2010 – 2014 progress report: Using a Network of Sites to Evaluate How Climate-mediated Changes in the Arctic Ecosystem are Affecting Shorebird Distribution, Ecology and Demography

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Abstract

To obtain a better understanding of how shorebirds will respond to climate-mediated changes in the Arctic's morphology and ecology, we have established a network of sites, known as the Arctic Shorebird Demographics Network (ASDN), wherein we collected information on a suite of predictor variables thought to be responsive to climate change, with a future goal of correlating these variables with measures of shorebird distribution, ecology, and demography. Starting in 2010, we established nine field sites across the Arctic, from Nome, Alaska to Hudson Bay, Nunavut. The number of sites was expanded from 9 to 11 sites in 2011, 11 to 14 in 2012, and 14 to 16 in 2013. This includes work being conducted by 32 principal investigators and 8 graduate students (4 PhD, 4 M.Sc.) from 15 institutions. Protocols were adopted/modified from prior studies in the Arctic to create a standardized protocol that has been updated prior to each field season. We have compiled all of the data from the various sites during the first five years of the ASDN operation, and results from all four field seasons are presented here.

A total of 9,204 nests belonging to 39 species were located in the five years of the study. The largest number of nests belonged to the five ASDN focal species: Dunlin, Semipalmated Sandpipers, Red and Red-necked Phalaropes, and Pectoral Sandpipers. Unexpectedly high number of Western Sandpiper and American Golden-Plovers were also discovered. Nest initiation dates varied tremendously across sites for the focal shorebird species investigated during this study. Apparent nest success was 55% across all sites and species; rates varied between years within sites, and also between sites within years. An investigation into what environmental variables best explain the variation in nest success is underway. A total of 5,482 adults belonging to 27 species were banded in the five years of the study. The number of adults banded per species ranged from 1 to 1,618 during the study (mean ± SD = 203.0 ± 366.1). ASDN focal species were again captured the most frequently, but like nests, high numbers of Western Sandpipers and American Golden-Plovers were also captured. A total of 5,700 chicks belonging to 27 species were banded in the five years of the study. The number of chicks banded per species ranged from 3 to 1,209 during the study (mean ± SD = 211.1 ± 369.7). The highest returns of color-marked adults were observed in American Golden-Plover, Dunlin, Hudsonian Godwit, Red-necked Phalarope, Ruddy Turnstone, Semipalmated Sandpiper, Western Sandpiper, and Whimbrel, which should allow adult survival estimates to be made (detailed analysis beginning now). Besides the shorebird data, field personnel kept daily species lists throughout all five years of the study, and established sampling stations to document aquatic and terrestrial invertebrate diversity, phenology, and abundance (primarily during first three years of the study). In addition, data were collected on predators, small mammals and other alternative prey for predators of shorebirds, snow and surface water, and general climatic variables. These data show tremendous variation across sites and within sites that are currently being explored to help understand variation in shorebird densities.

ASDN principal investigators are collaborating on 22 projects that use the geographically vast and taxonomically rich ASDN data. This includes work being conducted by 33 principal investigators and 10 graduate students (8 PhD, 1 M.Sc. and Honors B.S.) from 21 institutions. ASDN studies include investigations of the potential for an ecological mismatch between invertebrate emergence and shorebird hatching, variation in shorebird nest predation across the Arctic, and factors affecting shorebird settlement patterns. Avian health issues being investigated include avian influenza, avian malaria, gut microbiota, and mercury exposure. Migratory connectivity studies include projects using light-level geolocators to document migratory pathways and wintering areas of American Golden-Plover, Dunlin, and Semipalmated

Sandpipers. An additional study is using stable isotope signatures to document connections between breeding, migration and wintering areas of Semipalmated Sandpipers. Other studies are focusing on the effects of spring phenology on timing of breeding in shorebirds, invertebrate phenology in relation to habitat and weather, long-distance dispersion of moss by shorebirds, the distribution of Arctic invertebrates, trends in shorebird population trends, and genetic diversity of shorebirds in relation to population size and other factors.

The ASDN principal investigators have been highly successful at producing products from the data collected at their field sites. Although the major analyses and publications that will address core objectives of the ASDN have not been completed, investigators have collectively produced 26 peer-reviewed publications, 2 Master's thesis, 2 popular articles, 29 reports, and 70 presentations. We anticipate that many more publications will be produced in the coming years.

Although this report summarizes information collected during all five years of the planned study, we are preparing a final report that will include more information on adult and nest survival, and update on the progress of the many side projects, which will be available on 28 September 2015.

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Other principal investigators and graduate students running field camps within the Arctic Shorebird Demographic Network are listed in Appendix 2. The data and accomplishments for this report are a product of all of these people.

No information contained within this report should be used without written consent by the report's authors and the principal investigators responsible for the data.

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Background

The Arctic has experienced the most pronounced warming of the entire world (ACIA 2004). Within the circumpolar Arctic, terrestrial areas in northern Alaska, western Canada, and central Russia have experienced the most rapid warming (Martin et al. 2009). For example, the Arctic Coastal Plain of Alaska is projected to have a 1.6° Celsius increase in temperature and a 12% increase in precipitation by 2051 to 2060. Further, the overall length of the frost-free season is expected to increase by 18 days by mid-century, with most of this occurring in the fall (Martin et al. 2009). The higher summer temperatures and longer summer season may increase the amount of water lost to evapotranspiration, resulting in a drier landscape, although enhanced cloud cover, which reduces evapotranspiration, and possible increases in precipitation may counteract this drying trend to some degree. The warmer air temperatures are predicted to accelerate ice wedge degradation and accompanying thermokarst pond development, a pattern already observed that has led to an increase in the proportion of land covered with surface water (Shur et al. 2003).

These climate-mediated habitat changes are likely to have a profound effect on the animals using the Arctic regions of Alaska and Canada, particularly for the millions of shorebirds that breed and raise their young between June and September (Johnson and Herter 1989). Predicting how long-term changes will affect shorebirds, however, is difficult, and it seems likely that there will be both positive and negative effects on any given species. Beyond direct effects on habitat conditions, earlier snowmelt may decouple the apparent synchrony between shorebird breeding chronology and food availability (MacLean 1980). The timing and availability of surface-active insects is critical to shorebirds for egg production (Klaassen et al. 2001), chick growth (Schekkerman et al. 2003), and pre-migratory fattening before southward departure (Connors et al. 1979, 1981; Connors 1984; Andres 1994). Decoupling of phenological events could negatively affect shorebird productivity and survival. In contrast, warmer summers and delayed freeze-up may improve shorebird reproductive success through prolonged availability of invertebrates, since cold weather conditions have been shown to slow chick growth and reduce chick survival (Soloviev et al. 2006). Climate warming may also affect shorebirds indirectly by altering the availability of alternate prey (i.e., Brown Lemming [*Lemmus sibiricus*] and Collared Lemming [*Dicrostonyx groenlandicus*] to shorebird predators [Ims and Fuglei 2005, Kausrud et al. 2008]).

Beyond anticipated climate changes and their impacts on shorebirds, humans are causing more direct impacts on the landscape and the bird communities. New and expanding Native villages, along with a recently legalized spring and summer subsistence harvest of shorebirds in Alaska (Alaska Migratory Bird Co-Management Council 2003), may negatively affect shorebirds through habitat alteration and direct mortality. Mineral, oil, and natural gas production in the Arctic has expanded in recent years (Gilders and Cronin 2000, National Research Council 2003), and areas previously closed to oil and gas exploration and development have been leased within Alaska (U.S. Bureau of Land Management 2006). Potential effects of oil and gas development on wildlife include the loss of habitat through the building of roads, pads, pipelines, dumps, gravel pits, and other infrastructure. Roads and pads also increase levels of dust, alter hydrology, thaw permafrost, and increase roadside snow accumulation (Auerbach et al. 1997; National Research Council 2003). Anthropogenic impacts may decrease habitat quantity and quality for nesting shorebirds (Meehan 1986; Troy Ecological Research Associates 1993a; Auerbach et al. 1997). Furthermore, oil field infrastructure may enhance predator numbers by providing denning and nesting habitat and supplemental food (through human

garbage) during winter months. An increase in predators may result in lower adult shorebird and nest survival (Eberhardt et al. 1983; Day 1998; National Research Council 2003, but see Liebezeit et al. 2009). Lower adult survival and nesting success may create population sinks in the vicinity of human developments (National Research Council 2003), especially for species with high site fidelity. Therefore, expanding oil development could have cumulative negative effects on breeding shorebirds using the Arctic region of Alaska and Canada.

Goals and Objectives

To obtain a better understanding of how shorebirds will respond to climate-mediated changes in the structure and function of the arctic ecosystem, we established a network of sites in 2010 known as the Arctic Shorebird Demographics Network (ASDN). Biologists at these sites collected information on a suite of predictor variables thought to be responsive to climate change, as well as information on shorebird ecology and demography. Special emphasis was placed on obtaining data on the abundance and distribution of surface water, which affects the distribution and abundance of invertebrates and indirectly the distribution of some shorebird species (e.g., Red and Red-necked Phalaropes). We also collected data to investigate how summer temperatures and growing season length affect insect emergence and abundance, and how the timing of invertebrate emergence relates to adult shorebird breeding phenology, body condition, and survival.

These data were collected within a larger framework of objectives that the ASDN has developed to ascertain why many arctic-breeding shorebird populations are declining.

Objectives included:

1) Collecting demographic data (nest survival, adult survival, mate and site fidelity, age at first breeding) on a select group of Arctic-breeding shorebirds that will allow us to assess potential factors limiting population growth.

2) Documenting contemporary patterns of species presence and abundance (i.e. breeding densities) of shorebirds, and when possible assessing how species assemblages and abundance have changed historically.

3) Documenting seasonal patterns of nest initiation, habitat use, and presence of species.

4) Collecting environmental information, including avian and mammalian predators of shorebirds, alternative prey availability, and weather.

5) Correlating data from objectives 1) through 4) to assess impacts of climate change on shorebird breeding ecology.

6) Participate in projects that take advantage of the ASDN's large geographic footprint, multi-year study, and diversity of shorebird species, to investigate shorebird health, migratory connectivity, and ecotoxicology.

Methods

The methods used in this study rely on the knowledge gained by partners through decades of collective work at shorebird breeding areas in Alaska and Canada. Protocols have been adopted/modified from prior projects such as the Tundra Predator study (Liebezeit et al. 2009), the Arctic Wildlife Observatories Linking Vulnerable Ecosystems (WOLVES) project (http://www.cen.ulaval.ca/arcticwolves/en_project_descrip_CAN_method.htm), and the US Fish and Wildlife Service study protocols from the Barrow Shorebird Breeding Ecology Study (Liebezeit et al. 2007, Naves et al. 2008, Saalfeld and Lanctot 2015) and the Arctic National Wildlife Refuge. Version 5 of this protocol was completed in March 2014, and can be found at https://www.manomet.org/ASDN

Results and Discussion

Network Sites Establishment

Nine ASDN sites were established in 2010, ranging from Nome in the western part of Alaska to East Bay in northeastern Canada (Figure 1). See Appendix 1 and 2 for list of sites, their locations and the entities responsible for implementing field methods. Two new sites, Bylot Island and the Colville River, joined in 2011, and one site, Prudhoe Bay, was down scaled so as to not include marking birds and nest searching in 2011. The ASDN network continued to grow in 2012, with two new sites added in Russia (Chaun River Delta and Lower Khatanga River) and one site added in Canada (Burntpoint Creek). In 2013, the ASDN network expanded again, with the Igloolik and Coats Island sites located in Nunavut, Canada added. All 16 sites were maintained in 2014.

Database Development and Population

Excel files have been established for the data described below. Most data have GPS locations that will allow georeferencing. A list of all data collected at each ASDN site between 2010 and 2014 is presented in Table 1. Most of these data, as well as similar information collected before the ASDN became operational, are now archived in the ACADIS Gateway: An Arctic Data Repository (see https://www.aoncadis.org/dataset/ASDN.html).

- Field camp Metadata: field personnel, plot and sampling locations
- Adult and chick banding records
- Band resighting records
- Nest records
- Snow and surface cover
- Pond water level monitoring
- Lemmings: winter nest counts, incidental observations, intensive trapping
- Predator point counts and area surveys
- Food resources: terrestrial and aquatic invertebrates
- Weather: automated hourly measurements: manual rainfall and snow
- Daily species list
- Daily camp journal

Shorebird Data

Prior to the start of the field season, principal investigators agreed to focus their studies on key species of arctic-breeding shorebirds ('focal species' hereafter) that 1) exhibited high site fidelity and were therefore good candidates for estimating annual survival; 2) were present at two or more ASDN field sites, thereby providing comparative data under different environmental conditions; 3) were sufficiently common to allow reliable estimates of nest success; and 4) were likely to be influenced by climate change, based on a range of reasonable scenarios. Based on these four criteria, we chose our five focal species to be Dunlin, Semipalmated Sandpiper, Pectoral Sandpiper, Red Phalarope, and Red-necked Phalarope. Additional species were monitored at various ASDN camps where they were common or because they were the subject of other studies. A full list of species, with genus and species names, is provided in Appendix 3.

Number and Diversity of Shorebird Nests

A total of 9,204 nests belonging to 39 species were located during the five year study (Table 2). The number of nests located in each year of the study has grown from 1117 in 2010 to 2,351 in 2014. This increase is partially explained by the higher number of sites operating within the ASDN network, but also reflects an increase in the number of nests found at each site generally. Number of nests per species ranged from 1 to 2,033, with the largest number of nests belonging to the ASDN focal species (i.e., Dunlin, Semipalmated Sandpipers, Red and Red-necked Phalaropes, and Pectoral Sandpipers). Relatively high numbers of nests were also found for American Golden-Plover and Western Sandpiper. Only a single nest was found for the Purple Sandpiper and Wood Sandpiper. There was a large amount of variation in the number of nests found, particularly for Pectoral Sandpiper, Semipalmated Sandpiper, and Red Phalarope (Figure 2). The number of nests found per ASDN site ranged from 41 to 220 in 2010, from 63 to 407 in 2011, from 36 to 396 in 2012, from 42 to 358 in 2013, and from 45 to 431 in 2014 (Table 2). *Sarah Saalfeld and Richard Lanctot have proposed to investigate environmental and social factors that may explain the annual variation in settlement patterns (i.e., species distribution and nest density) of shorebird species found at the ASDN sites across the Arctic.*

Nest Initiation Dates

Nest initiation also varied tremendously across sites for the six focal shorebird species investigated during this study, with nests initiated earlier in field camps lower in latitude (Figure 3). Timing of egg-laying appeared to vary less within sites across years than among sites although no formal analysis has been conducted to date. A number of investigators are exploring initiation date variation in greater detail as part of either core or side project investigations. *Eunbi Kwon and Brett Sandercock are investigating how nest initiation (and consequently egg hatching) relates to timing of insect emergence. Kirsty Gurney and David Ward are investigating how nest initiation relates to satellite-derived measures of NDVI (i.e., tundra green-up) and soil temperature.*

Nest Success and Survival

Most nests were monitored every 3-5 days for survival. The average apparent nest success rate (no. of nests with at least one young hatching) for all sites and years was 55%, but this rate varied among years and sites tremendously (Table 3, Figure 4). Combining all sites across years, the lowest nest success rate was recorded in 2013 (49%) and the highest in 2011 (70%). The overall lowest apparent nest success rate was recorded at the Canning River in 2012 (14%) and the highest

was at Chaun River Delta (93%). The Barrow site was likely artificially high due to a fox removal program occurring at this site (R. Lanctot and S. Saalfeld, in prep.). In the future, we plan to use the nest survival model in Program Mark to estimate nest daily survival rates (DSR) while accounting for the effects of environmental and ecological covariates. *Paul Smith and Joe Liebezeit are analyzing how shorebird nest DSR varies across a large geographic area, and how environmental covariates such as predators, lemmings, weather and invertebrates affect survival rates. Emily Weiser and Brett Sandercock will explore nest success in more detail as part of life cycle analyses.*

Adult and Chicks Captured

A total of 5,482 adults belonging to 27 species were banded between 2010 and 2014 across all field sites (Table 4). The number of newly banded adults increased from 1,113 in 2010 to a peak of 1,277 in 2011. The number banded decreased in subsequent years due to increasingly higher numbers of already banded birds returning. The total number of species banded each year went from 16 in 2010 to a maximum of 25 in 2013; new sites in Russia added several species not available for banding in early years. Number of adults banded per species ranged from 1 to 1,618, with the largest number of adults banded belonging to the ASDN focal species (i.e., Dunlin, Semipalmated Sandpipers, Red and Red-necked phalaropes, and Pectoral Sandpipers). American Golden-Plover and Western Sandpipers were also banded in good numbers. *From most of these individuals, additional data were collected including biometric measurements, molt scores, body condition, and a variety of samples (e.g., blood, feathers, feces) for use in side projects (see below).* Blood and feather samples have been archived either at the U.S. Fish and Wildlife Service Office in Anchorage or with the site investigators.

A total of 5,700 chicks belonging to 27 species were banded between 2010 and 2014 across nine sites (Table 5). Over half of the chicks were banded at Barrow (3,646), with the next highest numbers at Nome, Churchill, Mackenzie Delta and Cape Krusenstern. The single highest number of chicks banded within a year was in 2012 when 1,982 chicks were banded.

Adult Return Rate

The percentage of color-marked adults that return from year to year is difficult to show either in a table or figure since individuals may be resighted one to four years after being marked and new individuals are being banded each year as well. As a simple presentation, we show in Table 6 the percentage of color-marked adults that were resighted at each ASDN site in any year following their banding year. The highest returns were observed in Hudsonian Godwit, Whimbrel, Dunlin, Semipalmated Sandpiper, Red-necked Phalarope, and Western Sandpiper. The percentage returning varied substantially among sites within each species, especially American Golden-Plover, Red-necked Phalarope and Western Sandpiper. Our preliminary data suggest that sufficient numbers of birds returned for American Golden-Plover, Dunlin, Semipalmated Sandpiper, Red Phalarope, Red-necked Phalarope and Western Sandpipers for each of these species to obtain reliable adult survival estimates. Much lower return rates were observed in Long-billed Dowitcher and Pectoral Sandpiper, making adult survival estimates impossible to calculate. Other species, such as Ruddy Turnstone and Whimbrel had sizeable numbers of birds banded at one or two sites; adult survival estimates may be possible for some of these but will be based on a much smaller geographic scale. For many species listed in Table 6, adult return rates are not meaningful because the number of birds marked was too small at any given site. In these situations, it might be necessary to pool data from multiple sites on a given species. A post-doctoral research associate, Emily Weiser, was recently hired to analyze adult survival rates among shorebirds at the ASDN sites. She will work with Brett Sandercock to conduct these demographic analyses.

Daily Species List

All ASDN sites recorded a daily species list between 2010 and 2014; in most cases this list included not only presence and absence of birds and mammals but also a rough count of the number of animals as well as a measure of effort made to detect these animals (e.g., number of people involved in the count). These data provide a good measure of relative abundance, especially for species that fluctuate dramatically in number from year-to-year. Good examples of such "irruptive" species include Snowy Owls (*Bubo scandiacus),* Pomarine Jaegers (*Stercorarius pomarinus*) and lemmings, which can vary tremendously in population numbers among years. Many of the ASDN sites have also contributed their bird observation data to eBird, which is a real-time, online checklist program that collects bird observations made by recreational and professional bird watchers (http://ebird.org/content/ebird/about), as well as the Arctic Breeding Birds Conditions Survey (http://www.arcticbirds.ru/).

Food Resources

ASDN sites established sampling stations to document aquatic and terrestrial invertebrate diversity, phenology, and abundance. Each ASDN site established five replicate samples in the following three habitats: aquatic, mesic terrestrial, and dry terrestrial. Data collection dates and sample acquisition for 2010 – 2013 are listed in Table 7. Few sites collected invertebrate data in 2013 and 2014 due to no money being able to process samples. To date, all of the 2010-2012 terrestrial and aquatic samples have been processed. This work is being done by Bob Wisseman of Aquatic Biology Associates, Inc. Three sites have opted to process their own invertebrate data, including Bylot Island, Nome, and Churchill.

An example of the invertebrate information obtained from this sorting process is presented in Figure 5 for the Barrow site. Because these data are so voluminous, we do not report them here. Food resource data are being used in several core and side-project investigations that include many of the ASDN sites. *Dan Rinella is using this information along with pond hydrology and weather data to predict dates of invertebrate emergence (see below). Eunbi Kwon and Brett Sandercock are exploring how patterns of invertebrate emergence relate to nest hatching (i.e., the mismatch hypothesis; e.g. see Figure 6). Other researchers are using invertebrate data as covariates to explain density of shorebird nests and nest success. Finally, the invertebrate biologist community has taken an interest in the invertebrate species themselves (see side project descriptions below).*

Predator and Alternative Prey Surveys

Avian and mammalian predators were surveyed by conducting point counts weekly throughout the summer at each ASDN site in 2010 (Table 8). During the fall of 2010, ASDN collaborators requested a protocol change to address the low encounter rates for predators at some arctic sites. Accordingly, an index approach was developed to cover a wider geographic area within each study area and allow predator abundances to be recorded throughout the day. Some ASDN sites continued point count surveys in 2011 to ensure long-term continuity in data collection. As part of this change, observers were also instructed to count Brown and Collared lemmings during these surveys (revised in version 2 and subsequent protocols). Lemmings and other small mammals are also inventoried by conducting daily opportunistic counts and a single nest count transect shortly after snow melt. With the data restricted to the last four years of the study when common methods were used, it is clear that like the other environmental co-variates, there was substantial variation in predator and rodent numbers across time (Figure 7).

Snow and Surface Water

Snow cover was measured at the beginning of each field season to estimate the date of 50% snow melt and to obtain information on the rates of snow melt for comparison among years and among sites. Surface water was measured less intensively, with the goal to obtain general rates of water loss from the tundra through time. The approach to measure snow and surface water changed between 2010 and 2011 (Table 9). In 2010, personnel collected visual measures of snow cover at a minimum of 10 fixed locations (e.g., at 50 m square quadrats) every other day until 90% of the snow had melted. Surface water, in contrast, was measured independently of snow by locating three unique sites within each of four habitat types: the troughs of high-centered polygons, the centers of low-centered polygons, small ponds or waterbodies, and non-polygonized areas. At each of these locations, water depth was recorded once a week throughout the field season. Not all sites had each of these habitat types and not all sites recorded these data. In 2011 and thereafter, snow and surface water measurements were combined. To do this, we expanded the measurements done at the snow sites in 2010 to include all surface cover features (e.g., snow, water, and land). To accomplish both snow and surface water objectives, surface cover was recorded every other day during the beginning of the season when the snow melts quickly, and then weekly to the end of the field season to gauge changes in surface water. No water depths were recorded during the 2011 to 2014 period, but rather the percentage of each quadrat that had water was recorded. *Snow melt dates are being used as covariates in nest initiation and nest survival core studies within the ASDN.*

Climatic conditions

Climate data were collected at a federally maintained weather facility in a nearby community (fixed) or with remote weather stations (remote) at all ASDN sites (Figure 8, Table 10). Data were collected for air temperature, relative humidity, as well as wind speed and direction at most sites. In addition, field crews measured precipitation (snow, rain) manually using rain/snow gauges. Similar data from the fixed weather stations have been downloaded from internet sites. Figure 9 shows the variation in the average June temperatures across all sites and years.

Shorebird Ecological and Environmental Variables

Preliminary analysis correlating the predictor variables thought to be responsive to climate change and measures of shorebird distribution, ecology, and demography are on-going because data are still being collected. We have italicized areas above where ASDN core or side-projects are on-going.

Projects Using ASDN Data

The Network has taken an active role in encouraging projects related to the ecology and conservation of shorebirds that can take advantage of the taxonomic diversity and geographic dispersion of our ASDN sites. Below we provide the project title and a brief description of each project. See Appendix 4 for a list of principal investigators, their institutions and graduate students that are participating in the 22 side projects listed below. Brief project proposals are available for all of these studies.

1) Avian Influenza – To evaluate the presence of H5N1 highly pathogenic avian influenza in shorebirds, four sites in Arctic Alaska collected cloacal swabs from birds in 2010. The four sample sites included Barrow, Ikpikpuk River, Prudhoe Bay and the Canning River. No positive

cases of H5N1 influenza were detected from any shorebird. An annual report describing samples obtained was submitted to the US Fish and Wildlife Service in the spring of 2011.

2) Migratory connectivity of Dunlin using geolocators –To determine the spatial relationships among important wintering, migration, and breeding areas of Dunlin, a total of 268 light level geolocators were placed on Dunlin at five of the ASDN sites (Cape Krusenstern, Barrow, Ikpikpuk, Canning River, Churchill) and two additional sites outside of the ASDN network (Cold Bay and Yukon Delta, Alaska) in June of 2010. A total of 96 and 12 of these devices were retrieved from birds in June 2011 and June 2012, respectively. Preliminary analysis of the track lines of these birds has been completed and a manuscript describing the migratory connectivity of the three North American subspecies of Dunlin is in preparation.

3) Migratory connectivity of Semipalmated Sandpiper using stable isotopes – To determine the spatial relationships among important wintering, migration, and breeding areas of Semipalmated Sandpipers, the 6th primary covert feathers were collected from birds captured at ASDN sites in 2011. Stable isotope values obtained from these feathers will be used to determine if birds breeding in eastern and western Arctic regions use different wintering areas. Preliminary results indicate that nearly two-thirds of the feather samples collected appear to be from French Guiana, despite 70% of all birds observed during aerial surveys being in Suriname. This suggests ASDN birds may be preferentially wintering in French Guiana. Feather samples obtained from two new ASDN sites (Coats Bay and Igloolik) in 2013 have yet to be analyzed. A better understanding of migratory connectivity is badly needed given the recent population declines observed in eastern Canada. Reports to funding agencies are due September 2013 and a manuscript will be ready for submission shortly thereafter.

4) Avian malaria of shorebirds – To further understand the role of Arctic-breeding shorebirds in the global transmission cycle of avian malaria, this study's objectives were to 1) estimate avian malaria pathogen prevalence of Arctic-breeding shorebirds, 2) identify haematozoa lineages (strains) to describe the pathogen community in shorebirds, and 3) determine the biogeography of haematozoa to identify hotspots along migratory routes and infer cross-species transmission events across the globe. Analysis of the 2011 samples has been completed; avian malaria prevalence in Arctic-breeding shorebirds was 2.39% (n=10). Two unique *Plasmodium* strains were recovered in Pectoral sandpipers and Semipalmated sandpipers, one *Haemoproteus* strain was recovered from Semipalmated sandpipers and Western Sandpipers. The biogeographic analysis indicated that one *Plasmodium* strain had a narrow geographic range occurring in only 4 countries within two geographic regions (Asia, North America) and an equally narrow host range occurring in only 9 host species, while the other strain had a nearly panglobal distribution occurring across 31 countries within five geographic regions (Africa, Asia, Europe, North America, Oceania). This *Plasmodium* strain had a broad host range, occurring in 106 host species that belong to 5 orders. The *Haemoproteus* strain had a global distribution (occurring in 25 countries) and broad host range of 56 species that belong to 9 orders. Molecular analysis of samples from 2012/2013 is to be completed by the end of the year, and additional samples are planned for collection in 2014.

5) Gut microbiota of shorebirds – To better understand the relationship between health of migratory birds and their gut microbial communities, this study sought to determine if the diversity and prevalence of microbiota in Arctic-breeding shorebirds varies with migration route, habitats

used, and general wintering region of the world. Between 2011 and 2013, 1435 fecal samples of 11 shorebird species were collected at 11 ASDN sites to investigate shorebird gut microbiota in relation to life-history characteristics. Of these fecal samples, 534 samples from 2011 have been sequenced using the Illumina MiSeq next-generation sequencing platform. In addition, gut microbiota of 30 Dunlin and 20 Semipalmated Sandpiper embryos were collected in Barrow, AK, to investigate maternal transfer of microbes during egg formation. Sequences generated from 2011 are currently being classified to bacterial species level, and embryonic samples will be sequenced in the coming months. Sample collection is expected to be concluded in summer 2014, and sequence analyses and publication of results is expected to be concluded in spring 2017.

6) Mercury exposure in shorebirds – To evaluate the risk of mercury exposure across a diversity of shorebird species over a large geographic range, a project was funded in 2011 to sample and test shorebirds for exposure in 2012 and 2013. Shorebirds are predicted to be exposed to mercury through the local food web in concentrations that may impair health and, ultimately, have adverse effects at the population level. Contaminant exposure has already been identified as one of five leading factors that may be limiting shorebird populations (Butler et al. 2004), but the degree to which mercury contamination may be contributing to reduced reproductive success and population declines has not been well studied. Samples are currently being analyzed for this study and a study report is due for later in 2014.

7) Effects of spring phenology on timing of breeding in shorebirds – To assess spatial and annual variation in arctic shorebird breeding phenology and to understand how spring phenology affects these patterns, satellite-derived information on spring thaw (i.e., soil temperature) and greening of vegetation (i.e., NDVI) was gathered for participating ASDN sites and related to nest initiation data. We have acquired ASDN nesting data from 12 arctic sites (2010 – 2012), including historical data from 7 sites (1990 – 2009), and the support of ASDN has resulted in a pan-Arctic collaboration with researchers at Zackenberg, Greenland also contributing data for multiple species (1995 – 2011). To index the onset of spring conditions on arctic breeding grounds, we have secured remote sensing data (NDVI and soil temperature) for all relevant sites and years. Analyses are anticipated to begin this summer, with manuscript preparation occurring during fall and winter of 2014.

8) Invertebrate phenology in relation to habitat features and weather – To better understand invertebrate phenology and abundance, statistical models will be developed that relate the timing and duration of (1) aquatic insect emergence and (2) terrestrial insect activity to a suite of climatic and weather predictors. Models will be used to forecast changes in the timing of invertebrate prey availability for arctic-breeding shorebirds and other consumers based on scenarios of future climate change. The investigations of phenology for this project rely on invertebrate, weather, and snow melt data collected at ASDN sites in 2010-2011, as well as project-specific data on pond habitat (e.g., bathymetry) and water temperature data collected in 2011. Over 1500 invertebrate samples were collected in each of 2010 and 2011, and pond habitat and temperature data were collected from 35 ponds in 2011. Additional data were collected in 2012. All 2010 to 2012 terrestrial invertebrate data (wet and dry tundra pitfall traps) are now together in an Access database; nearly all of the aquatic insect emergence data have also been added. All 2010 to 2012 weather data from all camps contributing invertebrate data are also in the database, including data for those sites that used airport weather instead of HOBO

weather stations (a fair bit of formatting magic was required to make these compatible). A plan for building the models has been developed and initiated for the terrestrial samples. The terrestrial analysis will be completed in the summer 2014 and a manuscript completed in the fall. Emergence data analysis will take place data after that. Funds for this study were provided independently from the Arctic LCC in 2011. The Arctic LCC grant has been extended through May, 2015.

9) Test of the Phenological Mismatch Hypothesis in Arctic-breeding Shorebirds – To test for the potential mismatch between the spring phenology of Arctic shorebirds and their prey invertebrates, seasonal changes in the invertebrate abundance and breeding timing of a total of 3,099 shorebird nests were monitored on the following 10 network sites in 2010-2012: Nome, Cape Krusenstern, Barrow, Ikpikpuk, Colville Delta, Canning River, Prudhoe Bay, Mackenzie Delta, East Bay and Churchill. Collected invertebrate samples are being processed for the last site, and complete dataset for both trophic levels has become available for 7 of the 10 sites. The dates of maximum food requirement for the shorebird chicks (5 days post-hatch) mistimed the dates of peak biomass by -63 ~ 37 days across 7 Arctic sites during 2010-2012. The degree of phenological mismatch varied significantly among years, sites and shorebird species with the year explaining the most of observed variance in the degree of mismatch and followed by site and species. The degree of phenological mismatch was also positively correlated with the latitudes of survey sites. Further analysis is due for better understanding on the geographic and inter-specific variation in the extent of the phenological mismatch and its potential causes.

10) Migratory connectivity of American Golden-Plovers – To determine the spatial relationships among important wintering, migration and breeding areas of American Golden-plovers, light-level geolocators were placed on plovers. To date, we have deployed 177 geolocators on plovers and retrieved 19 of them across the 7 sites of the study (USA: Nome, Barrow, Ikpikpuk River; Canada: Caw-Ridge, Churchill, Igloolik, Bylot Island). We plan to deploy over 80 geolocators in 2014 across the sites and retrieve as many as possible. Geolocator data will be analyzed in the fall of 2014, and collectively this information will be used to prepare a paper describing the migratory connectivity of this species.

11) Migratory connectivity of Semipalmated Sandpipers – To determine the spatial relationships among important wintering, migration, and breeding areas of Semipalmated Sandpipers, 194 light level geolocators were placed on birds at eight ASDN sites (Nome, Cape Krusenstern, Barrow, Ikpikpuk, Canning River, Mackenzie Delta, Coats Island, Igloolik) in the Arctic during the 2013 field season. An additional 30 geolocators were placed on birds at one site in Brazil in 2013. In 2014, we recovered 41 units at breeding sites, with an average return rate of 22% across all sites, and no recoveries at the wintering site. Return rates were much lower in the Eastern Arctic breeding sites suggesting that overwinter mortality might be higher and/or site fidelity lower. Results confirmed an eastern arctic connection with northeastern South America. Two birds tagged on Coats Island in Hudson Bay bypassed the traditional Bay of Fundy stopover site, but then wintered in the core wintering area in Brazil. In contrast, birds from central Alaska and western Canada used the entire wintering range, and birds west of Barrow wintered in NW South America. These patterns of migratory connectivity do not fully support the idea that habitat degradation in NE South America is driving population declines in the eastern breeding population.

12) Do migratory shorebirds disperse Moss (Bryophyta) diaspores? – To test the hypothesis that long-distance dispersal of moss is occurring by transport on migratory shorebirds, personnel collected breast feather samples from shorebirds captured throughout the ASDN network in 2013. Prior support for this hypothesis had been based simply on correlations between migratory bird flyways and species distributions. We have screened the feathers of transequatorial migrant shorebirds, and provide the empiric evidence of migrant birds harboring unspecialized bryophyte diaspores in their migratory plumage. A manuscript describing the results has been published in the journal of *PeerJ*. This project has provided formative research opportunities to three undergraduate students, two of which have been awarded competitive grants from the University of Connecticut to support their contributions to the project.

13) Variation in shorebird nest predation across the North American Arctic – To better understand geographic patterns in shorebird nest survival, variation in nest survival will be related to shorebird nest density, predator abundance, lemming abundance, and other environmental variables (such as timing of snow melt or mean June temperature). This study will use data from the first four years of the ASDN operation (2010-2013 field seasons). Nest data from most ASDN sites have been collated and analysis is beginning now, with plans for submission of a manuscript to a peer-reviewed journal by August 2015.

14) Arctic shorebird settlement patterns – Shorebirds appear to use conservative and opportunistic settlement strategies to exploit the unpredictable Arctic environment. However, no study has used long-term data from intensively marked populations of shorebirds from multiple sites to systematically assess whether these two settlement strategies exist and if species consistently follow one strategy or another through time. Furthermore, no study has evaluated the environmental and social factors influencing how individual birds settle. This study will use data collected at ASDN sites over the five year study period to investigate how shorebird nest density relates to invertebrate amount and dependability, abundance of predators and alternative prey, timing of snow melt and vegetation green-up, prior reproductive success of shorebirds in an area, and social cues.

15) Global distribution and drivers of breeding wader population declines – There is an urgent need to assess the global pattern of change in shorebirds, i.e., where are species declining and where are they stable or increasing? Knowing this information will help us understand the drivers of declines. Data on wader population counts are being collected across the globe and over an extensive period of time within the framework of several continental-scale surveys. Many of the ASDN sites are contributing data to this analysis. Specifically, this project will assess the spatial distribution of population changes in breeding wader species at the global scale, it will identify areas showing population declines across species, and explore drivers explaining spatial patterns. Data from a wide range of wader breeding sites will be collected between April and June 2015, and analysis and paper writing is projected to be completed by February 2016.

16) Distribution of Arctic invertebrates – A request was made to summarize and publish information collected from ASDN sites on the distribution and abundance of species within the Trichoptera (caddisflies), Plecoptera (stoneflies), Ephemeroptera (mayflies or shadflies), and Diptera (true flies) orders. These publications would involve researchers from a number of different universities across the United States. In addition, Joe Bowden at the University of California

San Diego has obtained the spiders collected by the ASDN and is investigating how spider diversity and abundance varies across the Arctic in relation to glaciation and other factors. Kelly Miller at the University of New Mexico has requested the ability to archive predacious diving beetles (Coleoptera, Dytiscidae) at the Museum of Southwestern Biology.

17) Using feathers to measure stress in wintering shorebirds and relating this to breeding success – A study is currently being conducted to evaluate variation in cortisol levels within winter-grown feathers of Semipalmated Sandpipers wintering in different areas.. The investigators will focus on three breeding populations that are experiencing different levels of population change, and there is additional information on winter location being gathered from these birds using geolocators and stable isotopes. The investigators will first check to see if corticosterone levels in feathers varies with winter location and then evaluate how feather corticosterone relates to nest initiation, and clutch size and volume.

18) Variation in incubation patterns of biparental shorebirds – Incubation is a major part of avian parental care. However, thorough investigations of how bi-parental incubating species share their duties within a 24h period and over the incubation period are scarce. The aim of this side project is to use geolocator-based incubation data to conduct a comparative project to reveal the between- and within-species variation in biparental incubation patterns and to test hypotheses that may explain this variation (size of the bird, latitude, presence and use of tidal habitats). ASDN leaders will provide information on Semipalmated Sandpiper, Dunlin and other species across their breeding range to improve our understanding of biparental incubation patterns. Currently data from many different investigators on many different shorebirds around the world have been collated. Analyses are on-going and a manuscript will be delivered within the coming year.

19) Effects of geolocators on return rates of Arctic-breeding shorebirds – Successful management of migratory birds requires knowledge of their movements, and light-level geolocators have served as a valuable tool for recording migratory routes. However, carrying such a device could reduce survival or change behavior, especially for long-distance migrants. In this study, the effects of geolocators on return rates will be assessed on a host of shorebirds, including American Golden-Plover, Dunlin, Semipalmated Sandpiper, and Western Sandpipers monitored at 11 ASDN sites between 2010 and 2014. Data analysis and summary for this side project is on-going, with a completion date of the fall 2015 for completing a manuscript.

20) Investigating patterns of genetic diversity and differentiation in shorebirds – Genetic diversity is the most fundamental level measure of biodiversity and crucial to species persistence. It holds high significance in both evolutionary biology and conservation science and has been found to be related to several factors including body size, population size, extinction risk, ecological disturbance, latitude and life history traits. However, research involving these relationships is inconsistent and requires further investigation. Shorebirds provide an ideal opportunity to study these relationships as their biology is well understood and they are distributed throughout the world. Within shorebirds, many studies exist which investigate the genetic population structure of single species (e.g. Piping plover, Temmnicks' Stint). However, no current publication exists which examines patterns of genetic structure across this highly widespread and diverse group of birds, indicating a significant research opportunity. We propose to address this large gap present in the current understanding of patterns of shorebird genetic diversity and differentiation by

taking both an evolutionary biology and conservation science approach. Using both DNA sequences and microsatellite genetic markers we will investigate how latitude, body mass and effective population size are related to genetic differentiation and diversity in species throughout the world. Our large across species study will be the first of its kind in shorebirds and will provide vital insights into how gene flow is affected by biogeographic variables, which is key to understanding how to ensure their protection and persistence in the future. Many ASDN project leaders are currently collating samples to contribute to this newly proposed study.

21) The effects of feather sampling on shorebirds – Feather sampling is a common approach for gathering data for stable isotope analysis, genetic analysis, or physiological analyses such as corticosterone, However, there is little information on the effects of feather sampling, both on the morphological effects on feather re-growth but also fitness effects. The objective of this project is to describe the qualitative and quantitative effects of pulling primary and secondary feathers. We hope to obtain information on the morphological effects of feather pulling (ie. effects on feather regrowth or lack thereof), as well as the potential fitness effects in terms of adult survival. In 2014, ASDN field investigators evaluated feather regrowth in adults that had feathers pulled in 2013. Data summarization and analyses are on-going.

22) Feather and blood collection for stable isotope and genetic investigations – We have collected feather and blood samples from captured individuals between 2010 and 2014 for future studies on migratory connectivity (via stable isotopes), and population genetics and phylogeography. To date, feathers have been or are planned to be used from Dunlin and Semipalmated Sandpipers, and the genetic diversity study (# 20 listed above). We anticipate future use of these tissues as funds become available and new principal investigators become interested.

Other Accomplishments

Principal investigators met in person or by teleconference to discuss data collection and protocols related to conducting field work during the Alaska Bird Conference in November 2010, the Western Hemisphere Shorebird Group meeting in August 2011, the North American Ornithological Congress in August 2012, the Vth Western Hemisphere Shorebird Group meeting in September 2013, the American Ornithologist's Union meeting in September 2014, and the Alaska Bird Conference in December 2014. We have also held regular teleconference calls outside of these meetings to discuss protocols and data collection techniques so as to ensure standardization and consistency in quality data collection. We also learned of issues faced by individual ASDN site leaders that prohibited them from conducting various field tasks during these meetings. This "face time" was critical for obtaining buy-in from all site leads and allowing us to make progress towards our goals. Based on discussions at this meeting, we established a comprehensive Memorandum of Understanding (MOU) among all of the organizational partners sponsoring a field site. The MOU was signed by all parties in March 2011. This document guides the interactions of the partners, and ensures that collaborative data analysis and publication proceed smoothly following completion of the project. We have also developed a standardized side-project MOU that discusses the roles and responsibilities of side project principal investigators and ASDN network leaders.

As of this writing, we have generated the following publications, reports, popular articles, and presentations from work associated with data collected at all or particular sites within the Arctic Shorebird Demographics Network between 2010 and now. Items are listed chronologically and by

author within each topic. We plan to hold a large symposium (ca. 10 talks) on the ASDN at the 6th Western Hemisphere Shorebird Group meeting in Wallops Island, Virginia in September 2015.

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Bêty, J. 2011. Arctic birds highly scrutinized: global change and recent discoveries. Society of Canadian Ornithologist, University of Moncton, New Brunswick, Canada

Bêty, J. 2011. Ecology and evolution of arctic migrants. Animal Migration Symposium, Royal Swedish Academy of Sciences and Wenner-Gren Foundations, Sweden.

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Brown, S., R.B. Lanctot, and B. Sandercock. 2011. The Arctic Shorebird Demographics Network: Understanding the mechanisms behind shorebird declines. 4th Western Hemisphere Shorebird Group, Vancouver, British Columbia.

Doll, A., M. Wunder, R.B. Lanctot, and C. Stricker. 2011. Estimating arrival times of Arctic-breeding Dunlin using stable isotopes. 4th Western Hemisphere Shorebird Group, Vancouver, British Columbia.

Kwon, E., and Sandercock, B.K. 2011. Population dynamics of arctic-breeding shorebirds under environmental change. Invited talk. Ewha Women's University, Seoul, Korea. December 22, 2011.

Kwon, E., and Sandercock, B.K. 2011. Age-specific demography and population dynamics of the Western Sandpiper (*Calidris mauri*). 4th Western Hemisphere Shorebird Group Meeting. Vancouver, Canada. August 11-15, 2011.

Kwon, E., and Sandercock, B.K. 2011. Changes in breeding phenology of arctic-breeding shorebirds: comparative study over two decades. KOS 2011 Fall Meeting. Great Bend, KS. USA. September 30-October 2, 2011.

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Doll, A., M. Wunder, R.B. Lanctot, and C. Stricker. 2012. Estimating temporal movements of a migratory species using stable carbon isotopes. 8th International Conference on Applications of Stable Isotope Techniques to Ecological Studies, Brest, France.

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Cunningham, J.A., D.C. Kesler, and R.B. Lanctot. 2013. Habitat and social factors influence nest site selection in Arctic-breeding shorebirds. Joint Meeting of American Ornithologists' Union and Cooper Ornithological Society. Chicago, Illinois.

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Lamarre, J.-F., J. Bêty, and G. Gauthier. 2013. Predator-mediated interactions between shorebirds and colony-nesting snow geese on Bylot Island, Nunavut. 5th Western Hemisphere Shorebird Group Meeting, Santa Marta, Columbia.

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Smith, P.A. 2013. Variable nest survival in arctic shorebirds: ecological and conservation implications. Biology Dept., Carleton University, Ottawa, ON.

Smith, P.A. 2013. Variable nest survival in arctic shorebirds: ecological and conservation implications. Biology Dept., Trent University, Peterborough, ON.

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Doll, A.C., R.B. Lanctot, C.A. Stricker, M.B. Wunder. 2014. Arctic climate events reveal tradeoff between timing of migratory and nesting behaviors. Joint Meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornthologists, Estes Park, Colorado.

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Grond, K., R.B. Lanctot, J. Santo-Domingo, H. Ryu, and B.K. Sandercock. 2014. The Avian gut microbiota. 26th International Ornithological Congress, Tokyo, Japan.

Grond, K., R.B. Lanctot, J. Santo-Domingo, H. Ryu, and B.K. Sandercock. 2014. Gut microbiota of migratory shorebirds: species or site. Annual meeting of the American Ornithologists' Union (132nd Stated Meeting), the Cooper Ornithological Society (84th Stated Meeting), and the Society of Canadian Ornithologists. Estes Park, Colorado.

Kwon, E., D. Lank, R.B. Lanctot, S. Brown, and B.K. Sandercock. 2014. Temporal gradient of prey availability and shorebird breeding phenology in the Arctic. Division of Biology BioForum. Manhattan, Kansas.

Kwon, E., D. Lank, R.B. Lanctot, S. Brown, and B.K. Sandercock. 2014. Test of ecological mismatches in an Arctic network. Annual meeting of the American Ornithologists' Union (132nd Stated Meeting), the Cooper Ornithological Society (84th Stated Meeting), and the Society of Canadian Ornithologists. Estes Park, Colorado.

Kwon, E., D.B. Lank, R.B. Lanctot, S. Brown, and B.K. Sandercock. 2014. Test of ecological mismatches in an Arctic Network. 15th Alaska Bird Conference, Juneau, Alaska.

Kwon, E. D.B. Lank, R.B. Lanctot, S. Brown, and B.K. Sandercock. 2014. Temporal gradient of prey availability and shorebird breeding phenology in the Nearctic. 26th International Ornithological Congress, Tokyo, Japan. 2014.

Lanctot, R.B., and S.T. Saalfeld. 2014. Conservative and opportunistic settlement strategies in Arctic-breeding shorebirds. International Wader Study Group Meeting, Haapsalu, Estonia.

Perkins, M., I.J. Stenhouse, N. Basu, J. Bety, H.R. Gates, M.-A. Giroux, J.-F. Lamarre, R.B. Lanctot, N. Lecomte, and D. Ward. 2014. Quantifying mercury exposure for multiple shorebird species across the North American Arctic using blood and feather samples. Arctic Climate Change, Ottawa, Ontario.

Smith, P.A. 2014. Status and conservation of Arctic shorebirds. National Wildlife Research Centre, Ottawa, Ontario.

Smith, P.A. and J. Rausch. 2014. Bird research and monitoring in Nunavut: methods and applications. Seminar presented to the meeting of all Nunavut Area Co-management Committees, Iqaluit, Nunavut.
Smith, P.A. 2014. Status and conservation of Arctic shorebirds. Pacific Wildlife Research Centre, Delta, British Columbia.
Weiser, E.L., B.K. Sandercock, S. Brown, R. Lanctot, & Arctic Shorebird Demographics Network. 2014. Drivers of adult survival in Arctic-breeding shorebirds. Alaska Bird Conference, Juneau, Alaska.
Weiser, E.L., B.K. Sandercock, R. Bentzen, J. Bêty, V. Loverti, M. Boldenow, S. Brown, B. Casler, W. English, M.-A. Giroux, E. Kwon, D. Lank, J.-F. Lamarre, R. Lanctot, N. Lecomte, J. Liebezeit, L. McKinnon, D. Mizrahi, E. Nol, R. Porter, R. Gates, J. Rausch, P. Smith, & S. Yezerinac. 2014. Effects of geolocators on return rates of Arctic-breeding shorebirds. Alaska Bird Conference, Juneau, Alaska.
Kwon, E., D. Lank, R.B. Lanctot, S. Brown, and B.K. Sandercock. 2015. Test of ecological mismatches in an Arctic network. Invited talk at Emporia State University, Emporia, Kansas.

Relevance to Arctic LCC conservation goals:

The Arctic Shorebird Demographics Network (the Network) is a geographically broad, multi-partner strategy that on-going support from the U.S. Fish and Wildlife Service, U.S. Geological Survey, the Canadian Wildlife Service, Environment Canada, academic partners, and many non-governmental conservation organizations (including Manomet, Inc.). Our study meets several stated objectives within the Arctic Landscape Conservation Cooperative Development and Operations Plan (draft plan December 2009). Specifically, it:

1) has a broad geographic scope that is focused on the Arctic;
2) currently includes a host of partners, including State and Federal Agencies and NGOs, as well as universities;
3) focuses on measuring habitat availability and quality; as well as priority migratory shorebirds that occupy a predominant role in the Arctic environment;
4) will improve our fundamental understanding of ecological changes by providing an inventory of surface water, insects, climate conditions, predators, alternative prey, and shorebird ecology; and
5) will build science capacity, by leveraging funds acquired elsewhere to operate the ASDN, and by doing so, complement the priority science needs identified by the WildREACH workshop.

Fund Expenditures

Funding from the Arctic LCC allowed the ASDN to become a reality in 2010. These funds were critical for successful completion of protocols and data collection, and provided a small boost to many sites that allowed them to start-up in 2010 and continue in 2011. Funds were used to equip sites with necessary equipment (e.g., weather stations, nest traps, invertebrate sampling materials), to hire and supervise field technicians collecting data to meet Arctic LCC specific-objectives at field sites, to pay for invertebrate analysis, and to hire a logistical coordinator that has developed protocols and collated the data from 2010 and 2011. A follow-up grant from the Arctic LCC in 2012 provided funds to cover analyses of invertebrates samples collected in 2012. Seed funding from the Arctic LLC was vital in allowing us to prepare competitive grants proposals that were successfully funded by a series of different sponsors, including NFWF (successful in 2010-2013), Neotropical Migratory Bird Conservation Program of the U.S. Fish and Wildlife Service (successful in 2010-2013), and the Alaska Department of Fish and Game (successful in 2010, failed in 2011). We also submitted a proposal to the National Science Foundation's Research Coordination Network grant program in October 2011 that was declined. During July 2012, a proposal was submitted to the U.S.

Fish and Wildlife Service's Survey, Monitoring, and Assessment program to hire a 3-year post-doctoral research associate to help with data analyses. Our project was ranked number one in the nation and subsequently funded. Emily Weiser was hired as a new post-doctoral research associate and began work on 1 April 2014. Principal investigators from each site (Appendix 2) fund most of the costs of their sites and collectively acquire funds from many funding agencies, both public and private (see list below). Overall, the seed funding provided by the Arctic LCC has been leveraged by at least 10:1.

The Future

One of our most impressive achievements is the number of network projects that have developed due to the collection of data over many species over a large geographic area. The 22 projects listed above will surely increase as people think of new and creative ways to use the archived data and samples. We are currently exploring new ways to continue the ASDN beyond the initial 5-year study. Possibilities include focusing on migratory connectivity, goose foraging and impacts to shorebirds, and climate effects on shorebird productivity.

Acknowledgements

Our progress report summarizes field work conducted by many individuals from many different organizations. Appendix 2 and 4 lists the principal investigators and graduate students working at each ASDN site and on the side projects, respectively. At each ASDN site, there were many additional field technicians whose names are not mentioned. We thank them all for being willing to work in a collaborative nature to address very large scale questions. Besides the Arctic LCC funding, which necessitated this report, field crews were supported by the U.S. Fish and Wildlife Service (including the Arctic National Wildlife Refuge, Selawek National Wildlife Refuge, Migratory Bird Management Division, and Avian Influenza programs); Manomet Center for Conservation Sciences; the National Fish and Wildlife Foundation; the Neotropical Migratory Bird Conservation Act; U.S. Geological Survey, Alaska Science Center's Changing Arctic Ecosystem Initiative; National Park Service, Cape Krusenstern National Monument and a Murie Science and Learning Center grant to River Gates; Bureau of Land Management; ArcticNet; Department of Indian Affairs and Northern Development Canada, Cumulative Impacts Monitoring Program and Arctic Research Infrastructure Fund; Environment Canada, Canadian Wildlife Service & Science and Technology Branch; Natural Resources Canada, Polar Continental Shelf Program; Natural Sciences and Engineering Research Council of Canada (Discovery Grant, Northern Supplement, International Polar Year, graduate student scholarships), EnviroNorth Program (Canada); National Science Foundation (Office of Polar Programs, and Doctoral Dissertation Improvement Grant to Nathan Senner); the Alaska Department of Fish and Game; FQRNT (Quebec); University of Alaska Fairbanks; Université du Québec à Rimouski, Cornell University Graduate School Mellon Grant (Nathan Senner); Churchill Northern Studies Centre; American Ornithologists' Union; Liz Claiborne / Art Ortenberg Foundation; Faucett Family Foundation; and Athena Foundation.

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Table 1. Site activity and data collected by ASDN sites between 2010 and 2014. See subsequent tables for when surveys were conducted and level of effort expended. x = collected data, no = no data.

2010	Nome	Cape Krusenstern	Barrow	Ikpikpuk	Prudhoe Bay	Canning River	Mackenzie Delta	East Bay	Churchill
Dates site active	11 May – 14 Jul	10 - 29 Jun	25 May – 31 Jul	9 Jun – 13 Jul	4 Jun – 18 Jul	3 Jun – 12 Jul	9 Jun – 7 Jul	2 Jun – 27 Jul	25 May – 2 Aug
# of personnel	5	2	6 - 10	7-8	5	6-9	3 - 5	6	7
Site latitude	N64.4	N67.1	N71.2	N70.5	N70.2	N70.1	N69.3	N63.9	N58.7
Site longitude	W164.9	W163.5	W156.6	W154.7	W148.5	W145.8	W134.9	W81.7	W93.8
Data collected									
Geo metadata	x	x	x	x	x	x	x	x	x
Nest record	x	x	x	x	x	x	x	x	x
Egg mm	no	x	x	no	no	no	no	no	no
Adult banding	x	x	x	x	x	x	x	x	x
Adult Resight	no	no	x	no	no	no	no	x	no
Chick banding	no	no	x	no	no	no	no	no	no
Weather- hourly	x	no	x	x	x	x	x	x	x
Weather-manual rain fall and snow	x	no	no	x	no	x	x	x	no
Invert collection	x	no	x	x	x	x	x	x	x
Lemming-live and winter nest counts	x	no	x	x	x	x	no	x	no
Predator	x	no	x	x	x	x	x	x	x
Snow melt	no	no	x	x	x	x	no[a]	x	no
Surface water	x	no	x	x	x	x	x	x	no
1st occurrence	x	x	x	x	x	x	x	x	x
Daily species list	x	x	x	x	x	x	x	x	x
Pond hydrology	no	no	no	no	no	no	no	no	no

[a] no snow was present upon arrival.

Table 1. Continued

2011	Nome	Cape Krusenstern	Barrow	Ikpikpuk	Colville	Prudhoe Bay	Canning River	Mackenzie Delta	Bylot Island	East Bay	Churchill
Dates site active	17 May – 23 July	27 May - 4 July	27 May – 1 August	5 June – 17 July	18 May – 3 Aug.	3 Jun – 18 July	2 June – 14 July	4 June – 12 July	5 June – 5 August	11 June – 25 July	24 May – 2 Aug
# of personnel	5	4	6 - 9	8	2	2 - 3	8	4 - 6	5	4	4
Site latitude	N64.4	N67.1	N71.2	N70.5	N70.4	N70.2	N70.1	N69.3	N73.2	N63.9	N58.7
Site longitude	W164.9	W163.5	W156.6	W154.7	W150.7	W148.5	W145.8	W134.9	W80.1	W81.7	W93.8
Data collected											
Geo metadata	x	x	x	x	x	x	x	x	x	x	x
Nest record	x	x	x	x	x	x	x	x	x	x	x
Egg mm	x	x	x	x	x	x	no	x	x	no	x
Adult banding	x	x	x	x	x	no	x	x	x	x	x
Adult Resight	x	x	x	x	x	x	x	x	x	x	x
Chick banding	x (few)	no	x	no	no	no	no	x	x	no	x
Weather- hourly	x	x	x	x	yes	x	x	x	x	no	x
Weather-manual rain fall and snow	x	x	no	x	yes	no	x	x	x	x	no
Invert collection	x	x	x	x	x	no	x	x	x	x	x
Lemming-live and winter nest counts	None observed	None observed	x	x	None observed	x	x	x	x	x	None observed
Predator	x	x	x	x	x	x	x	x	x	x	x
Snow surveys	x	x	x	x	x	x	x	x	x	x	x
1st occurrence	x	x	x	x	x	x	x	x	x	x	x
Daily species list	x	x	x	x	x	x	x	x	x	x	x
Pond hydrology	x	x	x	x	x	no	x	x	x	no	x

Table 1. Continued

2012	Nome	Cape Krusenstern	Barrow	Ikpikpuk	Colville	Prudhoe Bay	Canning River	Mackenzie Delta	Bylot Island
Dates site active	17 May – 23 Jul	19 May - 8 July	24 May – 3 Aug	3 Jun – 19 Jul	18 May – 27 Jul	2 Jun – 21 Jul	2 Jun – 17 Jul	3 Jun – 10 Jul	1 Jun – 15 Aug
# of personnel	4	4	6 - 9	5	2	3	8	5	5
Site latitude	N64.4	N67.1	N71.2	N70.5	N70.4	N70.2	N70.1	N69.3	N73.2
Site longitude	W164.9	W163.5	W156.6	W154.7	W150.7	W148.5	W145.8	W134.9	W80.1
Data Collected									
Geo metadata	x	x	x	x	x	x	x	x	x
Nest record	x	x	x	x	x	no	x	x	x
Egg mm	x	x	x	x	x	x	no	x	x
Adult banding	x	x	x	x	x	no	x	x	x
Adult Resight	x	x	x	x	x	no	x	x	x
Chick banding	x	x	x	no	x	no	no	x	x
Weather- hourly	x	x	x	x	x	x	x	x	x
Weather- manual rain fall and snow	x	x	no	x	x	no	x	no	x
Invert collection	x	x	x	x	x	no	x	x	x
Lemming-live and winter nest counts	no	None observed	x	x	x	x	x	no	x
Predator	x	x	x	x	x	x	x	x	x
Snow surveys	x	x	x	x	x	x	x	x	x
1st occurrence	x	x	x	x	x	x	x	x	x
Daily species list	x	x	x	x	x	x	x	x	x
Pond hydrology	x	x	x	x	x	no	x	no	x

Table 1. Continued

2012 cont.	East Bay	Churchill	Burntpoint	Chaun River	Lower Khatanga
Dates site active	6 Jun – 27 Jul	1 Jun – 6 Aug	6 Jun – 18 Jul	16 May – 29 Aug	17 June – 18 July
# of personnel	6	6	9	9	4
Site latitude	N63.9	N58.7	N55.2	N68.8	N72.8
Site longitude	W81.7	W93.8	W84.3	E170.5	E106.0
Data Collected					
Geo metadata	x	x	x	x	x
Nest record	x	x	x	x	x
Egg mm	no	x	x	x	x
Adult banding	x	x	no	no	x
Adult Resight	x	x	no	no	no
Chick banding	no	x	no	no	x
Weather- hourly	x	x	x	no	x - daily
Weather-manual rain fall and snow	x	no	x	X	x
Invert collection	x	x	x	no	no
Lemming-live and winter nest counts	x	x	x	no	x
Predator	x	x	no	x	x
Snow surveys	x	x	x	no	no
1st occurrence	x	x	x	x	no
Daily species list	x	x	x	x	no
Pond hydrology	no	x	no	no	no

Table 1. Continued

2013	Nome	Cape Krusenstern	Barrow	Ikpikpuk	Colville	Prudhoe Bay	Canning River	Mackenzie Delta	Bylot Island
Dates site active	26 May – 14 July	24 May - 10 July	23 May – 10 August	4 Jun – 19 Jul	16 May – 4 Aug	3 Jun – 22 Jul	2 Jun – 21 Jul	6 Jun – 12 Jul	7 Jun – 21 Aug
# of personnel	5	5	6 - 12	4	3	2	6	5	7
Site latitude	N64.4	N67.1	N71.2	N70.5	N70.4	N70.2	N70.1	N69.3	N73.2
Site longitude	W164.9	W163.5	W156.6	W154.7	W150.7	W148.5	W145.8	W134.9	W80.1
Data collected									
Geo metadata	x	x	x	x	x	x	x	x	x
Nest record	x	x	x	x	x	x	x	x	x
Egg mm	x	x	x	x	x	no	no	no	x
Adult banding	x	x	x	x	x	no	x	x	x
Adult Resight	x	x	x	x	x	no	x	x	x
Chick banding	x	x	x	no	no	no	no	x	x
Weather- hourly	x	x	x	x	x	x	x	x	x
Weather-manual rain fall and snow	x	x	no	x	no	no	x	x	x
Invert collection	x	no	x	no	No[c]	no	no	no	x
Lemming-live and winter nest counts	No	None observed	x	x	x	no	x	None observed	x
Predator	x	x	x	x	x	x	x	x	x
Snow surveys	x	x	x	x	x	x	x	x	x
1st occurrence	x	x	x	x	x	x	x	x	x
Daily species list	x	x	x	x	x	x	x	x	x
Pond hydrology	no	no	no	no	no	no	no	no	no

[c] invertebrate data collected for USGS but not reported to ASDN

Table 1. Continued

2013 cont.	East Bay	Churchill	Burntpoint	Chaun Delta	Lower Khatanga	Igloolik	Coats Island
Dates site active	5 Jun – 25 Jul	1 Jun – 2 Aug	5 Jun – 3 Jul	7 Jun – 9 Jul	20 Jun – 24 Jul	15 Jun – 31 Aug	16 – 30 Jun
# of personnel	5	11	11	3	4	3	4
Site latitude	N63.9	N58.7	N55.2	N68.8	N72.8	N69.4	N62.9
Site longitude	W81.7	W93.8	W84.3	E170.5	E106.0	W81.5	W82.3
Data collected							
Geo metadata	x	x	x	x	x	x	x
Nest record	x	x	x	x	x	x	x
Egg mm	no	no	no	x	no	x	no
Adult banding	x	x	x	x	no	x	x
Adult Resight	x	x	no	no	no	no	no
Chick banding	no	x	no	no	x	no	no
Weather- hourly	no	x	x	no	no	x	no
Weather-manual rain fall and snow	x	x	x	no	x	x	no
Invert collection	x	x	x	no	no	x	no
Lemming-live and winter nest counts	x	x	x	no	x	x	no
Predator	no	no	no	x	no	x	no
Snow surveys	x	x	no	no	no	x	no
1st occurrence	x	x	x	x	no	no	x
Daily species list	x	x	x	x	no	no	x
Pond hydrology	no	no	no	no	no	no	no

Table 1. Continued.

2014	Nome	Cape Krusenstern	Barrow	Ikpikpuk	Colville	Prudhoe Bay	Canning River	Mackenzie Delta	Bylot Island
Dates site active	14 May – 1 July	21 May - 7 July	15 May – 10 August	3 Jun – 21 Jul	24 May – 4 Aug	3 Jun – 22 Jul	3 Jun – 21 Jul	4 Jun – 14 Jul	7 Jun – 21 Aug
# of personnel	5	5	6 - 12	4	3	2	6	5	7
Site latitude	N64.4	N67.1	N71.2	N70.5	N70.4	N70.2	N70.1	N69.3	N73.2
Site longitude	W164.9	W163.5	W156.6	W154.7	W150.7	W148.5	W145.8	W134.9	W80.1
Data collected									
Geo metadata	x	x	x	x	x	x	x	x	x
Nest record	x	x	x	x	x	x	x	x	x
Egg mm	x	x	x	x	x	no	no	no	x
Adult banding	x	x	x	x	x	no	x	x	x
Adult Resight	x	x	x	x	x	no	x	x	x
Chick banding	x	x	x	no	no	no	no	x	x
Weather- hourly	x	x	x	x	x	x	x	x	x
Weather-manual rain fall and snow	x	x	no	x	no	no	x	x	x
Invert collection	x	no	x	no	no	no	no	no	x
Lemming-live and winter nest counts	no	x	x	x	x	no	x	x	x
Predator	x	x	x	x	x	x	x	x	x
Snow surveys	x	x	x	x	x	x	x	x	x
1st occurrence	x	x	x	x	x	x	x	x	x
Daily species list	x	x	x	x	x	x	x	x	x
Pond hydrology	no	no	no	no	no	no	no	no	no

Table 1. Continued

2014 cont.	East Bay	Churchill	Burntpoint	Chaun Delta	Lower Khatanga	Igloolik	Coats Island
Dates site active	11 Jun – 29 Jul	29 May – 2 Aug	10 Jun – 30 Jun	11 Jun – 7 Jul	17 Jun – 17 Jul	15 Jun – 27 Jul	6 – 24 Jul
# of personnel	5	11	11	3	4	3	4
Site latitude	N63.9	N58.7	N55.2	N68.8	N72.8	N69.4	N62.9
Site longitude	W81.7	W93.8	W84.3	E170.5	E106.0	W81.5	W82.3
Data collected							
Geo metadata	x	x	x	x	x	x	x
Nest record	x	x	x	x	x	x	x
Egg mm	no	no	no	x	no	x	x
Adult banding	x	x	x	x	no	x	x
Adult Resight	x	x	no	no	no	no	x
Chick banding	no	x	no	no	x	no	no
Weather- hourly	no	x	x	no	no	x	x
Weather-manual rain fall and snow	x	x	x	no	x	x	no
Invert collection	x	x	x	no	no	x	no
Lemming-live and winter nest counts	x	x	x	no	x	x	x
Predator	no	x	x	x	no	x	x
Snow surveys	x	x	no	no	no	x	x
1st occurrence	x	x	x	x	no	no	x
Daily species list	x	x	x	x	no	no	x
Pond hydrology	no	no	no	no	no	no	no

Table 2. Number of nests located at ASDN sites between 2010 and 2014. See Appendix 3 for list of bird species abbreviations.

	Barrow					Burntpoint			Bylot Island					Cape Krusenstern					Canning River					Chaun Delta		
	2010	2011	2012	2013	2014	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2012	2013	2014
AMGP	11	9	13	14	9	1	-	-	78	78	50	77	103	-	-	-	-	-	3	2	5	2	2	-	-	-
BASA	-	-	4	-	-	-	-	-	21	25	40	27	37	-	-	-	-	-	1	-	1	-	-	-	-	-
BBIS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BBPL	-	-	-	-	-	-	-	-	6	8	4	7	11	-	-	1	1	-	2	2	-	-	-	1	-	1
BBSA	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3	-	11	5	-	-	-
BLTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	5	3	-	-	-	-	-	-	-	-
BARG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COSN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CRPL	-	-	-	-	-	-	-	-	5	2	2	4	19	-	-	-	-	-	-	-	-	-	-	-	-	1
CUSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DUNL	32	31	36	54	53	8	13	10	-	-	-	-	-	21	14	22	21	16	12	15	15	12	11	13	35	30
HUGO	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KILL	-	-	-	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LBDO	15	35	17	15	7	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	2	2	-	2	-
LESA	-	-	-	-	-	9	10	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LEYE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LIST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
PAGP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-
PESA	35	108	91	63	119	-	-	-	8	1	-	5	3	-	-	-	-	-	47	78	18	69	209	5	10	11
PUSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REKN	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
REPH	72	160	144	102	176	-	-	-	5	5	-	1	-	-	-	-	-	1	15	27	14	42	70	-	-	2
RNPH	7	12	24	7	9	-	1	-	-	-	-	-	-	7	11	18	13	26	30	34	52	40	33	10	31	20
RNST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUFF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	5	2
RUTU	-	-	1	-	1	-	-	-	-	-	-	1	1	-	-	-	-	-	3	1	3	2	3	1	-	-
SAND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
SBDO	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEPL	-	-	-	-	-	8	7	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SESA	39	42	52	58	50	-	-	-	-	-	-	-	-	17	36	55	40	35	72	80	136	97	67	-	-	-
SPRE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPTS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	3	3	3	-	-	-
TEST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	5	2
WESA	8	9	14	45	5	-	-	-	-	-	-	-	-	10	10	35	65	53	-	-	-	-	-	-	-	-
WHIM	-	-	-	-	-	10	24	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WISN	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
WRSA	1	1	-	-	2	-	-	-	26	10	8	16	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**220**	**407**	**396**	**358**	**431**	**40**	**60**	**45**	**149**	**129**	**105**	**138**	**181**	**55**	**71**	**146**	**145**	**134**	**190**	**248**	**248**	**280**	**405**	**36**	**90**	**70**

Table 2. Continued

	Churchill					Coats Island	Colville				East Bay					Igloolik		Ikpikpuk				
	2010	2011	2012	2013	2014	2014	2011	2012	2013	2014	2010	2011	2012	2013	2014	2013	2014	2010	2011	2012	2013	2014
AMGP	3	-	10	11	12	8	1	1	1	1	-	2	-	-	3	13	18	-	-	-	5	1
BASA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-
BBIS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BBPL	-	-	-	-	-	6	4	6	4	8	12	11	8	9	11	1	3	1	-	4	4	3
BBSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
BLTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARG	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	5	-	-	1	1
COSN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CRPL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CUSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DUNL	26	35	28	34	24	11	14	11	19	15	3	2	3	2	7	-	1	21	13	17	16	17
HUGO	-	-	9	12	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KILL	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LBDO	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	4	4	6	13	1
LESA	8	-	15	9	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LEYE	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LIST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAGP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PESA	-	-	-	-	-	-	5	10	3	10	-	-	-	-	-	-	1	17	3	4	11	14
PUSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
REKN	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
REPH	-	-	-	-	-	7	13	14	16	33	25	13	5	23	5	11	22	15	14	20	23	22
RNPH	15	11	1	1	2	1	19	21	27	10	-	-	-	-	-	-	-	8	9	20	18	27
RNST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUFF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUTU	-	-	-	-	-	9	7	14	9	13	28	12	13	8	7	1	2	-	-	-	-	-
SAND	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
SBDO	12	-	11	11	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEPL	-	-	-	-	-	2	1	-	-	-	7	11	8	5	11	-	-	-	-	-	-	-
SESA	-	-	-	-	-	30	77	101	109	79	-	-	2	2	-	10	7	70	65	50	64	58
SPRE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPTS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STSA	2	-	3	3	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TEST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WESA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHIM	20	17	52	57	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WISN	-	-	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WRSA	-	-	-	-	-	3	-	-	-	-	33	23	17	24	19	4	22	-	-	-	-	-
Total	**86**	**63**	**132**	**140**	**94**	**77**	**143**	**179**	**189**	**169**	**110**	**74**	**56**	**73**	**63**	**42**	**78**	**141**	**108**	**121**	**157**	**144**

Table 2. Continued

	Lower Khatanga River			Mackenzie Delta					Nome					Prudhoe Bay		Grand
	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2013	Totals
AMGP	-	-	-	1	1	2	1	-	-	-	-	-	-	-	2	**554**
BASA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**159**
BBIS	2	1	10	-	-	-	-	-	-	-	-	-	-	-	-	**13**
BBPL	4	3	5	-	-	-	-	-	-	-	-	-	-	-	-	**151**
BBSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	**25**
BLTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**22**
BARG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**8**
COSN	3	5	5	-	-	-	-	-	-	-	-	-	-	-	-	**13**
CRPL	1	1	13	-	-	-	-	-	-	-	-	-	-	-	-	**48**
CUSA	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	**4**
DUNL	11	22	26	-	-	-	-	-	-	3	2	3	4	-	2	**866**
HUGO	-	-	-	-	1	2	3	1	-	-	-	-	-	-	-	**41**
KILL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**6**
LBDO	-	-	1	4	-	2	1	-	-	-	-	1	-	-	5	**142**
LESA	-	-	-	-	4	-	1	1	-	-	-	-	1	-	-	**81**
LEYE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2**
LIST	15	-	8	-	-	-	-	-	-	-	-	-	-	-	-	**24**
PAGP	8	11	15	-	-	-	-	-	-	-	-	-	-	-	-	**36**
PESA	50	17	52	-	10	1	10	6	-	1	-	-	-	11	13	**1129**
PUSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**
REKN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**4**
REPH	49	8	29	-	-	-	-	-	-	-	-	-	-	2	3	**1208**
RNPH	7	3	9	8	24	29	55	34	24	50	96	80	56	3	12	**1065**
RNST	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	**3**
RUFF	16	25	30	-	-	-	-	-	-	-	-	-	-	-	-	**81**
RUTU	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	**142**
SAND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2**
SBDO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**45**
SEPL	-	-	-	4	7	5	7	7	-	-	-	-	-	-	-	**95**
SESA	-	-	-	9	17	17	29	27	30	69	62	70	47	30	26	**2033**
SPRE	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	**4**
SPTS	5	1	2	-	-	-	-	-	-	-	-	-	-	-	-	**8**
STSA	-	-	-	4	3	5	3	-	-	-	-	-	-	-	3	**47**
TEST	20	8	18	-	-	-	-	-	-	-	-	-	-	-	-	**55**
WESA	-	-	-	-	-	-	-	-	44	89	74	50	84	-	-	**595**
WHIM	-	-	-	11	10	9	8	14	-	-	-	-	-	-	-	**270**
WISN	-	-	-	-	-	-	-	-	-	1	1	2	-	-	-	**9**
WOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**
WRSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**212**
Total	**195**	**107**	**228**	**41**	**77**	**72**	**118**	**90**	**98**	**213**	**235**	**206**	**192**	**48**	**68**	**9204**

Table 3. Apparent nest success [% hatch, (n)] of shorebirds breeding at ASDN sites between 2010 and 2014. See Appendix 3 for list of bird species abbreviations. Species not breeding at each site denoted with "-".

	Barrow					Burntpoint			Bylot Island					Cape Krusenstern				
	2010	2011	2012	2013	2014	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
AMGP	27 (11)	89 (9)	85 (13)	64 (14)	100 (9)	100 (1)	-	-	75 (20)	62 (24)	9 (23)	6 (36)	33 (48)	-	-	-	-	-
BASA	-	-	100 (3)	-	-	-	-	-	71 (17)	90 (20)	14 (28)	25 (16)	71 (24)	-	-	-	-	-
BBIS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BBPL	-	-	-	-	-	-	-	-	-	33 (3)	33 (3)	20 (5)	50 (4)	-	-	-	100 (1)	-
BBSA	-	-	-	-	-	-	-	-	-	-	-	-	100 (1)	-	-	-	-	-
BLTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0 (3)	-	-
BARG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COSN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CRPL	-	-	-	-	-	-	-	-	-	-	100 (1)	100 (2)	100 (11)	-	-	-	-	-
CUSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DUNL	54 (28)	90 (30)	89 (36)	83 (53)	70 (53)	33 (3)	89 (9)	14 (7)	-	-	-	-	-	71 (14)	100 (12)	79 (19)	30 (20)	42 (12)
HUGO	-	-	-	-	-	-	-	100 (2)	-	-	-	-	-	-	-	-	-	-
KILL	-	-	-	-	-	0 (2)	-	-	-	-	-	-	-	-	-	-	-	-
LBDO	8 (13)	61 (33)	69 (16)	53 (15)	14 (7)	-	-	-	-	-	-	-	-	-	-	100 (1)	-	-
LESA	-	-	-	-	-	100 (1)	100 (6)	25 (4)	-	-	-	-	-	-	-	-	-	-
LEYE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LIST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAGP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PESA	42 (26)	80 (101)	89 (89)	82 (60)	60 (117)	-	-	-	86 (7)	-	-	0 (4)	100 (1)	-	-	-	-	-
PUSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REKN	-	-	-	-	-	-	-	-	-	-	0 (1)	-	-	-	-	-	-	-
REPH	73 (60)	85 (150)	92 (140)	89 (100)	60 (169)	-	-	-	100 (2)	100 (1)	-	-	-	-	-	-	-	0 (1)
RNPH	100 (7)	91 (11)	92 (24)	100 (7)	78 (9)	-	-	-	-	-	-	-	-	0 (5)	86 (7)	50 (18)	36 (11)	11 (19)
RNST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUFF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUTU	-	-	100 (1)	-	100 (1)	-	-	-	-	-	-	-	0 (1)	-	-	-	-	-
SAND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SBDO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEPL	-	-	-	-	-	-	100 (1)	0 (3)	-	-	-	-	-	-	-	-	-	-
SESA	76 (34)	98 (42)	86 (51)	70 (54)	70 (43)	-	-	-	-	-	-	-	-	43 (7)	86 (35)	71 (49)	9 (35)	31 (29)
SPRE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPTS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TEST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WESA	50 (8)	44 (9)	71 (14)	66 (41)	60 (5)	-	-	-	-	-	-	-	-	33 (3)	86 (7)	74 (31)	13 (60)	23 (39)
WHIM	-	-	-	-	-	0 (3)	50 (4)	11 (9)	-	-	-	-	-	-	-	-	-	-
WISN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WRSA	0 (1)	100 (1)	-	-	0 (2)	-	-	-	79 (19)	0 (2)	33 (3)	50 (6)	-	-	-	-	-	-
Total	**59 (188)**	**83 (386)**	**88 (387)**	**79 (344)**	**63 (415)**	**30 (10)**	**85 (20)**	**20 (25)**	**77 (65)**	**70 (50)**	**15 (59)**	**17 (69)**	**53 (90)**	**48 (29)**	**89 (61)**	**69 (121)**	**19 (136)**	**26 (118)**

Table 3. Continued

	Canning River					Chaun Delta			Churchill				Coats Island	Colville			
	2010	2011	2012	2013	2014	2012	2013	2014	2011	2012	2013	2014	2014	2011	2012	2013	2014
AMGP	0 (1)	0 (1)	0 (5)	0 (2)	50 (2)	-	-	-	-	100 (7)	82 (11)	75 (12)	17 (6)	-	0 (1)	0 (1)	0 (1)
BASA	0 (1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BBIS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BBPL	100 (1)	0 (1)	-	-	-	-	-	-	-	-	-	-	0 (6)	25 (4)	100 (6)	75 (4)	75 (8)
BBSA	-	0 (1)	-	50 (8)	20 (5)	-	-	-	-	-	-	-	-	-	-	-	-
BLTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARG	-	-	-	-	-	-	-	-	-	-	-	-	-	100 (1)	-	-	-
COSN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CRPL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CUSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DUNL	82 (11)	0 (10)	8 (13)	45 (11)	64 (11)	100 (8)	25 (24)	26 (23)	85 (34)	62 (26)	88 (34)	48 (23)	64 (11)	73 (11)	73 (11)	41 (17)	91 (11)
HUGO	-	-	-	-	-	-	-	-	-	86 (7)	56 (9)	17 (6)	-	-	-	-	-
KILL	-	-	-	-	-	-	-	-	-	-	-	0 (1)	-	-	-	-	-
LBDO	-	100 (1)	0 (1)	50 (2)	100 (2)	-	100 (1)	-	-	-	-	-	-	0 (1)	-	100 (1)	-
LESA	-	-	-	-	-	-	-	-	-	90 (10)	100 (6)	67 (6)	-	-	-	-	-
LEYE	-	-	-	-	-	-	-	-	-	100 (1)	-	-	-	-	-	-	-
LIST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAGP	-	-	-	-	-	-	0 (1)	-	-	-	-	-	-	-	-	-	-
PESA	70 (33)	45 (65)	6 (16)	41 (58)	55 (182)	100 (1)	50 (6)	12 (8)	-	-	-	-	-	67 (3)	89 (9)	50 (2)	50 (8)
PUSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REKN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REPH	78 (9)	70 (20)	8 (13)	34 (38)	46 (59)	-	-	0 (2)	-	-	-	-	29 (7)	67 (12)	92 (13)	50 (14)	55 (29)
RNPH	67 (24)	56 (27)	15 (47)	47 (36)	60 (30)	100 (7)	13 (15)	10 (10)	50 (10)	100 (1)	100 (1)	100 (2)	0 (1)	68 (19)	89 (19)	48 (25)	75 (8)
RNST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUFF	-	-	-	-	-	100 (3)	75 (4)	0 (1)	-	-	-	-	-	-	-	-	-
RUTU	100 (1)	100 (1)	33 (3)	100 (1)	67 (3)	100 (1)	-	-	-	-	-	-	11 (9)	67 (6)	83 (12)	33 (6)	10 (10)
SAND	0 (1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SBDO	-	-	-	-	-	-	-	-	-	80 (5)	100 (8)	40 (10)	-	-	-	-	-
SEPL	-	-	-	-	-	-	-	-	-	-	-	-	0 (2)	100 (1)	-	-	-
SESA	89 (64)	78 (67)	15 (120)	37 (89)	70 (60)	-	-	-	-	-	-	-	61 (28)	68 (72)	87 (98)	58 (90)	66 (70)
SPRE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPTS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STSA	33 (3)	100 (5)	33 (3)	33 (3)	100 (3)	-	-	-	-	100 (2)	100 (2)	50 (2)	-	-	100 (1)	-	-
TEST	-	-	-	-	-	100 (2)	50 (4)	0 (1)	-	-	-	-	-	-	-	-	-
WESA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHIM	-	-	-	-	-	-	-	-	18 (17)	29 (52)	74 (57)	0 (26)	-	-	-	-	-
WISN	-	-	-	-	-	-	-	-	-	-	100 (1)	0 (1)	-	-	-	-	-
WRSA	-	-	-	-	-	-	-	-	-	-	-	-	100 (3)	-	-	-	-
Total	**77 (149)**	**59 (199)**	**14 (221)**	**40 (248)**	**57 (357)**	**93 (28)**	**31 (55)**	**16 (49)**	**61 (61)**	**55 (111)**	**81 (129)**	**36 (89)**	**42 (73)**	**67 (130)**	**86 (170)**	**53 (161)**	**61 (145)**

Table 3. Continued

	East Bay					Igloolik		Ikpikpuk					Lower Khatanga River		
	2010	2011	2012	2013	2014	2013	2014	2010	2011	2012	2013	2014	2012	2013	2014
AMGP	-	0 (2)	-	-	33 (3)	80 (10)	67 (15)	-	-	-	0 (4)	100 (1)	-	-	-
BASA	-	-	-	-	-	100 (2)	0 (1)	-	-	-	-	-	-	-	-
BBIS	-	-	-	-	-	-	-	-	-	-	-	-	0 (1)	100 (1)	33 (3)
BBPL	45 (11)	33 (9)	25 (8)	43 (7)	25 (8)	100 (1)	67 (3)	-	-	67 (3)	0 (4)	0 (2)	0 (3)	33 (3)	0 (2)
BBSA	-	-	-	-	-	-	-	-	-	-	0 (2)	-	-	-	-
BLTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARG	-	-	-	-	-	-	-	25 (4)	-	-	0 (1)	0 (1)	-	-	-
COSN	-	-	-	-	-	-	-	-	-	-	-	-	100 (1)	25 (4)	67 (3)
CRPL	-	-	-	-	-	-	-	-	-	-	-	-	-	100 (1)	100 (2)
CUSA	-	-	-	-	-	-	-	-	-	-	-	-	100 (1)	0 (1)	100 (2)
DUNL	0 (3)	0 (2)	33 (3)	50 (2)	0 (5)	-	100 (1)	50 (2)	85 (13)	47 (15)	7 (15)	21 (14)	9 (11)	71 (21)	38 (21)
HUGO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KILL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LBDO	-	-	-	-	-	-	-	0 (2)	100 (2)	17 (6)	9 (11)	0 (1)	-	-	100 (1)
LESA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LEYE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LIST	-	-	-	-	-	-	-	-	-	-	-	-	54 (13)	-	20 (5)
PAGP	-	-	-	-	-	-	-	-	-	-	-	-	0 (6)	45 (11)	11 (9)
PESA	-	-	-	-	-	-	0 (1)	33 (3)	100 (2)	100 (3)	0 (10)	36 (11)	4 (46)	31 (16)	16 (44)
PUSA	-	-	-	-	-	-	100 (1)	-	-	-	-	-	-	-	-
REKN	100 (1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REPH	4 (23)	0 (11)	20 (5)	33 (18)	0 (5)	56 (9)	27 (22)	50 (4)	89 (9)	83 (18)	33 (18)	70 (20)	20 (45)	86 (7)	41 (17)
RNPH	-	-	-	-	-	-	-	33 (3)	50 (4)	35 (17)	31 (16)	60 (25)	50 (4)	100 (3)	100 (8)
RNST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100 (1)
RUFF	-	-	-	-	-	-	-	-	-	-	-	-	27 (15)	68 (19)	24 (21)
RUTU	21 (19)	50 (12)	0 (13)	25 (4)	17 (6)	100 (1)	0 (2)	-	-	-	-	-	-	-	-
SAND	100 (1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SBDO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEPL	20 (5)	45 (11)	33 (6)	80 (5)	0 (8)	-	-	-	-	-	-	-	-	-	-
SESA	-	-	0 (2)	50 (2)	-	50 (8)	29 (7)	56 (9)	88 (60)	82 (38)	7 (60)	41 (46)	-	-	-
SPRE	-	-	-	-	-	-	-	-	-	-	-	-	0 (1)	100 (1)	100 (1)
SPTS	-	-	-	-	-	-	-	-	-	-	-	-	20 (5)	100 (1)	0 (1)
STSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TEST	-	-	-	-	-	-	-	-	-	-	-	-	100 (10)	100 (7)	100 (13)
WESA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHIM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WISN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WRSA	25 (32)	29 (17)	15 (13)	40 (20)	33 (15)	100 (2)	41 (22)	-	-	-	-	-	-	-	-
Total	**23 (96)**	**30 (64)**	**16 (50)**	**41 (58)**	**18 (50)**	**70 (33)**	**41 (76)**	**41 (27)**	**87 (90)**	**65 (100)**	**12 (141)**	**47 (154)**	**23 (162)**	**62 (96)**	**39 (154)**

Table 3. Continued

	Mackenzie Delta					Nome					Prudhoe Bay		
	2010	2011	2012	2010	2014	2010	2011	2012	2013	2014	2010	2013	**Grand Totals**
AMGP	-	100 (1)	0 (1)	-	-	-	-	-	-	-	-	100 (2)	**47 (297)**
BASA	-	-	-	-	-	-	-	-	-	-	-	-	**54 (112)**
BBIS	-	-	-	-	-	-	-	-	-	-	-	-	**40 (5)**
BBPL	-	-	-	-	-	-	-	-	-	-	-	-	**40 (110)**
BBSA	-	-	-	-	-	-	-	-	-	-	-	50 (2)	**37 (19)**
BLTU	-	-	-	-	-	-	-	-	-	-	-	-	**0 (3)**
BARG	-	-	-	-	-	-	-	-	-	-	-	-	**29 (7)**
COSN	-	-	-	-	-	-	-	-	-	-	-	-	**50 (8)**
CRPL	-	-	-	-	-	-	-	-	-	-	-	-	**94 (18)**
CUSA	-	-	-	-	-	-	-	-	-	-	-	-	**75 (4)**
DUNL	-	-	-	-	-	-	-	-	67 (3)	0 (2)	-	100 (2)	**61 (727)**
HUGO	-	100 (1)	50 (2)	0 (3)	0 (1)	-	-	-	-	-	-	-	**50 (32)**
KILL	-	-	-	-	-	-	-	-	-	-	-	-	**0 (3)**
LBDO	75 (4)	-	-	0 (1)	-	-	-	-	100 (1)	-	-	60 (5)	**47 (128)**
LESA	-	100 (3)	-	-	100 (1)	-	-	-	-	0 (1)	-	-	**82 (38)**
LEYE	-	-	-	-	-	-	-	-	-	-	-	-	**100 (1)**
LIST	-	-	-	-	-	-	-	-	-	-	-	-	**44 (18)**
PAGP	-	-	-	-	-	-	-	-	-	-	-	-	**22 (27)**
PESA	-	86 (7)	0 (1)	20 (5)	67 (6)	-	0 (1)	-	-	-	14 (7)	55 (11)	**55 (972)**
PUSA	-	-	-	-	-	-	-	-	-	-	-	-	**100 (1)**
REKN	-	-	-	-	-	-	-	-	-	-	-	-	**50 (2)**
REPH	-	-	-	-	-	-	-	-	-	-	0 (1)	67 (3)	**64 (1074)**
RNPH	100 (1)	67 (12)	17 (12)	8 (36)	46 (28)	37 (19)	61 (49)	73 (94)	39 (74)	27 (37)	33 (3)	80 (10)	**51 (865)**
RNST	-	-	-	-	-	-	-	-	-	-	-	-	**100 (1)**
RUFF	-	-	-	-	-	-	-	-	-	-	-	-	**44 (63)**
RUTU	-	-	-	-	-	-	-	-	-	-	100 (2)	-	**36 (116)**
SAND	-	-	-	-	-	-	-	-	-	-	-	-	**50 (2)**
SBDO	-	-	-	-	-	-	-	-	-	-	-	-	**71 (24)**
SEPL	100 (4)	86 (7)	67 (3)	75 (4)	83 (6)	-	-	-	-	-	-	-	**52 (66)**
SESA	50 (2)	62 (8)	86 (7)	57 (14)	87 (23)	75 (24)	58 (57)	75 (57)	29 (62)	10 (40)	67 (18)	89 (18)	**60 (1699)**
SPRE	-	-	-	-	-	-	-	-	-	-	-	-	**67 (3)**
SPTS	-	-	-	-	-	-	-	-	-	-	-	-	**29 (7)**
STSA	25 (4)	67 (3)	33 (3)	0 (1)	-	-	-	-	-	-	-	100 (2)	**62 (37)**
TEST	-	-	-	-	-	-	-	-	-	-	-	-	**92 (37)**
WESA	-	-	-	-	-	81 (37)	55 (74)	63 (71)	40 (47)	12 (72)	-	-	**46 (518)**
WHIM	60 (10)	67 (9)	0 (9)	0 (6)	43 (14)	-	-	-	-	-	-	-	**38 (221)**
WISN	-	-	-	-	-	-	-	-	0 (1)	-	-	-	**33 (3)**
WRSA	-	-	-	-	-	-	-	-	-	-	-	-	**39 (158)**
Total	**64 (25)**	**75 (51)**	**32 (38)**	**21 (70)**	**62 (79)**	**69 (80)**	**57 (182)**	**70 (223)**	**37 (188)**	**15 (152)**	**52 (31)**	**76 (55)**	**55 (7501)**

Table 4. Number of new (previously unbanded) adult birds banded at each ASDN site by species from 2010-2014. See Appendix 3 for list of bird species abbreviations. ˝

	Barrow					Burntpoint		Bylot Island					Cape Krusenstern					Canning River					Chaun Delta	
	2010	2011	2012	2013	2014	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2013	2014
AMGP	16	19	20	14	12	-	-	22	40	19	22	41	-	-	-	-	-	-	-	-	-	-	-	-
BASA	2	11	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
BBPL	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BBSA	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
BLTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	4	-	-	-	-	-	-	-
BARG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CRPL	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-
DUNL	69	90	50	71	56	3	2	-	-	-	-	-	20	17	11	12	15	21	13	2	8	7	28	17
HUGO	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KILL	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LBDO	15	50	28	13	4	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
LESA	-	-	-	-	-	3	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LEYE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAGP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PESA	26	75	78	34	88	-	-	-	-	-	1	-	-	-	-	-	-	39	38	12	24	24	-	3
REKN	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
REPH	56	39	92	67	119	-	-	-	-	-	-	-	-	-	-	-	1	11	7	6	2	21	-	-
RNPH	6	8	22	5	11	-	-	-	-	-	-	-	1	8	11	4	15	19	8	21	4	11	3	3
RUFF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUTU	-	2	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-
SBDO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEPL	-	1	-	-	-	7	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SESA	67	180	66	75	61	-	-	-	-	-	-	-	17	53	51	15	39	97	46	44	63	13	-	-
STSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TEST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WESA	15	11	20	38	7	-	-	-	-	-	-	-	10	18	45	35	66	-	-	-	-	-	-	-
WHIM	-	-	-	-	-	15	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WRSA	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**272**	**487**	**383**	**317**	**361**	**33**	**16**	**24**	**43**	**19**	**23**	**64**	**48**	**96**	**136**	**66**	**140**	**194**	**112**	**85**	**101**	**76**	**31**	**23**

Table 4. Continued

	Churchill						Coats Island	Colville				East Bay					Igloolik		Ikpikpuk				
	2010	2011	2012	2013	2014	2013	2014	2011	2012	2013	2014	2010	2011	2012	2013	2014	2013	2014	2010	2011	2012	2013	2014
AMGP	-	-	3	10	9	-	8	-	-	-	-	-	-	-	-	2	13	22	-	-	-	5	-
BASA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
BBPL	-	-	-	-	-	-	1	-	-	-	-	-	10	5	7	5	-	-	-	-	-	-	-
BBSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-
CRPL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DUNL	37	39	23	43	12	-	6	4	9	16	9	1	-	-	-	1	-	-	32	27	15	10	2
HUGO	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KILL	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LBDO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	1
LESA	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAGP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PESA	-	-	-	-	-	-	-	3	-	-	4	-	-	-	-	-	-	-	30	-	-	-	1
REKN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REPH	-	-	-	-	-	-	5	4	12	-	4	22	-	-	16	4	-	3	17	6	15	16	4
RNPH	6	3	-	-	-	-	-	2	-	9	2	-	-	-	-	-	-	-	12	7	14	16	4
RUFF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUTU	-	-	-	-	-	-	7	8	3	5	1	18	11	13	5	2	-	-	-	-	-	-	-
SBDO	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEPL	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	7	-	-	-	-	-	-	-
SESA	-	-	-	-	-	35	29	31	14	14	15	-	-	-	-	-	12	3	40	54	28	38	11
STSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TEST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WESA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHIM	-	12	27	24	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WRSA	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	17	-	6	-	-	-	-	-
Total	**43**	**54**	**54**	**78**	**33**	**35**	**56**	**52**	**38**	**44**	**35**	**65**	**21**	**18**	**28**	**38**	**27**	**34**	**145**	**94**	**72**	**85**	**23**

Table 4. Continued

	Lower Khatanga River		Mackenzie Delta					Nome					Prudhoe Bay	Grand Totals
	2012	2013	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2010-14
AMGP	-	-	-	2	-	1	-	-	-	-	-	-	-	300
BASA	-	-	-	-	-	-	-	-	-	-	-	-	-	23
BBPL	-	-	-	-	-	-	-	-	-	-	-	-	-	33
BBSA	-	-	-	-	-	-	-	-	-	-	-	-	5	7
BLTU	-	-	-	-	-	-	-	-	-	-	-	-	-	21
BARG	-	-	-	-	-	-	-	-	-	-	-	-	-	6
CRPL	-	-	-	-	-	-	-	-	-	-	-	-	-	20
DUNL	-	-	-	-	-	-	-	-	1	-	-	-	5	804
HUGO	-	-	-	-	3	3	-	-	-	-	-	-	-	9
KILL	-	-	-	-	-	-	-	-	-	-	-	-	-	4
LBDO	-	-	-	-	-	-	-	-	-	-	-	-	1	121
LESA	-	-	-	-	-	1	-	-	-	-	-	-	-	17
PAGP	-	2	-	-	-	-	-	-	-	-	-	-	-	2
PESA	-	-	-	8	-	8	6	-	-	-	-	-	20	522
REKN	-	-	-	-	-	-	-	-	-	-	-	-	-	1
REPH	2	-	-	-	-	-	-	-	-	-	-	-	5	556
RNPH	-	-	6	12	15	38	27	12	43	95	71	1	5	560
RUFF	1	-	-	-	-	-	-	-	-	-	-	-	-	1
RUTU	-	-	-	-	-	-	-	-	-	-	-	-	3	86
SBDO	-	-	-	-	-	-	-	-	-	-	-	-	-	7
SEPL	-	-	8	6	3	1	8	-	-	-	-	-	-	46
SESA	-	-	9	14	16	26	31	34	86	65	66	25	35	1618
STSA	-	-	4	4	2	1	-	-	-	-	-	-	-	11
TEST	1	-	-	-	-	-	-	-	-	-	-	-	-	1
WESA	-	-	-	-	-	-	-	35	101	87	36	30	-	554
WHIM	-	-	5	5	5	3	6	-	-	-	-	-	-	107
WRSA	-	-	-	-	-	-	-	-	-	-	-	-	-	45
Total	**4**	**2**	**32**	**51**	**44**	**82**	**78**	**81**	**231**	**247**	**173**	**56**	**79**	**5482**

Table 5. Number of shorebird chicks (not juveniles caught away from nest) banded at each ASDN site by species from 2010-2014. See Appendix 3 for list of bird species abbreviations. ˝

	Barrow					Bylot Island					Cape Krusenstern			Churchill					Colville	Igloolik
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2012	2013	2014	2010	2011	2012	2013	2014	2012	2014
AMGP	8	33	37	20	33	23	-	4	-	-	-	-	-	-	-	-	-	-	-	7
BASA	3	-	10	-	-	27	7	-	-	-	-	-	-	-	-	-	-	-	-	-
BBPL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
BARG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COSN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CRPL	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-
CUSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DUNL	92	136	121	139	127	-	-	-	-	-	41	19	13	66	65	38	91	39	-	-
HUGO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LBDO	3	58	33	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LESA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LIST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAGP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PESA	34	224	230	138	176	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REPH	119	277	348	213	242	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RNPH	11	23	58	20	13	-	-	-	-	-	7	10	4	14	6	-	-	-	-	-
RUFF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUTU	-	4	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SBDO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-
SEPL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SESA	96	102	148	111	64	-	-	-	-	-	77	5	16	-	-	-	-	-	56	4
SPTS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TEST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WESA	9	14	28	56	8	-	-	-	-	-	57	22	21	-	-	-	-	-	-	-
WHIM	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	17	31	-	-	-
WRSA	-	1	-	-	-	14	-	-	4	-	-	-	-	-	-	-	-	-	-	9
Total	**375**	**872**	**1015**	**720**	**664**	**65**	**7**	**5**	**4**	**6**	**182**	**56**	**54**	**81**	**71**	**55**	**122**	**58**	**56**	**20**

Table 5. Continued

	Lower Khatanga River		Mackenzie Delta					Nome					Grand Totals
	2012	2013	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010-14
AMGP	-	-	-	1	-	-	-	-	-	-	-	-	166
BASA	-	-	-	-	-	-	-	-	-	-	-	-	47
BBPL	-	3	-	-	-	-	-	-	-	-	-	-	4
BARG	2	1	-	-	-	-	-	-	-	-	-	-	3
COSN	-	4	-	-	-	-	-	-	-	-	-	-	4
CRPL	3	2	-	-	-	-	-	-	-	-	-	-	11
CUSA	3	1	-	-	-	-	-	-	-	-	-	-	4
DUNL	-	21	-	-	-	-	-	-	-	-	-	-	1008
HUGO	-	-	-	5	3	-	-	-	-	-	-	-	8
LBDO	2	-	-	-	-	-	-	-	-	-	-	-	119
LESA	-	-	-	-	4	3	-	-	-	-	-	-	7
LIST	12	3	-	-	-	-	-	-	-	-	-	-	15
PAGP	-	7	-	-	-	-	-	-	-	-	-	-	7
PESA	3	6	2	6	-	3	7	-	-	-	-	-	830
REPH	6	4	-	-	-	-	-	-	-	-	-	-	1209
RNPH	-	-	-	8	4	9	8	-	-	187	62	7	451
RUFF	6	13	-	-	-	-	-	-	-	-	-	-	19
RUTU	-	-	-	-	-	-	-	-	-	-	-	-	7
SBDO	-	-	-	-	-	-	-	-	-	-	-	-	19
SEPL	-	-	17	14	3	6	5	-	-	-	-	-	45
SESA	-	-	21	12	19	21	33	2	-	141	60	14	1002
SPTS	3	-	-	-	-	-	-	-	-	-	-	-	3
STSA	-	-	7	4	4	4	-	-	-	-	-	-	19
TEST	12	4	-	-	-	-	-	-	-	-	-	-	16
WESA	-	-	-	-	-	-	-	10	3	257	62	26	573
WHIM	-	-	12	9	-	-	6	-	-	-	-	-	76
WRSA	-	-	-	-	-	-	-	-	-	-	-	-	28
Total	**52**	**69**	**59**	**59**	**37**	**46**	**59**	**12**	**3**	**585**	**184**	**47**	**5700**

Table 6. Percentage of color-marked adults (captured on a nest, on a study plot) that were resighted at ASDN sites in any year following their banding year. See Appendix 3 for list of bird species abbreviations. ˝-˝means no adults of that species were banded at that ASDN site.

Species	Barrow	Burnt-point	Bylot Island	Cape Krusenstern	Canning River	Chaun Delta	Churchill	Coats Island	Colville	East Bay	Igloolik	Ikpikpuk	Lower Khatanga River	Mackenzie Delta	Nome	Prudhoe Bay
AMGP	15	-	33	-	-	-	50	0	-	0	-	-	-	50	-	-
BASA	0	-	21	-	0	-	-	-	-	-	-	-	-	-	-	-
BBPL	-	-	-	-	-	-	-	0	-	7	-	-	-	-	-	-
BBSA	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
BARG	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-
DUNL	36	-	-	56	43	26	43	0	55	0	-	34	-	-	50	0
HUGO	-	-	-	-	-	-	100	-	-	-	-	-	-	67	-	-
LBDO	1	-	-	0	-	-	-	-	-	-	-	0	-	-	-	0
LESA	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
PAGP	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-
PESA	1	-	0	-	1	0	-	-	0	-	-	0	-	0	-	0
REPH	9	-	-	-	4	-	-	0	15	2	0	22	0	-	-	0
RNPH	14	-	-	21	28	0	0	-	17	-	-	28	-	11	33	0
RUFF	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-
RUTU	0	-	-	-	0	-	-	0	62	7	-	-	-	-	-	0
SBDO	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
SEPL	-	-	-	-	-	-	-	-	-	7	-	-	-	0	-	-
SESA	34	-	-	39	46	-	-	18	38	-	0	48	-	18	34	3
STSA	-	-	-	-	-	-	-	-	-	-	-	-	-	30	-	-
WESA	4	-	-	25	-	-	-	-	-	-	-	-	-	-	35	-
WHIM	-	0	-	-	-	-	60	-	-	-	-	-	-	50	-	-
WRSA	0	-	0	-	-	-	-	-	-	2	0	-	-	-	-	-

Table 7. Range and number of food resource data collection events at ASDN sites between 2010 and 2014. Number of collection events is noted in parentheses. Each collection event represents 3 to 5 samples, except for where both bottle traps and sweep net samples were employed for aquatic sampling (East Bay in 2010, and Nome and Canning River in 2011). Twice as many samples were collected at the latter three sites. no: samples not collected.

Site	Terrestrial		Aquatic
	Dry	Mesic	
2010			
Nome	4 June – 10 July (13)	4 June – 10 July (13)	4 June – 10 July (13)
Cape Krusenstern	no	no	no
Barrow	14 June – 29 July (16)	20 June – 29 July (14)	23 June – 29 July (13)
Ikpikpuk	13 June – 13 July (11)	13 June – 10 July (10)	14 June – 13 July (11)
Prudhoe Bay	12 June – 11 July (10)	12 June – 11 July (10)	12 June – 11 July (10)
Canning River	13 June – 7 July (9)	13 June – 7 July (9)	13 June – 7 July (9)
Mackenzie Delta	15 June – 7 July (8)	15 June – 7 July (8)	15 June – 7 July (8)
East Bay	23 June – 25 July (11)	23 June – 25 July (11)	23 June – 25 July (11)
Churchill	2 June – 1 Aug (21)	2 June – 1 Aug (21)	2 June – 1 Aug (21)
2011			
Nome	25 May - 21 July (20)	31 May – 21 July (18)	7 June – 21 July (15)
Cape Krusenstern	3 June – 3 July (11)	3 June – 3 July (11)	3 June – 3 July (11)
Barrow	4 June – 28 July (19)	4 June – 28 July (19)	7 June – 28 July (19)
Ikpikpuk	8 June – 14 July (13)	8 June – 14 July (13)	8 June – 14 July (13)
Prudhoe Bay	no	no	no
Canning River	8 June – 8 July (11)	8 June – 8 July (11)	8 June – 8 July (11)
Colville	28 May – 13 July (16)	3 June – 13 July (14)	31 May – 13 July (15)
Mackenzie Delta	8 June – 11 July (12)	8 June – 11 July (12)	8 June – 11 July (14)
East Bay	19 June – 24 July (13)	19 June – 24 July (10)	no
Churchill	9 June – 30 July (18)	9 June – 30 July (18)	9 June – 30 July (18)
Bylot	12 June – 17 Aug (34)	14 June – 17 Aug (32)	14 June – 1 Aug (23)
2012			
Nome	26 May – 19 July (20)	26 May – 19 July (20)	29 May – 19 Jul (19)
Cape Krusenstern	30 May – 8 July (14)	2 Jun – 8 July (13)	2 Jun – 8 Jul (13)
Barrow	7 June – 28 July (18)	7 June – 28 July (18)	7 June – 28 July (18)
Ikpikpuk	10 Jun – 13 July (12)	10 Jun – 13 Jul (12)	13 Jun – 13 Jul (12)
Prudhoe Bay	no	no	no
Canning River	9 Jun – 12 Jul (12)	12 Jun – 12 Jul (11)	9 Jun – 12 Jul (12)
Colville	28 May – 18 Jul (18)	6 Jun – 28 Jul (15)	6 Jun – 18 Jul (15)
Mackenzie Delta	10 Jun – 7 Jul (10)	10 Jun – 7 Jul (10)	10 Jun – 7 Jul (10)
East Bay	20 Jun – 19 Jul (11)	24 Jun – 19 Jul (9)	no
Churchill	6 Jun – 30 Jul (19)	6 Jun – 30 Jul (19)	6 Jun – 30 Jul (19)
Bylot	15 Jun – 16 Aug (35)	15 Jun – 14 Aug (34)	23 Jun – 31 Jul (20)
Burntpoint	16 Jun – 16 Jul (16)	16 Jun – 16 Jul (16)	no
Chaun Delta	no	no	no
Lower Khatanga	no	no	no

Table 7. Continued.

Site	Terrestrial		Aquatic
	Dry	Mesic	
2013			
Nome	29 May – 13 July (16)	1 June – 13 July (15)	no
Cape Krusenstern	no	no	no
Barrow	1 June – 31 July (20)	1 June – 31 July (20)	7 June – 31 July (18)
Ikpikpuk	no	no	no
Prudhoe Bay	no	no	no
Canning River	no	no	no
Colville	no	no	no
Mackenzie Delta	no	no	no
East Bay	15 Jun – 22 Jul (11)	15 Jun – 22 Jul (11)	no
Churchill	7 Jun – 31 Jul (18)	7 Jun – 31 Jul (18)	4 Jun – 31 Jul (19)
Bylot	17 Jun – 16 Aug (30)	17 Jun – 16 Aug (30)	no
Burntpoint	17 Jun – 2 Jul (8)	17 Jun – 2 Jul (8)	no
Chaun Delta	no	no	no
Lower Khatanga	no	no	no
Igloolik	28 Jun – 2 Aug (13)	28 Jun – 2 Aug (13)	no
Coats Island	no	no	no
2014			
Nome	no	no	no
Cape Krusenstern	no	no	no
Barrow	12 Jun – 6 Aug (36)	12 Jun – 6 Aug (36)	12 Jun – 6 Aug (36)
Ikpikpuk	no	no	no
Prudhoe Bay	no	no	no
Canning River	no	no	no
Colville	no	no	no
Mackenzie Delta	no	no	no
East Bay	no	no	no
Churchill	no	no	no
Bylot	17 Jun – 10 Aug (27)	17 Jun – 10 Aug (27)	no
Burntpoint	13 Jun – 26 Jun (7)	13 Jun – 26 Jun (7)	no
Chaun Delta	no	no	no
Lower Khatanga	no	no	no
Igloolik	25 Jun – 27 Jul (13)	28 Jun – 27 Jul (14)	no
Coats Island	no	no	no

Table 8. Range and number of predator surveys and small mammal inventory at ASDN sites between 2010 and 2014. Number of collection events is noted in parentheses. no = no data were collected.

Site	Predator Point-Counts	Predator / Lemming Index	Lemming Nest Count	Trapping of Lemmings	Small Mammal Daily Species List
2010					
Nome	2 Jun (1)	no	no	yes[1]	18 May – 12 Jul
Cape Krusenstern	no	no	no	no	--
Barrow	1 Jun – 29 Jul (8)	no	yes	yes[2]	25 May – 30 Jul
Ikpikpuk	17 Jun – 7 Jul (3)	no	yes	no	9 Jun – 13 Jul
Prudhoe Bay	17 Jun – 14 Jul (3)	no	yes	no	7 Jun – 17 Jul
Canning River	6 – 30 June (4)	no	yes	no	5 Jun – 10 Jul
Mackenzie Delta	14 Jun – 2 Jul (3)	no	no	no	10 Jun – 5 Jul
East Bay	20 Jun – 22 Jul (3)	no	yes	no	2 Jun – 25 Jul
Churchill	20 July (1)	no	yes	no	25 May – 2 Aug
2011					
Nome	no	18 May – 21 Jul (60)	yes	yes[1]	18 May – 8 Jul
Cape Krusenstern	no	4 – 28 Jun (9)	yes	no	28 May – 3 Jul
Barrow	2 Jun – 26 Jul (9)	2 Jun – 26 Jul (9)	yes	yes[2]	27 May – 1 Aug
Ikpikpuk	no	5 Jun – 16 Jul (39)	yes	no	4 Jun – 16 Jul
Colville	no	30 May – 13 Jul (45)	yes	no	18 May – 31 Jul
Prudhoe Bay	no	no	no	no	4 Jun – 18 Jul
Canning River	7 Jun (1)	7 Jun – 10 Jul (12)	yes	no	3 Jun – 12 Jul
Mackenzie Delta	no	7 Jun – 7 Jul (17)	no	no	5 Jun – 10 Jul
East Bay	no	no	yes	no	11 Jun – 25 Jul
Churchill	no	9 Jun – 20 Jul (24)	yes	no	26 May – 3 Aug
Bylot Island	no	7 Jun – 16 Aug (35)	yes	yes[3]	5 Jun – 5 Aug
2012					
Nome	no	15 May – 13 Jul (57)	no	yes[1]	13 May – 19 Jul
Cape Krusenstern	no	27 May – 8 Jul (14)	no	no	19 May – 8 Jul
Barrow	4 Jun – 24 Jul (9)	4 Jun – 24 Jul (9)	yes	yes[2]	24 May – 31 Jul
Ikpikpuk	no	6 Jun – 12 Jul (35)	yes	no	5 Jun – 15 Jul
Colville	no	30 May – 15 Jul (42)	yes	no	18 May – 19 Jul
Prudhoe Bay	no	8 Jun – 21 Jul (39)	yes	no	2 Jun – 21 Jul
Canning River	no	5 Jun – 10 Jul (10)	yes	no	3 Jun – 15 Jul
Mackenzie Delta	no	9 Jun – 3 Jul (6)	no	no	5 Jun – 8 Jul
East Bay	no	7 – 15 Jun (9)	yes	no	7 Jun – 23 Jul
Churchill	no	24 Jun – 24 Jul (29)	yes	no	1 Jun – 6 Aug
Bylot Island	no	1 Jun – 20 Aug (40)	yes	yes[3]	1 Jun – 15 Aug
Burntpoint	no	no	yes	no	6 Jun – 18 Jul
Chaun Delta	no	19 Jun – 10 Jul (16)	no	no	16 Jun – 10 Jul
Lower Khatanga	no	17 Jun – 16 Jul (28)	yes	no	no
2013					
Nome	no	13 May – 9 Jul (50)	no	yes[1]	13 May – 9 Jul
Cape Krusenstern	no	30 May – 4 Jul (20)	no	no	24 May – 9 Jul
Barrow	3 Jun – 16 Jul (8)	3 Jun – 16 Jul (8)	yes	yes[2]	23 May – 29 Aug
Ikpikpuk	no	7 Jun – 13 Jul (33)	yes	no	5 Jun – 15 Jul
Colville	no	30 May – 15 Jul (46)	yes	no	16 May – 16 Jul
Prudhoe Bay	no	2 Jun – 18 Jul (39)	no	no	2 Jun -21 Jul
Canning River	no	4 Jun – 19 Jul (17)	yes	no	2 Jun – 20 Jul
Mackenzie Delta	no	9 Jun – 8 Jul (7)	no	no	6 Jun – 11 Jul
East Bay	no	no	yes	no	7 Jun – 18 Jul

Table 8. Continued

2013 Continued					
Churchill	no	no	yes	no	1 – 21 Jun
Bylot Island	no	14 Jun – 19 Aug (66)	yes	yes[3]	7 Jun – 21 Aug
Burntpoint	no	no	yes	no	5 Jun – 3 Jul
Chaun Delta	no	7 Jun – 7 Jul (27)	no	no	7 Jun – 7 Jul
Lower Khatanga	no	no	yes	no	no
Igloolik	no	15 Jun – 21 Jul (21)	yes	yes	15 Jun – 21 Jul
Coats Island	no	no	no	no	18 – 28 Jun
2014					
Nome	no	14 May – 1 Jul (44)	no	no	14 May – 1 Jul
Cape Krusenstern	no	22 May – 5 Jul (25)	no	no	22 May – 5 Jul
Barrow	no	5 Jun – 5 Aug (10)	yes	yes[2]	5 Jun – 5 Aug
Ikpikpuk	no	5 Jun – 5 Jul (42)	yes	no	5 Jun – 5 Jul
Colville	no	26 May – 29 Jul (54)	yes	no	26 May – 29 Jul
Prudhoe Bay	no	5 Jun – 23 Jul (15)	no	no	5 Jun -23 Jun
Canning River	no	3 Jun – 19 Jul (47)	yes	no	3 Jun – 19 Jul
Mackenzie Delta	no	9 Jun – 30 Jun (9)	no	no	9 Jun – 30 Jun
East Bay	no	no	yes	no	no
Churchill	no	30 May – 24 Jul (49)	yes	no	30 May – 24 Jul
Bylot Island	no	no	yes	yes[3]	no
Burntpoint	no	no	yes	no	12 – 13 Jun
Chaun Delta	no	11 Jun – 6 Jul (23)	no	no	11 Jun – 6 Jul
Lower Khatanga	no	no	yes	no	no
Igloolik	no	15 Jun – 18 Jul (26)	yes	yes	15 Jun – 18 Jul
Coats Island	no	7 Jun – 20 Jul (40)	no	no	7 Jun – 20 Jul

[1] Live trapping conducted by ASDN staff.
[2] Trapping of lemmings is being conducted independently of the ASDN by Kaithryn Ott (live-traps; USFWS, Ecological Services) and Denver Holt (snap traps; Owl Research Institute).
[3] Live and snap trapping of lemmings are being conducted independently of the ASDN by Gilles Gauthier's field personnel located at Université Laval, Quebec City, Canada.

Table 9. Sampling period, frequency and method for estimating snow and surface water measurements at each ASDN site between 2010 and 2014.

	Nome	Cape Krusenstern	Barrow	Ikpikpuk	Colville River	Prudhoe Bay	Canning River	Mackenzie Delta	East Bay	Churchill	Bylot Island
2010: snow											
Sampling Period	no	no	30 May – 19 Jun	9 – 29 Jun	n/a	4 – 19 Jun	5 – 30 Jun	No snow present	2 Jun – 25 Jul	no	n/a
Frequency†	no	no	2d	3-5d	n/a	3-5d	5d	n/a	1d	no	n/a
Method	no	no	50 m^2	50 m^2	n/a	50 m^2	50 m^2	n/a	Area	no	n/a
Date 50% loss	no	no	12 Jun	Unk[2]	n/a	Unk[3]	15 Jun	n/a	9 Jun	no	n/a
2010: surface water											
Sampling Period	4 Jun – 10 Jul	no	22 Jun – 24 Jul	12 Jun – 3 Jul	n/a	15 Jun – 13 Jul	10 Jun – 7 Jul	no	2 Jun – 25 Jul	no	n/a
High Center polygons	no	no	6	4	n/a	5	10	no	no	no	n/a
Low centered polygons	no	no	6	4	n/a	5	10	no	no	no	n/a
Non-polygonized	no	no	6	4	n/a	5	no	no	no	no	n/a
Pond	8	no	6	4	n/a	5	10	no	no	no	n/a
Tidal inlet	8	no	no	no	n/a	no	no	no	no	no	n/a
General Study area	no	no	no	no	n/a	no	no	no	1	no	n/a
2011: snow and surface water combined											
Sampling Period	20 May – 20 Jul	7 – 20 Jun	29 May – 26 Jul	9 – 29 Jun	20 May – 13 July	3 Jun – 16 Jul	6 Jun – 9 Jul	6 Jun – 6 Jul	15 Jun – 25 Jul	24 May – 28 Jul	18 May – 8 July
Frequency†	2d, then 7d	7d	2d, then 7d	3-5d	2d, then 7d	2-4d	5d	1d, then 5d	1d	3d, then 7d	3d
Method	Area	Area	50 m^2	50 m^2	Area	50 m^2	50 m^2	Area	Area	Area	Area
Date 50% loss	20 May	Unk‡	14 Jun	Unk‡	30 May	Unk‡	11 Jun	Unk‡	Unk‡	Unk‡	9 Jun
2012: snow and surface water combined											
Sampling Period	17 May – 13 Jul	20 May – 29 Jun	29 May – 24 Jul	6 June – 12 Jul	19 May – 15 Jul	2 Jun – 15 Jul	5 – 30 Jun	5 Jun – 3 Jul	9 Jun – 21 Jul	6 Jun – 10 Jul	2 – 27 Jun
Frequency†	2d, then 7d	variable	2d, then 7d	2d, then 5 d	2d, then 7d	2d, then 7d	2 d, then 5d	7d	1d, then 3,7d	Variable	3d
Method	100 m Area	Area	50 m^2	50 m^2	50 m^2	50 m^2	50 m^2	Area	Area	Area	Area
Date 50% loss	21 May	21 May	8 Jun	Unk‡	3 Jun	Unk‡	Unk‡	Unk‡	11-17 Jun	Unk‡	10 Jun

Table 9. Continued

	Nome	Cape Krusenstern	Barrow	Ikpikpuk	Colville River	Prudhoe Bay	Canning River	Mackenzie Delta	East Bay	Churchill	Bylot Island
2013: snow and surface water combined											
Sampling Period	21 May – 2 July	27 May – 2 Jul	30 May – 16 Jul	7 Jun – 16 Jul	18 May – 9 Jul	2 Jun – 18 Jul	3 Jun – 13 Jul	9 Jun – 7 Jul	9 – 18 Jul	3 Jun – 27 Jul	7 – 20 Jun
Frequency†	Variable	2d, then variable	2d, then 7d	7 d	2d, then 7	5-7d	3d, then 7d	7d	1-3d	7d	3d
Method	100 m Area	Area	50 m^2	50 m^2	50 m^2	50 m^2	50 m^2	Area	Area	Area	Area
Date 50% loss	26 May	29 May	2 Jun	Unk‡	7 Jun	Unk‡	Unk‡	Unk‡	15 Jun	Unk‡	10 Jun
2014: snow and surface water combined											
Sampling Period	18 May – 25 Jun	23 May – 5 Jul	31 May – 5 Aug	5 Jun – 17 Jul	24 May – 16 Jul	no	5 Jun – 13 Jul	6 Jun – 7 Jul	11 – 14 Jun	31 May – 7 Jul	no
Frequency†	Variable	2d, then variable	7d	7 d	2d, then 7	no	3d, then 7d	7d	1-3d	7d	no
Method	100 m Area	Area	50 m^2	50 m^2	50 m^2	no	50 m^2	Area	Area	Area	no
Date 50% loss	Unk‡	Unk‡	11 Jun	15 Jun	24 May	Unk‡	6 Jun	Unk‡	15 Jun	Unk‡	10 Jun

No = no sampling done; n/a = not applicable since ASDN site was not established

† d = day; #d, then #d indicates interval snow was measured and then surface water was measured.

‡ Unk = Unknown, snow was <50% when field camp was established

Table 9. Continued

	Burntpoint	Chaun Delta	Lower Khatanga	Igloolik	Coats Island
2012: snow and surface water combined					
Sampling Period	No	No	30 May – 14 June	n/a	n/a
Frequency[†]	n/a	n/a	daily	n/a	n/a
Method	n/a	n/a	Area - satellite	n/a	n/a
Date 50% loss	n/a	25 May	4 Jun	n/a	n/a
2013: snow and surface water combined					
Sampling Period	No	No	28 May – 11 June	16 Jun – 9 Jul	no
Frequency[†]	n/a	n/a	Variable	1d, then variable	no
Method	n/a	n/a	Area – satellite	Area	no
Date 50% loss	n/a	Unk[‡]	2 Jun	19 Jun	no
2014: snow and surface water combined					
Sampling Period	No	No	No	11 Jun – 25 Jun	10 Jun – 20 Jul
Frequency[†]	n/a	n/a	n/a	daily	Variable
Method	n/a	n/a	n/a	Area	Area
Date 50% loss	Unk[‡]	Unk[‡]	8 Jun	21 Jun	Unk[‡]

[#] No = no sampling done; n/a = not applicable since ASDN site was not established

[†] d = day; #d, then #d indicates interval snow was measured and then surface water was measured.

[‡] Unk = Unknown, snow was <50% when field camp was established

Table 10. Dates where weather information was collected at ASDN sites between 2010 and 2014.[1]

	Nome	Cape Krusenstern	Barrow	Ikpikpuk	Colville River	Prudhoe Bay	Canning River	Mackenzie Delta	East Bay	Churchill	Bylot Island
2010											
Sampling Period	16 May – 12 Jul	no	25 May – 31 Jul	10 Jun – 13 Jul	no	4 Jun – 18 Jul	4 Jun – 11 Jul	9 Jun – 7 Jul	3 Jun – 27 Jul	25 May – 2 Aug	n/a
Method	Remote	no	Fixed	Remote	no	Fixed	Remote	Remote	Remote	Fixed	n/a
Interval	1 hr	no	1 hr	1 hr	no	1 hr	1 hr	1 hr	12h	4 hr	n/a
2011											
Sampling Period	16 May – 21 Jul	2 Jun – 4 Jul	1 May – 31 Aug	5 Jun – 16 Jul	10 Jun – 9 Aug	1 Jun – 30 Jul	5 Jun – 13 Jul	7 Jun – 11 Jul	17 Jun – 22 Jul	1 May – 15 Aug	5 Jun – 5 Aug
Method	Remote	Remote	Fixed	Remote	Remote	Fixed	Remote	Remote	Remote	Fixed	Fixed
Interval	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	12h	4 hr	1 hr
2012											
Sampling Period	20 May – 21 Jul	1 May – 27 Jun	1 May – 31 Aug	12 Jun – 16 Jul	19 May – 9 Aug	1 Jun – 1 Jul	5 Jun – 16 Jul	5 Jun – 9 Jul	12 Jun – 27 Jul	1 Jun – 6 Aug	1 Jun – 15 Aug
Method	Remote	Fixed, Remote	Fixed	Remote	Remote	Fixed	Remote	Remote	Remote	Fixed	Fixed
Interval	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr
2013											
Sampling Period	26 May – 13 Jul	2 Jun – 9 Jul	1 May – 31 Aug	5 June to 15 Jul	18 May – 13 Aug	1 May – 31 Aug	3 Jun – 21 Jul	8 Jun – 11 Jul	5 Jun – 25 Jul	1 Jun – 2 Aug	7 Jun – 21 Aug
Method	Remote	Remote	Fixed	Remote	Remote	Fixed	Remote	Remote	Remote	Fixed	Fixed
Interval	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr
2014											
Sampling Period	19 May – 1 Jul	1 May – 31 Jul	1 May – 31 Aug	5 June to 19 Jul	1 May – 31 Aug	1 May – 31 Aug	4 Jun – 19 Jul	7 Jun – 12 Jul	14 Jun – 25 Jul	29 May – 7 Aug	7 Jun – 21 Aug
Method	Remote	Remote	Fixed	Remote	Remote	Fixed	Remote	Remote	Remote	Fixed	Fixed
Interval	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr

Table 10. Cont.

	Burntpoint	Chaun Delta	Lower Khatanga	Igloolik	Coats Island
2012					
Sampling Period	1 May – 30 Aug	18 May – 28 Aug	18 Jun – 16 Jul	n/a	n/a
Method	Fixed	Fixed	Remote	n/a	n/a
Interval	1 hr	3 hr	daily	n/a	n/a
2013					
Sampling Period	1 Jun – 31 Jul	no	21 Jun – 23 Jul	15 Jun – 31 Aug	no
Method	Fixed	no	Remote	Fixed	no
Interval	1 hr	no	Daily	1 hr/variable	no
2014					
Sampling Period	1 Jun – 30 Jun	no	19 Jun – 17 Jul	8 Jun – 26 Jul	29 Jun – 24 Jul
Method	Fixed	no	Remote	Fixed	Remote
Interval	1 hr	no	30 min	1 hr	daily

[1] No = no data collected, n/a = no data available since site not established

Figure 1. Location of the sixteen ASDN sites active between 2010 and 2014. Map courtesy of JF Lamarre.

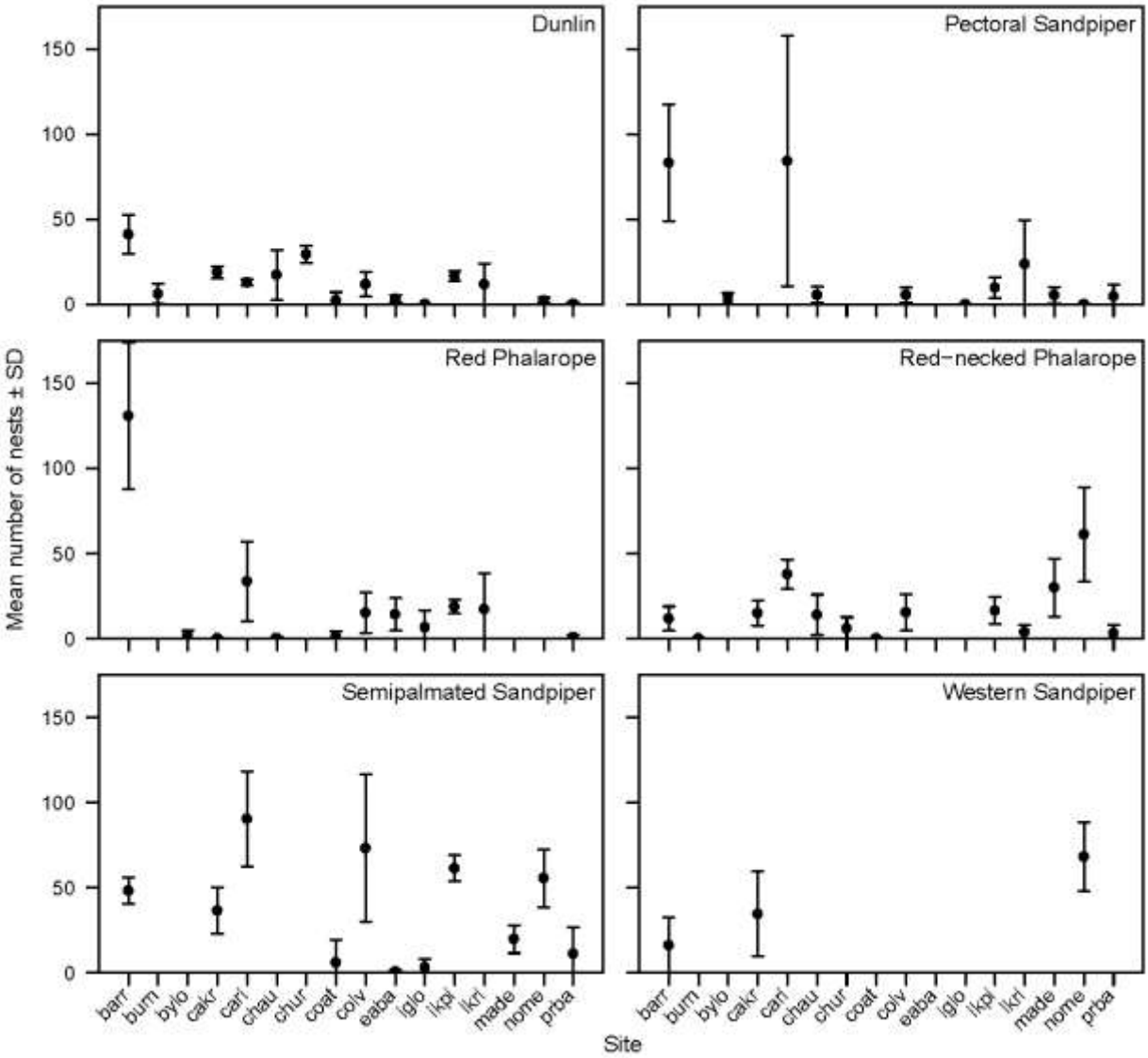

Figure 2. Variation in the number of nests found for the six focal species at each ASDN site between 2010 and 2014. See Appendix 1 for list of site abbreviation codes.

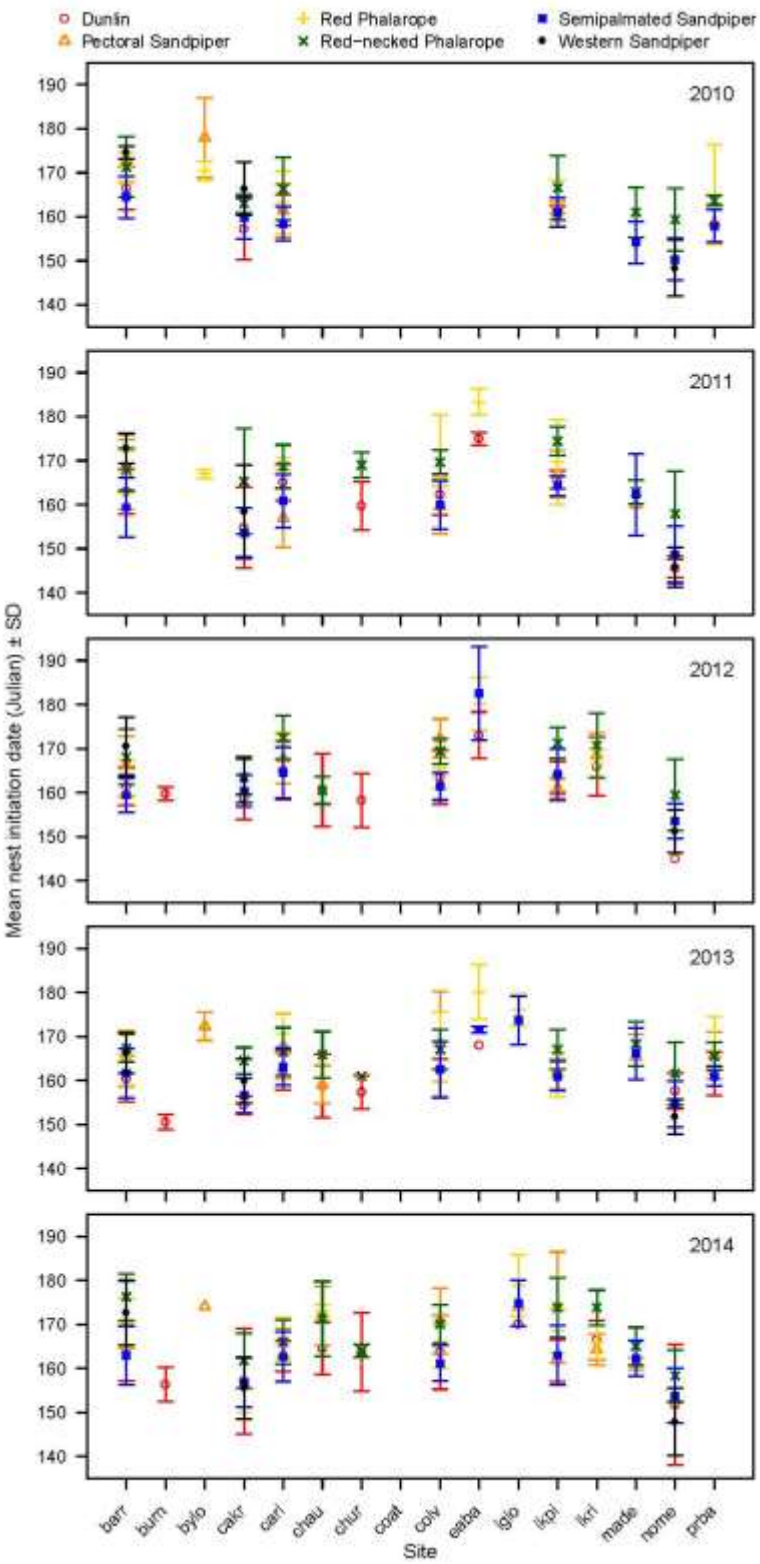

Figure 3. Nest initiation dates of the six focal species at each ASDN site between 2010 and 2014. See Appendix 1 for list of site abbreviation codes.

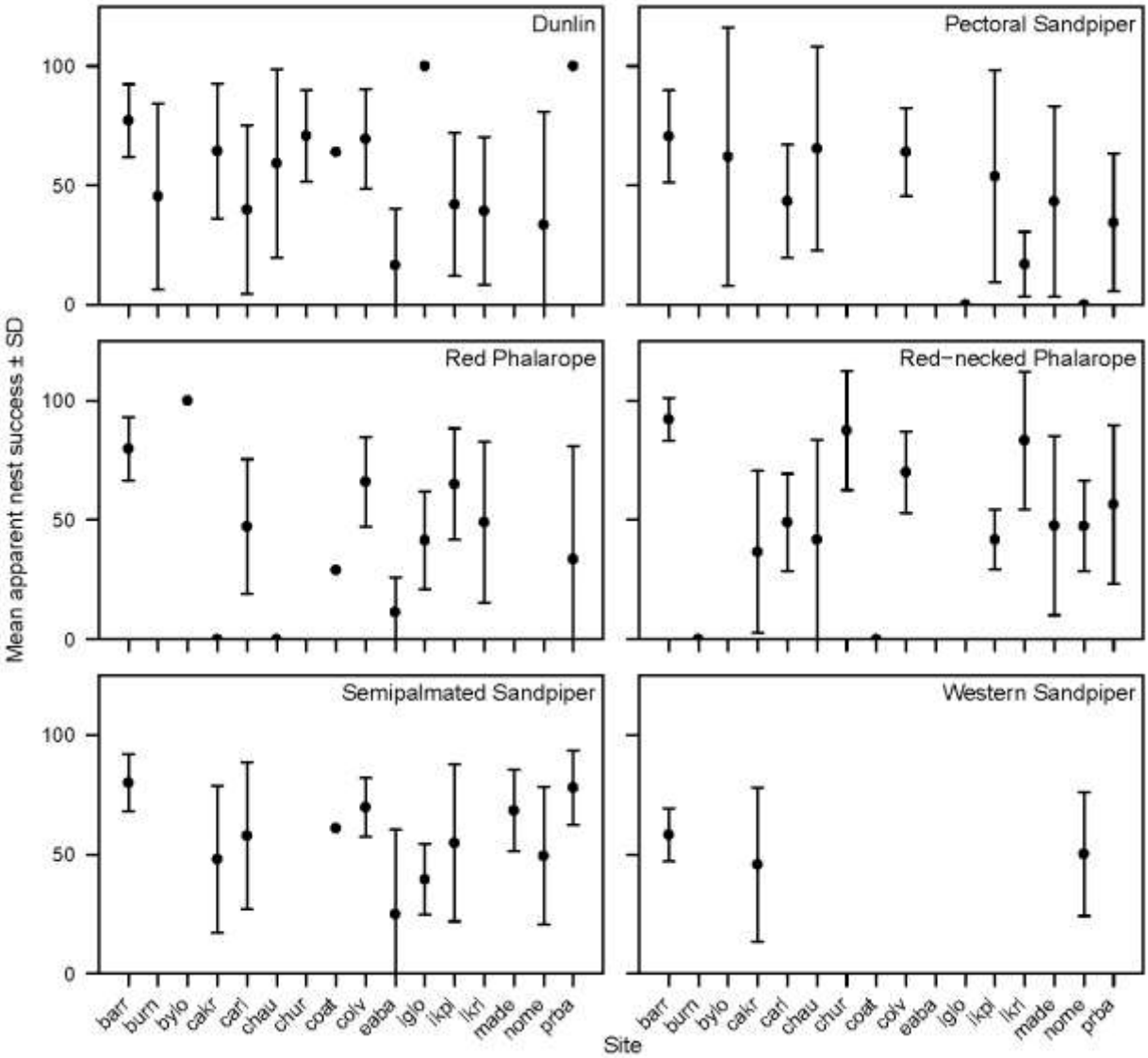

Figure 4. Variation in nest success for the six focal species at each ASDN site between 2010 and 2014. See Appendix 1 for list of site abbreviation codes.

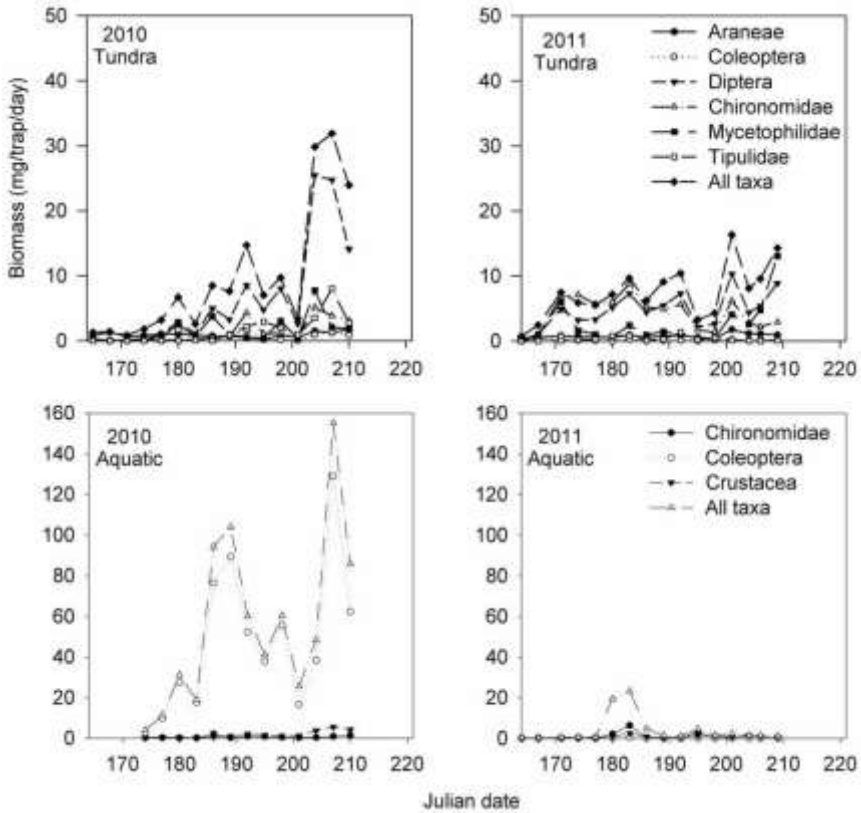

Figure 5. Seasonal variation in invertebrate biomass from mesic/xeric tundra samples and aquatic samples near Barrow, Alaska from 2010 - 2011.

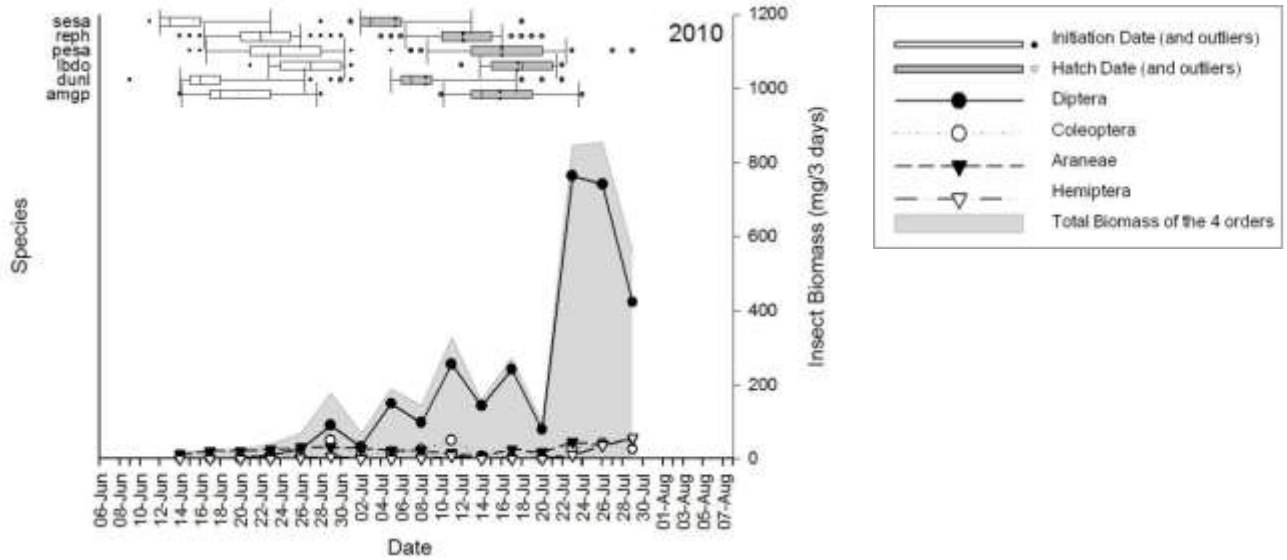

Figure 6. Phenology of shorebird egg-laying, hatch, and invertebrate emergence at Barrow, Alaska in 2010. Biomass abundance is listed for four dominant invertebrate orders (all families combined) separately and together (gray shaded area). Box plots illustrate 25% and 75% quartiles, median (solid line), mean (dashed line), and outliers (dots outside of bars).

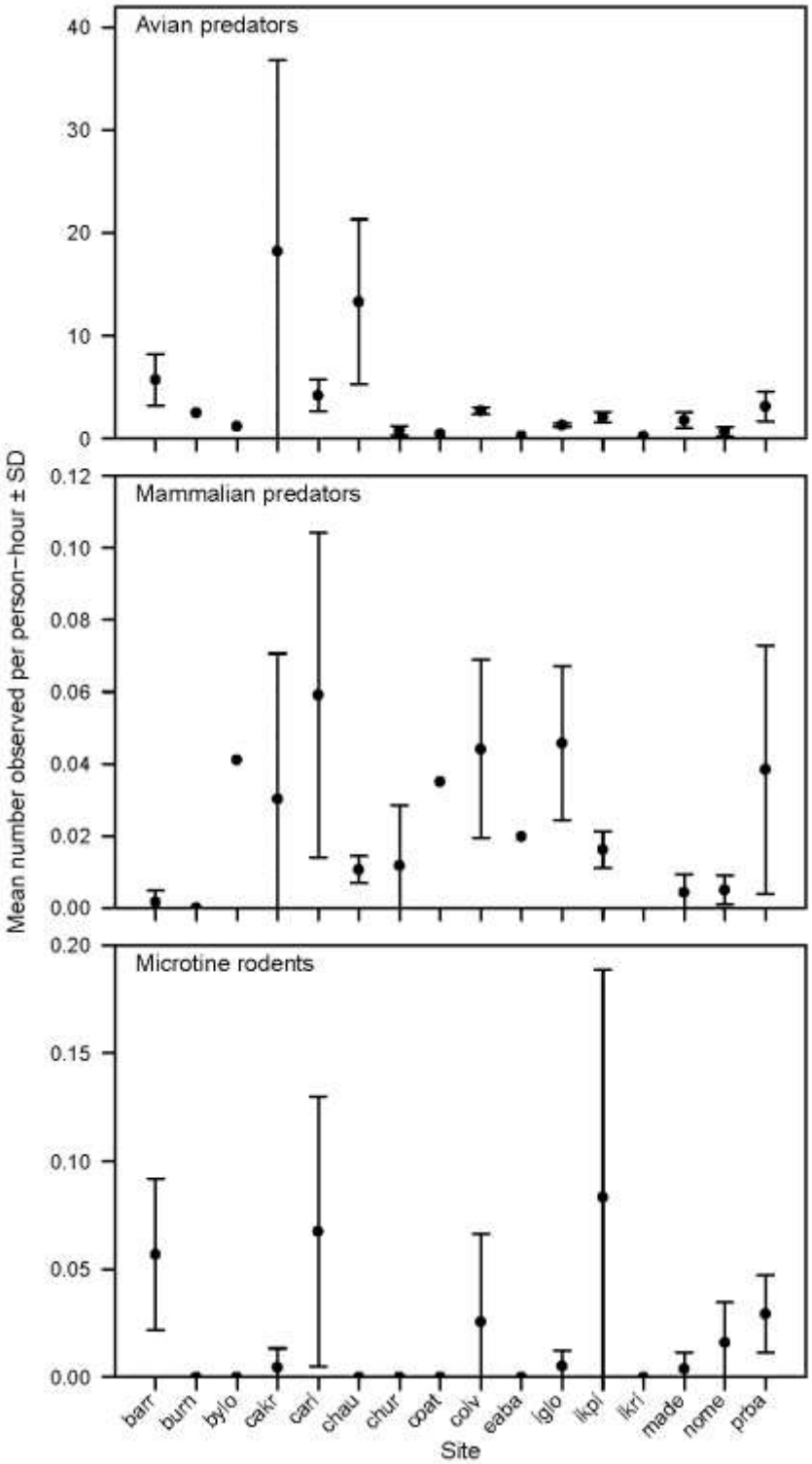

Figure 7. Variation in avian and mammalian predators, and microtine rodents at each ASDN site between 2011 and 2014. Predator and lemming counts are from the Daily_pred_lemm datasheet, and are only available for 2011-2014. (Not all sites shown have data for every year.) See Appendix 1 for list of site abbreviation codes.

Figure 8. Example of a remote weather station deployed at ASDN sites.

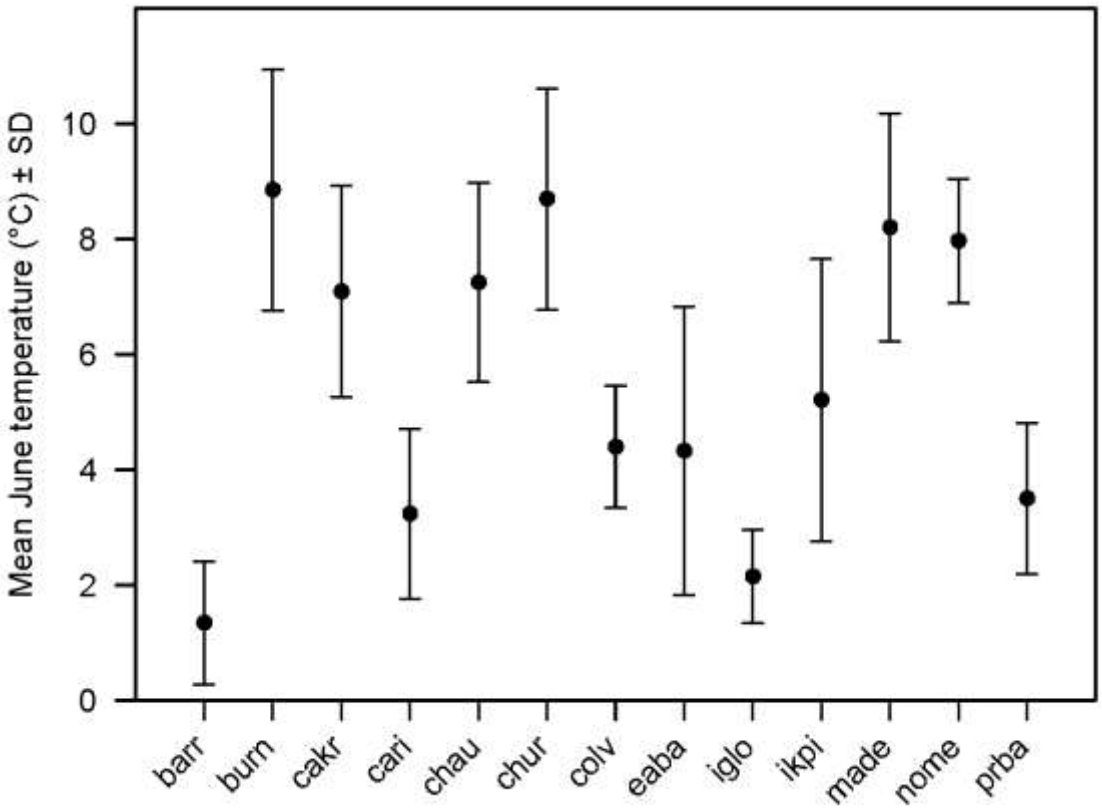

Figure 9. Variation in mean June temperatures at each ASDN site from 2010 - 2014. Temperatures are from HOBOs when available; otherwise from nearby permanent weather station. See Appendix 1 for list of site abbreviation codes.

Appendix 1. ASDN field camp name abbreviations, location and size.

Code	Site name	Location	Latitude	Longitude	Total Study Plot Area (ha)
barr	Barrow	Alaska, USA	71.3	-156.6	220.4
burn	Burntpoint Creek	Ontario, Canada	55.2	-84.3	63.0
bylo	Bylot Island	Nunavut, Canada	73.2	-80.0	723.6
cakr	Cape Krusenstern	Alaska, USA	67.1	-163.5	54.1
cari	Canning River Delta	Alaska, USA	70.1	-145.8	722.0
chau	Chaun River Delta	Chukotka, Russia	68.8	170.6	248.2
chur	Churchill	Manitoba, Canada	58.7	-93.8	866.9
coat	Coats Island	Nunavut, Canada	62.9	-82.5	1239.1
colv	Colville River Delta	Alaska, USA	70.4	-150.7	324.8
eaba	East Bay	Nunavut, Canada	64.0	-81.7	1205.5
iglo	Igloolik	Nunavut, Canada	69.4	-81.6	59.8
ikpi	Ikpikpuk	Alaska, USA	70.6	-154.7	174.1
lkri	Lower Khatanga River	Krasnoyarsk, Russia	72.9	106.1	270.9
made	Mackenzie Delta	Northwest Territories Canada	69.4	-135.0	667.3
nome	Nome	Alaska, USA	64.4	-164.9	90.1
prba	Prudhoe Bay	Alaska, USA	70.3	-148.6	120.0

Appendix 2. Sponsoring organization(s), principal investigators, and graduate students for ASDN sites established between 2010 and 2014.

ASDN Site	Institution	Principal Investigator	Graduate Student(s)
Active sites in 2010			
Nome, Alaska, USA	Simon Fraser University, Kansas State University	David Lank, Brett Sandercock	Eunbi Kwon (PhD) Willow English (MSc)
Cape Krusenstern, Alaska, USA	U.S. Fish and Wildlife Service, Migratory Bird Management, University of Alaska Fairbanks	Richard Lanctot (formerly River Gates), Abby Powell	Megan Boldenow (MSc)
Barrow, Alaska, USA	U.S. Fish and Wildlife Service, Migratory Bird Management	Richard Lanctot, Sarah Saalfeld	Andy Doll (MSc) Jenny Cunningham (MSc) Kirsten Grond (PhD)
Ikpikpuk River, Alaska, USA	Wildlife Conservation Society	Martin Robard, Rebecca Bentzen (formerly Joe Liebezeit and Steve Zack)	
Prudhoe Bay, Alaska, USA	Wildlife Conservation Society	Martin Robard, Rebecca Bentzen (formerly Joe Liebezeit and Steve Zack)	
Canning River, Alaska, USA	U.S. Fish and Wildlife Service, Arctic NWR; Manomet Center for Conservation Sciences;	David Payer, Stephen Brown (formerly Steve Kendall)	
Mackenzie Delta, Northwest Territories, Canada	Environment Canada	Jennie Rausch, Paul Woodard (formerly Lisa Pirie)	
East Bay, Nunavut, Canada	Environment Canada, Smith and Associates Ecological Research Ltd	Grant Gilchrist, Paul Smith	
Churchill, Manitoba, Canada	Trent University, Cornell University	Erica Nol Laura McKinnon	Nathan Senner (PhD) Laura Koloski (MSc) Johanna Perz (MSc)
New in 2011			
Bylot Island, Nunavut, Canada	University of Quebec at Rimouski	Joël Bêty	Jean-François Lamarre (PhD)
Colville River Delta, Alaska, USA	U.S. Geological Survey, Alaska Science Center	David Ward Dan Ruthrauff	
Reduced in 2011			
Prudhoe Bay, Alaska, USA	Wildlife Conservation Society	Martin Robards, Rebecca Bentzen (formerly Joe Liebezeit and Steve Zack)	
New in 2012			
Burntpoint, Ontario	Ontario Ministry of Natural Resources	Rod Brook, Ken Abraham, Kim Bennett	
Chaun River Delta,	Ornithology Institute of Biological	Diana Solovyeva,	

ASDN Site	Institution	Principal Investigator	Graduate Student(s)
Russia	Problems of the North, Wildlife Conservation Society	Martin Robards, Rebecca Bentzen	

Appendix 2. Continued

ASDN Site	Institution	Principal Investigator	Graduate Student(s)
New in 2013			
Lower Khatanga River, Taimyr, Russia	Lomonosov Moscow State University	Mikhail Soloviev	
Coats Island, Nunavut, Canada	Environment Canada, Manomet Center for Conservation Sciences	Paul Smith, Stephen Brown	
Igloolik, Nunavut, Canada	Université de Moncton, Moncton, NB	Nicolas Lecomte, Marie-Andree Giroux	

Appendix 3. Species whose nests were located or were banded at ASDN sites between 2010 and 2014. Species are listed alphabetically by common name to match other tables.

Common name	Scientific name	4-letter acronym
American Golden-Plover	*Pluvialis dominica*	AMGP
Baird's Sandpiper	*Calidris bairdii*	BASA
Bar-tailed Godwit	*Limosa lapponica*	BARG
Black Turnstone	*Arenaria melanocephala*	BLTU
Black-bellied Plover	*Pluvialis squatarola*	BBPL
Bristle-thighed Curlew	*Numenius tahitiensis*	BTCU
Broad-billed Sandpiper	*Calidris falcinellus*	BBIS
Buff-breasted Sandpiper	*Calidris subruficollis*	BBSA
Common Ringed Plover	*Charadrius hiaticula*	CRPL
Common Snipe	*Gallinago gallinago*	COSN
Curlew Sandpiper	*Calidris ferruginea*	CUSA
Dunlin	*Calidris alpina*	DUNL
Hudsonian Godwit	*Limosa haemastica*	HUGO
Killdeer	*Charadrius vociferus*	KILL
Least Sandpiper	*Calidris minutilla*	LESA
Lesser Yellowlegs	*Tringa flavipes*	LEYE
Little Stint	*Calidris minuta*	LIST
Long-billed Dowitcher	*Limnodromus scolopaceus*	LBDO
Marbled Godwit	*Limosa fedoa*	MAGO
Pacific Golden-Plover	*Pluvialis fulva*	PAGP
Pectoral Sandpiper	*Calidris melanotos*	PESA
Purple Sandpiper	*Calidris maritima*	PUSA
Red Knot	*Calidris canutus*	REKN
Red Phalarope	*Phalaropus fulicarius*	REPH
Red-necked Phalarope	*Phalaropus lobatus*	RNPH
Red-necked Stint	*Calidris ruficollis*	RNST
Rock Sandpiper	*Calidris ptilocnemis*	ROSA
Ruddy Turnstone	*Arenaria interpres*	RUTU
Ruff	*Calidris pugnax*	RUFF
Sanderling	*Calidris alba*	SAND
Semipalmated Plover	*Charadrius semipalmatus*	SEPL
Semipalmated Sandpiper	*Calidris pusilla*	SESA
Sharp-tailed Sandpiper	*Calidris acuminata*	SPTS
Short-billed Dowitcher	*Limnodromus griseus*	SBDO
Spotted Redshank	*Tringa erythropus*	SPRE
Spotted Sandpiper	*Actitis macularius*	SPSA
Stilt Sandpiper	*Calidris himantopus*	STSA
Temminck's Stint	*Calidris temminckii*	TEST
Western Sandpiper	*Calidris mauri*	WESA
Whimbrel	*Numenius phaeopus*	WHIM
White-rumped Sandpiper	*Calidris fuscicollis*	WRSA
Wilson's Snipe	*Gallinago delicata*	WISN
Wood Sandpiper	*Tringa glareola*	WOSA

Appendix 4. Sponsoring organization(s), principal investigators, and graduate students for side projects associated with the ASDN.

Side Project	Institution	Principal Investigator (s)	Graduate Student(s)
Avian Influenza monitoring	U.S. Fish and Wildlife Service	Richard Lanctot	
Avian Malaria	University of Florida Gainesville	Sam Wisely	Claudia Ganser (PhD) Jamie Nicholson (BS)
Dunlin Migratory Connectivity	U.S. Fish and Wildlife Service	Richard Lanctot Stephen Yezerinac	
Semipalmated Sandpiper Migratory Connectivity – stable Isotopes	New Jersey Audubon	David Mizrahi	
Gut Microbiota	Kansas State University	Brett Sandercock	Kirsten Grond (PhD)
Mercury Exposure	Biodiversity Research Institute, McGill University	Dave Evers Iain Stenhouse	Marie Perkins (PhD)
Spring Phenology and Nest Initiation	Environment Canada, U.S. Geological Survey	Kirsty Gurney David Ward	
Invertebrate Phenology	University of Alaska Anchorage	Daniel Rinnella	
Phenological Mismatch	Kansas State University	Brett Sandercock	Eunbi Kwon (PhD)
American Golden-Plover Migratory Connectivity	Université du Québec à Rimouski	Joël Bêty	Jean-François Lamarre (PhD)
Semipalmated Sandpiper Migratory Connectivity – geolocators	Manomet Center for Conservation Sciences, New Jersey Audubon, Environment Canada, U.S. Fish and Wildlife Service	Stephen Brown David Mizrahi Cheri Gratto-Trevor Richard Lanctot	
Moss Dispersion	University of Connecticut	Chris Elphick	Lily Lewis (PhD)
Variation In Nest Predation	Environment Canada, Wildlife Conservation Society	Paul Smith Joe Liebezeit	
Settlement Patterns	U.S. Fish and Wildlife Service	Sarah Saalfeld Richard Lanctot	
Drivers of Shorebird Declines	University of Bath, University of Cambridge,	Tamás Székely Tatsuya Amano Hélène Deleu William J. Sutherland	Sergio Ancona (PhD)

Appendix 4. Continued.

Side Project	Institution	Principal Investigator (s)	Graduate Student(s)
Distribution of Arctic Invertebrates	Aquatic Biology Associates, Inc., University of California San Diego, University of New Mexico	Bob Wisseman Joe Bowden Kelly Miller	
Stress Measures In Winter-grown Feathers	University of Alaska Fairbanks	Abby Powell, Sasha Kitaysky	Megan Boldenow (MSc)
Incubation Patterns	Max Planck Institute for Ornithology	Bart Kempenaers	Martin Bulla (PhD)
Geolocator Effects	Kansas State University	Emily Weiser	
Patterns of Genetic Diversity	University of Bath, Cardiff University	Tamás Székely, Mike Bruford	Josie D'Urban Jackson (PhD)
Effects of Feather Sampling	British Trust for Ornithology	Sam Franks, David Hodkinson	
Feather and Blood Archive	U.S. Fish and Wildlife Service	Richard Lanctot	