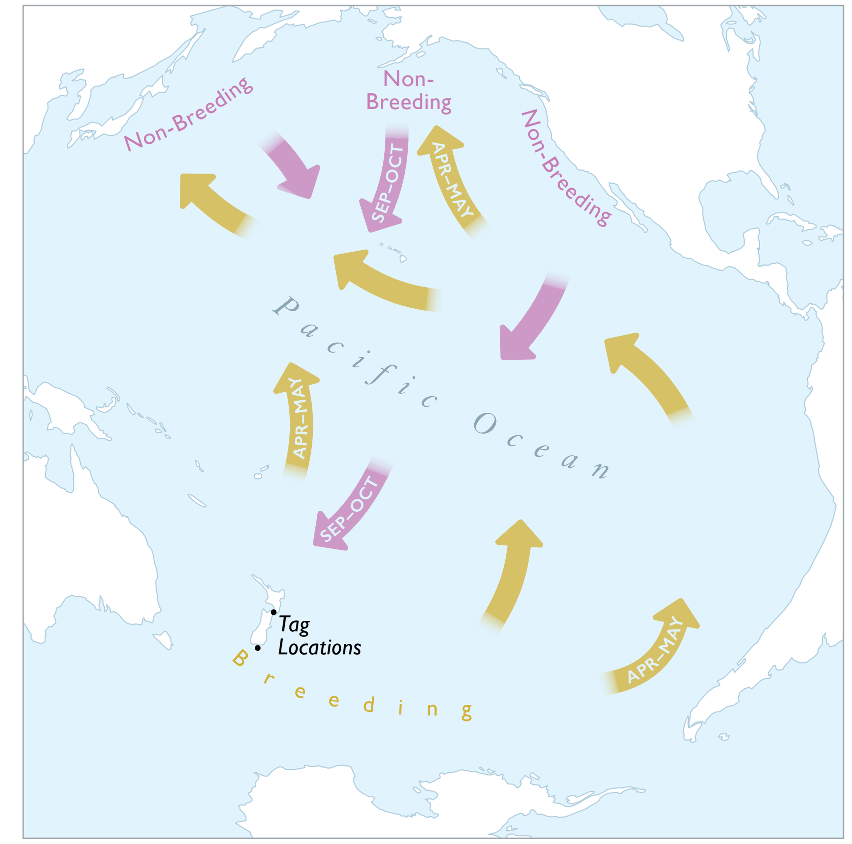


FIGURE 5.16-2. **Sooty Shearwater migration:** From New Zealand breeding grounds (tagging location), Sooty Shearwaters travel northeast or east towards South America before heading north to Alaska or northwest towards Japan for the Austral winter (Boreal summer). They complete their "figure 8" migration by crossing the Pacific to return to their breeding grounds for the Austral summer (Boreal winter). Source: Shaffer et al. (2006).

within 62 miles (100 km) of another observation. Shearwater observations from these data sources were then buffered with a 62-mile (100-km) radius and merged. In some cases, inconsistencies were manually edited and smoothed.

To determine regular-use and concentration areas, survey data were averaged across 3.1-mile (5-km) bins representing species density summarized by year and survey. We ran kernel density analyses to convert binned data into smoothed distribution data, then selected areas of repeated occurrence. In Alaska, the regular-use areas represent the 99% isopleth from a kernel density raster, using a search radius of 78 miles (125 km). For the concentration areas, we ran a 31-mile (50-km) kernel density analysis, then delineated density values that are 1 or more standard deviations above the project area mean density.

High-concentration areas were represented using global Important Bird Areas (IBAs). In Alaska, we used IBA data from Audubon Alaska (2014). Because IBA boundaries often encompass multiple-species hotspots, we also showed single-species IBA core areas (Audubon Alaska 2015) to indicate high concentrations specific to Sooty Shearwaters and Short-tailed Shearwaters (see Smith et al. 2014c). No IBAs for shearwaters are present in the Russian and Canadian portions of the project area (BirdLife International 2017a).

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines are based on an Audubon Alaska (2016h) analysis of 2006–2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See "Sea Ice Mapping Methods" section for details.

Data Quality

The at-sea survey data used in the analysis have variable coverage across the project area, with greater effort in the US, lower effort in Russia, and lowest effort in Canada. Shearwaters generally do not use the Canadian waters in our project area. The primary data source for at-sea observation data, the NPPSD, includes data from more than 350,000 transects designed to survey birds at sea, conducted over 37 years. Survey data are most robust in Alaska, and therefore distribution and concentration areas may be biased toward US waters (where more data exist). Additionally, areas of Alaska vary greatly in survey coverage and effort, influencing overall accuracy of the resulting map. There is little to no survey coverage in the Russian portions of the project area, potentially leaving major data gaps for this species. However, while data for the Russian portion of the map is limited, kernel density analyses of tracking data for both Sooty and Short-tailed Shearwaters indicate that these species' use of the Russian Bering Sea is much less than their use of waters in Alaska's Bering Sea (Carey et al. 2014, Thompson et al. 2015). Refer to Map 5.3.2 of Bird Survey Effort in this chapter for more insight into the relative accuracy of this map.

Reviewer

- Martin Renner

MAP DATA SOURCES

Extent of Range: Audubon Alaska (2016e) based on Audubon Alaska (2016a) and eBird (2015)

Regular Use: Audubon Alaska (2016c) based on Audubon Alaska (2016a)

Concentration: Audubon Alaska (2016c) based on Audubon Alaska (2016a)

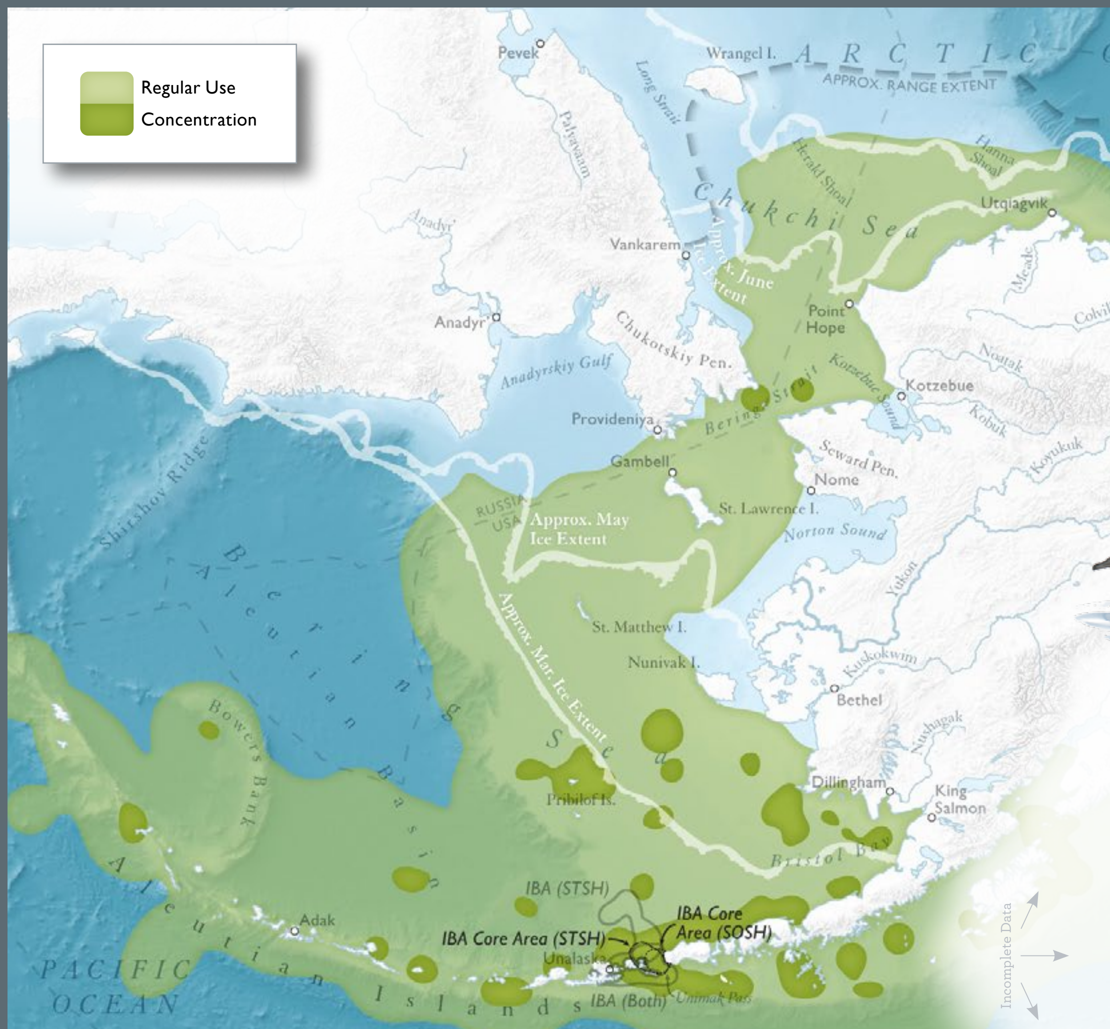
IBAs: Audubon Alaska (2014)

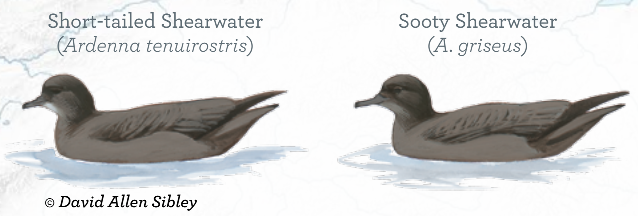
IBA Core Areas: Audubon Alaska (2015)

Sea Ice: Audubon Alaska (2016h) based on Fetterer et al. (2016)

Shearwaters

Audubon ALASKA





Shearwaters

Short-tailed and Sooty Shearwaters breed in the Southern Hemisphere, in and near Australia and New Zealand. After breeding, they migrate huge distances to spend the austral winter in the highly productive waters of the Bering and Chukchi Seas. This map shows the northern range extent of these global migrants within the project area, as well as areas of different concentration. In general, the farther north in the Bering Sea one goes, the more likely one is to encounter Short-tailed, rather that Sooty, Shearwaters.

Audubon Alaska (2014); Audubon Alaska (2015); Audubon Alaska (2016c) [based on Audubon Alaska (2016a)]; Audubon Alaska (2016e) [based on Audubon Alaska (2016a) and eBird (2015)]; Audubon Alaska (2016h) [based on Fetterer et al. (2016)]

Map Authors: Melanie Smith and Erika Knight
Cartographer: Daniel P. Huffman

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During the Austral winter (summer in the Northern Hemisphere), Short-tailed and Sooty Shearwaters descend upon the Bering Sea in staggering numbers, becoming the most abundant seabird in the Arctic as soon as they arrive. They gather in massive groups, along with other seabirds such as kittiwakes, puffins, fulmars, and auklets. Shearwaters breed in the Southern Hemisphere during the Austral summer (winter in the Northern Hemisphere), and migrate thousands of miles during their non-breeding season to take advantage of the huge blooms of productivity in the far north during the ice-free months.

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