Ecological Atlas of the Bering, Chukchi, and Beaufort Seas, 2nd Edition: Metadata

Chapter 5: Birds

Shortcut to metadata for

Map 5.1.1 Marine Bird Colonies

MAPPING METHODS (MAP 5.1.1)

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 Additional colony locations for Common Eiders, as well as one colony for Thick-billed Murres, were provided from unpublished nesting colony data collected by the Canadian Wildlife Service (2013).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 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).

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.

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)

Reference list available here.

Maps 5.1.2a–d Foraging Guilds

MAPPING METHODS (MAPS 5.1.2a–d)

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 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.

MAP DATA SOURCES

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

Reference list available here.

Map 5.2 Important Bird Areas

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.

MAP DATA SOURCES

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

Reference list available here.

Map 5.3.1 Annual Bird Density

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.

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

This map is 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 Whitefronted Goose (1994–2008), Yukon Delta Goose Swan Crane (1985–2008), Yukon Delta Waterbird (1988–2008)

Reference list available here.

Map 5.3.2 Bird Survey Effort

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.

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

This map is 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 Whitefronted Goose (1994–2008), Yukon Delta Goose Swan Crane (1985–2008), Yukon Delta Waterbird (1988–2008)

Reference list available here.

Maps 5.3.3a–d Seasonal Bird Density

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.

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).

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

This map is 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 Whitefronted Goose (1994–2008), Yukon Delta Goose Swan Crane (1985–2008), Yukon Delta Waterbird (1988–2008)

Reference list available here.

Map 5.4.1 King Eider

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.

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)

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.

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)

Reference list available here.

Map 5.4.2 Spectacled Eider

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.

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

	King Elder *Somateria spectabilis*	**Spectacled Elder** *S. fischeri*	**Common Elder** *S. mollissima*	**Steller's Elder** *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)

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.4.3 Common Eider

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.

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)

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.4.4 Steller's Eider

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.

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)

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.5 Long-tailed Duck

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 (AGDB) (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.

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)

Reference list available here.

Map 5.6.1 Yellow-billed Loon

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.

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)

Reference list available here.

Map 5.6.2 Red-throated Loon

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.7 Red-faced Cormorant

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.

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)

Reference list available here.

Map 5.8.1 Red-necked Phalarope

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 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.

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)

Reference list available here.

Map 5.8.2 Red Phalarope

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 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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.9 Aleutian Tern

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.

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)

Reference list available here.

Map 5.10.1 Red-legged Kittiwake

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.

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)

Reference list available here.

Map 5.10.2 Black-legged Kittiwake

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.11 Ivory Gull

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.

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.

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)

Reference list available here.

Map 5.12.1 Common Murre

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.

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)

C**olonies:** Canadian Wildlife Service (2013); Seabird Information Network (2011)

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

Reference list available here.

Map 5.12.2 Thick-billed Murre

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.12.3 Total Murres

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.13.1 Horned Puffin

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.

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)

Reference list available here.

Map 5.13.2 Tufted Puffin

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.14.1 Parakeet Auklet

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.

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)

Reference list available here.

Map 5.14.2 Crested Auklet

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.14.3 Whiskered Auklet

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.14.4 Least Auklet

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.

MAP DATA SOURCES

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)

Reference list available here.

Map 5.15 Short-tailed Albatross

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.

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)

Reference list available here.

Map 5.16 Short-tailed / Sooty Shearwater

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 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.

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)

Reference list available here.