Identifying temporal shifts in trophic level of a rare and declining seabird, the Kittlitz's murrelet, in Icy Bay, Wrangell-St. Elias National Park

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Project Partners: Dancing Star Foundation, Wildlife Conservation Society

Project Duration: May 2008 – May 2009

Project Summary

The Kittlitz's murrelet (*Brachyramphus brevirostris*; family Alcidae; KIMU) is a small, poorly understood seabird endemic to the Alaskan coast and eastern Russia. KIMU populations have declined by up to 75% across their range prompting the U.S. Fish and Wildlife Service (USFWS) to elevate KIMU to a Listing Priority 2 for listing under the Endangered Species Act. Possible reasons for decline include oil pollution, gillnet mortality, factors related to climate change, and availability of preferred forage fish. Important prey species may have shifted their distribution or are now significantly reduced in numbers, which may lead to nutritional stress and lower reproductive success or elevated mortality rates. Yet very little is known regarding the diet and foraging habits of KIMU, resulting in an inability to track changes in prey base and connect known changes in physical landscapes due to climate change with dynamics of prey and resulting KIMU response, including how reproductive success may be influenced by prey changes. We propose to describe the current diet of KIMU in Icy Bay, Alaska in order to better understand the nutritional ecology and energetic demands during the pre- and post-breeding seasons. Icy Bay, Wrangell-St. Elias National Park, may support up to 14% of the world's population of KIMU, with the highest density found in any surveyed areas. This important population center is one of the few areas remaining where adequate sample sizes can be collected. Stable isotope signatures of carbon and nitrogen isolated from feathers reflect nutrient sourcing at the time the feathers were grown. Ratios of stable carbon can be used as an index of nearshore versus offshore foraging. Ratios of stable nitrogen provide estimates of the relative trophic level of the forage prey. We will match isotopic signatures of breast (prebreeding) and secondary (post-breeding) feathers from birds to those of suspected prey species to describe variation in relative diet quality. Unlike traditional methods (e.g., gut analysis), this method uses nonlethal sampling techniques and can provide a more quantitative, less biased assessment of the diet. This project will be embedded as part of a larger related effort where adult KIMU will be captured at sea to deploy radio tags to identify and monitor active nest sites, and quantify the rate of by-catch carcasses and predation by raptors. We will also be collecting prey samples using a beach seine and plankton tow, and use these fish samples for stable isotope analyses to match the trophic level identified from feathers collected during captures. Both the fish and feather isotopic values will allow us to construct multivariate and mixed models to evaluate temporal shifts (pre- and post-breeding) in the relative trophic level of KIMU.

Project Justification

Endemic to coastal Alaska and eastern Russia, the non-colonial KIMU is largely restricted to tidewater glaciers, glaciated fjords, outflows of glacial streams, and recently

deglaciated areas during the breeding season. The recent and rapid retreat of Alaska's glaciers has raised concerns for the fate of this species, and in fact, recent surveys have demonstrated that populations have declined sharply (up to 18% per year) and ubiquitously across their range. If range-wide declines of 18% per year remain constant, extirpation of KIMU is expected to occur in the next 30 years and possibly sooner in areas such as Prince William Sound. These declines provoked the USFWS to upgrade KIMU to a Listing Priority 2 in 2007; KIMU are also considered 'critically endangered' under the IUCN Red List (2006) and listed as one of the top 10 most endangered birds in the United States by the National Audubon Society (2007). Given these precipitous declines, it is critical not only to identify causal factors contributing to the population decline, but to determine the life- history stage that is limiting population growth and therefore prohibiting recovery of the species. Many factors have been proposed to be influencing the decline such as global climate change (acting on changes in prey distribution or altering nesting habitat), increased predators or predation on nestlings or adults, or entanglements in gill nets. Yet to date, only a few studies have examined any of these hypotheses, including nutritional stress caused by changes in prey base. KIMU are considered one of the least known seabirds in North America and even the most central information on the ecology of this species, such as what they eat and to what degree, is generally lacking. This significantly inhibits the ability to generate conservation and management plans that address causal factors associated with the decline. Given the conservation concerns and imminent listing under the Endangered Species Act, results of this study will provide critical information needed for understanding spatial and temporal shifts in diet and trophic structure of KIMU, thereby providing insight into which prey species may be important throughout the nesting cycle, and identifying prey species that will need to be monitored to understand how prey dynamics are contributing to the declines.

Project Objectives and Conceptual Approach

In this study, we propose to characterize and describe the pre-breeding and post-breeding diet of KIMU in Icy Bay, Alaska. It is difficult to estimate diet composition of this species using non-invasive techniques because, unlike most seabirds, they are non-colonial and do not regurgitate pellets. Therefore diet information is limited to bill load identification of birds at sea (observational method), forced regurgitation (invasive method), or stomach content analysis (lethal method). While it is possible to observe KIMU foraging, only larger forage fishes are large enough to be identified in bill, and it is unclear whether small items (e.g., macrozooplankton or smaller larval fish) are consumed under the water surface or in such a way as to be invisible to the observer. Furthermore, fish-holding behavior, common to many piscivorous alcids, does not necessarily reflect adult diet since these prey items are likely provisioned to young at a nest.

Stable isotopes are candidate biochemical markers that can be used to estimate relative contributions of different items in the diet of seabirds and other taxa. Isotopic signatures of carbon and nitrogen isolated from feathers reflect nutrient sourcing at the time the feathers were grown. Ratios of stable-carbon can be used as an index of near shore versus offshore foraging or pelagic versus benthic habitat use. Ratios of stable-nitrogen provide estimates of the relative trophic level of the forage prey. Based on these two measures, we can determine the relative location (nearshore versus offshore) and relative trophic level utilized by KIMU during the period of molt and regrowth of plumage. This method uses non-lethal sampling techniques and can provide a more quantitative, less biased assessment of KIMU diet than is capable using traditional methods described above.

We will use stable-carbon and -nitrogen analyses to describe sourcing and relative trophic-level respectively, of diet of the KIMU and any temporal shifts in diet quality. We will collect whole breast feathers (pre-breeding) and a clip of the tips of fifth secondary feathers (post-breeding) from birds captured at-sea as part of a larger study of the nesting ecology of KIMU in Icy Bay. Murrelet handling will follow animal care and use guidelines from the Ornithological Council (Gaunt et al. 1997). KIMU undergo a partial pre-alternate molt in

April/May, replacing the all-white breast feathers with dark tipped feathers, and a complete pre-basic molt in the late August/September. Dark tipped body feathers grown during pre-alternate molt reflect the nutrient signatures of the pre-breeding diet, whereas the white body feathers and flight feathers reflect post-breeding diet. We will also collect feather samples from active nest sites, by-catch carcasses, and prey remains collected at raptor nests (also part of the larger study). Similarly, forage fish and macrozooplankton will be sampled throughout the summer using a combination of methods including beach seine, dip net, cast net, and plankton tow. All samples will be identified to species and frozen in the field. We will process samples and measure isotopic ratios of stable-carbon and -nitrogen at the Oregon State University Stable Isotope Unit, Corvallis. We will analyze isotope frequencies of murrelet feathers using IsoError, augmenting our prey sample data with published isotopic ratios for known prey items.

Roles and Responsibilities

There are four partners involved in this proposed project. The National Park Service (NPS) and USFWS will spearhead the effort and cover the majority of field expenses as part of an ongoing study of the ecology of KIMU in Icy Bay, Alaska, including secured funds for logistics and salaries (8 weeks aboard the 70' M/V Curlew; skiff and motor, gas, lodging, equipment for captures, funding for aerial telemetry, salaries, etc.; which in 2008 will exceed $400,000). For the proposed project we will use feathers collected as part of captures of murrelets and fish captured as part of the larger project to examine isotopic ratios for quantifying variation in diet and trophic levels.

In order to raise awareness of the plight of the KIMU and to leverage additional funding, we have recently partnered with two non-governmental, non-profit organizations, Dancing Star Foundation (DSF), and the Wildlife Conservation Society (WCS).

Target Audience

The Alaska Region of the USFWS recently submitted a request for funding for a listing package as part of the Candidate Status of KIMU. Data collected during this and related studies will be invaluable for helping identify important prey species for a core population of KIMU, and generate a recovery plan which includes management and conservation of important prey species. This study will also serve as the most comprehensive assessment of diet and trophic levels ever conducted for this species, with the results published in a scientific journal. Thus the target audience of this project will be scientists, conservation organizations, and fishery, wildlife, and land managers.

Project Schedule and Products

The proposed project will take advantage of, and build on, the ongoing efforts related to KIMU in Icy Bay. Field efforts will occur from May-August 2008, laboratory analyses will be conducted by graduate student (Nick Hatch, under the direction of Dr. Dan Roby, Oregon State University) from September-December 2008, and data analyses and reporting will be completed by May 31, 2009 (although final analyses and reporting will not be available until December 31, 2010). The data will be published in a peer-reviewed scientific journal and used as part of the recovery plan generated by the USFWS.