Alaska Shorebird Group

# *Annual Summary Compilation*

# New or ongoing studies of Alaska shorebirds

**December 2018**

Photo above: A stitched image of a flock that estimated at more than 7,000 godwits near the mouth of the Opagyarak River on the Yukon Delta National Wildlife Refuge. Photo by: Dan Ruthrauff

# EXECUTIVE SUMMARY

Welcome to the 2018 summary report of ongoing or new studies of Alaska shorebirds. This is the eighteenth consecutive report put together by the Alaska Shorebird Group (ASG). In this document, members of the ASG compiled annual summaries for **31 studies** and **23 publications** in this year alone. The Alaska Shorebird Group continues to be a highly collaborative organization with a large membership of productive principal investigators both within and beyond Alaska. This annual compilation is the only written record we have of projects addressing shorebirds occurring in the state of Alaska and provides a valuable timeline of shorebird science activities for this region. This year, in order to reach a broader readership, we have added an online story map version of this report, albeit with the omission of some figures and tables. Share the link with colleagues, friends, and those interested in learning about shorebirds.

To see where projects are situated, visit our story map (link provided below) and click each shorebird icon on the map to read about the work being done in the indicated location within the state. Additionally, some projects include work that occurs outside of Alaska; this is indicated in each project description. I would also like to thank investigators, research technicians, and skilled photographers that made this report possible. I'm honoured (Canada, eh?) to be a part of the shorebird research community here in Alaska, so thank you all for my time as Secretary for the Alaska Shorebird Group.

Lisa Kennedy, PhD Candidate

Secretary, Alaska Shorebird Group


To see where shorebird research is happening in the state and a brief project summary, visit https://uploads.knightlab.com/storymapjs/24062d881c0d738b741054e3c7078996/alaska-shorebird-group-annual-report/index.html.

# TABLE OF CONTENTS

# #1— ALASKA SHOREBIRD CONSERVATION PLAN, VERSION III

Investigators: Alaska Shorebird Group

In recognition of 1) declines among perhaps half of Alaska's breeding shorebirds, 2) ongoing or emerging threats to shorebirds and their habitats, and 3) considerable knowledge of Alaska's shorebirds acquired since Version II of the Alaska Shorebird Conservation Plan in 2008, we, the Alaska Shorebird Group, determined during our December 2015 meeting that it was time to revise our plan again. Some three years in the making, the third version of the plan should be available by early 2019. We again structured the plan in two parts: Part I describes Alaska's nearly 30 priority species, their conservation threats, and strategies to improve statewide conservation, and Part II looks at these three elements for our five Bird Conservation Regions (BCR; Aleutians, Western Alaska, Arctic, Interior Forest, Southeast). In addition to special recognition paid to our species of greatest and high conservation concern, we newly included "Stewardship" species for which Alaska supports at least half of a population during its annual cycle. Climate change and severe weather, pollution, and energy- and mining-related activities ranked highest among conservation threats in Alaska. In addition to our holdover tools for implementing conservation (research, inventory/monitoring, habitat management/protection, education/outreach, international collaboration), we introduced an evaluation of conservation progress to increase accountability. Based on considerable advances in tracking technologies largely unavailable prior to Version II, this plan stresses conservation approaches that recognize species' full annual cycles. Indeed, this was truly a collaborative effort among many ASG members, including regional BCR panels and editors, priority species experts, and a central editorial team that updated figures, tables, appendices, and Part I.

*Contact:* Chris Harwood, U. S. Fish and Wildlife Service, Kanuti NWR, 101 12th Ave., Room 206, Fairbanks, AK 99701; phone: (907) 455-1836; email: christopher_harwood@fws.gov

## #2 — COPPER RIVER DELTA SHOREBIRD FESTIVAL

Investigators: Erin Cooper and Melissa Gabrielson, USDA Forest Service, Cordova, Alaska

The 28th annual shorebird festival was held on 3–6 May 2018. The Copper River Delta Shorebird Festival is a collaborative event with partners from the Cordova Chamber of Commerce and the USDA Forest Service, Cordova Ranger District. The Festival focuses on educating the public about birds, bird conservation, and bird life cycles and strategies through a variety of activities, classes, crafts, and workshops.  This year's festival featured guest speakers from Central and South America, as well as western coastal Alaska. Yenifer Díaz of Panama Audubon and Diana Eusse from Asociacion Calidris (Cali, Colombia) presented on the importance of wetlands along the Pacific Flyway as birds migrate north and south across continents, without concept of borders. Kristine Sowl joined the festival from the Yukon Delta National Wildlife Refuge in western Alaska, where many shorebirds are headed after their integral stopover on the rich mudflats of the Copper River Delta. This year's keynote speaker was Dr. Stephen Kress, Vice-President for Bird Conservation for the National Audubon Society and Director of the Audubon Seabird Restoration Program, as well as Hog Island Audubon Camp. Dr. Kress is the founder of Project Puffin, and manages nesting sites for over 43,000 colonial seabirds on the coast of Maine. He presented on seabird conservation and highlighted lessons learned from puffins applicable to bird conservation worldwide. Maya, the Western Sandpiper, was able to make an appearance at the 2018 Festival. She provided excitement within the community about the Festival and helped educate the public about the interconnectivity of shorebirds and their international ties. Copper River Delta Birds by Hand, was an exciting new addition to the festival. The Net Loft Traditional Handcrafts, invited makers of all kinds to craft their own birds and send it on a "migration" to Cordova to be displayed on exhibit during the festival. A Cocktail Hour Cruise with Major Marine Tours and a guided field trip to Alaganik Slough were also part of the Festival weekend.

This festival meets objectives listed under Environmental Education and Public Outreach of the Alaska Shorebird Conservation Plan to raise the profile of Alaska's shorebirds by supporting shorebird festivals in Alaska and by collaborating with education programs on the Copper River Delta and elsewhere.

Viewing shorebirds at Hartney Bay. Photo by: Mirna Borrego

*Location:* Copper River Delta: 60° 22.7' N, 145° 53.6' W

*Contact:* Melissa Gabrielson, U.S. Forest Service, Chugach National Forest, Cordova Ranger District; PO Box 280, Cordova, AK 99574; Phone: (907) 424-7661 x 243; Email: melissalgabrielson@fs.fed.us

# #3— COPPER RIVER DELTA SHOREBIRD SURVEYS

Investigators: Hillary Chavez, Environment for the Americas Intern, USDA Forest Service, Cordova Alaska

Shorebird populations are valuable indicators of estuarine biodiversity and the health of wetland ecosystems. Healthy wetlands provide shorebirds with an ideal habitat for feeding, resting, and raising young. As a major component of their life history, migration is energetically expensive for shorebirds. Depending on the shorebird species, flocks migrate from their wintering grounds in the southern cone of South America to their breeding grounds in the Arctic Circle of Alaska and Canada. Due to this long journey, shorebirds require stop-over sites to refuel and replenish fat reserves. Stop-over sites can be found all along the coasts of North and South America.

One essential stop-over site for millions of migrating shorebirds is the Copper River Delta (CRD). In fact, the CRD has been designated by the Western Hemisphere Shorebird Reserve Network as having "hemispheric importance." Within the CRD lies the town of Cordova. Cordova not only provides essential habitat for shorebirds during migration, but is also an accessible natural area for the public. Every May Cordova celebrates the arrival of shorebirds with the Copper River Delta Shorebird Festival. The festival is an important outreach event that encourages the community and festival participants to learn about the biodiversity and ecological importance of the CRD to migrating shorebirds. As a partner in the festival, the United States Forest Service (USFS) has collaborated with Environment for the Americas (EFTA) to bring Latino interns to Cordova to assist with the festival and conduct the Pacific Flyway Shorebird Surveys.

The Pacific Flyway Shorebird Survey (PFSS), hosted by Point Blue Conservation, is a set of international surveys spanning 10 countries in collaboration with more than 30 partner organizations along the Western Hemisphere. The survey conducted in Cordova is the Copper River Delta Shorebird Survey (CRDSS). The goal of the PFSS and CRDSS is to monitor shorebird species' population trends and habitat conditions along the Pacific Flyway. Information from these surveys can fill in knowledge gaps and guide resource managers in making informed decisions on how to best conserve shorebird habitats in the face of environmental change.

A total of 133,324 shorebirds were counted in the three designated survey sites in 2018: Odiak Slough, 3 Mile Bay, and Hartney Bay. This total was less than in 2017 (229,582) but more than in 2016 (51,681). The peak number of shorebirds for 2018 occurred on 4 May with 24,931 shorebirds.

The most abundant shorebirds species observed were mixed flocks of Western Sandpipers and Least Sandpipers with a total of 88,935 or 67% of the total shorebirds observed. The second most abundant population of shorebirds observed were mixed flocks of Western Sandpipers, Least Sandpipers, and

Dunlin at 32%. Other shorebirds or focal species that were abundant during surveys included Whimbrels and Semipalmated Plovers.

These surveys meet objectives listed under Environmental Education and Public Outreach and Population Monitoring of the Alaska Shorebird Conservation Plan.

Volunteers help Hillary Chavez, Environment for the Americas Intern, complete shorebirds surveys at Odiak Slough. Photo by: Mirna Borrego

*Location:* Copper River Delta: 60° 22.7' N, 145° 53.6' W

*Contact:* Melissa Gabrielson, U.S. Forest Service, Chugach National Forest, Cordova Ranger District; PO Box 280, Cordova, AK 99574; Phone: (907) 424-7661 x 243; Email: melissalgabrielson@fs.fed.us

# #4— PRUDHOE BAY LONG-TERM NEST MONITORING

Investigators: Rebecca Bentzen and Martin Robards, Arctic Beringia Program, Wildlife Conservation Society

Since 2003, the Wildlife Conservation Society, in cooperation with BP Exploration (Alaska), Inc., has monitored nest survivorship, nest predator abundances, predator identity, and other parameters that may influence nesting success in the Prudhoe Bay Oilfield. This ongoing monitoring effort is allowing a better understanding of potential impacts from industry, climate change, and other factors on breeding birds.

In 2018 we discovered and monitored 94 nests of 10 tundra-nesting species (8 shorebird species) from 14 June to 13 July on 12 10-ha study plots using both rope drag and behavioral nest search techniques. Semipalmated Sandpiper, Pectoral Sandpiper, and Lapland Longspur nests accounted for the majority (57%) of those found. During the 2018 season, we found slightly higher nest numbers than in 2017, but lower than previous years, which may be due to the later onset of spring and increased snow and ice during nest initiation in 2017 and 2018. Nests initiated between 6 June and 9 July 2018, which is about a week later than in 2017 when initiation ranged from 30 May to 2 July (Figure 1). Of the 94 nests found, 47 were successful, 30 were depredated, 4 were abandoned, 1 was trampled by caribou, and 12 were of unknown or undetermined cause(s) (Table 1). For shorebirds, this is a 59% apparent nest success, which is similar to that seen in previous years at Prudhoe.

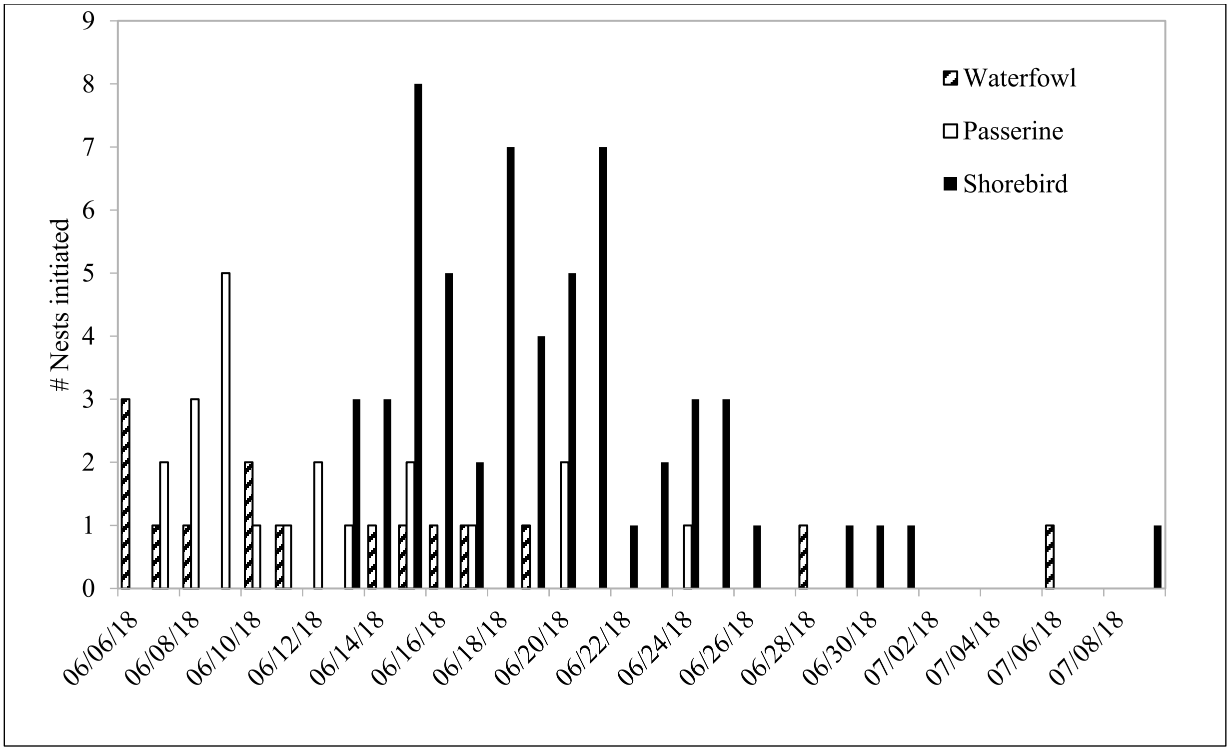
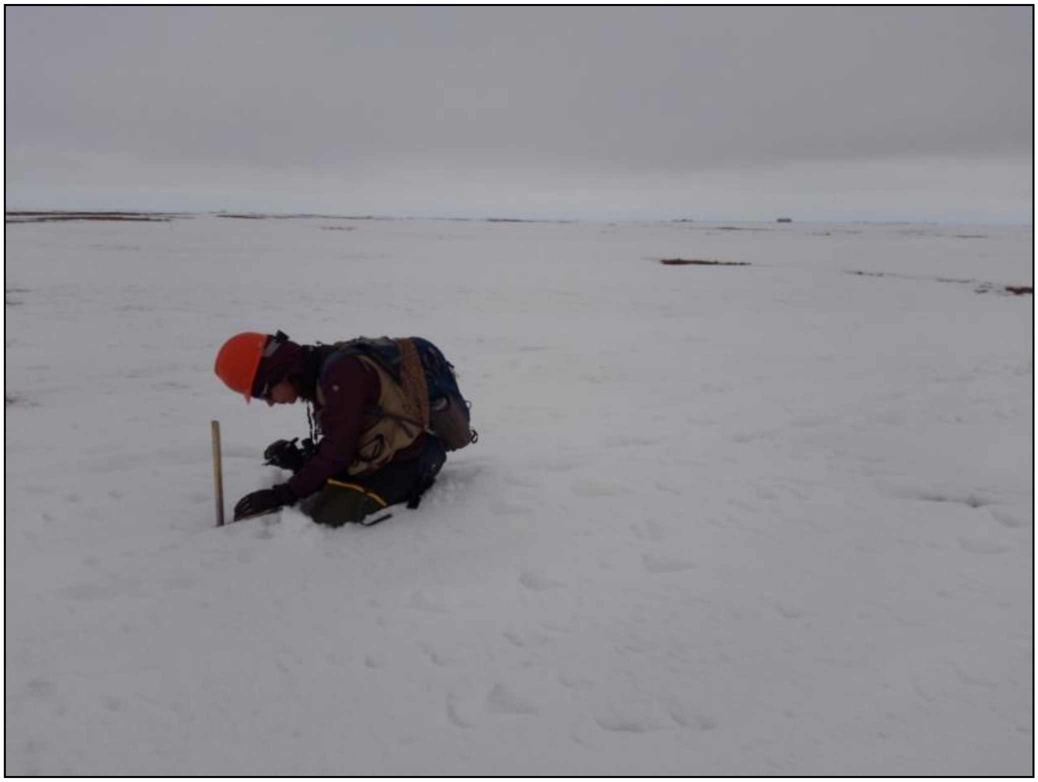



Table 1. Numbers and fates of nests found on the long-term nest monitoring plots in Prudhoe Bay, 2018.

Buff-breasted Sandpiper chicks in a nest (*photo credit Peter Detwiler/WCS*).

Figure 1. Number of nests initiated on each date, Prudhoe Bay, Alaska, 2018

| Species | Nests | Success | Predation | Unknown | Abandoned | Trampled | Undetermined |
|---|---|---|---|---|---|---|---|
| **Shorebirds** | | | | | | | |
| Semipalmated Sandpiper | 22 | 14 | 4 | 3 | 0 | 1 | 0 |
| Red-necked Phalarope | 12 | 7 | 2 | 1 | 1 | 0 | 1 |
| Pectoral Sandpiper | 11 | 7 | 3 | 1 | 0 | 0 | 0 |
| Stilt Sandpiper | 4 | 2 | 1 | 1 | 0 | 0 | 0 |
| Red Phalarope | 3 | 2 | 1 | 0 | 0 | 0 | 0 |
| Dunlin | 3 | 2 | 0 | 1 | 0 | 0 | 0 |
| Long-billed Dowitcher | 2 | 0 | 0 | 1 | 1 | 0 | 0 |
| Black-bellied Plover | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| **Waterfowl** | | | | | | | |
| Greater White-fronted Goose | 13 | 7 | 5 | 1 | 0 | 0 | 0 |
| Long-tailed Duck | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Greater Scaup | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| **Passerines** | | | | | | | |
| Lapland Longspur | 21 | 6 | 11 | 2 | 2 | 0 | 0 |
| **Total** | **94** | **47** | **30** | **11** | **4** | **1** | **1** |



Relabeling plots in the early season, Prudhoe Bay, Alaska (*photo credit Peter Detwiler/WCS*)

*Location:* Prudhoe Bay, Alaska, Arctic Coastal Plain, 70.30754° N, 148.6104° W

*Contact:* Rebecca Bentzen, Wildlife Conservation Society, 3550 Airport Way unit 5, Fairbanks, AK. 99709; Phone: 907.505.0071; email: rbentzen@wcs.org

# #5—KACHEMAK BAY SHOREBIRD MONITORING PROJECT

Investigators: George Matz and Kachemak Bay Birders volunteers.

In May 2018, Kachemak Bay Birders, based in Homer, Alaska, completed its tenth consecutive year of shorebird monitoring. The main purpose of this citizen science project is to attain a better understanding of the status of shorebird populations in the Kachemak Bay area, particularly during spring migration, and to add to our enjoyment of watching shorebirds. Secondary purposes are: 1) to contribute information that might be useful to others assessing shorebird populations across the entire Pacific Flyway, and 2) to use the monitoring data to help protect Kachemak Bay/Homer Spit shorebird populations and habitat.

Between 14 April and 24 May 2018 we had nine monitoring sessions. We simultaneously monitored four sites on the Homer Spit as well as Beluga Slough and the south side of the bay by boat for two hours once every five days when the outgoing tide reached 15.0 feet (or at high tide if less). These tide conditions provide consistency and optimized shorebird viewing conditions. We continued monitoring at Anchor Point/River and the Kasilof River, where we now have six years of data. This year we added the upper part of Seldovia Bay to our sites, which had some access challenges. We had a total of 52 volunteers participate in this year's effort. We also recorded any disturbance to shorebirds, which were minimal this year.

This year at the Kachemak Bay sites (excluding Seldovia Bay) we observed a total of 24 species of shorebirds and counted a total of 18,709 individual shorebirds (adjusted for a slight amount of double-counting between sites). Our average for the past ten years has been 24 species and 13,688 individual shorebirds. There were no rare species, although a Bristle-thighed Curlew was reported and verified on eBird on one of our non-monitoring days. Our supplemental analysis, which uses eBird data to get some idea of shorebirds that may have come and gone between scheduled monitoring dates included a count of 72,092 shorebirds at Kachemak Bay hotspots during our monitoring period. It should be noted that although obvious duplicate reports were subtracted from this total, there probably still is significant double-counting in the supplemental data.

At the Anchor River, which is about 15 miles north of Homer, we saw a total of 25 species of shorebirds and the total count was 1,162. The six-year average for this site is 19 species of shorebirds with a count of 1,759 shorebirds. At the Kasilof River, about 60 miles north of Homer, we saw 20 species of shorebirds and had a total count of 16,899 shorebirds. The five-year average for this site is 17 species of shorebirds with an average count of 8,558 shorebirds.

All of these observations, plus other species of birds seen, were entered in eBird. The monitoring data spreadsheets can be viewed at http://kachemakbaybirders.org/ .

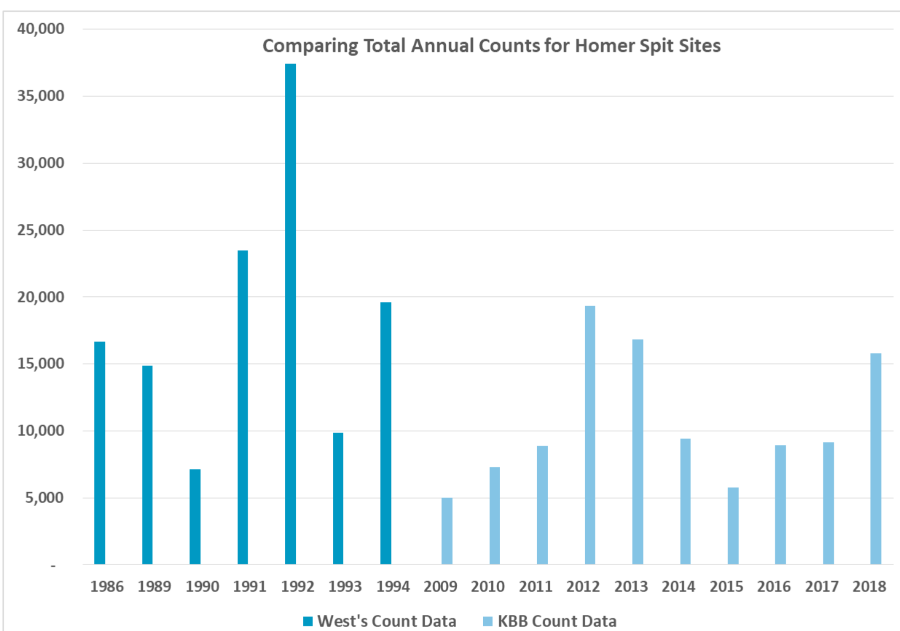
The table below lists all the species seen at all Kachemak Bay sites, plus their total count for that year.

| | **2009-2018 Kachemak Bay Shorebird Count** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Sorted by average abundance** | | | | | | | | | | | |
| # of Sp. | Species | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | **Average** |
| 1 | Western Sandpiper | 3,229 | 4,996 | 4,100 | 16,375 | 7,964 | 4,000 | 2,267 | 1,403 | 7,225 | 14,508 | 6,607 |
| | LESA/WESA/SESA | 104 | 803 | 3,336 | 844 | 5,305 | 987 | 306 | 6,269 | 360 | 404 | 1,872 |
| 2 | Red-necked Phalarope | 1,630 | 1,500 | 5,152 | 1,501 | 703 | 3,006 | 1,503 | 39 | 102 | 1,025 | 1,616 |
| 3 | Surfbird | 292 | 110 | 574 | 2,919 | 748 | 2,644 | 2,111 | 1,335 | 1,186 | 715 | 1,263 |
| 4 | Dunlin | 1,097 | 561 | 1,283 | 1,205 | 2,548 | 1,530 | 826 | 508 | 590 | 928 | 1,108 |
| 5 | Semipalmated Plover | 194 | 203 | 197 | 142 | 92 | 251 | 273 | 270 | 246 | 322 | 219 |
| 6 | Black-bellied Plover | 179 | 315 | 282 | 354 | 221 | 114 | 210 | 107 | 80 | 135 | 200 |
| 7 | Least Sandpiper | 136 | 245 | 219 | 103 | 128 | 195 | 168 | 245 | 102 | 164 | 171 |
| 8 | Black Turnstone | 81 | 373 | 121 | 71 | 21 | 56 | 352 | 55 | 122 | 92 | 134 |
| 9 | Rock Sandpiper | 141 | 405 | 482 | 6 | 4 | 6 | 6 | 4 | 47 | 12 | 111 |
| | Dowitcher sp. | 99 | 82 | 57 | 76 | 344 | 49 | 65 | 17 | 14 | 139 | 94 |
| 10 | Greater Yellowlegs | 24 | 36 | 59 | 68 | 90 | 24 | 39 | 44 | 58 | 59 | 50 |
| 11 | Wandering Tattler | 13 | 56 | 30 | 18 | 62 | 39 | 39 | 58 | 58 | 55 | 43 |
| 12 | Short-billed Dowitcher | 125 | - | 33 | 76 | 18 | 15 | - | 20 | 57 | 24 | 37 |
| 14 | Whimbrel | 10 | 22 | 27 | 28 | 65 | 26 | 28 | 43 | 51 | 25 | 33 |
| 13 | Pacific Golden Plover | 5 | 42 | 5 | 95 | 96 | 17 | 4 | 23 | 13 | 16 | 32 |
| 15 | Pectoral Sandpiper | - | 7 | - | 1 | 146 | 98 | 11 | - | 15 | 11 | 29 |
| 16 | Long-billed Dowitcher | - | - | 15 | 1 | 22 | 36 | - | 1 | 37 | 7 | 12 |
| 17 | Semipalmated Sandpiper | 1 | 5 | 3 | 34 | - | 13 | 33 | 3 | 10 | 10 | 11 |
| 18 | Black Oystercatcher | 11 | 11 | 13 | 8 | 2 | 8 | 18 | 15 | - | 7 | 9 |
| 19 | Lesser Yellowlegs | - | 26 | 3 | 15 | 9 | 4 | 11 | 1 | 5 | 13 | 9 |
| 20 | Marbled Godwit | 3 | 12 | 1 | 7 | - | 8 | 5 | 5 | 11 | 29 | 8 |
| 21 | Ruddy Turnstone | 1 | 10 | 1 | 2 | 9 | 2 | 6 | 9 | 7 | 3 | 5 |
| | Yellowlegs sp. | 2 | 18 | - | 2 | 2 | - | 5 | - | 15 | 1 | 5 |
| 22 | Hudsonian Godwit | 18 | - | 2 | - | 3 | 3 | - | - | 1 | 3 | 3 |
| 23 | Sanderling | - | 1 | 8 | 8 | - | 2 | - | - | - | 1 | 2 |
| 24 | American Golden-Plover | 3 | 1 | 1 | 1 | 10 | - | - | - | - | - | 2 |
| 25 | Bar-tailed Godwit | 3 | - | - | 4 | 6 | - | - | 1 | 1 | 1 | 2 |
| 26 | Wilson's Snipe | 1 | 5 | 1 | 1 | - | - | - | - | - | - | 1 |
| 27 | Baird's Sandpiper | 1 | - | - | 6 | - | - | - | 1 | - | - | 1 |
| 28 | Bristle-thighed Curlew | - | - | - | - | 5 | - | - | - | - | - | 1 |
| 29 | Red Phalarope | - | - | - | - | - | 5 | - | - | - | - | 1 |
| 30 | Spotted Sandpiper | 3 | - | - | 1 | - | - | - | 1 | - | - | 1 |
| 31 | Red Knot | - | - | 2 | - | - | 1 | 1 | - | - | - | 0 |
| | **Total Individuals** | 7,406 | 9,845 | 16,007 | 23,972 | 18,623 | 13,139 | 8,287 | 10,477 | 10,413 | 18,709 | 13,688 |
| | **Total Species** | 24 | 23 | 25 | 27 | 23 | 25 | 21 | 23 | 22 | 24 | 24 |

One of the most exciting events this year was a large pulse of shorebirds (about 75% Western Sandpipers and 25% Dunlin) that arrived on the Homer Spit on 6 May. This wowed Homer birders; many were lined up on the spit road enjoying this aerial ballet. The estimate by those with years of experience in counting shorebirds was that there were at least 20,000 shorebirds there at the time. It was difficult to estimate a count since it appeared that birds were arriving and leaving at the same time. Although most of these birds had left before our next monitoring date (9 May), new arrivals still provided a count of 6,904 Western's and 460 Dunlin.

Figure 1. Some of the sandpipers that arrived at Mud Bay on 6 May.

One of our objectives each year is to compare our monitoring results with that of the late George West from 1986 through 1994. To provide a more direct comparison, adjustments had to be made to the data. Despite our more intensive approach, Homer Spit monitoring over the past ten years has counts that on average are only about 58% of what George West had observed. But while there has been an obvious decline in the number of shorebirds that stopover at Homer Spit, it doesn't appear that a decline in the number of shorebirds is continuing.



Kachemak Bay is in BCR 4 Northwestern Interior Forest. Most of the objectives for this BCR pertain to breeding shorebirds. The importance of Kachemak Bay for shorebirds is to provide a stopover with abundant food and little human disturbance on its intertidal mud flats and rocky shores. Consequently, most of the objectives don't apply to our project. But the ones that do are;

- Assess the use of ephemeral habitats by migrant shorebirds and identify any important areas.
- Assess shorebird use of Cook Inlet in winter.

We have identified the important shorebird stopovers on the Cook Inlet side of the Kenai Peninsula and have been monitoring the spring migration of those that are accessible. Also, our monitoring begins while some of the Rock Sandpipers that overwinter in the Kachemak Bay area are still in the area. We have noted that in years with warm springs, Rock Sandpipers leave early and there have been some years when we have missed them.

*Contact:* George Matz, PO Box 15182, Fritz Creek, AK 99603
Phone: 907 235-9344 email: geomatz41@gmail.com

# #6— REPRODUCTIVE ECOLOGY OF SHOREBIRDS: STUDIES AT UTQIAĠVIK (FORMERLY BARROW), ALASKA, IN 2018

Investigators: Richard Lanctot, U.S. Fish and Wildlife Service; Sarah Saalfeld, U. S. Fish and Wildlife Service

In 2018, we conducted the 16th year of a long-term shorebird study at Utqiaġvik (formerly Barrow), Alaska. The objectives of this study are to (1) collect baseline data on temporal and spatial variability of shorebird diversity and abundance, (2) collect information on nest initiation and effort, replacement clutch laying, clutch and egg size, nest and chick survival, and other demographic traits of Arctic-breeding shorebirds, (3) establish a marked population of as many shorebird species as possible that will allow us to estimate adult survival, mate and site fidelity, and natal philopatry, and (4) relate weather, food availability, and predator and prey abundances to shorebird productivity.

The summer of 2018 had the latest snow melt recorded in the past 16 years, with 20% snow cover remaining on the tundra until 24 June (average long-term date is 10 June). Lemming numbers in 2018 were slightly higher than the previous few years, but far below that experienced in 2006 and 2008. Despite the lack of lemmings, avian predator densities were still fairly high. Arctic foxes were also fairly common, as fox trapping efforts were not conducted in 2018.

We located and monitored nests in six 36-ha plots in 2018. All six plots were the same as those sampled in 2017, with five of the six plots sampled since 2005; all plots were searched with the same intensity as in past years. A total of 180 nests were located on our plots and an additional 81 nests were found outside the plot boundaries. Our total number of nests located on plots was lower than the past ten years (i.e., 2008–2017 where number of nests ranged from 219–506), but generally higher than the first five years of this study (i.e., 2003–2007; only 2006 had more nests with 318; all other years ranged from 75–177 nests/year). Nests on plots included 65 Red Phalarope, 33 Pectoral Sandpiper, 29 Semipalmated Sandpiper, 28 Dunlin, 10 American Golden-Plover, 9 Red-necked Phalarope, 4 Western Sandpiper, and 2 Long-billed Dowitcher. No Ruddy Turnstone, White-rumped, Baird's, or Buff-breasted sandpiper nests were found on the plots in 2018. The breeding density of all shorebird species on our study area was 83.3 nests/km$^2$ in 2018; this was less than our long-term average of 126.3 nests/km$^2$. In 2018, only two species nested in slightly higher densities than the 16-year average (American Golden-Plover and Red-necked Phalarope); all others nested at densities below the 16-year average.

The first shorebird clutch was initiated on 9 June—8 days later than the long-term average of 1 June. Median initiation date was 22 June—7 days later than the long-term average. Median nest initiation dates for the more abundant species were 18 June for Dunlin, 20 June for Semipalmated Sandpiper, 22 June for Red Phalarope, and 27 June for Pectoral Sandpiper; all 7–10 days later than their respective 16-year averages.

Predators destroyed 85.7% of the known-fate nests in 2018 (excluding human-caused mortalities). This is substantially greater than the long-term average of 34.7%, but only somewhat greater than the 62.2% average for other years without fox control (2003–2004). Apparent hatching success (# hatching at least one young/total number of known-fate nests) was highest in Dunlin (33.3%), Red-necked Phalarope (33.3%), and Red Phalarope (30%), and lowest in Semipalmated Sandpiper (25%), American Golden-plover (20.0%), Pectoral Sandpiper (19.4), Long-billed Dowitcher (0.0%), and Western Sandpiper (0.0%).

We captured and color-marked 259 adults located both on and off plots. This was more than the 170 banded in 2017, but less than the 16-year average of 285. Twenty-five of these adults (19 Dunlin, 3 Semipalmated Sandpiper, 1 American Golden-plover, 1 Red Phalarope, and 1 Western Sandpiper) had been banded as adults in a prior year. Adults captured included 104 Red Phalarope, 75 Dunlin, 28 Semipalmated Sandpiper, 28 Pectoral Sandpiper, 15 American Golden-plover, 5 Red-necked Phalarope, and 4 Western Sandpiper. We also re-sighted 44 adults banded in prior years while nesting on our plots in 2018. This included 24 Dunlin, 15 Semipalmated Sandpiper, and 5 American Golden-Plover. We captured and color-marked 160 chicks. This was less than the 16-year average of 513.

We continued to collect data for other Arctic-wide collaborations focused on 1) tracking shorebirds during the post-breeding period (see Richard Lanctot entry), 2) measuring the cascading impacts of indirect trophic interactions on nest success, renesting in Red Phalaropes (see Jillian Cosgrove entry), and migratory connectivity of Dunlin (see Ben Lagasse' entry).

This study fulfills action items identified in the Alaska Shorebird Conservation Plan under the Research section (i.e., "encourage long-term studies synthesizing measures of shorebird breeding phenology and environmental conditions") and Population Monitoring section (i.e., "monitor demographic parameters to better understand limiting factors at the population level").

Field assistance for conducting this work was provided by Ben Lagassé (co-crew leader), Jillian Cosgrove (co-crew leader), Laura Makielski, Wyatt Engelhoff, Philipp Maleko, Sam Gale, Dawn Brown, Tobie Getti, David Li, and Lindall Kidd. Funding was provided by the National Fish and Wildlife Foundation, Manomet, Inc., and USFWS Migratory Bird Management division.

*Location:* Utqiaġvik (formerly Barrow), Alaska, North Slope, 71.29° N, 156.64° W
*Contact:* Richard Lanctot, Shorebird Coordinator, U.S. Fish and Wildlife Service, 1011 East Tudor Road, MS 201, Anchorage, AK 99503, Email: richard_lanctot@fws.gov, Phone: 907-786-3609

Figure 1. Banded adult male Red Phalarope with chick. Photo credit: T. Getti

# #7— POTENTIAL CLIMATE-MEDIATED IMPACTS ON THE REPRODUCTIVE OUTPUT OF SHOREBIRDS AT THE COLVILE RIVER, ALASKA

Investigators: Dan Ruthrauff and Vijay Patil, U.S. Geological Survey

In 2018, we monitored the seasonal timing and outcomes of reproductive events of shorebirds at our study site on the Colville River Delta (70.437° N, 150.677° W) following Arctic Shorebird Demographic Network protocols. This season marked the eighth year of monitoring the reproductive output of shorebirds at the Colville River Delta under the Alaska Science Center's Changing Arctic Ecosystems initiative. As in 2017, spring phenology was considerably delayed in 2018 due to unusually cold temperatures and persistent snow cover. For perspective on the spring conditions over the recent years of our study, we accessed climate records at Utqiagvik (~240 km west of the Colville River Delta). 2016 was the earliest snow-off date on record (13 May) at this nearby site, while 2017 was the latest snowmelt date (18 June) since 1988. 2018 was even later, with a snow-off date (24 June) that was tied with the years 1942, 1945, and 1947 as the second-latest since 1931. Not surprisingly then, we arrived (3 June) at our study site in 2018 to near-complete snow cover and unusually cold temperatures. Average daily temperatures during the last 3 weeks of June were 2–10° C colder than the long-term mean. As in 2017, this period of unusual cold overlapped with the period during which shorebirds attempted to establish nest sites and lay eggs, and caused significant impacts to the shorebird community at our site.

Over the period 2011–2016, the mean date of nest initiation across all species was 10 June, but nest initiation was delayed by about five days in 2018. We have intensively monitored a 2.6- $km^2$ study site since 2015, and in 2018 we found and monitored >50% fewer nests than in 2015 and 2016. We discovered and monitored 91 shorebird nests in 2018, compared to 259, 242, and 109 in 2015, 2016, and 2017, respectively. Snow had mostly disappeared by late June, but temperatures remained cold and variable throughout July. Due to staffing limitations, in 2018 we did not collect arthropod samples or measure the growth of Semipalmated Sandpiper chicks as in previous years, so we are unable to quantitatively assess potential effects of the cold, late season on the post-hatch reproductive output of local shorebirds. By the time we departed the study site on 10 July, however, we had not yet observed any obvious arthropod emergence events, suggesting that food was limited for insectivorous birds in 2018 and that breeding conditions were poor overall. Because 2015 and 2016 were the (consecutive) earliest and warmest years on record at our site, only to be followed by historically late years in 2017 and 2018, we will compare the response of the avian community to these contrasting environmental conditions to determine the resilience of different species groups to such interannual variation. These studies relate to conservation issues identified for BCR 3 in the Alaska Shorebird Conservation Plan relating to Climate Change and Severe Weather.

*Location:* Colville River Delta (70.437° N, 150.677° W)
*Contact:* Dan Ruthrauff, US Geological Survey – Alaska Science Center, 4210 University Drive, Anchorage, AK 99508
Phone: 1-907-786-7162 email: druthrauff@usgs.gov

Colville researchers performing surveys. *Photo by Dan Ruthrauff*

Colville Camp. *Photo by Dan Ruthrauff*

``

# #8— MIGRATORY MOVEMENTS OF PACIFIC GOLDEN-PLOVERS: GPS TRACKING AND RETURN RATES

Investigators: Oscar Johnson, Montana State University; Lee Tibbitts, USGS Alaska Science Center, Anchorage; Michael Weber, BYU-Hawaii; David Bybee, BYU-Hawaii; Paul Brusseau, Anchorage; Nancy Brusseau, Anchorage; Diane Smith, Cape Elizabeth, ME; Allison Taylor, BYU-Hawaii; Rachel Fears, BYU-Hawaii; Malia Scoville, BYU-Hawaii; Emmalee Buss, BYU-Hawaii, Errika Smith, BYU-Hawaii; Lindsey Hayes, Kennewick, WA; Susan Scott, Honolulu.

This report is the final phase of a study begun in June 2017 when we attached Lotek Pinpoint GPS tags to 11 Pacific Golden-Plovers *Pluvialis fulva* (8 males, 3 females) captured at their nests near Nome. Attachment was with a leg-loop harness made of stretchable monofilament. Battery life was limited to obtaining 30 GPS locations and we programmed the tags to cover the fall 2017 migration only. We successfully tracked five individuals to wintering grounds at Midway Atoll, NW Hawaiian Islands; Mili Atoll, Marshall Islands; Maiana Atoll, Kiribati; New Britain Island, Papua New Guinea; and the coast of Queensland at approximately 20.4º S. In addition, we received partial southward tracks from two individuals before their tags reached capacity; one bird was last located flying past the NW Hawaiian Islands and one was still on the Alaska Peninsula. The remaining four tags only functioned briefly.

In 2018, we conducted fieldwork from 15–21 June to determine: 1) whether tagged birds had survived and returned to nesting grounds while still retaining their tags, 2) if the harness had caused harmful wear on plumage or skin, and 3) if tagged birds were nesting normally. We relocated four of the eight tagged males and each of them was still wearing the tag that had been attached a year earlier. These four birds were each incubating a clutch of eggs and appeared to display normal behaviors associated with nesting (as in photo below). All four males were recaptured and released after removal of their tags. From the list above, the four recaptured males were: the partial track NW Hawaiian Islands bird, the Mili Atoll bird, the New Britain Island bird, and the Queensland bird. While the 50% return rate of males is consistent with earlier studies of banded and radio-tagged plovers at Nome, we think that some GPS-tagged birds could have been missed because our searches were hampered by strong winds and we were unable to find a banded male (possibly a bird that had lost its tag) that had been reported to us. No tagged females were found, but this was not unexpected since female Pacific Golden-Plovers, unlike males, have low site-fidelity on nesting grounds. As typical for males, the returnees were nesting in the same breeding territories they occupied in 2017 with inter-year nest distances ranging from 111 to 181 m. We were pleased to find that after a year of wearing the harness, there was no apparent damage to feathers (except for slight disarray) or skin. It was also encouraging that body weights were almost the same as those recorded when the birds were initially captured. Clearly, Pacific Golden-Plovers are capable of successfully carrying these GPS tags roundtrip on long transpacific flights between Alaska and distant wintering grounds. Furthermore, our findings shed additional light on connectivity between Alaska and specific sites in the vast non-breeding range of this species.

*The Queensland* plover in distraction display near his nest at Woolley Lagoon, June 2018. The bird is carrying a 4.0 g Pinpoint-GPS tag with trailing aerial. Photo by Susan Scott.

*Location:* Nome, Seward Peninsula. Two study sites: Glacier Creek Area (64.58° N, 165.46° W) and Woolley Lagoon (64.87° N, 166.26° W).

*Contact:* Oscar (Wally) Johnson owjohnson2105@aol.com

# #9— SHOREBIRD USE AND ABUNDANCE ON MILITARY LANDS IN INTERIOR ALASKA

Investigators: Ellen Martin, Fish, Wildlife and Conservation Biology Department, Colorado State University; Paul F. Doherty, Jr., Fish, Wildlife and Conservation Biology Department, Colorado State University; Kim Jochum, Center for Environmental Management of Military Lands, Colorado State University; Calvin Bagley, Center for Environmental Management of Military Lands, Colorado State University

The boreal forest in interior Alaska is difficult to access and remote. Few studies have been conducted on shorebird status and trends, and little evidence exists documenting shorebird presence, areas of use, or abundance in interior Alaska (Bird Conservation Region 4). We implemented a design-based survey of shorebird habitat use in interior Alaska. This study used a modified Arctic PRISM protocol to determine shorebird habitat relationships in interior boreal forest Alaska, specifically on military lands on Tanana Flats Training Area and Donnelly Training Area near Fairbanks and Delta Junction, Alaska (Figure 1.1). Over 450,000 hectares of land in interior Alaska are managed by the Department of Defense and are composed of a vast boreal forest, where shorebird densities are hypothesized to be low. Although densities are predicted to be low, this area is so large that we hypothesized it may be an important breeding area for shorebirds. From 2016 to 2018, we conducted plot surveys to meet three objectives: (1) identify shorebird species using military lands in interior Alaska (BCR 4) and estimate species richness, (2) create occupancy/habitat use models and maps for these species and test hypotheses about species-specific covariate relationships (e.g., elevation, shrub height, distance to water; Figure 1.2), and (3) estimate shorebird abundance for species of conservation concern in Alaska.

We surveyed 78 plots in 2016 and 142 plots in 2017 twice on both training areas. On these plots, we conducted habitat surveys and presence absence surveys for all species of shorebirds (Figure 1.2). We found that interior Alaska military lands host 12 species of shorebirds (Table 1.1). Specifically, it hosts 6 shorebird species of moderate to high conservation concern as listed by the Alaska Shorebird Conservation Plan (American Golden Plover (*Pluvialis dominica*), Black-bellied Plover (*Pluvialis squatarola*), Solitary Sandpiper (*Tringa solitaria*), Lesser Yellowlegs (*Tringa flavipes,* Figure 1.3), Upland Sandpiper (*Bartramia longicauda*), Whimbrel (*Numenius phaeopus*), and Wilson's Snipe (*Gallinago delicata*) and 4 species of conservation concern as listed by the US Fish and Wildlife Service (Solitary Sandpiper, Lesser Yellowlegs, Upland Sandpiper, and Whimbrel). Habitat covariates such as elevation, percent scrub canopy cover, distance to wetland, and percent water on plot were all important determinants of shorebird use on our study site. Covariates such as percent water on plot, scrub presence, and percent scrub canopy cover were important in the detection process. As climate change impacts habitat suitability for shorebirds, our results suggest that suitable habitat for shorebirds is most likely to shift and be less available and more dispersed with the changing climate. We further found differences in species richness by training areas and by survey years. Abundance estimates suggest that lowland military lands in interior Alaska support large numbers of shorebirds.

We used this information to provide the military with predictive maps indicating areas of high probability of use by shorebirds during the breeding season. From these, we made management recommendations regarding proposed development and training activities in areas of high probability of shorebird use. Environmental changes are occurring on military lands in interior Alaska. Such changes are predicted to impact all the habitat covariates identified as important determinants of shorebird use. Some of these projected changes can be addressed with environmental manipulation and management, while others can be addressed by timing trainings differently or locating trainings in different places during peak breeding season. Our recommendations help support the military mission by supporting the military's stated goal of conservation.

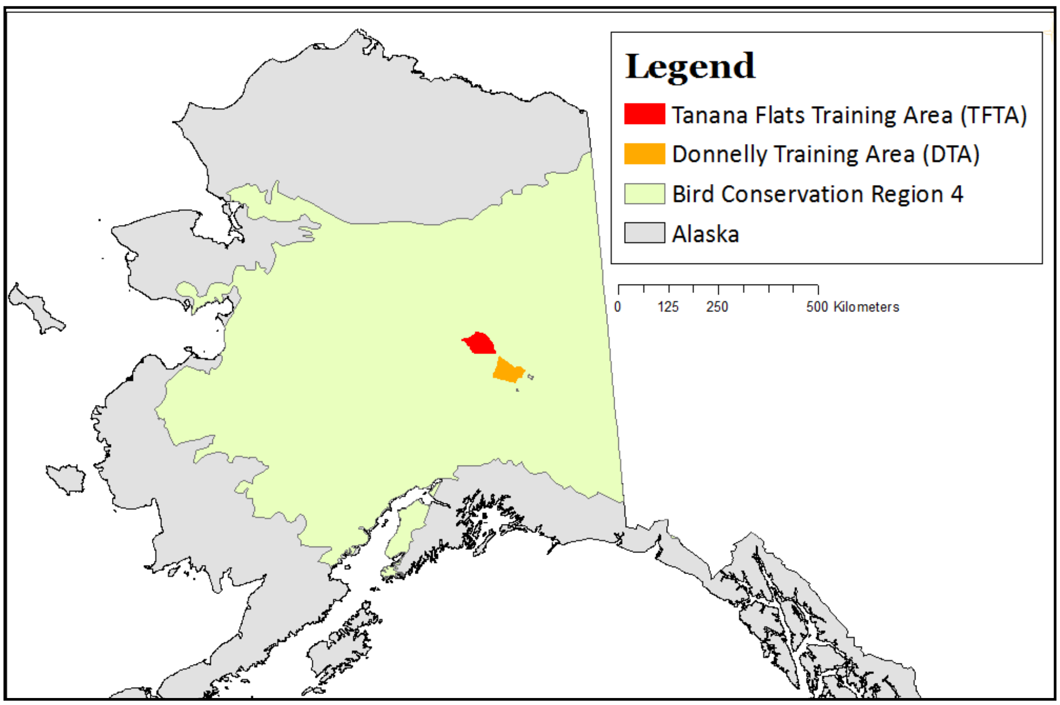



Figure 1.1: Study areas in interior Alaska, Bird Conservation Region 4.

Figure 1.2. Ellen Martin surveying upland plot on Donnelly Training Area East.

Figure 1.3. Two Lesser Yellowlegs on plot in Donnelly Training Area East.

Figure 1.4. Dr. Kim Jochum (r) and Laura Williams on Tanana River.

*Table 1.1*: Shorebird raw counts and conservation status.

| Species | Upland vs Lowland | 2016 Count | 2017 Count | AK Shorebird Cons. Plan (High Concern List) | USFWS (High Concern List) |
|---|---|---|---|---|---|
| Lesser Yellowlegs (*Tringa flavipes*) | Lowland | 43 | 144 | ✓ | ✓ |
| Wilson's Snipe (*Gallinago delicata*) | Lowland | 41 | 153 | | |
| Spotted Sandpiper (*Actitis macularius*) | Lowland | 10 | 21 | | |
| Solitary Sandpiper (*Tringa solitaria*) | Lowland | 4 | 5 | ✓ | ✓ |
| Dunlin (*Calidris alpina*) | Lowland | 1 | 0 | ✓ | |
| Least Sandpiper (*Calidris minutilla*) | Lowland | 0 | 1 | | |
| Whimbrel (*Numenius phaeopus*) | Upland | 5 | 11 | ✓ | ✓ |
| Black-bellied Plover (*Pluvialis squatarola*) | Upland | 2 | 3 | | |
| Upland Sandpiper (*Bartramia longicauda*) | Upland | 1 | 3 | ✓ | ✓ |
| American Golden-Plover (*Pluvialis dominica*) | Upland | 0 | 1 | ✓ | |
| Baird's Sandpiper (*Calidris bairdii*) | Upland | 0 | 1 | | |
| Pectoral Sandpiper (Calidris melanotos) | Upland | 0 | 1 | | |
| Total | - - | 120 | 364 | | |

*Location:* Tanana Flats Training Area and Donnelly Training Area, Fairbanks and Delta Junction, Alaska.

*Contact(s):* Ellen Martin, Fish, Wildlife and Conservation Biology Department & Center for Environmental Management of Military Lands (CEMML), Warner College of Natural Resources, Colorado State University. Email: martinec@rams.colostate.edu.

Dr. Kim Jochum, Center for Environmental Management of Military Lands (CEMML), Colorado State University, & DPW Environmental Division, United States Army Garrison Alaska, P.O. Box 1291, Delta Junction AK 99737. Email: kim.jochum@colostate.edu; Phone: 907-873-1616.

# #10— SHOREBIRD SURVEYS AND GIS DATA ANALYSIS ALONG ARCTIC FLYWAYS

Investigators: Falk Huettmann PhD, Professor, -EWHALE Lab, Inst. of Arctic Biology, Biology and Wildlife Dept., University of Alaska Fairbanks (UAF), 99885 USA

The EWHALE lab keeps working on several shorebird project data along the Arctic flyways; most of them comprise multi-year surveys, GIS analysis and socio-economic questions at breeding, stop-over and suspected wintering grounds. In 2018 field work and exploration was done in northern Papua New Guinea, Qinqhia Lake as well as Siberia, Russian Far East (Northern Sea of Okhotsk), Vietnam, Japan and Nepal. An ongoing project is funded to support international Avian Influenza explorations in the Pacific Rim.

While data are still cleaned for data sharing and an earlier project still awaits its write-up for Eastern China (wintering ground; local fisheries issues), a new project was started on the Russia High Arctic concerning GIS prediction for waterbirds; it possibly could accommodate shorebird work with a good and solid digital infrastructure needed for impact and population assessments.

While not directly tied to the Alaska Shorebird Conservation Plan, the EWHALE lab has also heavily invested into GIS data, sustainability and methodology, namely open access GIS layer compilations, machine learning and data mining workflows. Done together with two former UAF PhD students, a new book of ours just came out on that topic (not shorebirdspecific) but which should be of generic value for 'shorebird people' for their research efforts and for analyzing habitats, predictions, movement and geo-locator data for instance. It's currently employed and tested for shorebird prediction work in the high Arctic.

*Location:* Arctic Flyways, Circumpolar, south to 80 degrees south (latitude)

*Contact:* Falk Huettmann PhD, Professor, -EWHALE Lab, University of Alaska Fairbanks, 99885 USA
Phone: 907 474 7882 email: fhuettmann@alaska.edu

# #11— SUBSPECIFIC MIGRATION ECOLOGY AND REGIONAL CONSERVATION PRIORITIES FOR AN ARCTIC BREEDING SHOREBIRD, THE DUNLIN (*CALIDRIS ALPINA*)

Investigators: Ben Lagasse and Mike Wunder, University of Colorado Denver; Richard Lanctot, Chris Latty, Sarah Saalfeld, and Kristine Sowl, U.S. Fish and Wildlife Service; Stephen Brown, Manomet Center for Conservation Science; Rebecca Bentzen and Martin Robards, Wildlife Conservation Society; (and many other collaborators outside of Alaska)

Understanding the spatiotemporal connectivity of migratory populations is essential for developing landscape-scale conservation plans. The Dunlin is a migratory shorebird with 10 subspecies that breed throughout the circumpolar Arctic and Subarctic. These subspecies migrate south, sometimes with other subspecies and sometimes alone, along most of the eight flyways emanating from the Arctic. Many of these subspecies are showing declines. Understanding the spatiotemporal extent that subspecies segregate or mix while migrating is important for directing conservation efforts in the appropriate locations. This is particularly true along the East Asian-Australasian Flyway given the extensive alteration and loss of habitat (e.g., intertidal habitats around the Yellow Sea have declined by >65%), and large differences in population sizes of the four subspecies that use this area (e.g., *C. a. actites* number ~1,000 and the others are ~550,000).

The primary objectives of this study are to generate spatiotemporally explicit migratory tracks for Dunlin from breeding sites throughout the Holarctic using archival light-level geolocators (Table 1). With this information, we plan to identify 1) migratory bottlenecks and subspecific regions of conservation priority at the flyway level, 2) the extent to which different subspecies mix during migration and on wintering grounds, and 3) possible sex-specific differences in distribution and migratory timing.

Between 2010 and 2018, a total of 619 geolocators were deployed and 220 recovered from tagging efforts focused on 9 subspecies at 21 breeding sites throughout Greenland, North America, Russia, and Scandinavia (Table 1). During the summer of 2018, we recovered 10 geolocators across 3 sites (Table 1). Of the 10 recovered, 3 were recovered near Utqiġvik, Alaska (*C. a. arcticola*), 5 were recovered on the Kamchatka Peninsula, Russia (*C. a. kistchinski*), and 2 were recovered in Norway (*C. a. alpina*). We also deployed an additional 40 at Utqiaġvik, Alaska.

Field biologists will continue to capture tagged Dunlin in 2019 as they are relocated. Once all the data are available, we will use FLightR and a network model approach to determine patterns of connectivity between nonbreeding regions for each subspecies. The information from this study is intended to help inform international efforts to develop effective landscape-scale conservation plans for the Dunlin and other sympatric migratory shorebirds throughout the Northern Hemisphere.

This study is focused on the Dunlin, one of the priority shorebird species identified in the Alaska Shorebird Conservation Plan (Alaska Shorebird Group 2008). The study also fulfills action items identified in the Alaska Shorebird Conservation Plan under the Research section (i.e., "develop and implement contemporary research techniques (e.g., geolocators) to identify unique populations of shorebirds that reside in Alaska and to link sites used throughout their annual cycles"), and the International Collaborations section (i.e., "foster cooperative research efforts throughout the Western Hemisphere, Asia, and elsewhere along migratory flyways", and "participate in species-specific conservation planning efforts").

Locations in Alaska in 2018: Utqiaġvik, North Slope (71.2652°N, 156.6359°W)

Contact: Ben Lagasse, University of Colorado Denver, Campus Box 171, P.O. Box 173364, Denver, CO 80217; Phone: 774-722-5397; email: Benjamin.Lagasse@ucdenver.edu

**Table 1.** Past, current and future tagging efforts of Dunlin on their Holarctic breeding grounds. "-" indicates number to be recovered is unknown at present.

| Field site | Latitude, longitude | Subspecies | Year | Number deployed | Number recovered |
|---|---|---|---|---|---|
| Zackenberg, Greenland | 74.4667, -20.5667 | *arctica* | 2016-2017 | 2 | 1 |
| Hochstetter, Greenland | 75.2253, -19.6309 | *arctica* | 2017-2018 | 11 | 0 |
| Churchill, Canada | 58.7376, -93.8195 | *hudsonia* | 2010-2012 | 35 | 17 |
| | | | 2016-2017 | 30 | 10 |
| Canning River, Alaska | 70.1180, -145.8506 | *arcticola* | 2010-2012 | 22 | 6 |
| | | | 2016-2017 | 13 | 3 |
| Ikpikpuk River, Alaska | 70.5525, -154.7309 | *arcticola* | 2010-2012 | 35 | 5 |
| Utqiaġvik, Alaska | 71.2652, -156.6359 | *arcticola* | 2010-2012 | 51 | 18 |
| *(formerly Barrow*) | | | 2016-2017 | 46 | 18 |
| | | | 2017-2018 | 8 | 3 |
| | | | 2018-2019 | 40 | - |
| | | | 2019-2020 | 20 | - |
| Cape Krusenstern, Alaska | 67.1142, -163.4956 | *pacifica* | 2010-2012 | 30 | 15 |
| Yukon-Kuskokwim Delta NWR (Manokinak) | 61.1944, -165.1025 | *pacifica* | 2010-2012 | 48 | 21 |
| Yukon-Kuskokwim Delta NWR (Kanaryarmiut) | 61.3700, -165.1200 | *pacifica* | 2016-2017 | 15 | 6 |
| Izembek NWR, Alaska | 55.2587, -162.8576 | *pacifica* | 2010-2012 | 46 | 24 |
| Cape Pogodny, Russia | 56.2645, 162.5815 | *kistchinski* | 2017-2018 | 20 | 5 |
| Meinypilgyno, Russia | 62.5833, 177.0300 | *sakhalina* | 2014-2016 | 5 | 3 |
| | | | 2016-2017 | 7 | 5 |
| Belyaka Spit, Russia | 67.0647, -174.5000 | *sakhalina* | 2011-2013 | 10 | 5 |
| | | | 2013-2015 | 15 | 6 |
| | | | 2016-2017 | 14 | 8 |
| Chaun Delta, Russia | 68.7750, 170.5495 | *sakhalina* | 2013-2015 | 35 | 12 |
| Chaivo Bay, Russia | 52.5000, 143.2833 | *actites* | 2016-2017 | 18 | 2 |
| Bely Island, Russia | 73.2500, 70.8000 | *alpina* | 2016-2017 | 3 | 0 |
| | | | 2017-2018 | 3 | 0 |
| Sabetta, Russia | 71.2400, 71.8000 | *alpina* | 2016-2017 | 15 | 4 |
| Erkuta, Russia | 68.2200, 69.1500 | *alpina* | 2016-2017 | 1 | 0 |
| Gamvik, Norway | 71.0715, 28.2360 | *alpina* | 2016-2017 | 12 | 5 |
| | | | 2017-2018 | 8 | 2 |
| Ammarnas, Sweden | 65.9600, 16.2100 | *alpina* | 2016-2017 | 8 | 0 |
| Oulu, Finland | 64.8333, 25.0000 | *schinzii* | 2013-2014 | 30 | 16 |
| | | | 2014-2016 | 23 | 10 |

# #12— AERIAL SURVEYS OF SHOREBIRDS AT MIGRATORY STAGING SITES IN WESTERN ALASKA, 2018

Investigators: Dan Ruthrauff, US Geological Survey, Heather Wilson and Zak Pohlen, U.S. Fish and Wildlife Service

From 7–9 September, 2018, we conducted aerial surveys for shorebirds staging during fall migration at sites across western Alaska. The primary objective of our survey was to replicate the timing and route of surveys last flown in 1997 on the Yukon-Kuskokwim Delta and Alaska Peninsula by Brian McCaffery and Bob Gill. Although we counted and attempted to identify all shorebirds that we encountered along our route, our primary focal species was the Bar-tailed Godwit. Recent analyses (Conklin et al. 2015 *Emu*; Studds et al. 2017 *Nature Communications*) from nonbreeding sites in the East Asia-Australasia Flyway indicate that the Alaska-breeding population of Bar-tailed Godwits is decreasing. Bob Gill and Brian McCaffery demonstrated (Gill and McCaffery 1999 *Wader Study Group Bulletin*) that counts of fall-staging Bar-tailed Godwits in western Alaska closely matched population estimates derived from counts at nonbreeding sites in New Zealand and Australia, suggesting that most of the Alaska population (breeding adults and young-of-year juveniles) of Bar-tailed Godwits staged contemporaneously at these sites. We wanted to replicate these surveys and assess the potential efficacy of monitoring this population via periodic aerial surveys in Alaska.

We timed our surveys to occur over a series of strong diurnal high tides in early September, a period that both coincided with the timing of Gill and McCaffery's previous surveys and ensured that godwits were not spread across vast mudflats during our flights. Taking advantage of unusually benign and calm weather conditions across much of western Alaska, we flew the coastline of the Yukon-Kuskokwim Delta from Jacksmith Bay north to Kigigak Island on 7 September, and completed the remainder of this region (Kigigak Island north to the mouth of the Yukon River) on 8 September. We surveyed the north coast of the Alaska Peninsula from Egegik Bay to Nelson Lagoon on 9 September. In total, we counted just over 430,000 shorebirds, the majority of which (399,198) were identified as small calidridine shorebirds (likely Western Sandpipers, Rock Sandpipers, and Dunlin). We counted 33,176 Bar-tailed Godwits, a figure considerably lower than Gill and McCaffery's high count of 94,000 birds. Based on subsequent discussions with colleagues in New Zealand, it appears that the timing of our surveys was late in 2018. About four days after the completion of our surveys, Bar-tailed Godwits were recorded arriving at nonbreeding sites in New Zealand, indicating that an unknown proportion of the Alaska-breeding population had departed on southbound migration prior to the start of our surveys (godwits require ~10 days to complete their non-stop migration between Alaska and New Zealand). Thus, we are unable to meaningfully compare our survey totals to those of Gill and McCaffery because we did not survey a closed population. Nonetheless, the distribution of godwits during our surveys matched that of Gill and McCaffery (1999), with the majority of godwits occurring along the northern mouth of the Kuskokwim River near Cape Avinof. The largest discrepancy between our survey (and all partial surveys conducted since 1997) concerns the near absence of Bar-tailed Godwits at sites along the Alaska

Peninsula. Gill and McCaffery (1999) recorded over 33,000 godwits in the region, nearly all at Egegik Bay, but we detected only 330 along this segment of our survey. Although the timing of our surveys was not apparently optimal for sampling the entire Alaska population of Bar-tailed Godwits, we nonetheless implemented improved survey protocols (e.g., voice-activated recordings with time/location stamps, machine-learning photo verification for deriving estimates of observer error). In future years, we hope to refine the timing of surveys to better assess the abundance and distribution of fall-staging Bar-tailed Godwits in Alaska. Of note, these surveys were possible only because Migratory Bird Management dedicated a pilot-biologist and plane to fly the entire survey route. Additionally, we relied heavily upon the support of the staffs of the Yukon Delta and Alaska Peninsula/Becharof National Wildlife Refuges to accomplish this work. That only three days of aerial surveys required such a substantial level of cooperation and logistical coordination is something future survey efforts must consider when planning similar aerial shorebird surveys.

*Location:* Western Alaska
*Contact:* Dan Ruthrauff, US Geological Survey – Alaska Science Center, 4210 University Drive, Anchorage, AK 99508
Phone: 1-907-786-7162 email: druthrauff@usgs.gov

# #13— MOVEMENT PATTERNS AND HABITAT USE OF TUNDRA-BREEDING SHOREBIRDS DURING POST-BREEDING AND SOUTHBOUND MIGRATION

Investigators: Richard Lanctot, Chris Latty and Sarah Saalfeld, U.S. Fish and Wildlife Service; Stephen Brown, Manomet, Inc.; Rebecca Bentzen, Wildlife Conservation Society; Kyle Elliot, McGill University; J.F. Lamarre, Polar Knowledge Canada; and Daniel Ruthrauff, U.S. Geological Survey.

To better understand shorebird post-breeding movements and habitat use along the Arctic Coast, we initiated a multi-year GPS tracking project in 2017. This effort continued in 2018. This study will provide essential baseline information on shorebird use of coastal regions and contribute to understanding how climate-mediated and development-related habitat change is likely to affect shorebirds. Because we do not currently know basic information on the inter-connectedness of breeding and stopover sites, as well as residency time and movements among stopover sites, it is difficult to estimate what resources are at risk, and therefore, what mediation responses to recommend.

During the 2018 field season, we deployed 4- to 5-g GPS PinPoint tags manufactured by Lotek Wireless on 15 Pectoral Sandpipers and 13 American Golden-Plovers at four breeding sites along the Arctic Coastal Plain of Alaska (Utqiaġvik, Colville River, Prudhoe Bay, and Canning River) and one site in Canada (Cambridge Bay, Nunavut). These tags collected and transmitted to satellites GPS-quality location data during both the post-breeding season (June–October), as well as throughout the southbound migration and early wintering period. We also recovered 1.2-g GPS logger tags deployed in 2017 from a total of six Dunlin and one Semipalmated Sandpiper from three of the sites. These smaller tags require individuals to be recaptured so that tags can be removed and data downloaded. Collectively, these tags provided high accuracy locations of the birds every one or two days, depending on the species. Both projects provided some of the best information on post-breeding and southbound migration ever recorded for these species. Examples of movements can be found on movebank.org – use the browse tracks function and search for “Arctic Shorebird Migration Tracking study - <<species name>>.”

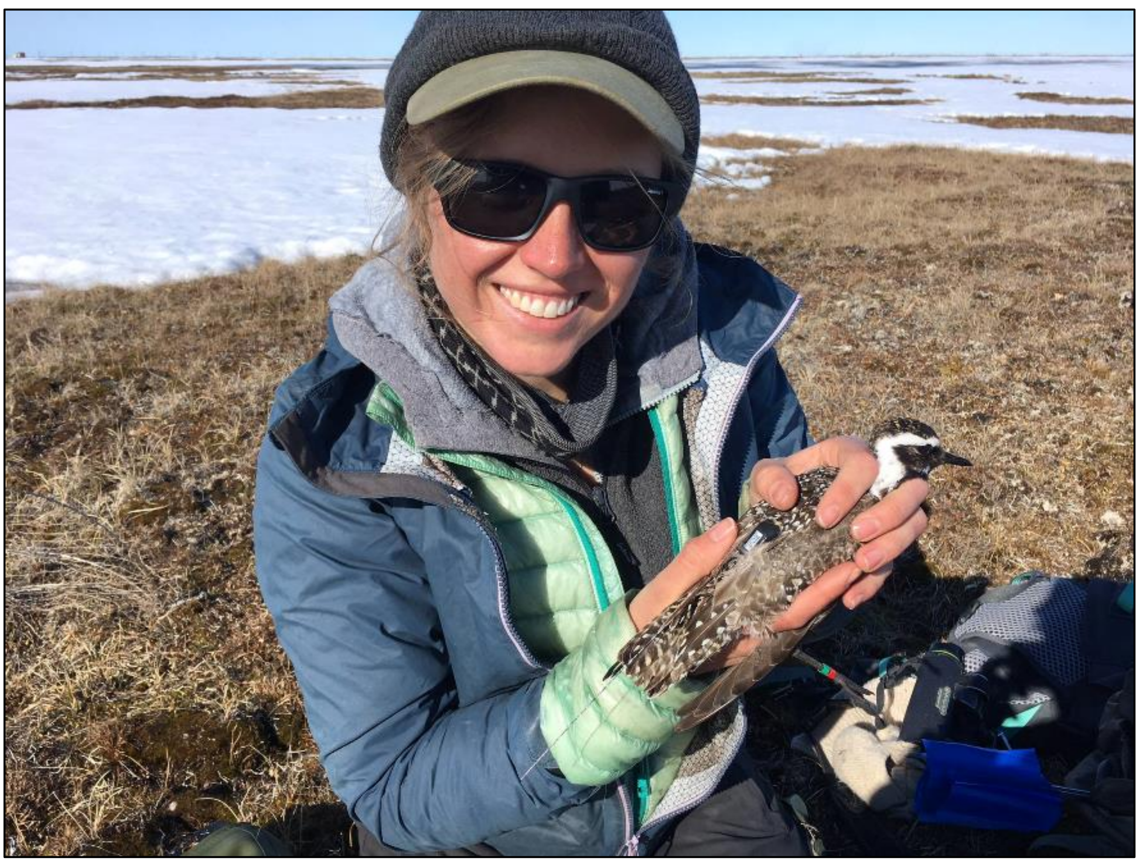
For each tagged individual, we also collected information on reproduction that can be related to migration patterns. Additionally, we collected feather and blood samples for each tagged individual, allowing us to genetically sex birds, and in future studies, assess stress levels from winter-grown feathers that can be related to migration patterns and productivity. In 2019, we plan to continue to monitor post-breeding movements and habitat use of American Golden-Plovers and Pectoral Sandpipers at 2–4 sites in Alaska and at least 4 sites in Canada, as well as expand the tagging effort to follow the post-breeding movements of male Red Phalarope at many of these same sites.

This study fulfills action items identified in the Alaska Shorebird Conservation Plan under the Research section (i.e., “develop and implement contemporary research techniques to identify unique populations of shorebirds that reside in Alaska and to link sites used throughout their annual cycles") and the Habitat Management and Protection section (i.e., "identify important shorebird habitats throughout the state").

Field assistance for conducting this work in 2018 was provided by Ben Lagassé, Lindall Kidd, Laura Makielski, and Dawn Brown at Utqiaġvik; Meret Beutler and Jeremy Pustilnik at the Colville River Delta; Peter Detwiler and Danielle Gerik at Prudhoe Bay; Shiloh Schulte, Shilo Felton, and Sarah Hoepfner at the Canning River; and Emma Sutherland, Jasmine Tiktalek and Aili Pedersen at Cambridge Bay.  Funding or logistical support for this study was provided by the National Fish and Wildlife Foundation, Neotropical Migratory Bird Conservation Act, Manomet, Inc., U.S. Fish and Wildlife Service, Wildlife Conservation Society, U.S. Geological Survey, and BP Exploration (Alaska), Inc.

*Location:* Cross-Arctic project with multiple study sites located at Utqiaġvik, Colville River, Prudhoe Bay, and Canning River in Alaska, and Cambridge Bay in Nunavut, Canada

*Contact(s):* Richard Lanctot, Shorebird Coordinator, U.S. Fish and Wildlife Service, 1011 East Tudor Road, MS 201, Anchorage, AK 99503, Email: richard_lanctot@fws.gov, Phone: 907-786-3609



Laura Makielski holding an American Golden-Plover with attached GPS tag. Photo by Lindall Kidd.

# #14— IN SEARCH OF THE SPOON-BILLED SANDPIPER IN NORTHWESTERN ALASKA

Investigators: Richard Lanctot and Sarah Saalfeld, U. S. Fish and Wildlife Service (USFWS); Elena Lappo and Evgeny Syroechkovskyi, BirdsRussia; Laura Phillips and Mary Hake, National Park Service (NPS); Stephen Brown, Manomet, Inc.; and Jonathan Slaght, Wildlife Conservation Society (WCS)

This study began as a result of a collaboration between the Royal Society for the Preservation of Birds (RSPB; Graeme Buchanan and Alison Beresford) and BirdsRussia that modeled habitat selection of Spoon-billed Sandpipers (SBSA) using environmental data from three sources (SPOT vegetation, Aqua MODIS ocean colour, and bioclimatic variables), as well as altitude and slope of land to determine potential breeding sites of SBSA in Far Eastern Russia. After the model results were projected to Alaska, a number of other areas were highlighted as being potentially suitable. Most of these sites had not been surveyed by professional biologists in the past, especially during the month of June when SBSA would be breeding. However, single observations of SBSA had been observed some 40 years ago along the coasts of Alaska. These facts suggested that some part of the SBSA population could live in small numbers in Alaska. After long discussions during meetings of the East Asian-Australasian Flyway Partnership and the Arctic Migratory Bird Initiative (AMBI), we decided to pursue the project.

The primary objective of the expedition was to survey suitable coastal regions for evidence of breeding SBSA using variable circular point count survey methodology. Field crews also documented the occurrence, habitat use, breeding status, and distribution of other waterbird species at survey sites. Field surveys were conducted on foot after crews were transferred to pre-selected sites using a Robinson 44 helicopter or a Cessna 206 aircraft. E. G. Lappo and E. Syroechkovskyi evaluated sites both from the air and ground for SBSA suitability prior to conducting surveys. From 5–12 June 2018, 25 sites were visited and 175 point counts were examined within 100 km of the village of Kotzebue, including coasts of Kotzebue Sound; Selawik Lake; lower reaches of the Selawik, Noatak and Kobuk rivers; and near Cape Krusenstern. Unfortunately field crews were unable to locate any SBSA in Alaska in 2018. However, 1,174 individuals belonging to 18 shorebird species were counted, and an additional 60 other waterbirds or landbirds were documented as being present in one or more sites.

Despite not locating SBSA, it is still possible that the species breeds in Alaska, as our work in this poorly studied area was quite short, and other areas thought to be promising for SBSA were not visited. Objectively, the chance to find this rare species in Alaska is small, especially considering that even in its optimal nesting sites in Chukotka it is quite rare. Further, it is unknown how the earlier phenology of potential breeding habitats in Alaska compared to sites in Chukotka may influence the occurrence of the SBSA. Despite these issues, we remain hopeful that SBSA will be sighted during future work in northwestern Alaska.

This study fulfills action items identified in the Alaska Shorebird Conservation Plan under the Population Monitoring section (i.e., "develop regional, national, and international partnerships to promote range-wide monitoring of shorebird populations" and "develop and implement standardized methods for assessing the distribution and population size of shorebirds in various habitats of Alaska"). This study also supported an AMBI objective to increase the exchange of experiences between Russian and American experts on SBSA and other Beringian shorebirds. Elena Lappo also provided a lecture to local people on conservation measures and studies of the SBSA at the Northwest Arctic Heritage Center in Kotzebue, Alaska, during her visit (see photo).

NPS and Manomet, Inc. provided funding to charter a helicopter and pay for food and supplies, and field personnel to conduct this study. USFWS provided staff to organize, plan and conduct the surveys. WCS funded Elena and Evgeny's travel to Alaska and provided survey personnel. Selawik National Wildlife Refuge and the Western Arctic National Parkland office (NPS) provided housing and/or other logistical support for the crew in Kotzebue. Metta McGarvey and Brad Winn gathered logistical supplies for the study and/or conducted surveys. Zach Elkins from Pollux Aviation and Eric Sieh from Arctic Backcountry Flying Service safely navigated us to our survey locations.

*Location:* Kotzebue, Alaska, 66.89° N, 162.59° W

*Contact:* Richard Lanctot, Shorebird Coordinator, U.S. Fish and Wildlife Service, 1011 East Tudor Road, MS 201, Anchorage, AK 99503, Email: richard_lanctot@fws.gov, Phone: 907-786-3609

Elena Lappo giving a lecture on the conservation and studies of Spoon-billed Sandpipers in Russia at the Northwest Arctic Heritage Center in Kotzebue, Alaska, in June 2018.

# #15— THE INTERACTIVE EFFECTS OF TEMPERATURE AND ORGANIC CONTAMINANTS ON EMBRYO DEVELOPMENT IN SHOREBIRDS

Investigators: Ella Lunny and Kirsty Gurney, University of Saskatchewan; Dan Ruthrauff, U.S. Geological Survey

Suboptimal incubation temperature and environmental contaminants can both affect avian development *in ovo*, and the combination of these stressors may have more detrimental effects than either stressor individually. For example, incubation temperature can influence physiological processes, and thus may affect the rate at which contaminants are absorbed in the developing embryo. Yet, to our knowledge, no avian ecotoxicological studies have evaluated the relationship between incubation temperature and contaminants in eggs. This type of interaction could especially be a concern for avian species breeding in the Arctic, where embryo development is incredibly temperature-sensitive. Shorebirds are the dominant avian fauna in many Arctic systems and can be exposed to elevated organic contaminant concentrations when foraging in wetlands and estuaries. Therefore, these birds are ideal models to test hypotheses related to the interactive effects of incubation temperature and contaminant exposure. Specifically, our field-based research focused on Semipalmated Sandpiper (*Calidris pusilla*) breeding at the Colville River delta (CRD) (*Figure 1.1)*, where we evaluated organic contaminant levels of shorebirds eggs and investigated linkages between organic contaminants and chick mass at hatch. This research addresses the issue regarding environmental pollution in the 2008 Alaska Shorebird Conservation Plan.

Our preliminary results show contaminant concentrations in Semipalmated Sandpiper (SESA) eggs at CRD are relatively low compared to other Arctic sites *(Figure 1.2).* Flame-retardant concentrations at all sites were much lower than organochlorine and polychlorinated biphenyl concentrations (PCB) *(Figure 1.3).* At CRD flame-retardant concentrations in SESA eggs ($n$ = 9) averaged 0.081± 0.06 (ng/g). Additionally, organochlorine concentrations average 0.0013 ± 0.001 (ug/g) and PCBs averaged 0.0002 ± 0.0003 (ug/g) at CRD. Contaminant concentrations' relationship to mass at hatch was not significant but does indicate a negative correlation between contaminant concentrations and mass at hatch, most notably with PCBs and flame retardants (*Figure 1.4 and 1.5*).

*Location:* Colville River site, Alaska (70˚42' N, 150˚68' W) (*Figure 1.1)*

*Contact(s):* Ella Lunny, University of Saskatchewan, 115 Perimeter Road, Saskatoon, SK S7N 0X4, Saskatchewan. Phone: 639-470-3103; Email: Ella.lunny@usask.ca

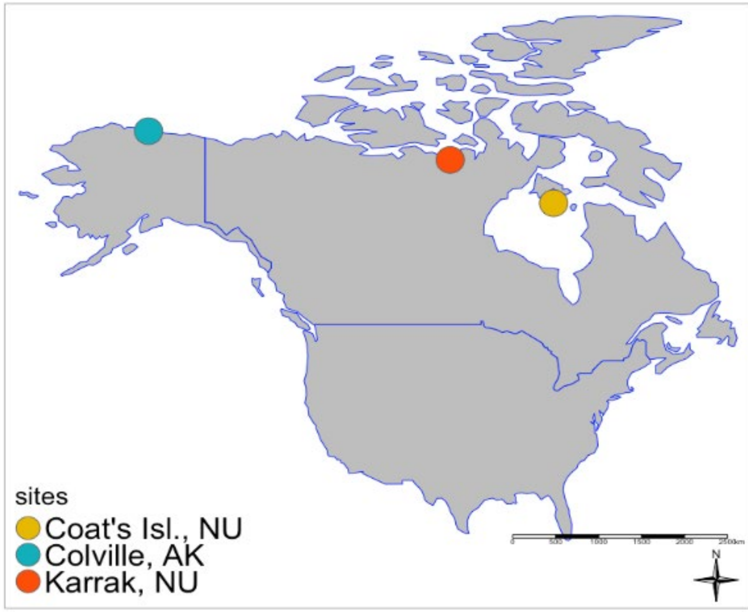



*Figure 1.1* Contaminant concentrations in Semipalmated Sandpiper eggs were collected at three Arctic field sites, Colville River Delta, AK (70˚42' N, 150˚68' W), Queen Maud Gulf Migratory Bird Sanctuary (Karrak), NU (67˚14' N, 100˚30' W), and Coats Island, NU (62°79’ N, 82°28’ W).

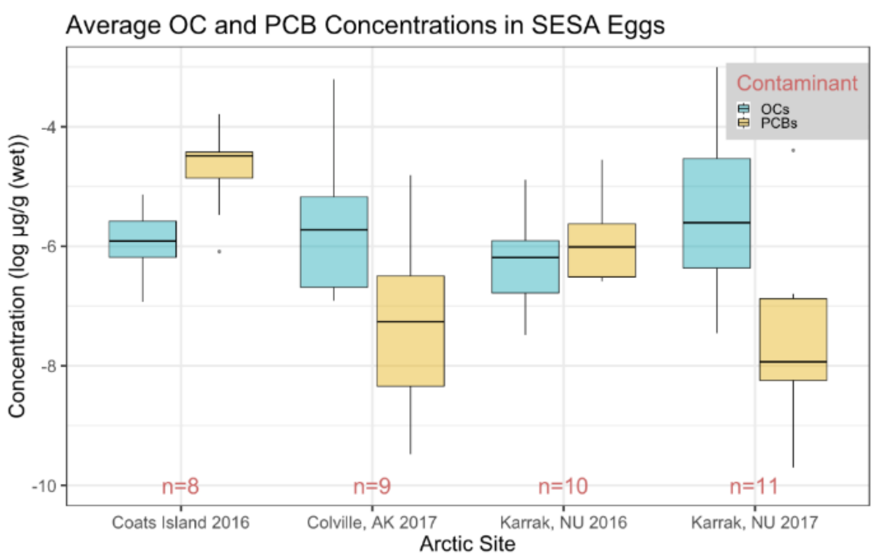



*Figure 1.2* Boxplot of mean organochlorine and PCB concentrations (natural log of µg/g wet weight) found in Semipalmated Sandpiper eggs at three Arctic sites in 2016 and 2017. Results show that PCB concentrations at Coats Island are significantly different than other sites (*P* = 0.0381). We tested eggs for 20 different organochlorine compounds and 35 different PCB compounds. The upper and lower boundaries of the boxes represent the 75th and 25th percentiles, and the line within the boxes indicates the median value.

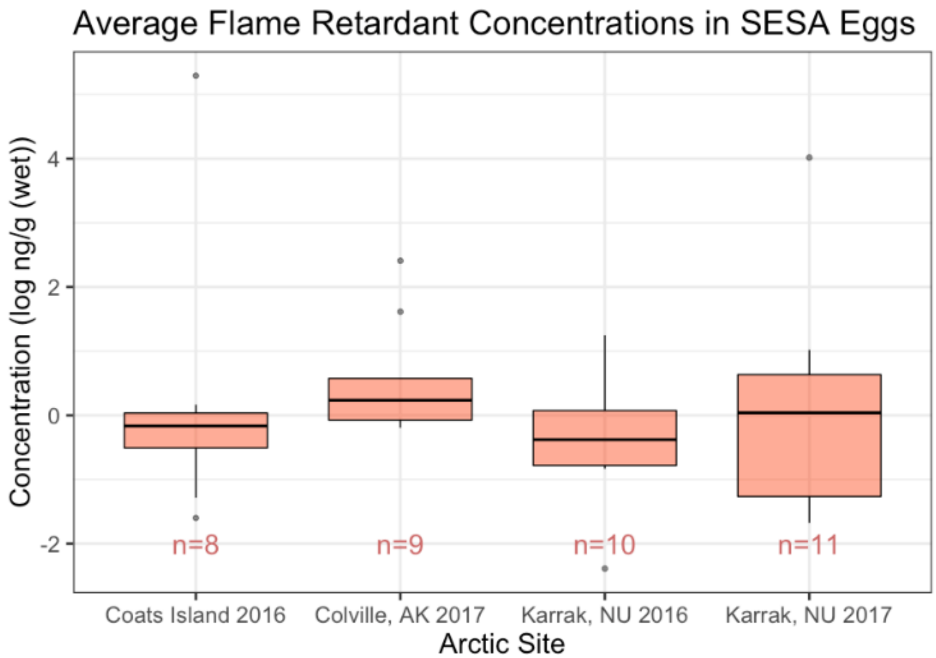



*Figure 1.3* Boxplot of mean flame retardant concentrations (natural log of ng/g wet weight) found in Semipalmated Sandpiper eggs at three different Arctic sites in 2016 and 2017. We tested for 22 different flame-retardant compounds in eggs. The upper and lower boundaries of the boxes represent the 75th and 25th percentiles, and the line within the boxes indicates the median value.

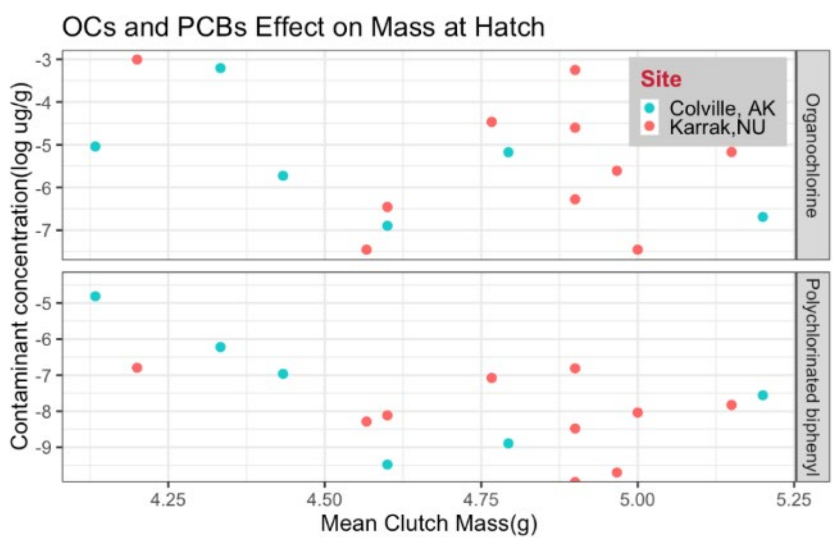



*Figure 1.4* Scatter plot indicating negative correlation between average concentration of organochlorines and polychlorinated biphenyls (log ug/g) in eggs and mean clutch mass of Semipalmated Sandpiper hatchlings at two Arctic sites.

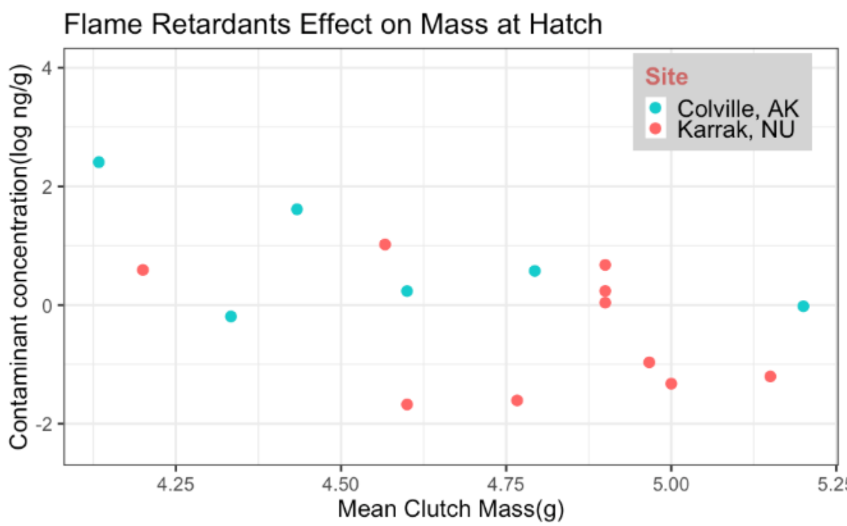



*Figure 1.5* Scatter plot indicating negative correlation between average concentration of flame retardants (log ng/g) in eggs and mean clutch mass of Semipalmated Sandpiper hatchlings at two Arctic sites.

# #16— MIGRATORY CONNECTIVITY OF LESSER YELLOWLEGS (*TRINGA FLAVIPES*)

Investigators: Katie Christie, ADF&G; Jim Johnson, USFWS; Laura McDuffie, USFWS; Audrey Taylor, UAA

Shorebird hunting is a significant threat to Lesser Yellowlegs that stage and/or overwinter in Caribbean and northern South American countries (Clay et al. 2012). It is estimated that 7,000 to 15,000 individuals are killed in shooting swamps on Barbados annually (Burke 2008, Reed and Burke 2011). The objectives of this study include to: 1) determine migration routes of birds from Anchorage and across Canada, 2) determine if genetic markers can be used to explain migratory connectivity, 3) understand the breeding origins of harvested birds, 4) determine the vital rates of populations in Alaska, and 5) understand what conservation actions can be taken to reduce unregulated hunting in the Caribbean and South America.

In 2018, collaborators successfully implemented and completed the pilot year of a multi-year project. Study locations included: Anchorage, AK; Yellowknife, NT; Churchill, MB; and James Bay, ON. In Anchorage, we captured and banded 43 adult and 23 hatch-year Lesser Yellowlegs. Additionally we collected biological samples from all captured birds, and deployed 19 PinPoint GPS-Argos satellite tags (Lotek Wireless) and 10 light-level geolocators (Migrate Technology Ltd) on adults. In Yellowknife, partners collected biological samples from 4 adults and deployed 1 PinPoint tag. In Churchill, partners banded and collected biological samples from 14 adults, and at James Bay, partners banded and collected biological samples from 14 adults and 37 hatch-year birds. Our James Bay partners also deployed 7 PinPoint tags on breeding adults.

Preliminary results indicate that Lesser Yellowlegs migratory movements are variable across all population segments and migratory connectivity is weak. Birds breeding in Anchorage used the Central, Mississippi and Atlantic flyway corridors of the contiguous United States and dispersed across Central and South America and the Caribbean Islands. Birds migrated as far east as Antigua and Barbuda and as far south as Buenos Aires Province, Argentina. Birds breeding at James Bay used the Atlantic Flyway exclusively and traveled through regions of the Caribbean and northeastern South America. Current data indicate that birds will travel as far east as coastal Guyana.

We will continue migration tracking in 2019, by expanding our efforts to include study sites in Kanuti National Wildlife Refuge, AK, and Mingan, QC (Figure 1). In 2019, our goal is to deploy an additional 60 PinPoint GPS-Argos satellite tags divided among all study sites.

*Collaborators:* **:** Katie Christie and Marian Snively (ADF&G); Audrey Taylor (UAA); Christopher Harwood (USFWS); Sarah Sonsthagen and Lee Tibbitts (USGS- Alaska Science Center); Jennie Rausch, Christian Friss, Sam Hache, and Eric Reed (Environment and Climate Change Canada); Erin

Bayne (University of Alberta); Erica Nol and Alexandra Anderson (Trent University); Brad Andres (Atlantic Flyway Shorebird Initiative); Michael Hallworth, Pete Marra and Autumn-Lynn Harrison (Smithsonian Migratory Bird Center); Gerrit Vyn (Cornell Lab of Ornithology)
*Funding:* Alaska State Wildlife Grant, Department of Defense, USFWS Candidate Conservation Grant, USFWS Migratory Bird Management

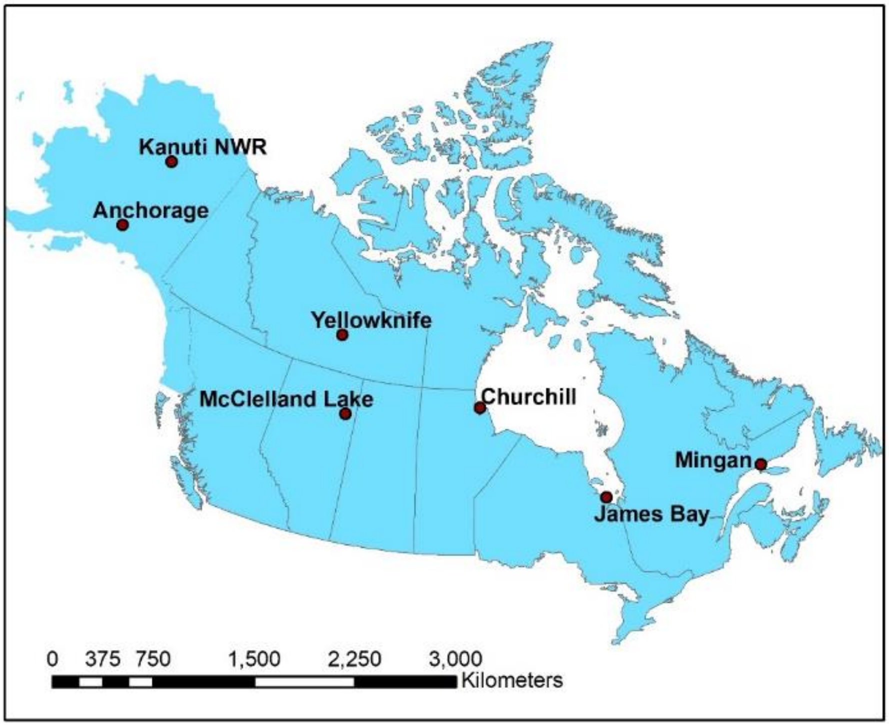



*Figure 1.* Lesser Yellowlegs study sites for 2019.

*Figure 2.* Lesser Yellowlegs carrying PinPoint GPS-Argos satellite tag (Lotek Wireless), Anchorage, AK. Photo credit: Zak Pohlen (USFWS)

*Figure 3.* Lesser Yellowlegs chick immediately post-hatch, Anchorage, AK. Photo credit: Laura McDuffie (USFWS)

*Location:* Anchorage, Alaska (61° 11' 33.8604" N, 149° 51' 32.4324" W)

*Contact:* Katie Christie, ADFG, 333 Raspberry Rd, Anchorage AK 99518, Email: katie.christie@alaska.gov, Phone (907) 267-2332; Jim Johnson, USFWS, 1011 E. Tudor Rd, Anchorage, AK, 99503 Email: jim_a_johnson@fws.gov , Phone: (907) 786-3423; Laura McDuffie, USFWS, 1011 E. Tudor Rd, Anchorage, AK, 99503 Email: laura_mcduffie@fws.gov, Phone: (907) 786-3979

# #17— BREEDING ECOLOGY OF RED KNOT (*CALIDRIS CANUTUS ROSELAARI*)

Investigators: Jim A Johnson, U.S. Fish and Wildlife Service

The 2018 field season marked the ninth consecutive year studying aspects of Red Knot breeding on the Seward Peninsula. Our primary objectives were to monitor chick growth rates and brood survival, deploy and recapture adults with geolocators, and continue to monitor the marked population.

Six observers conducted fieldwork this year at the same seven ridgelines along Teller Road outside of Nome. Similar to 2017, fieldwork targeted peak hatch and brood rearing. However, after missing peak hatch and early brood development in 2017, we arrived two weeks earlier on 23 June and stayed until 15 July for a total of 103 people-days in the field.

Environmental conditions in 2018 paralleled observations at other field camps on the North Slope. The Seward Peninsula experienced a late spring and summer, which contrasted with our early springs and summers in 2014–2017. Nome experienced record snowfall late in the winter, resulting in later than expected snow cover at much of our study site, with cooler temperatures persisting later than the previous four years.

In 2018, we resighted 19 previously flagged individuals, 18 of which were banded at study sites in Nome and 1, which was banded two months prior in Grays Harbor, WA, while trapping birds to track migratory movements. Four new adults were banded at the study site while attending broods, and 13 geolocators were deployed on adults.

We found 17 broods in 2018 and deployed 7 VHF radios on brood-attending adults to assist in monitoring brood activity. Of these 17 broods, we banded and monitored 54 chicks. Preliminary results indicate that chick growth in 2018 was greater than chick growth in the early summers of 2014–2017 when the Seward Peninsula experienced unusually early snowmelt and warm weather. Chick growth rates in 2018 were less than growth rates in 2012 when snowmelt and temperatures were more similar to 2018. Chick mass at 25 days was also the highest ever in 2018, and chick mass at 25 days in early years (2014–2017) is lower than chick mass in later years (2012, 2018)

Although our primary focus was finding broods, we incidentally discovered two nests while searching for broods. Both nests were successful and hatched on 28 June and 7 July. The hatch date of 7 July 2018 was the latest recorded or estimated hatch date in the history of the project. In contrast, the first brood discovered in 2018 had an estimated hatch date of 8 June, the earliest hatch date in the history of the project. Median hatch date in 2018 was 21 June.

Overall, 2018 was a successful year where we managed to thoroughly cover the hatching and brood-rearing period, and provided an interesting contrast to the early summers we have been experiencing in the previous four years. The work could not have been completed without the help of Laura McDuffie, Callie Gesmundo, Casey Weissburg, Ben Clock, Jim Johnson, and Zak Pohlen. This project was supported by USFWS Migratory Bird Management.

*Location:* Seward Peninsula, Alaska (64.805103° N, 166.023428° W)

*Contact:* Jim Johnson, USFWS, Migratory Bird Management, 1011 East Tudor Road, Anchorage, AK 99503. Phone: 907-786-3423; E-mail: jim_a_johnson@fws.gov

# #18— MIGRATORY MOVEMENTS OF SOLITARY SANDPIPER (*TRINGA SOLITARIA*)

Investigator: Jim A. Johnson and Laura McDuffie, U.S. Fish and Wildlife Service; Lucas DeCicco, University of Kansas

The migratory tracking study of Solitary Sandpipers began on Joint Base Elmendorf-Richardson, Anchorage, AK, in 2016. The study objectives include: 1) understanding site fidelity and vital rates of breeding adults and 2) identifying important stopover sites for migrating Solitary Sandpiper. We deployed 4 light-level geolocators (Migrate Technology Ltd.) in 2016, 10 in 2017 and 6 in 2018. We recovered 3 geolocators during the 2017 field season and 4 during the 2018 field season.

Our preliminary results indicate that birds use the Central Flyway in autumn to reach wintering areas in northeastern Argentina. On average, it took birds 70 days to reach wintering areas due to the frequency of stops and the length of stay at each stopover site, which ranged from 2 to 29 days. Spring migration routes were similar to fall routes, however birds completed spring migration in 30 days on average, and stopped for shorter durations of 2 to 21 days. The average distance traveled within the annual migratory cycle for breeding adults was 24,734 km.

Figure 1. Solitary Sandpiper chicks at 3–5 days old, Anchorage, AK. Photo credit: Laura McDuffie (USFWS)


Figure 2. Removal of a light-level geolocator, Anchorage, AK. Photo credit: Donna Dewhurst (USFWS)

*Location:* Joint Base Elmendorf-Richardson, Anchorage, Alaska (61° 15' 10" N, 149° 47' 36" W)

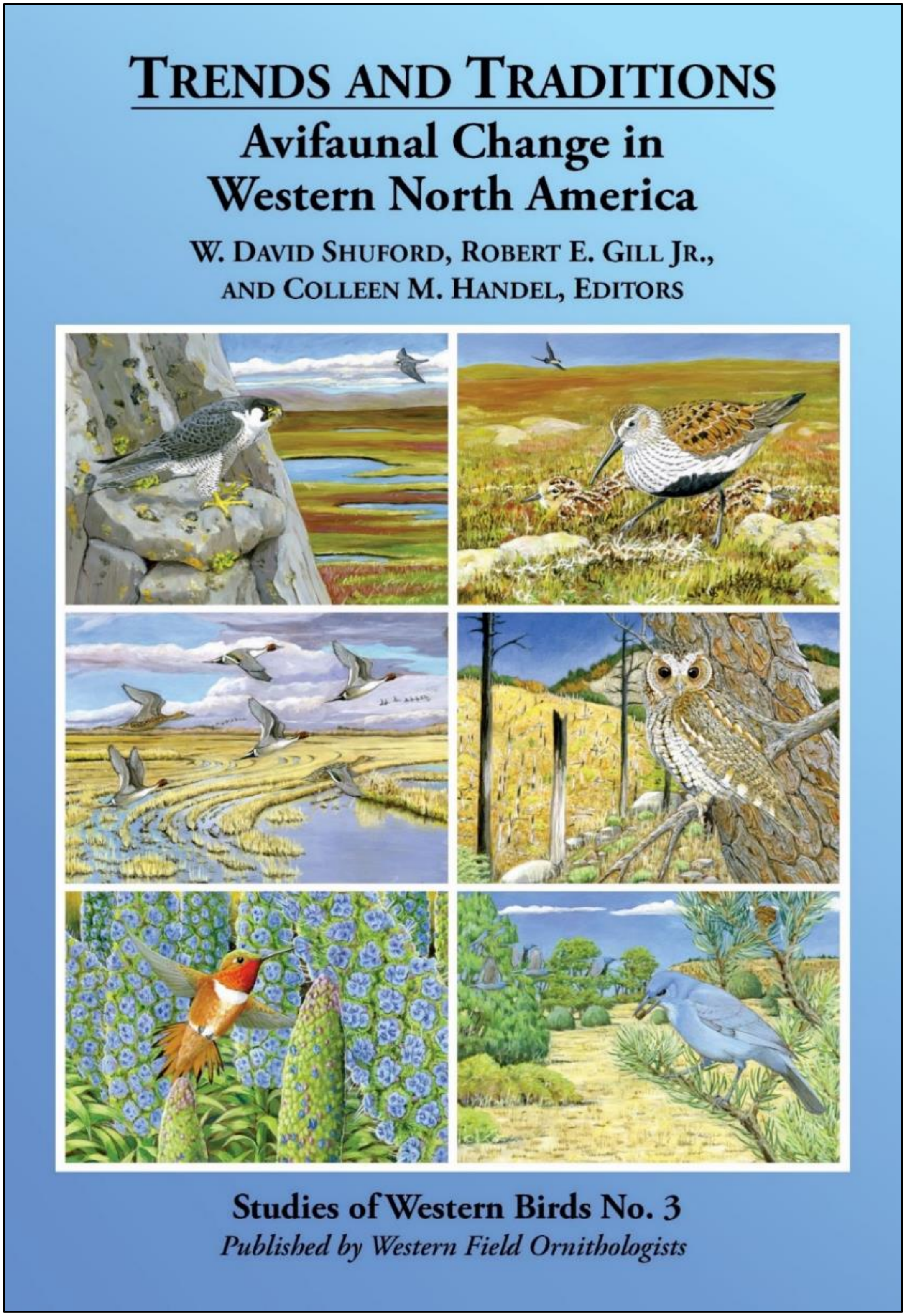
*Contact:* Jim A. Johnson, USFWS, 1011 E. Tudor Rd, Anchorage, AK 99503, Email: jim_a_johnson@fws.gov, Phone: (907)786-3423; Laura A. McDuffie, USFWS, 1011 E. Tudor Rd, Anchorage, AK 99503, Email:laura_mcduffie@fws.gov, Phone (907)786-3979

# #19— TRENDS AND TRADITIONS: AVIFAUNAL CHANGE IN WESTERN NORTH AMERICA

Editors: W. David Shuford, Point Blue Conservation Science, and Robert E. Gill Jr. and Colleen M. Handel, U. S. Geological Survey, Alaska Science Center

The status of the rich avifauna of western North America is ever changing in response to human influences, geomorphic processes, and natural climatic variation. Documenting and synthesizing the patterns, rate, and causes of these changes is crucial for the conservation of birds in this region, particularly in a time of rapid climate change, expanding human population, and accelerated resource extraction. To that end, a symposium on avifaunal change was held at Western Field Ornithologists' annual conference in San Diego, California, in October 2014, which formed the basis for the current volume, published in September 2018. The 26 papers herein emphasize the overarching themes of the effects of extensive habitat loss and degradation on the avifauna of the West in the 19th and 20th centuries and the responses of birds to environmental change and variation. Several papers portray rays of hope, documenting reversals of trends in the loss of some important habitats, the recovery of some avian populations in response to management, and resiliency in other species as they adapt to novel habitats. Others express increasing concern for the potential future effects of a rapidly changing climate. Most emphasize the importance of long-term monitoring of the population trends, distribution, and ecological attributes of the region's birdlife. Among the volume's chapters are two dealing with Alaska shorebirds. Craig Ely, Brian McCaffery, and Bob Gill present a four-decade-long assessment of arrival times of shorebirds on the Yukon-Kuskokwim Delta, while Audrey Taylor, Rick Lanctot, and Dick Holmes treat shorebird response to environmental change at Utqiaġvik (Barrow) over a 60-year period. Also of interest are two other papers authored by Alaskan colleagues with implications to Alaska shorebirds. Julian Fischer and his coauthors present results of long-term (1985–2014) aerial and ground surveys of geese and eiders on the Yukon-Kuskokwim Delta, and Ted Swem and Angela Matz look at the natural history and recovery of Arctic Peregrine Falcons along the Colville River between 1981 and 2011.

Contact: The volume is available for online purchase at: http://www.wfopublications.org/Avifaunal_Change-order.html.


TRENDS AND TRADITIONS
Avifaunal Change in Western North America
W. DAVID SHUFORD, ROBERT E. GILL JR., AND COLLEEN M. HANDEL, EDITORS
Studies of Western Birds No. 3
Published by Western Field Ornithologists

# #20— FACTORS INFLUENCING WATERBIRD ABUNDANCE ON THE COPPER RIVER DELTA

Investigators: Jillian Jablonski and Audrey Taylor, University of Alaska Anchorage

The Copper River Delta is a highly productive coastal wetland and an important breeding ground for waterbirds. We are investigating a suite of biological, chemical, and physical factors to understand what is driving waterbird distribution and breeding chronology on the Delta, and how the aquatic invasive plant *Elodea canadensis* and differences in pond temperatures may be affecting the food web supporting the waterbird community. Fieldwork for this project was conducted in 2016 and 2017. Sixteen study ponds were selected along a gradient of temperature and hydrological characteristics. Each pond was visited five times, at approximately two-week intervals from late May through early August. All waterbirds on or within 10 m of the pond edge were recorded to species. Nests near ponds were recorded and monitored for success.

Data have been analyzed using waterbird foraging guild densities, species diversity (Shannon Weiner Diversity Index), and habitat characteristics across study ponds using multiple regression techniques. Candidate models were selected using backwards stepwise regression; Akaike weight was used to select the best-fitting models. Models were fit for all waterbird density, and the shorebird, dabbling duck, diving duck, and herbivore guilds. Overall, greater waterbird density was positively related to warmer pond water temperatures and increasing distance from the nearest glacier terminus. Similarly, shorebird density was positively related to warmer pond water temperature and increasing distance from the nearest glacier terminus, while also showing a significant positive association with ponds surrounded by grass/sedge terrestrial vegetation communities.

Location: Copper River Delta
Contact(s): Jillian Jablonski, Department of Geography and Environmental Studies, University of Alaska Anchorage. Phone: 630-542-9424; email: jcjablonski@alaska.edu

# #21— POPULATION SIZE AND NEST SURVIVAL FOR TWO ENDEMIC BIRDS BREEDING ON BERING SEA ISLANDS

Investigators: Rachel Richardson, U.S. Geological Survey and University of Alaska Anchorage; Steve Matsuoka, U.S. Geological Survey; Jim Johnson, U.S. Fish and Wildlife Service; Marc Romano, U.S. Fish and Wildlife Service; and Audrey Taylor, University of Alaska Anchorage

Monitoring wildlife populations is essential for determining the health and status of species over time. This is especially important for species with heightened vulnerability to ecological disturbances due to small population sizes and restricted geographic ranges. Interannual fluctuations in population numbers are common and can result from widespread breeding success or failure. Thus, identifying factors responsible for these cycles is necessary for understanding potential impacts to breeding populations. If declines are detected in sensitive populations, it becomes necessary to identify probable causes of change before appropriate management actions and conservation efforts are developed and implemented.

The McKay's Bunting (*Plectrophenax hyperboreas;* MCBU) and Pribilof Rock Sandpiper (*Calidris p. ptilocnemis;* ROSA) are rare endemic birds in Alaska, identified as priority species for research and monitoring, and designated as birds of high conservation concern. This important designation is supported by population estimates derived from counts in the early 2000s that suggest both populations have less than 50,000 individuals. Breeding ranges are restricted to remote Bering Sea islands where MCBU breed only on uninhabited St. Matthew and Hall Islands, while ROSA also nest on the two Pribilof Islands of St. Paul and St. George. Only one population estimate currently exists, and monitoring efforts have not been undertaken since 2003 due to the time and expense necessary to reach the islands. Data collected for this study will thereby provide a second population estimate for each species and identify factors potentially influencing breeding populations. Additionally, these data will be used to inform development of a long-term population monitoring plan necessary for assessing future threats and changes. The main objectives that will be addressed include: (1) estimating abundance using line-transect and distance estimation surveys to compare to 2003 population estimates, and (2) searching for and monitoring nests to quantify nest survival and productivity and to determine the influence of predation and habitat characteristics on reproductive success.

During the 2018 field season, we conducted population surveys from 7–10 June resulting in completion of 34 transects on St. Matthew Island and 12 transects on Hall Island. Additionally, we monitored 71 MCBU nests and 62 ROSA nests from 10 June to 6 July. Of known fate nests, 86% of MCBU nests fledged at least one chick, and 50% of ROSA nests hatched at least one chick. Reasons for nest failures included: (1) predation (MCBU: 5 nests; ROSA: 18 nests), (2) abandonment (ROSA: 1 nest), and (3) human disturbance (ROSA: 1 nest). Finally, we collected data on habitat characteristics to evaluate the use of microhabitats for nesting. Forthcoming products will include spatial models of abundance and population change and estimates of reproductive success and nest failure rates.

Additional field assistance for this study was provided by Tony DeGange, Robert Gill, Andy Johnson, Irby Lovette, Bryce Robinson, Stephanie Walden, and Aaron Wells. Funding and logistical support for this study was provided by the National Fish and Wildlife Foundation, Alaska Maritime National Wildlife Refuge, USFWS Migratory Bird Management, University of Alaska Anchorage, Cornell Lab of Ornithology, and USGS Alaska Science Center. Special thanks to John Faris and the crew of the *R/V Tiglax* for providing hospitality, accommodations, and safe transport to and from St. Matthew and Hall Islands.

*Location:* St. Matthew and Hall Islands, 60°27′ N, 172°50′ W
*Contact:* Rachel Richardson, U.S. Geological Survey, Alaska Science Center, 4210 University Drive, Anchorage, AK 99508; Phone: (907) 786-7194; Email: rrichardson@usgs.gov

View of Bull Seal Point on St. Mathew Island, Bering Sea, Alaska. Photo credit: Rachel Richardson.

View of Glory of Russia Cape on St. Matthew Island, Bering Sea, Alaska.
Photo credit: Rachel Richardson.

# #22— INFLUENCE OF WETLAND CONTEXT ON THE DISTRIBUTION AND ABUNDANCE OF BOREAL BIRDS

Investigators: Sabre Hill, University of Alaska Anchorage; Dr. Audrey Taylor, University of Alaska Anchorage

The human footprint on boreal forest habitat is increasing, particularly in the Anchorage/ Mat-Su region where an average annual growth rate of 0.85% has been recorded since 2010. Modification of boreal forest for commercial and residential development may be affecting habitat quality for boreal bird species, many of which are already in decline.

The purpose of this research is to better understand how habitat used by declining boreal bird species may be changing as a result of this human footprint. We plan to accomplish this objective by contrasting the nesting habitat use of migratory boreal bird species on relatively unimpacted wetlands located on Joint Base Elmendorf-Richardson (JBER) with comparable wetlands within the urbanized Anchorage metropolitan area.

To date, ArcGIS has been used to create a geodatabase of boreal bird survey data collected on JBER and in Anchorage from 2014–2017. This database will be used to quantify habitat characteristics at the wetland and landscape scales and use these variables to predict occupancy of several declining boreal bird species, including Greater and Lesser Yellowlegs, Solitary Sandpiper, and Rusty Blackbirds. Currently, we are in the process of determining habitat and anthropogenic variables to analyze the probability of occupancy of any given species across various classes of wetlands. These results will be analyzed to evaluate how man-made structures and ecology are affecting habitat selection by boreal birds. This work began in spring 2017 and will likely be completed by fall of 2019.

*Location:* Anchorage and JBER wetlands

*Contact(s):* Sabre Hill, University of Alaska Anchorage, MS Candidate, smhill2@alaska.edu, (303) 912-1447; Audrey Taylor, University of Alaska Anchorage, Department of Geography and Environmental Studies, artaylor@alaska.edu, (907) 786-6854

JBER Summer 2017 Photo Credit: Sabre Hill

## #23— BIRDS 'N' BOGS CITIZEN SCIENCE PROGRAM

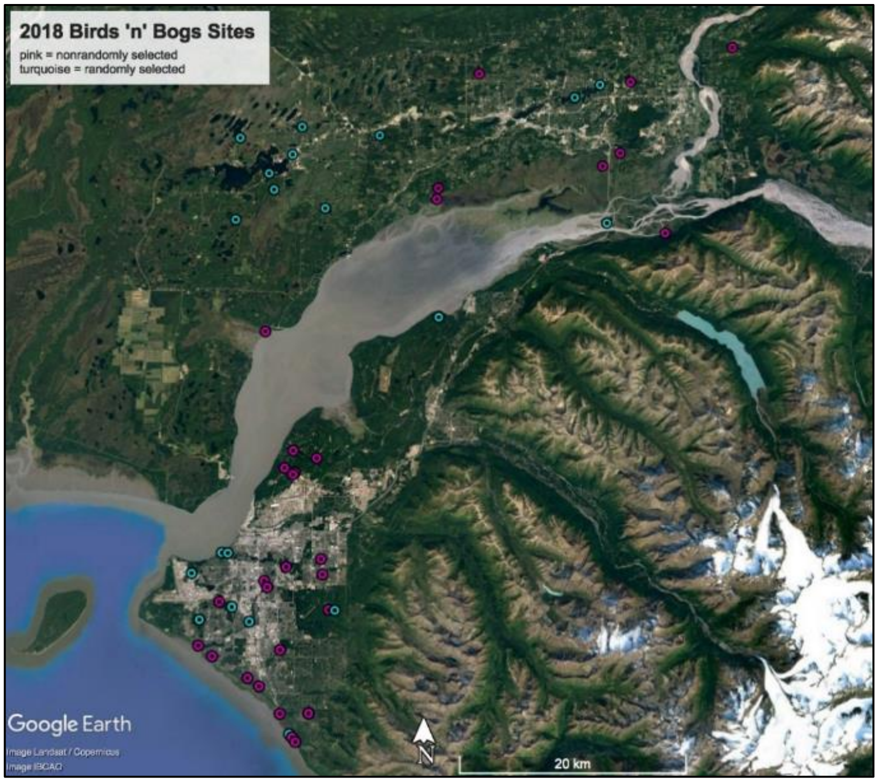
Investigators: Audrey Taylor, University of Alaska Anchorage; Marian Snively and Katie Christie, Alaska Department of Fish & Game

2018 represented the sixth year of Birds 'n' Bogs, a citizen science program initiated through Audubon Alaska and the University of Alaska Anchorage's Department of Geography and Environmental Studies. The goal of this program is to document spring distribution of 12 boreal bird species found in wetland habitats of Anchorage, JBER, and the Matanuska Valley, as well as to foster greater awareness of declines in these species across the boreal forest biome.

Thirty-six participants contributed 135 volunteer hours in 2018. Participants reported (visual and audible detections combined) 182 Lesser Yellowlegs, 106 Greater Yellowlegs, 17 Solitary Sandpipers, 62 Rusty Blackbirds, 9 Olive-sided Flycatchers, 968 Tree Swallows, 237 Violet-Green Swallows, 41 Common Loons, 32 Pacific Loons, 11 Red-throated Loons, and 319 Red-necked Grebes. These totals represent the sum of detections across all four survey periods in the month of May, so likely include repeat observations of multiple individuals.

We plan to continue this effort for an additional four years using a more rigorous survey framework that will enable occupancy analysis. Laura McDuffie, who assisted with surveys on JBER this year, recently submitted a publication assessing Common and Pacific Loon abundance and productivity trends based on data from the first 30 years of the ADFG Loon and Grebe Watch program, which has now been combined with Birds 'n' Bogs. Lastly, Sabre Hill (MS student, UAA) is using the Anchorage Birds 'n' Bogs data from 2013–2017 to compare habitat use by declining boreal wetland bird species (including Greater and Lesser Yellowlegs and Solitary Sandpipers) across JBER and Anchorage wetlands (see her abstract, #22 this volume).

*Location:* multiple sites in southcentral Alaska: Anchorage, JBER, Matanuska-Susitna Borough
*Contact(s):* Audrey Taylor, Department of Geography & Environmental Studies, UAA. (907) 786-6854, artaylor@alaska.edu




Connors Lake, Anchorage

# #24— RED PHALAROPE (*PHALAROPUS FULICARIUS*) RENESTING STUDY IN UTQIAĠVIK

Investigators: Jillian Cosgrove and Bruce Dugger, Oregon State University; Richard Lanctot, U.S. Fish and Wildlife Service.

Renesting propensity can be defined as the likelihood that a bird will lay a replacement clutch after a first nest is lost. Whether a bird re-lays or not has implications for estimating an individual's annual reproductive success, for modeling population dynamics, and for estimating nest density on monitored plots. While several studies have incidentally documented renesting in Arctic-breeding shorebirds, only one study to date (i.e., for Dunlin *Calidris alpina arcticola*) has assessed renesting rates by experimentally removing clutches at early and late stages of incubation (Gates et al. 2013). This study found much higher rates of nest replacement than previously thought possible given the short Arctic summers. Here, we used experimental clutch removal methods similar to Gates et al. (2013) to assess renesting rates in Red Phalaropes (*Phalaropus fulicarius*). This is the first experimental investigation of renesting rates of an Arctic-breeding shorebird with a sequentially polyandrous breeding system and an opportunistic settlement pattern.

From 11–24 June 2018, we captured and radio-tagged Red Phalaropes on or near a 1-km$^2$ area located between Laura Madison Road and Kaleak Street (hereafter, the "study plot") in Utqiaġvik, Alaska (71.15° N, 156.48° W). We trapped 59 Red Phalaropes with mist nets or bownets: 18 during incubation (17 males, 1 female), 5 during laying (3 males, 2 females), 8 during pre-laying (5 males, 3 females), and 28 with unknown nesting status (14 males, 14 females). We deployed 34 radio-transmitters on male Red Phalaropes (21 on nesting males and 13 on males of unknown status, Figure 1). We tracked males daily through 11 July by scanning for radio frequencies along the road system in Utqiaġvik to determine their location, pairing status, and occurrence of initial or renests. We defined the "study area" as the area within two kilometers of the road system in Utqiaġvik, which is the estimated range transmitters could be detected with our telemetry system. Of the 13 males that were radio-tagged with unknown nesting status, 3 initiated nests on the study plot and later had their clutch experimentally removed (see below), 1 initiated a nest away from the study plot, 1 stayed on the study plot but never nested, and 8 disappeared from the study area without initiating nests. Of the 21 males captured while nesting (laying or incubation), 1 dropped a tag soon after clutch removal and the others had their nests removed.

Of the 24 males that had their clutches experimentally removed, only 1 was found renesting on our study plot. Of the remainder: 14 were never resighted and disappeared from the study area before 5 July (date when any renesting was likely); 3 moved from the study plot and were resighted within the study area, but disappeared before 5 July; 4 stayed on the study plot after 5 July and did not renest; and 2 moved from the study plot but stayed within the study area past 5 July and did not renest (Figure 1).

For the one male that renested, his initial nest was initiated on 16 June and appeared to be abandoned on 28 June, 10 days into incubation. According to float data, the initiation and incubation dates for the renest were 26 June and 28 June, respectively. Based on the behavior of the male, which included feeding and copulating with a female while also periodically incubating the first clutch, it appears that the male continued to incubate his first clutch until a new clutch was laid by the female, and then abandoned the first clutch to incubate the second. Collaborators at the Max Planck Institute of Ornithology are conducting paternity analysis on the first and second clutches to determine whether both clutches were laid by the same female. Strangely, this male's second clutch was also abandoned on 7 July.

Though we confirmed renesting for only one male, we were unable to track all males due to the limited range of our radio transmitters. Because shorebird monitoring data from 16 breeding seasons in Utqiaġvik indicates Red Phalaropes do not initiate nests after 5 July, it is possible that birds that disappeared before this date (i.e., 17 out of 24) renested outside of our study area. However, we consider renesting to have been very unlikely for birds that we were able to monitor after 5 July (i.e., 6 out of 24). Taken together, this indicates that renesting by Red Phalaropes was at least 4.2% (1 of 24) and possibly as high as 75% (18 of 24). This compares to renesting rates of 82–95% and 35–50% in Dunlin for nests removed in early and late incubation, respectively (Gates et al. 2013). In contrast to the Dunlin study, our radio tracking documented unexpected large movements of males away from their original nest locations after clutch removal. Indeed, we documented movements of up to 15 km within our limited study area. These facts indicate future inquiries into renesting rates of Red Phalaropes or other polygamous arctic-breeding shorebird species need to be able to track birds large distances after clutch removal to relocate potential renests.

Red Phalaropes are ranked as moderate conservation concern by the 2008 Alaska Shorebird Conservation Plan (p. 11). Assessing renesting rates contributes to the research objective of developing quantitative population models, measuring key demographic parameters, and analyzing population dynamics of shorebird populations (p. 20), and addresses the monitoring objective of developing and implementing standardized methods for assessing shorebird population size (p. 21).

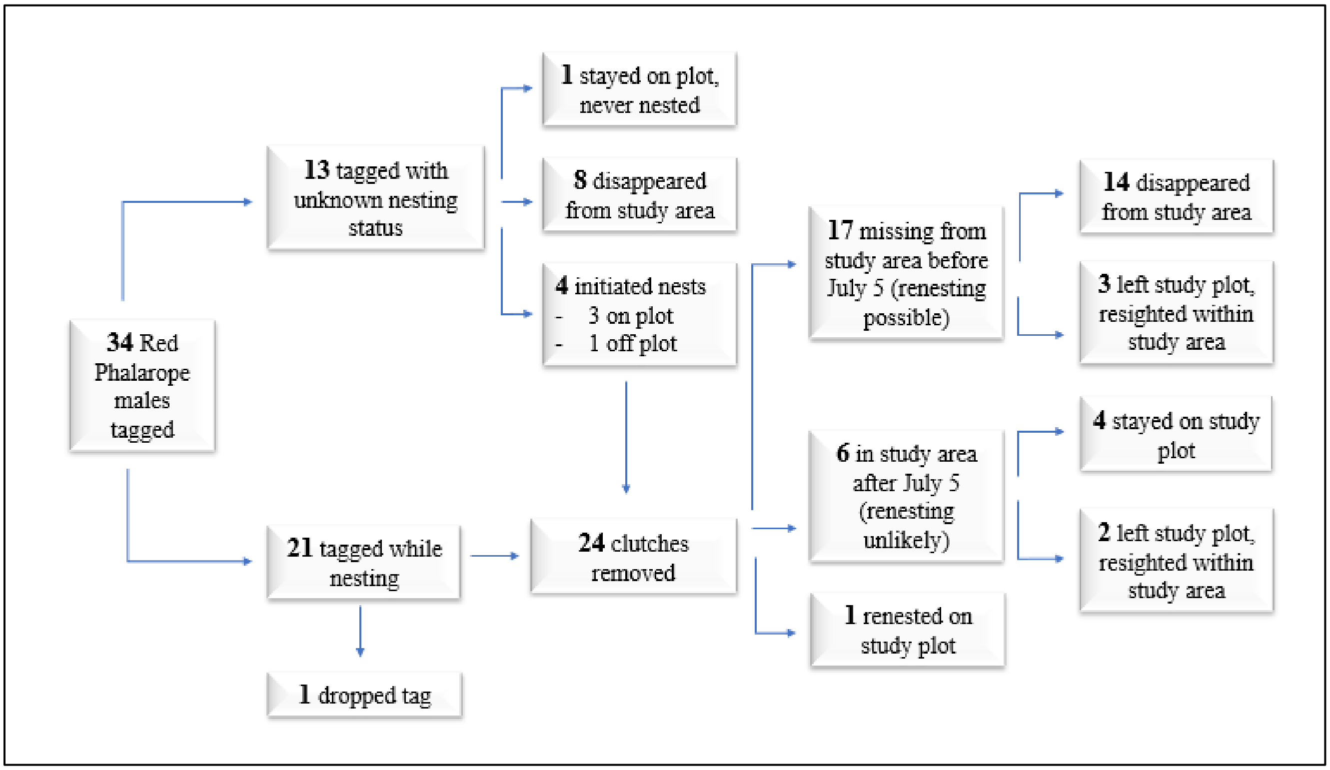



**Figure 1.** Bubble diagram showing the fates of the 34 Red Phalarope males that were radio-tagged and tracked to determine occurrence of nesting or renesting near Utqiaġvik, Alaska, from 11 June to 11 July 2018.

**Figure 2.** Red Phalarope pair captured during pre-nesting near Utqiaġvik, Alaska. Photo by Jillian Cosgrove.

*Location:* Utqiaġvik, Alaska (71.15° N, 156.48° W)

*Contact:* Jillian Cosgrove, Oregon State University, Nash Hall, 2820 SW Campus Way, Corvallis, OR 97331, phone: (408) 410-2173, email: jillian.cosgrove@oregonstate.edu

# #25— MONITORING SEMIPALMATED PLOVERS BREEDING AT EGG ISLAND, COPPER RIVER DELTA

Investigators: Mary Anne Bishop, Prince William Sound Science Center and Erica Nol, Trent University

North American shorebirds have experienced population declines over the last several decades. Semipalmated Plover, however, is one shorebird species whose numbers are apparently stable. Building on research conducted in 2006 and 2008, we began a study in 2011 on a breeding population of Semipalmated Plovers at Egg Island, a barrier island on Alaska's Copper River Delta. The objectives of our study are to monitor breeding phenology and to determine survivorship based on return rates of banded breeders. We conducted field work 3–7 and 12–13 June 2018. A total of 15 plover nests were located. In all, we banded 13 Semipalmated Plover adults and resighted 7 birds from previous years. Additional field work is planned for Egg Island in 2019.

*Location:* Copper River Delta, 60° 22.7' N 145° 53.6' W

*Contact(s):* Mary Anne Bishop, Prince William Sound Science Center, PO Box 705, Cordova, AK 99574. Phone: 907-424-5800 x 228; email: mbishop@pwssc.org.

# #26— MIGRATORY CONNECTIVITY OF INTERIOR ALASKA LESSER YELLOWLEGS

Investigators: Chris Harwood, Tina Moran, and Lisa Maas, U.S. Fish and Wildlife Service

The legal and illegal harvest during fall migration of Lesser Yellowlegs (hereafter, yellowlegs) in the Caribbean and northern South America has been recently identified (i.e., after publication of the 2008 Alaska Shorebird Conservation Plan) as a potential threat to the Alaskan population of this species. In summer 2018 colleagues deployed GPS tags on yellowlegs in the Anchorage Bowl to understand the fall migratory movements of these birds and whether they might be susceptible to harvest during this season (**see project #16**). Our research objective was to determine if there were sufficient numbers of yellowlegs breeding along a relatively small stretch of the Kanuti River in north-central Alaska, some 350 miles north of Anchorage, to function as a complementary study population. Our goal was that given a sufficient pool of individuals, we could return in 2019 to mark birds and deploy GPS tags so as to determine the fall migration movements of this more northern population, and possibly investigate apparent survival of returning birds.

Crew members of Kanuti National Wildlife Refuge returned on 22 May 2018 to our administration cabin at Kanuti Lake, base of operations for shorebird work nearly annually from 2008–2014. Almost daily between 24 May and 1 June we searched on foot and by boat for presumably incubating yellowlegs pairs in wetland, taiga, and tundra habitats some four km upriver (east), downriver (west), and south of the cabin. During this week, the Kanuti River was at considerable flood stage, effectively connecting all waterbodies and seasonal wetlands within the floodplain and making access to these habitats fairly efficient. We observed about 11 individual yellowlegs during the week.

After conducting unrelated fieldwork until 13 June, we resumed nearly daily yellowlegs reconnaissance on 14 June. After several quiet days, from 18–21 June we observed vociferously alarm-calling yellowlegs, estimating 8, 2, 2, and 2 presumable family groups each day. Given the quietness experienced prior to 18 June, we assumed these family groups comprised just-hatched chicks. Brood-rearing sites generally exhibited moist shores with emergent graminoids of both permanently full and seasonally drying lakes; lichen-black spruce woodlands were also used. With the exception of the former, all shoreline habitats abutted patches of low-lying upland tundra which could have served as nesting areas during this year of extreme local flooding.

As we had located at least 14 pairs of breeding yellowlegs, we deemed the area sufficiently populous to support additional studies (e.g., movement tracking, adult survival). To that end, we secured funding to purchase 10 GPS tags. We expect to capture birds during brood rearing of 2019 and deploy all 10 tags in the study area. We will attempt to capture and mark all yellowlegs encountered, even beyond those with GPS tags, to increase the probability of having a sufficient sample for an adult survival study.

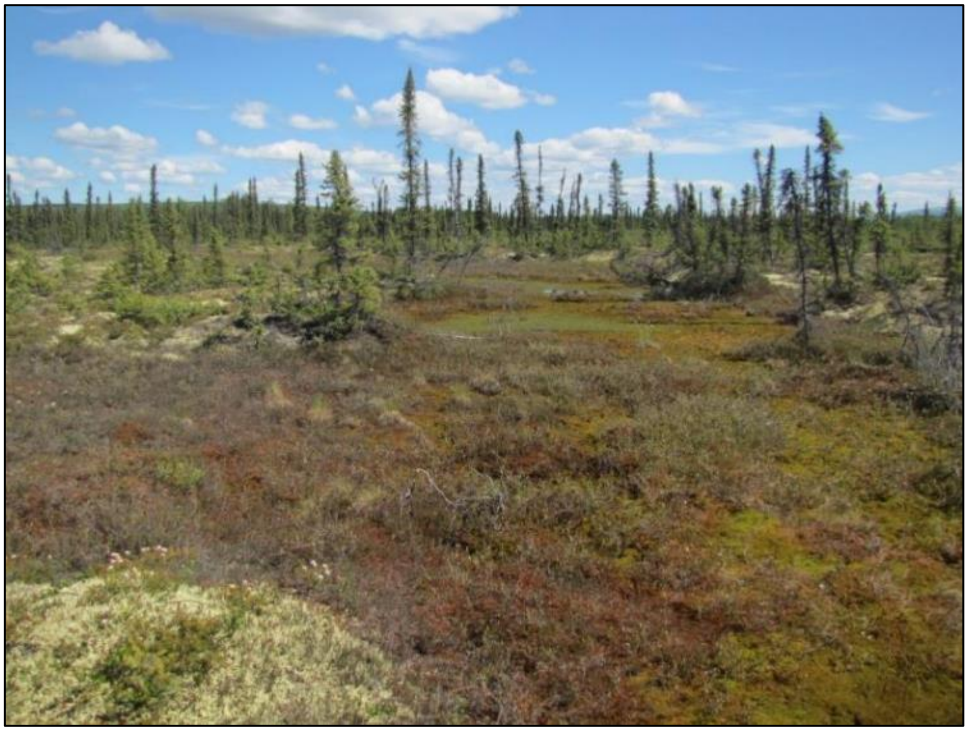


Figure 1 • Lichen-black spruce woodlands with interspersed *Sphagnum* bogs

Figure 2 • Now-separate boreal ponds (they were connected during May 2018 peak flooding)

Figure 3. Seasonally drying oxbow lakes (floods annually, not just in extreme years like 2018)

*Location:* Kanuti Lake, 66° 10.76’ N, 151° 44.30’ W

*Contact:* Chris Harwood, U. S. Fish and Wildlife Service, Kanuti NWR, 101 12th Ave., Room 206, Fairbanks, AK 99701; phone: (907) 455-1836; email: christopher_harwood@fws.gov

# #27— LONG-TERM MONITORING OF BLACK OYSTERCATCHERS IN THE GULF OF ALASKA

Investigators: Brian Robinson and Daniel Esler, U.S. Geological Survey; Heather Coletti, National Park Service

The Gulf Watch Alaska nearshore program monitors ecologically important species and key physical parameters in the nearshore marine environment (Fig. 1). These species include sea ducks, sea otters, intertidal invertebrates, and Black Oystercatchers. Monitoring of Black Oystercatchers began in 2006 and has been done nearly yearly in three sampling blocks: Katmai National Park and Preserve, Kenai Fjords National Park, and western Prince William Sound. In 2018, we expanded our monitoring efforts to include Kachemak Bay. In each block, surveys are conducted along four or five transects to determine nest density, productivity, and chick diet. We estimate species composition and size distributions of prey fed to chicks by collecting and measuring all prey remains found near a nest, indicative of adults provisioning their offspring. Here we present preliminary results.

In 2018, we located a total of 33 nests in all four sampling blocks. Nest density this year ranged from 0.02 to 0.16 nests per km of shoreline, with the highest density in Katmai National Park and Preserve. Productivity (number of eggs + chicks / nest) was highest (3.0 ± 0; mean ± SE; $n = 2$) in Kachemak Bay and lowest (1.58 ± 0.15; $n = 10$) in Katmai National Park and Preserve. We collected 2,808 prey items from nests in 2018, representing 19 different taxa. While chick diet varied by block and transect, overall it was dominated by three species of limpets (*Lottia pelta, L. persona, and L. scutum*); together they made up 80% of the diet in 2018 and have dominated diet throughout the 12 years of sampling. The black katy chiton (*Katharina tunicata*) and Pacific blue mussel (*Mytilus trossulus*) represented much smaller proportions in the diet (13% and 5%, respectively). Long-term monitoring of Black Oystercatchers provides an opportunity to understand how a top-level predator in the intertidal food web may respond to changes in a highly dynamic ecosystem.

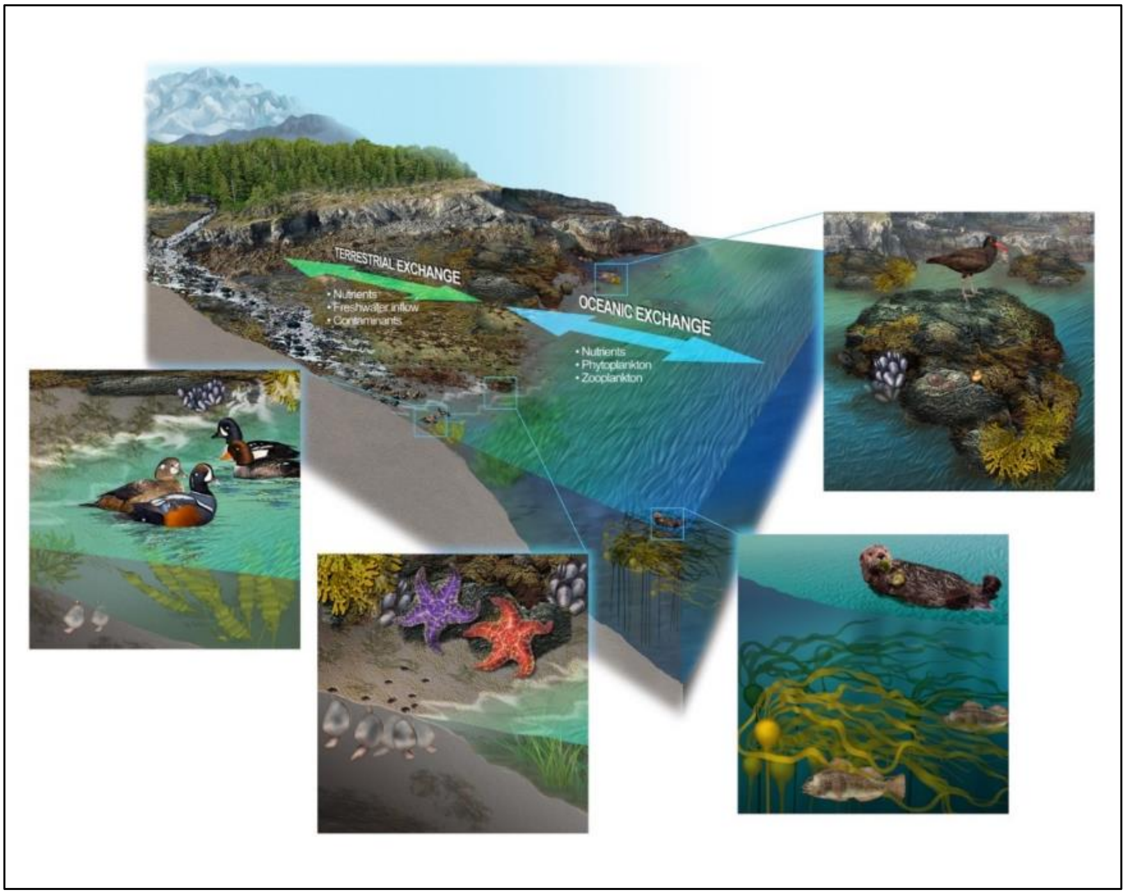



Figure 1. The Black Oystercatcher is one of many ecologically important species in the nearshore marine ecosystem that is monitored by Gulf Watch Alaska.

*Contact:* Brian Robinson, Alaska Science Center, U.S. Geological Survey, 4210 University Drive, 907-786-7058, brobinson@usgs.gov

# #28— BEHAVIORAL ECOLOGY OF RED PHALAROPES (*PHALAROPUS FULICARIUS*)

Investigators: Johannes Krietsch, Bart Kempenaers, Mihai Valcu, Max Planck Institute for Ornithology - Department of Behavioural Ecology & Evolutionary Genetics; Richard Lanctot, U.S. Fish and Wildlife Service

The main objective of this study is to better understand the social and genetic mating system of the Red Phalarope. Red Phalaropes are a textbook example of sex-role reversal and their mating system is described as monogamous and sequentially polyandrous. Understanding the selective drivers that led to the evolution of this sex-role reversal represents a challenge for evolutionary biologists, since it is not clear which ecological, life-history, or social factors facilitated conventional sex roles to be reversed. We are investigating the behavioral ecology of Red Phalaropes using a combination of detailed behavioral observations on individually marked birds, parentage analysis, data loggers to record nest attendance, and satellite and GPS tags to record large-scale and fine-scale movements, respectively. We hope to obtain a better understanding of the species' within-season mobility and post-breeding movements, which are necessary to better understand their demography and to create targeted conservation plans.

We banded 573 adult Red Phalaropes (248 in 2017 and 325 in 2018) in Utqiaġvik, Alaska. We fitted Solar Argos PTT satellite transmitters on 71 female Red Phalaropes (40 in 2017 and 31 in 2018) to follow individual movements. With a focus on following both members of a pair, we also equipped 100 adult Red Phalaropes with radio transmitters with GPS to study local movements on a high temporal and spatial resolution. These detailed movement data, coupled with behavioral observations, allow us to investigate pair formation and mate guarding. Overall we found 75 Red Phalarope nests within our study site (36 in 2017 and 39 in 2018). We took blood samples from chicks and tissue samples from unhatched eggs from these nests and the USFWS's long-term study plots to be used for parentage analysis. Most nests were equipped with temperature loggers giving us data on nest attendance. We plan to continue our work in 2019.

*Location:* Utqiaġvik, Alaska (71.3232° N, 156.6464° W)

*Contact:* Johannes Krietsch and Bart Kempenaers, Max Planck Institute for Ornithology, Department of Behavioural Ecology & Evolutionary Genetics; email: jkrietsch@orn.mpg.de, b.kempenaers@orn.mpg.de

# #29— MIGRATION ECOLOGY OF BUFF-BREASTED SANDPIPERS

Investigators: Lee Tibbitts U.S. Geological Survey; Richard Lanctot and Sarah Saalfeld, U.S. Fish and Wildlife Service; Rebecca Bentzen, Wildlife Conservation Society; Juliana Bosi de Almeida, SAVE Brasil; Joaquin Aldabe, Aves Uruguay; Gabriel Castresana, Reserva Natural Bahía Samborombón; Rob Clay and Arne Lesterhuis,, Manomet, Inc.; Daniel Blanco, Wetlands International; and Carlos Ruiz, Asociación Calidris.

We conducted the third and final year of fieldwork to determine range-wide migratory routes, migratory timing, and stopover habitats of Buff-breasted Sandpipers (*Calidris subruficollis*). This species breeds in low densities across the High Arctic in Russia, Alaska, and Canada, and winters primarily in the pampas grasslands of Brazil, Uruguay, and Argentina.

To track Buff-breasted Sandpipers, we have deployed both 2.0-gram solar-powered, Argos PTTs and 4.0-gram battery-operated GPS Argos Pinpoint tags on breeding, migration and wintering areas. To document northbound migration, we deployed tags on a total of 25 birds at three different nonbreeding sites in November 2017: Lagoa de Peixe, Brazil (4 PTTs, 2 GPS); Laguna de Rocha, Uruguay (4 PTTs, 5 GPS); and Bahia de Samborombón, Argentina (4 PTTs, 6 GPS). To document southbound migration, we deployed tags at one breeding site at Prudhoe Bay, Alaska (17 GPS) in June 2018, and one stopover site at two coastal turf farms in Central Texas (30 GPS) in August 2018. Most tags provided 1–2 months' worth of location data at 1-, 2-, or 5-day intervals; the solar-powered PTT tags provided information more frequently and some provided data for many months.

The emerging picture of the overall migration route of Buff-breasted Sandpipers between southern South America and the Canadian and Alaskan Arctic looks like an hourglass with the narrow neck of the glass focused on the Central Flyway between Texas and Saskatchewan (Figure 1). Buff-breasted Sandpipers spent about three months to traverse this route during both northbound (late March to early June) and southbound (late July to late October) migration. Migration trips for most birds consisted of short hops along four migration legs punctuated by multiple week long breaks at staging areas. The staging areas used by the majority of the tagged Buff-breasted Sandpipers were in northern Colombia (north and south migration), central coastal Texas (north and south), southern Saskatchewan (north), and the central highlands of Bolivia (south).

The precision of the GPS data allowed us to begin evaluating habitat use. Based on scrutinizing Google Earth maps, staging birds relied on turf farms, fallow fields, pastures, and natural grasslands. Breeding birds, as expected, were associated exclusively with High Arctic tundra whereas nonbreeding birds were detected in grazed pastures, natural grasslands, agriculture fields, and river bars. We visited a subset of bird location points in North and South America to collect detailed *in situ* data on plant species composition, vegetation heigh,t and other factors. These data are currently being analyzed to assess habitat use across the species' range.

Like last year, birds tagged in Alaska moved east after breeding to stage in Nunavut in late June and July before heading south over the boreal region of Canada, and then stopped periodically throughout the Midwest on their way to Texas. Birds spent several weeks in Texas and then embarked on mostly nonstop flights across the Gulf of Mexico and Central America before swinging west out over the Pacific Ocean and making landfall in Colombia, Ecuador, and Peru. These birds continued south, stopping in Bolivia and occasionally in Paraguay, before heading to the pampas region of Argentina, Brazil, and Uruguay. This year we learned that northbound birds also made a nonstop flight across the Gulf of Mexico along a route that took them directly over the Caribbean Sea and thus much farther east than southbound tracks. Finally, we received a second year of migration data from a single PTT-tagged individual; this bird returned to Nunavut to breed but took different routes to get to and from its traditional wintering site along a large inland lake in Uruguay. As documented by Almeida in the past, this bird, and perhaps others, tends to have greater site fidelity to wintering areas than breeding areas.

Field assistance for conducting this work in 2018 was provided by Lindsay Brown, Peter Detwiler, Jason Loghry, Brent Ortego, Nate Selleck, and Kelli Stone, in Texas; Danielle Gerik and Peter Detwiler at Prudhoe Bay; Pablo Rojas, Eduardo Elissondo, Melina Lunardelli, Alex Fletcher, and David Balderrama, at Bahía Samborombón, Argentina; Sasha Hackembruck, Graciela Amorín, Héctor Caymaris, Virginia Sanz, Hugo Inda, and Leandro Bergamino at Laguna de Rocha, Uruguay; and Fernando Faria, Cindy T. Barreto, Riti S. dos Santos, Lauro J. de Souza Lemos, Danielle Paludo, and Guilherme Tavarnes Nunes at Lagoa do Peixe in Brazil. Housing was provided by Steven Goertz of the Nature Conservancy, and Laurie Gonzales and Stuart Marcus at the Trinity National Wildlife Refuge in Texas. BP Exploration (Alaska), Inc. (especially Christina Pohl, Eric Van Dongen) helped us gain access to the Prudhoe Bay oil field and provided logistical support. Logistical support was provided by Parque Nacional da Lagoa do Peixe in Brazil; Enrique Zunini, Martín Segredo, and Fundación Amigos de las Lagunas Costeras de Rocha provided access and accommodation at the "La Rinconada" ranch in Uruguay; and the Reserva Natural Bahía Samborombón in Argentina. In 2018, funding was provided by Environment and Climate Change Canada, U.S. Geological Survey's Science Support Program, U.S. Fish and Wildlife Service, the U.S. Geological Survey, Manomet Inc./WHSRN Executive Office and Instituto Elektro in Brasil.

This study is focused on the Buff-breasted Sandpiper, one of the priority shorebird species identified in the Alaska Shorebird Conservation Plan (Alaska Shorebird Group 2008). The study also fulfills action items identified in the Alaska Shorebird Conservation Plan under the Research section (i.e., "develop and implement contemporary research techniques (e.g., PTT and GPS tags) to identify unique populations of shorebirds that reside in Alaska and to link sites used throughout their annual cycles"), and the International Collaborations section (i.e., "foster cooperative research efforts throughout the Western Hemisphere, Asia, and elsewhere along migratory flyways" and "participate in species-specific conservation planning efforts").

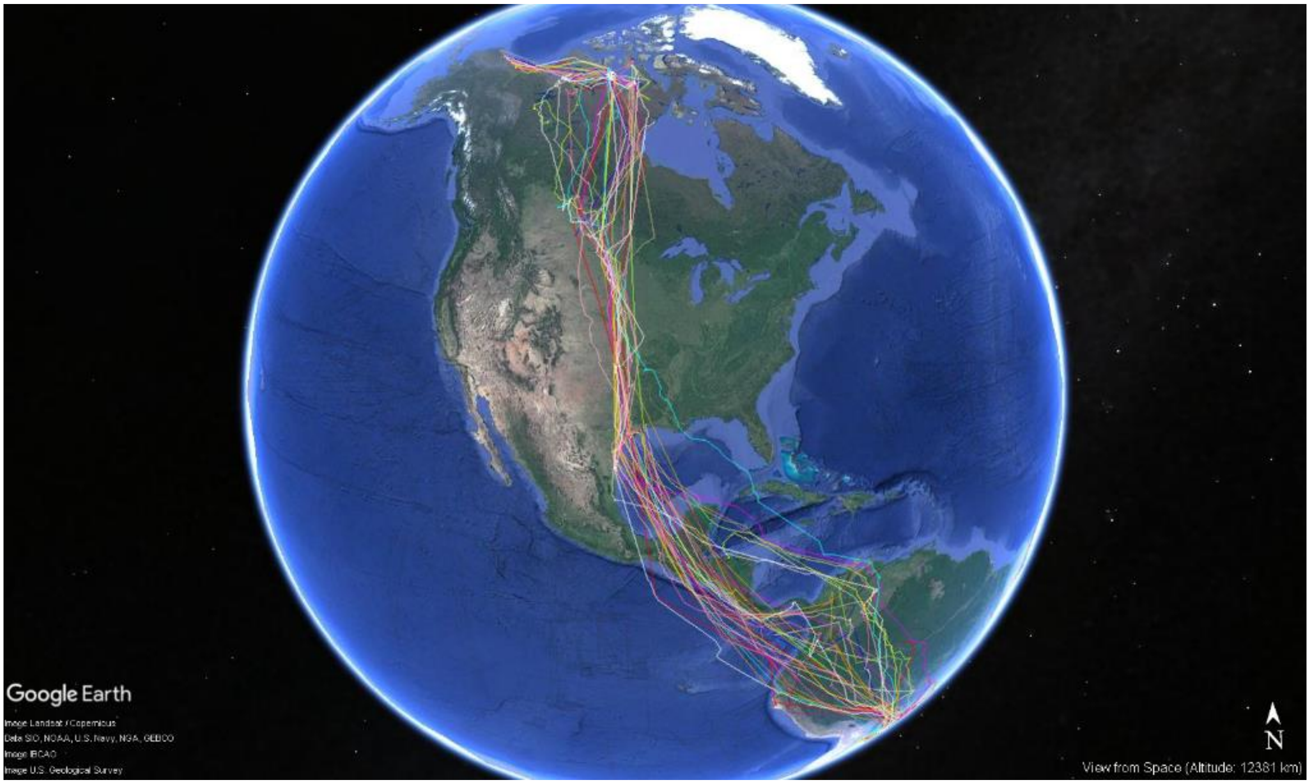



Figure 1. North- and southbound migration routes of Buff-breasted Sandpipers based on GPS and satellite tag tracking.

Buff-breasted Sandpipers tolerate the extreme temperatures of turf farms in coastal Texas (38ºC) during migration (left picture) and the Arctic tundra (-2ºC) during breeding (right picture showing Peter Detwiler cleaning a mist net after a night capture event). To cope with the very hot and humid conditions in Texas during August 2018, birds rely on the misting and thin lines of shade provided by this irrigation system. In contrast, Buff-breasted Sandpipers coped with the very late snow melt in June 2018 by retreating back south over the boreal forest before going north again to breed. Photos by Lee Tibbitts (Texas) and Rick Lanctot (Alaska).

*Locations:* Prudhoe Bay, Alaska, 70.260° N, 148.360° W; coastal Texas, 28.820° N, 96.140° W; Lagoa de Peixe, Brasil,31.250° S, 50.970° W; Laguna de Rocha, Uruguay, 34.650° S, 54.315° W; Bahia de Samborombón, Argentina, 36.340° S, 57.000° W

*Contact:* Lee Tibbitts, Geological Survey, Alaska Science Center, Anchorage, AK 99508, Phone: 907 786 7038, email: ltibbitts@usgs.gov

# #30— ARCTIC SHOREBIRD DEMOGRAPHICS NETWORK

Investigators: Emily Weiser, U.S. Geological Survey, Stephen Brown, Manomet Center for Conservation Science, Richard Lanctot, U.S. Fish and Wildlife Service, and Brett Sandercock, Norwegian Institute for Nature Research, and many other ASDN collaborators

To better understand how shorebirds will respond to climate-mediated changes in the Arctic's morphology and ecology, we established a network of field sites across Alaska, Canada, and Russia, known as the Arctic Shorebird Demographics Network (ASDN). Our work was conducted over five years (2010–2014) at 16 field sites by 32 principal investigators and 11 graduate students (4 PhD, 7 M.Sc.) from 15 institutions. We used standardized field protocols to collect information on shorebird ecology and demography, as well as a suite of predictor variables related to demographic parameters and climate change.

In 2018, several articles were published that investigated seasonal declines in reproductive traits, effects of environmental conditions on reproductive effort and nest success, effects of environmental and ecological conditions at Arctic breeding sites on survival of adult shorebirds, and the effects of leg flags on nest survival of Arctic-breeding shorebirds. Many additional papers are being prepared by graduate students who used samples collected by ASDN personnel across multiple sites.

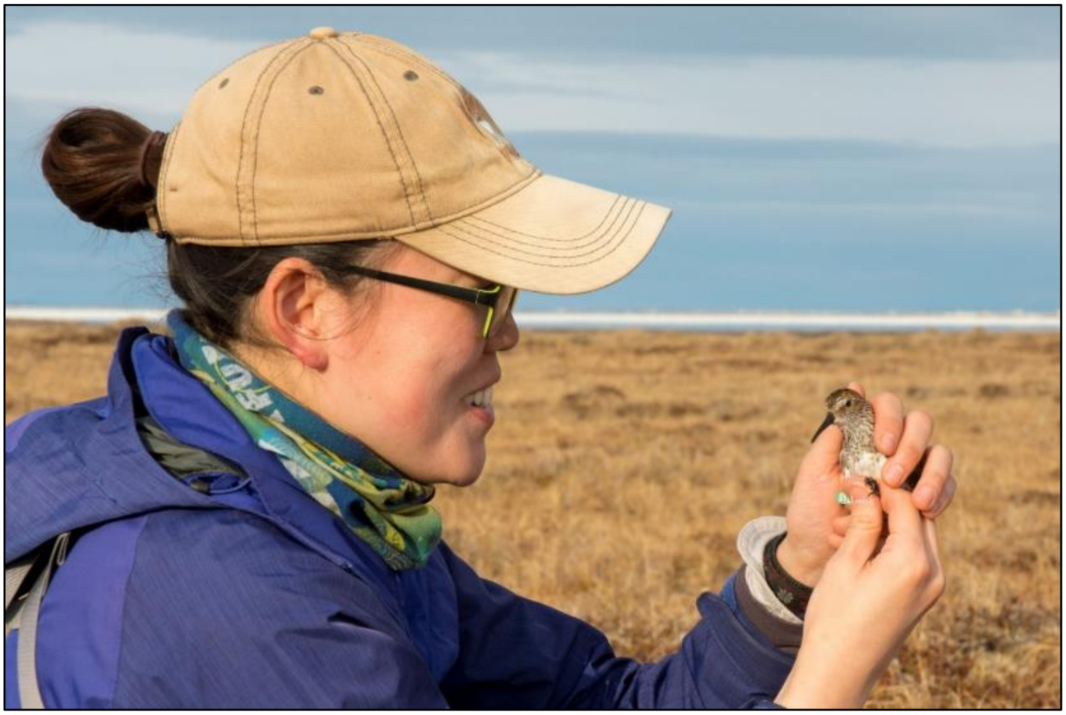
The ASDN focused on four priority species identified in the Alaska Shorebird Conservation Plan (2008), including the American Golden-Plover, Western Sandpiper, Dunlin, and Buff-breasted Sandpiper. The study also fulfills three Alaska-wide *research* objectives, including to: "investigate causes of shorebird population declines," "encourage long-term studies synthesizing measures of shorebird breeding phenology and environmental conditions," and "develop quantitative population models, measure key demographic parameters, and analyze population dynamics to estimate the long-term effects of subsistence harvest, depressed productivity, and other factors that may affect viability of shorebird populations" (Alaska Shorebird Conservation Plan 2008). Finally, the study fulfills one Alaska-wide *monitoring* objective, which is to "monitor demographic parameters and use demographic models to better understand limiting factors at the population level" (Alaska Shorebird Conservation Plan 2008).

Nest-searching on the ASDN study plot at Nome. *Photo by Emily Weiser.*


Western Sandpiper marked at Nome. *Photo by Emily Weiser.*

*Stilt* Sandpiper chicks at Prudhoe Bay. *Photo by Emily Weiser.*

American Golden-Plover at Utqiaġvik. *Photo by Emily Weiser.*



Eunbi Kwon marks a Western Sandpiper at Nome. *Photo by Emily Weiser.*

High-center polygons at Prudhoe Bay. *Photo by Emily Weiser.*

Low-center polygons near Utqiaġvik. *Photo by Emily Weiser.*

*Location:* Alaskan ASDN study sites were at Nome (64.443° N, 164.962° W), Cape Krusenstern (67.114° N, 163.496° W), Utqiaġvik (formerly Barrow; 71.302° N, 156.760° W), Colville River Delta (70.437° N, 150.676° W), Prudhoe Bay (70.256° N, 148.339° W), and Canning River Delta (70.118° N, 145.851° W).

*Contact:* Emily Weiser, U.S. Geological Survey, 2630 Fanta Reed Rd, La Crosse, WI 54603, E-mail: Emily.l.weiser@gmail.com, Phone: 785-571-3403; Stephen Brown, Manomet Center for Conservation Sciences, P.O. Box 545, Saxtons River, VT 05154, Email: sbrown@manomet.org, Phone: 774-454-0030; Richard Lanctot, US Fish and Wildlife Service, Migratory Bird Management, 1011 East Tudor Road, MS 201, Anchorage, AK 99503, E-mail: Richard_lanctot@fws.gov.  Phone: 907-786-3609.

# #31— SHOREBIRD SUBSISTENCE HARVEST AND INDIGENOUS KNOWLEDGE IN ALASKA

Investigators: Liliana Naves, Jacqueline Keating, Alaska Department of Fish and Game; Lee Tibbitts, Daniel Ruthrauff, U.S. Geological Survey

Shorebird population declines worldwide have increased the need for knowledge and collaboration among stakeholders. Shorebird subsistence harvest has occurred in Alaska for millennia. Although this harvest is relatively small, it includes species of conservation concern. Our objectives were to provide Alaska-wide shorebird harvest estimates and to better understand the importance of shorebirds as food and cultural resources for Alaska's subsistence communities. Harvest estimates were based on surveys conducted in 1990–2015 ($n$ = 775 community-years). Indigenous knowledge interviews ($n$ = 72) conducted in 2017 focused on ethnotaxonomy and ethnography in the Yukon-Kuskokwim Delta. The Alaska-wide shorebird harvest was 2,783 birds/year and godwits accounted for 1,115 birds/year. The egg harvest was 4,676 eggs/year. We identified 24 Yup'ik shorebird ethnotaxonomic categories. Respondents appreciated shorebirds and other birds as intrinsic and joyful environment components. Traditionally, small birds including shorebirds have been the focus of children learning hunting skills. Cultural items related to shorebirds included stories, songs, worldviews, place names, and wooden masks. However, shorebirds were not primary food and cultural resources. Many respondents reported that numbers of shorebirds have declined. This study provided insights to improve harvest monitoring and management, and culturally relevant approaches to engage subsistence users in shorebird conservation.

*Location:* Yukon-Kuskokwim Delta

*Contact:* Liliana Naves, Alaska Department of Fish and Game, Division of Subsistence, Anchorage, AK
liliana.naves@alaska.gov

# PUBLICATIONS

Amundson, C. L., C. Handel, D. R. Ruthrauff, T. L. Tibbitts, and R. E. Gill, Jr.. 2018. Montane-breeding bird distribution and abundance across National Parks of Southwestern Alaska. Journal of Fish and Wildlife Management 9: 158–185.

Bentzen, R., J. Liebezeit, M. Robards, B. Streever, S. Strindberg, and S. Zack. *In Press*. Bird Use of Northern Alaska Oilfield Rehabilitation Sites. Arctic.

Burke, W. 2008. "Barbados." *In* Important bird areas in the Caribbean: Key sites for conservation, edited by D. Wege and V. Anadón-Irizarry, 82–89. Cambridge: BirdLife International.

Clay, R. P., A. J. Lesterhuis, and S. Centrón. 2012. Conservation plan for the Lesser Yellowlegs (*Tringa flavipes*) (Version 1.0). Manomet Center for Conservation Sciences.

Ely, C. R., B. J. McCaffery, and R. E. Gill, Jr. 2018. Shorebirds adjust spring arrival schedules with variable environmental conditions: Four decades of assessment on the Yukon-Kuskokwim Delta, Alaska. Pages 296–311 *in*: Trends and traditions: Avifaunal change in western North America (W. D. Shuford, R. E. Gill, Jr. & C. Handel, Eds.). Western Field Ornithologists, Camarillo, California.

Herzog, P., S. T. Saalfeld, H.-H. Kaatz, and R. B. Lanctot. 2018. Nest reuse in Arctic-breeding shorebirds: an analysis of potential benefits and factors affecting the occurrence of this rare behavior. Journal of Avian Biology: e01737. DOI: 10.1111/jav.01737.

Humphries, G., D. Magness, and F. Huettmann. 2018. Machine Learning for Ecology and Sustainable Natural Resource Management. Springer Publishers, New York ISBN 978-3-319-96978-7

Johnson, O. W., P. G. Connors, and P. Pyle. 2018. American Golden-Plover (*Pluvialis dominica*), version 3.0. *In*: The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York.

Johnson, O. W., P. G. Connors, and P. Pyle. 2018. Pacific Golden-Plover (*Pluvialis fulva*), version 3.0. *In*: The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York.

Lanctot, R. B. (in press 2018). Buff-breasted Sandpiper Working Group Meeting. Page xxx-xxx In Seventh meeting of the Western Hemisphere Shorebird group, 11–14 November 2017, Paracas, Peru. Wader Study.

McDuffie, L., J. Hagelin, G. Pendleton, M. Snively, and A. Taylor. (in review). Using long-term citizen science data to examine trends in Common and Pacific Loon populations in southcentral Alaska. Submitted to *Journal of Fish and Wildlife Management*.

Rakhimberdiev, E., S. Duijns, C. J. Camphuysen, V. Castricum, A. Dekinga, R. Dekker, A. Gavrilov, J. ten Horn, J. Jukema, J. Karagicheva, A. Saveliev, M. Soloviec, T. L. Tibbitts, J. A. van Gils, and T. Piersma. 2018. Fuelling conditions at staging sites can mitigate Arctic warming effects in a migratory bird. Nature Communications. https://doi.org/10.1038/s41467-018-06673-5.

Reed, E. T. and W. Burke. 2011. Assessment of shorebird harvest in Barbados and development of a harvest strategy. Vancouver: Presentation at IV Western Hemisphere Shorebird Group.

Robinson, B. H., H. A. Coletti, L. M. Phillips, and A. N. Powell. 2018. Are prey remains accurate indicators of chick diet? A comparison of diet quantification techniques for Black Oystercatchers. *Wader Study* 125(1): 20–32.

Ruthrauff, D. R., A. Dekinga, R. E. Gill, Jr., and T. Piersma. 2018. Energetic solutions of Rock Sandpipers to harsh winter conditions rely on prey quality. Ibis 160: 397–412.

Ruthrauff, D. R., T. L. Tibbitts, and R. E. Gill, Jr. In press. Flexible timing of annual movements across consistently used sites by Marbled Godwits breeding in Alaska. Auk doi: 10.1642/AUK-18-82.1.

Savage, S.E., T. L. Tibbitts, K. A. Sesser, and R. A. S. Kaler. 2018. Inventory of lowland-breeding birds on the Alaska Peninsula. Journal of Fish and Wildlife Management. Vol. 9 (2).

Taylor, A. R., R. B. Lanctot, and R. T. Holmes. 2018. An evaluation of 60 years of shorebird response to environmental change at Utqiaġvik (Barrow), Alaska, *in* Trends and traditions: Avifaunal change in western North America (W. D. Shuford, R. E. Gill Jr., and C. M. Handel, eds.), pp. 312–330. Studies of Western Birds 3. Western Field Ornithologists, Camarillo, CA; doi 10.21199/SWB3.17

Tiusanen, M., T. Huotari, P. D. N. Hebert, T. Andersson, A. Asmus, E. Davis, J. Gale, B. Hardwick, D. Hik, C. Körner, R. B. Lanctot, M. J. J. E. Loonen, R. Partanen, K. Reischke, S. T. Saalfeld, F. Senez-Gagnon, J. Sulavik, I. Syvänperä, C. Urbanowicz, S. Williams, P. Woodard, Y. Zaika, and T. Roslin. (in press 2019). Flower-visitor communities of an arcto-alpine plant– global patterns in species richness, phylogenetic diversity and ecological functioning. Molecular Ecology.

Weiser, E. L., R. B. Lanctot, S. C. Brown, H. R. Gates, R. L. Bentzen, M. L. Boldenow, J. A. Cunningham, A. Doll, T. F. Donnelly, W. B. English, S. E. Franks, K. Grond, P. Herzog, B. L. Hill, S. Kendall, E. Kwon, D. B. Lank, J. R. Liebezeit, J. Rausch, S. T. Saalfeld, A. R. Taylor, D. H. Ward, P. F. Woodard, and B. K. Sandercock. 2018. Effects of leg flags on nest success of four species of Arctic-breeding shorebirds. Journal of Field Ornithology 89:287–297. DOI: 10.1111/jofo.12264.

Weiser, E. L., R. B. Lanctot, S. C. Brown, H. R. Gates, R. L. Bentzen, J. Bêty, M. L. Boldenow, W. B. English, S. E. Franks, L. Koloski, E. Kwon, J.-F. Lamarre, D. B. Lank, J. R. Liebezeit, L. McKinnon, E. Nol, J. Rausch, S. T. Saalfeld, N. R. Senner, D. H. Ward, P. F. Woodard, and B. K. Sandercock. 2018. Environmental and ecological conditions at Arctic breeding sites have limited effects on true survival rates of adult shorebirds. The Auk: Ornithological Advances 135:2943.

Weiser, E. L., S. C. Brown, R. B. Lanctot, H. R. Gates, K. Abraham, R. L Bentzen, J. Bêty, M. L. Boldenow, R. Brook, T. F. Donnelly, W. B. English, S. Flemming, S. E. Franks, H. G. Gilchrist, M.-A. Giroux, A. Johnson, L. V. Kennedy, L. Koloski, E. Kwon, J.-F. Lamarre, D. B. Lank, N. Lecomte, J. R. Liebezeit, L. McKinnon, E. Nol, J. Perz, J. Rausch, M. Robards, S. T. Saalfeld, N. R. Senner, P. A. Smith, M. Soloviev, D. Solovyeva, D. H. Ward, P. F. Woodard, and B. K. Sandercock. 2018. Life-history tradeoffs revealed by seasonal declines in reproductive traits of Arctic-breeding shorebirds. Journal of Avian Biology: e01531. DOI:10.1111/jav.01531.

Weiser, E. L., S. C. Brown, R. B. Lanctot, H. R. Gates, K. F. Abraham, R. L Bentzen, J. Bêty, M. L. Boldenow, R. W. Brook, T. F. Donnelly, W. B. English, S. A. Flemming, S. E. Franks, H. G. Gilchrist, M.-A. Giroux, A. Johnson, S. Kendall, L. V. Kennedy, L. Koloski, E. Kwon, J.-F. Lamarre, D. B. Lank, C. J. Latty, N. Lecomte, J. R. Liebezeit, L. McKinnon, E. Nol, J. Perz, J. Rausch, M. Robards, S. T. Saalfeld, N. R. Senner, P. A. Smith, M. Soloviev, D. Solovyeva, D. H. Ward, P. F. Woodard, and B. K. Sandercock. 2018. Effects of environmental conditions on reproductive effort and nest success of Arctic-breeding shorebirds. Ibis 160: 608–623. DOI: 10.1111/ibi.12571.