

MONTANA COOPERATIVE



Report for the Coordinating Committee Meeting

16 September 2009

Bozeman, Montana

# **Montana Cooperative Wildlife Research Unit**

**Report of Activities  
October 2008 – September 2009**

## **Cooperating Agencies**

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U. S. Fish and Wildlife Service

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**Cover: Whiteheads Broadbill – Malaysia 2009 - Photo by Thomas E. Martin**

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## Coordinating Committee Members

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Thomas E. Martin, Assistant Unit Leader  
Vanetta Burton, Administrative Associate IV

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Rich Harris, Research Scientist  
Cynthia Hartway, Post Doc  
Juan Oteyza, Research Assistant I  
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## **Graduate Students Advised by Unit Faculty**

### **Mike Mitchell**

Ben Jimenez, M.Sc. Candidate  
Barbara McCall, M.Sc. Candidate\*  
Lindsey Rich, M.Sc. Candidate  
Bill Sparklin, M.Sc. Candidate\*  
Jeff Stetz, Ph.D. Candidate

### **Tom Martin**

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### **Mike Mitchell**

Jami Belt, M.Sc. Candidate  
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Steve Patterson, Ph. D. Candidate  
Rachel Sprague, Ph.D. Candidate\*  
Paula A. Trillo, Ph.D. Candidate  
Carin Williams, Ph.D. Candidate

\*Graduated

## **DIRECTION STATEMENT**

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The Montana Cooperative Wildlife Research Unit performs research designed to address the needs of cooperators, bridging the gap between applied and basic wildlife science. Our studies provide new insights useful to management and conservation, based on understanding the ecological mechanisms that underlie habitat requirements and demography of individual and coexisting wildlife species. Research emphases within the Unit include ecology and management of carnivores, applied landscape ecology, management of large game, interactions between forest management and wildlife, environmental influences (predators, habitat, ungulates) on demography and diversity of birds, habitat requirements and community ecology of birds, and comparative demography and life history strategies of birds in differing environmental and geographical contexts. Other research topics are addressed as needed, in keeping with the Cooperative Research Program's mission to best meet the needs of the Cooperators by remaining flexible and open to new areas of inquiry. When Cooperator's needs occur outside Unit expertise, the assistance of appropriate University faculty will be recruited.

Unit staff will advance the training and education of graduate students at the University of Montana by teaching up to one graduate-level course per year in wildlife science, chairing graduate committees of Unit students, and serving on graduate committees of non-Unit students. Technical support and training will be provided to Cooperators and other agencies as the need exists.

## MTCWRU – Federal and State Vehicles

| Description                                     | Tag number | Mileage as of 9/1/09 |
|---|------------|----------------------|
| 1987 Chevy Custom Deluxe 20 Pickup, 4x4 3/4 ton | FED 261577 | 140,497              |
| 1991 Dodge Ram Pickup 4x4                       | FED 430733 | 113,403              |
| 1993 Chevrolet Fleetside Pickup, 4x4            | FED 261122 | 111,985              |
| 1995 Ford Styleside Pickup, 4x4, 8cyl           | FED 261124 | 125,597              |
| 1996 Dodge Ram Pickup, 4x4                      | FED 261125 | 135,577              |
| 1999 Ford Truck, Extended Cab Pickup 4 x 2      | FED 252524 | 91,282               |
| 2003 Chevy Suburban 1500                        | FED 430256 | 54,707               |
| 2006 Ford F250 Crew Cab Pickup, 4 x 4,          | FED 430965 | 54,690               |
| 1997 Chevy Suburban, 3/4 ton, 2wd               | UM 7788    | 136,367              |
| 1997 Chevy Suburban, 3/4 ton, 2wd               | UM 7787    | Salvaged             |
| 1998 Ford Taurus 4 Door Sedan                   | UM 7623    | 108,041              |
| 1999 Chevy Tahoe Suburban                       | UM 6992    | 162,577              |
| 2001 Dodge Van - 15 passenger - Maroon          | UM 7495    | 53,924               |



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**Wolf Monitoring Protocols**

**Total funds obligated: \$343,589**

Research Associate: **David Ausband**

Funding Source(s): Regina B. Frankenberg Foundation for Animal Welfare  
Nez Perce Tribe – Idaho, Idaho Department of Fish and Game  
Defenders of Wildlife, Wolf Recovery Foundation  
Wilburforce Foundation, MT Department of Natural Resources &  
Conservation, MT Fish Wildlife and Parks, Safari Club – Spokane, The  
Oregon Zoo Future for Wildlife Grants, The Mountaineers Foundation

Project Duration: 2006 – 2011

UM Project Affiliation: MTCWRU

**Objectives:**

The U.S. Fish and Wildlife Service recently removed Endangered Species Act protections for wolves in the Northern Rockies. As Endangered Species Act protections are removed so too are federal monitoring dollars used to gauge overall wolf population health. States and tribes in the Northern Rockies are now faced with the task of monitoring wolf populations to ensure their conservation with much limited budgets. Radiotelemetry has been the primary tool for monitoring wolves in the Northern Rockies, requiring intensive trapping and handling of wolves. Maintaining radiocollared wolves dispersed widely across the landscape is an expensive and logistically difficult monitoring approach and its efficacy as the sole method for monitoring will wane as federal funding declines. Recently, the Nez Perce Tribe, Idaho Fish and Game, and the Montana Cooperative Wildlife Research Unit began a research project to develop cost effective yet accurate methods for monitoring wolves in Idaho.

**Progress:**

We used logistic regression and data collected from wolves in the Northern Rockies over the last 20 years to estimate the probability a pack of a given size contains a Breeding Pair. Our results indicate that if pack size is known then the probability that the pack contains a Breeding Pair can be accurately estimated. In addition, to test new monitoring methods we identified 5 study areas based on wolf density ranging from low to high (2 low, 3 high). We have VHF and GPS collared wolves in the study areas to determine wolf density and to allow comparisons of wolf abundance estimates from new methods to estimates obtained from radiotelemetry. From 2007-2009 we surveyed nearly 500 sites annually and collected over 3,000 genetic samples. Population estimates derived from DNA encompass the true number of wolves inhabiting our study areas. We also surveyed 2,500 hunters over the last 3 years in our 5 study areas to ascertain the accuracy of their wolf observations. Results show the public is largely truthful in their reporting and that public observations may be one tool for monitoring wolves in the future. For use in roadless areas, we have developed an automated tool called a “howlbox” which can remotely survey an area by broadcasting a wolf howl, recording responses, and then shutting down until the next scheduled broadcast. In addition, we have developed a tool to actively solicit hair samples from wolves using rub stations. Analyses are ongoing but preliminary results indicate we can obtain hair samples from wolves using this method. All of these methods are designed to also feed a patch occupancy model which can then be used to generate statewide metrics of wolf abundance and distribution.

## ***Upper Clark Fork Wildlife resource monitoring assessment – Aquatic Furbearers***

**Total funds obligated: \$14,000**

Principal Investigator: **Kerry R. Foresman, Professor of Biology and Wildlife Biology**

Funding Source: Montana Fish, Wildlife, and Parks

Project Duration: July 5, 2009-December 15, 2009

UM Project Affiliation: WBIO – MTCWRU

### **Objectives:**

Conduct surveys for river otters along pre-selected reaches of the Upper Clark Fork River and associated tributaries. Predicted sites of otter use will be identified by examining aerial photos to locate logjams and by floating the river and associated tributaries. Hair snares will be placed at latrine sites and feeding areas to collect genetic material from otter. Subsequent analysis of nuclear DNA from hairs will be used to identify individuals and specify a minimum number of otter present in the Basin. Incidental observations of other aquatic furbearers (beaver lodges, muskrat houses, mink observations, scat and willow cuttings) will be recorded. Species occurrence and distribution data will be made available to MFWP for inclusion in the NRDP Terrestrial Assessment and Prioritization Effort.

### **Progress and Status:**

We have completed the summer field collection season; approximately 120 miles of the Upper Clark Fork River were floated as well as approximately 5 miles of the Little Blackfoot River and 10 miles of Flint Creek. A total of 46 otter scats were collected for DNA analysis from 13 latrine sites and 4 possible otter den sites were located. A few hair samples were collected from the snares and photos were obtained using remote cameras (attached). Fifty-eight beaver lodges and 8 dames were observed along the Clark Fork River proper and 6 lodges were observed along the Little Blackfoot River. An additional dam was located in the lower end of Rock Creek. Thirteen muskrat and 1 mink were sighted and 9 mink scat were collected for analysis. The USDA Rocky Mountain Research Station (Laboratory of Dr. Michael Schwartz) is currently conducting the DNA analyses and we are analyzing bank habitat data and constructing GIS distribution maps of all data collected. Preliminary food analyses are also being conducted on the otter scat samples.

## ***Evaluation of risks and benefits of population augmentation for peninsular Bighorn Sheep***

**Total funds obligated: \$77,000**

Post-Doc Researcher:           **Richard Fredrickson**

Principal Investigator:        L. Scott Mills

Funding Source:                California Department of Fish and Game

Project Duration:               2008 – 2009

UM Project Affiliation:        WBIO – MTCWRU

### **Objectives:**

The goal of this project is to evaluate the relative costs and benefits of augmenting the endangered Peninsular Ranges bighorn sheep population. The potential demographic benefits from the release of captive-reared animals and/or the translocation of free-ranging animals, will be weighed against the risk of potential disease epizootics to provide information on the effects of these management options on population viability and the likelihood of meeting recovery criteria

Objectives are to:

1. estimate sex- and age-specific survival, cause specific mortality, recruitment, and disease profiles of captive-raised animals (both release animals and those still in captivity) versus those of wild-born, free-ranging sheep in the two augmented subpopulations and the six non-augmented subpopulations;
2. conduct a population viability analysis (PVA) and risk assessment to evaluate the relative costs and benefits of various augmentation options over 10 and 20 year periods; and
3. based on the results of the PVA, develop a decision framework to guide augmentation decisions and identify important gaps in existing knowledge.
- 4.

### **Progress and Status:**

Demographic and health (seroprevalence and titers of pathogen antibodies) data from eight wild subpopulations and two captive populations monitored for 16 years are being analyzed to: 1) understand the effects (or predictive ability) of sheep density, sex, age, and body weight, rainfall, and health data on the occurrence of clinical disease, particularly bronchopneumonia, and mountain lion predation; and 2) provide estimates of demographic parameters for use in PVA. PVA software for this project is currently being developed.

## ***Multiscale effects of forest roads on Black Bears***

**Total funds obligated: \$45,000**

Student: **Ben Jimenez**

Degree: M.Sc. Wildlife Biology

Advisor: Mike Mitchell

Funding Source(s): Idaho Fish and Game, MTCWRU

Project Duration: 2007 – 2009

UM Project Affiliation: WBIO/MTCWRU

### **Objectives:**

Black bears (*Ursus americanus*), are a highly adaptable landscape species with few natural predators. With high road densities and increasing traffic volumes throughout much of their range however, the potential effects of roads on bears as well as the habitat which they rely upon are of growing concern (IUCN Bear Specialist Group 2007). The black bear population within the Coeur d'Alene (CDA) river watershed of Northern Idaho is exposed to high road densities and moderately high hunting pressure. Hunting regulations allow for the use of bait and dogs in both spring and fall hunting seasons, and dogs are permitted for non-lethal pursuit during the summer pursuit season. In an effort to better understand the effects of these pressures on black bears, the objectives of this study are as follows:

1. Provide a fine scale analysis of habitat selection of black bears (2<sup>nd</sup> and 3<sup>rd</sup> order habitat selection).
2. Assess the effects of road density and traffic volume on this multi-scale habitat selection.
3. Assess alterations to activity patterns due to seasonal shifts in traffic volumes.
4. Evaluate potential functional habitat loss for black bears within the area.

### **Progress and Status:**

Between June 1, 2007, and July 25, 2008, we captured 43 individual black bears, and instrumented 28 adults with Global Positioning Systems (GPS) collars. Collars were set to acquire positions at 20 minute intervals from April 10 – November 10. During the winters of 2008 and 2009, we visited 32 dens to collect and redeploy collars. All dropped collars were retrieved, and all collars were collected from harvested animals. This two year trapping and collaring effort produced a total of 180,000 locations. Analysis of this data is currently underway.

## ***Analysis of wildlife movements in relation to Denali Park Road Traffic***

**Total funds obligated: \$97,325**

Research Biologist:           **Rick Mace**  
Cooperator:                   Bureau of Land Management/CESU  
Project Duration:            2007 – 2009  
UM Project Affiliation:      MTCWRU

### **Objectives:**

The study's purposes are first, to provide for the preservation of the physical, biological and social environment of Denali National Park; second, to promote the enjoyment of the park by the public and the economic activity associated with public use, and third; to support the research and educational mission of the cooperating universities.

Using GPS radio telemetry, this project will quantify the distribution, movement patterns, and daily activity patterns of grizzly bears and Dall sheep along the park road corridor. Spatio-temporal relationships among these ecological parameters and traffic flow along the road corridor will be investigated. Results will be combined with traffic flow studies, visitor and driver surveys and logistical analyses to create a traffic model for the Denali Park Road. A comprehensive model that evaluates the impacts of road traffic will allow wise decisions about traffic volume and timing, in order to maximize opportunities to view wildlife in Denali without degrading resources or visitor experiences.

***Noninvasive genetic sampling reveals black bear population dynamics driven by changes in food productivity***

Total funds obligated: \$64,207

Student: **Barbara McCall**  
Degree: Master's Wildlife Biology - Graduated 2009  
Advisor: Mike Mitchell  
Cooperator: Idaho Department of Fish and Game  
Project Duration: 2007 – 2009  
UM Project Affiliation: MTCWRU – WBIO

**Abstract:**

I conducted research on the demography of a harvested north Idaho black bear (*Ursus americanus*) population to determine the underlying dynamics of changes in population abundance, to determine how much these dynamics were driven by variation in food productivity, and to evaluate how these processes could influence inferences based on mark-recapture analysis. In cooperation with Idaho Department of Fish and Game and the USDA Forest Service, I used barb-wire corrals to collect black bear DNA during 2003-2006 in the Purcell Mountains of Idaho. We analyzed these DNA samples to determine the number of uniquely identified individuals in each year,  $N_u$ . I used a combination of both genetic and mark-recapture analyses to evaluate the sources of variation in  $N_u$  over the four years and to what extent this variation was driven by changes in productivity of foods on the landscape. Specifically, I investigated deviations of Hardy-Weinberg equilibrium and genetic substructure in relation to changes in abundance, and whether variation in vital rates were a function of changing berry productivity in the study area. I found a heterozygote deficiency and detected genetic substructure indicating I sampled  $\leq 4$  subpopulations within the same area over the four years (a Wahlund Effect). My mark-recapture analyses suggest this pattern was probably in response to landscape changes in summer berry abundance. My results suggest important variation in population dynamics driven by changes in food productivity, which should be considered when using mark-recapture analyses to monitor population trends for black bears.

***Development of a monitoring protocol for wolves in the northern Rockies based on patch occupancy modeling***

**Total funds obligated: \$55,000**

Post-doctoral Researcher: **TBD**

Principal Investigators: Mike Mitchell

Funding Source: Montana Fish, Wildlife and Parks, Idaho Fish and Game, Nez Perce Tribe, US Fish and Wildlife Service, the Frankenberg Foundation

Project Duration: 2009 - 2011

UM Project Affiliation: MTCWRU

**Objectives:**

Working closely with collaborators, we will develop monitoring protocols for wolves in the northern Rocky Mountains based on patch occupancy modeling. We will develop the potential for population and harvest modeling that is present conceptually in patch occupancy modeling but has yet to be realized. Specifically, we will incorporate trends in distribution, reproduction, and the distribution of pack sizes to estimate population size and distribution, with confidence intervals, for each state in the northern Rockies. Further, understanding population dynamics by integrating our monitoring with insights derived from empirical exploration of historical data and results of highly focused simulations could lay the groundwork for follow-on or complementary research estimating sustainable harvests of wolves in the northern Rockies. Such an approach would allow geographically targeted planning and refinement of management practices (e.g., control actions, harvest quotas, etc.) to meet local, state-wide, and regional objectives.

**Progress and Status:**

Recruitment of a post-doctoral researcher is underway.

## ***Effects of Rocky Mountain Elk on small mammals and nutrient cycling in Arizona***

Student: **Elliott Parsons**

Degree: Ph.D. Candidate

Advisor: John Maron

Funding Source: USDA CREES Managed Ecosystems Program

Project Duration: 2006 - 2009

UM Project Affiliation: WBIO - MTCWRU

### **Objectives:**

My research examines how impacts of ungulate herbivory on plant community structure affect both small mammal abundance and litter and nutrient dynamics. To explore these questions I am using three ungulate exclosures erected in fall 2004 in northern Arizona, and three paired non-fenced plots. We have been using live-trapping since 2004 to determine how small mammal species abundance and community composition change as a result of ungulate browsing. Furthermore, we are examining how browsing by ungulates impacts deciduous tree recruitment and whether subsequent changes in litter quantity or quality impacts available nitrogen in the soil, and understory plant growth.

### **Progress and Status:**

Abundant Rocky Mountain elk (*Cervus elaphus*) in our study system are currently having a significant impact on vegetation and small mammal populations as revealed by our exclosure study. We have seen a significant increase in maple and aspen recruitment inside of exclosures as compared to non-fenced plots since 2004. These changes in vegetation have paralleled changes in small mammal populations. Voles (*Microtus mexicanus*), woodrats (*Neotoma mexicana*), and rock squirrels (*Spermophilus variegatus*) have all increased inside of our exclosures relative to our non-fenced plots since 2006. In addition, yearly line transect surveys have revealed increased red squirrel (*Tamiasciurus hudsonicus*) middens and sightings on exclosures relative to non-fenced plots indicating potentially higher red squirrel density. Changes in small mammal abundances are likely due to differences in habitat quality and we are using resource selection functions to determine whether habitat characteristics selected by different species are changing inside of our exclosures. Significant increases in deciduous tree recruitment and height since 2005 have also led to higher quantities of high quality leaf litter being deposited within exclosure plots. We found that aspen leaves in 2007 had the highest relative nitrogen content followed by maple and white fir and that these species decomposed at different rates. We are currently finishing a leaf litter addition experiment to determine whether differences in litter species influences plant-available nitrogen in this system.



***Combining hunter surveys and territorial dynamics to monitor wolf pack abundance and distribution in Montana***

**Total funds obligated: \$161,650**

Student: **Lindsey Rich**

Degree: M. Sc. Candidate

Advisor: Mike Mitchell

Funding source: Montana Fish, Wildlife, and Parks

Project Duration: 2008 – 2010

UM Project Affiliation: WBIO – MTCWRU

**Objectives:**

My overall objective is to develop a patch occupancy model (POM) using hunter surveys as my sampling method to monitor wolves in the Northern Rocky Mountains. I am developing a POM which provides an estimate of the number of wolf packs and their distribution in Montana. To develop a POM that is robust to variation in wolf territory size, however, an ecological understanding of factors influencing territory size is required. To address this, I am answering the following questions:

1. What factors drive the spatial and temporal variation in wolf territory size?
2. How does a POM developed using hunter surveys compare to known abundance and distribution of wolf packs in Montana?

**Progress and Status:**

During the summer and fall of 2008 9 GPS collars were deployed on wolves in 9 different packs located throughout Montana. The GPS collars were programmed to collect 8 locations a day and these locations are transmitted via Argos to an internet accessible database once every two weeks. I download the locations and map them with ArcMap to monitor the wolves' movements. Of these 9 collared wolves one was illegally shot, one dispersed and was hit by a car, one dispersed and was shot by a rancher in Idaho, and one dispersed and died in Colorado. In the summer of 2009 5 GPS collars were deployed on wolves and all of these wolves are still alive and the collars are functioning.

In the fall of 2008 I worked on completing my master's thesis proposal. I presented my proposal during wildlife graduate seminar and defended it to my graduate committee in November 2008. My graduate committee signed off on my proposal in spring 2009. In the past year I have also plotted all of my hunter survey data from 2007 and 2008, began working on preliminary patch occupancy models, and have started putting together different GIS layers that I will need for my analyses.

***Linking resource selection and mortality modeling for population estimation of mountain lions in Montana.***

**Total funds obligated: \$66,760**

Post-doctoral Researcher: **Hugh Robinson**

Principal Investigators: Mike Mitchell and Mark Hebblewhite

Funding Source: Montana Department of Fish Wildlife and Parks

Project Duration: 2009 - 2011

UM Project Affiliation: MTCWRU

**Objectives:**

In Montana a combination of limited entry and quotas are used by the Department of Fish Wildlife and Parks (MFWP) to allow recreational opportunities for the public, while maintaining viable mountain lion populations, thus creating a need for accurate and defensible population estimates. Advances in generalized linear modeling and geographical information systems (GIS) have made available new techniques to quantify and spatially represent resource selection, mortality risk, and population dynamics. Using data provided by MFWP, I propose to produce spatially explicit models of mountain lion resource selection, survival, densities, and population dynamics. This research will be directed towards aiding MFWP personnel in developing local harvest strategies and a statewide mountain lion management plan.

**Progress and Status:**

The project began in August 2009 and is currently in the data acquisition and management phase. Our first milestone will be to produce a mountain lion Resource Selection model by February 2010.

***Home range sizes, habitat selection, and movements of feral pigs on Fort Benning, Georgia***

**Total funds obligated: \$38,562**

Student: **Bill Sparklin**

Degree: Master's Wildlife Biology – Graduated Spring 2009

Advisor: Mike Mitchell

Cooperators: Auburn University, Fort Benning Natural Management Branch

Project Duration: 2003-2008

UM Project Affiliation: WBIO – MTCWRU

**Abstract:**

Feral pigs are one of the most successful, widespread, economically and environmentally damaging invasive mammalian species worldwide. I conducted a study of feral pig sounders (female social groups) on Fort Benning, Georgia to test our hypotheses that feral pigs were territorial at the sounder level and that territoriality was a key factor influencing habitat selection of feral pigs on Fort Benning. I used Global Positioning System (GPS) location data from 24 individuals representing 18 sounders combined with mark-recapture and camera trap data to evaluate evidence of territorial behavior at the individual and sounder levels by comparing the degree of overlap between home ranges. I categorized the landscape into five land cover types (open grassy areas, upland hardwood forest, pine forest, pine-hardwood forest, and hardwood bottomland forest) based on differences in the food and cover resources they provided feral pigs and used Ivlev's index to evaluate habitat use within sounder home ranges.

Sounders had nearly exclusive home ranges and had completely exclusive core areas, suggesting that female feral pigs on Fort Benning were territorial at the sounder level but not at the individual level. Sounders used the majority of forested cover types in proportion to availability and this supports our hypothesis that territorial behavior is a key factor influencing habitat selection by feral pigs on Fort Benning. Furthermore, the need for territory maintenance (patrolling, scent-marking) may mask changes in habitat selection based solely on resource availability. Territorial behavior in feral pigs could influence population density by limiting access to reproductive space. Removal strategies that: 1) match distribution of removal efforts to distribution of territories, 2) remove entire sounders instead of individuals, and 3) focus efforts where high quality food resources strongly influence territorial behaviors may be best for long-term control of feral pigs. Since feral pigs use the majority of forest cover types in proportion to availability, feral pig management actions need to address potential impacts across Fort Benning instead of limiting management actions to hardwood bottoms where pig activity is more apparent.

***Exploring noninvasive genetic sampling methods for long-term, multi-species monitoring***

**Total funds obligated: \$56,230**

Student: **Jeff Stetz**

Degree: Ph.D. Candidate

Advisor: Mike Mitchell

Funding Source(s): U.S. Forest Service, U.S. Geological Survey

Project Duration: 2009-2013

UM Project Affiliation: MTCWRU

**Objectives:**

The purpose of this project is to perform specific tasks in support of managing black bear populations and working toward recovery goals for the grizzly bear population in northwestern Montana via support for ongoing U.S. Geological Survey research efforts. In part, this project will

1. providing information on the size and distribution of the black bear population in Glacier National Park and
2. developing and testing a web interface for a comprehensive database of grizzly bear information in the Northern Continental Divide Ecosystem (NCDE).

**Status:**

Coursework was started this semester. Funding has been secured for at least one additional year. Proposal development and committee member selection is underway.

***Which environmental factors explain differences among species in parent and offspring responses to brood size variation?***

**Total funds obligated: \$121,500**

Student: Daniel Barton  
 Degree: Ph.D. Candidate  
 Advisor: Thomas E. Martin  
 Funding Source(s): National Science Foundation, Montana EPSCoR, U.S. Geological Survey  
 U.S. Department of Agriculture  
 Project Duration: 2005-2010  
 UM Project Affiliation: DBS-OBE and MTCWRU

**Objectives:**

Life history theory explains variation in age-specific fecundity and mortality, which is enigmatically arranged along a 'slow-fast' gradient. Species at the 'slow' end express long life span, low fecundity, and low reproductive effort, while species at the 'fast' end express the converse. Understanding extrinsic factors causing this pattern is key to understanding evolution of life history traits and demography of wildlife populations. Food limitation, age-specific mortality, and offspring quality are advanced to explain this variation. We test the predictions of each of these alternatives by examining variation among species in their responses to natural and experimental perturbations. For example, rate of feeding offspring is a key life history trait. It varies substantially among species and incurs energetic costs to parents (reproductive effort) and fitness benefits to offspring (e.g. increased growth, survival). Simultaneously, variation in offspring number and quality strongly influences parental fitness. Comparison among species of the responses of parents to natural and experimentally induced variation in offspring number allows for tests of alternative explanations for life history diversity. Predictions for within- and among-species variation in responses are generated under alternative hypotheses and we test them using brood size manipulations. This approach of testing life history theory by comparing responses among species yields tests that are unattainable with traditional single or multiple species studies.

**Progress and Status:**

Field work for this research began in 2007 and is ongoing. We manipulated clutch size and measured parental and offspring responses at 240 nests of 20 species in Arizona and Venezuela. Over natural variation in brood size, we tested whether food limitation or age-specific mortality explain variation in parental feeding behavior among 29 songbird species from Arizona, Argentina, South Africa, and Venezuela. Our results supported the age-specific mortality hypothesis and suggested species with high adult mortality increase feeding rate proportionately with increasing brood size, while species with low adult mortality do not. In contrast, food limitation theory predicts proportional adjustment of feeding rate across species and this was not the case. This suggests an important role for adult mortality in the evolution of provisioning strategies, which are a key component of life histories. However, alternatives remain and experimentally induced variation in brood size will provide stronger inference. The first set of results of this research are currently in review for publication.

## ***Does nest size constrain clutch size? A tropical-temperate test***

Student: **Atilio L. Biancucci**

Degree: Master's Wildlife Biology – Graduated Spring 2009

Advisor: Thomas E. Martin

Funding Source: National Science Foundation

Project Duration: 2007 – 2008

UM Affiliation: WBIO – MTCWRU

### **Abstract:**

The smaller clutch size of tropical as opposed to north temperate birds has intrigued researchers for a long time. An untested hypothesis posits that higher nest predation in the tropics favors smaller nests thereby constraining clutch-size. We tested this hypothesis by conducting an experiment to test whether nest predation increases with nest size in a tropical forest. Furthermore, we studied north temperate and tropical birds to examine if: (1) predation rates increased with nest size, (2) nest sizes were smaller in the tropics, and (3) clutch size was explained by nest size controlled for body size. We used data on predation rates, nest sizes, and clutch sizes for > 2000 north temperate and tropical bird nests of 36 altricial bird species that nest in open cups. Nest predation risk increased with nest size in both the experiment and in the comparison across latitudes, justifying a major premise underlying the nest size hypothesis. However, nest sizes were not smaller in the tropics. As a result, clutch sizes were not related to nest sizes either between latitudes or within sites. Nest sizes were strongly correlated with adult body sizes. Hence, (1) body size might influence reproductive success by affecting nest predation through nest size; and (2) we rejected the hypothesis that nest size explains clutch size in the tropics.

***Differential growth of body components among coexisting passerine species in response to nest predation risk***

Student: Yi-Ru Cheng  
Degree: Master's Wildlife Biology – Graduated Winter 2008  
Advisor: Thomas E. Martin  
Funding Sources: Taiwan National Fellowship, USGS Climate Change  
Project Duration: 2005 - 2008  
UM Project Affiliation: WBIO - MTCWRU

**Abstract:**

Environmental sources of mortality can exert strong selection pressures on growth strategies across taxa. Studies of growth responses need to consider multiple body components because components can compete for resources during growth in an integrated growth strategy. However, such studies are lacking and little is known about the extent to which body components may differ in their growth responses to environmental selection pressures. Theory predicts that growth of body components with relatively higher advantages for survival should be prioritized. For example, increases in time dependent mortality, like nest predation risk in birds, should favor growth of body features that enhance the ability to leave nests earlier. We studied 12 coexisting species of passerines to specifically test predictions that species with higher nest predation rates would prioritize growth of locomotor components (e.g. tarsi and wings) at the expense of growth of body mass. We also tested the prediction that these altricial birds should develop endothermy earlier to facilitate their ability to leave the warm nest environment. We found species that experience higher nest predation rates exhibited relatively faster growth rates of wing chord, but not tarsus, compared with body mass. Furthermore, species with higher nest predation rates achieved adult-sized tarsi and 60% of adult wing-chord lengths at relatively smaller body mass, further demonstrating the prioritization of wing and tarsus development. Species with higher nest predation risk also developed endothermy earlier at relatively smaller body mass. Thus, our results suggest that growth responses among species to differences in nest predation risk include an integrated strategy across body components to facilitate an ability to escape a risky environment.

## ***Revision of the Montana Bald Eagle Management Guidelines***

**Total funds obligated: \$15,000**

Research Associate: **Christopher A. M. Hammond**  
Principal Investigator: Mike Mitchell  
Cooperators: Montana Fish, Wildlife and Parks  
Project Duration: 2009  
UM Project Affiliation: MTCWRU

### **Objectives:**

Coordinate the completion of revised Montana Bald Eagle Management Plan (1994) guidelines.

1. Soliciting and compiling feedback and assistance from the Montana Bald Eagle Working Group.
2. Assigning committees of the Montana Bald Eagle Working Group to contribute to or complete specific sections of the management guidelines revision where appropriate.
3. Summarizing the most current professional literature on activity impacts (e.g. subdivision development, highway construction), potential threats and buffers for inclusion in guideline delineation.
4. Drafting management guidelines for Montana Bald Eagle Working Group review and finalization.
5. Drafting management guidelines in a format suitable for diverse users including land and wildlife management professionals, construction contractors, energy development contractors, etc.
6. Summarizing current federal regulations under the Bald and Golden Eagle Act within the context of Montana guidelines in a format suitable for diverse users including land and wildlife management professionals, construction contractors, energy development contractors, etc.
7. Summarizing management actions that could be used to enhance habitat.
8. Coordinating final review of revised guidelines through Montana Bald Eagle Working Group.
9. Time permitting: Drafting management guidelines for Golden Eagles

### **Progress:**

An initial meeting with the Bald Eagle Working Group Chair (Kristi DuBois) and the Avian Biologist/Bird Conservation Coordinator for Fish, Wildlife and Parks (Catherine Wightman) was held in Missoula to discuss expectations and deliverables associated with the contract. Habitat management was identified as a high priority since habitat protection was lost with recent delisting and habitat loss is potentially the biggest threat facing viable eagle populations in Montana. We agreed that the goal was not to rewrite the Montana Bald Eagle Management Plan of July 1994, but we would incorporate results of more recent research and most likely create an addendum to the plan. We also decided that the Living with Bald Eagles pamphlet would also require updating. We did not decide on how to focus our habitat management efforts, but plan to in future meetings.

After the first meeting, we began a literature review. This included peer reviewed literature as well as other existing state management plans, resources, etc. In addition, we have had several conversations with working group members regarding monitoring, subdivisions and other development, contaminants, etc. A technical review committee was formed with participants from the following agencies: Fish, Wildlife and Parks, University of Montana, U. S. Forest Service, Bureau of Land Management, Plum Creek Timber Company, Army Corps of Engineers, U. S. Fish and Wildlife Service, and the National Park Service (retired). The review committee has met on two occasions. The draft guideline package will be sent to the Bald Eagle Working Group.



***Identification of aspen habitat features that affect reproductive success and diversity of birds***

**Total funds obligated: \$330,000**

Student: **Amy Johnson**

Degree: M.Sc. Candidate

Advisor: Thomas E. Martin

Funding Source(s): Montana Fish, Wildlife and Parks; The Bair Foundation

Project Duration: 2008-2010

UM Project Affiliation: DBS - OBE-MTCWRU

**Objectives:**

Understanding the aspen patch features that affect the reproductive success and diversity of native birds is of great interest to wildlife management and conservation because aspen forest area is declining in western North America. Aspen forests are biodiversity hotspots, and declining aspen presence may be associated with population declines in a variety of organisms dependent on this community type, including many species of birds. Identification of habitat features (e.g., landscape context, conifer component, and microhabitat features) that affect the reproductive success and species composition of aspen-associated birds will help managers determine the appropriate actions for bird conservation. Aspen management plans are primarily determined by the amount of conifers within and around the aspen forests because conifers shade out aspen trees. Conifer removal from aspen patches increases aspen recruitment in most cases, but little is known about how conifer removal affects bird populations. I am examining the influence of conifers within and around aspen patches on bird reproductive success and species composition. In addition, I am examining how variation in microhabitat features between conifer- and grassland-embedded aspen patches affect predation rate, parasitism rate, and nest-site selection.

**Progress and Status:**

I am testing the effects of conifers within and around aspen patches on bird reproductive success by finding and monitoring songbird nests and associated vegetation within grassland- and conifer-embedded aspen patches at two study sites in Montana. Field work started this year (2009). Conifer component was measured through systematic vegetation surveys within each aspen patch. Microhabitat features were also surveyed around each nest. Point counts and predation surveys were conducted within each study plot and will be used to determine species composition between grassland- and conifer-embedded aspen patches. This Fall I will look for relationships between habitat features and nest success (including predation and parasitism rates) and species composition. I will analyze the data and make preliminary conclusions before going back out to the field sites next summer.

## ***The importance of embryonic development for offspring and adult immune function***

Student: **Ania Majewska**

Degree: Ph.D. Candidate

Advisor: Thomas E. Martin

Project Duration: 2008-2013

UM Project Affiliation: WBIO - MTCWRU - M-EID

Funding Source: National Science Foundation

### **Objectives:**

Tropical birds are typified by slow development, low fecundity, high adult survival and are thought to experience increased exposure to parasites compared with north temperate species. Slow development in tropical birds may represent an evolutionary response to parasite pressure because strong immune function is thought to require time-consuming cellular differentiation. Tropical Asian birds appear to challenge this long-standing view of the necessity of slow development for enhanced immune function and high adult survival. Although accepted as a standard measure of development, the length of the embryonic period is not necessarily representative of embryonic development rate. In birds development rate is a function of temperature, thus parents may influence developmental period and offspring immune function by inducing fluctuations in egg temperatures. Indeed, studies of passerine birds show that decreased average egg temperatures result in extended embryonic periods and decreased offspring quality. Yet, parental effects on development rate and offspring quality may extend well into postnatal period and also deserve attention. Previous studies primarily focused on length of the embryonic period and a single measure of adult immune function, while overlooking the possible influence of parasites and of parental effects on offspring phenotypes. I am testing alternative hypotheses in a rigorous design in two developmental stages and at multiple levels of immune function. Summer 2009 I began to examine two major hypotheses that explain variation in immune function and developmental rates of tropical Asian versus temperate birds. This study is the first to test theoretical predictions of the two hypotheses in a strong comparative context.

### **Progress and Status:**

Field work for this project began in summer 2009 in Coconino National Forest, Arizona. A total of 751 blood samples were collected from adult and nestling passerine birds representing 26 species. Samples are being analyzed in the laboratory using various immune assay. In addition, nearly 100 birds were sampled for intestinal parasites and ectoparasites. Finally, approximately 480 adult birds were sampled for avian influenza as part of collaboration with UCLA's Center for Tropical Research. Laboratory analyses are underway.



***Understanding the environmental causes of a major global divergence in life history strategies of tropical birds***

**Total funds obligated: \$193,680**

Principal Investigator: **Thomas E. Martin**  
Funding Source: National Science Foundation  
Project Duration: 2009-2012  
UM Project Affiliation: MTCWRU

**Objectives:**

Measure demographic and life history strategies (clutch size, nest predation, development rates, parental care, adult survival rates) of bird species in montane Malaysian Borneo (Kinabalu Park) to compare with related bird species in Arizona and previous work in tropical Venezuela at similar elevations. Examine the relative importance of nest predation, food limitation, and adult mortality on variation in demography and life history strategies.

**Progress and Status:**

Life history strategies are comprised of age-specific fecundity and mortality, plus parental care behaviors and developmental rates influencing these fitness components. Altogether these traits determine demography of populations in ecological time and influence evolution of phenotypes to provide critical insight into environmental selection pressures. By examining geographic variation in life history strategies and the selection pressures favoring differing strategies, new insights are gained into the environmental influences on population regulation. Particularly strong insight is gained by examining major divergences in strategies because they reflect differing historical environmental pressures on populations and species. Tropical Asia has a major life history divergence that has gone un-noticed: clutch sizes are larger and more variable for many species, development rate of embryos is faster, and yet adult mortality remains low. This combination of traits is thought to be impossible under current theory.

We initiated a new project in tropical Borneo because it retains large blocks of pristine forest at mid-elevation. Plots for nest searching and netting birds were established and mapped via GPS in 2009. About 400 nests were found and monitored, nestling growth measured, parental care video-taped, and egg temperatures quantified. In addition, some 500 birds were banded to aid in estimating adult survival and re-nesting efforts. Data are in the process of being entered into the database and videos are being transcribed to allow initial analyses later in the year. We will take a full field crew in 2010.

This work includes an important training component for young US and Malaysian scientists. The perception that reproduction cannot be studied in the field is corrected by training young scientists in the conduct of this field work. In addition, the most motivated are invited to the lab in Montana where they are taught to write their first publications on the life history of some species that is previously undescribed.

***Effect of climate change and elk browsing on population trajectories and trophic interactions in a high elevation riparian ecosystem***

**Total funds obligated: \$588,484**

Principal Investigator: **Thomas E Martin**

Funding Source(s): US Geological Survey, US Department of Agriculture

Project Duration: 1985-ongoing

UM Project Affiliation: MTCWRU

**Objectives:**

Measure and examine annual variation in avian nest success and predation, adult survival, population size, habitat selection, and parental care behaviors, as well as small mammal density and species composition, vegetation density and species composition in a high-elevation riparian ecosystem in north-central Arizona relative to climate variation and elk browsing.

**Progress and Status:**

Climate has had large consequences over the past 24 years for 32 bird species based on study of their populations and >15,000 nests by affecting trophic levels below (plants) and above (predators) them. Winter snowfall has declined strongly across the 24 years of study, as typical throughout western North America, which has increased over-winter densities of elk in the study area. This decline in snowfall and increase in overwinter elk was strongly associated with the loss of deciduous vegetation (aspen, canyon maple, New Mexican locust) that represents preferred bird habitat, and birds have declined in abundance associated with the decline in preferred habitat. In addition, summer precipitation has also declined over the 24 years of study and drier summers have yielded greater predation on offspring.

The direct effects of climate on differing trophic levels together with indirect effects arising from altered interactions among trophic levels substantially change ecosystem structure. An enclosure experiment was initiated in the fall of 2004 to test the effects of elk and winter snow on plant, bird and small mammal communities. Three large (10 ha) enclosures were established on three different canyons. Results through 2009 already show a large effect on aspen recruitment and ground cover, and a slower but increasing effect on maple and locust recruitment; plant abundance and diversity (e.g., increased perennial flower diversity) have increased in the 5 years since fence establishment. In addition, several bird species have already increased in abundance compared with adjacent controls. Small mammal species also show responses, with some species (deer mice, wood rats) increasing and others (chipmunks) decreasing on fenced areas compared with controls.

Continuation of this project will help to differentiate the interacting effects of elk browsing and climate on plant reproduction, and subsequent effects on higher trophic levels (birds, small mammals), as well as the interaction among these trophic groups.

## ***Ecological determinants of variation in life history strategies between related tropical and temperate birds***

**Total funds obligated: \$493,000**

Principal Investigator: **Thomas E. Martin**  
Funding Sources: National Science Foundation, Venezuela National Parks  
Project Duration: 2001 – 2008 (ending)  
UM Project Affiliation: MTCWRU

### **Objectives:**

Measure life history strategies of bird species in montane Venezuela (Yacambu National Park) to compare with related bird species in the long-term Arizona study to examine the relative importance of nest predation, food limitation, and adult mortality.

### **Progress:**

Life history strategies are comprised of age-specific fecundity and mortality, plus parental care behaviors and developmental rates influencing these fitness components. Altogether these traits determine demography of populations in ecological time and influence evolution of phenotypes to provide critical insight into environmental selection pressures. By examining geographic variation in life history strategies and the selection pressures favoring differing strategies, new insights are gained into the environmental influences on population regulation. Particularly strong insight is gained by comparing phylogenetic relatives in different geographic regions because it allows examination of differing historical pressures on populations and species.

Very little detailed information on life history strategies has been quantitatively described for tropical birds. It is a common perception that nests are too difficult to find. However, we have located and monitored just over 3,700 nests in tropical Venezuela to date. We have video-recorded parental behaviors such as nest attentiveness (% time spent on the nest) during incubation, feeding rates of nestlings relative to their ages, and brooding of nestlings, and measured: length of incubation and nestling periods, fresh egg mass, loss of mass by eggs over the incubation period, nestling growth rates and sizes, embryo metabolism rates, egg temperatures, and rates of development of endothermy.

The results to date show that adult mortality can be of greater importance in the longer-lived tropical birds than temperate birds and explain large regional differences such as smaller clutch sizes, lower parental effort, slower development and cooler embryo temperatures. This has led to discovery of broad patterns that have never been recognized previously. For example, we documented for the first time that there is a general world-wide pattern of parents exhibiting lower nest attentiveness (less time on the nest) during incubation than north temperate birds. This then explains long incubation periods in a way never before considered. Nest predation can influence strategies within each region, but does not explain differences among regions. Finally, we netted and banded more than 4,000 birds to allow examination of adult survival.

***Population viability analysis for Greater Sage-grouse in select areas of the Miles City Field Office***

**Total funds obligated: \$103,774**

Post-Doc Researcher: **Rebecca Taylor**

Principal Investigators: David Naugle and L. Scott Mills

Funding Source: Bureau of Land Management

Project Duration: 2008 – 2010

UM Project Affiliation: WBIO – MTCWRU

**Objectives:**

1. Use existing lek count data and location and survival information from marked birds to conduct population viability analyses for sage-grouse in the Powder River Basin, Montana and Wyoming.
2. Work with managers to formulate potential and realistic future management scenarios for populations.
3. Use management scenarios to simulate future viability of populations to provide decision support to BLM officials at field office, state and national levels.
4. Assemble data and conduct viability analyses for other basins outside the PRB but within sage-grouse management zones I & II that also are affected by energy development.

**Progress:**

Progress since June 1 includes an analysis of sage grouse population growth rates to determine the relative contribution of different demographic rates to population growth. These demographic rates have been estimated from marked birds in Montana, Wyoming and beyond. Preliminary analyses of population growth rates based on Montana lek counts has begun.

## ***Black-backed Woodpecker study***

**Total funds obligated: \$71,439**

Student: **Jennifer Woolf**  
Degree: Ph.D. Candidate, WBIO  
Advisor: Fred Allendorf  
Funding Sources: USFS Rocky Mountain Research Station Wildlife, Genetics Laboratory, Montana Department of Fish, Wildlife and Parks, U.S. Forest Service, Rocky Mountain Research Station, Yellowstone to Yukon Initiative and Wilburforce Foundation, National Center for Landscape Fire Analysis, U. S. Forest Service Region One, McIntire-Stennis Cooperative Wildlife Research Program, Five Valleys Audubon, Northwest Scientific Association, Glacier National Park, The Glacier Fund, Bureau of Land Management, Black Hills NF, Global Forest Science, Avian Science Center, Univ. of Montana  
Project Duration: 2003-2009  
UM Project Affiliation: WBIO-DBS

### **Objectives:**

My primary goal is to describe the genetic population structure and dispersal dynamics of black-backed woodpeckers. In addition, I plan to test whether the black-backed woodpecker is a strong habitat specialist, or a moderate habitat specialist in terms of breeding habitat requirements. Specifically, I will address the following research questions:

1. Models of Population Structure: What patterns and amounts of gene flow result in discrete genetic clusters vs. a continuous population? If the population is continuous, what patterns and amounts of gene flow result in isolation by distance vs. panmixia?
2. Population Structure of black-backed and hairy woodpeckers: What are the patterns of genetic variation observed at different spatial scales? Which population model best fits genetic population structure observed? What is the distribution of dispersal distances? How does the observed pattern of genetic variation inform the monitoring and management of populations?
3. Synthesis and Comparison: Based on the simulation data, what demographic parameters could result in the observed population structure of black-backed and hairy woodpeckers? Can life history combined with genetic data of a common species inform life history of a rare species, given genetic data?

### **Progress:**

We completed our collection of field data in July 2007. Over the course of the study, we obtained samples from 186 black-backed and 92 hairy woodpeckers. We have preliminary results on both mtDNA and nuclear DNA relationships. In the winter of 2007-2008, we will complete the genetic analysis of all of the samples and determine relationships among individuals at different field sites.



### ***Investigation of hybridization between native Sauger and introduced Walleye in the Missouri River Drainage, Montana***

**Total funds obligated: \$65,044**

Student: Daniel Bingham

Degree: M.Sc. Candidate, WBIO

Advisor: Fred Allendorf

Funding Source: Montana Fish, Wildlife and Parks

Project Duration: 2009 – 2010

UM Project Affiliation: WBIO – MTCWRU

#### **Objectives:**

This proposed graduate research project has three main objectives.

1. Find five to ten diagnostic DNA microsatellite markers between sauger and walleye. Such markers can be analyzed using non-lethal sampling.
2. When the diagnostic loci have been identified they will be used to investigate the extent and dynamics of hybridization between the species throughout the Missouri River drainage. This portion of the research will use random samples collected from spawning aggregations.
3. Finally, if appropriate the same samples will be used to investigate the genetic population structure of sauger throughout the drainage. This portion of the project may require analysis of additional microsatellite loci depending on how much genetic variation exists at the diagnostic microsatellite loci within sauger.

#### **Progress:**

Student is reviewing the literature for microsatellites that may be useful as diagnostic markers between sauger and walleye. He has identified over twenty, polymorphic loci that amplify in both species and many more that amplify in closely related species indicating their potential usefulness in identifying sauger-walleye hybrids. He will be ordering primers for these loci in the near future to begin examining their usefulness in identifying sauger-walleye hybrids.

***A risk assessment framework for defining scientifically-defensible recovery goals for listed species***

**Total funds obligated: \$296,779**

Post-doctoral Researcher: **Cindy Hartway**

Principal Investigator: L. Scott Mills (In collaboration with co-PIs at University of Idaho [Oz Garton, Michael Scott] and University of Wyoming [Matthew Kauffman])

Cooperators: U. S. Department of Defense, University of Idaho, University of Wyoming

Project Duration: 2006 - 2010

**Objective:**

Management of sensitive species is often complicated by incomplete data on the species, and by the lack of a framework to prioritize recovery actions. The objective of this project is to develop and test tools that can be used to better manage listed species on Department of Defense (DoD) installations by developing a framework to estimate trend, prioritize management actions, and estimate extinction risk under a range of life history attributes, available data, and training, testing, and management actions. The main focus of the University of Montana portion of this collaborative grant is to first determine how key population attributes such as survival or reproduction respond to specific anthropogenic disturbance and/or management actions (e.g. grazing, removal of exotic predators), and whether these responses are consistent across taxa. We will next use demographic matrix models for multiple species in multiple taxonomic groups to see how the expected change in demographic rates due to management actions would translate into changes in population growth rate. For each taxonomic group the vital rates – and management actions -- most typically responsible for population declines and endangerment will be determined. These “rules of thumb” will allow managers to choose the most efficient management options most likely to increase population growth, even for endangered species for which little specific data exists.

**Progress:**

This year we completed our initial project with the development of a web-based guide for managing data-poor T&E species on DoD lands. Our approach combines a suite of demographic models (developed from basic life history information of T&E species) with the results of our review and meta-analysis of management effects on species vital rates (e.g. – survival and reproductive rates). The graphical output of these models allows managers to predict how vital rate alterations will affect population growth rate, which vital rates have the greatest influence on growth rates, and, most importantly, the likely population-level effects of vital rate alterations resulting from specific management actions. This tool helps managers formulate broad guidelines on the efficacy of alternate management options, research and data collection efforts.

We have received additional funding from SERDP to extend our project to develop analyses quantifying the effect of parameter uncertainty (due to environmental variation or observer error) and model structure on estimates of population persistence. We will be determining the impact of spatial and temporal variability on the overall effectiveness of management actions to alter species’ demographic rates, and making inference from results about the type and amount of information necessary to effectively manage species.

***Genetic population structure and conservation of Bull Trout in the East Fork Bitterroot River, Montana***

**Total funds obligated: \$55,053**

Student: Leslie Nyce  
Degree: M.Sc Wildlife Biology  
Advisor: Lisa Eby  
Funding Source(s): Montana Fish, Wildlife & Parks (through Section 6 & SWIG funds)  
Project Duration: 2008-2010  
UM Project Affiliation: WBIO

**Objectives:**

1. Determine genetic population structure of bull trout in the East Fork Bitterroot River.
2. Determine which tributaries are important for fluvial fish. (3) Re-evaluate the current monitoring plan to determine if it captures the status and trends of fluvial fish.

**Progress and Status:**

To determine genetic population structure, we sampled all East Fork tributaries with known bull trout presence to collect non-lethal tissue samples during the summers of 2008 and 2009. Analysis of the tissue samples will include DNA extraction, polymerase chain reaction and fragment analysis using 16 microsatellite loci with allelic diversity. Seven of the loci are diagnostic allowing examination of hybridization with brook trout. In addition to analyses to describe population structure, I will test for relatedness among individual samples within tributaries as well as examine whether there is evidence for population bottlenecks. To date, DNA extraction has been completed on 264 samples along with fragment analysis on 192 samples. Initial analysis shows no hybridization and an allelic diversity between 2-22 alleles. To examine which tributaries are important for fluvial fish, I implanted six fluvial bull trout with radio transmitters in order to identify spawning tributaries. Three of the six fish were tracked to spawning tributaries and a fourth to the East Fork Wilderness area. In addition, we collected tissue samples from the East Fork mainstem and Bitterroot River to assign to a tributary of origin. Between the different approaches (following fluvial fish and assigning fluvial fish to natal tributaries), I hope to be able to highlight the key tributaries producing fluvial fish. Once I have a better understanding of the distribution and sources of fluvial fish, I will evaluate the current monitoring plan and existing data to examine whether it has captured the trends in the fluvial component and make recommendations for future monitoring approaches. The field component of this project will be completed fall of 2009 with final data analyses and writing in 2010.

***State-wide assessment of status, predicted distribution, and landscape-level habitat suitability of amphibians and reptiles in Montana***

**Total funds obligated: \$288,458**

Student: **Bryce A. Maxell**

Degree: Ph.D. Wildlife Biology - Graduated Spring 2009

Supervisors: Andrew Sheldon and Lisa Eby

Cooperators: Region 1 U.S. Forest Service, U.S. Geological Survey - Biological Resources Division, Montana Fish, Wildlife and Parks, Bureau of Land Management, Montana Department of Environmental Quality, EPA, IUCN Declining Amphibians Population Task Force

Project Duration: 2000 – 2008

UM Project Affiliation: WBIO – FOR – DBS/MTCWRU

**Abstract:**

Beginning in the late 1980s herpetologists began to realize that amphibians around the world had undergone, and were continuing to undergo, declines, extirpations, and extinctions. In most cases, detections of declines and determinations of the underlying causes has been hampered by a lack of available baseline information on distribution and status.

This project was a cooperative effort to address these data deficiencies for amphibians and reptiles in Montana. Watersheds with greater than 30 percent federal or state land ownership were randomly selected for survey in each of 11 geographic strata. Visual encounter and dipnet surveys of all standing water bodies on public lands within these watersheds yielded watershed and site occupancy estimates as a measure of status. Occupancy estimates from this first-ever state-wide base level assessment can be more validly used for future comparisons with future status assessment, provided additional support for declines in Western Toad (*Bufo boreas*) and Northern Leopard Frog (*Rana pipiens*) populations in western Montana, and identified a variety of conservation issues of concern that can be addressed through management actions (e.g., clear evidence for negative impacts of fish and importance of maintaining natural disturbance regimes such as flooding, beaver, and fire).

The information gathered during field inventories was combined with other existing information and used in maximum entropy modeling to predict state-wide distribution and habitat suitability for all of Montana's amphibians and reptiles. These models out performed GAP analysis models by simultaneously reducing the area predicted and omission error rates. Among other things, models identified scale dependent responses to environmental variables, potentially isolated populations in need of conservation efforts, and areas that are critical for maintaining landscape connectivity.

In conjunction with field inventories, a state-wide assessment of the distribution of the pathogenic chytrid fungus (*Batrachochytrium dendrobatidis*) (Bd) was undertaken using PCR-based detection in skin swabs or tissue samples. Bd was found across Montana in 6 of the 9 species tested at a variety of elevations, habitats, and distances from human activities. The widespread presence of Bd highlights the need for additional studies and measures to prevent the spread of Bd and other novel pathogens.

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- Sharp, N. W., **M. S. Mitchell**, and J. B. Grand. 2009. Sources, sinks, and spatial ecology of cotton mice in longleaf pine stands undergoing restoration. *Journal of Mammalogy*, in press.
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## PRESENTATIONS AND POSTERS

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- Ausband, D. E., M. S. Mitchell,** C. Mack, M. S. Nadeau, and P. Zager. 2007. Developing a monitoring framework for wolves in Idaho. Annual Meeting, Montana Chapter, The Wildlife Society.
- Hartway, C., L.S. Mills** and M. Kauffman. 2009. Prioritizing species recovery actions for data-poor species. National Military Fish & Wildlife Association, Technical Workshop. Washington, D.C.
- Jimenez, B. S.,** and **M. S. Mitchell.** 2009. Multi-scale effects of roads on black bear habitat selection. Western Black Bear Workshop.
- Martin, T. E.** Northern Rockies Aspen conference – 2009 – Climate change and aspen habitat relative to bird use (invited).
- Martin, T. E.** XIII Reunión Argentina de Ornitología - June 2009 – New hypotheses of life history evolution in tropical birds. (Invited Keynote Lecture) Tafi de Valle, Argentina..
- McCall, B. S.,** and **M. S. Mitchell.** 2009. Non-invasive genetic sampling reveals black bear population dynamics driven by changes in food productivity. Western Black Bear Workshop.
- Mitchell, M. S.** 2008. Panelist: wildlife panel discussion on wolves. Rural Law Symposium, University of Montana School of Law (invited).
- Mitchell, M. S.** 2009. Panelist: Predator/prey open session. North American Moose Conference (invited).
- Powell, R. A., and **M. S. Mitchell.** 2009. Optimality models, cognitive maps, fitness and home ranges (and other jargon). Annual meeting, American Society of Mammalogists (invited).
- Stenglein, J., C. Mack, **D. Ausband, M. Mitchell,** P. Zager, S. Nadeau, and L. Waits. 2009. Monitoring an Idaho gray wolf population: A noninvasive genetic approach. Annual Meeting, Idaho Chapter, The Wildlife Society.

## AWARDS AND RECOGNITIONS

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### **Daniel Barton**

- National Science Foundation Graduate Research Fellowship, 2009-2010

### **Ania Majewska**

- NSF IGERT Fellowship, 2009-2010
- Montana-Ecology of Infectious Disease Small Grant Award, 2009
- AOU Student Membership Award, 2009
- Cooper Society Student Membership Award, 2009

### **Thomas E. Martin**

- President of the Cooper Ornithological Society
- Invited to give Keynote lecture for XIII Reunión Argentina de Ornitología in Argentina (June 09)