My father was in the United States diplomatic corps and being raised in such an environment instilled in me an early thirst for learning and exploration. When my father was given a three-year assignment in Moscow in the early 1990s, I began to study Russia closely. Ultimately, this led to a Bachelor's degree in Russian Language (1998; Drew University). Now, I am fluent in Russian and have extensive experience in the Russian Far East (RFE) through my involvement in research and conservation of birds for more than a decade. In 1997, as an undergraduate at Drew University, I spent a semester in Vladivostok, the capital of Primorye province. After my studies, I spent several months as a volunteer at a small nature park which was famous as nesting habitat for several rare bird species. There, I led nature walks for local children and acted as an interpreter for visiting American biology teachers. After earning my baccalaureate degree in 1998, I spent a year in Alaska as a manual laborer while searching for an environment-based job in the RFE. I quickly discovered that most positions available to me were in the extractive industries: logging, fishing, and oil. One exception was the Peace Corps, which I joined.

While in the Peace Corps, I worked as an environmental educator and English teacher (1999-2002). I also took the initiative to collaborate with Russian ornithologists from two Primorye nature preserves (Lazo and Sikhote-Alin) and from Moscow State University. From them I learned the basic skills of field ornithology: mist-netting, bird banding and measuring, and species identification in a region largely devoid of bird field guides. As acknowledgement for acquiring this valuable skill set, Dr. Dale Miquelle, director of the Russia program of the Wildlife Conservation Society (WCS), offered WCS field support in 2001 if I undertook a Master's project to study a pressing conservation issue potentially threatening Primorye's birdlife. Because conservation efforts in Primorye are frequently hampered by difficult field conditions, and a volatile political climate, Dr. Miquelle recognized that I was in a unique position to conduct meaningful science in the region. Specifically, through my time in the Peace Corps, I was able to establish key contacts and collaborators to form a strong in-country support base. In fact, due to the difficulties associated with field work in the region, I remain the only foreign ornithologist conducting long-term research in Primorye.

Since completion of my M.S. degree in Conservation Biology (2005; University of Minnesota) studying the impact of logging on forest birds in Primorye, I took further initiative to learn skills necessary to work with large raptors (e.g. hawks, owls). I trained at the University of Minnesota's Gabbert Raptor Center to handle birds, draw blood for DNA analysis, and safely attach transmitter harnesses, techniques that I have used for my Ph.D. research. I have taught these skills to my Russian colleagues, returning expertise to them after their generosity to me.

My expertise in the Russian Far East has been acknowledged both in Russia and the United States, and I participated in an endangered species awareness campaign that resulted in local and national media attention. Also, for two years (2006-08) I was a consultant to the Minnesota Zoo on their exhibit highlighting wildlife of the Russian Far East (called "Russia's Grizzly Coast").

My current project with fish owls, described in my research proposal, is another step towards realizing my goal to be an ornithologist implementing and managing conservation projects in the Russian Far East. Once I receive my Ph.D. in Wildlife Conservation (May 2010; University of Minnesota), I intend to solicit employment with a large, international conservation organization such as WCS, or with a smaller institution such as the conservation biology departments of the Minnesota or Denver Zoos. These organizations will allow me to use my expertise of Russia's birds, language, and geopolitics to identify and design avian conservation projects in the region, as well as take my fish owl and other avian research in new directions.

Habitat Selection by Blakiston's Fish Owls in Primorye, Russia: Foundation for Conservation of the World's Largest Owl

Background

Blakiston's fish owl (*Ketupa blakistoni*), named after the British explorer that discovered the species, is a charismatic, endangered owl that lives exclusively in the old-growth forest river valleys of northeast Asia (Surmach 1998). Fewer than 1000 pairs of these massive birds—which stand 28 inches tall and can weigh more than 10 pounds—are thought to persist in the wild. The species is represented by two subspecies, a highly endangered island subspecies (about 60 pairs) that is found mostly in northern Japan, and a mainland subspecies (about 800 pairs) that has a broad distribution (but very low density) along much of Russia's Pacific Ocean coast. Despite being a species of strong conservation interest, almost nothing is known about the ecology or biology of Blakiston's fish owls in Russia (Slaght and Surmach 2008). This scarcity of information is largely due to the elusive nature of the species, and the difficulties of conducting field work in remote regions of the Russian Far East.

The greatest global concentrations of Blakiston's fish owl (hereafter, "fish owl") are thought to occur along coastal river systems in Primorye, the southern-most province in the Russian Far East (Surmach 2006). Positioned between the Sea of Japan, China, and North Korea, Primorye is a wild land notable for both its severe winters and its unique assemblages of wildlife. The province, about two-thirds the size of Minnesota, contains the highest biodiversity in Russia. It is the only place in the world where northern and subtropical forests intermingle, and Amur tigers (*Panthera tigris altaica*) share pristine wilderness with grizzly bears (*Ursus arctos*). Avian predators in Primorye are equally diverse; the fish owl is one of 13 owl species found there.

Fish owls face many potential threats in Russia. They drown in salmon nets set by poachers, and are shot by hunters (Slaght and Surmach 2008). However, it is their dependence on large cavities in old-growth trees for nest sites that places them at risk from their greatest threat—logging. In recent years, demand for timber from Primorye's forests has grown, and this demand has led to unsustainable harvest practices. Despite Primorye's importance to biodiversity preservation in Russia, few projects in the province have been designed with sufficient scientific or statistical rigor to guide conservation. For conservation to be effective, management plans must be based on strong science, and provide reasonable guidelines for balancing wildlife needs with sustainable resource use. Knowledge of how a species selects its habitat is fundamentally important to developing these guidelines, yet practically nothing is known about fish owl habitat use. As a result, fish owls are not adequately protected: more than 95% of known fish owl territories in Primorye fall outside the borders of existing nature preserves.

Goal and Objectives

The primary goal of this study is to develop a practical, scientifically-credible conservation plan for fish owls in Primorye, Russia. Specifically, I will meet my goal by accomplishing three primary objectives: (1) I will study the selection of habitat by fish owls, (2) I will create a habitat map of Primorye to be used as a basis for predicting areas of high probability of use by fish owls, and (3) I will formulate conservation recommendations for fish owls based on my analyses in objectives 1 and 2. I have been capturing fish owls and attaching small radio or GPS transmitters to them using backpack-style harnesses to monitor habitat selection and movements. Once I have analyzed their habitat selection and movement patterns, I will create a map using this information to identify likely fish owl habitat in Primorye, which will be the foundation for a

conservation and habitat management plan. In particular, I will use this map to identify areas of high conservation priority, and to develop recommendations for forest management and sustainable resource use of old-growth river valleys by local people.

The most feasible way to gather critical information about this species is to radio-mark a study population of fish owls to observe their habitat selection at different spatial scales and seasons, to observe their territorial behavior, and to estimate their fitness (i.e. survival, reproduction, and dispersal). By understanding the habitat use, home range size, and spatial distribution of the radio-marked owls, I can also estimate the potential population size and status of these owls in Primorye. My results will help guide selection of high-priority conservation areas in order to most effectively conserve the species. Once my study is completed, I intend to work with decision makers in the conservation community and the logging industry to foster implementation of my conservation strategies.

Design and Methodology

Study Design: Animals select habitat at different spatial scales, and therefore examining habitat selection at more than one scale has advantages for evaluating patterns of selection over a single spatial scale alone (Manly et al. 2002). I will estimate habitat selection by fish owls at two important spatial scales for conservation: a landscape scale (among-home range) and a finer scale (within-home range). For my among-home range analysis I will investigate fish owl selection of home ranges within my 7,000 square mile study area. This will allow me to better understand which components of the landscape, such as mountain slope or river valley, the owls are selecting for their home ranges. For my within-home range analysis, I will investigate habitat selection at a finer scale by comparing the actual use of specific resources by owls (such as a nest tree or river stretch), compared with the availability of those resources at randomly-selected sites. This will allow me to estimate which specific habitat features the owls are selecting. Initially, I will examine hypotheses that fish owl habitat selection can be adequately described by the presence of two predictor variables: (1) nesting sites (old-growth tree cavities) and (2) winter foraging sites (unfrozen patches of fish-rich rivers). These variables have been described frequently in the Russian literature as limiting factors for the owl, but such hypotheses have never been rigorously evaluated. I will quantify additional resources available to the owl as alternative hypotheses for predicting habitat selection (see *Data Analysis and Inference*, below). I will delineate habitats using satellite images coupled with field-based vegetation sampling. I will measure habitat use by capturing 16 fish owls, marking them with radio or GPS transmitters, and observing their use of habitat based on radio signals.

Data Analysis and Inference: Model selection is considered one of the best modern analytical techniques to evaluate the statistical inference that can be drawn from research data (Burnham and Anderson 2002). Model selection involves comparing a set of hypotheses (models) that might explain a response by owls (i.e., whether an owl is present or not present in a certain habitat). The first model includes the two predictor variables (old-growth tree cavities, open water sources) identified in the Russian literature as critical resources for fish owls. Other models will include predictor variables such as (1) forest type, (2) prey density, (3) prey diversity, (4) distance to human settlement, (5) distance to roads, and (6) proportion of home range covered by water and/or old-growth forest. Predictor variables involving prey will be measured using standard fish sampling methods; all other variables will be quantified using a computer-based habitat map generated from satellite images. I will analyze my data using logistic regression to develop resource selection functions, which are statistical models that quantify the probability of use of a certain habitat (Manly et al. 2002). Then, I will use these

resource selection functions in conjunction with satellite imagery to create a map that predicts probability-of-use by fish owls for any given location in Primorye.

Potential Significance of the Research

In the foreseeable future, conservation of Blakiston's fish owls in Russia may rely on the success of my project. By extension, conservation of fish owl habitat can serve as an "umbrella" for protecting the habitats of numerous other species that rely on forested river valleys as well. The fish owl conservation plan that will result from this project will be based on my probability-of-use map, and will include ancillary data such as home range size and species fitness. The plan I develop will be sensitive to the needs of both fish owls and the logging industry, with whom I will share my study findings. At minimum, I expect to identify specific areas in Primorye that are candidates for protection, and I will subsequently work to see such protection realized. In areas used for logging and other purposes, patterns of fish owl habitat selection can help guide the placement of logging roads to minimize impacts on resident owls, and to develop priority criteria for closing unused logging roads. Although loggers and conservationists usually find themselves at odds, I have had initial success because I favored an inclusive approach to working with local industry. TerneiLes, Primorye's dominant logging company, has already expressed interest in fish owl conservation. Importantly, the company has agreed to move logging operations away from identified fish owl territories in the Samarga river basin (northern Primorye) as a result of my survey work there in 2006, and they are now eager for advice on land use in potential fish owl habitat near the village Amgu. Their willingness to execute preliminary conservation measures demonstrates strong potential for my study to influence management of fish owl habitat on a broad scale.

Progress to Date and Schedule for Completion

I have completed three field seasons thus far (an exploratory trip in winter 2006, and two capture seasons in winters 2007 and 2008). I have captured and radio-tagged 8 individual owls, which is already four times as many fish owls captured by any other telemetry study of this species. I have collected habitat use data from all of these owls. I will travel to Russia again in winter 2009 for another 3-month capture season where I anticipate capturing 8 additional adult owls. I will then return to Russia for 4-6 weeks in late summer 2009 to collect vegetation data relating to within-home range habitat use. I plan to write my thesis during the 2009-2010 academic year with an expected May 2010 completion date for my dissertation program.

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