AUGUST 2019

Report Series: *Life in the Heart of the Arctic*

Nesting Birds in the Heart of the Arctic

A journey through the Arctic National Wildlife Refuge

Audubon | ALASKA

Lapland Longspur.
Photo: Mick Thompson

Contents

Suggested citation:
Sullender, B.K. 2019. Nesting Birds in the Heart of the Arctic: A journey through the Arctic National Wildlife Refuge. Audubon Alaska, Anchorage, AK.

Common Eider nest with eggs.
Photo: USFWS

Overview

From stunted black spruce forests to driftwood-strewn barrier islands, the Arctic National Wildlife Refuge encompasses a wide variety of habitats. The diversity of habitats fosters an abundance and diversity of birdlife: over 144 bird species are believed to breed in the Refuge and several key sites—called Important Bird Areas, or IBAs—support globally significant concentrations of breeding birds.

These birds select nesting sites based on habitat features such as nutritious wetland vegetation, tall grasses to conceal nests, or driftwood to shelter incubating eider hens—and her eggs—from the elements. Generally, habitats in the Refuge can be split into four main ecoregions: the boggy boreal forest in the south, the craggy Brooks Range, the rolling ridges and valleys of the Brooks Foothills, and the productive wetlands of the Arctic Coastal Plain.

Some of these regions are well-studied and well-known for their importance. For example, the Arctic Coastal Plain, due largely to its essential role in harboring migratory birds from all over the world, has been surveyed consistently for decades. Thanks to these surveys, we now know that the Refuge's portion of the Arctic Coastal Plain supports over 5% of the world's population of at least three shorebird species. Further south, the boreal forest has a handful of known hotspots for waterbirds, each recognized as an IBA. The aquatic habitat at the core of these hotspots is fed directly by the Refuge's network of rivers, weaving down from headwaters high in the Brooks Range.

Other regions are more mysterious and less well-understood. The Brooks Foothills are much drier than the neighboring Arctic Coastal Plain, and host different communities of birds. Despite being intended to focus on shorebirds, the handful of studies that have been done recorded impressive numbers of Lapland Longspurs, a charismatic songbird that combines ground-based and aerial acrobatics in courtship. Even when considering the lack of survey effort compared with other nearby locations, the Arctic Refuge's ecological importance is clear.

The gaps in scientific understanding of ecoregions such as the Brooks Foothills means that an honest, complete assessment of projected impacts is simply impossible. From what scientists, industry, and decision-makers know about existing oil development, there are unavoidable impacts on breeding birds. These impacts could be exacerbated in regions with different and largely unstudied ecological characteristics.

Breeding Bird Habitat and Ecoregions

Arctic Refuge, Sheenjek River. Photo: Dave Shaw

The Arctic National Wildlife Refuge contains a range of habitat types that foster a remarkably diverse bird community. 201 species of birds have been recorded in the Arctic Refuge; of these, over half (144 species) are believed to breed there (US Fish and Wildlife Service 2015; see Table 1). A few species – such as the year-round resident Rock Ptarmigan (*Lagopus muta*) and widespread Spotted Sandpiper (*Actitis macularius*) – can find places to nest throughout nearly the entire Refuge. Other bird species can successfully nest only in certain small portions of the Arctic Refuge: the Common Eider (*Somateria mollissima*), for example, nests almost exclusively on the handful of narrow barrier islands with enough driftwood to camouflage and protect incubating hens (Dau and Bollinger 2009).

The Arctic National Wildlife Refuge contains a range of habitat types that foster a remarkably diverse bird community.

Because birds rely on specific combinations of physical and biological variables to create suitable habitat, nesting bird distribution varies widely across the landscape, even within the Arctic National Wildlife Refuge itself (Table 1). The bird communities along the Beaufort coast include shorebirds and seaducks that are scarce or entirely absent from the boreal forest near the Refuge's southern boundary. Raptor species that prefer rugged mountains may only nest in the center of the Brooks Range, while grassland birds find ideal habitat in the upland tundra between coastal wetlands and taller mountains.

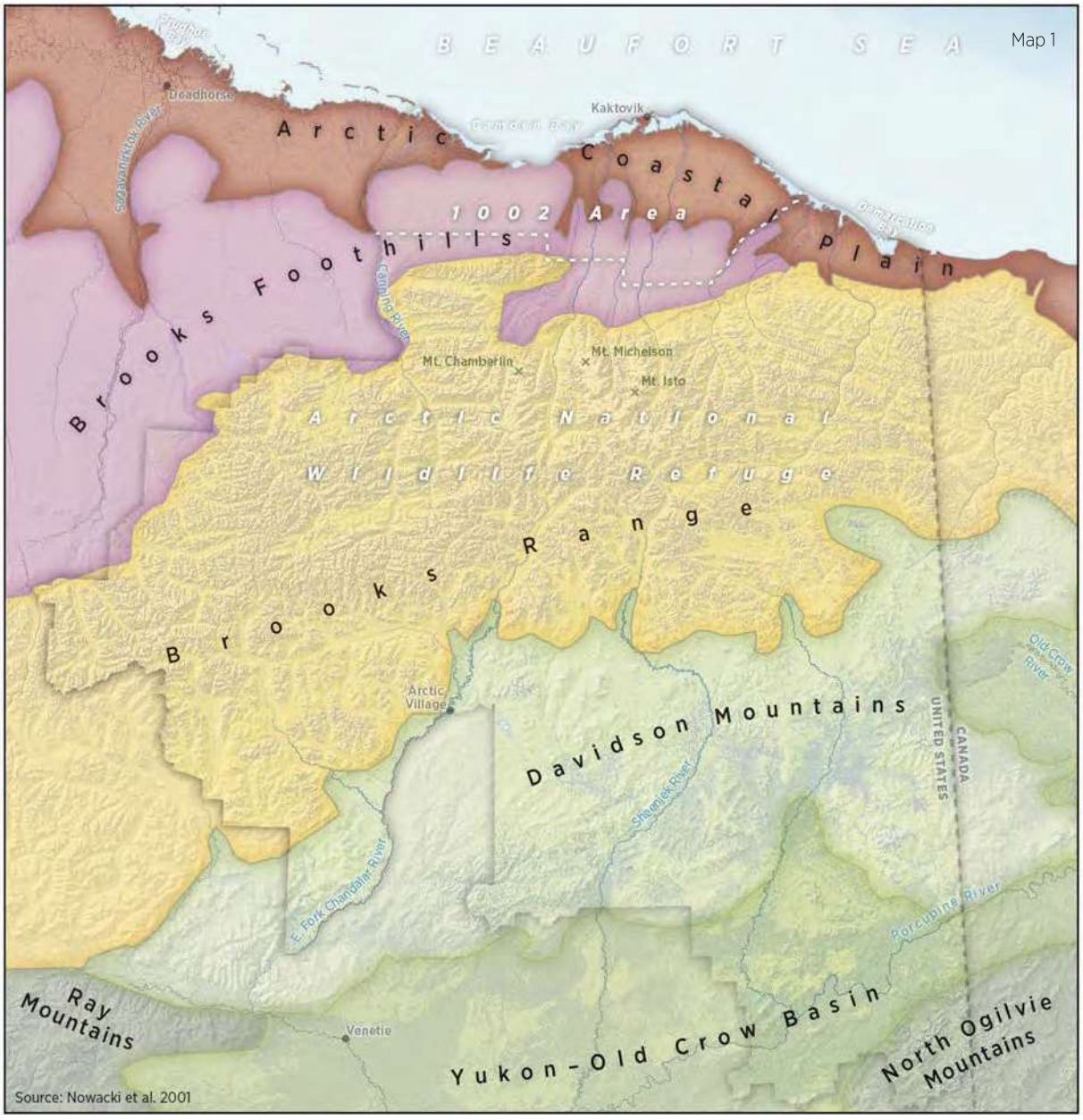
These different landscape types can be classified into broad ecological regions (ecoregions) with roughly analogous ecological processes. Ecoregions are delineated based on physical and biological factors such as climate, vegetation, geology, topography, hydrology, and disturbance regimes. The Arctic National Wildlife Refuge is comprised of five ecoregions: the Arctic Coastal Plain, the Brooks Foothills, the Brooks Range, the Davidson Mountains, and Yukon-Old Crow Basin (see Map 1). A sixth ecoregion – the North Ogilvie Mountains—extends slightly into the southeastern corner of the Refuge.

POLITICAL BOUNDARIES AND TERMINOLOGY

Scientifically, the Arctic Coastal Plain refers to a specific ecoregion spanning from Utqiaġvik to Canada. However, the term "Coastal Plain" is commonly used as a synonym for the "1002 Area," which is the portion of the Arctic National Wildlife Refuge north of the Mollie Beattie Wilderness. The 1002 Area is a 1.5-million acre, politically

designated portion of the Arctic Refuge that gets its name from Section 1002 of the Alaska National Interest Conservation Lands Act (ANILCA). Technically, the 1002 Area is split into two ecoregions: the Arctic Coastal Plain and the Brooks Foothills (see Map 1). The ecological differences between these areas are clear: the Arctic Coastal Plain is a low-lying wetland complex, whereas the Brooks Foothills are drier upland areas with better-defined drainage patterns.

In many instances, it is reasonable to use "1002 Area" interchangeably with "Arctic Refuge Coastal Plain." However, for this report, we will use "Arctic Coastal Plain" to refer to the ecoregion. When considering birdlife and assessing potential environmental impacts, the ecological distinctions between the Brooks Foothills and the Arctic Coastal Plain are critically important.



Map 1. Generalized ecoregions of Alaska, from Nowacki et al. (2001). Ecoregions are broad landscapes classified into similar units using shared geophysical and ecological features. The Arctic National Wildlife Refuge is comprised of five main ecoregions: the Arctic Coastal Plain, the Brooks Foothills, the Brooks Range, the Davidson Mountains, and Yukon-Old Crow Basin. Two additional ecoregions are nearby: the Ray Mountains and the North Ogilvie Mountains. Note that the politically important 1002 Area, which is also commonly referred to as the Arctic Refuge Coastal Plain, actually spans two distinct ecoregions (the Arctic Coastal Plain and the Brooks Foothills).

ECOREGION	BIRD SPECIES OBSERVED	BREEDING BIRD SPECIES
Davidson Mountains, Yukon-Old Crow Basin, and North Ogilvie Mountains	136	105
Brooks Range	107	68
Brooks Foothills and Arctic Coastal Plain	158	79
Entire Arctic National Wildlife Refuge	**201**	**144**

Table 1: Total bird species richness across geographic regions of the Arctic National Wildlife Refuge. Data from US Fish and Wildlife Service (2015).

IMPORTANT BIRD AREAS

Suitable habitat and biological productivity are not evenly distributed within ecoregions, and bird distribution varies correspondingly. Some areas that support extraordinarily high concentrations of birds are recognized as Important Bird Areas (IBAs). IBAs are identified according to a consistent set of scientific, quantitative criteria (BirdLife International 2012, 2017; National Audubon Society 2012). For each bird species present, an IBA may be significant on a global, continental, or state level, depending on factors such as that species' conservation status and local abundance relative to overall population size. For example, any area that seasonally supports ⩾1% of a species global population is considered a globally significant IBA. As part of in-depth spatial analyses, seven global IBAs have been identified within and adjacent to the Arctic National Wildlife Refuge (see Map 2 and Table 2). These IBAs indicate that the Refuge supports extraordinary concentrations of birds as well as high diversity.

INTERMONTANE BOREAL

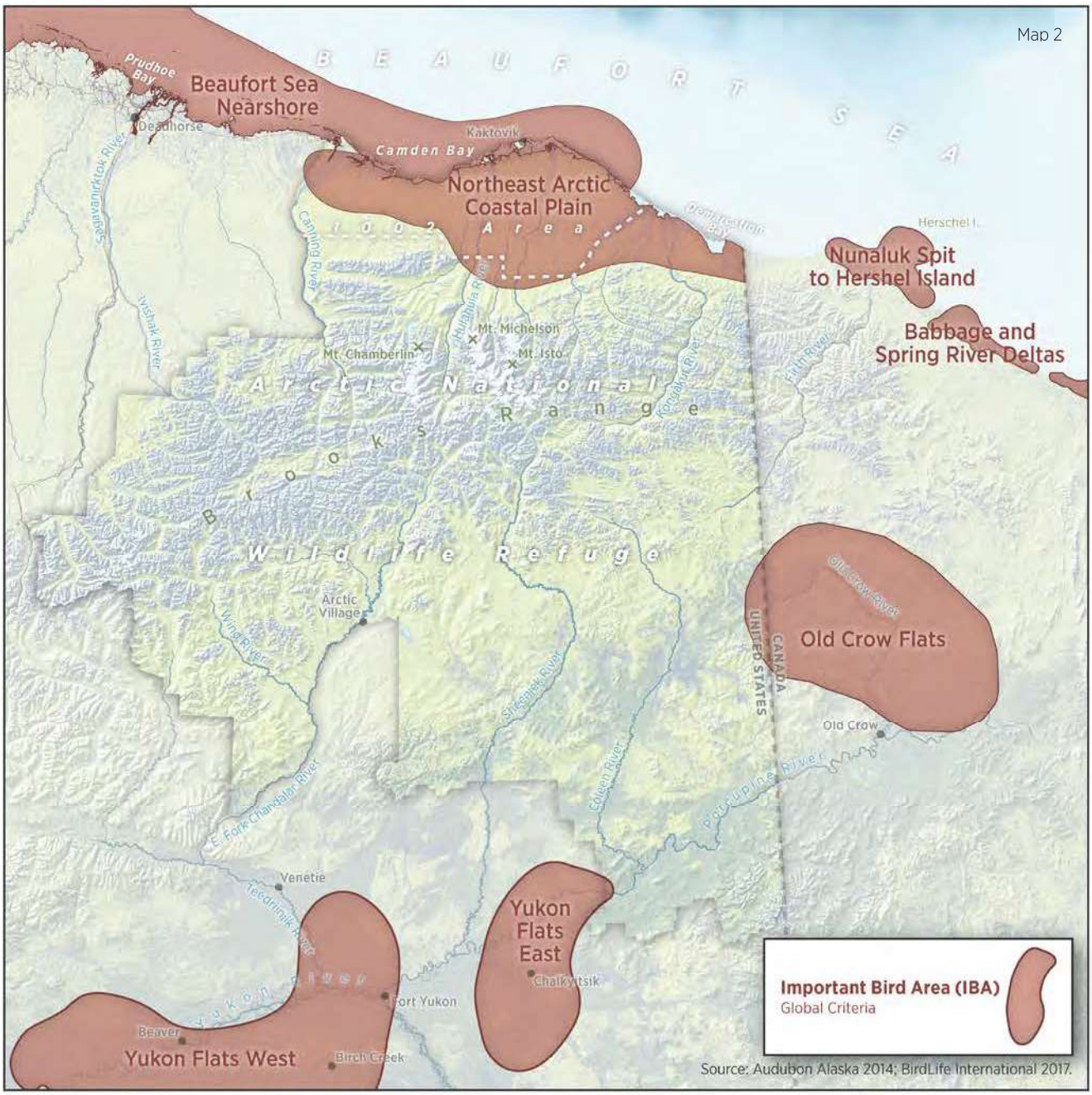
Although considered distinct ecoregions, the Davidson Mountains, Yukon-Old Crow Basin, North Ogilvie Mountains, and Ray Mountains are all comprised of a similar habitat type: the intermontane boreal forest. These forests, located between the Brooks Range and the Alaska Range, are characterized by extreme seasonal temperature differences, discontinuous permafrost, and expansive river networks that provide aquatic habitats (Nowacki et al. 2001).

Rivers whose headwaters spring from the Arctic National Wildlife Refuge fuel immensely productive wetlands further south. Just outside of the Arctic Refuge's southern boundaries are two boreal IBAs: Yukon Flats West IBA and Yukon Flats East IBA. These IBAs support high concentrations of ducks, loons, and swans, including tens of thousands of White-winged Scoters (*Melanitta deglandi*), thousands of Black Scoters (*Melanitta americana*), and significant abundances of eight other species (Audubon Alaska 2014). Beyond the US border is a third boreal IBA; Old Crow Flats IBA is in the boreal forest and supports hundreds of thousands of breeding waterfowl, primarily White-winged and Surf Scoters (*Melanitta perspicillata*), scaup (*Aythya* spp.), and Northern Pintails (*Anas acuta*; BirdLife International 2017). In addition to these boreal IBAs just outside the Refuge and associated waterfowl communities, the southern third of the Arctic Refuge is home to forest-dwelling passerines such as the Alder Flycatcher (*Empidonax alnorum*), Swainson's Thrush (*Catharus ustulatus*), and the conifer-adapted White-winged Crossbill (*Loxia leucoptera*).

Although the craggy landscape (of the Brooks Range) may appear inhospitable, it provides excellent breeding habitat for over 60 bird species.

BROOKS RANGE

Further north, the Brooks Range covers approximately the middle third of the Arctic Refuge, separating the boreal forest from the Beaufort coast. The Arctic Refuge contains the tallest peaks in the Brooks Range, with Mt. Isto (8,975 feet [2736m]), Mt. Hubley (8,916 feet [2718m]), and Mt. Chamberlin (8,899 feet [2712m]) all rising above glaciated valleys and steep ridges. Although the craggy landscape may appear inhospitable, it provides excellent breeding habitat for over 60 bird species (see Table 1).



Important Bird Area (IBA) Name	Country	Global IBA Trigger Species	Continental IBA Trigger Species	State IBA Trigger Species
Northeast Arctic Coastal Plain	USA	American Golden-Plover, Buff-breasted Sandpiper, Pectoral Sandpiper	Red Phalarope	Golden Eagle, Red-necked Phalarope, Red-throated Loon, Ruddy Turnstone, Semipalmated Plover, Semipalmated Sandpiper, Stilt Sandpiper
Beaufort Sea Nearshore	USA	Brant, Black Scoter, Common Eider, Glaucous Gull, King Eider, Long-tailed Duck, Red-throated Loon, Surf Scoter, White-winged Scoter, Yellow-billed Loon	Red Phalarope	Arctic Tern, Black-legged Kittiwake, Pacific Loon
Yukon Flats West	USA	Black Scoter, White-winged Scoter	Trumpeter Swan	Arctic Tern, Bufflehead, Canvasback, Common Loon, Mew Gull, Pacific Loon, Red-necked Grebe
Yukon Flats East	USA	Black Scoter, White-winged Scoter		Canvasback, Mew Gull
Old Crow Flats	Canada	Greater Scaup, Surf Scoter, White-winged Scoter, waterbirds		
Nunaluk Spit to Hershel Island	Canada	Red-necked Phalarope, Snow Goose, waterbirds		
Babbage and Spring River Deltas	Canada	Brant		

Global criteria: ≥1% biogeographic population of waterbird; ≥1% global population of seabird or terrestrial species; ≥20,000 waterbirds; or species of global conservation concern

Continental criteria: ≥1% flyway/subspecies population of waterbird; ≥1% biogeographic population of seabird or terrestrial species; or species of continental conservation concern

State criteria: ≥1% state population; or species of state conservation concern

Map 2 / Table 2: Important Bird Areas

The hardy Gray-crowned Rosy-Finch (*Leucosticte tephrocotis*) nests in extremely rugged environments and may be the highest-altitude breeding bird in North America (Macdougall-Shackleton et al. 2000). The nests of raptors such as Peregrine Falcons (*Falco peregrinus*) dot riverside bluffs and cliffs throughout the Brooks Range and northern foothills.

BROOKS FOOTHILLS

As the jagged mountains of the Brooks Range taper northward into rolling hills, rocky, scree-covered slopes give way to grasses and scattered shrubs. The rough terrain, although gentler than the Brooks Range, still provides enough topographic relief to largely prevent lakes from forming, instead funneling water towards streams and rivers (Nowacki et al. 2001).

Few systematic bird surveys have been conducted on these upland tundra habitats (see Map 3), meaning that little is known about bird distribution in this ecoregion. One exception is the Program for Regional and International Shorebird Monitoring (PRISM), established to survey plots for nesting birds across the Arctic (Bart et al. 2005; Bart and Johnston 2012). Although originally designed for shorebird observations, PRISM surveys also identified remarkably high densities of Lapland Longspurs (*Calcarius lapponicus*) in the Brooks Foothills (see Map 4). Within the Arctic Refuge, Lapland Longspur densities averaged over 100 individuals per square mile (40 individuals / km^2), longspurs were observed at every site along the Katakturuk River, and overall at 48 of 65 sites (74%) in the Refuge's portion of the Brooks Foothills (Bart and Johnston 2012).

Species distribution modeling based on PRISM data indicates that Long-billed Dowitchers (*Limnodromus scolopaceus*) and American Golden-Plovers (*Pluvialis dominica*) may find suitable nesting habitat (Saalfeld et al. 2013), although Arctic Refuge-specific studies have also found that breeding American Golden-Plover densities decrease in upland areas (Brown et al. 2007). Although rarely observed, Semipalmated Plovers (*Charadrius semipalmatus*) may nest more frequently in upland habitats (Johnson et al. 2007). Other than these few species and opportunistic observations of Buff-breasted Sandpipers (*Calidris subruficollis*), little is known about bird distribution in this area due to a paucity of surveys.

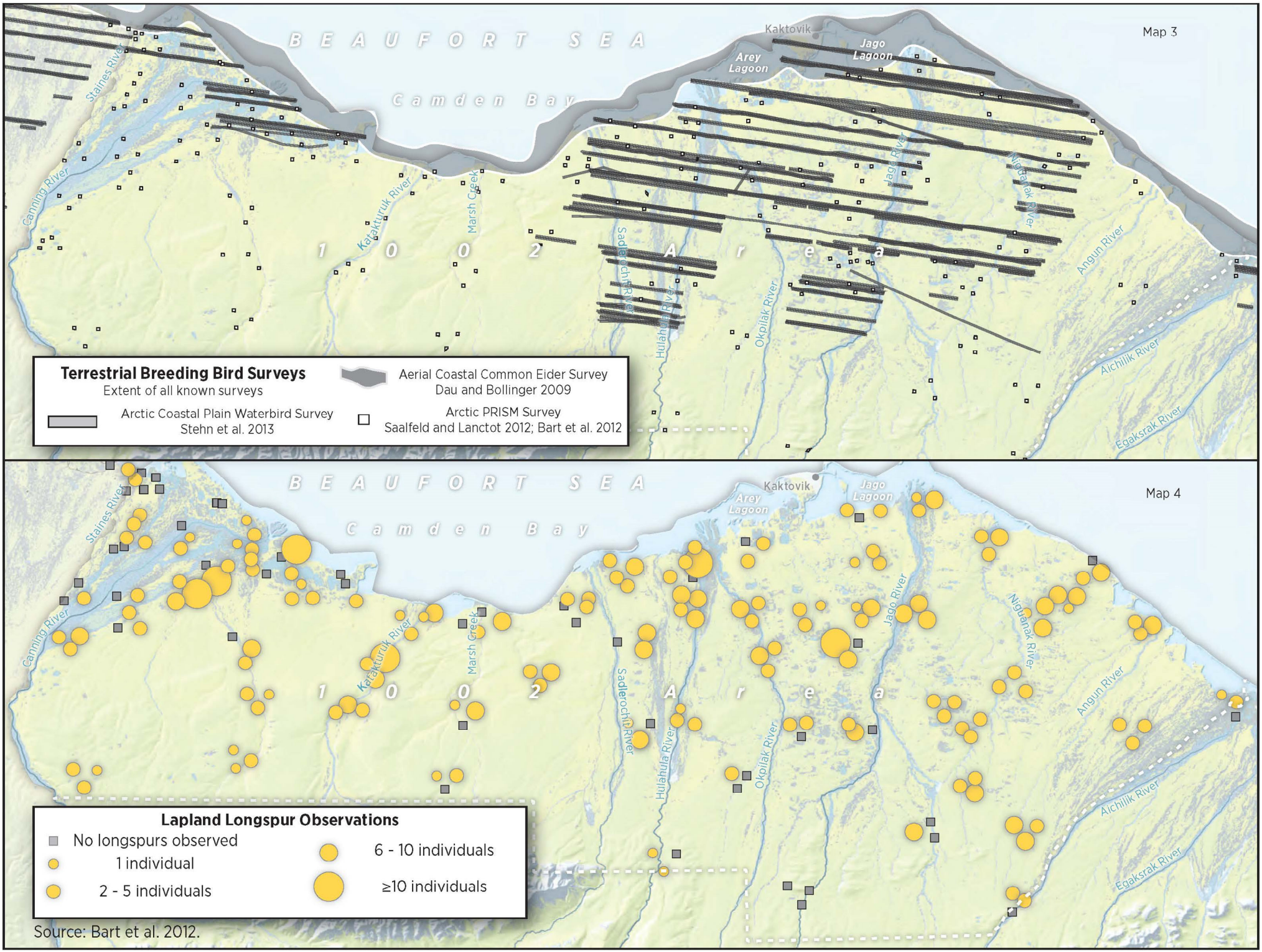
Arctic Refuge Coastal Plain. Photo: Rebecca Sentner

ARCTIC COASTAL PLAIN

Along the Beaufort Sea coast, mostly flat topography and thick permafrost impede drainage and create a mosaic of wetland habitats. This ecoregion—the Arctic Coastal Plain—is characterized by extensive small ponds, thaw lakes, and wet tundra habitats, and is internationally known for its biological importance.

Across the Alaskan Arctic, coastal wetlands consistently support large abundances of breeding shorebirds (Johnson et al. 2007), in addition to the importance of these areas for migrating and staging birds. The Refuge's portion of the Arctic Coastal Plain annually hosts around 230,000 breeding shorebirds, including 13.2% of the global population of Pectoral Sandpipers (*Calidris melanotos*), 7.8% of the global population of American Golden-Plovers, and 5.4% of the global population of Ruddy Turnstones (*Arenaria interpres*; Brown et al. 2007). Wetlands in the Canning River delta support the highest recorded densities of shorebirds (75 individuals per km^2) within the entire region (Brown et al. 2007). Modeled shorebird habitat suitability is shown in Maps 5, 6, 7, and 8.

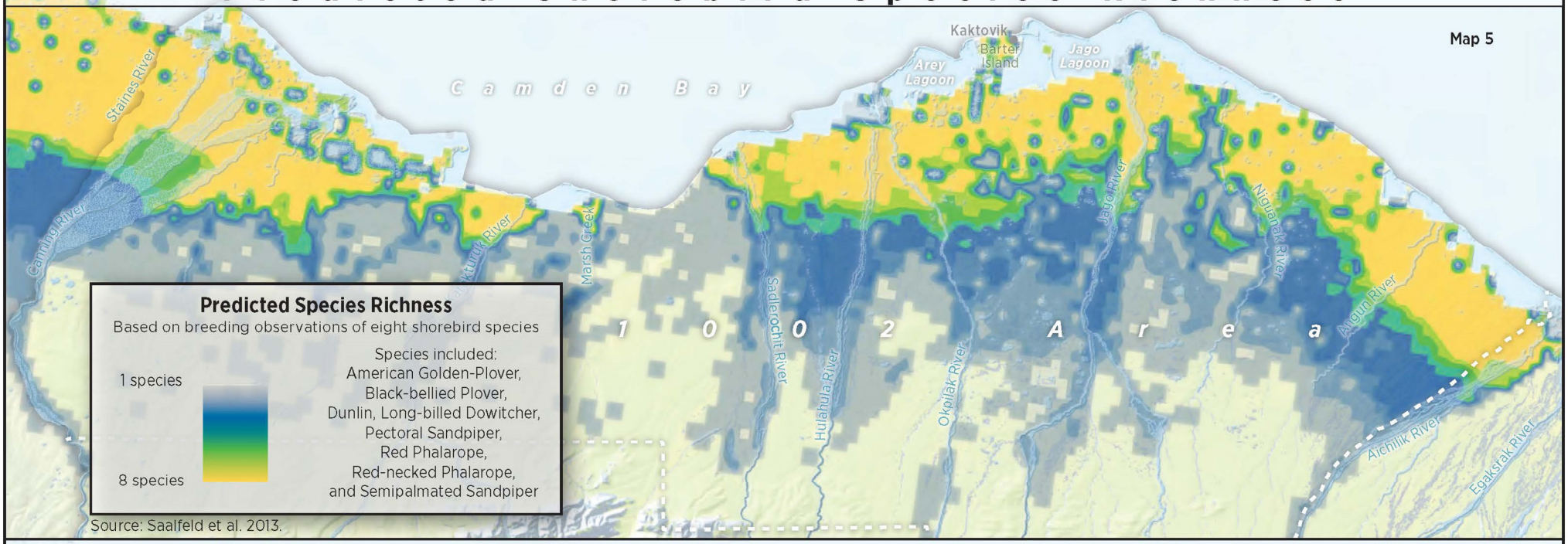
Only about 30% of the Refuge's Coastal Plain has been systematically surveyed for breeding birds (about 500,000 acres [2,000 km^2] of the 1.6-million-acre [6,500 km^2] 1002 Area; Stehn et al. 2013). Such low survey effort—shown in Map 3—complicates any definitive conclusions about species distributions, densities, or trends (Amundson et al. 2019). Because many other portions of the Arctic Coastal Plain have greater survey effort, comparisons across broader areas are difficult.



Source: Bart et al. 2012.

Predicted Shorebird Species Richness

Map 5



Predicted Species Richness

Based on breeding observations of eight shorebird species

1 species

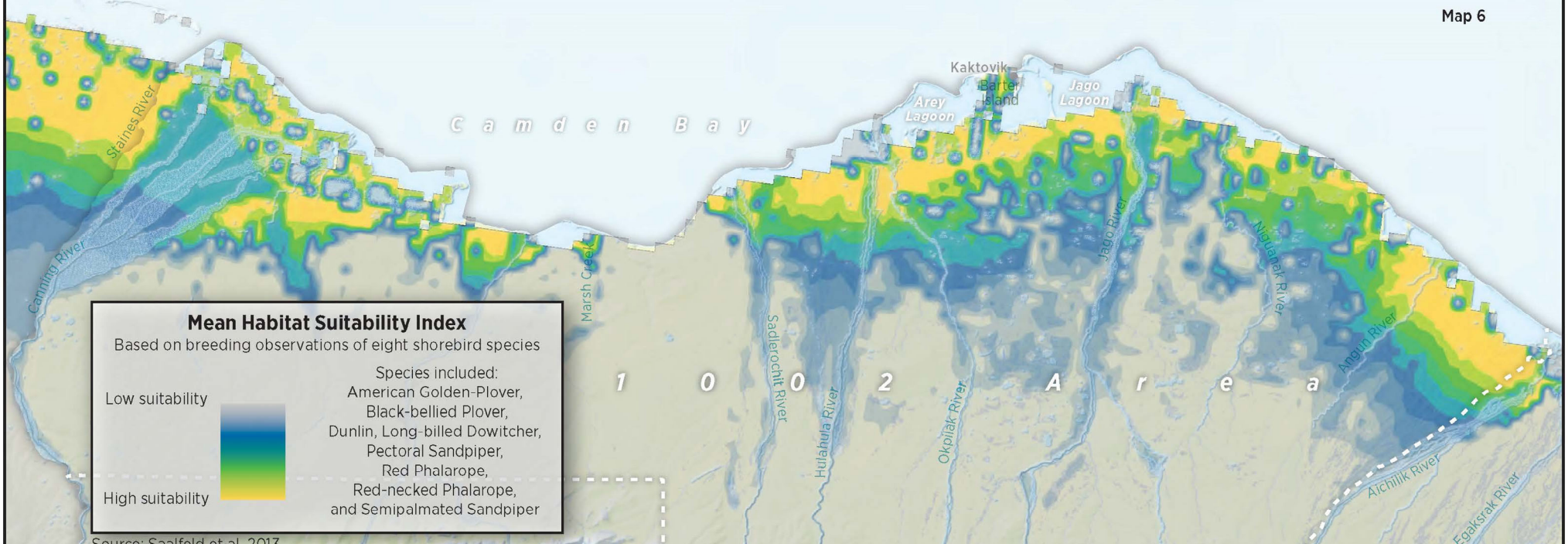
8 species

Species included:
American Golden-Plover,
Black-bellied Plover,
Dunlin, Long-billed Dowitcher,
Pectoral Sandpiper,
Red Phalarope,
Red-necked Phalarope,
and Semipalmated Sandpiper

Source: Saalfeld et al. 2013.

Mean Habitat Suitability Index

Map 6



Mean Habitat Suitability Index

Based on breeding observations of eight shorebird species

Low suitability

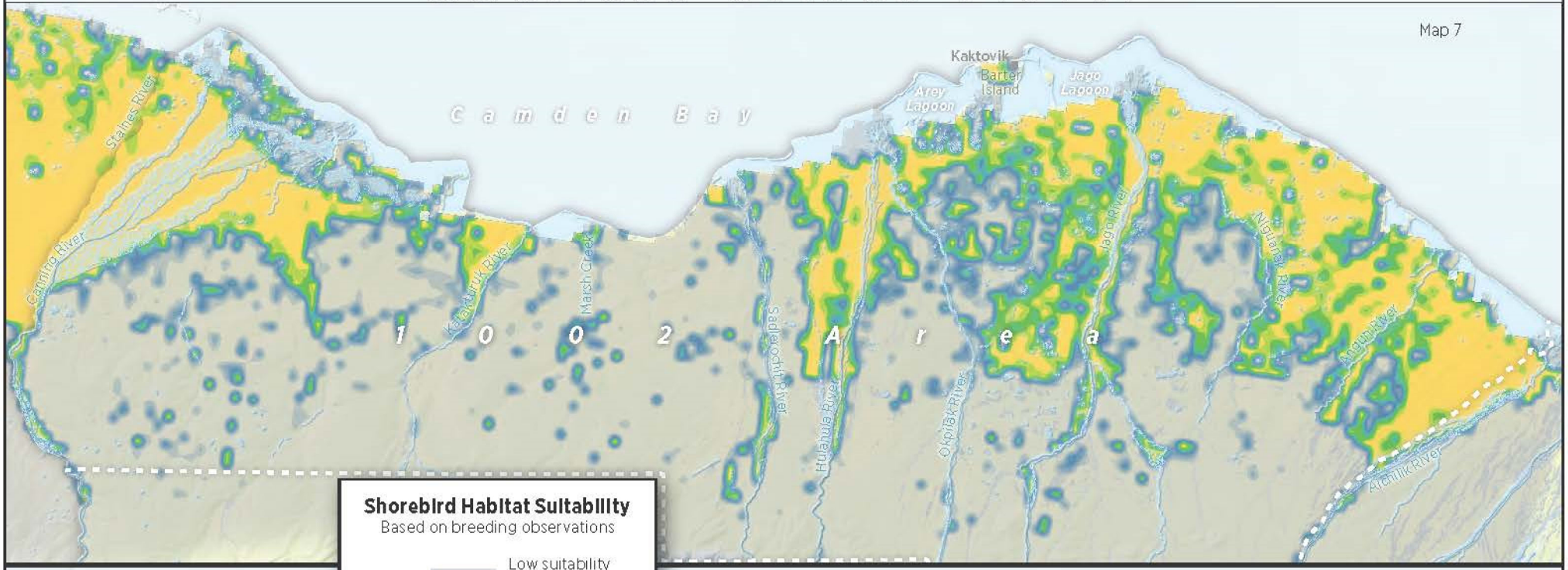
High suitability

Species included:
American Golden-Plover,
Black-bellied Plover,
Dunlin, Long-billed Dowitcher,
Pectoral Sandpiper,
Red Phalarope,
Red-necked Phalarope,
and Semipalmated Sandpiper

Source: Saalfeld et al. 2013.

American Golden-Plover

Map 7



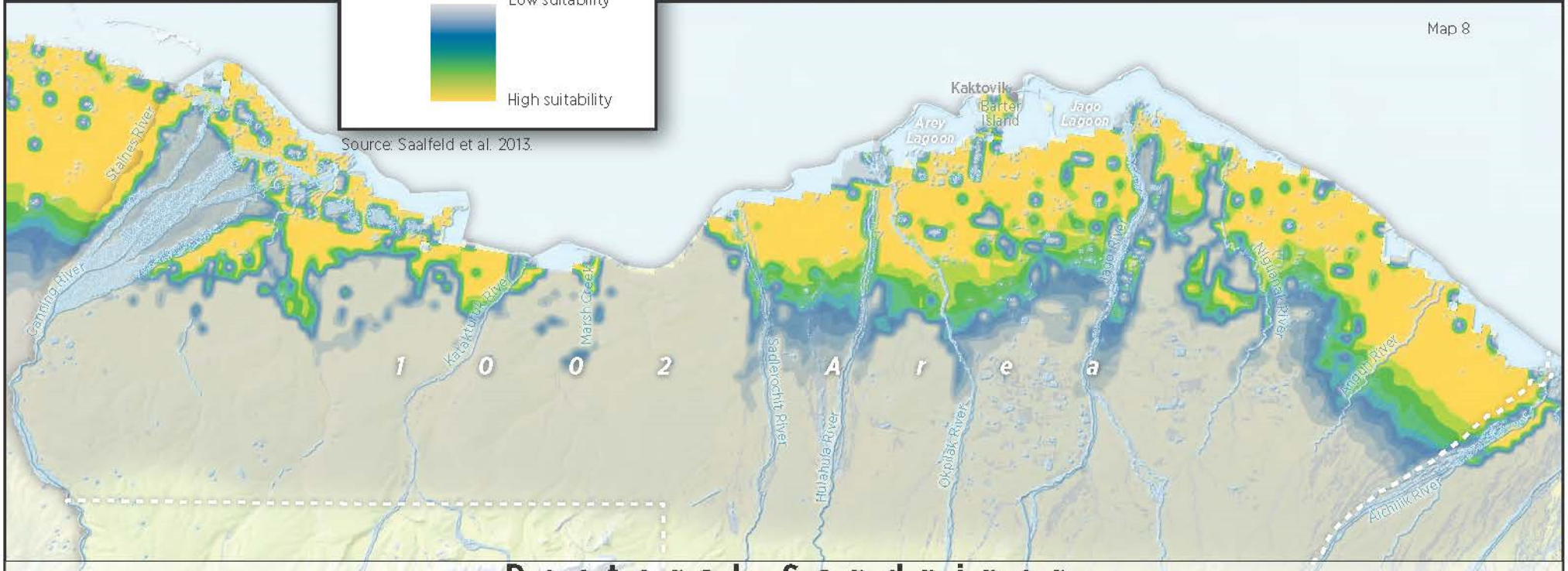
Shorebird Habitat Suitability
Based on breeding observations

Low suitability

High suitability

Source: Saalfeld et al. 2013.

Map 8



Pectoral Sandpiper

Species	Observations	Breeding Individuals	Individuals
Northern Pintail	208	226	339
Long-tailed Duck	176	228	330
Glaucous Gull	118	129	200
Greater White-fronted Goose	98	130	380
Unspecified Jaeger	92	98	104
Pacific Loon	85	122	125
Tundra Swan	77	105	115
Arctic Tern	35	42	101
Canada Goose	34	49	90
Red-throated Loon	33	43	43
Unspecified Scaup	32	39	49
King Eider	19	31	31
Common Eider	12	17	20
Snowy Owl	12	12	12
Willow Ptarmigan	11	10	14

Table 3. 15 most commonly observed waterbird taxa in the Refuge's Coastal Plain during aerial surveys, 1992-2015 (Stehn et al. 2013). Breeding individuals are the sum of observations of individual birds or pairs of birds; Individuals is the sum of all group sizes, including larger flocks. Numbers represent only birds observed on surveys.

However, even when considering these constraints and a general paucity of data, the Refuge's Coastal Plain is clearly important for breeding birds. Recent modeling efforts have identified several locations within the Refuge's Coastal Plain that are of importance relative to the rest of the Arctic Coastal Plain for Tundra Swans (*Cygnus columbianus*), Red-throated Loons (*Gavia stellata*), and King Eiders *(Somateria spectabilis*; Amundson et al. 2019). In addition to these three species, Table 3 highlights the 15 most commonly observed waterbirds seen in the Refuge's Coastal Plain during aerial surveys from 1992-2015 (Stehn et al. 2013).

Because bird distributions are so closely linked across neighboring ecoregions along the coast, the Refuge's entire Arctic Coastal Plain is combined with a portion of the Brooks Foothills to form the Northeast Arctic Coastal Plain IBA. In terms of political boundaries, this IBA overlaps most of the 1002 Area and extends further east to encompass adjacent coastal wetlands (see Map 2). The Northeast Arctic Coastal Plain IBA contains globally significant abundances of American Golden-Plovers, Buff-breasted Sandpipers, and Pectoral Sandpapers, and continentally or state-significant abundances of 11 other species (Audubon Alaska 2014). Additional data indicates that this IBA may also be a global IBA for a further six shorebird species (Brown et al. 2007).

Just east of the Arctic Refuge are two Canadian coastal IBAs: Nunaluk Spit to Hershel Island, and Babbage and Spring River Deltas. Nunaluk Spit to Hershel Island IBA supports myriad bird species, including the largest Black Guillemot colony in the Western Arctic, the highest density of breeding Rough-legged Hawks ever reported, and large abundances of migrating, staging, and molting shorebirds, waterfowl, and gulls (BirdLife International 2017). Just southeast of Hershel Island, the bays and wetlands of the Babbage and Spring River Deltas seasonally host as much as 4% of the global population of Black Brant, as well as many breeding waterfowl (BirdLife International 2017).

BARRIER ISLANDS

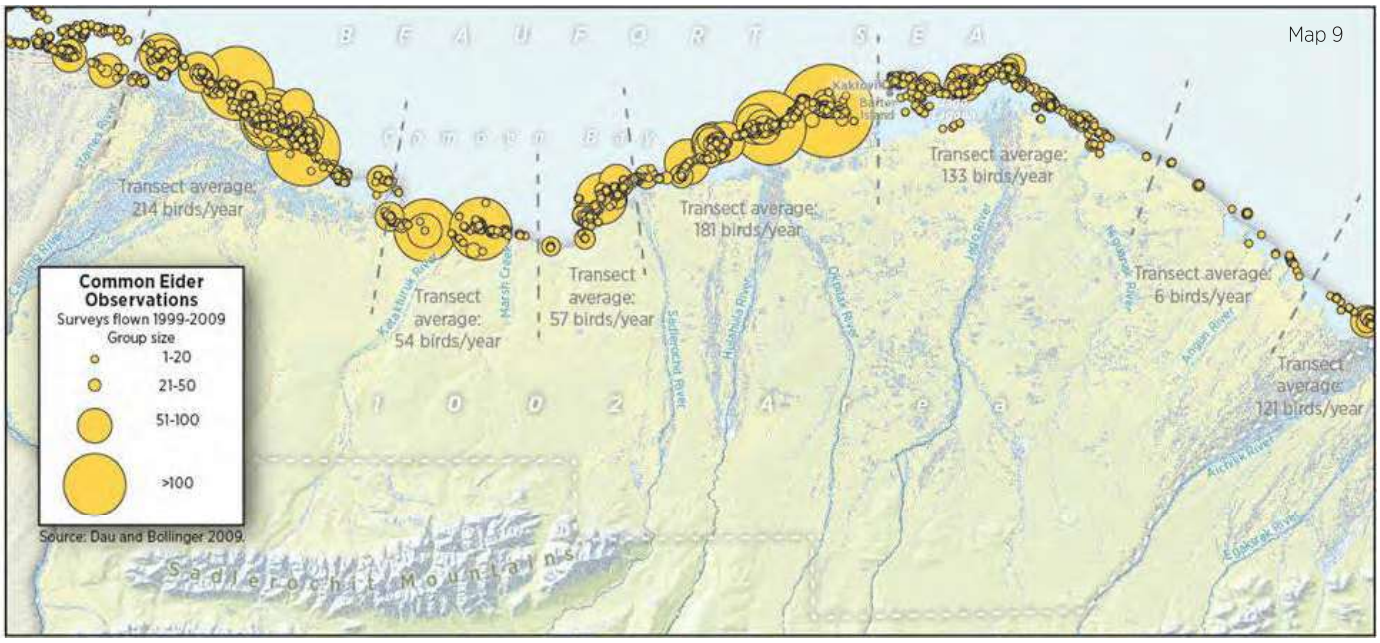
Although technically part of the Arctic Coastal Plain ecoregion, the expansive network of barrier islands in the Beaufort Sea nearshore play a critical ecological role in and of themselves. The constantly shifting islands shelter the Arctic Coastal Plain from the Beaufort Sea, providing breeding habitat for a variety of seabirds. Ocean currents and storm surges rapidly erode these islands while also delivering the critical structural feature for nesting birds: driftwood. Although Arctic tundra is completely devoid of large trees,

the Arctic Ocean's coastline receives a continual supply of logs from boreal forest-draining rivers such as the Mackenzie (Hole and Macias-Fauria 2017).

The nesting habits of the Common Eider (*Somateria mollissima*), North America's largest duck, take advantage of this unique resource (Noel et al. 2005). The Pacific subspecies (*S. mollissima v-nigrum*) of Common Eider nests in two main areas: coastal portions of the Yukon-Kuskokwim Delta and barrier islands along the Beaufort Sea. Although these populations are generally mixed in the winter, high female site fidelity means that these populations should be considered geographically distinct (Petersen and Flint 2002). The eiders found in the Arctic Refuge's Coastal Plain winter south of the Bering Strait. During spring migration, these birds follow the sea-ice edge to dense nesting colonies on exposed barrier islands on the Beaufort Sea coast. Nest site selection is of critical importance on otherwise exposed barrier islands: Common Eiders choose sites surrounded by driftwood or vegetation as a visual barrier to predators such as foxes and as a physical barrier against wind and cold ambient temperatures (Noel et al. 2005; Schamel 1977).

The barrier islands of the Arctic Refuge are especially important habitat for Pacific Common Eiders. This region supports about 30% of all Common Eiders observed across the entire Arctic Coastal Plain, despite covering only about 15% of the area's shoreline (Dau and Bollinger 2009). These high nesting densities are shown below in Map 9.

In addition to providing terrestrial nesting sites, the Arctic Refuge's barrier islands also contribute to marine foraging habitat. The islands entrain freshwater and riverine sediment discharged by braided river deltas, creating a network of shallow, brackish lagoons. On the seaward side of the islands – or offshore of the coastline where no islands exist – the Beaufort continental shelf also provides critical resources for nesting and migrating birds. The lagoon and marine habitats are combined into the Beaufort Sea Nearshore IBA (see Map 2), a large swath extending from the Refuge's Angun River delta to Cape Halkett near Teshekpuk Lake. This IBA harbors significant abundances of 14 species, with particularly high concentrations of Long-tailed Ducks (*Clangula hyemalis*), Surf Scoters, phalaropes (*Phalaropus* spp.), and eiders (*Somateria* spp.) just offshore of the Arctic Refuge's barrier islands (Smith et al. 2014). Many of these species nest nearby and make foraging trips into the marine waters that comprise the IBA.



Map 9. Breeding Common Eider observations, 1999-2009. Highest average densities are on the barrier islands offshore of the Canning River delta and on Arey Island. Data from Dau and Bollinger (2009).

Pectoral Sandpiper. Photo: Mick Thompson

Conservation Issues

IMPACT ASSESSMENT AND POLITICAL BOUNDARIES

Environmental impact assessments are conducted based on political boundaries. However, ecological reality often precludes a simple, combined analysis. In this case, the 1002 Area is comprised not just of the Arctic Coastal Plain ecoregion, but also the Brooks Foothills. Because these ecoregions have significantly different geophysical drivers of their ecology, potential oil and gas impacts would be dramatically different. For example, in the Arctic Coastal Plain, an oil spill may have a larger chance of being locally contained in a contaminated wetland complex, given the minimal drainage among many thaw lakes. However, in the Brooks Foothills, drainage patterns are much more dynamic, and spilled oil could be quickly carried downstream by the network of rivers into the highly productive lagoon ecosystem, washed up onto barrier islands, and carried offshore into the marine environment by consistent currents. Thus, a terrestrial spill in the Arctic Refuge's 1002 Area likely has a much higher chance of covering a significantly larger area and far more species—from shorebirds to ducks to bowhead whales to polar bears—than a similar spill in the Prudhoe Bay area.

Much of what scientists, industry engineers, and decision-makers know about oil and gas impacts is simply unknown in the Brooks Foothills ecoregion—there have been no oil production wells drilled anywhere in the Brooks Foothills. The known impacts of gravel mining, transportation corridors, and other oil-related development are specific to the Arctic Coastal Plain. Even the biological values of the Brooks Foothills remain largely unstudied—this area has only ever been surveyed for breeding birds on a handful of plots and is deliberately excluded from annual aerial surveys because of its ecological differences. It would be scientifically inappropriate to generalize what is known about the Arctic Coastal Plain to the Brooks Foothills. Before any oil and gas leasing occurs, these two drastically different ecoregions should be explicitly analyzed separately, including

gathering the necessary data to adequately describe potential impacts.

ANTHROPOGENIC INFLUENCES ON NEST PREDATION

Within the Arctic Coastal Plain, predation is the most common source of nest failure (Bentzen et al. 2008; Liebezeit et al. 2009; Meixell and Flint 2017). Key predators include Arctic foxes (*Vulpes lagopus*), red foxes (*Vulpes vulpes*), Glaucous Gulls (*Larus hyperboreus*), and Common Ravens (*Corvus corax*), all of which can benefit from aspects of human development such as food subsidies and artificial denning, nesting, or perching habitat (Lehner 2012; Liebezeit et al. 2009). However, lack of sufficient baseline data and high interannual variability make it difficult to draw any definitive conclusions about whether oil field development has resulted in increased predator densities (Liebezeit et al. 2009).

Regardless of whether oil development draws in more predators, anthropogenic disturbance can elevate the risk of nest failure. Predation rates dramatically increase when the attendant bird takes an incubation break, whether due to natural recess or due to disturbance (Meixell and Flint 2017; Stien and Ims 2016). Interspecific differences exist, with nesting Common and King Eiders easily disturbed by humans (Bentzen et al. 2008; Bolduc and Guillemette 2003). However, not all disturbances are equal: indirect sources such as aircraft or vehicular traffic may be less impactful than direct human encroachment (Meixell and Flint 2017).

HABITAT LOSS, OIL SPILLS, AND DISTURBANCES

Oil development causes a wide range of known and observed ecological impacts, including displacement of calving caribou, vegetation damage from dust fallout, degradation of permafrost, and general disturbance of wildlife. These impacts begin in the pre-leasing stages (e.g. seismic testing), continue through exploration (e.g. water extraction and ice road construction) and development (e.g. gravel mining and gravel pad placement), and persist well after planned decommission (melted permafrost, for example, will never recover to its pre-development state). Key information regarding many of these impacts is reviewed in Sullender (2019) and Sullender (2017).

CLIMATE CHANGE

Breeding birds are likely to be impacted by several aspects of climate change. Sullender (2019) reviews climate change impacts on migratory birds—most of which also breed—in the Arctic Refuge, with specific focus on potential phenological mismatches and uncertainty as a result of spatial and temporal heterogeneity.

Broadly, climate-driven changes to breeding bird habitat in the Arctic are predicted to be mostly negative. Shifts in vegetation communities and resource abundance are predicted to dramatically reduce habitat quality and extent for many Refuge-breeding birds, from Lapland Longspurs in particular (Boelman et al. 2015) to Arctic-breeding shorebirds in general (Galbraith et al. 2014). Birds that breed on the Arctic Coastal Plain have very few alternatives—if these species are displaced north by changing conditions, no additional habitat exists since they are already at the limits of their range (Galbraith et al. 2014). Habitat loss will also have a variety of indirect impacts on breeding birds. For example, as sea ice declines, polar bears may turn to terrestrial sites for foraging opportunities, including barrier islands and coastal nesting habitat. Polar bear depredation of Common Eider nests may increase in the future, even though these losses are expected to be offset by climate-mediated increases in breeding productivity (Dey et al. 2018).

Brooks Foothills. Photo: Rebecca Sentner

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