Alaska Shorebird Group

Summaries of ongoing or new studies of Alaska shorebirds during 2009

November 2009

No. 8

Compiled and edited by Joe Liebezeit for the Alaska Shorebird Group. Anyone wanting additional information about these studies should contact the individual(s) noted at the end of each project summary. Data provided within annual summaries should not be cited or used for any purpose without prior approval from the responsible contact person

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A note from the compiler:

Welcome to the 2009 summary report of ongoing or new studies of Alaska shorebirds. This is the eighth consecutive report put together by the Alaska Shorebird Group. In this document I compiled summaries for 27 studies highlighting many interesting projects investigating Alaska shorebirds. The number of studies reported here is down from 34 in 2008. A few projects have been completed since last year but it is also likely that some projects were not reported here. Please spread the word about this summary to other biologists studying Alaska shorebirds who may be unfamiliar with this effort. This summary is the only written record we have of shorebird projects in the region and provides a valuable timeline of such activities. In the future, we recommend that authors include information on how the study is specifically addressing objectives in the Alaska Shorebird Plan. Only one summary explicitly included such information this year.

Among the 27 projects there were a total of 65 investigators involved in these projects, 23 of which participated in more than one project. Women led nine of the total studies (33%) and accounted for 32% of the total investigators. Academic institutions led most of the studies (12 of the 27; 44%). Government agencies came up second leading 9 of the 27 projects (33%). For government agencies this included the U.S. Fish and Wildlife Service (n = 6), the U.S. Geological Survey (n = 2), and the U.S. Forest Service (n = 1). Lead academic institutions included the University of Alaska – Fairbanks (n = 6), Montana State University (n = 2), Brigham Young University, Simon Fraser University, Bishop's University, and the University of Delaware. The remaining five principal investigators represented non-government organizations including the Wildlife Conservation Society (n = 2), Audubon Alaska, Max Planck Institute for Ornithology, Prince of William Sound Science Center, and Katchemak Bay Birders.

As in the previous three years, in 2009, a significant number of projects had some component of Avian Influenza [H5N1] sampling involved (at least 8 of the 27 studies 30%). The map of our study site locations within Alaska (on the back page) clearly shows that shorebirds live up to their name, with all study sites, except for one, located relatively close to the coastline. Three studies were conducted entirely or partially overseas at Alaska shorebird wintering grounds or at stopover points along their migration routes. These studies ranged far and wide including four different countries / territories and Hawaii.

I would like to acknowledge the photographers who graciously allowed the use of their superb images in this document. Photo credits and a brief caption are listed for each photo. I also thank Rick Lanctot for assisting me in obtaining many of the summaries for this report. Finally, thanks to all the hard efforts of everyone involved in these important studies. We look forward to many more years of fruitful research on Alaska's shorebirds.

Contact: Joe Liebezeit (compiler), Wildlife Conservation Society, 718 SW Alder Street, Suite 210, Portland, OR 97205. Phone: 503-241-7231; email: jliebezeit@wcs.org.

PROJECT SUMMARIES

1. SITE FIDELITY WITIN THE COPPER RIVER DELTA, ALASKA BY MIGRANT SHOREBIRDS – Bishop

Investigator: Mary Anne Bishop, Prince William Sound Science Center

Migrant shorebirds are likely to exhibit fidelity in stopover site selection between years because coastal stopover sites are often widely spaced and limited in number. In 2008, we began a study at Hartney Bay on the western Copper River Delta to determine if site fidelity between years to specific locations is a common behavior during spring migration. During May 2009 we mist-netted and color-banded three species of shorebirds: Western Sandpiper (n = 58), Least Sandpiper (n = 94), and Semipalmated Plover (n = 8). We were unsuccessful in capturing Dunlin even though they are a common shorebird on the Delta. All birds received a green flag on the lower right and a USFWS band on the upper left leg. Color bands on the lower left leg were used to distinguish year cohort (light blue for 2009) and age. Adults received one light-blue band, while juveniles (based on molt) received two light-blue bands. We measured exposed culmen, flattened wing, and mass. We also scored fat visible in the furculum of the clavicle. Despite relatively low numbers at Hartney Bay compared with previous years, we recorded 3 resightings (1 Western Sandpiper, 2 Least Sandpiper) from the 2008 banded cohort. No birds banded in 2008 were recaptured in 2009. During spring 2010 we will color-band as well as search for returning color-banded shorebirds at Hartney Bay.

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

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2. EXTRA-PAIR PATERNITY, MATE RETENTION, NATAL PHILOPATRY IN RUDDY TURNSTONES AND BLACK-BELLIED PLOVERS AT WOLLEY LAGOON, SEWARD PENINSULA, ALASKA – Bruner et al.

Investigators: Phil Bruner, Andrea Bruner, Jennifer Johnson, and Roger Shane Gold, Department of Biology, Brigham Young University, Hawaii.

Our 2009 field season (9-22 June) was more productive than 2008 due to favorable weather. We lost only one nest to Arctic Foxes. This was the first year since our work at this site began in 1988 that we have seen Arctic Fox in our study area. Only one Red Fox was observed in 2009. We, however, had several three-egg Ruddy Turnstone and Black-bellied Plover nests. These may have been second clutches so perhaps predator pressure and harsh weather preceded our arrival.

We obtained DNA from blood samples of four previously untested pairs of Ruddy Turnstones plus their chicks. In addition we collected DNA from the chicks of three Ruddy Turnstone pairs we had previously (2007, 2008) obtained DNA. We are awaiting the extra-pair paternity findings from this 2009 DNA. We suspect similar results to our 2007, 2008 data which revealed that Ruddy Turnstones are socially but not reproductively monogamous. This season we also initiated an extra-pair paternity investigation of Black-bellied Plovers which nest at

Woolley Lagoon. We collected DNA from five pairs and their chicks. Results of this first attempt are also pending.

We had one Ruddy Turnstone pair together for their third consecutive breeding season. The female of this pair has only one functional leg. This has not affected her ability to retain her mate and nest successfully. Other interesting observations in 2009 included the return of a male Ruddy Turnstone to his same breeding territory for five consecutive seasons. Each season he has had a different mate. This year, the female was one that was originally banded in 2007 on a territory three miles away. Three chicks, two from 2004 and one from 2007, were seen back in their natal territories in 2009. The semi-colonial nesting behavior and small insular breeding population of Ruddy Turnstones at Woolley Lagoon may account for the regular observations of natal philopatry at this site. We have banded 47 Black-bellied Plover chicks between 1997 and 2003 at Woolley Lagoon but have had no natal philopatry in this population.

We had one of our undergraduate biology students with us this past season. She initiated the first phase of our investigation into whether or not nest cup location in Ruddy Turnstones is non-random. Her work involved determining the composition of biotic and abiotic components in a $1m^2$ area surrounding the nest cup. Thirty nest cup sites were photographed and 200 data points in each site were collected for a total of 6000 samples. These data are currently being evaluated and compared to data we previously obtained from Pacific and American Golden-Plover and Black-bellied Plover. Data from the territories of each of the 30 Ruddy Turnstone nests remains to be collected before we can conclude whether or not one or more of the components of the ground cover are significantly more abundant in the area immediately ($1m^2$) around the nest cup. In the three species of plover we found significantly more lichens around the nest cup. This may decrease aerial detection of the eggs which could be one factor favoring the location of the nest cup.

We will be at our Woolley Lagoon study site in June 2010. Our efforts will once again focus on obtaining DNA samples to test for extra-pair paternity investigations in both Ruddy Turnstones and Black-bellied Plovers. We will also begin examination of ground cover components in our Ruddy Turnstone territories. We will be joined by Sheila Conant, Ornithology Professor from University of Hawaii and perhaps another undergraduate biology student from BYUH.

Contact: Phil Bruner, Biology Dept. BYUH, 55-220 Kulanui St., Laie, HI 96762; Phone: 808-293-3820; email: brunerp@byuh.edu.

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3. ESTIMATING THE SIZE OF MIGRATORY SHOREBIRD POPULATIONS ON THE STIKINE RIVER DELTA USING AERIAL DIGITAL PHOTOGRAPHY - Cady and Anthony

Investigators: Melissa Cady, Tongass National Forest, Wrangell Ranger District; and Mike Anthony, USGS Retired.

The Stikine River Delta is a critical migratory stopover for shorebirds and waterfowl, but managers have very little current, reliable population data to substantiate its importance. To obtain contemporary estimates of shorebird numbers during spring migration on the Stikine River Delta, we assembled and tested an aerial photography system, which included high-

resolution digital cameras and automated computer analysis of images. We also hoped to evaluate feasibility of this system given weather, flight safety, and tidal conditions typical of the area. Between 2 and 8 May 2009, we took 1365 photographs at altitudes ranging from 500 to 1500'. We used four different camera configurations and both helicopter and fixed-wing aircraft as platforms for our pilot study. Most photographs that yielded countable images of shorebirds were taken at or below 1000' flight altitude. Weather conditions ranged from sunny to high overcast. Unfortunately, our attempts to determine the minimal weather conditions necessary to optimize this technology were inhibited by unusually fair weather.

In addition to our field efforts, we examined future tide forecasts and historic weather records during the spring migration window to assess the likelihood for favorable sampling conditions in future years and to determine optimal sampling dates. Because aerial photography is best conducted at a relatively high tide, we used the tide forecasts to determine dates when favorable tides occurred during daylight hours when aircraft flight was possible. This analysis indicated that adequate tide conditions occurred during daylight hours during the spring migration window during most years. Weather data were sparse, despite the presence of a weather station within five miles of the Stikine Delta. Temperature and precipitation data were complete, but wind, ceiling and visibility data were lacking, preventing us from reliably assessing whether weather conditions would have limited our aerial photography efforts in past years.

We used Photoshop and Fovea Pro to automate counting of shorebirds on photographs. We were surprised by the large variation in background colors and contrast along the mudflats, caused by areas with algae, grasses, or gravelly surfaces. Despite this challenge, imagery analysis indicated shorebirds could be counted reliably, and if an appropriate sampling regime was implemented, should allow us to estimate the number of shorebirds using the Stikine River Delta during spring migration. Further development of this methodology could be important for use on stopover and staging sites throughout the Pacific Flyway, although we caution that the size of the staging area should be considered due to limited, optimal flight windows available to survey.

U. S. Forest Service International Programs and the Copper River Migratory Bird Initiative provided funding for this project.

Contact: Melissa Cady, Wrangell Ranger District, PO Box 51, Wrangell, AK 99929; Phone: 907-874-7502; email: mncady@fs.fed.us.

Ron Hall and Melissa Cady prepare for aerial photography of shorebirds on the Stikine River.

***4. RESOURCE AVAILABILITY FOR SHOREBIRDS AT DELTA MUDFLATS DURING THE POST-BREEDING PERIOD IN THE ARCTIC NATIONAL WILDLIFE REFUGE** – Churchwell et al.*

Investigators: Roy Churchwell, University of Alaska, Fairbanks; Abby Powell, U. S. Geological Survey, Alaska Cooperative Fish and Wildlife Research Unit; Steve Kendall, U.S. Fish and Wildlife Service; Stephen Brown, Manomet Center for Conservation Sciences.

Studies have established that several species of shorebirds congregate along the coast of the Arctic National Wildlife Refuge during the post-breeding period. It is thought these birds are staging in preparation for a southern migration; however, it is possible these birds are already migrating when they reach refuge coastal areas. This research was initiated to investigate shorebird use of refuge delta mudflats during the post-breeding period.

We will estimate the abundance of invertebrates and shorebirds on refuge mudflats. Comparisons will be made to test our hypothesis that shorebird and invertebrate abundances are positively correlated. We will also measure blood triglyceride levels of birds using individual mudflats to create an index of habitat quality. We expect triglyceride levels to be positively correlated with bird and invertebrate abundance, but if we find this is not the case it would indicate the birds are not using all available resources due to some other factor such as predation pressure. Finally, we will attempt to calculate stopover time at each mudflat to see if there is a correlation between food resource availability and time spent on mudflats and to investigate if

these birds are staging prior to migration or stopping over in the midst of migration. Beyond the invertebrate and bird data we also collected data on weather and lagoon water levels that we hope to use to model the available habitat for shorebirds.

This year (2009) was the first field season for data collection and a pilot year for developing methods for the remainder of the study. We focused on one delta mudflat, the Jago River delta. We collected data on weather, water level, and tried to develop a digital elevation model (DEM) of the mudflat. The DEM was to be created from a survey of the mudflat at a 50-meter scale using a surveyor's laser level. This ended up being a monumental task that could not be completed given our time and personnel. However, it may be possible to create a DEM of the mudflat using high resolution elevation/image data (LIDAR) obtained from an aerial survey of coastal areas, but we need to first assess LIDAR's limitations. We collected invertebrate data at two scales (50 and 400 meter); and will use these data to determine the proper scale for future sampling. We also collected samples to determine the relationship between invertebrates and soil moisture, carbon content, and grain size.

We created a grid system across the mudflat for estimating shorebird abundance and use. Shorebirds were counted within each 100-meter cell every 3 days between mid-July and the end of August. We also captured Semipalmated Sandpipers early (within the first two weeks of surveys) and late (within the last two weeks of surveys) in the season to collect blood samples. We color-banded all captured Semipalmated Sandpipers and Dunlin. We attempted to resight marked birds during subsequent bird censuses but resighting rates were too low to calculate stopover time. We tried to capture Dunlin with mist-nets, noose mats, single nooses, walk-in traps, and a net gun but we were unsuccessful in capturing enough birds for our analyses.

We will analyze soil and invertebrate data during winter 2009/2010. We will also determine the proper scale and adequate sample size for invertebrate sampling to be used for the remainder of the study. We will analyze triglyceride samples during spring 2010 to determine if there is enough variability in the samples that we might detect differences between mudflats and to make sure the samples were collected correctly. Data collection of the bird abundance data went as we had planned, and we will look for correlations with invertebrate and triglyceride data this spring. In 2010 we plan to expand the study to three refuge deltas to investigate invertebrates and shorebirds.

Contacts: Roy Churchwell, University of Alaska Fairbanks, Biology and Wildlife Dept. 211 Irving I, Fairbanks, AK 99775. Phone: 907-474-5062; email: roychurchwell@hotmail.com; Steve Kendall, Arctic National Wildlife Refuge, 101 12th Ave., Room 236, Fairbanks, AK 99701. Phone: 907-456-0303; email: steve_kendall@fws.gov.

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5. REPLACEMENT CLUTCH LAYING IN AN ARCTIC-BREEDING SHOREBIRD IN RESPONSE TO EXPERIMENTAL REMOVAL – Gates et al.

Investigators: H. River Gates, U.S. Fish and Wildlife Service & University of Alaska, Fairbanks; Richard B. Lanctot, U.S. Fish and Wildlife Service; Abby N. Powell, U.S. Geological Survey.

Replacement of lost clutches is thought to be rare among Arctic-breeding shorebirds, due to energetic and time constraints of relaying, incubating and rearing offspring. During 2007—2009, we experimentally removed clutches from Dunlin to determine replacement clutch laying rates. Adults were radio-equipped at initial nests, their clutches were removed during early ($\bar{x}$ = 5.2 days, n = 60) and late incubation ($\bar{x}$ = 13 days, n = 29), and individuals were followed to detect replacement nests, assess divorce rate, and examine renest intervals. Eighty-seven percent of the females laid replacement clutches after early removal, while only 43% replaced clutches after late removal. Divorce rate was low in all years (8 %), and in all cases, males remained on their original territory while females moved (> 5 km) to renest. The average renest interval was six days for both early and late removal treatments. This unexpectedly high rate of clutch replacement suggests a female's propensity to lay a replacement clutch is not likely constrained by latitudinal factors as expected.

Contact: H. River Gates, email: hrivergates@gmail.com, Dept. of Biology and Wildlife. University of Alaska - Fairbanks, 209 Irving 1, P.O. Box 757020, 902 Koyukuk Ave., Fairbanks, AK 99775-7020.

Dunlin banded in Barrow, Alaska Brooke Hill

6. COMPARISON OF MORPHOLOGICAL AND GENETIC TECHNIQUES FOR SEX DETERMINATION IN ALASKAN DUNLIN (Calidris alpina arcticola and pacifica) *– Gates et al.*

Investigators: H. River Gates, U.S. Fish and Wildlife Service & University of Alaska, Fairbanks; Stephen M. Yezerinac, Bishop's University; Richard B. Lanctot, U.S. Fish and Wildlife Service; Abby N. Powell, U. S. Geological Survey.

The inability to accurately determine sex of sexually monomorphic bird species hinders studies of sex-specific behaviors, pair dynamics, and population demographics. Determining the sex of adult Dunlin in the field is problematic due to their weak size dimorphism and indistinct dichromatism. Previous studies show that females are heavier, have longer exposed culmens, wings, and tarsi, and exhibit a less decurved bill shape, whereas males tend to have a darker more distinct black breast patch. However, there is considerable overlap between sexes and variation among age classes. To assess the accuracy of different sexing techniques, we compared several morphological classifications to a genetic determination of sex. Measurements were taken from 448 breeding Northern Dunlin (*Calidris alpina arcticola*) at Barrow, Alaska, between 2003 and 2009, and 71 breeding Pacific Dunlin (*C. a. pacifica*) at three sites on the Yukon Delta in 2009. All individuals were captured on the nest; body mass, flattened wing chord, exposed culmen, and diagonal tarsus were measured according to standardized methods. DNA was extracted from blood or feather samples collected at the time of capture and the sex determined using PCR amplification of distinctly-sized fragments of the CHD1 genes on the W and Z chromosomes. We separately derived four morphological indicators of sex, assuming females were larger, based on: (1) absolute size of exposed culmen using distinct cutoff points derived from the literature; (2) relative size of exposed culmen compared to mate; (3) absolute overall body size (e.g. exposed culmen, wing and body mass) (4) relative overall body size compared to mate. We first evaluated the genetic sex classification by testing known-sex birds. We then assessed the precision and accuracy of each of these four field measures of sex against the genetic classification. Finally, we used Discriminant Function Analysis to predict individual sex using morphology measures for each subspecies in situations where no genetic testing is available.

Contact: H. River Gates, email: hrivergates@gmail.com, Dept. of Biology and Wildlife. University of Alaska Fairbanks, 209 Irving 1, P.O. Box 757020, 902 Koyukuk Ave., Fairbanks, AK 99775-7020.

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7. PACIFIC SHOREBIRD MIGRATION PROJECT *– Gill et al.*

Investigators: Bob Gill, Lee Tibbitts, Dan Ruthrauff, Dave Douglas, Dan Mulcahy, and Colleen Handel, U.S. Geological Survey; Chris Harwood, U.S. Fish and Wildlife Service; Nils Warnock, U. California, Davis; Gary Page, PRBO Conservation Science; Nathan Senner, Cornell University; Theunis Piersma, Global Flyway Network and University of Grönnigen; and Jesse Conklin and Phil Battley, Massey University.

The Pacific Shorebird Migration Project (PSMP) began its fifth year of fieldwork in 2009. The project continues to use remote sensing technology, primarily satellite telemetry, to address fundamental questions about the movement ecology of members of the tribe Numeniini (curlews and godwits). Six studies were initiated or continued in 2009. New studies included: 1) solar-powered backpack satellite transmitters (PTTs; 18 -g units) placed on 7 nesting Long-billed Curlews in Montana, 2) surgically implanted PTTs (26-g units) attached to 15 adult Black-tailed Godwits nesting in The Netherlands, and 3) 15 PTTs (26-g units) implanted in Whimbrels nesting on Kanuti NWR, Alaska. Nathan Senner continued his work on Hudsonian Godwits by retrieving geolocators placed on nesting godwits at Churchill, Manitoba, in 2008, and by deploying 25 new geolocators on birds captured on nests in Upper Cook Inlet (Beluga area). We continued to receive data from Long-billed Curlews and Marbled Godwits that were satellite-tagged in previous years. In addition, PSMP personnel and volunteers conducted a week-long reconnaissance of sites on the North Slope of Alaska (about the Colville River basin) where both nesting Bar-tailed Godwits and Whimbrels could be captured in 2010.

Highlights of these efforts (through late October 2009) include:

Numenius americanus: In May 2009, the PSMP and PRBO Conservation Science teamed with The Nature Conservancy (TNC) of Montana and the World Wildlife Fund to capture curlews nesting on TNC's Matador Ranch in north-central Montana. Seven curlews (3 females, 4 males) were fitted with solar-powered PTTs and tracked on southward migration. All migrated east of the Rocky Mountains with initial stops on agricultural areas in Colorado, New Mexico, or Texas; five soon continued south into Mexico and settled in agricultural areas in the states of Chihuahua, Tamaulipas, Durango, Aguascalientes, and Nuevo Leon. Of the two birds that stopped in the U.S., one recently moved to Mexico to coastal wetlands in Tamaulipas.

N. phaeopus: Thanks to Chris Hardwood and crew (see report this volume), nests or territorial pairs of Whimbrel were located at the Kanuti study site prior to the arrival of the 'implant crew' making this probably the least taxing of the PSMP efforts to date. In the end, 13 of 15 nests associated with implanted birds successfully hatched. All marked birds moved to coastal western Alaska following nesting where they staged for about a month before embarking on direct, nonstop flights to the Pacific Coast of North America. Initial landfall extended from southern California to Central America where most birds staged again for several weeks before initiating a second, nonstop flight to countries along the Pacific Coast of South America. Since then, two birds have continued to move south and have reached the Chiloe region of Chile.

Limosa l. limosa: PSMP expertise in use of satellite telemetry technology with Numeniini taxa was incorporated into a Global Flyway Network/BirdLife International- funded project to assess seasonal movements of Black-tailed Godwits nesting in agricultural landscapes of the Netherlands. In May, 15 birds were implanted with PTTs programmed to capture various phases of their annual cycle through their northward migration in spring 2010. Nine marked birds were tracked to wintering sites in West Africa in the countries of Mauritania, Guinea-Bissau, Senegal, and Mali; five birds remained in Europe in Spain and Portugal.

L. haemastica: In 2009, an unusually late spring throughout much of the Canadian Arctic resulted in one of the poorest godwit nesting efforts on record. Only 8 of 22 birds marked in

2008 were seen on the breeding grounds in 2009 and only 4 of these attempted to nest. Fortunately, all four were captured and information from their geolocators indicated they had successfully been tracked throughout the intervening year, including on both their southward (autumn 2008) and northward (spring 2009) migrations. An exploratory trip was made to Kanuti NWR in June 2009 to assess this site as a potential third study site for Hudsonian Godwits.

In 2010, we will assess the southward migration of Bar-tailed Godwits and Whimbrels nesting north of the Brooks Range, and continue work on Hudsonian Godwit populations at Churchhill, Manitoba, and at Susitna Flats and Kanuti NWR, Alaska.

Contacts: Bob Gill or Lee Tibbitts, USGS Alaska Science Center, 4210 University Drive, Anchorage, AK 99508; Phone BG 907-786-7184, LT 907-786-7038; email: robert_gill@usgs.gov or lee_tibbitts@usgs.gov.

Sex differences in godwits Dan Ruthrauff

8. WHIMBREL AND HUDSONIAN GODWIT BREEDING NEAR KANUTI LAKE, KANUTI NATIONAL WILDLIFE REFUGE, 2009 – *Harwood et al.*

Investigators: – Christopher Harwood, Dennis Kuleta, Pam Valle, U. S. Fish and Wildlife Service; Robert Gill, Lee Tibbitts, Dan Ruthrauff, Dan Mulcahy, U. S. Geological Survey; Nathan Senner, Cornell University; Sarah Warnock, Pacific Shorebird Migration Program.

In June 2008, Kanuti NWR biologists documented the breeding of at least 10 pairs each of Whimbrels (*Numenius phaeopus*) and Hudsonian Godwits (*Limosa haemastica*) in and near a

small, approximately five square-kilometer-patch of tundra adjacent to the refuge's administrative cabin at Kanuti Lake. USGS Alaska Science Center shorebird researchers studying the migration of Pacific Basin curlews and godwits were notified about this small, but largely accessible population. A partnership was established and plans were initiated to deploy satellite transmitters (PTTs) in 15 Whimbrels in June 2009. In addition, attempts would be made to fit Hudsonian Godwits with geolocators.

Kanuti NWR personnel arrived at the cabin on 30 April, 2009, just preceding the first arrivals of the Whimbrels and Hudsonian Godwits on 4 May. Breeding behavior of both species was observed promptly upon arrival, including Whimbrel copulation on 9 May. The first Whimbrel nest was discovered during laying (2 eggs) on 20 May and the first completed clutch (4 eggs) was observed on 22 May. USGS personnel arrived on 6 June, with 16 active Whimbrel nests having been located, providing a sufficient pool of birds from which to capture and deploy PTTs. Three additional Whimbrel nests were found by 10 June. Preliminary mean nearest neighbor distance for the 19 nests was 212 m (range 105–515 m). Helicopter surveys of surrounding areas did not suggest comparable concentrations of Whimbrels breeding on or near the refuge. No Hudsonian Godwit nests were located at any time and no geolocators were deployed.

Four Whimbrel nests failed prior to capture attempts, while one likely failed post-capture. Eleven nests were observed on 13–14 June in various stages of hatch (i.e., already hatched (1), hatching (4), pipped (1), starred (5)). Two nests were still being incubated at this time; however, telemetry data from individuals from these two nests that remained in the study area until at least 1 July suggest that those nests too may have hatched. No evidence of failure or success existed for one nest. The first Hudsonian Godwit brood, estimated at 3 days old, was observed on 9 June. At least eight Hudsonian Godwit families were ultimately located in the study area, primarily during Whimbrel capture efforts and subsequent nest re-checks.

Crews were absent from the study area from 14 June to 11 July. Kanuti NWR personnel returned to investigate habitat characteristics of the study area and nest sites. Analysis of those data is pending. One implanted male Whimbrel was last observed tending sizable, likely volant young on 14 July. An unbanded male Whimbrel (mate was implanted), whose nest contained starred eggs on 14 June, was vociferously alarm calling and mobbing ravens as of 16 July. Volant juvenile Hudsonian Godwits were observed congregating (10 individuals) in the study area as of 13 July. Nesting studies for both Whimbrels and Hudsonian Godwits are again scheduled for the 2010 breeding season.

Contact: Chris Harwood, U. S. Fish and Wildlife Service, Kanuti NWR, 101 12th Ave., Room 262, Fairbanks, AK. 99701; email: christopher_harwood@fws.gov.

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9. FACTORS AFFECTING CHICK SURVIVAL OF DUNLIN NEAR BARROW, ALASKA – Hill et al.

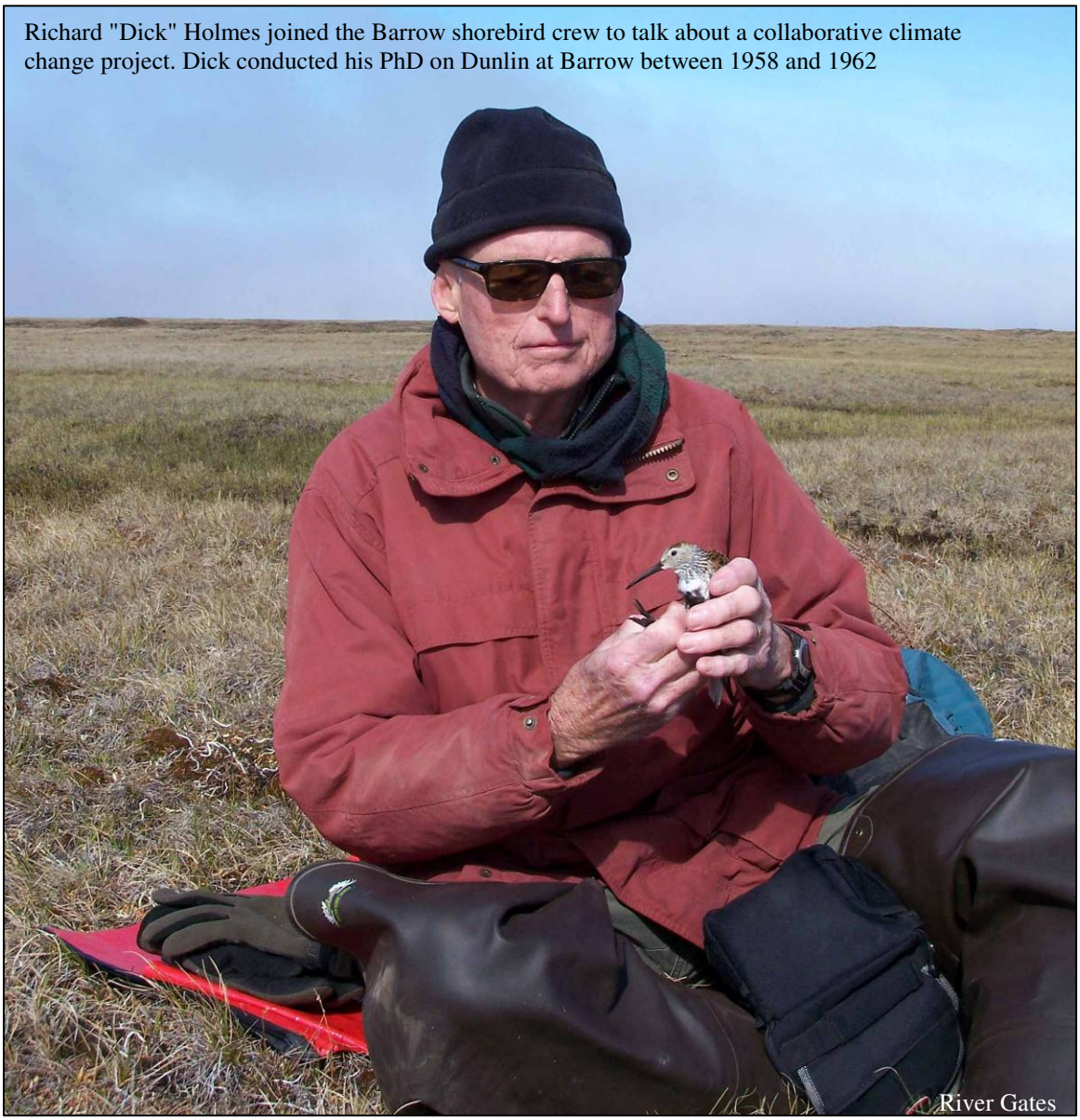
Investigators: Brooke Hill and Christine Hunter, University of Alaska – Fairbanks; and Richard Lanctot, U.S. Fish & Wildlife Service.

During the summers of 2008 and 2009, we studied chick survival of dunlin (*Calidris alpina arcticola*) and investigated the factors that affect their survival. There is a general lack of knowledge on how well precocial shorebird chicks fare after hatching. Monitoring chick fates is

logistically challenging because chicks are small, cryptic, and highly mobile. Several studies have found fledging success of waterbirds to be affected by hatch date, size at hatch, weather, insect abundance, and lemming abundance.

We investigated chick survival at three types of nests: unmanipulated (control) nests, and early and late replacement nests, from which an initial nest had been removed either early or late into incubation (see R. Gates summary). Eggs from initial clutches were removed 3-8 days into incubation in the early treatment, and 12-16 days in the late treatment. Replacement nests were found by tracking radio-equipped adults captured at the initial nests. To evaluate chick survival, we put radio transmitters on two chicks from initial and replacement clutches. We monitored 66 broods (2008: n = 38; 2009: n = 28) until their fate was determined. Of these broods, 19 broods were from experimental replacement clutches (early: n = 13; late: n = 6) in 2008, and only 8 broods (early: n = 7; late: n = 1) were from replacement clutches in 2009. Chicks were monitored at 2-day intervals until they fledged, died, or their radio signal was lost. During each visit we listened for radios and when possible visually counted the number of chicks present. When a chick with a radio was missing from a brood, we searched the surrounding areas and if possible determined the cause of death. For those chicks where we could determine a cause of death, chicks died from predators or adverse environmental conditions. Predators included both mammalian and avian species. Chicks found in burrows were assumed killed by a mammalian species, either brown lemmings or weasels. Chicks found in pellets were assumed killed by an avian species, presumably snowy owls or jaegers. We also assessed food availability from the beginning of hatch until the last broods fledged using arthropod pitfall traps. This approach provided a crude measure of terrestrial insect abundance. We also collected data on hatch date, weather (daily mean temperature, wind, and rainfall), predator abundance (using point count surveys), lemmings (daily counts) and chick mass at hatch. These factors will be evaluated to assess their impacts on individual and overall brood survival.

Contact: Brooke Hill, University of Alaska – Fairbanks, Biology & Wildlife Department, 211 Irving I, PO Box 756100, Fairbanks, AK 99775; email: blhill@alaska.edu.



Richard "Dick" Holmes joined the Barrow shorebird crew to talk about a collaborative climate change project. Dick conducted his PhD on Dunlin at Barrow between 1958 and 1962

10. PACIFIC AND AMERICAN GOLDEN-PLOVERS: GEOLOCATOR STUDIES NEAR NOME, ALASKA – *Johnson, W. et al.*

Investigators: Wally Johnson, Department of Ecology, Montana State University; Roger Goodwill and R. Shane Gold, Department of Biology, Brigham Young University–Hawaii; Richard Lanctot, USFWS, Anchorage.

We are using geolocators (data loggers) to study annual movements in the two species of golden-plovers that nest on the Seward Peninsula. The first phase of the project was conducted last summer in the Nome region. We captured nesting plovers during the period 12-28 June 2009 at several sites accessible along the Nome –Teller Road from mile 5 northwest of Nome to the Wooley Lagoon area near mile 40. Most trapping efforts were directed toward obtaining males as they are especially site faithful from year-to-year and more likely than females to return to the

same nesting territories in 2010. We equipped each bird (15 male Pacific Golden-Plovers; 6 male and 2 female American Golden-Plovers) with a 1.4 g geolocator (British Antarctic Survey model MK-14) attached to a leg band. The latter was worn on either the right or left tibiotarsus above (proximal to) a USGS metal band. A unique combination of color-bands was placed on the opposite tibiotarsus. Our plan is to re-trap the birds next season, retrieve the data loggers, and download the information stored therein. Also, we will capture additional individuals of each species and affix geolocators to them. These two plovers are among the world's longest-distance migrants, and we hope our efforts will significantly advance current knowledge of their migratory routes, wintering ground connectivity, and flight times across oceanic barriers.

Contact: Oscar W. Johnson, Department of Ecology, Montana State University, Bozeman, MT 59715. Phone: 406-585-3502; email: owjohnson2105@aol.com.

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11. GEOLOCATORS AS A MEANS FOR TRACKING THE MIGRATIONS OF PACIFIC GOLDEN-PLOVERS WINTERING ON OAHU, HAWAII – *Johnson, W. et al.*

Investigators: Wally Johnson and Patricia Johnson, Department of Ecology, Montana State University; Roger Goodwill and R. Shane Gold, Department of Biology, Brigham Young University–Hawaii.

We are using geolocators (data loggers) to investigate the spring and fall migratory routes, and the nesting ground destinations of Pacific Golden-Plovers that winter on Oahu. In March-early April 2009, we affixed 1.4 g geolocators to 12 plovers (5 males, 7 females) captured on their winter territories. For methodology (i.e., type of geolocator, its attachment to the bird, other banding details) see the summary of our Nome data logger project. All of the birds migrated in late April which is the typical time of departure from Hawaii. Of the 12 birds, 11 returned to their previous winter territories this past fall. Thus far, we have recaptured 9 of them and recovered their geolocators. Downloaded data from the latter are currently being analyzed. Preliminary findings include breeding connectivity with the Alaska Peninsula, and very rapid transoceanic flight of two days or less between Hawaii and Alaska.

Contact: Oscar W. Johnson, Department of Ecology, Montana State University, Bozeman, MT 59715. Phone: 406-585-3502; email: owjohnson2105@aol.com.

American Golden-plovers near Teshekpuk Lake Mark Maftei

***12. BEHAVIORAL ECOLOGY OF PECTORAL SANDPIPERS** - Kempenaers*

Investigators: Bart Kempenaers, Max Planck Institute for Ornithology, Germany

In 2009 we continued our field study on pectoral sandpipers in the same location (71.32 N, 156.66 W) as in previous years (2005-2008). In 2009 we followed the same standardized field protocol and captured (using mistnets or nest-traps) 136 adult individuals (86 males and 50 females). All individuals were marked with a unique combination of color bands. We measured the tarsus, wing and culmen length of each captured bird and a small blood sample, for hormones and genetic analysis, was additionally collected. The color bands allowed us to re-sight each individual present on the study area on a daily basis. For each re-sighting, the individual's GPS position and a set of standardized behavioral measures were recorded. Based on re-sightings we could then establish whether an individual remained to breed (was resident) or spend less then a day in the study area and then move on (was transient). An inter-season comparison suggests 2009 as a lowest density season in terms of both nest density and proportion of resident males relative to transients respectively.

In addition to the main project we collected sound recordings of all individually marked male Pectoral Sandpipers. Preliminary analyses suggest that that male's call frequency is strongly correlated with male's body size. Male Pectoral Sandpipers engaged in male-male competition are almost continuously active for periods lasting two weeks. Because such an extended period of sleeplessness is unprecedented we monitored the amount of sleep during and immediately after the peak of breeding activity in five male Pectoral Sandpipers using a state-of-the-art electroencephalogram (EEG) data logger specifically developed for recording brain activity from free-flying birds. The analysis of EEG data is in progress.

Contact: Bart Kempenaers, Max Planck Institute for Ornithology; Behavioural Ecology and Evolutionary Genetics, Eberhard-Gwinner-Straße 5 D-82319 Starnberg (Seewiesen) Germany; email: b.kempenaers@orn.mpg.de.

Sleeping Stilt Sandpipers, Egasarak Delta, Arctic National Wildlife Refuge

Stephen Brown

13. USE OF COASTAL HABITATS BY POST-BREEDING SHOREBIRDS ON THE ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA *– Kendall et al.*

Investigators: Steve Kendall, U.S. Fish and Wildlife Service; Stephen Brown, Manomet Center for Conservation Sciences; Joel Reynolds, U.S. Fish and Wildlife Service; Audrey Taylor, University of Alaska, Fairbanks; and Roy Churchwell, University of Alaska, Fairbanks.

After their breeding season several species of shorebirds aggregate in coastal habitats of Arctic National Wildlife Refuge (Arctic Refuge) and other regions of the Arctic Coastal Plain (ACP) of Alaska. Staging in these habitats is believed to be critical for building energy reserves necessary for migration. However, these coastal areas are vulnerable to contamination and disturbance associated with potential oil development in the eastern Beaufort Sea. They could also possibly face threats of habitat loss due to flooding and coastal erosion due to changing sea conditions associated with climate change. In 2005-06, we and several partners participated in cooperative studies of the use of coastal habitats by post-breeding shorebirds across the ACP. Since 2007 we have focused our investigations on coastal areas of the Arctic Refuge. We identified several high-use areas on the Arctic Refuge coast, but also observed considerable spatial and temporal variability. Potential mechanisms for this variability include weather, wind, and water

conditions, all of which likely affect food availability. In 2009, we continued studies to evaluate distribution and abundance of shorebirds using coastal habitats on the Arctic Refuge. We also initiated a doctoral student project to investigate some of the mechanisms driving use of these habitats (described in a separate summary).

Project objectives and methods included: *Assess the abundance, distribution, timing, species composition and habitat requirements of shorebirds staging on coastal areas.* To determine abundance, distribution and species composition a comprehensive survey of all major river deltas on the Refuge was conducted during the peak staging period. To look at the timing of use of coastal areas, multiple ground-based surveys were conducted on two of the largest river deltas on the refuge (Hulahula/Okpilak and Jago). In the final analyses of these data we will estimate total numbers of shorebirds utilizing Refuge coastal areas by correlating the timing of our comprehensive spatial surveys with the timing of use observed at sites with multiple surveys. Habitat relationships at the Jago Delta were investigated using multiple surveys in three habitat types: mudflat, salt marsh and barrier island.

We now have within season timing data on shorebird use of coastal habitats from multiple surveys conducted at the Okpilak/Hulahula (2005-06, 2008-09), Canning (2007-08) and Jago (2008-09). At all of these sites, except for Okpilak/Hulahula 2009, we also have data on use of three habitat types. Only mudflat habitats were surveyed at Okpilak/Hulahula in 2009. We also have a comprehensive survey of mudflat habitats at all major river deltas from 2006-09, conducted during a single survey each year.

In 2009, our preliminary results indicated that sites with multiple surveys (Hulahula/Okpilak and Jago), Semipalmated Sandpipers were by far the most abundant species, followed by Dunlin, Black-bellied Plover, Pectoral Sandpiper and Western Sandpiper. Previous years showed similar patterns, except that Western Sandpiper abundance was higher in 2009 than earlier years. Densities of Semipalmated Sandpipers and Dunlin were generally higher at the Jago compared to the Hulahula/Okpilak in 2009. This supports the importance of the Jago Delta first documented in 2008. Previously we considered the Jago to be less important for post-breeding shorebirds than other Arctic Refuge deltas.

Densities of Semipalmated Sandpipers peaked during the first week of August at both the Hulahula/Okpilak and Jago and then quickly dropped off. Densities of Dunlin peaked during the last survey in the third week of August at both sites. In 2009, shorebird (all species combined) densities were slightly higher on the mudflats compared to the salt marsh at the Jago. In contrast, in 2008 densities were considerably higher on the mudflats compared to any other habitat, with salt marsh having the lowest densities.

In 2009 we conducted a comprehensive survey of all the larger river deltas on the Refuge, in late July and early August. In this spatial comparison we found highest densities of shorebirds at the Jago and Kongakut River Deltas, two of the four largest deltas on the Refuge Coast. The other two large deltas, the Canning and Hulahula/Okpilak had relatively low densities of shorebirds.

There has been considerable annual and spatial variability in shorebird use of the Refuge deltas and it appears that no one delta stands out as singularly important for staging. Rather birds may rely on the aggregate of these coastal habitats during the staging period. They may move among sites depending on environmental conditions and food availability. We anticipate that graduate studies looking at some of mechanisms driving use of coastal habitats by post-breeding shorebirds will begin to provide insight into why and when specific habitats are important for these birds.

This project addressed the following action items present in the Alaska Shorebird Conservation Plan (version 2):

- Identify important areas used by breeding and post-breeding shorebirds and advocate for protection, or development of "Geographic Response Strategies", for the most important sites (page 44).
- Assess the value of shorebird habitats along shipping and transportation lanes and at port sites to mitigate impacts on populations (page 47).

Contacts: Steve Kendall, Arctic National Wildlife Refuge, 101 12th Ave., Room 236, Fairbanks, AK 99701. Phone: 907-456-0303; email: steve_kendall@fws.gov; Stephen Brown, Manomet Center for Conservation Sciences, P.O. Box 565, Manomet, MA 0234. Phone: 508-224-6521; email: sbrown@manomet.org.

Hatching Whimbrel Dan Ruthrauff

***14. THE AUDUBON ALASKA WATCHLIST, 2010** – Kirchhoff*

Investigator: Matt Kirchhoff, Audubon Alaska

The Audubon Alaska WatchList is revised and published every 3-5 years as a means of drawing public attention to regularly occurring birds in Alaska that are either declining or are deemed vulnerable. We use data from breeding bird surveys, Christmas bird counts, and agency surveys to inform population size and trend scores. Minimum-area-occupied scores based either on breeding and wintering ranges, staging areas, or migration stopovers, are used to reflect additional vulnerability. A new "stewardship" score was added this year, based on the proportion of the North American population that occurs in Alaska. We sum the scores for each regularly occurring species, or subspecies, in Alaska, and identify a threshold for making the list. The process is straightforward in concept, but messy in execution. The main obstacles include

inadequate or conflicting survey data on population size and trend, uncertainty about "minimum–area-occupied" scores for many species, and the inherent advantage subspecies hold over species in such scoring systems. Despite these limitations, the Audubon Alaska WatchList has proven itself an effective means of increasing public awareness about the state of the birds in Alaska, and promoting their conservation. The presentation at the Alaska Shorebird Group Meeting will review the scoring for shorebirds, identify which species are expected to make the Audubon Alaska WatchList, and compare those findings with other listing efforts.

Contact: Matt Kirchhoff Audubon Alaska, 441 west 5th Ave., Suite 300, Anchorage, AK 99501, email: mkirchhoff@audubon.org.

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15. USFWS Migratory Bird Management shorebird avian influenza monitoring efforts – Lanctot et al.

Investigators: Richard Lanctot, USFWS, H. River Gates and B. Hill, University of Alaska—Fairbanks, Stephen Yezerinac, Bishop's University, B. Kempenaers and M. Valcu, Max Planck Institute for Ornithology

Serious concerns surround the probability that migratory waterbirds might spread highly pathogenic H_5N_1 avian influenza (HPAI) from Asia to North America. Five of the 26 high target avian influenza species are shorebirds that breed on the North Slope of Alaska. These include the *arcticola* subspecies of Dunlin, Pectoral Sandpiper, Long-billed Dowitcher, Ruddy Turnstone, and Buff-breasted Sandpiper. All five species winter to some degree in Southeast Asia where exposure to the HPAI is likely. Since 2006, the USFWS and the Max Planck Institute for Ornithology has led an effort to sample a group of shorebird species for the presence of HPAI in Barrow, Alaska. We studied shorebirds at this site between the 28 May and 10 August 2009, and we collected 320 paired oral-pharyngeal and cloacal AI samples from 10 shorebird species that we live-captured using mist nets during pre-breeding and bow nets at nest sites. Of the 320 paired samples, 211 were from high priority HPAI species. Most of the 320 samples (n = 196; 61%) were from two high priority HPAI target species (Dunlin and Pectoral Sandpiper). The remaining samples were from American Golden-plover (n = 13), Buff-breasted Sandpiper (n = 2), Long-billed Dowitcher (n = 13), Red Phalarope (n = 26), Red-necked Phalarope (n = 7), Semipalmated Sandpiper (n = 57) and Western Sandpiper (n = 6). USFWS personnel (Gates) also visited the Manokinak field camp on the Yukon-Kuskokwim Delta to capture *pacifica* Dunlin between the 5 and 18 June where 30 Dunlin were captured on nests with bow nets. No positive cases of H_5N_1 avian influenza virus were detected from the 211 and 30 priority shorebirds sampled at Barrow and Manokinak (National Wildlife Health Center's HEDDS database). Most birds also had feathers and blood collected for additional studies. Feathers and a portion of the blood sample are being used to investigate Dunlin migratory connectivity (see Lanctot et al. summary), to investigate paternity in American Golden-plovers (see S. Yezerinac et al. summary), and to determine exposure to methyl mercury in collaboration with David Evers at the Biodiversity Research Institute. The remaining blood samples are being stored for future population genetic or paternity work.

Contact: Richard Lanctot, Shorebird Coordinator, U.S. Fish and Wildlife Service, 1011 East Tudor Road, Anchorage, AK 99503. Phone: 907-786-3609; email: Richard_Lanctot@fws.gov.

16. REPRODUCTIVE ECOLOGY OF SHOREBIRDS: STUDIES AT BARROW, ALASKA, IN 2009 *– Lancot et al.*

Investigators: R. Lanctot, U.S. Fish and Wildlife Service; H. River Gates and B. Hill, University of Alaska, Fairbanks; S. Yezerinac, Bishop's University.

In 2009, we conducted the seventh year of a long-term shorebird study at Barrow, Alaska (71.29°N, 156.64°W). The objectives of this study are to collect baseline data on (1) temporal and spatial variability of shorebird diversity and abundance, (2) arrival date, nest initiation and effort, clutch and egg size, hatching success and chick survival, and other demographic traits of arctic-breeding shorebirds, (3) to establish a marked population of as many shorebird species as possible that would allow us to estimate adult survival, mate and site fidelity, and natal philopatry, and (4) to relate weather, food availability, and predator and prey abundances to shorebird productivity. Data on demographic parameters are vitally needed to understand why many shorebird species are declining.

We located and monitored nests in six 36-ha plots in 2009. All six plots are the same as those sampled in 2005-2008 and were searched with the same intensity as in past years. The breeding density of all shorebird species on our study area was 101.4 nests/km^2 in 2009; this was slightly higher than the long-term average of 90.0 but substantially less than the long-term high

of 150.5 nests/km^2. Unlike in 2005-2008, nest predation was quite high despite the presence of a fox removal program. Lemming numbers were very low in 2009, in stark contrast to the very high years in 2006 and 2008. Pomarine Jaegers and Snowy Owls did not nest in the Barrow area in 2009.

In 2009, we recorded the highest breeding density ever of American Golden-plover, Dunlin, Red-necked Phalarope, Semipalmated Sandpiper, and Western Sandpiper on our plots during the seven years of this study. The biggest increase was in the Western Sandpiper, whose nest densities reached 5.09 nests/km^2, nearly five times higher than the 7-year running average. The next largest increase was in the American Golden-plover, whose nest density of 11.6 nests/km^2 was nearly twice as high as the next highest year, and three times higher than the 7-year running average. Semipalmated Sandpiper nest densities also increased substantially; their nest density of 24.5 nests/km^2 was over twice that of the long-term average. The other species increased a lesser amount. On the flip-side, several species had much lower nest densities than historically, including the traditionally abundant Pectoral Sandpiper and Red Phalarope – two species known for their nomadic tendencies. A total of 219 nests were located on our plots and another 156 nests were found outside the plot boundaries. This was just 20 nests less than the long-term high, which occurred in 2006, but nearly 100 more than the seven-year average. Nests on plots included 15 Pectoral Sandpipers, 42 Red Phalaropes, 46 Dunlin, 53 Semipalmated Sandpipers, 14 Long-billed Dowitchers, 9 Red-necked Phalaropes, 25 American Golden-plovers, 11 Western Sandpipers, 3 Buff-breasted Sandpipers, and 1 White-rumped Sandpiper. No Baird's Sandpipers were found on the plots in 2009. A large effort was spent locating Dunlin nests off plots as part of a continuing avian influenza sampling effort, and also for a clutch replacement study (see summary by H. R. Gates et al.). The fact that we experimentally removed nests during the clutch replacement study and natural predation was quite high likely led to a good level of renesting. This would have artificially inflated the nest densities observed in this study since the same individuals were nesting at least twice.

The first shorebird clutch was initiated on 30 May in 2009 – a full 4 days earlier than the long-term average and 4 days earlier than in any other year of the study. Typical first initiation date is the 3 June but can be as late as the 6 June. Peak initiation date was the 6 June and median initiation date was the 10 June; these dates were about 5 and 4 days earlier, respectively, than the long-term average. Median nest initiation dates for the more abundant species were the 7 June for Dunlin, 9 June for Semipalmated Sandpiper, 11 June for Red Phalarope, and 18 June for Pectoral Sandpiper. These dates are either the earliest or among the earliest dates of nest initiation documented during our 7-year study. Predators destroyed 68.8% of the known-fate nests in 2009– nearly twice that of the 7-year average of 35.5%, and substantially higher than the 11.7, 8.6, 11.1 and 24.2% observed in 2005-2008, respectively. In fact this level of predation was half-way between the 44.6 and 80% recorded in 2003 and 2004, respectively, when no fox control was in place. Across the more abundant species, hatching success (# hatching at least one young/total number of nests) was highest in Pectoral Sandpipers (38.9%, N = 18), followed by Semipalmated Sandpiper (38.5%, N = 52), Red Phalarope (32.1%, N = 53), Dunlin (22.5%, N = 138), and Long-billed Dowitcher (17.6%, N = 17). We suspect that the relatively low hatching success in 2009 was due to a number of factors. First, lemmings, which occurred in historically high numbers in 2008, ate the vegetation extensively, making some of our plots look more like a golf course than a normal tundra environment. The lack of vegetation to conceal nests made them more visible to aerial predators (and us). This idea is supported by higher hatching success on plots where vegetation was less denuded. Second, the lack of lemmings in 2009 appeared to

dissuade Arctic Fox and the various jaeger/gull species from establishing den or nest sites. The absence of denning fox made trapping more difficult as there were no predetermined places to set traps where the hunters knew the fox would return. The lack of territorial fox also appeared to lead to higher number of transient fox moving into the area. In the past, fox could be trapped at historic den sites and once trapped, were not likely to be replaced immediately. Similarly, the absence of nesting (i.e., territorial) gulls or jaegers allowed transient birds to hunt over the plots at will. This was in stark contrast to 2008 when territorial Pomarine Jaegers nested on our plots and chased other jaegers and gulls for long distances (like a protective umbrella). However, the percentage of successful nests was lower than in other years with fox control (i.e., 2005 – 2007). This difference is likely due to the high number of avian predators, combined with the lack of nesting cover resulting from intense grazing by lemmings on our plots.

In 2009 we captured and color-marked 236 adults. This was slightly lower than the 7-year average of 240, and much lower than the previous three years. Forty-eight of these adults (35 Dunlin, 9 Semipalmated Sandpipers, 2 Red Phalarope, 1 American Golden-plover, and 1 Red-necked Phalarope) had been banded in a prior year. Adults captured included 107 Dunlin, 13 Long-billed Dowitchers, 54 Semipalmated Sandpipers, 7 Pectoral Sandpipers, 26 Red Phalaropes, 13 American Golden-plovers, 6 Western Sandpipers, 7 Red-necked Phalaropes, and 2 Buff-breasted Sandpipers. We captured and color marked 253 chicks in 2009. This was considerably lower than the 7-year average of 363 and much lower than the previous four years. The lower number of adults and chicks captured in 2009 was due primarily to nests being depredated prior to the adults being caught or young hatching.

We continue to conduct ancillary studies as time allows at Barrow. Avian influenza sampling was a prominent feature of our work in 2006--2009 – all captured birds were swabbed to test for the highly pathogenic H5N1 avian influenza virus. Audrey Taylor (PhD candidate, UAF) continued analyzing data related to documenting the distribution, movements, and physiology of post-breeding shorebirds in Barrow and other sites on the Alaska Arctic Coast (see her summary). River Gates (MS candidate, UAF) completed her third field season in which she documented the rates of clutch replacement laying (see her summary). Brooke Hill (MS candidate, UAF) conducted her second season of her masters in which she investigated the survival of Dunlin chicks from un-manipulated, and early and late replacement clutches (see her summary). Charlie Governali (intern, Dartmouth College) measured the volume, length, and breadth of eggs of five species of Scolopacids to empirically derive constants for use in equations to estimate volume (see his summary). Blood was collected for methyl mercury contaminant analysis in collaboration with D. Evers at the Biodiversity Research Institute. Finally, Stephen Yezerinac (Professor, Bishop's Univeristy) conducted a genetic paternity analysis on American Golden-plover using adult and offspring samples collected over the seven years of this study (see his summary).

Contact: Richard Lanctot, Shorebird Coordinator, U.S. Fish and Wildlife Service, 1011 East Tudor Road, Anchorage, AK 99503. Phone: 907-786-3609; email: Richard_Lanctot@fws.gov.

Measuring wing chord on a Pectoral Sandpiper, Prudhoe Bay Steve Zack

17. USE OF BAND RESIGHTINGS, MOLECULAR MARKERS AND STABLE ISOTOPES TO UNDERSTAND THE MIGRATORY CONNECTIVITY OF DUNLIN BREEDING IN BERINGIA AND WINTERING IN THE EAST ASIAN-AUSTRALASIAN FLYWAY *– Lanctot et al.*

Investigators: R. Lanctot, U.S. Fish and Wildlife Service; M. Barter, Victoria, Australia; C. Chiang, Taiwan Wader Study Group; R. Gill, C. Ely, USGS-ASC; M. Johnson and S. Haig, USGS FRESC, Z. Ma, Fudan University; C. Stricker, USGS-Denver Field Station; P. Tomkovich, Moscow State University; L. Wassenaar, Environment Canada; and M. Wunder, University of Colorado Denver

We used resightings of banded adults and hatch year birds, molecular markers and stable isotopes to document the migratory connectivity of five subspecies of Dunlin (*Calidris alpina*) that breed in Beringia and migrate either along the East Asian-Australasian Flyway or the Pacific Flyway of North America. Of more than 4000 Dunlin banded in the past decade, roughly 230 (~6%) have been resighted away from their capture site. Most resightings were of *arcticola* Dunlin seen in Japan and Taiwan, although a smaller number of *kistchinski* and *sakhalina* Dunlin have also been resighted along the East Asian-Australasian flyway. Few resightings have occurred in mainland China despite this being a major nonbreeding area for Dunlin. Due to potential biases associated with resighting marked Dunlin, we also employed molecular and stable isotope markers to indirectly assess migratory connectivity. In order to use genetic markers, which rely on the relatedness of individuals to establish linkages, it must be shown that individuals belonging to the five subspecies can be differentiated from one another. Preliminary results from variable microsatellite DNA markers indicated this was not possible among individuals of the *sakhalina, pacifica* and *arcticola* subspecies. However, we

still need to test two more Russian-breeding subspecies and conduct mitochondrial DNA analysis on all five subspecies before we can determine the value of this technique. Should either the microsatellite or mitochondrial DNA reveal significant population structure, we can then use samples collected from birds on the nonbreeding grounds and try to link them to breeding areas. We also used stable isotope signatures of particular feathers grown by Dunlin on their breeding and nonbreeding grounds to determine if individuals from the five subspecies could be differentiated. Use of stable isotope markers to establish migration connectivity relies on the fact that feathers carry chemical markers that reflect the chemical composition of the resources used by birds as they grow the feathers, and that these chemical markers vary spatially across the surface of the earth. Preliminary results indicate that isotope markers from feathers acquired on the breeding grounds can distinguish among individuals from three subspecies (*arcticola, pacifica, sakhalina*) with some certainty. Additional analysis involving more individuals of all five subspecies is needed to fully evaluate this technique, although several classification procedures yielded low mis-classification rates. Like the genetic technique, we need to first determine whether this technique can differentiate the five Dunlin subspecies before attempting to connect individuals sampled on the staging and nonbreeding grounds to breeding areas. Dunlin exhibit a number of features that make them especially vulnerable to degradation or loss of habitats required during their migration and nonbreeding period. These features include a tendency to aggregate in a limited number of locations, a migration schedule timed to seasonally abundant food resources, and use of wetland habitats that are affected by a wide variety of human activities and developments. Because of this, it is essential that we understand how the various subspecies use the landscape so we can identify areas in need of recognition or protection, and promote their conservation.

Contact: Richard Lanctot, Shorebird Coordinator, U.S. Fish and Wildlife Service, 1011 East Tudor Road, Anchorage, AK 99503. Phone: 907-786-3609; email: Richard_Lanctot@fws.gov.

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18. POPULATION STRUCTURE AND MIGRATORY CONNECTIVITY OF WESTERN SANDPIPERS – Lank et al.

Investigators: David B. Lank, Samantha Franks, Birgit Schwarz, David Hope, Simon Fraser University; Richard B. Lanctot, U.S. Fish and Wildlife Service; Guillermo Fernandez, Instituto de Ciencias del Mar y Limnología, UNAM, Unidad Académica Mazatlán; and many others

In our study, which was initiated in 2008, we are attempting to assess the degree of population structure and migratory connectivity of Western Sandpipers (*Calidris mauri*) with population genetic methods and stable isotope and trace element analyses. As an additional means of assessing Western Sandpiper population structure and to further understand its potential causes and consequences, we have also started to investigate whether Western Sandpiper mating vocalizations show geographic variation across the breeding range.

We continued our field work at breeding sites in Alaska, begun last year. In addition to obtaining blood and feather samples and morphological measurements from these sites, this year's efforts also included data on breeding success and acoustic recordings. David Hope and Ummat Somjee collected additional samples from Safety Sound, near Nome. They also

individually marked nesting Western Sandpipers with color-flags containing unique number/ letter combinations and collected data on nest initiation dates and nesting success. Birgit Schwarz and Ian Jong recorded songs from male Western Sandpipers at Nome, and obtained additional blood and feather samples, and recordings, from a previously visited site near Wales, and from a new site close to the town of Kotzebue. Diane Tracy and Jay Schamel obtained samples and recordings from Western Sandpipers at Kanaryarmiut in the Yukon Delta. They were unsuccessful at locating Westerns near Goodnews Bay. We were also fortunate enough to again receive blood and feather samples from Barrow that Rick Lanctot and his crew were able to obtain.

Prior to the breeding season, we collected blood and feather samples from 15 sites throughout the non-breeding range and one important stop-over site. On the non-breeding grounds, sampling efforts were most extensive in Western Mexico where Guillermo Fernandez captured hundreds of Western Sandpipers at seven different sites. We also obtained samples from sites in California, South Carolina, Florida, Texas, Puerto Rico, the Yucatán Peninsula, Panama and Ecuador. At nearly all of these sites we received valuable assistance and advice from local collaborators. In addition to our sampling efforts on the non-breeding grounds we have also captured spring and fall migrants at the Fraser River Delta in British Columbia, Canada. Thank you to all who have supported this project.

Contact: David B. Lank, Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia, Canada V5A 1S6; email: dlank@sfu.ca.

Semipalmated plover and nest near a pipeline at Prudhoe Bay

Vitek Jirinec

19. LONG-TERM MONITORING OF TUNDRA-NESTING BIRDS IN THE PRUDHOE BAY OILFIELD, NORTH SLOPE, ALASKA *– Liebezeit and Zack*

Investigators: Joe Liebezeit and Steve Zack, Wildlife Conservation Society

Since 2003, the Wildlife Conservation Society (WCS), in cooperation with BP Exploration [Alaska], Inc., has monitored nest survivorship, nest predator abundances and other parameters that may influence nesting success in the Prudhoe Bay Oilfield. This on-going monitoring effort will help us better understand potential impacts from industry, climate change, and other factors on the nest survivorship of breeding birds.

In 2009, we discovered and monitored 103 nests of 11 species from 3 June to 11 July on 12 10-ha study plots using both rope drag and behavioral nest search techniques. Lapland Longspur and Semipalmated Sandpiper nests accounted for the majority (54%) of those found. Among all species, 37 nests successfully hatched/fledged, 48 failed, and 18 nests were of unknown or undetermined fate. Nest predation was the most important cause of nest failure (92%). Other sources of nest failure included abandonment for unknown reasons (n = 2), failure due to infertile eggs (n = 1), and a field observer inadvertently alerting a predator to a nest (n = 1). Overall nest density was 75.0 nests / km^2, noticeably lower than at this site in 2006 (101.6 nests / km^2) but comparable to all other years monitored. Program MARK constant survivorship model (Mayfield) estimates of nesting success ranged from 40 to 56%, for the three most common breeding species, and overall daily survival rate for shorebirds and longspurs was lower but not significantly different from that observed in 2008 (2009: 0.964 ± 0.006 vs. 2008: 0.975 ± 0.005; mean ± SE).

Lemming activity at this site was similar to last year (0.039 lemmings / 30 min. count in 2008 vs. 0.031 in 2009) and slightly higher than most previous years, however levels were still less than half of that observed in the "high" lemming year of 2006 (0.085 lemmings / 30 min. count). Pomarine Jaegers were rarely detected and, unlike in 2006, they did not nest in the study area this year. Overall, eight species of potential nest predators were detected during timed surveys in 2009 with the most common being Glaucous Gulls and Parasitic Jaegers (67 % of detections).

Snow melt and subsequent tundra exposure occurred as early in 2009 as in 2008 and earlier than in all other previous years monitored. Snow melt was essentially complete by the time we started conducting field work on 7 June (<1.0 snow cover on all study plots). From 2003-07 the mean date for completion of snow melt was 12 June. Over the past seven years we have documented an earlier trend in nest initiation dates for the three most common species. We continued our multi-year efforts in using remotely activated camera systems to identify nest predators at active shorebird nests. This year we monitored four nests with two Trailmaster® cameras. One nest was depredated but we did not record the event because the motion sensor was not triggered.

Contact: Joe Liebezeit, Wildlife Conservation Society, Pacific West office, 718 SW Alder Street, Suite 210, Portland, OR 97205. Phone: 503-241-7231; email: jliebezeit@wcs.org.

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20. SURVEILLANCE FOR AVIAN INFLUENZA H5N1 IN BREEDING SHOREBIRDS IN THE PRUDHOE BAY AND KUPARUK OIL FIELDS, NORTH SLOPE, ALASKA *– Liebezeit et al.*

Investigators: Joe Liebezeit and Steve Zack, Wildlife Conservation Society; Richard B. Lanctot, U.S. Fish and Wildlife Service

In continuing efforts to monitor for the potential spread of H5N1 avian influenza (HPAI) from Asia to North America via their flyways in Alaska, the Wildlife Conservation Society (WCS), with support from the U.S. Fish and Wildlife Service, led these efforts in the Prudhoe Bay and Kuparuk oilfields. Six shorebirds deemed most likely to carry the virus to North America were sampled including Dunlin (*arcticola* subspecies), Pectoral Sandpipers, Long-billed Dowitchers, Buff-breasted Sandpipers, and both phalarope species.

Sampling took place between 4 June and 9 July 2009. Shorebirds were captured by finding active nests (primarily using the rope drag method) and then trapping at least one of the adult birds on the active nest during mid-late incubation using bow-nets. For Buff-breasted Sandpipers, we trapped displaying males and attendant females using mist nets at known lek locations. Birds were sampled throughout both the Prudhoe Bay and Kuparuk Oilfields on 36 10-ha study plots originally established for a previous shorebird study (or in nearby areas). For each bird we recorded culmen and tarsus length, head length, wing cord, and stage of molt for flight and tail feathers. For both Dunlin and Buff-breasted Sandpipers we collected blood samples to be used in genetic and hormone studies. We also collected one or more feathers from Dunlin for use in stable isotope studies. Personnel followed the protocols of the National Wildlife Health Center (NWHC) to protect themselves from Asian H5N1 and to collect, store, and ship samples. Cloacal and Oral-pharyngeal swabs from target species were sent to the NWHC for screening for Asian H5N1.

We trapped and sampled 124 birds for Avian Influenza taking samples from 42 Buff-breasted Sandpipers, 40 Pectoral Sandpipers, 24 Dunlin, seven Red-necked Phalarope, and three Red Phalarope.

To date, no positive cases of H5N1 avian influenza virus has been detected and feather / blood samples have been distributed to collaborators for additional studies.

Contact: Joe Liebezeit, Wildlife Conservation Society, Pacific West office, Portland, OR 97204. Phone: 503-241-7231; email: jliebezeit@wcs.org.

Trapping Buff-breasted Sandpipers at a lek, Prudhoe Bay Steve Zack

***21. KACHEMAK BAY SHOREBIRD MONITORING PROJECT - REPORT FOR SPRING 2009 SURVEY** - Matz*

Investigator: George Matz (with support from Kachemak Bay Birders)

Kachemak Bay, located in Alaska's Cook Inlet region, is recognized as an important stopover for migrating shorebirds. Two areas of the Bay (Fox River Flats and Mud Bay/Mariner Park Lagoon on the Homer Spit) have been named as Western Hemisphere Shorebird Reserve Network sites of international significance. Other parts of the Bay also have conservation designations. In fact, virtually the entire Bay has been named a State Critical Habitat Area as well as a National Estuarine Research Reserve unit.

Last winter, the Homer-based Kachemak Bay Birders wanted to know more about the status of the local shorebird population during spring migration. Although the Kachemak Bay Shorebird Festival has documented shorebird observations for the past 17 years, this weekend event covers only a portion of the migration period. Accordingly, it was decided to use volunteers to monitor the entire spring migration (mid April through late May) every five days at seven sites on or near the Homer Spit using a modified version of the International Shorebird Survey protocol. The data would then be compared to the seven years of data captured by George West from 1986 and 1989-1994 in order to provide some indication of shorebird population trends.

The weather for the 2009 spring was fairly typical for Kachemak Bay. During the monitoring project, 16 volunteers observed a total of 7,406 shorebirds represented by 25 species. No rare or accidental species were seen. The top ten most common species surveyed (including the number counted) were the Western Sandpiper (3229), Red-necked Phalarope (1630), Dunlin (1097), Surfbird (292), Semipalmated Plover (194), Black-bellied Plover (179), Rock Sandpiper (141), Least Sandpiper (136), Short-billed Dowitcher (125), and Black Turnstone (81). Highest counts were during the second week of May. Mud Bay was the most prolific site.

West reported that during his surveys, the "total number of shorebirds counted in Mud Bay and along the Spit averages almost 100,000 birds per year, most of which are Western Sandpipers." However, he did daily counts. Adjusting his data to match our protocol still

showed a significant difference. The 2009 count for the Homer Spit sites is 68% of West's lowest year (1990) and only 13% of his highest year (1992). Obviously, there is need to continue this effort and, hopefully, to expand monitoring it to other parts of the Bay.

Contact: George Matz, P.O. Box 15182, Homer, Alaska.

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22. USGS ALASKA SCIENCE CENTER SHOREBIRD AVIAN INFLUENZA MONITORING EFFORTS – Ruthrauff and Gill

Investigators: Dan Ruthrauff and Bob Gill, USGS

In a continuation of annual efforts initiated in 2006, the USGS Alaska Science Center Shorebird Project sampled a group of shorebird species for the presence of the Asian H5N1 subtype of highly pathogenic avian influenza. As previously, we focused our 2009 sample collection in western Alaska during the fall migration period. Our crew of four was present near Punaorat Point in Angyoyaravak Bay, Yukon Delta National Wildlife Refuge, from 17 August to 20 September. We captured 825 individuals of 14 shorebird species utilizing rocket nets, whoosh nets, and mist nets, and these captures yielded 805 paired oral-pharyngeal and cloacal samples AI samples from 12 shorebird species . Most of the samples (n = 711; 88%) were from two target species (Dunlin and Rock Sandpiper), and the remaining samples were from Sharp-tailed Sandpiper (n = 55), Bar-tailed Godwit (n = 13), Ruddy Turnstone (n = 10), Red Knot (n = 5), Pacific Golden-Plover (n = 4), Black Turnstone (n = 2), Pectoral Sandpiper (n = 2), Red Phalarope (n = 1), Semipalmated Sandpiper (n = 1), and Red-necked Stint (n = 1). In addition to collecting AI samples, we collected blood, measurements, and wing photos from 25 Dunlin to attempt to differentiate between *pacifica* and *arcticola* subspecies. We targeted adult Dunlin with culmens ≤34.4mm, and this effort was invigorated by the recapture of a Dunlin originally banded in Taiwan in March, 2007.

The prevailing weather patterns were noticeably different this fall than in past years, and this may have affected the timing and abundance of certain shorebird species. In previous years, fall weather has typically been mild and warm at this site, with prevailing weather patterns generating winds from the south or south west. This year, however, winds were typically from the north, rain was frequent, and cold prevalent; indeed, we experienced an unusually early first frost of the season on 24 August. Perhaps as a result of these patterns, we observed two Asian vagrants not seen in previous years (a juvenile Gray-tailed Tattler and a juvenile Red-necked Stint), and a marked decline in the prevalence of Red-necked Phalaropes, measured as the number captured and banded (1 in 2009 compared to 49 in 2008). Additionally, the passage of Sharp-tailed Sandpipers, Pacific Golden-Plovers, and Long-billed Dowitchers was noticeably delayed by one to two weeks compared to previous years at the same site. With only four years of observations it is premature to assume that we clearly understand the nature of fall phenology at this site, but the aberrant weather patterns were nonetheless noteworthy and may have affected the seasonal occurrence of certain shorebird species.

Contact: Dan Ruthrauff, USGS Alaska Science Center, 4210 University Drive, Anchorage, AK 99508. Phone: 907-786-7162; email: druthrauff@usgs.gov.

***23. ALASKA PENINSULA BREEDING RANGE AND AVIAN INFLUENZA SAMPLING IN PACIFIC GOLDEN-PLOVER** - Savage*

Investigator: Susan Savage, U.S. Fish and Wildlife Service

During a joint USFWS and USGS study to determine distribution and abundance of Alaska Peninsula shorebirds (2004 – 2007), biologist found Pacific Golden-Plover (*Pluvialis fulva*) nesting on the Big Sandy River (56.22°N, -160.25°W). Prior to 2004, breeding range had only been documented to just south of the Koktuli and Stuyahok Rivers northwest of Lake Iliamna. Because this species is a high priority species for sampling Avian Influenza (AI), I secured funding to find nests, capture and band birds, and collect AI samples on known nesting grounds at Big Sandy and to search for plovers south of Port Moller at David River. We visited Big Sandy from 20-28 May, found three nesting pairs, and captured and sampled five adults. Poor weather precluded travel to David River and instead we visited Port Heiden from 28 May to 1 June where we found five nesting pairs and captured five adults. All captured birds were banded and color-marked (hot pink was used over metal on all birds; other colors included red, dark green and dark blue). We obtained AI swabs, photos, and feathers for all birds. Morphological measures were obtained for nine birds. Summary details of capture locations, morphological measures, and nest details are available in a report from the Refuge.

Contact: Susan Savage, U.S. Fish and Wildlife Service, Alaska Peninsula/Becharof National Wildlife Refuge, King Salmon, Alaska 99613; email: susan_savage@fws.gov.

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***24. DISTRIBUTION AND COMMUNITY CHARACTERISTICS OF STAGING SHOREBIRDS ON ALASKA'S ARCTIC COASTAL PLAIN** – Taylor et al.*

Investigators: Audrey R. Taylor, University of Alaska – Fairbanks; Richard B. Lanctot, U.S. Fish and Wildlife Service; Abby N. Powell, U. S. Geological Survey, Alaska Cooperative Fish

and Wildlife Research Unit, University of Alaska – Fairbanks; Falk Huettmann, University of Alaska – Fairbanks; Debora A. Nigro, Bureau of Land Management; and Steven J. Kendall, U.S. Fish and Wildlife Service

Avian studies conducted in the 1970's on Alaska's Arctic Coastal Plain (ACP) indicated that littoral habitats are important to arctic-breeding shorebirds for staging prior to fall migration. However, relatively little recent, broad-scale, or quantitative information exists on shorebird use of staging areas on the ACP. During the summers of 2005-2007, we conducted aerial surveys to locate possible shorebird concentration areas (based on relative shorebird abundance) along the ACP littoral zone from the southwest end of Kasegaluk Lagoon on the Chukchi Sea to Demarcation Bay in the Beaufort Sea. These surveys identified persistent within- and between-year concentrations of staging shorebirds at Peard Bay, Pt. Barrow/Elson Lagoon, Cape Simpson, and Smith Bay to Cape Halkett, and at the Jago and Kongakut River deltas in the eastern Beaufort Sea. We also collected data on shorebird community characteristics, staging phenology, and habitat use in 2005 and 2006 by conducting land-based surveys at six camps: Kasegaluk Lagoon, Peard Bay, Pt. Barrow/Elson Lagoon, Colville River Delta, Sagavanirktok River Delta, and Okpilak River Delta. The shorebird community was more even and diverse (evenness E and Shannon Weiner *H'*) along the Beaufort Sea compared to the Chukchi Sea and in 2005 versus 2006. Staging phenology varied by species and location, and there was a general trend of species arriving at staging areas earlier than reported in previous studies. Our results suggest the existence of three foraging habitat guilds among the shorebird species observed in this study: gravel beach, mudflat, and salt marsh/pond edge. These foraging associations appear to be conserved through time when compared to data collected on the ACP in the mid-1970's. Results from this research will be useful for land managers to monitor the effects of changing environmental conditions and human activity on shorebirds and their habitats in Arctic Alaska.

Contact: Audrey Taylor, Alaska Cooperative Fish and Wildlife Research Unit, 211 Irving I, University of Alaska Fairbanks, Fairbanks, AK 99775. Phone: 360-991-4995; email: artaylor@alaska.edu.

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***25. MOVEMENT PATTERNS OF POSTBREEDING SHOREBIRDS ON ALASKA'S ARCTIC COAST** – Tayor et al.*

Investigators: Audrey R. Taylor, University of Alaska – Fairbanks; Richard B. Lanctot, U. S. Fish and Wildlife Service; Abby N. Powell, U. S. Geological Survey, Alaska Cooperative Fish and Wildlife Research Unit, University of Alaska – Fairbanks; Steven J. Kendall, U. S. Fish and Wildlife Service; and Debora A. Nigro, Bureau of Land Management

Knowledge of movement patterns of individually-marked migratory birds may inform estimates of abundance, lend insight into spatial connectivity of habitats and populations across large areas, and assist development of species-specific conservation strategies. The northern coast of Alaska (comprising the Chukchi Sea coast from Kasegaluk Lagoon to Point Barrow and the Beaufort Sea coast from Point Barrow to the Alaska-Canada border) is used extensively by postbreeding shorebirds prior to fall migration. Little is known regarding the spatial connectivity

of this landscape during the staging period or the propensity and timing of individuals' movements between staging areas. We captured and radio-equipped 65 adult and juvenile Red Phalaropes (*Phalaropus fulicarius*), 41 Red-necked Phalaropes (*Phalaropus lobatus*), 91 Dunlin (*Calidris alpina arcticola*), and 139 Semipalmated Sandpipers (*Calidris pusilla*) at breeding and postbreeding locations on the ACP in 2005-2007. These birds were subsequently relocated with a combination of aerial and ground-based telemetry efforts conducted along the northern coast of Alaska from July-September, and on the Yukon-Kuskokwim Delta (YKD) in western Alaska in September and October (Dunlin only). Red and Red-necked Phalaropes exhibited no cohesive movement patterns along either the Chukchi or Beaufort Sea coasts. Dunlin moved both east and west across the northern Alaska coast despite having a known migration route from breeding areas on the Arctic Coastal Plain (ACP) to western Alaska during fall migration. Adult Dunlin moved on average 56.9 (± 39.9) km between breeding territories and coastal staging locations. Seven individuals were later detected on the YKD, providing an estimate of arrival date and the length of time taken to move between the ACP and western Alaska. Semipalmated Sandpipers moved consistently eastward along the Beaufort Sea coast, and 59% were ultimately detected at the Canning River Delta or along the Canning River south of the Arctic coast. Adult Semipalmated Sandpipers moved on average 137.2 (± 129.6) km between breeding territories and coastal staging locations. Their movements between detection sites often occurred within a single day, despite distances between sites of 100 km or more. Our data demonstrate that staging areas on the northern coast of Alaska are highly spatially connected, and are used by all four of the species we studied. Therefore, concentrations of postbreeding shorebirds at a given staging area are likely to represent individuals from multiple breeding populations across the ACP. Management and monitoring programs (e.g., aerial surveys for abundance and distribution) for staging shorebirds along the northern Alaska coast should consider the propensity of individuals to move between staging areas even within a relatively short survey window. Double counting such individuals could lead to overestimates of population size. Additionally, radio-equipped birds in this study were often detected at more than one site, indicating that postbreeding shorebirds rely on multiple staging sites to prepare for southbound migration. Thus decisions regarding the development of sites for human use should also consider the cumulative effect of habitat loss within an interconnected network of staging areas.

Contact: Audrey Taylor, Alaska Cooperative Fish and Wildlife Research Unit, 211 Irving I, University of Alaska Fairbanks, Fairbanks, AK 99775. Phone: 360-991-4995; email: artaylor@alaska.edu.


Shorebirds at Chickaloon Flats, Kenai National Wildlife Refuge

Sadie Ulman

26. THE VALUE OF CHICKALOON FLATS, KENAI NATIONAL WILDLIFE REFUGE, ALASKA, TO SHOREBIRD MIGRATION AND STAGING, IN 2009 - *Ulman et al.*

Investigators: Sadie E.G. Ulman and Dr. Chris Williams, University of Delaware; and Dr. John Morton, Kenai National Wildlife Refuge

Chickaloon Flats is a 70 km^2 mudflats on the northern portion of Kenai National Wildlife Refuge, Alaska. Chickaloon is located on Turnagain Arm, and is an extremely tidally influenced environment. It is qualitatively known as an important area for migration, but there is need for more baseline information about habitat distribution and overall value to migrating birds. Chickaloon is open to public use via three airstrips, so results of this project will assist wildlife managers of Kenai NWR in focusing management strategies and determining any potential harm by human activities and any future development in the area.

The main objectives of this master's research are: 1) conduct a focal stable isotopic study to reconstruct migration corridors of six shorebird species, selected based on utilization of mudflats during both spring and fall segments of their annual cycle. 2) Analyze plasma metabolites to determine refueling rates, 3) Define the distribution, area and biodiversity of vegetation zones, 4) Identify local food resources, and 4) Estimate spring and fall avian biodiversity and abundance.

The 2009 season is the first of two that will further explore Chickaloon Flats and focus on the utilization of these mudflats as a stopover site and breeding grounds for shorebirds.

To investigate a multi-tissue (feather, blood, plasma, RBC, liver and pectoral muscle) approach, lethal take was necessary during spring migration. Spring numbers were 20 Pectoral sandpipers, four Long-billed dowitchers and two Greater yellowlegs. During fall migration, drop nets and a net gun were used to capture 27 Greater yellowlegs, 24 Lesser yellowlegs, seven Least sandpipers, 14 Short-billed dowitchers, three Long-billed dowitchers and one Pectoral sandpiper. Each bird was banded with an aluminum FWS band and the following biometrics were measured: mass, exposed culmen, distance from proximal nares, tarsus, wing chord, and tail length. Due to the complex molt of shorebirds, numerous feathers were taken for stable isotope analysis to determine all potential molt locations. The 1st primary, central rectrice and breast

feather were taken from each bird, and depending on molt stage of several birds, 1st secondary covert, back pin feathers and/or marginal coverts were also taken**.** Blood samples were collected from the brachial vein.

Feather and tissue samples will be analyzed with a multi-isotopic approach utilizing carbon, nitrogen and deuterium to create a more precise location. Triglycerides (plasma metabolites) will be analyzed to determine refueling rates of birds.

Length of stay for known individuals could not be determined (FWS band only), but one banded Greater yellowlegs was sighted nine days after last capture day, and two different Lesser yellowlegs were each sighted at least one day after last capture day.

Ground based, aerial and high-tide tower surveys were conducted throughout the duration of the study to determine bird abundance and biodiversity throughout seasonal changes.

Contact: Sadie Ulman, Department of Entomology and Wildlife Ecology, 250 Townsend Hall, University of Delaware, Newark, DE, 19716. Email: sadieu@udel.edu.

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27. SOCIAL AND GENETIC MATING SYSTEM OF AMERICAN GOLDEN PLOVERS AT BARROW, ALASKA - Yezerinac

Investigators: Stephen Yezerinac, Bishop's University; Richard Lanctot, U.S. Fish & Wildlife Service; Sandra Talbot & George K. Sage, U.S. Geological Survey.

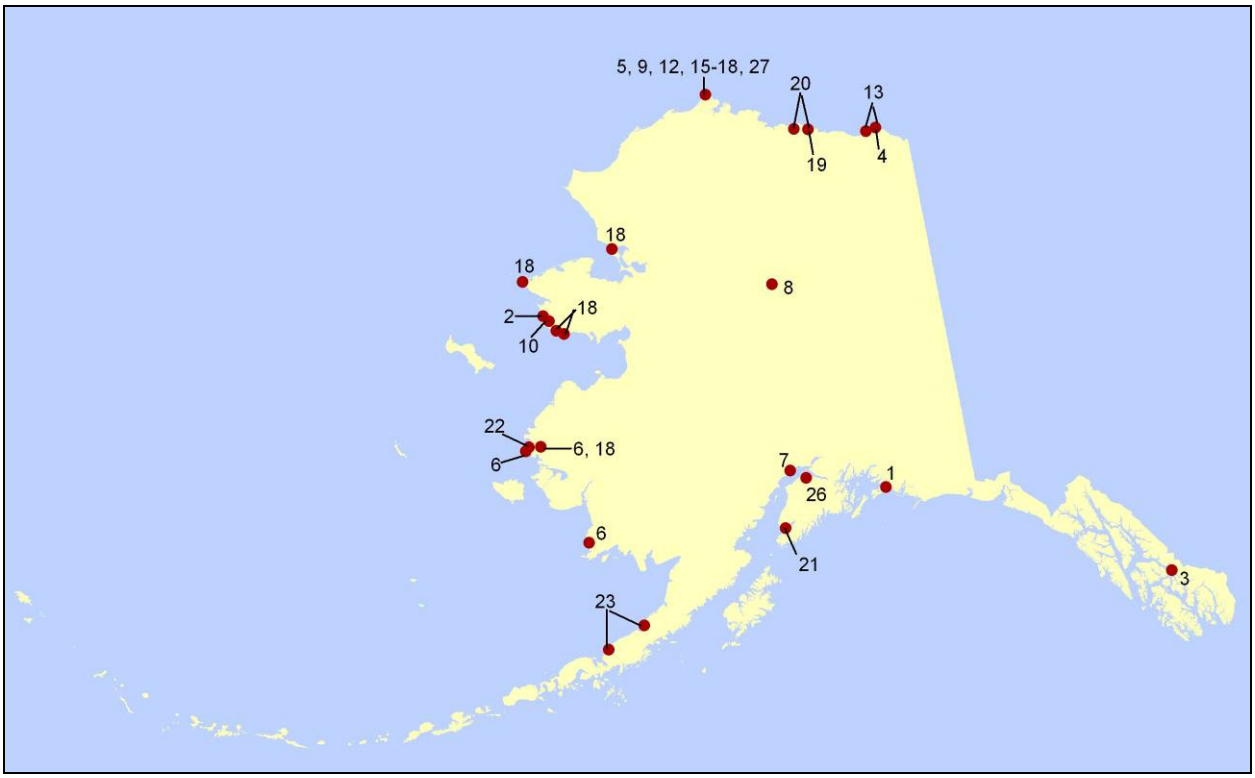
Shorebirds are thought to have diverse mating systems. Yet most species have been characterized as monogamous or polygamous solely from observation of social relationships, without genetic tests of actual parentage. We are using field observations of nesting chronology and adult nest attendance along with high resolution genetic markers for parentage analysis to more precisely describe the mating system of American Golden Plovers. Since 2003, breeding chronology has been monitored for American Golden Plovers nesting within six, 36-ha plots near Barrow, AK. Adults have been trapped at nests, and banded and blood sampled. Tissue samples have also been collected from hatchlings and any unhatched eggs. Following the 2009 field season we initiated genetic laboratory analyses of 40 families. To date we have tested nine microsatellite loci, originally isolated from other avian species, for PCR amplification in the American Golden Plover genome. Seven loci show polymorphism along with stable patterns of inheritance and non-significant departures from Hardy-Weinberg Equilibrium. Combined, these seven loci provide sufficient power (average probability of individual identity = 3.4×10^{-6}) to test whether each offspring is the progeny of the parent(s) attending the nest. At the time of writing, we are still collecting individual genotype data in the lab, but anticipate documenting the genetic mating system of the species and examining factors correlated with any variation before next year's ASG meeting.

Contact: Stephen Yezerinac, Biology Department, Bishop's University, 2600 College St. Sherbrooke, QC, J1M1Z7, Canada. phone: 819-822-9600 ext 2504; email: syezerin@ubishops.ca.

Red Phalarope warily approaching it's nest, near Teshekpuk Lake

Ian Ausprey

STUDY SITE MAP



This map displays the location of shorebird study sites summarized in this report. Each site is represented with a maroon dot and an accompanying number. The number corresponds to the numbered project title for each summary in the report. This map *does not* display sites where field work was conducted solely outside of Alaska (Project 11), studies that had no field data collection in 2008 (Projects 24, 25), and studies that had no field component and/or relied on data from other studies (Project 14).