Alaska Shorebird Group

Annual Summary Compilation
New or Ongoing Studies of Alaska Shorebirds

November 2021

A breeding Upland Sandpiper near Delta Junction, Alaska. Photo courtesy of Zak Pohlen/USFWS

EXECUTIVE SUMMARY

Welcome to the Alaska Shorebird Group (ASG) 2021 annual summary. This is the 22nd annual summary to document new and ongoing studies of shorebirds in Alaska. This document includes annual summaries for 21 studies and 21 publications from ASG members in 2021. This year also marked the second year of the novel Coronavirus pandemic; therefore, many field projects were either cancelled or postponed.

The Alaska Shorebird Group continues to be a highly collaborative organization with a large membership of productive principal investigators, early-professionals, and students both within and outside of Alaska. This annual compilation is the only written record that acknowledges the shorebird projects occurring in Alaska and provides a valuable timeline of shorebird activities for this region.

Thank you to all the principal investigators, research technicians, and amateur photographers that made this report possible. I am aware of the long hours, tricky logistics (including Covid-19 mitigation plans) and dedication that goes into the research occurring within Alaska and globally. I feel honored to be part of a group with such a strong passion for shorebird conservation and management, especially as we continue to face the challenge of population declines of arctic and sub-arctic breeders.

Laura McDuffie
Secretary, Alaska Shorebird Group

BIRD CONSERVATION REGIONS

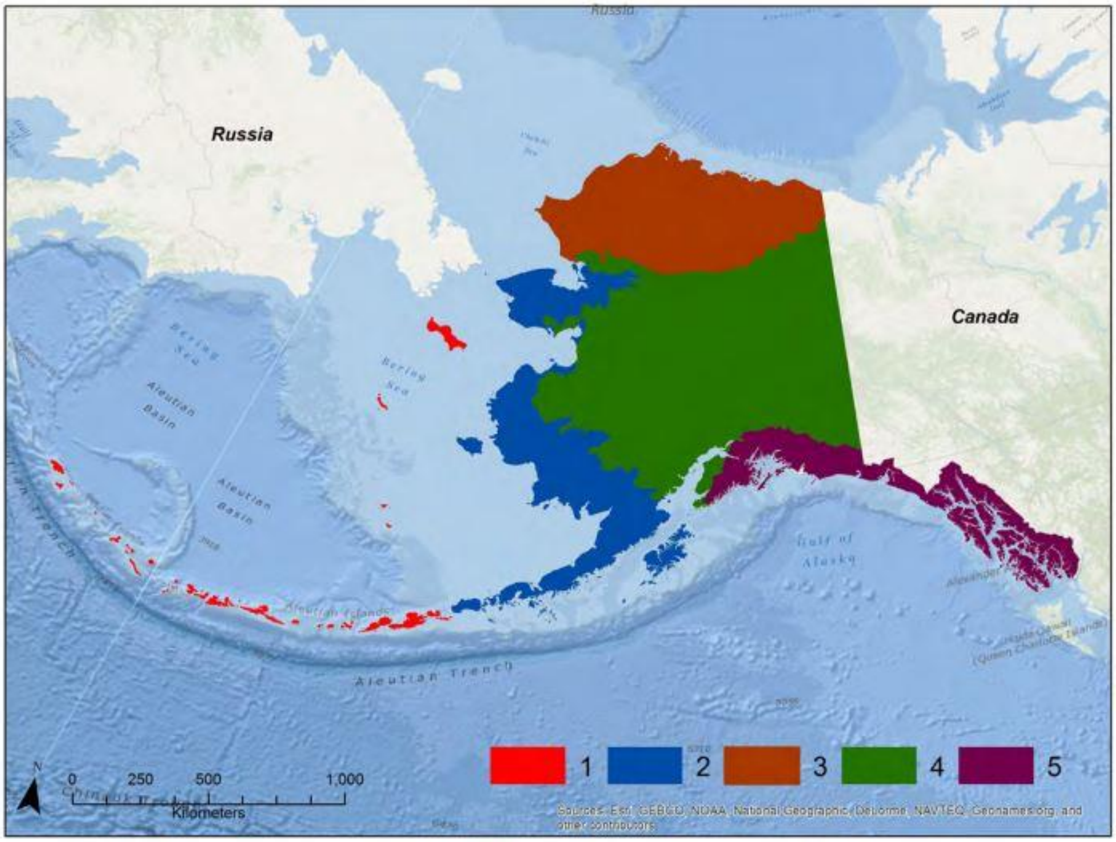


Figure 1. Bird Conservation Regions (BCRs) in Alaska: 1 = Aleutian and Bering Sea Islands, 2 = Western Alaska, 3 = Arctic Plains and Mountains, 4 = Northwestern Interior Forest, 5 = Northern Pacific Rainforest.

Bird Conservation Regions map published in:

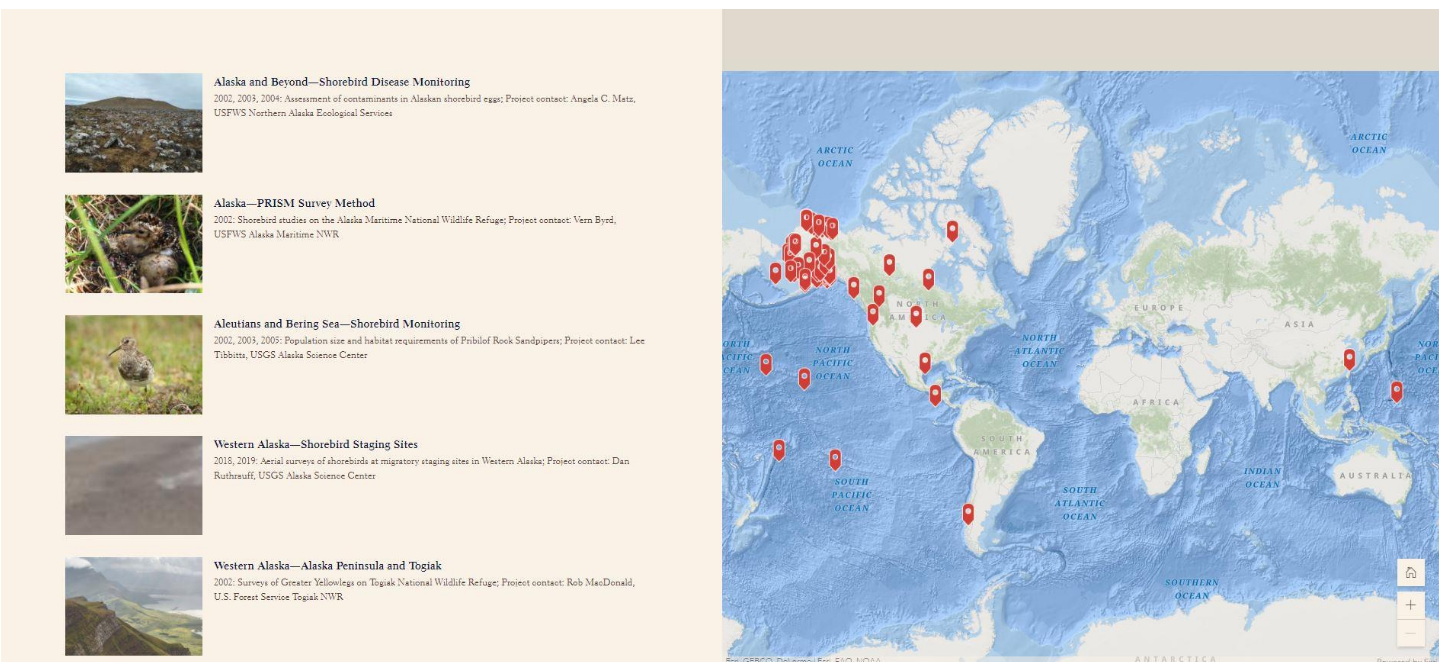
Handel, C.M., Stenhouse, I.J., and Matsuoka, S.M. (Eds.). 2021. Alaska Landbird Conservation Plan, version 2.0. Boreal Partners in Flight, Anchorage, AK. 146 pp.

STORY MAP: PAST AND PRESENT PROJECTS

To visualize where Alaska Shorebird Group projects have occurred since 1997, please visit our story map. Click through the sidebar to view project titles, locations, and contact information. Some projects include multiple study sites and this is indicated at the end of the project descriptions. Following the map tour, scroll down to see a list of all manuscripts/reports published by ASG members and collaborators. The Story Map is in draft form so please reach out with any suggestions/edits. Also, please feel free to send along any high-quality images to replace some of the low-resolution title photos; laura.mcduffie93@gmail.com

Share the link with colleagues, friends, and those interested in learning more about shorebirds!

https://storymaps.arcgis.com/stories/d3cb33e30b104f309d45e5ad6cb2633b



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1 (BCR 3): PHENOLOGICAL SHIFTS IN ARCTIC-NESTING SHOREBIRDS

Investigators: Eveling Tavera Fernandez, Environment and Climate Change Canada, Kirsty Gurney, Environment and Climate Change Canada; David Ward, U.S. Geological Survey (retired); David Douglas, U.S. Geological Survey

In North America, climate is changing disproportionately at high latitudes, relative to more southern locations, and cconcurrently, timing of spring green-up is changing. Temporal shifts in life history events (i.e. phenological shifts) have also been observed among avian taxa, but these shifts vary among and within species. Although the reasons for such variation remain poorly understood, some data suggest that less phenotypically plastic species may be more likely to be negatively affected by climate change. To forecast and monitor the effects climate change on migratory birds and northern biodiversity, it is therefore critical to identify the mechanisms that drive phenological shift. Here, to examine variation in phenological shift across shorebird species and to evaluate the relative influence of life history attributes and environmental attributes on phenotypically flexibility, we are working with remotely sensed green-up data and nest initiation data from eight species at nine sites in Alaska and nine Arctic breeding sites outside Alaska.

After we developed candidate model sets to test hypotheses of interest, we used generalized linear mixed models (lmerTest) in R and applied an information-theoretic approach to rank model support. We found that phenological shift does vary across arctic breeding shorebird species, suggesting that some species have more flexibility to adapt their nesting phenology within a changing climate than others. Among species, our data were consistent with an influence of a key life history variable – migration distance – on phenotypic shift (i.e. an organismal mechanism), with long distance migrants (such as red phalaropes and sanderling) adjusting timing of nesting in response to changes in spring conditions more than shorter distance migrants (dunlin). Finally, within select species, namely those with a broad breeding range, we found evidence of spatial variation in phenological flexibility, suggesting that differential phenological shifts can also be explained, in part, by differences in the environment (i.e. an environmental mechanism). We conclude that variation in phenological shift and explanatory factors should be considered carefully in future research projects.

A draft of the final manuscript for this project is currently under development.

Under the Alaska Shorebird Conservation Plan, our results are linked to two action items: "model the potential effect of climate change on shorebird habitats" and "assess the adaptability of shorebirds to habitat changes".

Location: Cross-Arctic project with multiple study sites located at Canada, U.S. and Russia.

Contact(s): Kirsty Gurney, Research Scientist, Environment and Climate Change Canada, Email: kirsty.gurney@ec.gc.ca, Phone: 306-975-5301

Figure 1. Dunlin on the Arctic Coastal Plain (Chipp North Study Site). Photo by Gregory Smart.

2 (BCR 3): 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; Shiloh Schulte and Stephen Brown, Manomet, Inc.; J.F. Lamarre, POLAR Knowledge Canada; and Mike Russell, Alberta Environment and Parks

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 – 2021.

The objectives of this study include:

1. Identify post-breeding habitats on the Arctic Coastal Plain for a variety of shorebird species including American Golden-Plover, Pectoral Sandpiper, Red Phalarope, and Whimbrel.
2. Document migration routes, stopover sites, and wintering locations of shorebirds.
3. Establish general connectivity among wintering, migration, and breeding locations.
4. Using information from #1 and #2, assess threats to survival of shorebirds along their migratory routes and while wintering, and
5. Share habitat use and stopover site information with local, regional, and national entities to educate and inform conservation decisions regarding where to conduct conservation actions and designate WHSRN and IBA areas.

During the 2021 field season, we deployed 4-g Lotek PinPoint GPS Argos tags on 13 Pectoral Sandpipers and 5-g Lotek PinPoint GPS Argos tags on 11 American Golden-Plovers at three breeding sites along the Arctic Coastal Plain of Alaska (Utqiaġvik, Canning River, and Katakturuk) and two sites in Canada (Cambridge Bay and Sulphur Ridge, see map below). In addition, we attached three 11-g Lotek Pinpoint GPS Argos solar-M tags and three 5-g Microwave Solar PTT Argos tags on Whimbrels at the Katakturuk camp on the Arctic National Wildlife Refuge. These tags collected and transmitted to satellites location data during both the post-breeding season, as well as throughout the southbound migration and early wintering period. By collecting data over multiple years, we hope to better understand how well individuals can adapt to changing environmental conditions (e.g., hurricanes) and threats faced during their migrations. Examples of movements can be found on movebank.org – go to "Data" tab and search for studies entitled "Arctic Shorebird Migration Tracking study - <<species name>>." Please do not use this information without first asking the authors.

For each tagged individual, we also collected information on reproduction that can be related to migration patterns. Additionally, we collected feather 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 2022, we plan to deploy more tags to continue monitoring the post-breeding movements and habitat use of these species.

This study fulfills action items under the Research (i.e., "determine migratory timing, routes, and site use of shorebirds"), Habitat Management and Protection (i.e., "apply abundance and distribution information to identify key shorebird habitats and sites"), and International Collaboration objectives (i.e., "foster and participate in cooperative research and monitoring efforts throughout species' ranges") of the Alaska Shorebird Conservation Plan (Alaska Shorebird Group 2019).

Field assistance for deploying tags in 2021 was provided by Lindsay Hermanns and Sarah Hoepfner at Utqiaġvik, Kirsti Carr and Sadie Ulman at Katakturuk and the Canning River, Ashley Crosby at Cambridge Bay, and Rolanda Steenweg, Caroline Seip, Jesse Watkins, Nils Anderson, Curtis Stambaugh and Roch Dallaire at Sulphur Ridge. Funding to purchase, receive data, and deploy the tags was provided by the U.S. Fish and Wildlife Service (Arctic National Wildlife Refuge, Migratory Bird Management), POLAR Knowledge Canada, Alberta Environment and Parks, and Manomet, Inc.

Location: Cross-Arctic project with multiple study sites located at Utqiaġvik, Canning River, and Katakturuk in Alaska, as well as Cambridge Bay, Nunavut, and Sulphur Ridge, Alberta (see attached figure).

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

Figure 1. Deployment location of GPS/PTT tags on Pectoral Sandpiper (PESA), American Golden-Plover (AMGP), and Whimbrel (WHIM) in 2021.

Figure 2. Whimbrel with a 11-g Lotek Pinpoint GPS Argos solar-M tag at the Katakturuk field study site, Arctic National Wildlife Refuge, Alaska, June 2021. Photo by Shiloh Schulte.

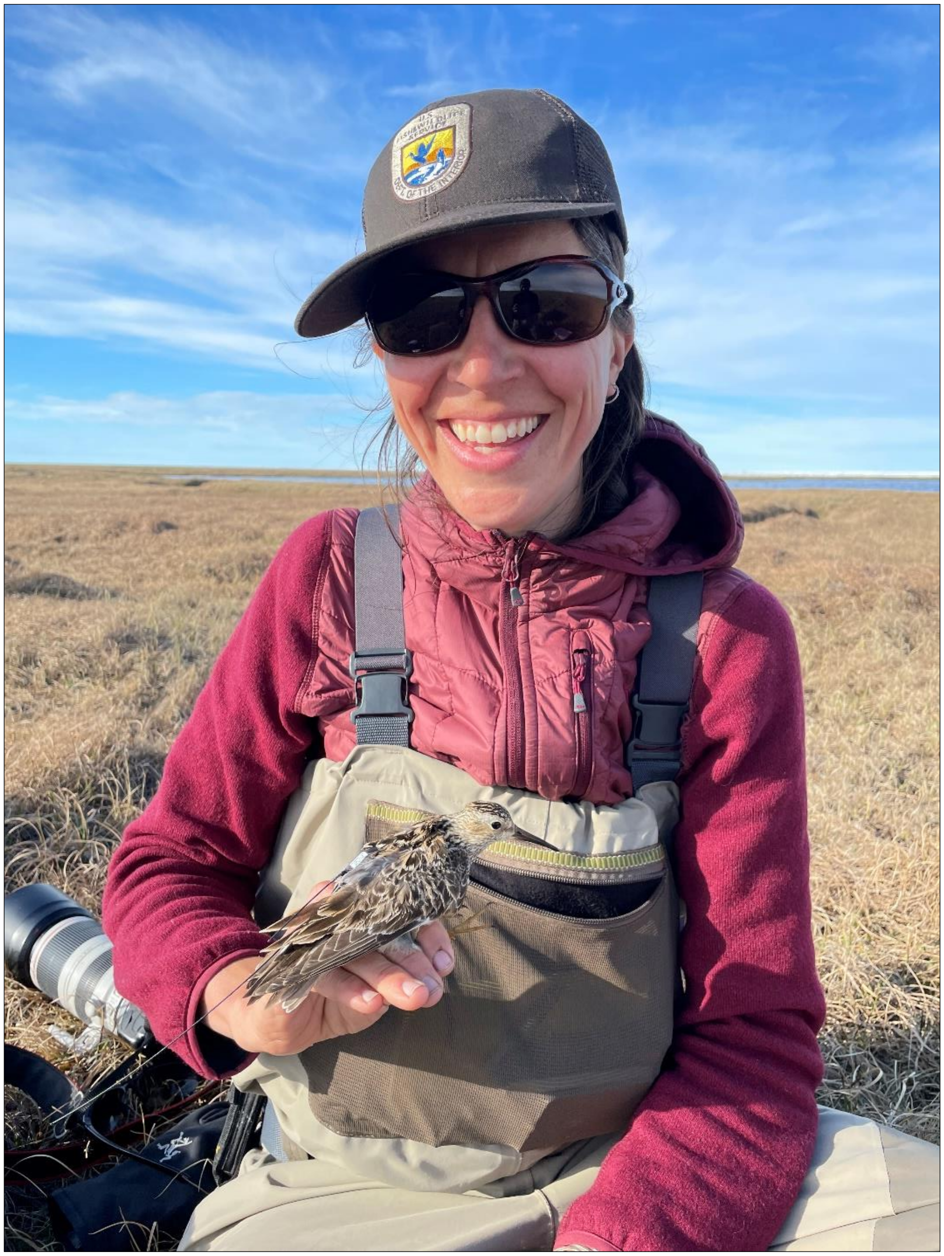

Figure 3. Sadie Ulman with a Pectoral Sandpiper equipped with a 5-g Lotek PinPoint GPS Argos tag at the Canning River field study site, Arctic National Wildlife Refuge, June, 2021. Photo by Shiloh Schulte.

3 (BCR 3): BREEDING ECOLOGY OF TUNDRA NESTING BIRDS AT THE CANNING RIVER DELTA ON ARCTIC NATIONAL WILDLIFE REFUGE

Investigators: Sadie E.G. Ulman and Christopher Latty, U.S. Fish and Wildlife Service

The Canning River Delta study site in Arctic Refuge was established in the late 1970s and has since become the primary tundra nesting bird research station for the refuge. Work at this location is a collaboration between numerous partners, including U.S. Fish and Wildlife Service Arctic National Wildlife Refuge, External Affairs, Migratory Birds, and Fairbanks Field Office; U.S. Geological Survey; Manomet, Inc.; Wildlife Conservation Society; University of Alaska Fairbanks; Alaska Department of Fish and Game; Washington Department of Fish and Wildlife; and Oregon Department of Fish and Wildlife. In 2021, crews flew into the camp on June 6 and the camp was demobilized on July 25. In general, there appeared to be fewer birds nesting at the Canning River Delta this summer compared to prior years. We located 219 nests, of which, 115 were shorebirds from 8 species.

This year was the first year of deploying a new style of cryptic camera placed directly at the nest bowl. Previously, cameras were placed at about 10 m. But this new design, using a modified Brinno camera with an external lens, was placed ~15-30 cm from the bowl and angled to peer into nests. This allowed us to easily visualize the behavior of the incubating adult, hatch, and loss of eggs to both large and small predators. In most cases, the incubation information we recorded (see images below) would have been missed by a camera set at a further distance.

In 2021, we also piloted a new method of locating nests at the Canning River Delta. By using line-transect distance sampling, we can cover a greater study area, with less disturbance, and fewer caveats as plot surveys. Moving to this new model is only possible by embracing remote monitoring, including the use of temperature loggers and cameras. In previous years we have investigated the efficacy of these tools and found them generally without significant effects and to be reliable (e.g., Mcguire et. al, 2021, No evidence that cameras affect shorebird nest survival on the coastal plain of Arctic National Wildlife Refuge, AK, Ibis). In 2022, we will move all our nest discovery effort to line transects and most nests will only be visited once at discovery, and again post-fate to collect devices. Nests will be monitored using remote devices (cameras and temperature loggers). By moving towards this new system we expect to increase our sample size, increase our accuracy and precision for derived parameters like fate and fate timing, reduce our impact to the local study area, and increase our area of coverage.

Location: Canning River Delta, Arctic National Wildlife Refuge

Contact: Sadie Ulman, Biological Technician, U.S. Fish and Wildlife Service, Arctic NWR, sadie_ulman@fws.gov

Figure 1. Images of nest bowl camera. Top: Nest bowl camera lens pointing towards a semipalmated sandpiper nest near the gloved hand. Bottom: Nest bowl camera at a ruddy turnstone nest. With some added vegetation placed on the setup to break up the silhouette, the cameras were quite camouflaged on the landscape.

Figure 2. Images from nest bowl camera. Top: Baird's sandpiper adult removing the hatch bottom of an eggshell, indicating a hatch. Bottom: The same Baird's sandpiper nest about 30 minutes later while the adult is on an incubation break. The 3 eggs and 1 newly hatched chick are clearly visible in the nest bowl.

Figure 3. Images from nest bowl camera demonstrating that even with natural overhead cover, a great deal of information can be determined from the bowl cameras. For example, in the top picture, an adult semipalmated sandpiper can be seen incubating. While in the bottom picture, the adult is absent, revealing 4 eggs in nest bowl.

Figure 4. Red phalarope chicks in nest bowl with temperature logger sensor (arrow pointing at sensor) that measures incubation behavior and provides cues used to determine nest success or failure. Photo courtesy of Robyn Thomas.

#4 (BCR 3): REPRODUCTIVE ECOLOGY OF SHOREBIRDS: STUDIES AT UTQIAĠVIK, ALASKA, IN 2021

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

In 2021, we conducted the 19th 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.

In 2021, the timing of snowmelt was fairly average, with 20% snow cover remaining on the tundra until 12 June, just 2 days later than the long-term average from 2003–2019 of 10 June. Lemming numbers in 2021 were fairly low, especially as compared to levels observed in 2006-2008 and in 2019. However, despite low abundance of lemmings, avian predator densities were higher than any other year, mainly because of several days with observations of large flocks of jaegers. Arctic foxes were fairly common, as fox trapping efforts were not conducted in 2021.

We located and monitored nests in six 36-ha plots in 2021. All six plots were the same as those sampled in 2019 (large scale fieldwork did not take place in 2020), with five of the six plots sampled since 2005; all plots were searched with the same intensity as in past years. A total of 272 nests were located on our plots, with an additional 78 nests found outside plot boundaries. Our total number of nests located on plots was average as compared to 2003-2019 where number of nests ranged from 75–506. Nests on plots included 140 Red Phalarope, 41 Pectoral Sandpiper, 40 Dunlin, 13 Red-necked Phalarope, 11 Semipalmated Sandpiper, 10 Western Sandpiper, 10 American Golden-Plover, 5 Long-billed Dowitcher, and 2 White-rumped Sandpiper. No Ruddy Turnstone, Baird’s Sandpiper, or Buff-breasted Sandpiper nests were found on the plots in 2021. The breeding density of all shorebird species on our study area was 126 nests/km^2 in 2021; this was very similar to our long-term average of 127 nests/km^2. In 2021, 6 species nested in higher densities than the long-term average (American Golden-Plover, Dunlin, Red Phalarope, Red-necked Phalarope, Western Sandpiper, and White-rumped Sandpiper); all others nested at densities below the long-term average.

The first shorebird clutch was initiated on 7 June–5 days later than the long-term average of 2 June. Median initiation date was 16 June–1 day later than the long-term average. Median nest initiation dates for the more abundant species were 12 June for Dunlin, 15 June for Semipalmated Sandpiper, 16 June for Red Phalarope, and 18 June for Pectoral Sandpiper; all of which were within 1–4 days later than their respective long-term averages.

Predators destroyed 72% of the known-fate nests in 2021 (excluding human-caused mortalities). This is substantially greater than the long-term average of 34%, but similar to the 66% average for other years without fox control (2003–2004 and 2017–2019). Apparent hatching success (# hatching at least one young/total number of known-fate nests) was highest in White-rumped Sandpiper (50%) and Semipalmated Sandpiper

(50%), followed by Red Phalarope (28%), Pectoral Sandpiper (25%), Red-necked Phalarope (25%), Dunlin (23%), Western Sandpiper (13%), Long-billed Dowitcher (0%), and American Golden-plover (0%).

We captured and color-marked 270 adults located both on and off plots. This was slightly less than the long-term average of 283. Eighteen of these adults (11 Dunlin, 4 Red Phalarope, 2 Red-necked Phalarope, 1 Semipalmated Sandpiper) had been banded as adults in a prior year. Adults captured included 104 Dunlin, 87 Red Phalarope, 29 Pectoral Sandpiper, 15 Semipalmated Sandpiper, 12 Western Sandpiper, 8 American Golden-plover, 8 Red-necked Phalarope, 6 Long-billed Dowitcher, and 1 White-rumped Sandpiper. We also re-sighted 29 adults banded in prior years on our plots in 2021. This included 14 Dunlin, 7 Semipalmated Sandpiper, 4 American Golden-plover, and 2 Red-necked Phalarope, 1 Red Phalarope, and 1 Western Sandpiper. We captured and color marked 159 chicks. This was less than the long-term average of 497.

We continued to collect data for other Arctic-wide collaborations including the “Interaction Working Group” – a joint circumpolar initiative on predator-prey interactions in Arctic terrestrial ecosystems. To estimate predation pressure on shorebird nests, we monitored survival of 50 artificial nests, as well as deployed Tiny Tags in 17 Semipalmated Sandpiper and 19 Dunlin nests, with survival determined using the nest bowl temperature signatures recorded by the Tiny Tag devices. We also counted predators opportunistically on 15 days throughout the breeding season to determine predator composition and densities. We also collected a fourth year of data for a Bird Vocalization project focused on using acoustic recorders to monitor species phenology, diversity, and abundance. In 2021, we expanded this project to investigate the influence of nesting predators (Parasitic Jaeger and Snowy Owl) and roads on the vocal activity of avian species. Preliminary analyses of these recordings are being done by Dr. Nicolas Lecomte at the Universitê de Moncton, Quebec.

In addition to these two projects, we also collected data for 1) tracking shorebirds during the post-breeding period (see Richard Lanctot et al. entry), 2) evaluating the migratory connectivity of Dunlin (see Ben Lagasse’ entry), 3) estimating adult survival of Dunlin (see Lindsay Hermanns entry), and 4) monitoring Dunlin nest survival without human disturbance (see Sarah Hoepfner entry).

This study fulfills action items under the Research (i.e., “identify and determine the magnitude of factors limiting shorebird populations during breeding and nonbreeding periods of the annual cycle”) and Population Inventory and Monitoring objectives (i.e., “conduct long-term population monitoring efforts”) of the Alaska Shorebird Conservation Plan (Alaska Shorebird Group 2019).

Field assistance for conducting this work was provided by Lindsay Hermanns (co-crew leader), Sarah Hoepfner (co-crew leader), Ben Lagassé, John Myles, Alexandra Cook, Jonah Benningfield, Sam Stevens, and Tara Rodkey. Field preparation and data quality control/archiving was done by Sarah Saalfeld. The USFWS (Migratory Bird Management, Rachel Carson National Award), the National Fish and Wildlife Foundation, the United States Navy and Air Force, Iowa State University, and the National Science Foundation (professional development award to Lindsay Hermanns) provided funding.

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. An adult Semipalmated Sandpiper in breeding plumage stands on the Arctic Tundra. Photo credit: Lisa Hupp/USFWS

Figure 2. Young Dunlin chick deep in the grass of the Arctic Tundra. Photo credit: Lisa Hupp/USFWS

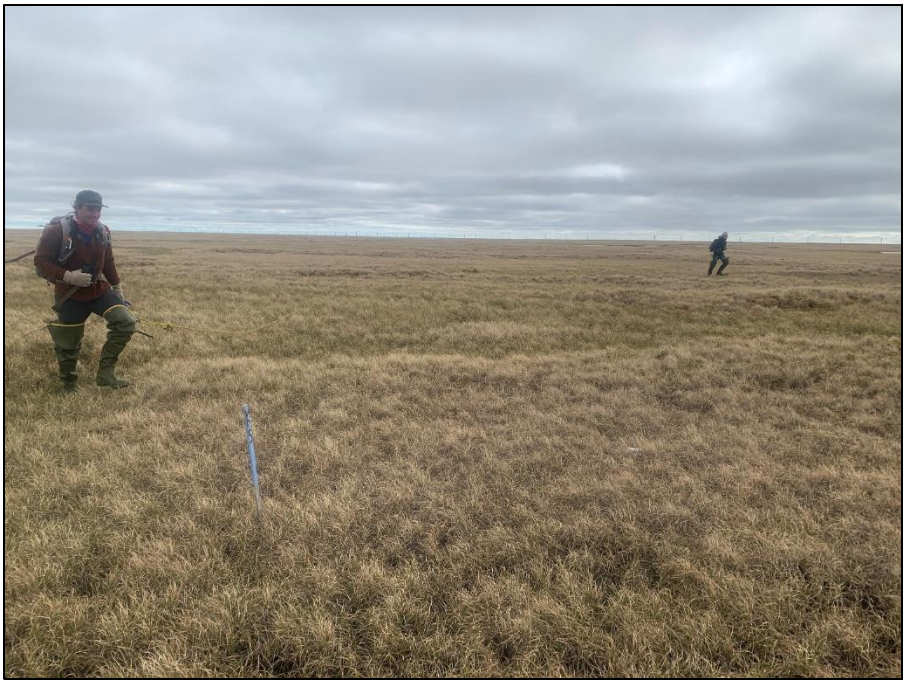

Figure 3. Jonah Benningfield and John Myles drag a rope across the tundra in an effort to flush secretive nesting shorebirds. Photo credit: Rick Lanctot/USFWS

Figure 4. Tara Lafabrêque Rodkey leaving for field work at Utqiaġvik, Alaska. ATVs are used only on roads, with technicians walking into the tundra to access plots. Photo credit: Rick Lanctot/USFWS

#5 (BCR 3): ASSESSING THE DUNLIN'S CAPACITY FOR ADAPTING TO ENVIRONMENTAL CHANGE

Investigators: Ben Lagasse and Mike Wunder, University of Colorado Denver; Richard Lanctot, U.S. Fish and Wildlife Service

Many arctic-breeding shorebirds are declining worldwide. Reasons for these declines are likely related to direct and indirect effects of human behavior including climate-induced changes in habitat conditions and food availability on breeding, migration and wintering grounds. However, the proximate link between a changing climate and habitat degradation on population-level declines is uncertain. It is also uncertain how arctic-breeding shorebirds might be adapting to these changes. Currently, we are studying the plasticity in the migratory behavior of four subspecies of Dunlin (*Calidris alpina*) that breed in the Arctic and migrate along three major flyways of the world, including the Atlantic and Pacific flyways of North America and the East Asian-Australasian Flyway of Asia. In this study, I will compare migration timing, routes, and stopover duration between individuals tracked from six breeding sites in 2010-2019, and within individuals tracked repeatedly from Utqiaġvik (formerly Barrow), Alaska between 2016 and 2021. This approach will allow me to determine the level of individual plasticity versus population-level microevolution present in the spatiotemporal migration ecologies of Dunlin from Utqiaġvik (data between 2010 and 2021), and how it compares to the between-individual variation seen in Dunlin from other flyways undergoing different levels of environmental change. Such information will determine how migratory shorebirds might be adapting to the diverse and unsynchronized changes occurring throughout their annual cycle.

In June 2021, I conducted the fifth field season for recovering light-level geolocators on Dunlin (*Calidris alpina*) breeding in Utqiaġvik, Alaska; prior work at this site dates to 2010. Field efforts included recapturing 1 individual that will provide migration tracks from June 2019 to June 2021.

This study is focused on the Dunlin, one of the high priority shorebird species identified in the Alaska Shorebird Conservation Plan (Alaska Shorebird Group 2019). The study also fulfills action items identified in the Alaska Shorebird Conservation Plan under the Research section (i.e., "determine migratory timing, routes, and site use of shorebirds"), and the International Collaborations section (i.e., "foster and participate in cooperative research and monitoring efforts throughout species' ranges").

Location: Utqiaġvik, North Slope (71.2652°N, 156.6359°W)

Contact: Ben Lagasse; email: Benjamin.J.Lagasse@gmail.com

Figure 1. A displaying Dunlin. Photo Credit: Ben Lagasse

Figure 2. Dunlins charting territory boundaries. Photo credit: Ben Lagasse

Figure 3. A Dunlin territorial dispute! Photo Credit: Ben Lagasse

Figure 4. The Dunlin victory scream. Photo credit: Ben Lagasse

#6 (BCR 3): USING HIGH-FREQUENCY GPS TRANSMITTERS TO INFER NESTING AND BREEDING BEHAVIOR OF DUNLIN

Investigators: Sarah Hoepfner and Stephen J. Dinsmore, Iowa State University; Richard B. Lanctot U.S. Fish and Wildlife Service

Recent studies suggest an increase in shorebird nest predation has occurred globally, with Arctic species experiencing drastically higher levels of predation compared to other areas (Kubelka et al. 2018). This finding was refuted due to statistical analysis issues, and the potential for recent increases in researcher activities leading to more disturbance at nests and ultimately higher predation (Bulla et al. 2019). To better understand the effects research activities have on nest survival, we remotely monitored nests by following shorebirds equipped with high-frequency GPS transmitters at Utqiaġvik throughout the 2021 breeding season. Traditional shorebird nest monitoring involves intensive searches of small areas to locate nests, placing physical markers and devices in or near nests, frequent visits to the nests to assess activity and fate, and capturing adults at nests for measurements and banding. All of these activities have the potential to attract both avian and mammal predators. By using GPS transmitters attached to pre-breeding and early-breeding birds that renested, we were able to remotely monitor movements and infer breeding behavior/success without ever seeing the bird or visiting the nest. Many of these individuals nested away from areas of human disturbance and provide some of the first true estimates of nest survival.

In 2021, we tagged Dunlin with high-frequency GPS transmitters (38 birds with 3.5 g Milsar NanoRadio Tag-3 and 4 birds with 2.7 g Druid NANO transmitters) at Utqiaġvik, Alaska (Figure 1). Transmitters were set to record a location fix every 15 minutes with a typical accuracy of 5-7 meters. Eleven transmitters were deployed on pre-breeding individuals, and 31 were placed on early nesting individuals whose clutch was subsequently removed to induce renesting. This allowed birds to be tracked from pre- to post-breeding and not be disturbed by humans (aside from having a transmitter attached). Location data were retrieved from 38 individuals at 24 nests, with over 92,000 locations recorded over 60 days (range 557 to 7,582 locations per bird). Downloaded data allowed us to locate nest sites that individuals repeatedly returned to incubate eggs. Using the distances males and females within pairs traveled from their located nest sites, we could determine start of incubation, timing and movements during incubation breaks, nest fate, and movements before and after nesting (Figure 2). To assess the effects of different ecological conditions and monitoring on nest survival, we will compare the nest survival rate of nests belonging to GPS monitored birds without any human disturbance bias with the nest survival rates of birds disturbed within the USFWS shorebird long-term plots.

This study focused on *arcticola* Dunlin, a species of highest conservation concern under the Alaska Shorebird Conservation Plan. It fulfills action items to “identify the immediate and cumulative effects of existing and future oil and gas development, disturbance, and other anthropogenic activities on shorebirds,” as well as, “determine the migratory timing, routes, and site use of shorebirds between and during prebreeding, breeding, and postbreeding stages,” and “assess the effect of predators in natural and human-altered settings on shorebird demography and population size.” By monitoring nests remotely we will learn how best to monitor their survival with the least impact, and what nest survival looks like without human disturbance and under different ecological (e.g., avian and mammalian predators, lemmings, weather) conditions.

Location: Utqiaġvik, 71.2539°N 156.6274°W

Contact: Sarah Hoepfner,
Phone: (907)-831-6532, email: hoepfner@iastate.edu

Figure 1. Alex Cook holding a newly banded and GPS tagged Dunlin. Photo credit: Sarah Hoepfner

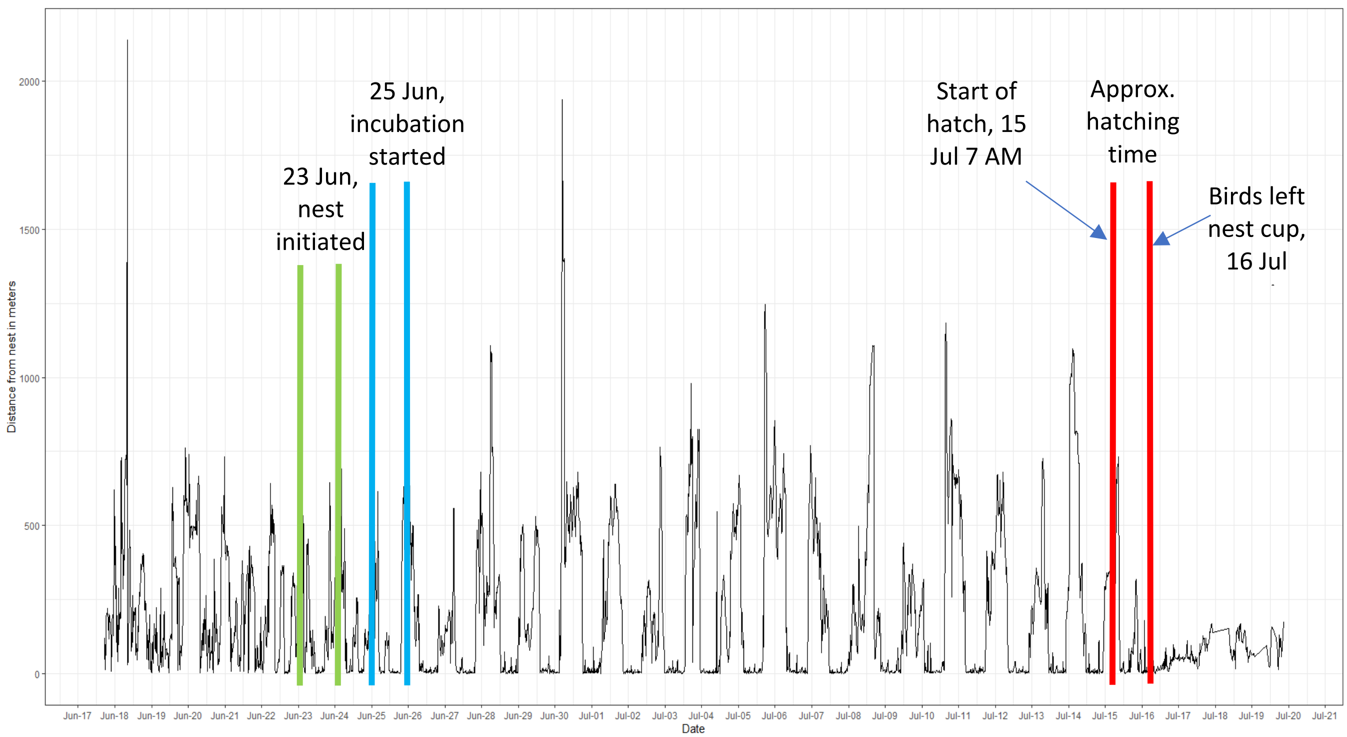

Figure 2. Distances a male Dunlin traveled from his eventual nest site with back calculated nest initiation and incubation dates determined from nest temperature data (this was a test nest with a temperature sensor used to truth the results of the GPS movements). Results indicate the male incubates a little during egg laying, but the true incubation pattern starts once the fourth egg is laid (blue lines) and continues until the pattern changes when the chicks hatch (red lines).

#7 (BCR 3): WORKING TO IMPROVE ADULT SURVIVAL ESTIMATES OF *ARCTICOLA* DUNLIN

Investigators: Lindsay Hermanns, Daniel H. Catlin, James Fraser, Virginia Polytechnic Institute and State University (Virginia Tech), and, Richard Lanctot and Sarah Saalfeld, U.S. Fish and Wildlife Service

The subspecies *Calidris alpina arcticola (arcticola* henceforth) is a shorebird which breeds in Arctic-Alaska and migrates along the East Asian-Australasian Flyway (EAAF). Unlike other dunlin subspecies, *arcticola* have been experiencing population declines for inconclusive reasons. The population also exhibits a low annual adult survival rate compared with other dunlin subspecies and sympatric Arctic-breeding shorebird species. Current hypotheses suggest that *arcticola* declines and low survival is driven by flyway conditions – the EAAF has been experiencing shorebird habitat loss, particularly intertidal habitat, which is thought to contribute to population declines of shorebird species using this flyway. Since 2003, the USFWS has been collecting shorebird breeding ecology data at Utqiagvik, Alaska on multiple migratory shorebirds including the *arcticola* subspecies. Our goal is to predict current survival estimates by using capture, recapture, and resight data collected at long-term (2003 – 2021) study plots at Utqiagvik; use supplemental resight data collected at *arcticola* non-breeding sites to refine estimates; and determine any significant environmental variables that may impact our predicted rates.

We used a Cormack-Jolly-Seber (CJS) survival model to predict *arcticola* annual adult survival rates with 16 years of capture, recapture, and resight data collected at this site. We examined effects of several breeding-site variables (predator counts, invertebrate abundance, climactic data) and individual variables (sex and morphological-measurements) on adult survival. We found survival estimates differed between sexes, and that rates were higher than previously published estimates of apparent survival, with female average apparent survival at 0.61 (range 0.40–0.92) and male average apparent survival at 0.66 (range 0.47–0.94). Weak relationships were detected between breeding site variables and apparent annual adult survival. Our findings suggest adult survivorship may be more affected by conditions experienced during the non-breeding life stages than during the breeding phase. Our CJS results are similar to survival studies on other migratory shorebirds that use the EAAF, which are known to exhibit low adult survival in addition to declining populations. We were also able to estimate a true survival rate by using the Barker model, which estimates survival by using both resight data collected along the *arcticola* non-breeding range, and, breeding site captures, recaptures, and resights. Using data collected from 976 banded individuals from the Utqiagvik breeding population, plus 1,796 breeding site resights, and 152 non-breeding resights from 16 years, we were able to predict a true survival rate of 0.71 (range 0.38–0.94; both sexes combined since they were not significantly different in our modelling), a value slightly higher than historic predicted rates.

In addition to these data, I collected additional resight data by conducting walking transects around the active nest-monitoring plots at Utqiaġvik. During resight transects, I used a camera to photograph – or, "capture" – previously banded *arcticola*. The off-plot resight transects allowed us to record a higher number of *arcticola* individuals that had dispersed from the nest monitoring plots where individuals were initially captured and banded. Since historically the majority of the Utqiagvik research effort is placed on monitoring predetermined nest plots, it is likely that returning individuals could be unaccounted for if they disperse from their original capture location. These data will further improve our estimates of the *arcticola* survival rates or indicate if our current estimates are accurate. We plan to continue resighting Dunlin on and off the conduct these resight transects during the 2022 breeding season.

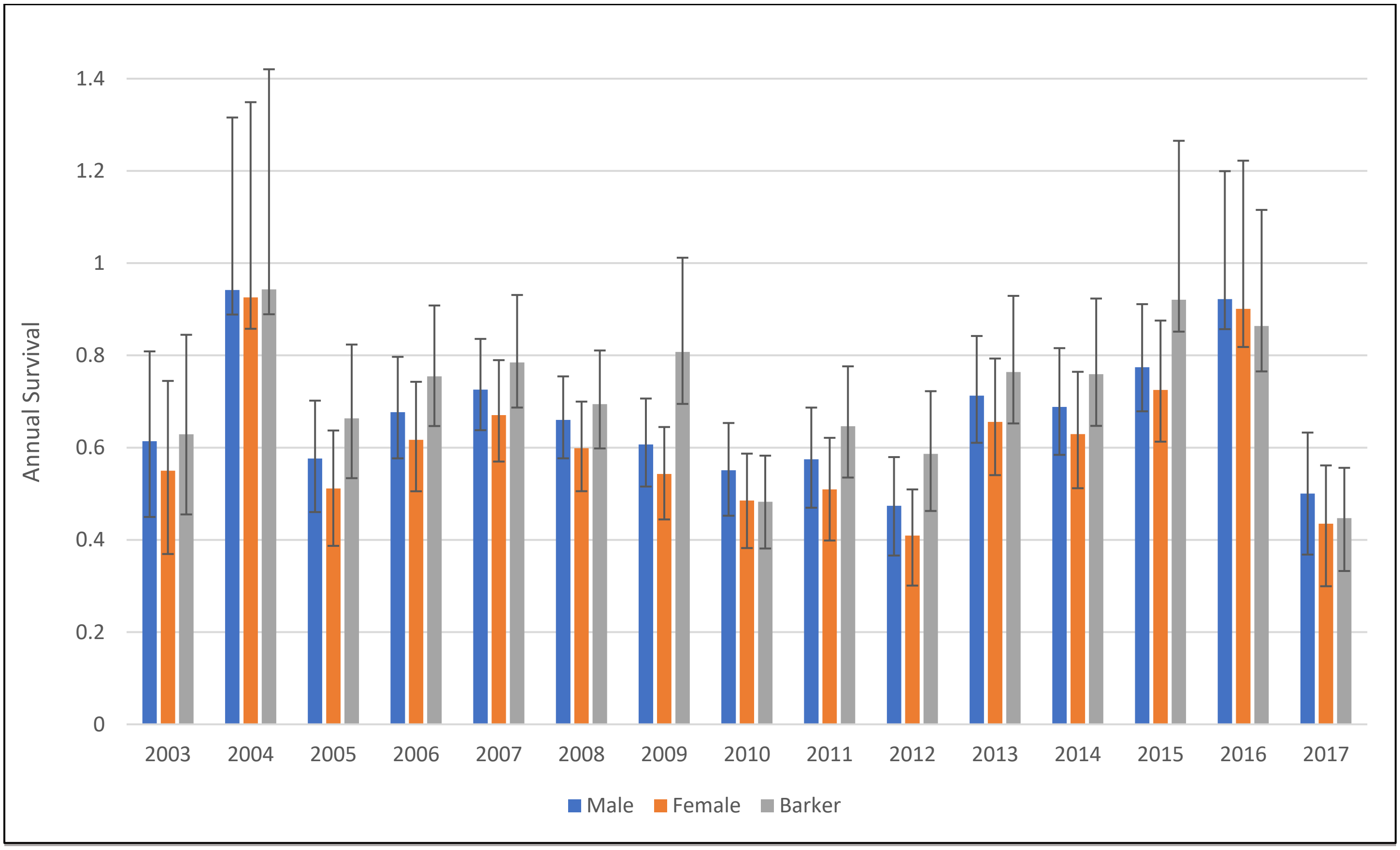

Figure 1. Apparent arcticola annual survival as predicted by the Cormack-Jolly-Seber model, by sex (female survival at 0.61, C.I. 0.30-0.99, ranging from 0.40-0.92, and male average survival at 0.66, C.I. 0.36-0.99, ranging from 0.47-0.94) compared to true survival preliminary estimates of males and females combined predicted by the Baker model (0.71, C.I. 0.31-0.97, ranging from 0.38-0.94). Data includes information from 2003-2018 from Utqiagvik, Alaska and resights on the winter grounds from 2003-2018.

This study is focused on the *arcticola* Dunlin, one of the priority shorebird species identified in the Alaska Shorebird Conservation Plan (Alaska Shorebird Group 2019). The study also fulfills action items identified in the Alaska Shorebird Conservation Plan under the Research section (i.e., “identify and determine the magnitude of factors limiting shorebird populations during breeding and nonbreeding periods of the annual cycle; determine migratory timing, routes, and site use of shorebirds; assess the effects of climate change on shorebird demography”), and the International Collaborations section (i.e., “foster and participate in cooperative research and monitoring efforts throughout species’ ranges”).

Location: Utqiaġvik, North Slope (71.2652°N, 156.6359°W) and many sites along the EAAF where resights were obtained.

Field assistance for conducting this work in 2021 was provided by Ben Lagassé, Sarah Hoepfner, Alex Cook, Tara Rodkey, John Myles, Samuel Stevens, Jonah Benningfield, and Peter Detwiler at Utqiaġvik. EAAF

collaborators providing resights included the Australasian Wader Studies Group, Global Flyway Network, Bird Ringing Center of Russia, Taiwan Wader Study Group, Yamashina Institute for Ornithology, FaceBook group: "Shorebird leg–flag sightings in the EAAF. Funding or logistical support for this study was provided by the National Fish and Wildlife Foundation, Neotropical Migratory Bird Conservation Act, Manomet, Inc., and the U.S. Fish and Wildlife Service,

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Figure 2. Lindsay Hermanns with a newly-banded arcticola Dunlin captured in Utqiagvik, Alaska. Photo: Jason Loghry

#8 (BCR 3): LONG-TERM SHOREBIRD MONITORING IN THE WILLOW PROJECT AREA, NPR-A

Investigators: Lauren B. Attanas, Kori S. Orion, and Alex K. Prichard; ABR, Inc.—Environmental Research & Services

ABR, Inc. Environmental Research & Services (ABR) was funded by ConocoPhillips Alaska, Inc. to conduct a multi-year shorebird breeding ecology study in and adjacent to the proposed Willow Development Project (Willow Project) area in the National Petroleum Reserve-Alaska (NPR-A). This study was initiated in order to satisfy North Slope Borough land rezone stipulations for the Willow Project and will include 5 consecutive years of intensive monitoring (2021–2025) during the pre-construction and construction phases of the project and monitoring approximately every 3 years post-construction. The primary objectives of this study are to:

- document the distribution, abundance, habitat associations, and nesting success of breeding shorebirds in the Willow project area,
- determine whether there are changes in these metrics from the baseline pre-construction period to the construction and post-construction (production) periods, and
- measure the effects, if any, of development and environmental factors on breeding shorebird densities and breeding success during construction and production.

During the 2021 field season, we established and monitored 20 new 10-ha (100 x 1,000 m) study plots in representative habitat types and at varying distances from proposed infrastructure (roads, pads, and airstrips) within the Willow Project area. Construction on the Willow project has not started, so data collected in 2021 represent baseline conditions. In addition to new plots, we also re-established 4 10-ha plots that ABR last monitored in 2004 and are located north of the recently constructed Greater Mooses Tooth 2 (GMT2) pad. Plots were clustered in groups of 4 to facilitate nest searching and helicopter logistics. We searched all plots using rope-dragging and behavioral nest searching methods described in ASDN protocols (Lanctot and Brown 2014). Plots were re-visited approximately every 7–8 days, depending on weather and logistics. All nests were marked and re-visited until they hatched or failed, and eggs of all passerine and shorebird nests were floated in order to estimate nest initiation and hatch dates. Biologists collected fine-scale habitat data including microtopography, microrelief, soil moisture, and percent cover of vegetation structure classes at each nest after hatch or fail.

In order to reduce disturbance to nesting shorebirds and obtain better-resolution data on the timing of nest hatch or failure, we installed 10 Gemini TinyTag data loggers (model TGP-4020) attached to thermistor probes (PB-5009-0M6) in the nests of 10 shorebirds. This was a pilot study to test the feasibility of using data loggers to monitor shorebird nests, and more may be used in the future. We intentionally selected nests near proposed infrastructure of species common in the NPR-A (Pectoral Sandpiper [5], Long-billed Dowitcher [3], Semipalmated Sandpiper [1], and Red-necked Phalarope [1]). All loggers installed in 2021 successfully collected data which will be used to calculate incubation parameters (recess frequency and duration, incubation start and end dates) and will be included in Daily Survival Rate (DSR) analysis (in progress).

During the 2021 season, we found 183 nests of 20 species of shorebirds, passerines, and waterfowl on and off-plot, including 92 nests of 10 shorebird species. Overall nest density on our plots was 60.4 nests/km^2, and shorebird nest density was 27.1 nests/km^2. Both of these are lower than reported nest densities during 2002–2004 NPR-A shorebird monitoring (overall range: 78.3–82.9 nests/km^2; shorebirds 38.3–50.0 nests/km^2; Wildman and Johnson 2004). The most common shorebird species nesting in the study area were Pectoral Sandpipers (9.6 nests/km^2), Red-necked Phalaropes (5.8 nests/km^2), Long-billed Dowitchers (4.2 nests/km^2), and Semipalmated Sandpipers (3.8 nests/km^2). Other shorebird species nesting in the study area were American Golden-Plover, Black-bellied Plover, Bar-tailed Godwit, Red Phalarope, Stilt Sandpiper, and Western Sandpiper (1 nest, off-plot).

Snow cover was low in the Willow Project area at the beginning of the study, and average snow cover estimates for individual plots ranged from 0–14.3% during initial visits in early June. Most plots were completely snow-free by 10 June. Jaegers and gulls were the most common nest predators observed during timed counts on study plots. Microtine abundance, as measured by the presence of sign and live animals, was relatively low at all plots in 2021.

This study helps to fulfill 2 of the research objectives of the Alaska Shorebird Conservation Plan, specifically,

- "Identify effects associated with energy production, mining, disturbance, and other anthropogenic activities on shorebirds."
- "Develop habitat-based models to predict the abundance and distribution of shorebirds and assess the adaptability of shorebirds to habitat changes."

One Population Inventory and Monitoring objective ("conduct long-term population monitoring efforts") is also addressed by this study.

Field assistance during the 2021 season was provided by Andy Bankert, Gerald (JJ) Frost, Dave Hejna, Tony LaCortiglia, and Steph Walden.

Location: Willow and Greater Moose's Tooth (GMT) project areas, NPR-A, Alaska

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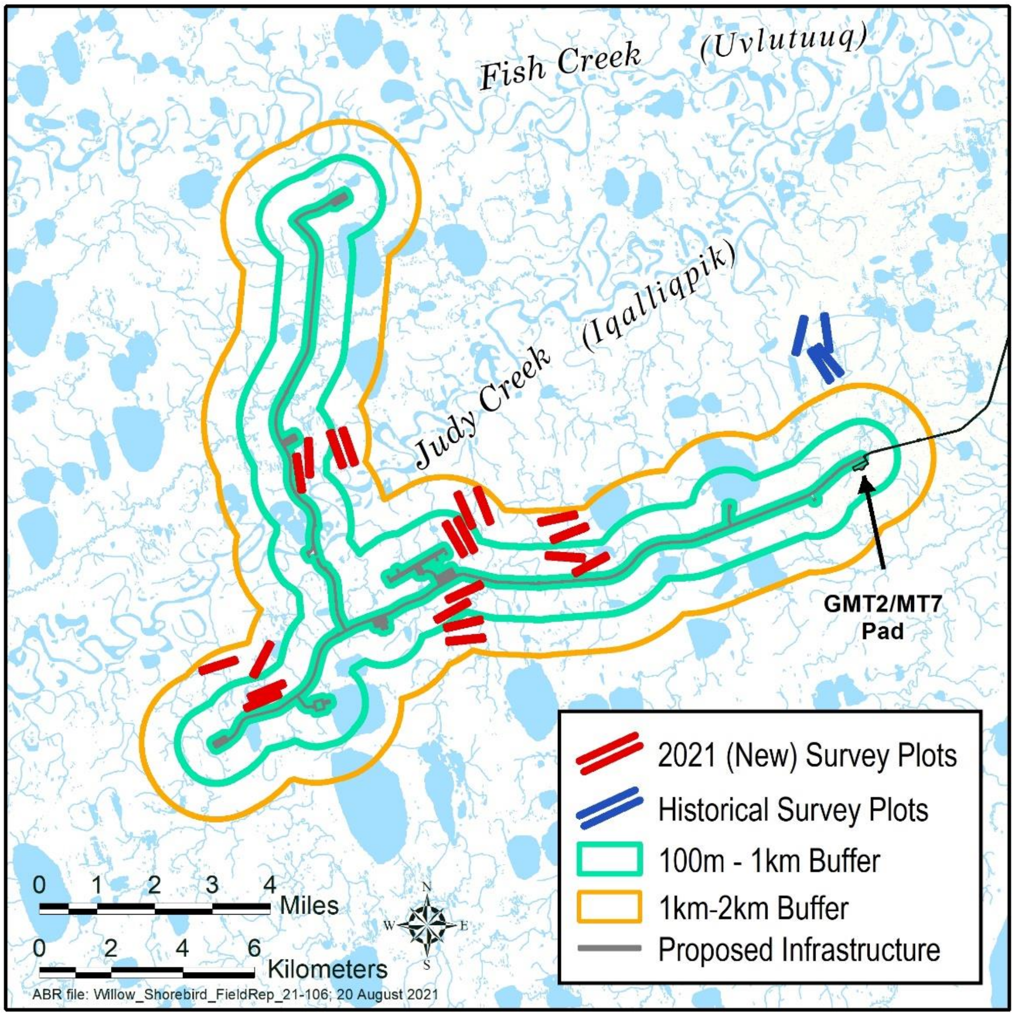

Figure 1. Study area for the Willow shorebird monitoring project, National Petroleum Reserve-Alaska. New survey plots were established in 2021, and historical plots were established in 2001–2002 and re-monitored in 2021.

Figure 2. Pectoral Sandpiper chicks and egg. Photo by Steph Walden.

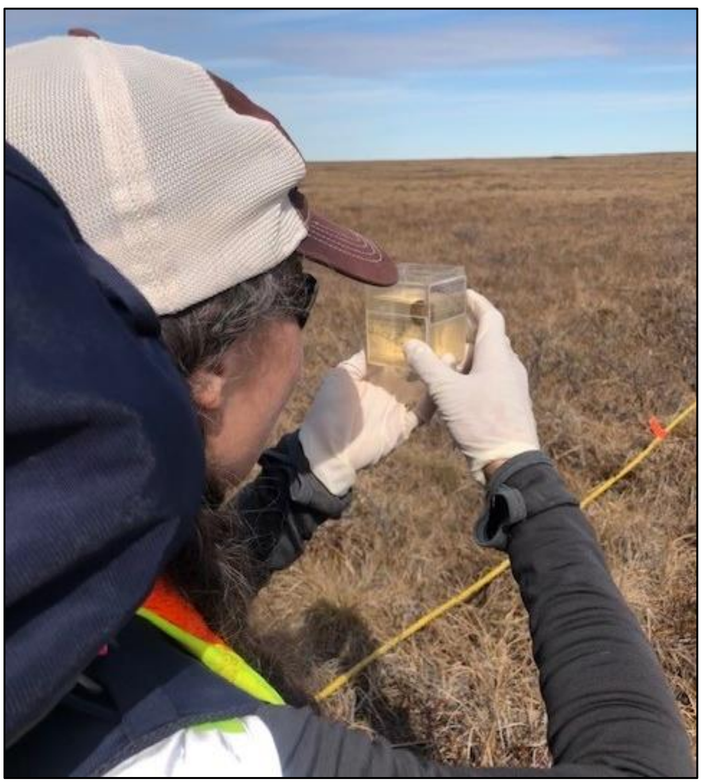

Figure 3. Floating eggs to determine nest age. Photo by Sarah Stewart, CPAI.

Figure 4. Long-billed Dowitcher adult. Photo by Andy Bankert.

#9 (BCR 3): QUPALUK AVIAN MONITORING

Investigators: Rebecca McGuire, Arctic Beringia Program, Wildlife Conservation Society; Martin Robards, Arctic Beringia Program, Wildlife Conservation Society

During 2021, the Wildlife Conservation Society, conducted research at the Qupaluk site (Figure 1) northeast of Teshekpuk Lake in the National Petroleum Reserve – Alaska (NPR-A). We evaluated nesting shorebird densities, timing of initiation, nest survival and conducted predator point counts. With increasing interest by oil and gas developers in the NPR-A, there is an imperative to provide managers with the information necessary to inform good management decisions. The Bureau of Land Management (BLM) has already worked with regional stakeholders to establish an Integrated Activity Plan that seeks a balance between operational best practices and areas that are too ecologically sensitive to disturb (Special Areas). However, data is lacking in many areas and for many species. Our work focuses on a specific area – Qupaluk – within the Teshekpuk Lake Special Area. This area is a recognized important breeding area for shorebirds, both for those that migrate to the west on the East Asian-Australasian Flyway, and those that migrate to the east and south on the Americas Flyways. While this site has been designated as an internationally important flyway site for migratory birds, there is still a dearth of data with which managers can monitor or manage the area to maintain it's important attributes, and for if, or when, development occurs in this area.

During June and July 2021, we established three 400x400m plots at Qupaluk and searched them for tundra-nesting birds. We found 56 nests on-plot and 7 nests off-plot for a total of 63 nests. We deployed 18 MSR tags. According to the Inupiat dictionary, Qupałuk means Lapland Longspur, which is a fitting name as 41% of our nests were Lapland Longspurs, 46% combined shorebirds, and 13% Greater White-fronted Geese. Apparent nest survival was 81% for shorebirds (Table 1). We conducted three replicates of timed predator counts on each plot throughout the season (Table 2).

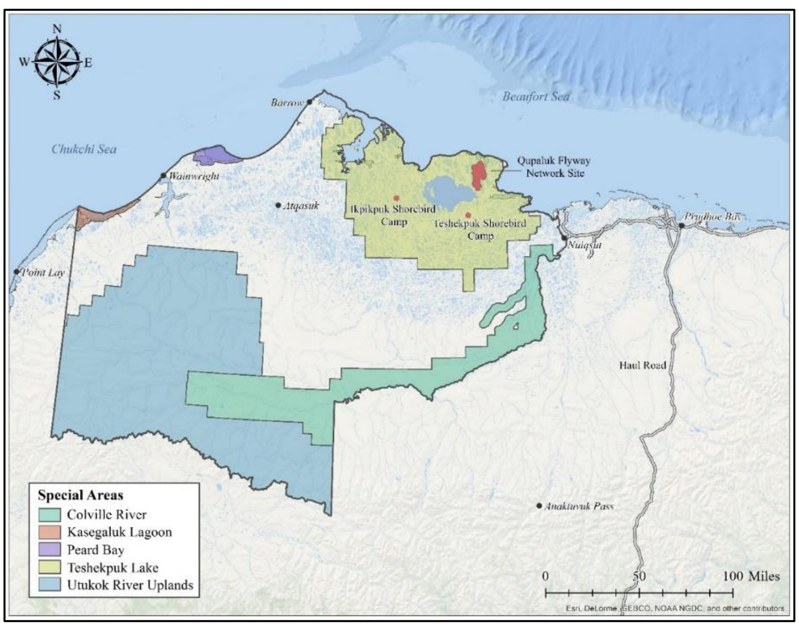

Figure 1. Location of the East Asian-Australasian Flyway site, Qupaluk, in northern Alaska. The boundary of the National Petroleum Reserve-Alaska with its five Special Areas, which are largely except from leasing under the current Integrated Activity plan, are shown.

Table 1. Shorebird nests found at Qupaluk, 2021.

Species	Total Nests	Success	Predation	Trampled	Unknown
Dunlin	8	7	0	0	1
Pectoral Sandpiper	6	5	1	0	0
Semipalmated Sandpiper	5	5	0	0	0
Red Phalarope	5	4	1	0	0
Western Sandpiper	1	0	1	0	0
Black-bellied Plover	1	0	1	0	0
Total	26	21	4	0	1
	100%	81%	15%	0%	4%

Table 2. Predator counts (three 10-minute counts on each plot) conducted early, mid and late-season, Qupaluk, 2021.

Species	Total # Observed	Detection Frequency	Early Season # Observed	Detection Frequency	Mid-Season # Observed	Detection Frequency	Late Season # Observed	Detection Frequency
Glaucous Gull	18	0.67	6	0.67	6	0.67	6	0.67
Parasitic Jaeger	5	0.19	2	0.22	3	0.33	0	0.00
Arctic Fox	2	0.07	0	0.00	1	0.11	1	0.11
Pomarine Jaeger	2	0.07	2	0.22	0	0.00	0	0.00
Short-eared Owl	1	0.04	1	0.11	0	0.00	0	0.00

Location: Qupaluk, Alaska, Arctic coastal plain, 70.666° N, -152.844° E

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#10 (BCR 4): MIGRATORY MOVEMENTS OF ALASKA BREEDING UPLAND SANDPIPERS (*BARTRAMIA LONGICAUDA*)

Investigators: Callie Gesmundo, Zak Pohlen, Richard Lanctot, Hannah Vincelette, and Jim Johnson, U.S. Fish and Wildlife Service, Migratory Bird Program.

Typically considered a denizen of the Prairie Region of the US and Canada, the Upland Sandpiper also breeds in a disjunct region in northwestern Canada and Alaska. In Alaska, the species nests in upland tundra and agricultural habitats across northern and interior portions of the state. Habitat use and migratory connectivity of Alaska-breeding Upland Sandpipers are poorly understood. In 2021, we initiated a study in interior Alaska to 1) determine breeding phenology and habitat use, 2) test methods for capturing adults, and 3) deploy tracking devices on adult birds. We conducted fieldwork during the incubation and brood-rearing periods, from 20 June to 4 July, with short visits in late May and early June to identify potential nesting territories.

Table 1. Summary of nests, broods, adult captures, and transmitter deployments among Upland Sandpipers near Delta Junction, Alaska in 2021.

	# nests	# broods	# birds captured	# birds tagged
Upland Sandpiper	1	12	15	14

We found one nest following extensive nest searching that included rope-dragging suitable habitat. Our limited success finding nests was likely a result of timing; our efforts were concentrated during incubation, when birds' behaviors are cryptic. We believe that we would find more nests during the pre-nesting and laying periods. We found a total of 12 broods. The nest and most broods (10) occurred in agricultural habitats, with the nest and all young broods found on Conservation Reserve Program (CRP) lands. We captured 2 birds as they incubated their eggs and 13 as they attended their chicks. We captured adults with broods by placing three adjacent 12-m mist nets horizontally on the ground to form a large square and broadcasted chick calls from a portable speaker centered under the nets. Adults landed on or walked underneath the mist net and were entangled. Capture success appeared to correlate with days since hatch, with both adults being most responsive to this capture method very early in the brood rearing stage (1-3 days post hatch).

We attached 10 PinPoint Argos GPS 75 transmitters (4 g; Lotek Wireless Inc.) and four Sunbird PTTs (2 g; Lotek Wireless Inc.) to adults between 22 June and 3 July 2021. Southbound movements (Figure 2) indicate a narrow migratory corridor used by all birds until they reached South America with wind influenced departures and trajectories over the Gulf of Mexico and Pacific Ocean and passage between the gulf and Pacific all through the Isthmus of Tehuantepec.

This project supports research objectives outlined in the Alaska Shorebird Conservation Plan, v.3 by determining migratory patterns and connectivity of Alaska breeding Upland Sandpipers, a spatially distinct population of shorebirds breeding in Alaska.

Acknowledgements: We thank Tucker Grigsby, Reina Galvan, and Evan Griffis for their assistance with fieldwork. Jeff Mason shared his extensive knowledge of Upland Sandpiper distribution in interior Alaska and provided valuable logistical support, including assisting with accessing private lands. Phil Caspari and Jay Tope, generously allowed us to access their properties.

Location: Delta Junction, Alaska.

Collaborators: Jeff Mason, Salcha-Delta Soil & Water Conservation District; Phil Caspari, private landowner in Deltana, AK; Jay Tope, private landowner in Deltana, AK.

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Anchorage, AK 99503, Email: jim_a_johnson@fws.gov, Phone: (907) 786-3423

Figure 1. Right to left: Zak Pohlen and Reina Galvan setting the net-capture array; Callie Gesmundo adjusting the Sunbird PTT transmitter on an Upland Sandpiper.

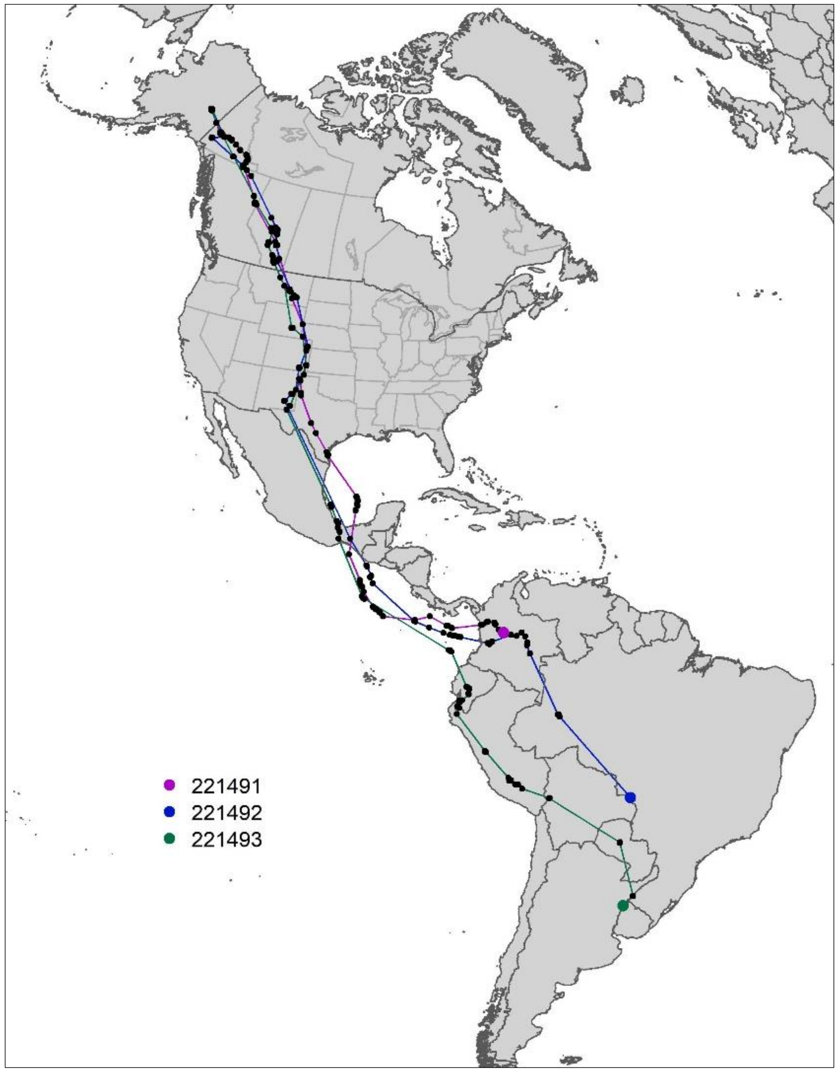

Figure 2. Track lines of three solar PTT transmitters deployed on Upland Sandpipers near Delta Junction, AK that are still reporting. Colored circles indicate the last known location as of late October 2021.

#11 (BCR 4): MIGRATORY PATTERNS AND VITAL RATES OF BOREAL BREEDING SHOREBIRDS

Investigators: Callie Gesmundo, Laura McDuffie, Zak Pohlen, Hannah Vincelette, and Jim Johnson, U.S. Fish and Wildlife Service, Migratory Bird Program; Katie Christie, Alaska Department of Fish and Game, Threatened, Endangered and Diversity Program; Nathan Senner, University of South Carolina

Shorebirds are among the continent's most rapidly declining avifauna. The population size of the Lesser Yellowlegs (T*ringa flavipes*), for example, is projected to decline by more than 50% within the next 10 years. Other species, such as the Solitary Sandpiper (*Tringa solitaria*) and western subspecies of Short-billed Dowitcher (*Limnodromus griseus caurinus*), are thought to be declining as well but a lack of information hinders an accurate understanding of the species' status and associated threats. Military lands in southcentral and interior Alaska and wetlands on the northwest side of Cook Inlet provide important habitats for Lesser Yellowlegs, Solitary Sandpipers and Short-billed Dowitchers, and since 2018 we have focused on determining their vital rates and movement patterns.

Table 1. Summary of nests monitored, adults captured and individually marked with engraved flags, tracking (tags/transmitters) devices deployed, and resighted birds in southcentral and interior Alaska during the 2021 breeding season.

	# nests	# birds captured	# birds tagged	# birds resighted
Lesser Yellowlegs	13	32	5	9
Solitary Sandpiper	1	27	20	0
Short-billed Dowitcher	10	31	22	0

Fieldwork occurred in southcentral Alaska at Joint-Base Elmendorf Richardson (JBER), Anchorage Coastal Refuge, and Beluga, and in interior Alaska at Eielson Air Force Base (AFB). We monitored 13 Lesser Yellowlegs nests, 10 Short-billed Dowitcher nests, and one Solitary Sandpiper nest at our four study sites to estimate nest success and causes of failure. As in past years, we placed temperature loggers in all Lesser Yellowlegs' nests and monitored 11 nests with game cameras. To estimate adult survival, we captured and individually marked Lesser Yellowlegs (32 adults), Solitary Sandpipers (27 adults), and Short-billed Dowitchers (31 adults). We resighted 9 Lesser Yellowlegs that were individually marked with engraved leg flags on JBER during previous years, including five birds banded in 2020, two birds banded in 2019, one bird banded in 2018, and three birds banded in 2017.

We deployed PinPoint GPS Argos 75 transmitters (4 g; Lotek Wireless Inc.) on 5 Lesser Yellowlegs and PinPoint 50 GPS archival tags (2 g; Lotek Wireless Inc.) on 15 Solitary Sandpipers at Eielson AFB and 5 at JBER. We deployed PinPoint GPS Argos 75 transmitters (Lotek Wireless Inc.) on 3 Short-billed Dowitchers at Anchorage Coastal Refuge, 7 dowitchers at JBER and 12 dowitchers at Beluga. Of the 5 Lesser Yellowlegs transmitters deployed, 4 are actively transmitting and their current locations vary in latitude from southern California to northwestern Argentina (Figure 2a). Of the 22 Short-billed Dowitcher transmitters deployed, 17 are actively transmitting from southern California and Mexico (Figure 2b). We won't know movements of Solitary Sandpipers until tagged birds are recaptured in 2022 and archived data are downloaded.

This project supports research objectives outlined in the Alaska Shorebird Conservation Plan, v. 3 by studying the breeding ecology and migratory patterns of Lesser Yellowlegs, Solitary Sandpiper and Short-billed Dowitcher, three declining boreal breeding shorebirds.

Acknowledgements: We thank Tucker Grigsby, Reina Galvan, Evan Griffis, Shelby McCahon, Mitch Paisker, Rachel Gingras and Arin Underwood for their major contributions to this study. Cassie Schoofs (JBER), Ron Gunderson (Eielson) and James "Brock" Brockriede (Eielson) provided helpful logistical support.

Funding: Department of Defense, University of South Carolina

Location: Joint-Base Elmendorf Richardson, AK; Anchorage, AK; Eielson Air Force Base, AK; and Beluga, AK

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Anchorage, AK 99503, Email: jim_a_johnson@fws.gov, Phone: (907) 786-3423

Figure 1. Right to left: PinPoint 50 GPS archival tag attached to a Solitary Sandpiper; Evan Griffis and Zak Pohlen admiring a net set up before a Lesser Yellowlegs capture attempt; PinPoint Argos 75 transmitter attached to a Lesser Yellowlegs.

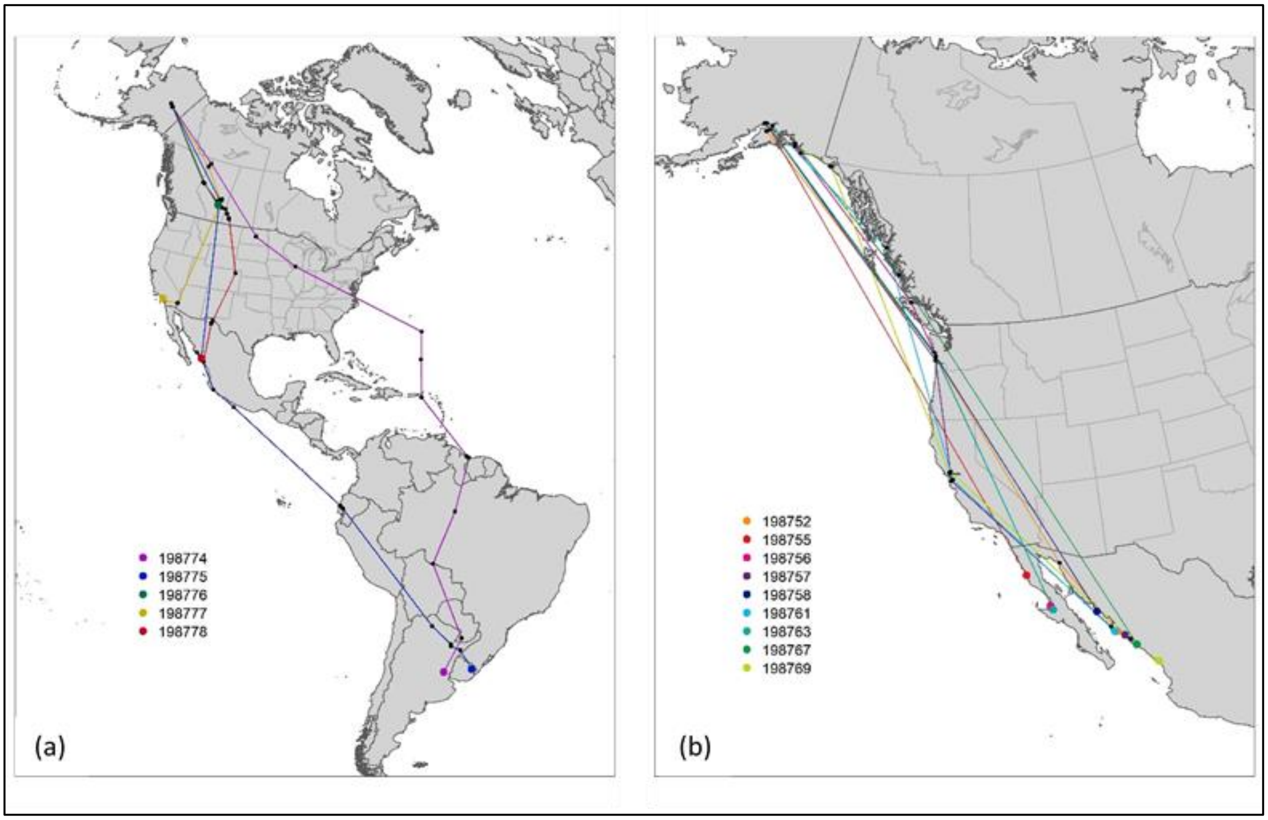

Figure 2. (a) Track lines of 5 Lesser Yellowlegs from Eielson, AFB during 2021 fieldwork. Colored circles represent the last known location as of late October 2021. All recent locations occurred in mid-October except for 198776, which stopped recording in late July in Alberta. (b) Track lines from 10 Short-billed Dowitchers tagged in Anchorage and Beluga AK during 2021 fieldwork. Colored circles represent the last known location as of late October 2021.

Figure 3. Reina Galvan and Tucker Grigsby attach a PinPoint GPS transmitter to an adult Short-Billed Dowitcher in Anchorage, AK. Photo credit: Laura McDuffie/USFWS.

#12 (BCR 4): HUDSONIAN GODWITS AND THE EFFECTS OF MULTIPLE, SIMULTANEOUS ANTHROPOGENIC STRESSORS

Investigators: Nathan R. Senner, Jennifer A. Linscott, and Lauren Puleo, University of South Carolina; Rose J. Swift, U.S. Geological Survey

Since 2009, our research group has monitored godwit breeding biology, including their habitat use, nest success, fledging success, adult survival, and recruitment on two study plots near Beluga, Alaska on the west side of Upper Cook Inlet (61.21°N, 151.02°W and 61.12°N, 151.10°W, respectively). We couple this focus on godwit breeding biology with measures of the phenology and abundance of the local invertebrates godwit chicks rely on for food. During this time, we have followed >200 godwit nests, individually marked >150 adults and >600 chicks, and counted ~600,000 invertebrates. These efforts have demonstrated that godwits breeding at Beluga have thus far been able to adequately respond to recent climatic changes by arriving in the region increasingly early each spring (Senner 2012). Upon arrival, female godwits are then able to rapidly transition to breeding readiness (Senner et al. 2014). In most years, this rapid transition allows godwits to properly time their reproductive efforts in synchrony with local invertebrate phenology, thereby allow their young sufficient resources to successfully fledge (Senner et al. 2017), but anomalously warm years have nonetheless led to significant phenological mismatches (Wilde et al. 2020). Importantly, we have also found that breeding godwits are not evenly distributed across all seemingly suitable habitat (Swift et al. 2017a). Instead, godwits nest in loose clusters associated with breeding colonies of Short-billed Gulls (*Larus brachyrhynchus*; Swift et al. 2017b). Gulls act as protector species while godwits are incubating their nests, helping shield those nests from potential nest predators (Swift et al. 2018).

Since 2012, godwit breeding densities have declined by 50% at Beluga, apparently as a result of declining adult survival driven by conditions on the nonbreeding grounds and along the godwit migration route, coupled with the effects of predators on chick survival in Beluga, where predators account for nearly 90% of all chick mortalities. Our current goals are thus three-fold: **(1)** Understand those factors influencing godwit migratory patterns such as wind (Linscott et al. in review) and water availability; **(2)** Quantify the degree to which trade-offs incurred during migration influence reproductive timing and success; and, **(3)** Assess how changing predator landscapes may exacerbate declines in godwit breeding densities (Wilde et al. in review).

Location: Beluga, Alaska

Contact: Nathan Senner, University of South Carolina, senner@mailbox.sc.edu

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Figure 1. Hudsonian Godwit: Photo: George Matz.

#13 (BCR 4): KACHEMAK BAY SHOREBIRD MONITORING PROJECT, 2021

Investigators: George Matz and Kachemak Bay Birders volunteers

Long-term Objective

The long-term objective for this citizen science project is to attain a better understanding of the status of shorebird populations in Kachemak Bay as well as the intertidal areas of the Anchor and Kasilof Rivers, particularly during spring migration. Also, volunteer participation provides local birders with more opportunity to observe and enjoy shorebirds. Secondary objectives 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 shorebird populations and habitat on the western side of the Kenai Peninsula.

Accomplishments

This year, the Kachemak Bay Birders (based in Homer, Alaska) completed its thirteenth consecutive year of shorebird monitoring. Between April 15 and May 25, we had nine monitoring sessions using a protocol that has been consistent from the start. Adjustments made due to the Covid-19 pandemic were slight. We kept all activities outside, which meant cancelling the meeting we would normally have after each session to review observations. Also, instead of written reports from each team, we required an electronic eBird report.

In Kachemak Bay, we had separate teams simultaneously monitor four sites on the Homer Spit as well as Beluga Slough and the islands and islets on the south side of Kachemak Bay. Sessions lasted two hours, once every five days and began when the outgoing tide reached 15.0 feet (or at high tide if less). These tide conditions provide consistency and optimized shorebird viewing conditions. Monitoring by boat on the south side of the Bay occurred the same day, weather permitting. This year we had a total of 56 volunteers participate in at least one Kachemak Bay monitoring session. This includes 7volunteers who were students in the UAA Kachemak Bay Campus Semester by the Bay Program and the instructor Debbie Tobin, Ph.D. Most of the volunteers have participated in previous years and are familiar with local shorebirds.

For the ninth consecutive year, we monitored the mouths of the Anchor River and Kasilof River. To reduce duplicate sightings, the Anchor River team monitored at the same time as the Kachemak Bay teams. A total of 11volunteers participated at this site this year. The Kasilof River had a total of 10 volunteers who monitored the same day but followed a different protocol due to tidal difference.

All observations, including all species of birds we counted, were entered in eBird using the ISS portal. We also recorded the weather conditions for each session using data from the National Weather Service located at Homer Airport

Results

This year at Kachemak Bay sites we observed a total of 25 species of shorebirds and counted a total of 12,226 individual shorebirds. This excludes double counting when we were certain that the same birds were seen at more than one site. Table 1 gives this year's count for each monitoring session. Detailed shorebird monitoring data spreadsheets for each site as well as summary data and analysis can be viewed at http://kachemakbaybirders.org/ .

Table 1. 2021 Kachemak Bay shorebird count, including all six sites.

		April				May					
#	SPECIES	15	20	25	30	5	10	15	20	25	Total
1	Semipalmated Plover	-	-	-	9	11	43	42	27	42	174
2	American Golden-Plover	-	-	-	-	-	-	1	-	-	1
3	Pacific Golden Plover	-	-	-	1	-	1	-	1	-	3
4	Black-bellied Plover	-	12	13	68	32	2	5	-	-	132
5	Black Oystercatcher	-	5	2	-	2	4	2	-	2	17
6	Greater Yellowlegs	3	17	28	37	7	5	5	6	-	108
7	Lesser Yellowlegs	-	-	-	-	1	-	-	-	-	1
8	Whimbrel	-	-	-	6	117	26	2	1	1	153
9	Hudsonian Godwit	-	-	-	-	7	-	-	-	1	8
10	Marbled Godwit	-	-	-	3	1	-	-	-	-	4
11	Wandering Tattler	-	-	-	-	-	14	13	15	1	43
12	Surfbird	-	-	12	-	28	2,700	-	-	-	2,740
13	Ruddy Turnstone	-	-	-	-	1	-	1	-	3	5
14	Black Turnstone	-	-	-	-	-	50	-	1	1	52
15	Western Sandpiper	-	-	-	279	698	2,401	1,047	85	128	4,638
16	Least Sandpiper	-	-	-	28	40	190	100	37	12	407
17	Semipalmated Sandpiper	-	-	-	-	-	5	1	3	1	10
	LESA/WESA/SESA	15	-	-	-	251	165	566	84	68	1,149
18	Pectoral Sandpiper	-	-	-	-	-	-	-	-	14	14
19	Dunlin	55	-	-	67	343	147	17	5	7	641
20	Rock Sandpiper	680	1	3	-	-	4	-	-	-	688
21	Red Knot	-	-	-	-	-	-	-	3	1	4
22	Short-billed Dowitcher	-	-	-	-	18	1	18	-	-	37
23	Long-billed Dowitcher	-	-	-	-	-	-	42	7	-	49
	Dowitcher sp.	-	-	-	18	28	29	53	-	-	128
24	Wilson's Snipe	-	2	-	-	-	2	1	1	-	6
25	Red-necked Phalarope	-	-	-	-	1,000	2	7	-	5	1,014
	Total	753	37	58	516	2,585	5,791	1,923	276	287	12,226

Notable observations this year:

- This year's count was slightly less than the 13-year average. But number of species was greater by one.
- This was the second year in a row that we have had a colder than average spring. Consequently, overwintering Rock Sandpipers have stayed in the Kachemak Bay area longer than in recent years. This year we had our highest count of Rock Sandpipers in the last 13 years. The Christmas Bird Count had 3,120 ROSA on the Homer Spit.
- A flock of Dunlin of variable size has been roosting with the Rock Sandpipers. On our first monitoring session there were 55 still in nonbreeding plumage. We didn't see any Dunlin until three sessions later and they were in breeding plumage. It would be interesting to know if these are the same birds that were here during our first session?
- Hundreds of Black Turnstones and Surfbirds usually roost on the rocks at the entrance to the Homer Harbor, but similar to last year, none were seen there this year. However, on May 10, about 2,700 were seen on the rocky islets on the south side of the Bay.
- ebird reported a couple of Bar-tailed Godwits seen the first week of May in the Mud Bay area. Adding in Marbled Godwits and Hudsonian Godwits that were seen about the same time, Kachemak Bay had three species of godwits this year.

Table 2. 2009-2021 Kachemak Bay shorebird count, sorted by average abundance.

# of Sp.	Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average
1	Western Sandpiper	3,229	4,996	4,100	16,375	7,964	4,000	2,267	1,403	7,225	14,508	2,941	14,011	4,638	6,743
	LESA/WESA/SESA	104	803	3,336	844	5,305	987	306	6,269	360	404	922	1,826	1,149	1,740
2	Red-necked Phalarope	1,630	1,500	5,152	1,501	703	3,006	1,503	39	102	1,025	2,513	102	1,014	1,522
3	Surfbird	292	110	574	2,919	748	2,644	2,111	1,335	1,186	715	850	350	2,740	1,275
4	Dunlin	1,097	561	1,283	1,205	2,548	1,530	826	508	590	928	579	1,156	641	1,035
5	Least Sandpiper	136	245	219	103	128	195	168	245	102	164	66	634	407	216
6	Semipalmated Plover	194	203	197	142	92	251	273	270	246	322	204	205	174	213
7	Rock Sandpiper	141	405	482	6	4	6	6	4	47	12	3	597	688	185
8	Black-bellied Plover	179	315	282	354	221	114	210	107	80	135	106	82	132	178
9	Black Turnstone	81	373	121	71	21	56	352	55	122	92	22	6	52	110
	Dowitcher sp.	99	82	57	76	344	49	65	17	14	139	176	55	128	100
10	Greater Yellowlegs	24	36	59	68	90	24	39	44	58	59	88	64	108	59
11	Semipalmated Sandpiper	1	5	3	34	-	13	33	3	10	10	-	613	10	57
12	Whimbrel	10	22	27	28	65	26	28	43	51	25	27	204	153	55
13	Wandering Tattler	13	56	30	18	62	39	39	58	58	55	28	5	43	39
14	Short-billed Dowitcher	125	-	33	76	18	15	-	20	57	24	2	17	37	33
15	Pacific Golden Plover	5	42	5	95	96	17	4	23	13	16	13	42	3	29
16	Pectoral Sandpiper	-	7	-	1	146	98	11	-	15	11	40	26	14	28
17	Long-billed Dowitcher	-	-	15	1	22	36	-	1	37	7	3	126	49	23
18	Black Oystercatcher	11	11	13	8	2	8	18	15	-	7	22	7	17	11
19	Marbled Godwit	3	12	1	7	-	8	5	5	11	29	4	6	4	7
20	Lesser Yellowlegs	-	26	3	15	9	4	11	1	5	13	-	2	1	7
21	Red Knot	-	-	2	-	-	1	1	-	-	-	-	67	4	6
22	Ruddy Turnstone	1	10	1	2	9	2	6	9	7	3	5	2	5	5
	Yellowlegs sp.	2	18	-	2	2	-	5	-	15	1	2	4	-	4
23	Hudsonian Godwit	18	-	2	-	3	3	-	-	1	3	1	6	8	3
24	Wilson’s Snipe	1	5	1	1	-	-	-	-	-	-	3	10	6	2
25	Sanderling	-	1	8	8	-	2	-	-	-	1	1	3	-	2
26	American Golden-Plover	3	1	1	1	10	-	-	-	-	-	2	-	1	1
27	Bar-tailed Godwit	3	-	-	4	6	-	-	1	1	1	-	-	-	1
28	Baird's Sandpiper	1	-	-	6	-	-	-	1	-	-	-	-	-	1
29	Spotted Sandpiper	3	-	-	1	-	-	-	1	-	-	-	1	-	0.5
30	Bristle-thighed Curlew	-	-	-	-	5	-	-	-	-	-	-	-	-	0.4
31	Red Phalarope	-	-	-	-	-	5	-	-	-	-	-	-	-	0.4
	Total Individuals	7,406	9,845	16,007	23,972	18,623	13,139	8,287	10,477	10,413	18,709	8,623	20,229	12,226	13,689
	Total Species	24	23	25	27	23	25	21	23	22	24	23	26	25	24

At the mouth of Anchor River, about 18 miles north of Homer, we saw a total of 19 species of shorebirds, which is average for this site, and a total individual count of 930, which is below average. Notable observations this year includes:

- We counted 124 Greater Yellowlegs, which is the highest count over the last nine years.

At the mouth of the Kasilof River, about 60 miles north of Homer, we saw 18 species of shorebirds, which included a Killdeer: the second record in nine years. We and had a total count of 7,280 shorebird which is slightly below our nine-year average. Notable observations include:

- Like the Anchor River, the Kasilof had a record number of Greater Yellowlegs (99) this year.
- Unlike the Homer Spit, all of the Rock Sandpipers that overwintered at the Kasilof left before this year’s monitoring began.
- The Conservation Fund recently purchased 309 acres of Kasilof River flats to be used for protection of prime waterfowl and shorebird habitat. https://pacificbirds.org/2021/09/kenai-peninsula-project-will-protect-habitat-in-a-globally-important-iba/?fl_builder John Wros from the Conservation Fund said that our Kasilof River monitoring record helped justify the purchase.

Table 3. 2021 Anchor River shorebird count, sorted by abundance.

		April				May					
#	**SPECIES**	15	20	25	30	5	10	15	20	25	**Total**
1	Western Sandpiper		1		1	18	449	4	10	1	484
2	Greater Yellowlegs	2	9	19	43	12	18	5	8	8	124
	LESA/WESA/SESA						32		37		69
3	Dunlin				4	2	45	2	1		54
4	Black Turnstone					6	35		1		42
	Dowitcher sp.				3			11	12	2	28
5	Whimbrel					12	1	12			25
6	Short-billed Dowitcher				1		16		3		20
7	Black-bellied Plover		1		8	3		1	5		18
8	Semipalmated Sandpiper								15		15
9	Semipalmated Plover					1	1	5	3	3	13
10	Pectoral Sandpiper							2	4	2	8
11	Least Sandpiper					2	2	3			7
12	Pacific Golden Plover				2	3		1			6
13	Spotted Sandpiper							1	1	3	5
14	Long-billed Dowitcher						2	1			3
	Yellowlegs sp.									2	2
15	Marbled Godwit				1		1				2
16	Surfbird								2		2
17	Hudsonian Godwit					1					1
18	Ruddy Turnstone						1				1
19	Wilson's Snipe		1								1
	Total	2	12	19	63	60	603	48	102	21	930

Table 4. 2021 Kasilof River shorebird count, sorted by abundance.

		April				May					
#	**SPECIES**	15	20	25	30	5	10	15	20	25	**Total**
1	Western Sandpiper					847	4,500	1,200	210	70	6,827
2	Dunlin					50	174	100	9	42	375
3	Short-billed Dowitcher			2	4		36	50	165	20	277
4	Greater Yellowlegs		80	11	1	2	2	1	2		99
5	Semipalmated Sandpiper						8	2	40		50
6	Least Sandpiper						44		1		45
7	Whimbrel							24	6	2	32
	Dowitcher sp.				3	11	7				21
8	Pectoral Sandpiper								20		20
9	Long-billed Dowitcher						4	7	1		12
10	Black-bellied Plover		3		4	3	1				11
11	Wilson's Snipe					4	4		2	1	11
12	Hudsonian Godwit						2	3	3	2	10
13	Semipalmated Plover							3	4		7
14	Lesser Yellowlegs						2	2	2		6
15	Pacific Golden Plover						4				4
	Godwit sp.						4				4
16	Surfbird								3		3
	LESA/WESA/SESA				3						3
17	Marbled Godwit						1		1		2
18	Killdeer								1		1
	Total	-	83	13	15	917	4,793	1,392	470	137	7,820

Next year, it would be useful to get a better idea as to how migrating shorebirds enter Kachemak Bay. Do they follow the coast, fly over the Kenai Mountain icefields, or is there a lower passage? Kachemak Bay Birders would need help with this and willing to collaborate with others. It should be noted that the assets we can provide are volunteers. We are entirely voluntary with no funding (or fund-raising hassles).

Alaska Shorebird Conservation Plan Objectives

Kachemak Bay is in BCR 4 Northwestern Interior Forest of the ASCP. The emphasis of this BCR is on Alaska-breeding boreal shorebirds, which are not of great significance in the Kachemak Bay area. The importance of Kachemak Bay is to provide a key stopover with abundant food and minimal human disturbance for shorebird migrants that breed in BCR's 2 and 3. Recognizing this, the ASCP also states that an action item is to "Continue to monitor the timing and use of key migratory stopover sites such as Kachemak Bay that face ever-increasing human population pressures." This is, in fact, is one of the core objectives for the Kachemak Bay Shorebird Monitoring Project. For the past thirteen years we have been following a protocol that monitors the spring shorebird 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 sites that are accessible for the past thirteen years. We have used this data to advance protection of shorebird habitat. The most significant example was when we submitted in 2016 a nomination to expand the Kachemak Bay WHSRN site from 7,260 acres to about 230,900 acres, which was accepted.

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

Figure 1. Dave Erikson scanning for shorebirds. Photo credit: Carla Stanley.

Figure 2. Mud Bay monitors. Photo credit: Paul Allan.

Figure 3. Mud Bay monitors scoping for shorebirds. Photo credit: Paul Allan.

#14 (BCR 5): MONITORING SEMIPALMATED PLOVERS BREEDING AT EGG ISLAND, COPPER RIVER DELTA

Investigators: Mary Anne Bishop, Prince William Sound Science Center

North American shorebirds have experienced population declines over the last several decades. Semipalmated Plover, however, are 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 3-8 June 2021. A total of 15 plover nests were located. In all, we banded 4 Semipalmated plover adults and resighted 21 birds from previous years. Additional field work is planned for Egg Island in 2022.

Our project addresses the ASG objective to promote research, monitoring, and outreach relevant to shorebirds.

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

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

Figure 1. An adult Semipalmated Plover on Egg Island, AK. Photo by A. Schaefer.

#15 (BCR 5): RED KNOT ABUNDANCE AND HABITAT USE IN CONTROLLER BAY

Investigators: Jenell Larsen Tempel, Alaska Department of Fish and Game; Erin Cooper, US Forest Service; Dan Ruthrauff, US Geological Survey

Controller Bay is a remote bay located southeast of the Copper River Delta and adjacent to the Chugach National Forest. Both historically and today it has been an area of interest for resource extraction for a variety of activities, including coal mining, oil exploration, and timber harvest. Recent telemetry studies have also indicated that this area is important to shorebirds as a spring stopover location (Bishop et al. 2016) including disproportionately high numbers of three species of high conservation concern (Red Knots, Marbled Godwits and Hudsonian Godwits). The overall goal of this study is to determine the importance of Controller Bay and its habitat as a stopover location for *roselaari* Red Knots. Understanding the number of birds that utilize this area, the areas that they use, and the prey items they rely on, will inform conservation actions, and fill in basic knowledge gaps about this species. A reconnaissance trip to Cordova and Controller Bay occurred in May 2021 to better inform the methods that will be used to determine population abundance during the 2022 pilot study. The objectives of the 2021 reconnaissance work were to determine an appropriate method for estimating Red Knot abundance during the spring migration at Controller Bay and methods for diet analysis. Fieldwork in Controller Bay occurred from May 9-13. It was anticipated that photographs of Red Knots taken during aerial surveys would be used for determining the abundance of Red Knots as this has been a successful method in Delaware Bay (Clark, Niles and Burger 1993) and South America (USFWS 2020). Observations and on-the-ground counts were carried out to determine the feasibility of conducting surveys by foot and bike, determine flock compositions, determine when the optimal tidal heights occurred for surveying knots, and to determine appropriate methods for analyzing Red Knot diet.

One aerial survey was flown at high tide over Controller Bay and photographs were taken of all flocks encountered when possible. It was determined that aerial surveys were not an ideal approach for counting Red Knots in Controller Bay. The fairly small tidal range and coastal topography of the bay made detection of flocks difficult. Furthermore, knots are too small to be easily identifiable from aerial photographs and the weather patterns in this area made controlling aircraft speed very difficult and resulted in flying too fast for surveying when tailwinds are present. Two biologists and one volunteer spent four days camping out at Controller Bay to identify roosting and foraging locations of knots and determine if they could be surveyed from the ground. Fat tire bikes were used to travel over the intertidal to get close to flocks that were spotted with binoculars. At the high tide, and within 2 hours afterward, roosting and foraging birds gathered in tightly knit, but often mixed flocks. Red Knots were usually present within larger flocks of Short-billed Dowitchers, making them difficult to distinguish, but these two species could be distinguished and counted with spotting scopes. Red Knot droppings were collected for diet reconstruction by one observer when homogenous groups were present, or by two observers when only a few knots were present in mixed flocks. This was done by having one observer locate the droppings through a spotting scope and direct the other observer where to retrieve them.

It was determined that a ground-based survey method was a more appropriate method for surveying Red Knots in Controller Bay than aerial survey methods. We initiated discussions with collaborators to further develop these methods, and plan to replicate the approach of Lyons et al. (2016) using a mark-resight approach for the abundance estimate in 2022. The pilot project in 2022 will meet two objectives under the 2019 Shorebird Conservation Plan: 1) Habitat Management and Protection Objectives: apply abundance and distribution information to identify key shorebird habitats and sites; 2) Research Objective: determine migratory timing, routes and site use of shorebirds.

Fieldwork was conducted by investigators Jenell Larsen Tempel, Erin Cooper, and Dan Ruthrauff and volunteer Mattheus Tempel. Support for the 2021 reconnaissance work was provided by Alaska State Wildlife Grant (SWG T-33-2021) and the US Forest Service's International Programs.

Collaborators: Grey Pendelton (ADF&G), Jim Lyons (USGS), Jim Johnson (FWS), Joe Buchanan (Washington Department of Fish and Wildlife), and Mary Anne Bishop (Prince William Sound Science Center).

Location: Controller Bay, Alaska

Contact: Jenell Larsen Tempel, Alaska Dept of Fish and Game, PO Box 115526, Juneau, AK 99811, Email: jenell.larsentempel@alaska.gov, Phone: 907-465-6318

Figure 1. Reconnaissance trip to Controller Bay, May 2021. Photo credits: Jenell Larsen Tempel and Mattheus Tempel.

#16 (BCR 5): COPPER RIVER DELTA SHOREBIRD FESTIVAL 2021

Investigators: Nick Docken and Erin Cooper, US Forest Service

In early May, the tidal flats of the Copper River Delta shimmer with the activity of up to 12 million shorebirds that rest and feed here during spring migration. The Copper River Delta Shorebird Festival provides the ideal opportunity for bird watchers to be part of this epic migration. Over the course of a weekend in early May, birders from around the world participate in activities, workshops, and community events that are offered as part of the festival. Since the first Shorebird Festival in 1990, people from around the globe have come to witness the spectacle of migration and learn more about these amazing birds. In early May, the tidal flats of the Copper River Delta shimmer with the activity of hundreds of thousands of shorebirds. As many as 5 million shorebirds (primarily Western Sandpipers, Least Sandpipers and Pacific Dunlin) rest and feed here during spring migration. The Copper River Delta Shorebird Festival provides the ideal opportunity for bird watchers to be part of this epic migration. Over the course of a weekend in early May, birders from around the world participate in activities, workshops, and community events that are offered as part of the festival. Since the first Shorebird Festival in 1990, people from around the globe have come to witness the spectacle of migration and learn more about these amazing birds. The Copper River Delta Shorebird Festival is a collaborative event with partners from the Cordova Chamber of Commerce and the US Forest Service Cordova Ranger District. The Cordova Ranger District has offered help in planning the festival events and contributing to the educational experience during the Festival. With last year witnessing the success of our first virtual festival, a hybrid festival was implemented 2021. With the majority of the festival tailored toward virtual attendees, there were in-person local activities with COVID mitigations in place. The shorebird committee team used Facebook

(https://www.facebook.com/CopperRiverDeltaShorebirdFestival/) and the Website for the event (www.coppershorebird.com) to connect with those tuning into the festival and migration from afar.
A host of honed skills from last year including video collection, live event hosting, connecting with remote sites helped reach over 21,000 people on Facebook and close to 5,000 people on Instagram. 275 people registered for the festival and 49 of those indicated they traveled to Cordova to participate in-person. There were also registrations from 13 different countries outside of the US. It is clear the benefits that social media and virtual portions of the event have on increasing our audience and engagement and will continue to be a component of our festival. Many of the lessons learned will be folded into future events increasing the wonder and spectacle of migration and the Copper River Delta to a worldwide audience be folded into future events increasing the wonder and spectacle of migration and the Copper River Delta to a worldwide audience.

Figure 1. Robert Masolini surveys shorebirds on the flats as part of the Festival's Virtual Field Trips. Photo by Nick Docken.

Figure 2. The Barrier islands of the Copper River Delta host a wide variety of migrating shorebirds (seen here: red knots, dunlin, short-billed dowitcher. Photo by James Ianni.

Figure 3. A roosting Western. Photo by James Ianni.

Figure 4. A mixed Western Sandpiper and Dunlin flock at Hartney Bay. Photo by James Ianni.

#17 (BCR 5): 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 component (https://gulfwatchalaska.org/monitoring/nearshore-ecosystems-4/) 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.

In 2021, we located a total of 32 nests in all four sampling blocks. Nest density this year ranged from 0.20 to 0.07 nests per km of shoreline, with the highest density in Katmai National Park and Preserve and the lowest in Kachemak Bay. Productivity (number of eggs + chicks / nest) was highest (2.8 ± 0.12; mean ± SE; n = 6) in Kachemak Bay and lowest (1.8 ± 0.22; n = 7) in Kenai Fjords National Park. We collected 565 prey items from nine nests, representing 12 different taxa. While chick diet varied by block and transect, overall it was dominated by three species of limpets (*Lottia pelta, L. persona. L. scutum*); together they made up 56% of the diet in 2021 and have dominated diet throughout the 16 years of sampling. The Pacific blue mussel (*Mytilus trossulus*) and black katy chiton (*Katharina tunicata*) represented much smaller proportions in the diet (21% 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.

We completed the third year of a Black Oystercatcher migration study that complements our long-term monitoring. See the summary entitled “Black Oystercatcher Movement Ecology” for more details.

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

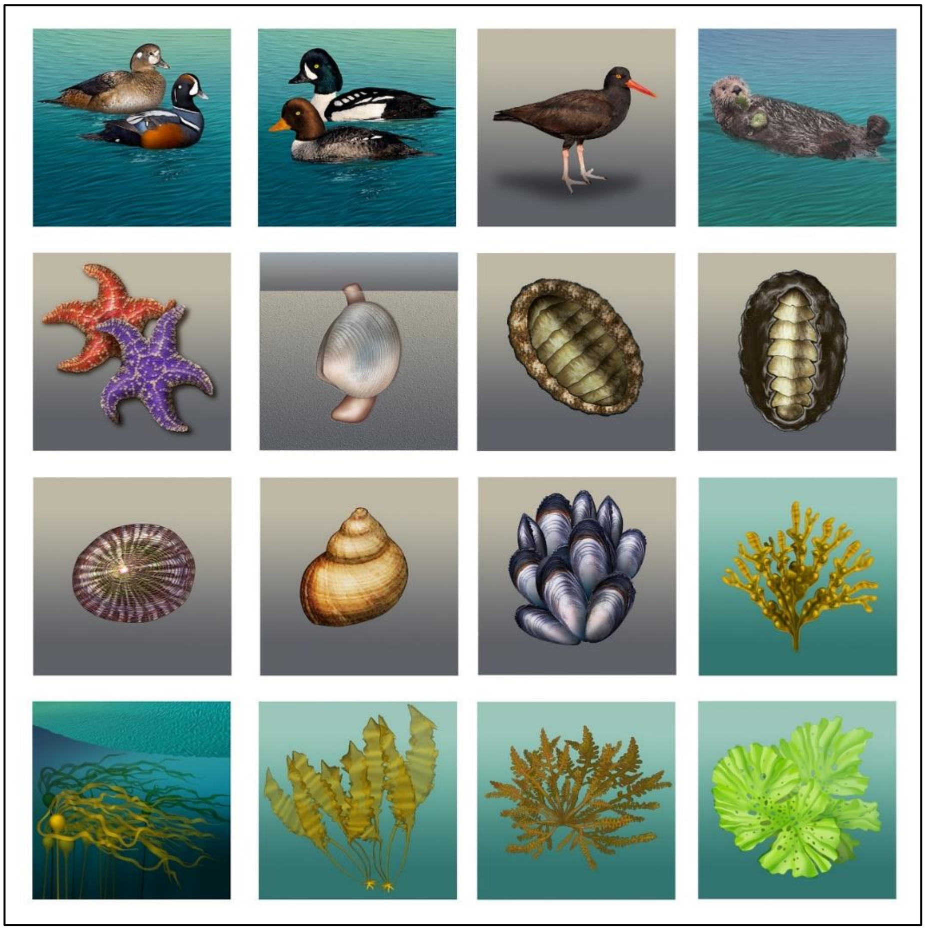

Figure 1. The Black Oystercatcher is one of many ecologically important species in the nearshore marine ecosystem that is monitored by Gulf Watch Alaska.

Figure 2. A Black Oystercatcher defends its nest early in the breeding season in Kenai Fjords National Park, Alaska.

#18 (BCR 5): MOVEMENT ECOLOGY OF BLACK OYSTERCATCHERS

Investigators: David Green, Cole Rankin, Lena Ware, Simon Fraser University; Daniel Esler and Brian Robinson, U.S. Geological Survey; Heather Coletti, National Park Service

In 2019, we initiated a tracking study on the Black Oystercatcher (*Haematopus bachmani*), a coastal shorebird that exhibits large scale partial migration on the west coast of North America. Our research investigates the underlying ecological factors that lead to different migratory strategies by comparing the phenotypes of migrants and residents in Alaska. This project will 1) examine the roles of body size and sex on whether Black Oystercatchers migrate, 2) identify wintering locations of individuals that breed in the northern Gulf of Alaska, 3) examine migration routes, stop-over sites, and habitat use of migrants and residents, and 4) determine how migration influences condition, survival and subsequent reproduction of a subarctic partial migrant shorebird.

In 2021, we conducted field work during the breeding season, from May to July, at four sampling blocks in the northern Gulf of Alaska: western Prince William Sound, Kachemak Bay, Kenai Fjords National Park, and Katmai National Park and Preserve. We captured 26 individuals at nest sites using noose-mats. We attached EcoTone solar GPS tags (7g, ~1% of body weight) with leg-loop ribbon harnesses to 18 individuals. Tag data were retrieved from 12 individuals that had been marked in 2019 or 2020. We determined sex of all captured birds using the eye fleck technique and collected morphometric data and tissue samples for stable isotope analysis.

We plan to deploy GPS tags for one more year in 2022 and retrieve them through 2023. Our findings will help to advance the study of partial migration by shedding light on the ecological attributes that influence migratory behaviour. Black Oystercatchers are susceptible to anthropogenic threats at all stages of their annual cycle and by identifying large and fine-scale movements of Black Oystercatchers in Alaska, our research will identify where critical habitat for this species overlaps most with anthropogenic stressors.

This study is being done in conjunction with the annual monitoring conducted by Gulf Watch Alaska. See the summary entitled “Long-term monitoring of Black Oystercatchers in the Gulf of Alaska” for details.

Location: western Prince William Sound, Kachemak Bay, Kenai Fjords National Park, and Katmai National Park and Preserve, Alaska

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

Figure 1. After removing a GPS tag that had been deployed for a year, Caitlin Marsteller releases a Black Oystercatcher at its nest territory in Kachemak Bay, Alaska.

#19 (BCR 67): EFFECTS OF A LARGE-SCALE RODENT ERADICATION ON MIGRATORY SHOREBIRD POPULATIONS AT MIDWAY ATOLL

Investigators: Lee Tibbitts, USGS Alaska Science Center, Beth Flint, USFWS Marine National Monuments of the Pacific, Jared Underwood, USFWS, Papahānaumokuākea Marine National Monument, Jon Plissner, USFWS Midway Atoll NWR, Amanda Adams Midway Atoll NWR, and Jim Lyons, USGS Patuxent Wildlife Research Center

Eradicating non-native rodents from oceanic islands is a powerful management tool that benefits native species and restores ecosystems. Unfortunately, eradication events can have unintentional negative impacts on non-target species, for example on our focal group, the migratory shorebirds of the Pacific Islands, who can be killed or sickened by consuming the poison bait or invertebrates with toxicants in their tissues. Quantitative assessments of the effects of rodent eradications on shorebird populations are not easily obtained due to the remoteness of most islands but are key to understanding the risks involved and developing mitigation measures. We are taking an opportunity to estimate the effects of an eradication on migratory shorebirds on the relatively accessible Midway Atoll in the Northwestern Hawaiian Islands. Our objectives are to measure the direct effects of a summer 2022 eradication on the three most common migratory shorebirds on the atoll, Bristle-thighed Curlew, Pacific Golden-Plover, and Ruddy Turnstone, by (1) comparing their relative population sizes on Midway pre- (2017-2021) and post- (2022-2023) the eradication, (2) estimating their apparent annual survival across this period, and (3) measuring any changes in local movement patterns relative to different types of hazing.

This year, Refuge biologists continued weekly, island-wide shorebird surveys along established routes and continued to document peak numbers of all species during August and September. We individually color-marked a winter 20-21 cohort of birds (3 BTCU, 16 PAGP, 21 RUTU), and are working on marking a winter 21-22 cohort (to date: 1 BTCU, 21 PAGP, 20 RUTU). We tagged several birds with GPS PinPoint Argos transmitters and preliminary location data indicate that while turnstones spend the night on the outer reef, plovers and curlews usually stay close to their daytime feeding territories. In the afternoon, some individuals join large roosting aggregations on the runway and at the catchment pond. Migratory connectivity, as suggested by the tagging, shows the Midway curlews breeding in the Andreafsky Wilderness of Alaska, plovers in the western Yukon-Kuskokwim Delta region, and turnstones on Wrangel Island, Russia.

This project is addressing some Population Inventory and Monitoring objectives of the Alaska Shorebird Conservation Plan (ASG 2019): inventory some poorly studied shorebird species, evaluate a long-term population monitoring system; assess the use of relatively new technologies (i.e., GPS tracking) to determine winter home ranges. The project is also addressing one of the International Collaboration objectives, albeit not outside the U.S., but rather in the southern portion of the annual range of Alaska-breeding shorebirds: foster and participate in cooperative research and monitoring efforts throughout the species' ranges.

Location: Midway Atoll National Wildlife Refuge, 28.208 -177.370

Contact: Lee Tibbitts, 4210 University Ave., Anchorage, AK 99508
Phone: 907 786 7038 email: ltibbitts@usgs.gov

Figure 1. Typical scene on Midway Atoll in April 2021; adult and nestling Laysan Albatross occur across the islands, Bristle-thighed Curlews loaf on rip-rap rocks; Green Turtles and Hawaiian Monk seals haul-out on the beach. Photo credit: Lee Tibbitts.

Figure 2. Assessing wing molt of a captured Pacific Golden-Plover to ascertain age class (this is an adult) at Midway Atoll in September 2021. Photo credit: Beth Flint.

#20 (BCR 67): HAWAII KOLEA COUNT

Investigators: Wally Johnson, Montana State University and Susan Scott, Hawaii Audubon Society

In 2020, the Hawaii Audubon Society launched a pilot citizen science program to count and monitor Pacific Golden-Plovers, called Kolea in Hawaiian. The website-based study, www.koleacount.org, has several categories, including arrival date, winter head count, departure dates, and over-summering birds. Wally Johnson is our science advisor.

In brief, 2020-2021 pilot study results below:

611: number of people who entered reports

4,196: number of bird observations reported

167: Number of Kolea with given names (Sir Lancelot, Bob, etc.)

Oahu: Island with most entries

40: number of Kolea reported in June, or birds that did not migrate (summered-over)

Based on citizen feedback, we modified the website to make observer reporting simpler and have started our 2021-2022 count. Community response is good with more people joining in as word gets around. Our intention is to continue this plover and other shorebird awareness campaign for at least 10 years.

Location: Hawaii Island, Kauai, Maui, Molokai and Oahu, Hawaii

Contact: Susan Scott, Kolea Count project manager, Hawaii Audubon Society, email: honu@susanscott.net

#21: STATUS OF THE MIDCONTINENT SHOREBIRD CONSERVATION INITIATIVE (MSCI)

Investigators: Kelli Stone and Brad Andres, U.S. Fish and Wildlife Service; Isadora Angarita-Martinez, (AMBI/Manomet); Rob Clay (Manomet) and Benoit Laliberte (Environment and Climate Change Canada)

The interior or "midcontinent" regions in the Americas are critical to numerous breeding, wintering and migrating populations of shorebirds, many of which are of global conservation concern (Figure 1). Interior portions of South America, North America (including the Arctic and Boreal) and the western Gulf of Mexico support over 16 million North American migrating shorebirds annually and declines in many shorebird populations are well documented (e.g., Rosenberg, K. V. et al. 2019). Ecosystem stresses will intensify with climate change, while disturbance and other threats continue, yet one large-scale, comprehensive and annual-cycle conservation approach similar to those developed for shorebirds in coastal environments along the Atlantic (2015) and Pacific (2016) Flyways is lacking. The Midcontinent Shorebird Conservation Initiative (MSCI) was launched in 2019 to address this gap in conservation planning. The Initiative's goal is to support shorebird populations and habitats while benefiting human well-being of communities across the Flyway. The first action of the MSCI is to develop a partner-driven hemispheric-scale strategic conservation plan or "framework" to integrate conservation efforts and enhance collaboration at the scale necessary to conserve shorebirds and their habitats for future generations.

Similar to the Atlantic and Pacific Initiatives, we used the "Conservation Standards" to develop the MSCI framework. This systemic and collaborative planning process ensures that workshops throughout this large geography (Figure 1) will produce compatible outputs that can be merged into a single hemispheric framework. Our intended in-person workshops for 2020 were replaced by virtual workshops due to the pandemic; however, these virtual (and very interactive) workshops often allowed more experts and interested parties to participate.

Workshops in North and South America started in 2020 and have concluded, however, there are still opportunities to participate in the Arctic and Boreal process. Workshop participants included experts in shorebird biology and conservation, habitat management and delivery, conservation policy, environmental law, sociology, as well as potential funders from a myriad of governments, non-government organizations, Indigenous peoples and communities. To date, approximately 277 people, from 242 institutions representing 18 countries and territories participated in workshops or were directly involved in the process. They helped identify prioritized significant threats, conservation actions and coordinated strategies to support shorebird habitats and 26 focal shorebird species. Climate change was the highest-ranking threat in the flyway (Table 1). Funding to develop the framework came from three federal agencies in the U.S. and Canada as well as ConocoPhillips. Of equal value is the in-kind work from workshop participants, technical steering committees and others.

The framework is scheduled to be finished in April 2022 with a Spanish version shortly following. We plan to host events to launch the framework and highlight how partners can contribute to its implementation. Ultimately, it will be partners and stakeholders who will use the framework to identify and then implement the conservation, management, legislation, and other local actions that meet their objectives while also contributing at the Midcontinent flyway scale. The framework will assist partners in obtaining and leveraging funding to implement projects. We look forward to collaborating with the Alaska Shorebird Working Group in implementing the framework, and being an active part of the Initiative.

For more information, contact: https://shorebirdflyways.org/

- Arctic/Boreal Coordinator: Benoit Laliberte, benoit.laliberte@ec.gc.ca
- North American Coordinator: Kelli Stone, kelli_stone@fws.gov
- South American Coordinator: Isadora Angarita-Martínez, Isadora@caff.is

The MSCI and the framework meet and support the implementation of the International Collaboration Objectives of the Alaska Shorebird Conservation Plan. Specifically by engaging partnerships at different scales and coordinating and participating in international conservation planning exercises. It will also address several crosscutting objectives of the Alaska Shorebird Conservation Plan related to Research, Population Inventory and Monitoring, Habitat Management and Protection and Environmental Education and Public Outreach.

Citation: Rosenberg, K. V. et al. 2019. Decline of the North American Avifauna. Science 365(6461) Rosenberg, K. V. et al. 2019. Decline of the North American Avifauna. Science 365(6461)

Figure 1: Midcontinent Shorebird Conservation Initiative's approximate geography.

Figure 2. Lesser Yellowlegs, one of the Midcontinent Shorebird Conservation Initiative's focal conservation targets.

Table 1. Major Threats (rated as very high to high) to Shorebirds and Habitats in the Midcontinent Flyway		
Arctic and Boreal	**North America**	**South America**
1. Phenological "mismatch" 2. Permafrost melt 3. Severe weather events 4. Shrub expansion 5. Sea level rise 6. Oil and gas activities 7. Overabundant geese and predators 8. Forest fires in the Boreal	1. Climate change (sea level rise and changes in precipitation and hydrological regimes 2. Water and sediment management and use 3. Native habitat conversion agriculture 4. Commercial, tourism, and industrial areas	1. Climate change 2. Dams and incompatible water use 3. Mining 4. Incompatible livestock practices 5. Housing and real estate development 6. Incompatible agricultural practices 7. Incompatible fire use and fire suppression

PUBLICATIONS & ABSTRACTS

Almeida, J.B., I.F. Lopes, L.W. Oring, T.L. Tibbitts, L.M. Pajot, and R.B. Lanctot. 2020. After-hatch and hatch year Buff-breasted Sandpipers *Calidris subruficollis* can be sexed accurately using morphometric measures. *Wader Study*. 127:147-155. https://doi.org/10.18194/ws.00189.

Determining the sex of birds quickly in the field can help in studies of behavior and distribution, and when selecting particular sexes for deploying tracking devices or collecting samples. However, discerning males from females is difficult in species that are plumage monomorphic and have overlapping sexual-size dimorphism, as in Buff-breasted Sandpipers *Calidris subruficollis*. We developed three discriminant functions to sex Buff-breasted Sandpipers based on measurements of live birds captured in Brazil whose sex was confirmed with molecular techniques. We validated these discriminant functions using morphometric measures from other independent samples of known-sex live birds from wintering (Brazil), migration (Texas), and breeding (Alaska) sites. Discriminant functions derived from birds captured in Brazil accurately sexed ≥88% of the validation sample from Brazil, Texas, and Alaska. Errors in classification occurred among males on the wintering (0–5%) and breeding (8–12%) grounds, and females during migration (0–11%). Discriminant functions worked well because of the substantial sexual size dimorphism present in the species, with male traits being in general 5.2–10.4% larger than female traits. The size of morphological traits did not vary by age (after controlling for sex) for birds sampled on the wintering grounds and during migration. Our results indicate that discriminant functions can be used to sex after-hatch year (AHY) Buff-breasted Sandpipers throughout their range, and for hatch year (HY) birds during their first southbound migration and winter. Being able to accurately sex both AHY and HY birds using only morphological measurements will improve studies of the ecology and population structure of this species and enhance the application of conservation measures.

Barrio, I.C., D. Ehrich, E.M. Soininen, V.T. Ravolainen, C. G. Bueno, O. Gilg, A.M. Koltz, J.D.M. Speed, D.S. Hik, M. Mörsdorf, J.M. Alatalo, A. Angerbjörn, J. Béty, L. Bollache, N. Boulanger-LaPointe, G.S. Brown, I. Eischeid, M.A. Giroux, T. Hájek, B.B. Hansen, S.P. Hofhuis, J.-F. LaMarre, J. Lang, C. Latty, N. LeComte, P. Macek, L. McKinnon, I.H. Myers-Smith, Å.Ø. Pedersen, J. S. Prévey, J.D. Roth, S.T. Saalfeld, N.M. Schmidt, P. Smith, A. Sokolov, N. Sokolova, C. Stolz, R. van Bemmelen, Ø. Varpe, P.F. Woodard, I.S. Jónsdóttir. 2021. Developing common protocols to measure tundra herbivory across spatial scales. *Arctic Science*. https://doi.org/10.1139/AS-2020-0020.

Understanding and predicting large-scale ecological responses to global environmental change requires comparative studies across geographic scales with coordinated efforts and standardized methodologies. We designed, applied, and assessed standardized protocols to measure tundra herbivory at three spatial scales: plot, site (habitat), and study area (landscape). The plot- and site-level protocols were tested in the field during summers 2014–2015 at 11 sites, nine of them consisting of warming experimental plots included in the International Tundra Experiment (ITEX). The study area protocols were assessed during 2014–2018 at 24 study areas across the Arctic. Our protocols provide comparable and easy to implement methods for assessing the intensity of invertebrate herbivory within ITEX plots and for characterizing vertebrate herbivore communities at larger spatial scales. We discuss methodological constraints and make recommendations for how these protocols can be used and how sampling effort can be optimized to obtain comparable estimates of herbivory, both at ITEX sites and at large landscape scales. The application of these protocols across the tundra biome will allow characterizing and comparing herbivore communities across tundra sites and at ecologically relevant

spatial scales, providing an important step towards a better understanding of tundra ecosystem responses to large-scale environmental change.

Bom, R.A., J.R. Conklin, Y.I. Verkuil, J.A. Alves, J.De Fouw, A.Dekinga, C.J. Hassell, R.H.G. Klaassen, A.Y. Kwarteng, E. Rakhimberdiev, A. Rocha, J.Ten Horn, T.L. Tibbitts, P.S. Tomkovich, R. Victor, T. Piersma. 2021. Central-west Siberian-breeding Bar-tailed Godwits (*Limosa lapponica*) segregate in two morphologically distinct flyway populations. *Ibis*. https://doi.org/10.1111/ibi.13024

Long-distance migratory species often include multiple breeding populations, with distinct migration routes, wintering areas and annual-cycle timing. Detailed knowledge on population structure and migratory connectivity provides the basis for studies on the evolution of migration strategies and for species conservation. Currently, five subspecies of Bar-tailed Godwits *Limosa lapponica* have been described. However, with two apparently separate breeding and wintering areas, the taxonomic status of the subspecies *L. l. taymyrensis* remains unclear. Here we compare *taymyrensis* Bar-tailed Godwits wintering in the Middle East and West Africa, respectively, with respect to migration behaviour, breeding area, morphology and population genetic differentation in mitochondrial DNA. By tracking 52 individuals from wintering and staging areas over multiple years, we show that Bar-tailed Godwits wintering in the Middle East bred on the northern West-Siberian Plain ($n = 19$), while birds from West Africa bred further east, mostly on the Taimyr Peninsula ($n = 12$). The two groups differed significantly in body size and shape, and also in the timing of both northward and southward migrations. However, they were not genetically differentiated, indicating that the phenotypic (i.e. geographical, morphological and phenological) differences arose either very recently or without current reproductive isolation. We conclude that the *taymyrensis* taxon consists of two distinct populations with mostly non-overlapping flyways, which warrant treatment as separate taxonomic units. We propose to distinguish a more narrowly defined *taymyrensis* subspecies (i.e. the Bar-tailed Godwits wintering in West Africa and breeding on Taimyr), from a new subspecies (i.e. the birds wintering in the Middle East and breeding on the northern West-Siberian Plain).

Brlík, V., P. Pipek, K. Brandis, N. Chernetsov, F.J.V. Costa, L.G.Herrera M., Y. Kiat, R.B. Lanctot, P.P. Marra, D.R. Norris, C.J. Nwaogu, P. Quillfeldt, S.T. Saalfeld, C.A. Stricker, R.L. Thomson, T. Zhao, and P. Procházka. 2021 The reuse of avian samples: opportunities, pitfalls, and a solution. *Ibis*. https://doi.org/10.1111/ibi.12997.

Tissue samples are frequently collected to study various aspects of avian biology, but in many cases these samples are not used in their entirety and are stored by the collector. The already collected samples provide a largely overlooked opportunity because they can be used by different researchers in different biological fields. Broad reuse of samples could result in multispecies or large-scale studies, interdisciplinary collaborations, and the generation of new ideas, thereby increasing the quality and impact of research. Sample reuse could also reduce the number of new samples needed for a study, which is especially pertinent to endangered species where sample collection is necessarily limited. Importantly, reusing samples may be mutually beneficial for both the researchers providing samples and those reusing them. Here, we identify the benefits of sample reuse, describe currently available sources of already collected samples and their limitations, and highlight the wide range of potential applications in a single research field – avian isotopic ecology. To facilitate the reuse of avian samples worldwide and across research fields, we introduce the AviSample Network metadata repository. The main aims of this metadata repository are to collate and provide access to descriptions of available avian tissue samples. We contend that the creation of the AviSample Network metadata repository will provide the opportunity for new collaborations and studies. Moreover, we believe that this will help create research connections between ornithologists across the globe and encourage sample reuse in other fields.

Cosgrove, J., B. Dugger, and R.B. Lanctot. 2020. No renesting observed after experimental clutch removal in Red Phalaropes breeding near Utqiaġvik, Alaska. *Wader Study* 127: 236-243. https://doi.org/10.18194/ws.00213.

Renesting is thought to be uncommon for shorebirds breeding in the Arctic, where breeding seasons are short and energy constraints may limit birds to a single clutch. However, few studies have assessed shorebird renesting using experimental clutch removal and tracking of adults. We conducted such an experiment on the sequentially polyandrous Red Phalarope *Phalaropus fulicarius* to assess renesting propensity and explore underlying factors that affect renesting. None of 24 males whose nests we experimentally removed (n = 19) or had been abandoned/depredated (n = 5) were known to renest in our study area. However, 19 males left our study area prior to the end of the laying period and three of those males were re-paired prior to disappearing, indicating they may have renested outside the range of our telemetry system. The operational sex ratio was strongly male-biased when most males lost their clutches, so opportunities to renest at our study site were likely limited. Had we conducted our clutch removal experiment in a year with an earlier and longer breeding season, it is possible that some males would have renested. Future studies on renesting in shorebirds, especially in opportunistic-breeding species, should track and monitor the behavior of individuals across large distances after their initial clutch loss.

Krietsch, J., M. Cragnolini, S. Kuhn, R.B. Lanctot, S.T. Saalfeld, M. Valcu, and B. Kempenaers. (in press) Extra-pair paternity in a sequentially polyandrous shorebird: limited evidence for the sperm-storage hypothesis. *Animal Behaviour*.

Lamarre, J-F., G. Gauthier, R.B. Lanctot, S.T. Saalfeld, O.P. Love, E. Reed, O.W. Johnson, J. Liebezeit, R.L. McGuire, M. Russell, E. Nol, L. Kolosky, F. Sanders, L. McKinnon, S.A. Flemming, N. Lecomte, M-A. Giroux, S. Bauer, T. Emmenegger, and J. Bêty. (in press). Timing of breeding site availability across the North-American Arctic partly determines spring migration schedule in a long-distance Neotropical migrant. *Frontiers in Ecology and Evolution, Behavioral and Evolutionary Ecology section.*

Matz, George. 12 Years of Shorebird Monitoring at Kachemak Bay. WHSRN Newsletter, Jan. 2021. https://whsrn.org/kachemak-bay-birders-complete-12-years-of-shorebird-monitoring/.

McDuffie, L. A. (2021). Migration ecology and harvest exposure risk of Lesser Yellowlegs. *ProQuest Dissertations Publishing.* 28413540.

The Lesser Yellowlegs (Tringa flavipes) is a migratory shorebird species that has experienced a precipitous population decline. The factors governing this decline are complex and may correspond to habitat traits and migratory dynamics. Recent advancements in GPS telemetry have allowed for a precise description of migratory patterns to interpret the spatial and temporal distributions of migratory bird species compared to prior approaches that used band recoveries, surveys, and morphological measurements. Understanding the similarities and differences in distributions among and within disparate populations of birds is critical for identifying the potential exposure to threats that influence a species' productivity and survival. Detailed distribution data provides the foundation for the development and implementation of targeted conservation applications for declining species, such as the Lesser Yellowlegs.

In 2018, 2019, and 2020, project cooperators and I deployed 110 PinPoint GPS Argos satellite tags on adult Lesser Yellowlegs at six sites spanning the boreal biome of Alaska and Canada. The Lesser Yellowlegs is a Neotropical migrant shorebird that breeds in the boreal forest and spends the winter in Central and South America and the Caribbean. Upon summarizing the locations received, I found that geographically disparate populations followed different routes during autumn migration, but experienced weak migratory connectivity, or high population mixing, at wintering locations. Differentiation in migratory timing, distances, and strategies were also variable among sexes and breeding populations. Further, I described the primary stopover, staging, and wintering sites and determined that the Prairie Pothole region and the Gulf Coast region were the primary stopover sites during autumn and spring migration, whereas northeastern Argentina was the primary wintering area. Within each of those regions, the highest proportion of Lesser Yellowlegs detections were in wetland habitats.

Lastly, I modeled the probability of Lesser Yellowlegs occurring within Caribbean and northeastern South American countries where shorebirds are harvested for sport and subsistence. I found that geographically disparate populations were differentially exposed to shorebird harvest. Populations originating from eastern Canada had the highest probability of occurrence and longest duration of stay within harvest zones from mid-August through October, while populations originating from Alaska had an exposure probability of nearly zero throughout the autumn.

The Lesser Yellowlegs has experienced a precipitous population decline of ~63% since the 1970s. Within the next decade, it is predicted that an additional 50% of the current population size will be lost if science-driven conservation actions are not practiced. By using real-time location data to identify annual migration patterns and the probabilities of harvest exposure among disparate populations of Lesser Yellowlegs, my thesis provides the knowledge for tailoring conservation priorities and actions for specific geographic regions or subpopulations that are at high risk (e.g. populations originating in eastern Canada). Focusing conservation efforts to areas where scientifically rigorous analyses illustrate serious concern is an effective approach to ensure the perseverance of a steeply declining shorebird.

McDuffie, L. A., K. S. Christie, A-L. Harrison, A. R. Taylor, B. A. Andres, B. Laliberté, and J. A. Johnson (in press). Differential migration potentially affects Lesser Yellowlegs harvest in the Caribbean and northeastern South America. *Ornithological Applications*.

McGuire, R. L., R. B. Lanctot, S. T. Saalfeld, D. R. Ruthrauff and J. R. Liebezeit (2020). Shorebird reproductive response to exceptionally early and late springs varies across sites in Arctic Alaska. *Frontiers in Ecology and Evolution*, 8577652. https://doi.org/10.3389/fevo.2020.577652

While increases in overall temperatures are widely reported in the Arctic, large inter-annual variation in spring weather, with extreme early and late conditions, is also occurring. Using data collected from three sites in Arctic Alaska, we explored how shorebird breeding density, nest initiation, nest synchrony, nest survival, and phenological mismatch varied between two exceptionally early (2015 and 2016) and late (2017 and 2018) springs. We assessed these differences in the context of long-term data from each site and whether species exhibited conservative or opportunistic reproductive strategies. Conservative shorebirds typically display nest-site fidelity and territoriality, consistent population densities, relatively even individual spacing, and monogamous mating systems with bi-parental incubation. In contrast, opportunistic shorebirds display the opposite traits, and a polygamous mating system with uniparental incubation. In this study, we evaluated 2,239 nests from 13 shorebird species, 2015– 2018, and found that shorebirds of both strategies bred earlier and in higher numbers in early, warm springs relative to historic levels (based on 3,789 nests, 2005–2014); opposite trends were observed in late springs. In early springs, nests were initiated less synchronously than in late springs. Nest survival was unrelated to spring type, but was greater in earlier laid nests overall. Invertebrate food resources emerged earlier in early springs, resulting in a greater temporal asynchrony between invertebrate emergence and chick hatching in early than late springs. However, invertebrate abundance was quite variable among sites and years regardless of spring type. Overall, our results were generally consistent with predicted relationships between spring conditions and reproductive parameters. However, we detected differences among sites that could not be explained by other ecological factors (e.g., predators or alternative prey). Differences in shorebird community composition and other subtler methodological/ecological differences among sites highlight the difficulty of understanding the complex nature of these ecological systems and the importance of evaluating questions at multiple sites across multiple years. Our study demonstrates that shorebirds exhibit a high degree of behavioral flexibility in response to variable Arctic conditions, but whether this flexibility is enough to allow them to optimally track changing environmental conditions or if evolutionary adjustments will be necessary is unknown.

Meyer, N., L. Bollache, M. Galipaud, J. Moreau, F-X Dechaume-Moncharmont, E. Afonso, A. Angerbjörn, J. Bêty, G. Brown, D. Ehrich, V. Gilg, M-A. Giroux, J. Hansen, R.B. Lanctot, J. Lang, C. Latty, N. Lecomte, L. McKinnon, L. Kennedy, J. Reneerkens, S.T. Saalfeld, B. Sabard, N.M. Schmidt, B. Sittler, P. Smith, A. Sokolov, V. Sokolov, N. Sokolova, R. van Bemmelen, O. Varpe, and O. Gilg. 2021. Behavioural responses of breeding arctic sandpipers to ground-surface temperature and primary productivity. *Science of the Total Environment 755:142485*. https://doi.org/10.1016/j.scitotenv.2020.142485.

Most birds incubate their eggs, which requires time and energy at the expense of other activities. Birds generally have two incubation strategies: biparental where both mates cooperate in incubating eggs, and uniparental where a single parent incubates. In harsh and unpredictable environments, incubation is challenging due to high energetic demands and variable resource availability. We studied the relationships between the incubation behaviour of sandpipers (genus Calidris) and two environmental variables: temperature and a proxy of primary productivity (i.e. NDVI). We investigated how these relationships vary between incubation strategies and across species among strategies. We also studied how the relationship between current temperature and incubation behaviour varies with previous day's temperature. We monitored the incubation behaviour of nine sandpiper species using thermologgers at 15 arctic sites between 2016 and 2019. We also used thermologgers to record the ground surface temperature at conspecific nest sites and extracted NDVI values from a remote sensing product. We found no relationship between either environmental variables and biparental incubation behaviour. Conversely, as ground-surface temperature increased, uniparental species decreased total duration of recesses (TDR) and mean duration of recesses (MDR), but increased number of recesses (NR). Moreover, small species showed stronger relationships with ground-surface temperature than large species. When all uniparental species were combined, an increase in NDVI was correlated with higher mean duration, total duration and number of recesses, but relationships varied widely across species. Finally, some uniparental species showed a lag effect with a higher nest attentiveness after a warm day while more recesses occurred after a cold day than was predicted based on current temperatures. We demonstrate the complex interplay between shorebird incubation strategies, incubation behaviour, and environmental conditions. Understanding how species respond to changes in their environment during incubation helps predict their future reproductive success.

Piersma, T., R. E. Gill, Jr. and D. R. Ruthrauff (2021). Physiomorphic transformation in extreme endurance migrants: revisiting the case of Bar-Tailed Godwits preparing for trans-Pacific flights. *Frontiers in Ecology and Evolution*, 9. https://doi.org/10.3389/fevo.2021.685764

In a 1998 paper entitled "Guts don't fly: small digestive organs in obese bar-tailed godwits," Piersma and Gill (1998) showed that the digestive organs were tiny and the fat loads huge in individuals suspected of embarking on a non-stop flight from Alaska to New Zealand. It was suggested that prior to migratory departure, these godwits would shrink the digestive organs used during fuel deposition and boost the size and capacity of exercise organs to optimize flight performance. Here we document the verity of the proposed physiomorphic changes by comparing organ sizes and body composition of bar-tailed godwits Limosa lapponica baueri collected in modesty midway during their fueling period (mid-September; fueling, n = 7) with the previously published data for godwits that had just departed on their trans-Pacific flight (October 19; flying, n = 9). Mean total body masses for the two groups were nearly identical, but nearly half of the body mass of fueling godwits consisted of water, while fat constituted over half of total body mass of flying godwits. The two groups also differed in their fat-free mass components. The heart and flight muscles were heavier in fueling godwits, but these body components constituted a relatively greater fraction of the fat-free mass in flying godwits. In contrast, organs related to digestion and homeostasis were heavier in fueling godwits, and most of these organ groups were also relatively larger in fueling godwits compared to flying godwits. These results reflect the functional importance of organ and muscle groups related to energy acquisition in fueling godwits and the consequences of flight-related exertion in flying godwits. The extreme physiomorphic changes apparently occurred over a short time window (≤1 month). We conclude that the inferences made on the basis of the 1998 paper were correct. The cues and stimuli which moderate these changes remain to be studied.

Piersma, T., E. M. A. Kok, C. J. Hassell, H-B. Peng, Y. I. Verkuil, G. Lei, J. Karagicheva, E. Rakhimberdiev, P. W. Howey, T. L. Tibbitts and Y-C. Chan (2021). When a typical jumper skips: itineraries and staging habitats used by Red Knots (*Calidris canutus piersmai*) migrating between northwest Australia and the New Siberian Islands. *Ibis*. https://doi.org/10.1111/ibi.12964.

The ecological reasons for variation in avian migration, with some populations migrating across thousands of kilometres between breeding and non-breeding areas with one or few refuelling stops, in contrast to others that stop more often, remain to be pinned down. Red Knots *Calidris canutus* are a textbook example of a shorebird species that makes long migrations with only a few stops. Recognizing that such behaviours are not necessarily species-specific but determined by ecological context, we here provide a description of the migrations of a relatively recently described subspecies (*piersmai*). Based on data from tagging of Red Knots on the terminal non-breeding grounds in northwest Australia with 4.5- and 2.5-g solar-powered Platform Terminal Transmitters (PTTs) and 1.0-g geolocators, we obtained information on 19 route-records of 17 individuals, resulting in seven complete return migrations. We confirm published evidence that Red Knots of the *piersmai* subspecies migrate from NW Australia and breed on the New Siberian Islands in the Russian Arctic and that they stage along the coasts of southeastern Asia, especially in the northern Yellow Sea in China. Red Knots arrived on the tundra breeding grounds from 8 June onwards. Southward departures mainly occurred in the last week of July and the first week of August. We documented six non-stop flights of over *c*. 5000 km (with a maximum of 6500 km, lasting 6.6 days). Nevertheless, rather than staging at a single location for multiple weeks halfway during migration, *piersmai*-knots made several stops of up to a week. This was especially evident during northward migration, when birds often stopped along the way in southeast Asia and 'hugged' the coast of China, thus flying an additional 1000–1500 km compared with the shortest possible (great circle route) flights between NW Australia and the Yellow Sea. The birds staged longest in areas in northern China, along the shores of Bohai

Bay and upper Liaodong Bay, where the bivalve *Potamocorbula laevis*, known as a particularly suitable food for Red Knots, was present. The use of multiple food-rich stopping sites during northward migration by *piersmai* is atypical among subspecies of Red Knots. Although *piersmai* apparently has the benefit of multiple suitable stopping areas along the flyway, it is a subspecies in decline and their mortality away from the NW Australian non-breeding grounds has been elevated.

Pohlen, Z. M., L. H. DeCicco, J. B. Buchanan, P. S. Tomkovich and J. A. Johnson (2021). Sex determination of Red Knots *Calidris canutus roselaari* using morphometrics. *Wader Study* 128(2), 183–188. https://doi.org/10.18194/ws.00241.

Researchers often lack tools to classify sex for monomorphic and weakly dimorphic species in the field, an important component of many avian ecology and demography studies. The Red Knot Calidris canutus roselaari exhibits minor differences in size and plumage patterns between sexes, although overlap is considerable and sex is not readily apparent in the field. We captured, measured, and molecularly sexed 198 individuals (68.7% males, n = 136; 31.3% females, n = 62) at two breeding sites and one migratory stopover site and found significant differences between sexes, with females having a longer total head, culmen, and wing than males. We used a jackknifed cross-validated discriminant function analysis (DFA) to correctly identify sex of 85.9% (95% CI 80.2–90.3%) of all roselaari knots (94.8% of males and 66.1% of females). When restricting the probability of group membership to >0.7, we increased our classification accuracy to 92.3% for females (n = 26) and 90.3% for males (n = 121) while leaving 25.7% unclassified (n = 51). We conclude that DFA provides a means for sexing roselaari Red Knots when molecular sex determination is not feasible, and we provide a formula for researchers to use in the field.

Ruthrauff, D. R., C. M. Harwood, T. L. Tibbitts, N. Warnock and R. E. Gill, Jr. (2021). Diverse patterns of migratory timing, site use, and site fidelity by Alaska-breeding Whimbrels. *Journal of Field Ornithology*, 92(2), 156–172. https://doi.org/10.1111/jofo.12365.

Birds that conduct long-distance migrations exhibit varied patterns of consistency in migratory timing and site use. Understanding variation in these traits among populations can help uncover mechanisms driving migratory behaviors and identify potential population threats. Whimbrels (*Numenius phaeopus*) are long-distance migratory shorebirds with a Holarctic breeding distribution, and recent studies have documented population-specific migrations that vary in duration (short to long) and frequency of stops (none/few to multiple). Factors driving these population-specific differences are unclear. We studied the migration ecology of Whimbrels breeding in Alaska, USA, using satellite transmitters deployed from 2006 to 2010 and tracked through 2015. Whimbrels moved entirely within the Pacific Americas Flyway, and some conducted nonstop flights that exceeded seven days across ~ 8700 km. Birds dispersed across numerous sites throughout the flyway, often using agriculture or aquaculture habitats. Whimbrels generally exhibited fidelity to breeding and non-breeding sites, but typically only exhibited fidelity to staging sites used prior to long, nonstop migratory flights. The duration of migration for Whimbrels at more southern non-breeding locations was longer than for those at more northern non-breeding sites, and birds at more southern sites also terminated southbound migration later and initiated northbound migration earlier than birds at more northern sites. Alaska-breeding Whimbrels exhibited greater variation in migratory behaviors than those in other populations in the species' range. We attribute this within-population diversity to the extensive breadth of non-breeding distributions (~ 70° latitude across ~ 8600 km), a range that naturally shaped individual responses to unequal migratory demands.

Ruthrauff, D. R., T. L. Tibbitts and J. M. Pearce (2020). Shorebird Research at the U.S. Geological Survey Alaska Science Center. U.S. Geological Survey Factsheet 2020-3056, https://doi.org/10.3133/fs20203056.

Shorebirds—which include sandpipers, plovers, and oystercatchers—are perhaps best known by their presence on sandy beaches, running along the water's edge while they probe for food. But they are probably less recognized for their impressive long-distance migrations. Millions of individuals travel from across the globe to breed throughout Alaska each spring, making these birds a familiar and important part of local wildlife communities and Alaska Native cultures. Unfortunately, many shorebird populations have steeply declined worldwide. Because shorebirds use the same coastal habitats as humans, anthropogenic development can lead to habitat loss that degrades the extent and quality of coastal sites important to these species. However, Alaska has an abundance of intact coastal ecosystems that provide important breeding and migratory stopover sites for shorebirds, making the State one of the world's most critical sites for shorebirds. The focus of shorebird research at the U.S. Geological Survey Alaska Science Center is to help identify important breeding and migratory sites, and to investigate the causes of the declines in many shorebird populations.

Saalfeld, S.T., B.L. Hill, C.M. Hunter, C.J. Frost, and R.B. Lanctot. 2021. Warming Arctic summers unlikely to increase productivity of shorebirds through renesting. *Nature Scientific Reports* 11, 15277. https://doi.org/10.1038/s41598-021-94788-z.

Climate change in the Arctic is leading to earlier summers, creating a phenological mismatch between the hatching of insectivorous birds and the availability of their invertebrate prey. While phenological mismatch would presumably lower the survival of chicks, climate change is also leading to longer, warmer summers that may increase the annual productivity of birds by allowing adults to lay nests over a longer period of time, replace more nests that fail, and provide physiological relief to chicks (i.e., warmer temperatures that reduce thermoregulatory costs). However, there is little information on how these competing ecological processes will ultimately impact the demography of bird populations. In 2008 and 2009, we investigated the survival of chicks from initial and experimentally-induced replacement nests of *arcticola* Dunlin (*Calidris alpina*) breeding near Utqiaġvik, Alaska. We monitored survival of 66 broods from 41 initial and 25 replacement nests. Based on the average hatch date of each group, chick survival (up to age 15 days) from replacement nests ($\hat{S}_i = 0.10$; 95% CI = 0.02–0.22) was substantially lower than initial nests ($\hat{S}_i = 0.67$; 95% CI = 0.48–0.81). Daily survival rates were greater for older chicks, chicks from earlier-laid clutches, and during periods of greater invertebrate availability. As temperature was less important to daily survival rates of shorebird chicks than invertebrate availability, our results indicate that any physiological relief experienced by chicks will likely be overshadowed by the need for adequate food. Furthermore, the processes creating a phenological mismatch between hatching of shorebird young and invertebrate emergence ensures that warmer, longer breeding seasons will not translate into abundant food throughout the longer summers. Thus, despite having a greater opportunity to nest later (and potentially replace nests), young from these late-hatching broods will likely not have sufficient food to survive. Collectively, these results indicate that warmer, longer summers in the Arctic are unlikely to increase annual recruitment rates, and thus unable to compensate for low adult survival, which is typically limited by factors away from the Arctic-breeding grounds.

Saalfeld, S.T., L. Phillips, S.C. Brown, J. Slaght, E.E. Syroechkovskyi, E.G. Lappo, M. Hake, and R.B. Lanctot. 2020. In search of the Spoon-billed Sandpiper *Calidris pygmaea* and other avian taxa in northwestern Alaska. *Wader Study* 127:219-227. https://doi.org/10.18194/ws.00208.

Recent declines of the Critically Endangered Spoon-billed Sandpiper Calidris pygmaea make documenting the location of all breeding populations essential for recovery efforts. The species is thought to breed only in Russia, but recent habitat modeling and anecdotal observations suggest there may be small populations breeding in Alaska. In 2018, we searched for breeding Spoon-billed Sandpipers in northwestern Alaska by surveying habitats similar to those they occupy in Russia. We also documented the presence of other avian species within this poorly studied region. We conducted 175 point counts at 25 sampling areas within 6 km of the coast and 150 km of Kotzebue, Alaska. While we did not observe any Spoon-billed Sandpipers, we counted 1,450 shorebirds of 20 species and 3,344 non-shorebirds of 57 species; these included 29 species of waterfowl, 9 species of gulls, terns, and jaegers, 4 species of raptors, and 15 species of landbirds. Breeding shorebirds were most prevalent near Sisualik Spit north of Kotzebue, the Baldwin Peninsula, and coastal areas within Cape Krusenstern National Monument. This baseline distribution and abundance information will be helpful when planning/mitigating future developments and assessing the potential impacts of climate change in this region. However, additional surveys are needed to confirm Spoon-billed Sandpipers do not breed here, refine breeding bird distributions, and estimate densities and local population sizes.

Schibley, Lisa. Site Highlight: Kachemak Bay, Alaska. International Shorebird Survey Newsletter, Sept. 2021. https://www.manomet.org/wp-content/uploads/2021/09/ISSnewsSept2021_ENG1.pdf.

Shaftel, R., D.J. Rinella, E. Kwon, S.C. Brown, H.R. Gates, S. Kendall, D.B. Lank, J.R. Liebezeit, D.C. Payer, J. Rausch, S.T. Saalfeld, B.K. Sandercock, P.A. Smith, D.H. Ward, and R.B. Lanctot. 2021. Predictors of invertebrate biomass and rate of advancement of invertebrate phenology across eight sites in the North American Arctic *Polar Biology*. https://doi.org/10.1007/s00300-020-02781-5.

Average annual temperatures in the Arctic increased by 2–3 °C during the second half of the twentieth century. Because shorebirds initiate northward migration to Arctic nesting sites based on cues at distant wintering grounds, climate-driven changes in the phenology of Arctic invertebrates may lead to a mismatch between the nutritional demands of shorebirds and the invertebrate prey essential for egg formation and subsequent chick survival. To explore the environmental drivers affecting invertebrate availability, we modeled the biomass of invertebrates captured in modified Malaise-pitfall traps over three summers at eight Arctic Shorebird Demographics Network sites as a function of accumulated degree-days and other weather variables. To assess climate-driven changes in invertebrate phenology, we used data from the nearest long-term weather stations to hindcast invertebrate availability over 63 summers, 1950–2012. Our results confirmed the importance of both accumulated and daily temperatures as predictors of invertebrate availability while also showing that wind speed negatively affected invertebrate availability at the majority of sites. Additionally, our results suggest that seasonal prey availability for Arctic shorebirds is occurring earlier and that the potential for trophic mismatch is greatest at the northernmost sites, where hindcast invertebrate phenology advanced by approximately 1–2.5 days per decade. Phenological mismatch could have long-term population-level effects on shorebird species that are unable to adjust their breeding schedules to the increasingly earlier invertebrate phenologies.
