Identifying nesting and foraging habitat of Kittlitz’s murrelets 
(*Brachyramphus brevirostris*) in Icy Bay, Alaska

2007 Annual Summary

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In 2005 the U.S. Fish and Wildlife Service and National Park Service cooperated on a multiyear project to develop a long-term monitoring plan and to identify important nesting and foraging habitats of Kittlitz’s murrelets (*Brachyramphus brevirostris*) in Icy Bay, Wrangell-St. Elias National Park. In 2005, we focused on identifying temporal and spatial variability of Kittlitz’s murrelets in Icy Bay throughout the breeding season. In 2006, we shifted our focus to identifying important foraging and nesting habitats and launched a pilot study to radio tag and locate 15 individuals throughout the breeding season. After success in 2006, we increased our effort in 2007 to radio tag and locate 30 birds during the breeding season. This annual report summarizes work completed in 2007 only. Please contact the authors for reports and publications describing the 2005 and 2006 field seasons.
Objectives

The long-term goal of radio-telemetry work is to gather information about the relationship between plumage and breeding status, determine population structure of Kittlitz’s murrelets, to describe juvenile plumage and movements, and ultimately to describe and quantify nesting habitat for this species in Icy Bay. This information will be used to generate long-term monitoring strategies (e.g., productivity indices), to develop recovery actions, and to direct resource management in Icy Bay and other tidewater bays in southeast Alaska.

Specific objectives for the 2007 field season were:

1) to determine characteristics of nesting habitat of Kittlitz’s murrelets at multiple spatial scales;
2) to identify and characterize primary foraging habitat of Kittlitz’s murrelets;
3) to quantify use and users of Icy Bay during the summer breeding and post-fledging period so as to identify any overlap between use and important foraging or nesting habitat.

Methods

Capture and Radio Tagging

We attempted to capture Kittlitz’s murrelets on the water using the night-lighting method (Whitworth et al. 1997). Capture efforts were limited to hours of adequate darkness, which was generally between 2300-0300 hrs (variable with cloud cover). We deployed two capture crews in 4.5 m inflatable skiffs. When a bird (or pair) was captured, it was immediately transported in a cloth bird bag to the M/V Curlew, which served as a stable processing platform. We recorded time of capture, geographic position, and group size. Murrelet handling followed animal care and use guidelines from the Ornithological Council (Gaunt et al. 1997). We recorded standard morphological measurements, including tarsus length, wing chord (natural), tail length, culmen length, and mass of all birds captured to compare with other populations. We also noted and photographed plumage, molt, and brood patch characteristics. Each captured bird was banded with a U. S. Fish and Wildlife Service band on one leg. We attached an ATS A4360 radio-transmitter (Advanced Telemetry Systems, Isanti, Minnesota), which weighed approximately 3g (<3% of body weight) and had an estimated battery life of 71 days. Transmitters were attached on the back, between the scapulars, using the subcutaneous anchor method (Newman et al. 1999) without suturing (Lougheed et al. 2002) and VetBond tissue adhesive (3M Animal Care Products, St. Paul, MN). Prior to attachment the implant location was disinfected with isopropyl alcohol and infused with a maximum of 2 mg/kg solution of Lidocaine with epinephrine (0.45cc of 2% solution), a local anesthetic. Blood samples (<1cc) were taken from the tibiotarsal or brachial blood vessel of each captured bird for sexing and reproductive hormone analyses (Gaunt et al 1997). At least three dried blood samples from each bird were preserved on filter paper for sex identification (Zoogen, Inc.) and genetic analyses (V. Friesen, Queen’s University). Liquid blood samples were centrifuged at 5000 rpm for 15 min using a Clay Adams TRIAC Centrifuge (Model 0200). We estimated levels of triglycerides and vitellogenin, indices of yolk precursor hormones, in blood plasma to identify fecund females (T. Williams, Simon Fraser University). We used hormone thresholds determined for the closely related marbled murrelet (Brachyramphus marmoratus; Vanderkist et al. 2000).

Characterizing Nesting Habitat

We relocated radio tagged murrelets 2-3 times/week using a fixed-wing Cessna 185/206 outfitted with opposing H-antennas and a Telonics TR-5 or ATS R4000 receiver unit. We recorded geographic coordinates using a handheld GPS unit.
(Garmin GPS 76CSX) and bird behavior (resting, diving). We also recorded ice conditions by drawing boundaries of four ice categories (pack ice, loose pack ice, loose ice bits, trace ice bits) on a topographical map. If a radio tagged bird was located in the uplands, we visited the site as soon as possible to determine the status of the bird (etc. active nesting, mortality, etc.).

In addition to the aerial telemetry effort, we investigated the feasibility of locating Kittlitz’s murrelet nests in the uplands surrounding Icy Bay by hiking and visually scanning suitable habitat. We identified suitable habitat within 2 km of the shoreline based on published descriptions of known nests (Day et al. 1999), verbal descriptions of recently discovered nests (R. Kaler, L. Kenney, S. Studebacher), and one previous record of a Kittlitz’s murrelet nest in Icy Bay (J. Johnson, 1996). To search for nests, 3-6 observers hiked from the water to suitable nest areas previously identified. Observers spread out and walked slowly across each area, stopping occasionally to look for flying birds or movement. For all surveys, we recorded general route traveled, search time, a general habitat description, and any nests discovered.

**Characterizing Foraging Habitat**  We conducted three *Brachyramphus* murrelet population surveys in July to identify at-sea areas with high densities of murrelets. We recorded sea surface temperature (at 1.0 m) and water clarity at transect end- and mid-points in addition to standard survey conditions (ice cover, glare, sea state, weather, etc.). We recorded the distance to the nearest meter to each bird or group, and the group size. We also noted locations of fish-holding and hatch-year murrelets, and any birds in basic plumage.

At the individual bird level, we recorded geographic coordinates and behavior (resting, diving) of each radio tagged bird on the water during aerial telemetry flights. Based on our work in 2006, we determined that it was relatively simple to categorize behavior during telemetry flights, which could provide a snapshot estimate of activity budgets throughout the breeding season and help to identify important foraging areas.

To sample forage fish species present in Icy Bay, we used a beach seine with dimensions of 36.6 m in length, 2.4 m deep at the midpoint, tapered to 0.5 m deep at the wings, and nylon mesh size of 6 mm at center and 28 mm at wings. We deployed the beach seine from a 4.5 m inflatable skiff. Based on criteria outlined in Romano et al. (2004) and previous seining efforts in Icy Bay (Arimitsu et al. 2003), we selected nine sites to sample regularly (Fig. 1). We identified and measured each fish in the net, and retained five samples of each species per site for future stable isotope work and confirmation of species identification (particularly smelt). When we encountered foraging murrelets, we used a dip-net and small plankton net to sample locally available prey items.

As part of our daily activities, we occasionally encountered fish holding murrelets on the water (during surveys and during transit). For each observation of murrelet fish holding behavior, we recorded a suite of oceanographic variables. We noted date, time, geographic coordinates, group size, depth, water clarity, and fish species. We also attempted to photograph each bird with fish.

We conducted behavioral watches on radio tagged and non-radio tagged focal birds throughout the field season. The primary purpose of these behavioral watches was to describe and quantify diving behavior and at-sea activity budgets, and to compare at-sea behavior of radio tagged and non-radio tagged birds. Each watch lasted a minimum of five minutes and extended to 30 minutes when possible. We recorded dive and surface duration, preening and wing flap behavior, group size, geographic coordinates, and, at the conclusion of the watch period, we attempted to sample forage items from the area.
Quantifying Use of Icy Bay – We documented and catalogued each use and user in Icy Bay from 15 May – 11 August 2007. We recorded group type, group size, dates of occupancy and areas accessed. We attempted to record camp sites, and kayaking and hiking routes of visitors to the coastal portion of Wrangell-St. Elias National Park.

Results

Capture and Radio Tagging – We captured 38 Kittlitz's murrelets and one ancient murrelet (Synthliboramphus antiquus) from 15 May-11 August 2007. Although we attempted to capture in Taan Fjord and in the upper reaches of the bay where murrelets were observed during the day, we captured all birds in deep, mostly ice free waters in the middle of the bay. This was consistent with our capture locations in 2006. We attached radio transmitters to 30 birds captured from 15-22 May. All birds captured, and most of those encountered, were paired except for one bird in a group of three. We captured both birds of eight pairs, and of these, radio-tagged both individuals of four pairs. For the other four pairs, we attached a radio-transmitter to the lighter weight of the two birds, assuming gravid females to be heavier and more susceptible to potential adverse transmitter effects. We captured 14 males, 23 females, and one unknown (Zoogen, Inc.). Mean female mass was 260±4g (X±SE) and mean male mass was 251±4g. All birds captured were either in late transitional molt into alternative plumage, with many sheathed feathers and fresh feather growth, or in full alternate plumage. Brood patch development varied from no feather loss (BP=0) to bare and vascularized (BP=3). Triglyceride levels were elevated for 84% (16/19) females and vitellogenin levels exceeded the threshold for 94% of females, indicating that 84-95% of radio tagged females had initiated egg production at the time of capture.

Characterizing Nesting Habitat – We conducted 27 aerial surveys, logging a total of 110 flight hours between 19 May and 07 August 2007. We tracked eight birds to inland locations – four mortalities and four nesting attempts. We confirmed four mortalities at bald eagle
or peregrine falcon (*Falco peregrinus*) plucking sites (Fig. 2). One bird was depredated by a peregrine falcon, but the other three birds were depredated by one of the two raptor species. At the mouth of Icy Bay, both peregrine falcons and bald eagles were present (including active nests and eyries) and therefore, it was difficult to discern the predator responsible for the murrelet mortality. We recovered three of four transmitters at the plucking sites; one transmitter was located high in a dead snag that was unsafe to climb, but feathers and prey remains were found at the base of the snag. The mortalities occurred on/near 13 June, 15 June, 16 July, and 17 July 2007.

![Fig. 2. Aerial telemetry relocations, nest locations, and mortality locations for radio tagged Kittlitz’s murrelets from 15 May – 11 August 2007 in Icy Bay, Alaska.](image)

We located four birds at inland locations in suitable nesting habitat and documented on/off behavior at these sites (Table 1). We assumed these birds were nesting based on nest site attendance patterns documented through aerial telemetry. Of the four nests, we attempted to reach three on the ground. We successfully reached two nest sites (07-08 and 07-15), but failed to locate 07-16 in the Samovar Hills due to steep terrain. We did not attempt to visit 07-26 due to logistical and safety issues. We discovered nests from 1 June – 5 July with nest initiation estimated as 27 May – 29 June. We confirmed nest success at one nest only (07-15; Fig. 3) and nest failure at one nest (07-08; egg collected; Fig 4). We assume 07-16 failed because the radio tagged adult was depredated early in the incubation phase. As of 27 July, 07-26 was still active and appeared to be in the incubation or early chick-rearing stage. The fate of this nest was unknown because the transmitter battery eventually failed. Overall, 25% (1/4) of nests fledged young, 50% (2/4) presumably failed, and 25% (1/4) unknown.
At the two nest sites we were able to reach on the ground, we collected data for describing nest behavior and characterizing nest locations at a fine scale (Table 1). At 07-15 site, we installed a video camera and digital video recording (DVR) system (www.seemorewildlife.com) to document incubation behaviors, chick development, food deliveries, and nest success. We recorded 24 hours a day for 43 days totaling 1032 hours of video footage. We are currently reviewing the video data. After fledging, we collected a standard set of nest measurements and photographs in a 5-m and 25-m nested plot at the nest site. At 07-08, we were unable to confirm the exact nest location until 19 July when the adult
appeared to be incubating an egg. During subsequent visits, the egg was unattended and there was no sign of the adult, and eventually, on our final visit on 5 August, we collected the egg. Sergei Droventski (University of Alaska Anchorage) prepared the egg and determined that the embryo was 7-10 days from hatching. We retained part of the embryo for future analyses and sent part for full contaminant screening. While recording nest measurements, we discovered three additional Kittlitz’s murrelet nests within the 25-m plot. All three nests had eggshell fragments, egg membrane, and/or remnant pieces of a chick (pin feathers). We also found two other nest cups but they did not contain direct evidence of nesting. We collected all eggshell fragments and other nest material for future analyses and recorded nest measurements at all of the satellite nests.

Table 1. Summary of active Kittlitz’s murrelet nests discovered during the 2007 breeding season in Icy Bay, Alaska. Nests were located inland using radio tagged murrelets.

<table>
<thead>
<tr>
<th>Nest</th>
<th>Bird ID</th>
<th>Bird sex</th>
<th>Nest initiation</th>
<th>Nest fate</th>
<th>Bird fate</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaspina Glacier</td>
<td>07-08</td>
<td>Male</td>
<td>1 June</td>
<td>Failed</td>
<td>Unknown</td>
<td>3-5 satellite nests within 25-m plot</td>
</tr>
<tr>
<td>Hoof Hill</td>
<td>07-15</td>
<td>Male</td>
<td>8 June</td>
<td>Fledged</td>
<td>Mortality</td>
<td>Video camera</td>
</tr>
<tr>
<td>Samovar Hills</td>
<td>07-16</td>
<td>Female</td>
<td>15 June</td>
<td>Presumably</td>
<td>Mortality</td>
<td>Unable to access</td>
</tr>
<tr>
<td>Libby Glacier</td>
<td>07-26</td>
<td>Female</td>
<td>29 June</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unable to access</td>
</tr>
</tbody>
</table>

We conducted ground-based visual searches for nesting Kittlitz’s Murrelets over three days in May, two days in June, and one day in July for a total of 208 person hours. We searched six areas of potential nesting habitat in Taan Fjord, two areas in Tsaa Fjord and two areas in the main section of Icy Bay. No nests were discovered during this effort.

Characterizing Foraging Habitat. We conducted bay-wide population surveys on 4 July, 13 July, and 23 July 2007. Kittlitz’s murrelet abundance estimates (±SE) for each survey were estimated as 848±389 (July 4), 559±142 (13 July), and 1000±159 (23 July). Despite the relatively pristine environment of Icy Bay, the local population of Kittlitz’s murrelets has declined by 53% (18% per year) since 2002 based on log-linear regression.

We recorded 572 locations of radio tagged murrelets in Icy Bay and the surrounding waters of the Gulf of Alaska (Fig. 2). The majority (78%) of birds were resting on the water as opposed to diving (22%) during telemetry flights. Although we identified a few consistent foraging sites, radio tagged murrelets foraged throughout the entire bay including the adjacent fjords. We also accumulated 21 locations of radio tagged birds using ground telemetry from a 6 m skiff.

During beach seining, we captured a total of 4712 individuals, comprising 19 species of fish, crab and marine invertebrate. The most common species captured were Pacific Sand Lance (Ammodytes hexapterus; 91%) and Surf Smelt (Hypomesus pretiosus; 7%). Selecting suitable beach seine sites in Icy Bay proved difficult. We found few moderately sloped beaches with a consistent, even-sized cobble substrate. Glacier ice packed into near-shore areas also limited our ability to sample efficiently. We were able to re-sample one of the historic sites (Kageet Point; Fig. 1), but the other (Kichyatt Point) was consistently obscured by heavy icy buildup. Using the dip-net, we captured numerous Euphausiid spp. (not yet identified) on two occasions and one capelin (Mallotus villosus).
During the breeding season, we opportunistically observed 18 fish-holding Kittlitz’s murrelets from 4 July – 2 August 2007. We were unable to identify most fish to species (n=10), but five birds were holding capelin and three had Pacific Sand Lance (*Ammodytes hexapterus*). We conducted behavioral watches on 12 radio tagged and 45 non-radio tagged Kittlitz’s murrelets. Combined with similar data collected in 2005 (n=46), we plan to analyze these data to understand at-sea activity budgets and potential impacts of radio transmitters.

**Quantifying Use of Icy Bay** – We documented 11 different user groups in Icy Bay, other than groups associated with either of the two lodges or the logging operation at the west entrance of the bay. We observed four yachts, one tour boat, two logging ships, one research vessel, three private kayak groups, and one commercial kayak group.

**Other Observations**

In addition to the Kittlitz’s murrelet work described above, we maintained bird and mammal species lists, records of colony nesting birds, and distribution and abundance of amphibians and vascular plants.

**Seabird Colony Counts** – Based on information collected in previous years of this study, we visited colonies within the bay at least one time during the 2007 breeding season. We monitored three Arctic tern (*Sterna paradisaea*) colonies at Gull Island, Independence Creek, and Riou Spit. The Riou Spit colony failed early in the season, presumably due to flood by tide. The Independence Creek colony had 14 nests with eggs on 8 June, but only produced one fledgling. This colony was located in an area of high off-road vehicle use from a guiding outfit operating in the bay. The Arctic tern colony on Gull Island was located directly adjacent to an active Caspian tern (*Sterna caspia*) colony and appeared to have complete nesting failure during the chick-rearing stage for unknown reasons. As in previous years, we monitored the Caspian tern colony on Gull Island. The colony moved to a different location on the island (compared to the 2005 and 2006 site) and grew in size. We had high counts of 150+ after-hatch-year Caspian terns and 35+ active nests. We observed Aleutian terns (*Sterna aleutica*) foraging in Icy Bay but we did not locate the colony. We searched areas where we have previously found nesting Aleutian terns (e.g., Riou Spit), but did not find evidence of nesting activity. We monitored the pigeon guillemot (*Cepphus columba*) colony in Taan Fjord, which consisted of roughly 15 breeding pairs nesting in small crevices on a talus slope leading down to the waters of Taan Fjord. The 2007 colony location was about 300 m southwest of the 2005 and 2006 location. We also located and documented 10 active black oystercatcher (*Haematopus bachmani*) nests on Gull Island and in Taan Fjord. Please contact the authors for further information related to the seabird colony counts.

**Amphibian Monitoring** We observed two species of amphibians in the terrestrial habitat surrounding Icy Bay. Boreal toad (*Bufo boreas*) was the most abundant amphibian species with 16 observations during the season, including one water body full of tadpoles. We also observed two wood frogs (*Rana sylvatica*). Observations were limited to the areas east of Icy Bay, south of the Caetani River, and west of the Agassiz Lobe of the Malaspina Glacier. We observed one deformed frog carcass of unknown species (probably a wood frog) which was collected and sent to Mari Reeves (U.S. Fish and Wildlife Service, Anchorage) for contaminant analysis.
**Plant Inventory**—We opportunistically inventoried the flora of Icy Bay providing baseline information regarding abundance, distribution, rarity, and phenology. We collected, pressed, and vouchered specimens when possible (in compliance with permitting) and sent them to the University of Alaska Fairbanks Herbarium. In lieu of physical samples, we took a representative photograph. As we compile these data, we are working closely with Mary Beth Cook (Wrangell-St. Elias National Park), Mary Stensvold (U.S. Forest Service), and Carolyn Parker (University of Alaska Fairbanks Herbarium) for verification of field identifications. Overall, we documented range expansions for at least 23 species, three invasive species, and six species of concern in Alaska. Ultimately, these data will be sent to the Alaska Natural Heritage Program for use in the statewide database.

**Avian Predator Monitoring** Due to the high incidence of murrelet depredation by raptors in the radio tagged population of murrelets (26% in 2006, 13% in 2007), we monitored plucking posts and nests of peregrine falcons and bald eagles in Icy Bay. In mid-May, we located four active bald eagle nests and two probable peregrine falcon eyries and, in July, we found one active peregrine falcon eyrie. We visited the confirmed eyrie and plucking posts at least once per week since their discovery to collect prey remains. We climbed one bald eagle nest but did not observe any murrelet remains. We have not yet identified and enumerated prey remains collected during the 2007 breeding season, but we can report that at the confirmed peregrine falcon eyrie, we collected a minimum of 25-30 Kittlitz’s murrelets (no radio tagged birds).

**Acknowledgements**

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**Literature Cited**


