

Bering Sea Integrated Ecosystem Research Project: Semiannual Progress Report for B63

Project #: B63

Title: BSIERP Seabird Telemetry - Pribilof Islands

Principal Investigator(s) and Recipient Organization(s):

PI: David B. Irons
Migratory Bird Management
U.S. Fish and Wildlife Service
1011 East Tudor Road
Anchorage, Alaska 99503

PI: Daniel D. Roby
USGS-Oregon Cooperative Fish and Wildlife Research Unit
Department of Fisheries and Wildlife
104 Nash Hall
Oregon State University
Corvallis, Oregon 97331-3803

Recipient Organizations:

Northern Forum
716 W. 4th Ave., Suite 100
Anchorage, AK 99501

St. George Island Institute
P.O. Box 940
St. George Island, Alaska 99591

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Lead Author of Report:

Rosana Paredes
Post-doctoral Research Associate
Oregon Cooperative Fish and Wildlife Research Unit
Department of Fisheries and Wildlife
104 Nash Hall
Oregon State University
Corvallis, Oregon 97331-3803

PROJECT OVERVIEW

We are comparing seabird foraging location and trip duration for Black-legged Kittiwakes and Thick-billed Murres nesting on two geographically associated islands in the Pribilof group, St. Paul and St. George. The maximum edge of the winter ice on the Bering Sea shelf is generally nearer to St. Paul than to St. George. St. George is nearer the productive edge of the Bering Sea shelf. To the extent that the influence of ice is greater in the vicinity of St. Paul, seabirds nesting on that island might be differentially affected by the loss of that influence if future warming reduces the incidence of ice in the area. This study will allow us to confirm where birds from each island forage, and to investigate variation in foraging location and trip duration among years of differing sea ice extent. This study is working closely with the seabird colony study (B65) to determine the effects of foraging behavior on diets, reproductive success, and adult survival.

Our objective is to compare the foraging behavior, at-sea habitat use, and foraging distribution of two piscivorous seabirds, Black-legged Kittiwakes (surface/plunge-dive feeder) and Thick-billed Murres (pursuit-diving feeder), nesting on the Pribilofs Islands. We used state-of-the-art GPS data logger technology to track breeding seabirds during at-sea foraging trips, as well as TDRs and wet/dry sensor tags to assess activity budgets and diving behavior at-sea.

We seek to test the hypothesis that climate warming and sea ice retreat from the southern portions of the Bering Sea will have a greater impact on seabird nesting success and population growth rates on St. Paul Island (STP) than on St. George Island (STG), because of the proximity of St. Paul Island to the historical southern limit of Bering Sea pack ice. Further, we hypothesize that seabirds nesting on St. George Island will be buffered more from the negative effects of climate change because of proximity to the productive Bering Sea shelf break. Our work addresses the following BSIERP hypotheses:

2. Climate and ocean conditions influencing circulation patterns and domain boundaries ... will affect ... prey-concentrating features and thus foraging success of seabirds and marine mammals (bottom-up). Specifically:
 - a. Changes will displace predictably located prey (hot spots) necessary for success of central place and hot spot foragers.
 - b. Central place foragers will shift their diet or colony locations to increase foraging opportunities.
3. Conditions will increase zooplankton production, resulting in more piscivorous fish (top-down [Oscillating Control Hypothesis] with possible trophic consequences:
 - a. Competition with piscivorous fish for forage species will lead to declines in fur seals, murres, and kittiwakes.
 - c. Changing conditions will affect fish and fishery distributions, local fishing pressure, and overlap and competition with other upper trophic predators.
 - d. Fishing will reduce top-down control of forage species ...combined with predation and competition between piscivorous species will result in.... a climax community dominated by arrowtooth flounder (similar to the Gulf of Alaska).

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Proposed timeline and milestones within report period:

- Review and update 2008 protocols for data collection in 2009 and order needed equipment and supplies. Irons, Roby & Paredes; March-April.
- Have protocols reviewed by other seabird on-colony team members. Byrd, Irons, Kitaysky, Roby; April-May.
- Coordinate field approaches to avoid conflicts during field data collection. Byrd, Irons, Kitaysky, Roby; May.
- Test new GPS data loggers and permanent casings. Paredes, Irons, Roby; May.
- Training field personnel at Anchorage and field sites. Irons, Roby, Paredes; June.
- Conduct field studies and collect data in field; Paredes, Roby, seasonal biologists; June-August
- Send diet and blood samples to contractor. Byrd/Renner & Paredes; September
- Summarize available data & complete NPRB progress reports. Irons, Roby, Paredes; September.
- Report to communities of St. Paul and St. George. Irons, Roby, Paredes; October.
- Report preliminary findings to other BSIERP PIs at annual PIs' meeting. Irons, Roby, Paredes; October.

Progress Summary:

All of our GPS logger tags were replaced with new units (GiPSy-3) by Technosmart. The GiPSy-3 tags are smaller and lighter (10 g) than the tags used in 2008 (12 g). Gipsy-3 tags were tested in Anchorage and on the Pribilof Islands in mid-late June. These tags were easier to use and download, but they had a set recording interval (every 3 min). When attached to birds, the GPS batteries lasted for a much shorter period than under outdoor testing conditions. Although GiPSy-3 tags provided complete kittiwake foraging tracks, the tracks varied in quality. Late in July, we exchanged the GiPSy-3 tags for GiPSy-2 tags that allow the recording interval to be programmed, so that power can be conserved and battery life extended. GiPSy-2 logger tags recorded complete and continuous foraging tracks, and in several cases tracks from more than one foraging trip, for both kittiwakes and murre nesting on both islands.

Seabird telemetry crews on both Pribilof Islands and on Bogoslof Island spent 10 days in Anchorage for training to standardize field methodology and final organization of logistics and field gear. The 2008 protocol for field activities was updated by R. Paredes during May-June 2009 and R. Orben prepared a Fish Guide for visual identification of murre bill-load in the field. Printed copies of both documents were provided to field crews on the three islands.

The 2009 breeding season was another challenging year for our research project. It was another anomalously cold year in the southeastern Bering Sea, and this was associated with poor nesting success for piscivorous seabirds on the Pribilof Islands, especially Black-legged Kittiwakes. Black-legged Kittiwakes started abandoning their nesting efforts late in June, during the incubation period. Breeding failure in Black-legged Kittiwakes was more severe on STG Island

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than on STP Island. Dean Kildaw's experience with kittiwakes in STG Island proved to be indispensable for finding and capturing the few remaining and very inaccessible Black-legged Kittiwakes with chicks on St. George Island. We managed to obtain GPS foraging tracks and wet/dry data from 16 and 21 Black-legged Kittiwakes raising chicks on STP and STG islands, respectively (Table 1).

We tested deployment of GPS and TDR dummies on seven nesting Thick-billed Murres at STG Island to investigate possible effects of double-tagging. All these tagged murres were seen at their nests within 3-4 days of deployment. We obtained GPS foraging tracks from 14 and 17 Thick-billed Murres raising chicks on STG and STP islands, respectively. We also collected TDR diving data from 17 Thick-billed Murres nesting on STG Island. Murres nesting on STG Island dived to a depth of up to 107 m (range = 37-107 m). STP Island murres were apparently more susceptible to effects of double-tagging, so most GPS data loggers were deployed without TDRs (Table 1).

As in 2008, there was almost no overlap in the foraging locations between seabirds nesting on the two Pribilof islands, regardless of species (Figure 1). Seabirds nesting on STG Island, both kittiwakes and murres, commuted longer distances to forage than their STP Island counterparts. Seabirds nesting on STG Island mostly foraged either beyond the shelf break in deep water (kittiwakes) or over the Pribilof Canyon (murres) (Figure 1 & Table 2). Unlike 2008, kittiwakes nesting on STP Island commuted mostly to the northwest of the island, on the shelf; only one commuted beyond the shelf break and foraged in deep water. Interestingly, more 1+ walleye pollock were found this year compared to last by the *F/V Frosti* and *Gold Rush* crews at-sea (At-sea Component B67), and the densest patches of 1+ pollock were encountered to the west and northwest of STP Island. Night-time foraging trips were usually longer than day-time foraging trips for both seabird species (Table 2). Most trips beyond the shelf break for STG Island kittiwakes and murres occurred at night. On STG Island, squid were a major component of the chick diet of Thick-billed Murres and euphausiids were often present in regurgitations of Black-legged Kittiwakes, compared to 2008. On STP Island, Thick-billed Murres delivered more gadids to their chicks than in 2008, another indication that 1+ pollock were aggregated within foraging distance of STP Island. Four 24-h days of behavioral observations were collected per species on each island to determine foraging trip duration, feeding frequency, and chick diet composition (murres) of tagged and non-tagged birds. Murres were frequently observed bringing food to their chicks following foraging trips that lasted less than 10 minutes. As part of R. Orben's Masters research (NPRB 911), we also recovered a total of 29 geolocators deployed in 2008, and deployed 52 more for data collection during the winter of 2009-10.

The success of the 2009 season was due to the excellent dedication, work, and enthusiasm of the field crews on both islands. Each color-track line in Figure 1 represents a tremendous amount of effort and patience in order to recapture birds with GPS loggers that, in many cases, were nearly impossible to recapture. At STP Island, **Rachael Orben** (Crew Leader) teamed up with **Dan Cushing** (Seabird Telemetry Tech), **John Warzybok** (Refuge Biologist with Project B65), and **Tom Harten** (PolarTREC teacher). At STG Island, **Rosana Paredes** (Project Leader) teamed up with **Robert Massengale** (Seabird Telemetry Tech), **Brie Drummond** (Refuge Biologist with Project B65), and **Dean Kildaw** (Seabird Telemetry Tech Extraordinaire).

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Table 1. Data loggers deployed on Black-legged Kittiwakes (BLKI) and Thick-billed Murres (TBMU) at the Pribilof Islands in 2009.

Species	Island	GPS data loggers		TDRs or wet/dry	
		deployed	Data*	deployed	Data
BLKI	St Paul	19	15	19	15
	St George	23	21	23	21
	Total	42	36	42	36
TBMU	St Paul	27	15	2	0
	St George	28	14	25	17
	Total	55	29	27	17

* For each individual bird, 1 - 5 foraging trip tracks were obtained.

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Table 2. Summary of foraging trips by Black-legged Kittiwakes and Thick-billed Murres at the Pribilof Islands in 2009 (STP = St. Paul Island, STG = St. George Island).

	Black-legged Kittiwake		Thick-billed Murre	
	STP	STG	STP	STG
# Tagged birds with				
1 trip	5	5	5	9
2 trips	3	11	6	5
3 trips	8	5	3	0
4 trips	0	0	2	0
5 trips	0	0	1	0
Total Tagged Birds	16	21	17	14
# Trips per				
Direction				
South	1	1	1	3
SW	2	17	15	14
East	2	6	0	0
SE	2	1	0	0
NE	0	16	0	0
West	1	0	4	0
North	4	0	0	0
NW	25	0	22	0
Timing				
Day	26	23	37	6
Night	11	18	5	11
Location				
On-Shelf	32	21	18	3
Nearshore	4	3	24	4
Off-Shelf	1	17	0	10
Total Foraging Trips	37	41	42	17
Mean max. distance (km)	58.8	86.3	12.6	54.7
Night	69.4	134.16	12.6	73.5
Day	54.3	48.8	11.0	20.1
Mean max. depth (m)	n/a	n/a	-	76.54

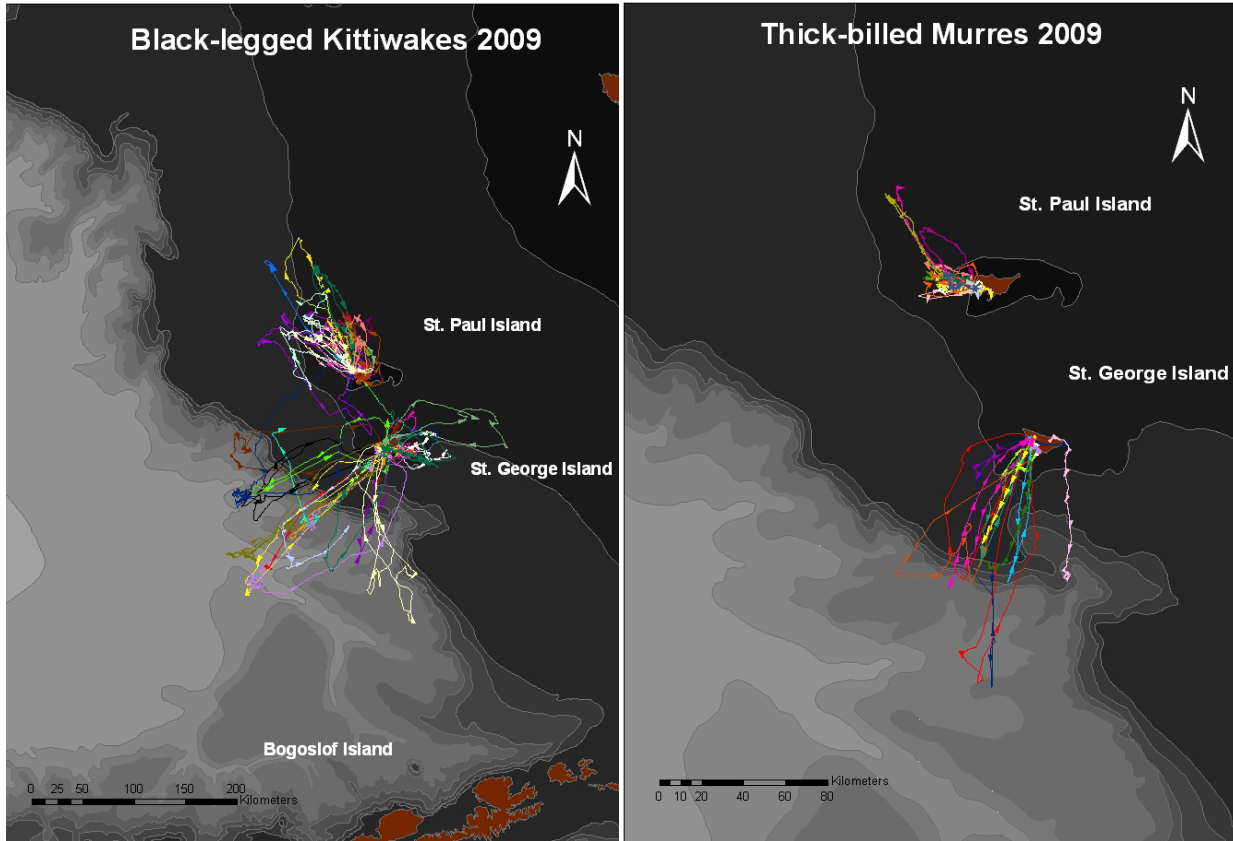


Figure 1. GPS foraging tracks of Black-legged Kittiwake and Thick-billed Murres nesting at either St. Paul Island or St. George Island during July-August 2009. Note difference in scale of the two maps.

Lessons learned and project adjustments

We learned that conditions for working with Black-legged Kittiwakes can be worse than in 2008. Near total breeding failure of Black-legged Kittiwakes at both Pribilof Islands made it significantly more difficult to reach study objectives in 2009 compared to 2008. Simply finding breeding adults whose young were still alive and therefore could have GPS data loggers deployed on them was a major challenge. Originally, the plan was to use GiPSy-2 tags (new firmware and better software) instead of GiPSy-3 tags on both seabird species. Unfortunately, these tags were not ready when the field season started. However, we managed to obtain and use GiPSy-2 tags on both species during the second half of the field season. We learned that it was possible to obtain an adequate sample of GPS tracks from Thick-billed Murres, which is excellent, but there were still software adjustments that needed to be made in order for both short and long foraging trips to be recorded concurrently. Longer position recording intervals are generally better when murres travel farther (i.e., those nesting on STG Island), but tags may not record short trips. Shorter position intervals are better when murres travel short distances (i.e. those nesting on STP Island), but the battery can die sooner so tracks of longer foraging trips may be incomplete. We plan to work with Technosmart technicians between now and the 2010 field season to find the most suitable script for programming GPS loggers in order to optimize

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position recording intervals. We learned that Thick-billed Murres are able to cope with double-tagging (both GPS and TDR loggers deployed simultaneously), which provided both location of and diving information from foraging areas. However, we noted seasonal variation in the responses of Thick-billed Murres to tagging. It appears that murres were able to better cope with tagging at the beginning of the chick-rearing period (i.e., smaller chicks or better foraging conditions) than later in chick-rearing. The percentage of deployed tags that were subsequently recovered dropped drastically from 80-90% to 50% by the end of the chick-rearing period, especially at STG Island.

Integration activity:

We worked in collaboration and cooperation with three other BSIERP Projects: B65 (Seabird Colony-based Study), B67 (Patch Dynamics Study), and B77 (Bogoslof Patch Dynamics Study). Coordination of field research activities with seabird crews for summer field season 2009 was initiated at the AMSS in January 2009. In April, R. Paredes (B63-Seabird Telemetry) met with Brie Drummond, Heather Renner (B65- Colony-based) and Ann Harding (B77- Bogoslof Patch Dynamics) to coordinate the selection of adequate plots for capturing/observing birds with data loggers, and to standardize field methodology between the Pribilofs and Bogoslof Island. Specifically, our field personnel on St. George Island and St. Paul Island worked closely with B65 personnel on the two islands to help collect data on-colony to assess reproductive success, diet composition, colony attendance, and foraging behavior of both Black-legged Kittiwakes and Thick-billed Murres. In addition, these two B65 personnel helped our study (B63) coordinate with on-going studies of seabird numbers and productivity at St. George and St. Paul islands, conducted by the Alaska Maritime National Wildlife Refuge, U.S. Fish and Wildlife Service. Field personnel with the Seabird Telemetry Study (B63) also coordinated with the Seabird Stress component (A. Kitaysky, PI) of the larger Patch Dynamics Study (B67; A. Trites, lead PI) to collect blood samples from adult kittiwakes and murres on both islands in order to assess overall condition. We also coordinated with the at-sea component (K. Benoit-Bird, S. Heppell, K. Kuletz, PIs) of the Patch Dynamics Study (B67) during July and August 2009. B63 personnel identified potential feeding areas for Black-legged Kittiwakes and Thick-billed Murres nesting on St. George and St. Paul islands, using the GPS data logger tracks, and provided the coordinates to the crew of the *F/V Frosti* and *Gold Rush* for their adaptive sampling of forage fish abundance and distribution. R. Paredes (B63) and Kathy Kuletz (B67) coordinated with Phyllis Stabeno (B52), Carol Ladd (NOAA), and Rob Suryan (Oregon State University) on the deployment of drifters by the at-sea component of the Patch Dynamics Study (B67) to study eddies in relation to seabird and fur seal feeding areas. In addition, the At-Sea Seabird component (N. Jones, field tech; K. Kuletz, PI) of the Patch Dynamics Study (B67) collected information on at-sea distribution, foraging behavior, and diet composition of Black-legged Kittiwakes and Thick-billed Murres that will prove invaluable in interpreting the GPS data logger tracks of both seabird species. Finally, B63 personnel worked in close collaboration with Rachael Orben, leader of the Winter Ecology Project (NPRB 911) to retrieve and deploy winter

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geolocators on murres and kittiwakes from both Pribilof Islands.

Education and Outreach:

Tom Harten, PolarTREC teacher, joined the St. Paul Seabird Telemetry field crew for one month. Tom did a great job posting daily journals of his experiences with the local community (e.g., Science Camp) and his daily activities with the research team. At the end of the field season he hosted a webinar about the seabird research projects with the participation of researchers (Dan Roby, Rachael Orben, and Ine Dorresteijn), teachers, and students. This work can be seen at the following website: <http://www.polartrec.com/seabird-ecology-in-the-bering-sea>

We provided posters of the Seabird Telemetry results for 2008 to the native communities of St. Paul and St. George for public display.

R. Paredes, B. Drummond, and B. Massengale gave a presentation of the Seabird Telemetry (B63), Colony-Based Study (B65), and Winter Ecology Project (NPRB 911) to native children participating in the Pribilof Marine Science Camp 2009, directed by Michelle Ridgeway and held on St. George Island. The event is summarized in an article in *The Dutch Harbor Fisherman* website: <http://www.thedutchharborfisherman.com/news/show/6917>

Next year’s Work plan : Please see below the update of our plan of work for 2010.

BSIERP PROJECT B63 - Seabird Telemetry Pribilof Islands; David Irons david_iron@fws.gov 907/786-3376; Dan Roby daniel.robby@oregonstate.edu 541/737-1955

<i>What</i>	<i>Who</i>	<i>Start (2010)</i>	<i>Other key dates</i>
Replace/fix GPS data loggers lost or damaged during 2009	Irons, Roby, Paredes	January-February	
Test GPS data loggers	Irons, Paredes	March-April	
Select seasonal biologists for St. Paul and St. George field crews	Irons, Roby and Paredes	March	Annually 2009-2010
Secure housing for seasonal biologists on the Pribilof Islands	Irons, Roby, Paredes	March	Annually 2009-2010
Review and update 2009 protocols for data collection in 2010 and order needed equipment and supplies	Irons, Roby, and Paredes	March-April	2009-2010
Have protocols reviewed by other seabird on-colony team members	Byrd, Irons, Kitaysky, Roby	May	Review annually as needed
Coordinate field approaches to avoid conflicts during field	Byrd, Irons, Kitaysky, Roby	April-May	Review annually as needed

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data collection			
Training field personnel at Anchorage and field sites	Irons, Roby, Paredes	June	June each year 2009-2010
Conduct field studies and collect data in field	Paredes, Orben seasonal field biologists	June-August	Complete field studies in August each year during 2009-2010
Send diet and blood samples to contractor	Byrd/Renner, Paredes	September	Expect annual results by end of year 2009-2010
Summarize available data	Irons, Roby, Paredes	October	Annually 2009-2010
Supply data to data manager	Irons, Roby, Paredes	November	Annually
Complete NPRB progress Reports	Irons, Roby, Paredes	1 October 1 April	Semi-annually 2009-2012
Report to communities of St. Paul and St. George	Irons, Roby, Paredes	TBD	Annually 2009-2012
Complete and submit publications	Collaborative among various PIs	January 2011	Continue thru 2012 January 2011