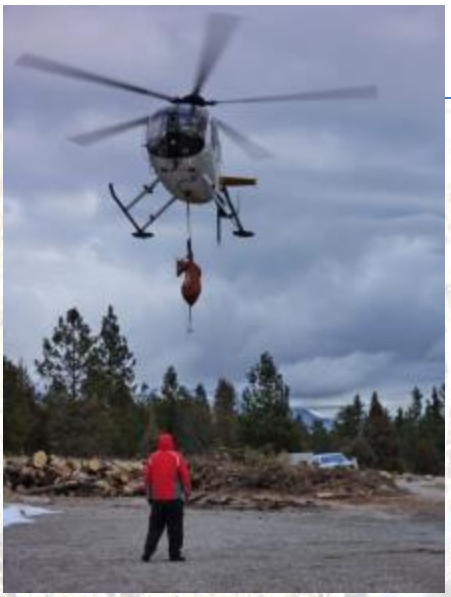
MONTANA COOPERATIVE Wildlife RESEARCH UNIT



Report for the Coordinating Committee Meeting

10 April 2013

The University of Montana

Cover – Photos by Sarah Sells

Research Project: Proactive management of pneumonia epizootics in bighorn sheep in Montana

Funded by Montana Fish, Wildlife and Parks

Montana Cooperative Wildlife Research Unit

Report of Activities for the Coordinating Committee Meeting
April 2013

Cooperating Agencies
U. S. Geological Survey, Biological Resources Division
Montana Fish, Wildlife and Parks
The University of Montana
Wildlife Management Institute
U. S. Fish and Wildlife Service

Project and fiscal information included in this report:
01 January 1 2012 through 31 March 2013

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

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Nathan Borg, M.Sc. Candidate
Charles Henderson, M. Sc. Candidate
Mark Hurley, Ph.D. Candidate
Sarah Sells, M.Sc. Candidate
Jeff Stetz, Ph.D. Candidate

Tom Martin

Andrew Boyce, M.Sc. Candidate
Karolina Fierro-Calderon, M.Sc. Candidate
Ross Crandall, M.Sc. Candidate
Joseph LaManna, Ph.D. Candidate
Juan Carlos Oteyza, Ph.D. Candidate
Riccardo Ton, Ph.D. Candidate

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Mike Mitchell

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Daniella Dekalaita , M.Sc. Candidate
Karolina Fiero, Ph.D. Candidate
Jessie Golding, M.Sc. Candidate
Clay Miller, M.Sc. Candidate *
Allison Moody, Ph.D. Candidate (Auburn) *
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Rebecca Smith, M.Sc. Candidate *
Derek Spitz, Ph.D. Candidate
Robin Steenweg, Ph.D. Candidate
Tshering Tempa, Ph.D. Candidate
Jody Tucker, Ph.D. Candidate
Tshewang Wangchuk, Ph.D. Candidate
Lindsey Webb, M.Sc. Candidate
Sara Williams, Ph.D. Candidate
Marketa Zimova, M.Sc. Candidate

* Graduated

Tom Martin

David Ausband, Ph.D. Candidate
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Margaret Riordan, M. S. Candidate
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Derek Arnold, Research Assistant	Jacob Graham, Research Assistant
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Keely Corder, Research Assistant	Genesis Machek, Research Assistant
Stephanie Couture, Research Assistant	Ania Majewska, Research Assistant
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John Nelson, Research Associate	Nicholas Sly, Research Assistant

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Maggie Raboin, Research Assistant	Eric Vane, Research Assistant
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Lindsey Rich, Research Assistant	Jake Wicken, Research Assistant
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Lisa Rosauer, Research Assistant	Anna Wrona, Research Assistant

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Kathleen Arledge	Ian Hamilton	Taylor Scherr
Daniel Barthelmew	Alleshen Holderman	Sara Schwartz
Carley Benda	Joe Hughes	Hannah Schwend
Seth Bergman	Chelsea Hutton	Lori Skyrud
Kaydee Borchers	Brittani Johnson	Caroline Smith
Eric Clewis	Margaret Kincaid	Sarah Stanick-Woods
Emily Cohen	Jedidiah Krebs	Eric Stratton
Joel Contreras	Jordan Kron	Shannon Thompson
Edwardo Contreras	Morgan LaPointe	Sarah Washko
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Audra Diemer	Caleb Matthew	Luann Whitacre
Taylor Dowell	Jack McAllister	Erica Wicker
Emily Dreke	Ashley Napier	Robert Wilson
Joshua Esquivel	Joseph Nelson	

Direction Statement

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.

Unit and Administrative Operating Funds		
U.S.G.S. – Cooperative Research Units – Administrative Funds	8,000	
University of Montana		
Full-time Administrative Associate - Salary/Benefits	53,447	
SPABA – FY11 IDC returned to Unit in FY13	87,656	
Subtotal		**$149,103**
FY 2013 – New Research Projects and Increase in Funding		
Montana Fish, Wildlife and Parks		
Operating Funds	20,000	
WBIO/MTCWRU Research Projects (FY13)	30,822	
T. Martin - PI		
Craighead Beringia South – Graduate Support	17,491	
EPA Star Award – Graduate Support	42,000	
NSF – Historical & Contemporary Influence/Biodiversity in Tropical Asia	1,326,915	
The Bair Ranch Foundation – Aspen Study	100,000	
UM Research Administration – Graduate Support	46,000	
M. Mitchell – PI or Co-PI		
RWO 96 - BLM – Sage-grouse – Migratory Populations	12,265	
RWO 99 – USGS – Sage Grouse Genetics – Graduate Support	117,925	
RWO 97 – USGS Rocky Mountain Elk	126,000	
Bernice Barbour Foundation – Pilot Study Bio-fences/wolves Central ID	69,680	
Idaho Fish & Game – Wolf, Bear, Mule Deer Research	81,363	
Oregon Department of Fish and Game – Elk Data Synthesis Study	10,000	
Panthera – Development of decision making tool/MT. Lions In Montana Year 2	30,546	
Rocky Mountain Elk Foundation Western States Elk Study	31,951	
State of Colorado – Analysis of Elk Survival Data	6,951	
University of Wyoming – Evaluating influence of climate/predation On survival of Rocky MT Elk	7,500	
U.S. Forest Service – Grizzly Bear DNA Study	33,000	
Waterton Biosphere Reserve Assoc. – Study plan to test monitoring For wolves in SW Alberta	174,742	
Gift/UM Foundation Funding for Wolf Research	82,000	
Subtotal		**$2,367,151**
Total Budget		**$2,516,254**

Completed Projects – 1 January 2012 – 31 December 2012

End Date	Principal Investigator	Funding Agency	Title
March 2012	Dave Ausband	Kampe Family Foundation	Biofence: Deterring wolf conflicts
May 2012	Lisa Eby	MTFWP	Analyses of restoration projects in the Blackfoot River, Basin, MT
June 2012	David Ausband	Animal Welfare Institute	Biofence: A novel, non-lethal tool
September 2012	Mike Mitchell	MTFWP	**RWO 90** - Using demographic analyses to develop monitoring and management tools for wolves in the northern Rocky Mountains
	Mike Mitchell L. Scott Mills	USGS – Climate Change	**RWO 95** – Can camouflage keep up with climate change? Connecting own-scaled climate models to adaptation for a key forest species
	Mike Mitchell	IDFG	Ungulate ecology in Idaho: Understanding predator/prey interactions
December 2012	Dave Ausband	Bernice Barbour Foundation	Monitoring the health of wolves by creating bio-fences and using DNA analyses
	Dave Ausband	Bosack and Kruger Foundation	Non-lethal wolf/livestock conflict resolution and non-invasive population monitoring of gray wolves in the Rocky Mountains
	Mike Mitchell	MTFWP	Intern Support
	Lisa Eby	USGS	**RWO 98** – Long-term population monitoring of Columbia Spotted Frogs

MTCWRU – Federal and State Vehicles

Description	Tag number	Odometer as of 3/31/13
1993 Chevrolet Fleetside Pickup, 4x4	FED 261122	124,828
1999 Ford Truck, Extended Cab Pickup 4 x 2	FED 252524	98,879
2003 Chevy Suburban 1500	FED 430256	83,003
2006 Ford F250 Crew Cab Pickup, 4 x 4	FED 430965	88,234
2010 Ford Expedition 4 x 4	FED 433441	23,885
2011 Ford F250 Crew Cab Pickup, 4 x 4	FED 433440	11,713
2011 Ford F250 Crew Cab Pickup, 4 x 4	FED 433610	12,170
2012 Dodge 1500 Crew Cab 4 x 4	FED 433621	7,453
1997 Chevy Suburban, 3/4 ton, 2wd	UM 7787	147,257
1998 Ford Taurus 4 Door Sedan	UM 7623	124,305
2005 Ford Explorer 4 x 4	UM 3787	119,323

BIRDS

Vincent Slabe with an adult, female golden eagle.
Photo by R. Crandall

Mountain-Wren Babbler – Borneo – Photo by J. Oetyza

The fight for space: Exploring the role of competition and environmental filtering in limiting elevational distributions and structuring communities in tropical birds

Student: Andrew Boyce

Degree: Ph.D. Student

Advisor: Tom Martin

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Project Duration: 2011 – 2016

Funding Source:

- National Science Foundation
- The University of Montana
- Montana Cooperative Wildlife Research Unit

Objectives

I have proposed an observational and experimental study to investigate the importance of competition and environmental filtering in limiting species distributions in clades of birds with parapatric elevational distributions. This pattern of abutting, non-overlapping, elevational ranges of close relatives is a key component of biodiversity and endemism in the tropics and has been documented across taxa (Cadena et al. 2011). However, the mechanisms underlying this pattern are poorly understood. I will perform playback experiments at congener interaction zones to determine the role of interspecific competition in limiting species' elevational ranges. Additionally, I will be measuring physiological tolerance to both cold and hot temperatures using a field respirometry system. I will combine data on metabolic response to temperature, with directly measured climatic conditions on the mountain to determine if abiotic factors such as temperature or humidity can act as elevational barriers to species with narrow physiological tolerances.

Progress and Status

I am currently conducting my fieldwork in Kinabalu National Park, Sabah, Malaysia. I am building on my first season where I mapped elevational ranges of all passerine species in the park, and conducted playback experiments in two parapatrically distributed pairs of congeneric species. This season I am continuing to conduct point counts to refine my elevational range data. However, I am focusing the majority of my time on measuring physiological tolerance to temperature in both low (1,450m) and high (3,200m) elevation bird communities. I am collaborating with Dr. Blair Wolf and his PhD student, Bill Talbot, who have extensive experience with field respirometry in both birds and mammals. I am extremely grateful for their assistance.

Determining the influence of landscape change on a breeding Golden Eagle population: 1962-Present

Student: Ross Crandall **Obligated funding: $35,484**

Degree: M.Sc. Candidate

Advisors: Tom Martin
Erick Greene

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Project Duration: 2011 – 2013

Funding Source:

- Craighead Beringia South

Glassing a golden eagle territory, looking for breeding adults

Objectives

Declining populations of native plant and animal species is a major problem threatening global biodiversity. Causes for declining populations have primarily been attributed to human-related impacts such as habitat loss or degradation, direct persecution and over exploitation of resources. Predicting and mitigating impacts is often a primary goal of conservation biologists and ecological research. Before efforts focus on determining causes for declining population, it is first necessary to collect information on the abundance, distribution and productivity of the species and monitor it over an appropriate time period so trends can be properly identified. Once a trend has been established, efforts can expand to determine factors influencing change in the population of interest. My project examines the influence of landscape change on a breeding population of an apex avian predator, the golden eagle (*Aquila chyrsaetos*), in an area of increased breeding density since the 1960's despite increased human presence and a population-level decrease of golden eagles. I am interested in determining the landscape and environmental factors necessary to support the current population and testing differences in identified factors between both time periods. This information will shed light on the role that landscape change has on ecosystem processes, provide information on factors influencing a species of conservation concern and provide tools managers can use to effectively create plans and implement guidelines or management action based on sound scientific evidence.

Progress and Status

To date, I have collected 3 years of data on breeding golden eagles on the study area including information on territory occupancy rates, nest initiation rates, and productivity. I will continue collecting this information in the 2013 breeding season to augment the information already collected. In addition, beginning in 2011 we began an effort to start tracking both fledgling and adult golden eagles. In 2011 and 2012, we were able to capture 13 adults and in February 2013 we captured 5 more bringing the total to 18 breeding adults. In addition, we put out 4 satellite transmitters on nestlings in 2012 which was considered the pilot year. We considered the effort a success and will continue in 2013. I'm currently finishing with the analysis of data from 2010-2012 where I was interested in questions related to habitat selection at multiple spatial scales and environmental factors that influence breeding success. I'm now continuing the analysis using results from the current phase to guide analysis of historic data to determine which environmental factors influenced the documented changes in the breeding population since the 1960's. I plan on defending my thesis during the fall of 2013.

Greater Sage-Grouse genetic connectivity across the species' eastern range

Obligated funding: $165,094

Student: Todd Cross

Degree: Ph. D. Candidate

Advisors: David Naugle & Michael Schwartz

Project Duration: 2011-2016

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding sources:

- Bureau of Land Management
- USDA NRCS – Sage Grouse Initiative
- Montana Fish, Wildlife & Parks
- U.S. Geological Survey – Research Work Order 99

Objectives

The greater sage-grouse (*Centrocercus urophasianus*) is a charismatic icon of the western sagebrush landscape, ranging across 11 Western states and 2 Canadian provinces. Sage-grouse are sagebrush obligates. They rely on sagebrush habitat for food, nesting, and spring breeding congregations known as leks (the male lek display can be viewed here: http://www.youtube.com/watch?v=m0M8pZnNlnI). Sagebrush habitat is rapidly being fragmented and lost due to anthropogenic impacts including subdivision, agricultural tillage, energy development, and invasive species. Sage-grouse currently occupy only 56% of potential pre-western settlement habitat and are warranted but precluded from the Endangered Species Act due to higher priority actions.

Habitat loss and fragmentation, and overall range contraction have heightened concerns regarding the risk of local population extinction due to the severing of genetic connectivity. Therefore, the conservation and management of sage grouse requires a detailed understanding of how landscape change influences gene flow, genetic dispersal, and genetic population structure.

I am partnered with the Bureau of Land Management, Montana Fish, Wildlife and Parks, the National Resource Conservation Service, and the University of Montana to gain a more comprehensive understanding of greater sage-grouse genetic connectivity across Montana, North Dakota, South Dakota, and Wyoming. I am using non-invasive collecting techniques, and molecular genetics monitoring tools in a landscape genetics framework to:

1. Assess the relative importance of individual leks in the network of leks in Montana, North Dakota, South Dakota, and the Powder River Basin of Wyoming.
2. Assign management importance to the persistence of individual leks as it relates to the population as a whole.
3. Test multiple hypotheses about which landscape and environmental features are critical to maintain connectivity, and which features hinder bird movement among leks and Montana and the surrounding states.
4. Model connectivity between and within the thirteen recently designated Montana Fish, Wildlife & Parks core breeding areas.
5. Identify corridors of conservation priority to be included in updating resource management plans.

Progress and Status

To date, I have determined genotypes for over 1000 birds representing over 500 leks across Montana and into North Dakota and South Dakota. I am completing the development phase and moving towards the application of a genome wide molecular marker panel. I have been expanding sampling extent and resolution and have begun to identify statewide population substructure as well as landscape and anthropogenic factors influencing these patterns. Over the last year, I have entered into collaboration with multiple state and federal agencies, and NGOs to further my own research and to pursue range-wide management and conservation objectives for greater sage-grouse.

Sandhill Crane and Long-Billed Curlew breeding season occupancy in response to habitat structure at multiple scales

Obligated funding: $56,424

Research Assistant: Stephanie Couture

Advisor: Mike Mitchell

Project Duration: 2012 - 2013

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding Sources:

- U.S. Fish and Wildlife Service

Objectives

The primary objective of this study is to examine the response of breeding season occupancy to habitat attributes affected by cattle grazing. However, birds select habitats at multiple scales and in response to habitat attributes independent of grazing. Landscape-scale attributes (e.g., distance to emergent marsh) will be included in the study design and occupancy modeling efforts. Explicitly accounting for habitat selection at the landscape scale will provide a better understanding of the relative role grazing has in breeding season occupancy of curlews and cranes. Moreover, modeling the response of curlew and crane breeding season occupancy to landscape-scale habitat attributes provides predictive models that can be used in conjunction with remotely-sensed data to target conservation efforts in other Intermountain West valleys.

The Red Rocks Wildlife Refuge conducted a pilot study in 2009 exploring the response of cranes and curlews to grazing (Stadum 2010). Data collection continued in 2010 and will be expanded onto recently acquired refuge lands in 2011. We conducted a final field season in 2012 and are currently working on completing analysis and synthesis of all 4 years of data. Preliminary analysis has already provided important insights into the response of crane and curlew breeding season occupancy to vegetation structure influenced by grazing (Stadum 2010).

Finalizing this work will:

- provide further information on curlew and crane response to habitat attributes affected by grazing,
- assist in developing an adaptive management plan for the current grazing program, and
- provide a predictive model based on landscape–scale habitat attributes for curlew and crane occupancy during the breeding season.

Assessing land use practices on the ecological characteristics of sagebrush ecosystems: multiple migratory bird responses

Obligated funding: $477,620

Student: Jessie Golding

Degree: M. Sc. Candidate

Principal Investigator: Mike Mitchell and Victoria Dreitz

Project Duration: 2012 – 2015

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding source:

- US Fish and Wildlife Service – Plains and Prairie Pothole Landscape Conservation Cooperative ($417,620)
- Bureau of Land Management ($30,000)
- Montana Fish, Wildlife and Parks ($30,00)

Objectives

- To evaluate the impact of rest-rotational grazing management on migratory bird species associated with sagebrush landscapes.
- To provide information to ensure the persistence of multiple sagebrush-obligate bird species and assist in developing natural resource policies

This project is in year 1 of a three-year student and will inform natural resource managers and private landowners of the impacts of conservation-minded livestock grazing practices in sagebrush ecosystems.

Progress and Status

This research study is designed to evaluate responses of migratory birds to rest-rotation grazing management in sagebrush system. Rest-rotation grazing management is likely to enhance important components of sagebrush, shrubland, and grassland habitat for a wide range of species, but little work has been done to evaluate impacts of prescribed rest-rotation grazing on birds. The scale and magnitude of benefits for avian species remains unclear. In 2012, we initiated a research project building off of the existing US Department of Agriculture - Natural Resource Conservation Service's Sage-Grouse Initiative infrastructure in eastern Montana to evaluate the impact of conservation managed rest-rotational grazing on migratory birds. Our results from the first year of this study indicate the highest presence of Brewer's Sparrow (*Spizella breweri*), Vesper Sparrow (*Pooecetes gramineus*), Western Meadowlark (*Sturnella neglecta*), and McCown's Longspur (*Rhynchophanes mccownii*) in our study area in 'traditional grazing' (non-conservation managed) systems. The results from year 1 of this study will help us further evaluate our sampling protocols and advance the progress of this study. They will guide follow up research of the breeding ecology (e.g., behavior, breeding phenology, solitary versus colony nesting, etc.) of individual species, which will help us meet our objectives to understand and measure species richness.

Which factors influence the coexistence among ground-nesting bird species and why?

Student: Karolina Fierro

Degree: Ph.D. Student

Advisor: Thomas E. Martin

UM affiliation: Wildlife Biology Program
Montana Cooperative Wildlife
Research Unit

Project duration: 2012 - 2015

Funding source:

- Montana Cooperative Wildlife Research Unit
- University of Montana
- Scholarship "Francisco Jose de Caldas" Colciencias and Fulbright Colombia

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Objectives

Why there are so many species and how they coexist have been primary questions in community ecology and conservation biology. Nowadays, scientists continue identifying factors that mediate coexistence among ecologically-similar species, in order to predict changes in the structure of natural communities when one species´ population disappear or is diminished due to climate change. According to theory, one the main forces structuring natural communities is competition between species. My research will contribute to understand the coexistence among ecologically-similar species by testing not only competition and its assumptions, but also by testing alternative factors such as individualistic responses of species to the environment and habitat productivity.

The main goal of my research is to identify which factors influence the coexistence of four species of ground-nesting songbirds and why. I work at the scale of territory because understanding the variables that influence coexistence of species at the local scale is a more feasible task than using higher scales. My specific objectives are: 1) I will examine whether individualistic preferences (vegetation preferences) of bird species drive territory selection, 2) I will test competition among the four ground-nesting birds by song playback experiments, 3) I will determine the fitness costs and benefits of overlapping versus non-overlapping territories with ecologically-similar species, and finally, 4) I will examine to what extent the presence and distribution of ecologically-similar species influence territory selection.

Progress and Status

- I started my first field season at the Coconino National Forest, Arizona, on May 2012. During three months, I collected preliminary data about the distribution of territories, interspecific interactions, and foraging strategies of my four focal bird species: Red-faced Warbler (*Cardellina rubrifrons*), Orange-crowned Warbler (*Oreothlypis celata*), Virginia´s Warbler (*Oreothlypis virginiae*), and Dark-eyed Junco (*Junco hyemalis*).
- Currently, I am planning the defense of my PhD research project for mid April 2013. By the first week of May, I will go back to the Coconino National Forest to start my field work. This will be the first one of three more seasons carrying on my experiments and data collection.

Effects of aspen forest restoration on songbird diversity, habitat selection, and reproductive strategies and success

Student: Joseph LaManna **Obligated funding: $382,000**

Degree: Ph.D. Candidate

Advisor: Thomas E. Martin

Project Duration: 2009-2015

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding Sources:

- The Bair Foundation
- Montana Fish, Wildlife and Parks
- Environmental Protection Agency – STAR Fellowship Program

Montana field site measuring Dusky Flycatcher

Objectives

Understanding features that enhance bird diversity and determine reproductive strategies and success is of great interest to science and conservation, especially in Aspen because these forests are declining across western North America. Aspen forests are biodiversity hotspots in North America, and conifer encroachment into aspen stands may be associated with population declines of a variety of organisms dependent on this community type, including many species of birds. Conifer trees are being removed from some aspen stands as one management treatment that can increase aspen survival and recruitment, and similar treatments are being planned and executed across western North America. However, the effects of such forest treatments on wildlife populations, such as breeding birds, are unknown. Conifer removal greatly alters predator communities and vegetation structure, which may strongly affect bird populations within the treated aspen stands. Therefore, I am interested in understanding how bird communities utilize aspen forests before and after treatments to improve management decisions and to test hypotheses regarding habitat selection and reproductive strategies. More specifically, we want to know how changes in predator and plant community assemblages influence songbird diversity, habitat selection, and reproductive strategies and success.

Progress and Status

Bird diversity, predator abundance, various measurements of reproductive success, and vegetation structure were surveyed during the 2009, 2010, 2011, and 2012 songbird breeding seasons. Bird diversity has been monitored each year with intensive point counts. A total of 1,676 nests from 43 songbird and woodpecker species were found and monitored during the four field seasons. Reproductive success data will be used in conjunction with vegetation surveys and the conifer removal treatment to examine bird community and reproductive responses to changing habitat conditions. Systematic vegetation survey points in each aspen stand will be used to answer questions about habitat preferences for nest placement, availability of nest sites, and overall aspen stand structure. Preliminary results indicate that songbird diversity declines and predator densities increase with conifer encroachment. As a result, nest predation increases with conifer encroachment for many species. Data analyses are underway and a dissertation proposal will be completed and defended in April 2013. Fieldwork begins again in May 2013.

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

Obligated funding: $915,015

Principal Investigator: Thomas E. Martin

Project Duration: 1985-ongoing

UM Affiliation: Montana Cooperative Wildlife Research Unit

Funding Source:

- U.S. Geological Survey – Research Work Order 92

Objectives

Measure and examine: 1) annual variation in avian nest success and predation, adult survival, population size, habitat selection, parental care behaviors, and physiological metrics, 2) small mammal density and species composition, and 3) 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 for 32 bird species by affecting trophic levels below (plants) and above (predators) them based on study of their populations and >17,000 nests over the past 26 years. Winter snowfall has declined strongly across the 26 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 25 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 exclosure 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) exclosures were established on three different canyons. Results through 2011 showed 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 7 years since fence establishment. In addition, several bird species 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 growth, and subsequent effects on higher trophic levels (birds, small mammals), as well as the interaction among these trophic groups. The results will have important implications for elk and ecosystem management in this vulnerable habitat type. This project also has a strong training component, training up to 20 students each year in a diversity of field techniques and conduct of hypothesis-testing science.

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

Obligated funding: $600,000

Principal Investigator: Thomas E. Martin

Project Duration: 2009-2013

UM Affiliation: Montana Cooperative Wildlife Research Unit

Funding Sources:

- National Science Foundation

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 U.S. and tropical Venezuelan birds studied 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

This project is ending in 2013, but elements will continue under a new collaborative grant described next. Life history strategies are comprised of age-specific fecundity and mortality, plus parental care behaviors and developmental rates. 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. Tropical Asia has a major life history divergence that has gone un-noticed: clutch sizes are larger and more variable for some species, development rates of embryos are faster, and yet adult mortality appears to remain low compared to other tropical regions. This combination of traits is thought to be impossible under current theory, but detailed studies of these traits across species do not exist.

We completed our third year studying these traits in tropical Borneo because it retains large blocks of pristine forest at mid-elevation from 1450 to 1900 m elevation. In the past three seasons, 1,576 nests were found and monitored (the largest sample size ever accrued for tropical Asia), nestling growth measured, parental care video-taped, and egg temperatures quantified. In addition, 1,703 new individuals were banded, and a total of 3,757 capture/recapture/resight events were accrued to aid in estimating adult survival and renesting 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. Nest predation rates are high, as common in many tropical areas, but show an elevational gradient where predation increases with elevation in the range we are working. Recapture rates of birds are reasonable, and higher than any other tropical locale that I have worked. This suggests that birds are relatively sedentary and potentially have quite high adult survival. Initial estimates based on the first 4 years of data suggest survival is above 70% for many species, but several more years are needed.

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.

Historical and contemporary influences on elevational distributions and biodiversity tested in tropical Asia

Obligated funding: $1,999,998

Principal Investigator: Thomas E. Martin,

Collaborators: Rob Fleischer, Smithsonian Institution; Rob Moyle, Kansas State University; Fred Sheldon, Louisiana State University

Project Duration: 2013-2017

UM Affiliation: Montana Cooperative Wildlife Research Unit

Funding Sources:

- National Science Foundation

Objectives

Measure functional biology (metabolic sensitivity to temperature, competitive interactions, clutch size, nest predation, development rates, parental care, adult survival rates), population genetics and dispersal, and phylogenetic relationships of bird species in montane Malaysian Borneo (Kinabalu Park) to compare with U.S. at similar elevations. This work will focus on trying to understand biological limits on elevational ranges of related species and the interacting influences of climate on those limits.

Progress and Status

This is a large, collaborative effort led by Martin that brings together population geneticists at Smithsonian and Phylogeneticists at LSU and KSU with the demography work of Martin. The work includes continuing elements from the prior work in Borneo, but adds significant new elements, with field work beginning in 2013. Causes of major gradients (latitudinal, elevational) in biodiversity are unclear, and remain a major scientific challenge. We outline traditional (physiological tolerance, competition, opposing boundaries) and novel (taxon age, adult survival, life history traits) hypotheses and integrate them with dispersal, genetic structure, and evolutionary history to provide a conceptual framework that has the potential to yield major advances in theory and understanding across disciplines. An early hypothesis for elevational zonation and adjacent distributions of related species was predicated on climate stability and a relationship between physiological tolerance and dispersal. This hypothesis has major ramifications for speciation, genetics, and evolution as well as ecology, but a relationship between physiological tolerance and dispersal remains untested. Other investigators have argued that biotic interactions, like competition, are more important in defining boundaries. Yet, evidence counter to competition also exists, and direct tests of the interacting and contrasting roles of physiological tolerances versus competition on range boundaries, dispersal, and genetic structure are lacking. Life history traits (e.g., development rates, parental care, longevity, extra-pair mating) may interact, but have not been considered. Ultimately, we propose alternative hypotheses for the potential interaction of an elevational climate gradient, physiological tolerance, competition and life history traits on dispersal propensity and genetic structure, and the consequences for diversification and community structure. Testing these hypotheses simultaneously has the potential to yield truly transformative advances in understanding distribution of species and genesis of biodiversity.

Elevational zonation of related species and diversity gradients are strongly expressed in tropical organisms, particularly tropical songbirds. Thus, we propose to work on an elevational gradient of tropical birds in Asia, where functional, genetic, and phylogenetic diversity of organisms are woefully understudied and underlying patterns provide a strong system for testing these hypotheses. We propose to carefully characterize bird species richness and community composition along a Bornean elevational gradient for two of the most diverse superfamilies in Asia. We will examine physiological tolerances of embryos and adult birds to variation in temperature. We also will test the role of competition in distributions with playback experiments. Both aspects

will then be integrated with data on dispersal obtained from genetic and capture/recapture methods, along with genetic estimations of species limits and structuring of communities to provide new understanding of elevational diversity gradients.

The proposed work will provide extensive opportunities for the training of large numbers of undergraduate and graduate students, and provide unique opportunities for cross-disciplinary training. The project will also provide a unique cross-cultural life experience as well as stringent educational and field experience for many students each year. Public outreach will also be achieved by working with high school students and teachers, Exhibits at the Smithsonian, and development of an educational video on tropical bird nesting behaviors. Finally, this project has critical conservation ramifications, as tropical Asian forests are being lost at the fastest rate of any tropical forests in the world, and our work will provide critical information on possible vulnerabilities to climate change.

The influence of nest predation on parental and offspring strategies

Student: Juan C. Oteyza

Degree: Ph.D. Candidate

Advisor: Thomas E. Martin

Project Duration: 2009 – 2015

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding Source:

- National Science Foundation
- Montana Cooperative Wildlife Research Unit
- The University of Montana

Juan hiding a camera – field site, Borneo

Objectives

Predation is an important selective force which can have important consequences for prey populations. In addition to this direct effect, the perception of predation *risk* alone is itself powerful enough to affect wildlife population dynamics. Animals can assess predation risk and adjust their behaviors accordingly, thus making predation risk an important selective force of life-history strategies. For example, predation on dependent offspring plays a central role in modulating avian life-histories. Specifically, nest predation can have important consequences on nestling feeding rates, nestling begging behavior, offspring growth strategies and, consequently, offspring fitness.

Feeding rates may be sensitive to predation risk because activity at the nest (feeding trips) may attract visually oriented predators to the nest. Thus, proximately, when predation risk increases provisioning rates are expected to decrease, with negative consequences on energy available to offspring for growth. Yet, at an ultimate level increased predation risk should favor faster nestling growth and shorter development periods to reduce exposure to risk at the nest. This leads to an antagonistic interaction between the nestling's need to develop fast under constrained access to food resources.

Additionally, nest predation can be a selective force influencing nestling begging behaviors. Begging serves as a signal to solicit food which is thought to benefit young by leading to an increase in allocation of resources to the solicitor. However, begging can also incur a cost by attracting acoustically oriented predators to the nest. Nestling begging calls vary greatly in acoustic characteristics across species and theory predicts that offspring of species that are under high predation risk will evolve vocalizations that are harder to locate by predators.

Progress and Status

To better understand the relative importance of offspring predation risk as a selective pressure on parental care and nestling development strategies, I am experimentally manipulating the *perceived risk of nest predation* by broadcasting predator calls near nests. At these experimental nests I measure feeding and offspring development rates. During the 2012 field season, predator playback experiments (and controls) were performed on nests of three species of passerine birds.

To test whether nestling begging calls correlate with nest predation rates, in 2012 I recorded nestling begging calls at 72 nests of 18 species that show great variation in predation rates. Additional data will be collected during the 2013 and 2014 field seasons. Filed work takes place in the tropical montane forest of Kinabalu National Park, in Malaysian Borneo.

Factors influencing survival of mountain plover chicks in Eastern Colorado

Obligated funding: $90,110

Student: Maggie Riordan

Degree: M. Sc. Candidate

Principal Investigators: Mike Mitchell and Victoria Dreitz

Project Duration: 2011 – 2013

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding source:

- State of Colorado

Objectives

- To investigate differences in and causes of mortality of Mountain Plover chicks among different habitat types – grassland with prairie dogs, grassland without prairie dogs, and agricultural fields.
- To provide information to assist in developing management actions for mountain plovers on public and private lands in eastern Colorado

This project is in final year and will provide information on the vulnerability of mountain plover reproductive performance on different types of habitats within the species range.

Progress and Status

The Mountain Plover (*Charadrius montanus*) is a neotropical, upland shorebird found on the xeric tablelands from Mexico to northern Montana. In both 1999 and 2010, the United States Fish and Wildlife Service (USFWS) petitioned to list the mountain plover as 'threatened' under the Endangered Species Act. The listing was considered unwarranted subsequent to the proposals in 2003 and 2011 (USFWS 2003, 2011). Regardless of the current conservation status, data are needed to address questions concerning potential factors contributing to population declines.

The findings of this field study suggest that causes of chick mortality differ among habitat types and years. Avian depredations occurred most often on prairie dog habitats during the 2011 field season, which is consistent with findings from the first year of the study (2010). In 2012, most avian-caused mortalities were identified on grasslands, likely because a higher proportion of avian predation was caused by hawks rather than burrowing owls (*Athene cunicularia*). Unlike in 2010, we were unable to confirm any mammalian depredations during 2011-2012, and, thus, cannot provide additional information on this mortality cause. As in 2010, weather events were responsible for some chick mortalities during the 2011 season, but these mortalities were not tied to a certain habitat type, as previously found. No weather-related chick mortalities were identified during the 2012 field season. Though the anticipated three years of field data collection for this chick mortality study have now been completed, additional years of field data collection would certainly strengthen the emerging patterns in chick mortality across different habitat types, especially given the differences in our findings across the last two years.

Conserving Montana's sagebrush highway: long distance migration in sage-grouse

Obligated funding: $198,112

Student: Rebecca Smith

Degree: Completed M. Sc. 2013

Advisor: Dave Naugle

Project Duration: 2010 – 2013

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding source:

- Bureau of Land Management
- World Wildlife Fund
- Parks Canada
- U.S. Geological Survey – Research Work Order - 96

Abstract

Landscape conservation is the mechanism for conserving migratory wildlife in sagebrush ecosystems. We study further a greater sage-grouse (*Centrocercus urophasianus*; hereafter 'sage-grouse') population with the longest-known annual migration, a 240-km journey between summer range in north central Montana, USA, and Saskatchewan, Canada, to winter range north of the Missouri River. We learned more about grouse migration by asking: Do birds fly quickly through a corridor, or do they use stopover habitats within a larger migratory pathway? New GPS-tracking technology revealed that migrating grouse frequent stopover habitats along multiple routes that coalesce to form an integrated pathway. A month-long fall migration in November was in contrast to a punctuated spring migration that lasted on average 2 weeks in late March/early April. Individual birds typically spent ~1 day at nine different stopovers, migrating 71-91 km in 11-15 days. Grouse migrated through gently rolling sagebrush flats (<5% slope), using native sagebrush rangeland in proportion to its availability, and avoiding cropland and badlands where food was scarce. Birds responded to record-breaking snowfall in winter 2011 (>274 cm) by extending their migration another ≤50 km south onto windswept ridge tops where sagebrush remained above snow. Grouse secured food resources by selecting the most similar habitat available on Charles M. Russell National Wildlife Refuge, and doing so was without consequence to winter survival; such was not the case for a nearby resident population. In spring, they made a mass exodus back north, and returned to summer range after migrating ~160 km in 18 days. Previously identified ranges remain important in most years but newly identified winter range suggests that high site fidelity is tempered by an ability to adapt quickly when resources become scarce. Ranching is a compatible land use that maintains this migratory population. We recommend a public land policy that provides grazing opportunities while precluding large-scale energy development or the whole scale removal of sagebrush to increase forage production. Management actions that maintain sagebrush as an emergency food source in newly identified sage-grouse wintering grounds will help to conserve this migratory population. Conservation easements provide a mechanism for maintaining privately-owned working ranches as a compatible and desirable alternative to sodbusting or subdivision along a sage-grouse migration pathway.

Ecological and physiological mechanisms explaining variation in embryonic and post embryonic development among passerine at different latitudes

Student: Riccardo Ton

Degree: Ph. D. Candidate

Advisor: Thomas E. Martin

Project Duration: 2011 – 2014

UM Affiliation: Division of Biological Sciences –OBE
Montana Cooperative Wildlife
Research Unit

Funding Source:

- National Science Foundation
- The University of Montana

Objectives:

Rates of embryonic and post-embryonic growth are critical life history traits that can have major effects on quality and fitness among organisms. For a given size, passerine vary dramatically in the rate at which their eggs and nestling grow, and these differences become even more striking when comparing north temperate versus tropical species. Therefore songbirds are an ideal system to test hypotheses about the intrinsic and extrinsic mechanisms that might cause variation in embryonic and post-embryonic growth rate.
Broadly I'm asking the following two questions:

1) What are the causes and the extent of phenotypic plasticity in egg growth rate among species?
2) What are the physiological mechanisms underlining variation in nestling growth rate within and between latitudes?

Progress and Status:

To answer the above questions I spent one field season of data collection in a montane tropical forest in Borneo Malaysia and two seasons in a high altitude riparian system in Arizona. I experimentally heated nests of 8 species covering a gradient of embryonic growth rates ranging from 12 to 24 days of incubation. I measured the metabolic rate of 82 embryos and 143 nestlings of these and other species. I'm currently working on a paper that summarizes the result for the Arizona field site.

Wolf yearling silhouette – Lamar Valley, Yellowstone Park. Photo by S. Bassing.

Wolf monitoring protocols

Research Associate: **David Ausband**

Project Duration: 2006 - 2012

UM Affiliation: Montana Cooperative Wildlife Research Unit

Funding Sources:

- Regina B. Frankenberg Foundation for Animal Welfare - $250,000
- Leonard X. Bosack & Bette M. Kruger Foundation - $169,600
- Bernice Barbour Foundation - $90,230
- Bureau of Indian Affairs $20,000
- Nez Perce Tribe – Idaho - $176,939
- Idaho Department of Fish and Game - $45,000
- Alberta Sustainable Resources Development - $6,095
- U.S. Fish and Wildlife Service – RWO 90 - $51,886
- MT Department of Natural Resources & Conservation - $1,500
- The Oregon Zoo Future for Wildlife Grants - $11,450
- Rocky Mountain Canada Support - $19,926
- Wilburforce Foundation - $5,000
- Montana Fish Wildlife & Parks
- Safari Club – Spokane
- Animal Welfare Institute – $10,000
- Wolf Recovery Foundation - $7,500
- Mountaineers Foundation - $5,500
- Defenders of Wildlife - $2,500

This report documents our efforts from 2011-12. For full information on previous years' results and detailed descriptions of survey methodology please visit: http://www.umt.edu/mcwru/personnel/ausband/default.aspx

Objectives

We have devised a wolf population monitoring program rooted in patch occupancy modeling, a statistical technique that can integrate data from multiple sampling methods. To populate a patch occupancy model, we are evaluating a variety of survey methods that have demonstrated strong relationships to wolf abundance and distribution. The survey methods we are testing are hunter surveys, rendezvous site surveys, howlboxes, and rub stations.

Progress and Status

The behavioral patterns and large territories of carnivores make them challenging to monitor. Occupancy modeling provides a framework for monitoring population dynamics and distribution of territorial carnivores. We used occupancy modeling to combine data from several survey techniques to estimate the distribution and abundance of wolf (*Canis lupus*) packs in Idaho during 2009 and 2010. We populated our model with data from hunter surveys, howling and sign surveys at predicted wolf rendezvous sites, and locations of radiocollared wolves and explicitly accounted for uncertain detections. We found agreement between occupancy modeling results and estimates of wolf abundance and distribution reported by Idaho Department of Fish and Game and Nez Perce Tribe derived from intensive radiotelemetry-based monitoring. Estimates from occupancy models that did not include data from radiocollared wolves were within 1-20% of existing statewide minimum counts. Furthermore, models populated with hunter survey and rendezvous site survey data outperformed those populated with radiotelemetry data. Estimates of abundance with precision can be useful for addressing state management objectives, evaluating population responses to management actions such as regulated hunting, and documenting federal recovery requirements for listed species. Occupancy models can be used to standardize estimates across large landscapes, even if different survey methods are used in different regions, allowing inferences about population dynamics to match the spatial scale at which they occur. Lastly, modeling covariates can illuminate aspects of wolf ecology and provide feedback to design future field survey efforts for increased efficiency. The methodology we present can be used to monitor wolves (or other species with a contiguous distribution of territories) across large spatial scales.

Biofence for manipulating wolf movements

Research Associate: **David Ausband**

Project Duration: 2010 - 2012

UM Affiliation: Montana Cooperative Wildlife Research Unit

Funding Sources:

- Regina B. Frankenberg Foundation for Animal Welfare
- Leonard X. Bosack & Bette M. Kruger Foundation
- Bernice Barbour Foundation
- Nez Perce Tribe – Idaho
- Idaho Department of Fish and Game
- Kampe Foundation - $5,000
- Wilburforce Foundation
- Wolf Recovery Foundation - $7,500
- Animal Welfare Institute

Objectives

Gray wolves (*Canis lupus*) can conflict with livestock production throughout Idaho, Montana, and Wyoming. Generally, wolves that prey on domestic livestock are killed by management agencies or private landowners. These actions typically stop depredations for producers in the short-term but are not a lasting solution because wolf packs generally fill the recently vacated territory within 1 year and livestock predation often continues. Most tools currently available for non-lethal control of wolves are short-lived in their effectiveness or require constant human presence. Wolves, like most canids worldwide, use scent-marking (deposits of urine, scat, and scratches at conspicuous locations) to establish territories on the landscape and avoid intraspecific conflict. We hypothesized that human-deployed scent-marks consisting of scat and urine (i.e., "biofence") could be used to manipulate wolf pack movements in Idaho.

Project and Status

We deployed 65 km of biofence within three wolf pack territories during summer 2010 and 2011 and used location data from satellite collared wolves and sign surveys to assess the effectiveness of biofencing. Location data provided by satellite collared wolves and sign surveys in 2010 showed little to no trespass of the biofence, even though the excluded areas were used by the packs in previous summers. We also opportunistically deployed a biofence in between a resident pack's rendezvous site and a nearby sheep grazing allotment; the pack was not implicated in any depredations in summer 2010 even though they had killed sheep every year since 2006. Location data provided by satellite collared wolves in summer 2011 showed that wolves did trespass biofences. Biofencing effectively manipulated the movements of wolves in the first year of our study but not the second. Our work suggests that biofencing may be most limited by the apparent necessity to maintain a continuous presence once the biofence is established. The inherent labor and costs associated with such efforts may limit the usefulness of biofencing. Our work can be improved upon through further testing that maintains biofencing over a longer timeframe (> 3 months), samples several animals per treatment pack, and employs a treatment/control design.

Effects of human-caused mortality on gray wolves

Research Associate: **David Ausband**

Project Duration: 2011 - 2015

UM Affiliation: Montana Cooperative Wildlife Research Unit

Funding Sources:

- Regina B. Frankenberg Foundation for Animal Welfare
- Leonard X. Bosack & Bette M. Kruger Foundation
- Bernice Barbour Foundation
- Eppley Foundation - $24,000
- Idaho Department of Fish and Game
- U.S. Fish and Wildlife Service
- Waterton Biosphere Reserve Association - $174,742
- Steven Leuthold Foundation - $8,000
- National Park Service
- Alberta Innovates

Objectives

Wolves (*Canis lupus*) live in family groups comprising a breeding pair, their offspring, and several related helper wolves. Mortality, however, can affect this family group structure and result in smaller packs with adopted, unrelated individuals. Little is known about how characteristics of groups (i.e. size, composition, tenure) affect population growth. Furthermore, group characteristics may also affect individual behavior, group stability, and reproduction. States in the Rockies recently initiated public hunting and trapping seasons for gray wolves and our study is well-positioned to answer important questions about how that new source of mortality might affect gray wolf pack composition and reproduction.

Project and Status

We began genetically sampling wolves in Idaho in 2008 (GMUs 28, 33-35) and currently have a multi-year dataset for packs in central Idaho that spans both before and after hunting and trapping began. By collecting fecal samples at rendezvous sites we are able to generate full pack pedigrees for each of our study packs and observe how pack composition and fecundity may change over time. In summer 2012, we conducted field surveys in three focal study areas that span a range of human-caused mortality; southwest Alberta, Idaho, and Yellowstone National Park. We surveyed 241 potential wolf rendezvous sites within pack territories that bred in 2012 and collected 2,620 fecal samples for DNA analysis. We detected 17 litters between the three study areas. DNA analyses of collected samples are currently underway. Lastly, we continue to gather wolf satellite-collar location data from multiple collaborators that can be used to answer questions about how wolf pack composition affects helping behavior, particularly pup-guarding behavior, in packs. Preliminary analyses using data from Idaho wolves indicates that female and male helper wolves do differ in the amount of time they spend guarding pups. Changes to pack composition may affect such helping behavior. Full analyses exploring the effects of group size and genetic relatedness as well as prey and predator abundance will be conducted once all of the data are compiled. We plan to continue field sampling in 2013 and 2014 and complete analyses and publish full study results in 2015.

Movements, gene flow, and relatedness of Bighorn Sheep in Central Idaho

Obligated funding: $108,517

Student: Nathan Borg

Degree: M. Sc. Candidate

Advisor: Mike Mitchell

Project Duration: 2010-2013

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding Source:

- Idaho Department of Fish and Game

Objectives

The primary objective of my research is to assess the level of connectivity between bighorn sheep populations across central Idaho in order to understand the potential for disease transmission between these populations. I am using genetic techniques to measure sex-specific levels of gene flow between populations and to identify landscape features that may regulate bighorn population connectivity. To understand connectivity at a local scale, I am combining radio-location and genetic data to assess bighorn social organization and spatial structuring, as well as to quantify interactions between social groups. Finally, I am measuring both nuclear and mitochondrial genetic diversity in bighorn populations to determine if there is a relationship between genetic diversity and variable levels of lamb recruitment observed across Idaho. This research will help managers identify populations with high levels of connectivity and a high potential for disease transmission should an outbreak occur. In addition, it will also provide an improved understanding of bighorn movements and allow possible insights into directional migration, source/sink dynamics, and social organization and interactions of bighorn sheep.

Progress and Status

In December 2011, we captured and radio-collared 3 rams and 9 ewes; of these, 6 ewes were marked with GPS collars. Total number of radio-collared bighorns at the beginning of 2012 was 31. An additional 135 fecal samples were collected during the 2nd field season for use in genetic connectivity analyses. Collection efforts focused on filling gaps in the sampling distribution across central Idaho and on re-sampling several radio-collared individuals. 40 blood and tissue samples collected during bighorn capture efforts in 2012 and 2013 have also been extracted and are included in the dataset. Currently, there are 403 nuclear DNA samples genotyped to individual. Landscape level Bayesian analysis is underway. Location data from 56 radio-collared bighorn sheep have been assembled. Data includes 25,100 GPS and VHF locations collected from 2007-2012 in GMUs 14, 19, and 20; cluster analysis is complete and fine-scale movement/space use analyses are progressing.

Linking resource selection with survival in female white-tailed deer

Obligated funding: $70,000

Student: Charles R. Henderson, Jr.

Degree: M.Sc. Candidate

Advisor: Mike Mitchell

Project Duration: 2011 – 2014

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding Source:

- Washington Department of Fish and Wildlife

Objectives

The main goal of this project is to use survival as a measure of habitat quality and to link portions of the landscape that have a high probability of use with area specific survival rates. I will also identify local population sources and sinks using movement and survival information. Finally, I will be examining what portion of the white-tailed deer population in the study area migrates and how this affects survival rates. I will address these questions by calculating resource selection probabilities, estimating survival rates for various age classes, and quantifying winter severity. The information generated from the study will result in seasonal maps that combine probability of use and survival data. These maps will allow agency personnel to more effectively manage the white-tailed deer population in this region. I will also provide information to managers that will increase the accuracy of local population estimates and identify migration patterns. On a broader scale, the resource selection information will increase scientific knowledge on a common species near the edge of its geographic distribution. The use of survival as a way to measure habitat quality will not only increase the understanding of habitat requirements for white-tailed deer but can also be used for a better understanding of the habitat needs of other species.

Progress and Status

In January 2013, we began our second season of capturing white-tailed deer. As of March 2013, we have captured a total of 128 deer and of those 81 have with active radio telemetry devices. I will present a poster of preliminary results at the western states and provinces deer and elk workshop in May 2013. Field work will resume in June 2013. This summer I will focus on monitoring deer survival and locations. In addition, I will continue to ground truth GIS data in order to estimate error rates in the classification of the land cover types being used to construct resource selection probabilities.

Linking resource selection to population dynamics of mule deer

Obligated funding: $48,326

Student: Mark Hurley

Degree: Ph. D. Candidate

Advisors: Mike Mitchell

Mark Hebblewhite

Project Duration: 2010 – 2013

UM Affiliation: Wildlife Biology
Montana Cooperative Wildlife Research Unit

Funding Source:

- Idaho Department of Fish and Game

Objectives

The broad goal of my Dissertation will be to answer the question: how does forage quality, predation risk and weather interact to determine habitat quality and, subsequently, how is habitat quality modified by mule deer behavior and local density to influence vital rates and population size? I will answer this question by investigating the interactive influence of weather patterns, resource selection, and predation risk on mule deer survival and population growth rate. I will integrate measures of population growth and fecundity with fine-scale resource selection and predator-caused mortality to estimate population dynamics and rank habitat components (vegetation type and quality, weather, density and predation) by their importance to population growth rate. These models will then enable wildlife managers to combine population data collected within climate and broad vegetation biomes with fine-scale habitat models to predict the potential mule deer population productivity in different habitats, weather patterns, and management regimes.

Progress and Status

This project will capitalize on mule deer research conducted by the IDFG research biologist and project staff in 52 fawn survival study sites and 8 permanent study sites across Idaho. From 1998 to date, >3,500 mule deer fawns and > 1700 adult females have been radio collared with VHF transmitters to monitor survival. Another 102 adult females were collared with GPS transmitters from 2003 to 2013 to estimate resource selection

This past year, I revised models to predict winter fawn survival by incorporating immediately available weather data from the MODIS satellites. Both NDVI (a measure of plant growth) and snow cover layers show promise to replace the PRISM weather data that, although accurately predicts fawn survival, availability is delayed for several months.

We initiated field work for mule deer habitat quality assessments this past summer. Of the 600 adult female were monitor annually, 250 adult female deer were selected to represent fawn rearing home ranges in all of the mule deer habitats across southern Idaho. Each of these deer was located 3-4 times during each summer for the past 2 seasons to estimate a coarse-scale use area. Fine-scale resource use has been determined with 102 individual GPS collared deer since 2003, providing a total of 235,000 locations. Through plant composition plots we will apply the fine-scale resource selection from GPS collars to the course-scale resource selection of the VHF collared females. The increase in sample will provide an avenue to link summer habitat quality to winter fawn survival in all of the southern Idaho Population Management Units (PMU). In the summer of 2012, we installed 49 permanent plant phenology plots across southern Idaho and monitored changes in plant growth and nutrition at 4 times during the summer. These will link changing vegetation quality to satellite based measures of habitat quality for temporal estimation of habitat quality across the landscape. We completed 85 adult female plant composition plots in summer 2012. We have produced winter range models for each PMU from survey group locations that can vary annually by incorporating weather and vegetation phenology. From this data, we will produce annually varying estimate of habitat quality for each PMU. I have completed all of the coursework, teaching, proposal, and comprehensive exam requirements for the Ph.D. program as of December, 2012. This season, we will complete the phenology plots and continue to assess plant composition and quality of fawn rearing home ranges.

Western Elk Research Collaborative

Obligated funding: $181,799

Principal Investigators: Mike Mitchell and Paul M. Lukacs

Data Technician: Matthew Nordhagen

Project Duration: 2010 - 2014

UM Affiliation: College of Forestry and Conservation
Montana Cooperative Wildlife Research Unit

Funding Source:

- U.S. Geological Survey – Research Work Order 97
- Idaho Department of Fish and Game
- State of Colorado
- Rocky Mountain Elk Foundation

Objectives

The challenges facing elk management in Western landscapes are increasing at a rapid pace as modifications to predator communities; habitat and climate influence the demography and behavior of elk populations. Uncertainty about the influence of predation in the context of other limiting and regulating factors on elk populations initiated communication among wildlife researchers in the northwestern states of Idaho, Montana, Wyoming, Oregon, Washington, Utah, and Colorado about shared management challenges and research needs. Whereas individual states conduct their own research projects on how these factors influence elk, the collaborators recognize the benefits of a region-wide analysis for informing local ecological processes. A region-wide analysis allows collaborators to assess greater spatial and temporal variation in these drivers than could be achieved within any single study site or state, and gain a more general understanding of factors influencing elk populations to inform future management strategies (i.e., harvest, predator management, habitat management, etc.). Furthermore, collaborative analyses increase and add value to pre-existing local data sets, maximizing their utility in guiding elk and carnivore management beyond individual jurisdictions. Therefore, the Western Elk Research Collaborative (WERC) is pooling data on elk (and other covariates) from populations across the Northwest to assess the relative influence of predation, habitat quality, weather, and their interactions on elk demography.

Progress and Status

We completed the analysis of factors affecting the survival of adult female elk across seven western states. This is one of the largest survival datasets analyzed for any large mammal. Working collaboratively, we developed a manuscript that has been accepted for publication by the Journal of Applied Ecology. We met as a group in 2012 to discuss future steps for the group, which agreed to contribute calf:cow data for a meta-analysis of elk recruitment across the northwestern US. This effort is being spear-headed by Dr. Paul Lukacs of UM, who is working with Matthew Nordhagen to gather data from collaborating states. We will hold a workshop in summer of 2013 where members of WERC will collaborate with Dr. Lukacs to develop and conduct analyses for this phase of the project. Members will also discuss the next research steps for the collaborative.

Grizzly bear population status in the Cabinet-Yaak ecosystem

Obligated funding: $1,593,000

Principal Investigator: Mike Mitchell

Project Duration: 2011 - 2015

UM Affiliation: Montana Cooperative Wildlife Research Unit

Funding Sources:

- Lincoln County
- U.S. D.A. Forest Service Northern Region
- Montana Fish, Wildlife and Parks

Jon Lynch baiting a corral lure made of fermented fish and cow's blood

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Objectives:

The grizzly bear (*Ursus arctos*) population in the Cabinet-Yaak Ecosystem (CYE) in northwestern Montana and northern Idaho was designated Threatened under the Endangered Species Act in 1975 and was found to be warranted for Endangered status in 1993. Information has been collected on this population since the late 1970's. Demographic data available include the number, location and cause of mortality, population trend, survival and reproductive rates, and minimum counts. Based on accumulated knowledge from trapping, observations, radio telemetry, DNA sampling at hair trap sites, and other sources, population size in the CYE Recovery Zone is estimated to be 30-40 bears. However, resources had not been available to sample the population intensively enough during one year to produce a population-wide estimate of grizzly bear abundance with a measure of precision. Agencies needed a statistically rigorous baseline of population size and distribution to develop and assess policies and practices designed to promote population recovery. The Selkirk-Cabinet/Yaak Subcommittee of the Interagency Grizzly Bear Committee identified obtaining a statistically valid population estimate in the CYE as a high research priority. The Commissioners of Lincoln County, MT initiated this study in March 2011 and requested USGS to take the lead in designing and implementing a DNA-based study of grizzly bear population size in the CYE. Funding became available in spring 2011 to undertake initial work to prepare for sampling the population in 2012. This USGS-led project is a cooperative effort involving federal, state, county, and tribal agencies with a broad base of private industry, NGO, and public partners. An interagency study team has been established to advise on study design and to promote communication about the project.

Progress and Status:

A Project Manager and a GIS/Database Specialist were employed from May 2011 – December 2012 to handle hiring, plan logistics, coordinate work, plan and oversee fieldwork, and perform QA/QC on data collected. For the 2012 field season, 52 biological technicians were hired to conduct fieldwork and 2 staff were employed to organize samples and enter data. Hair corrals were constructed and visited for 5 14-day sampling occasions June 1 – August 24. Bear rub sampling visits were conducted at 14- day intervals June 7 – September 21. Hair corrals were distributed on a 5 x 5 km grid with a target of having 1 corral in each grid of 395 grid cells during each sampling session. Of the 18,546 bear hair samples collected during the 2012 field season, 10,472 were selected to be submitted for genotyping to identify species, sex and individual identity.

Ungulate ecology in Idaho: Understanding predator/prey interactions

Obligated funding: $149,745

Principal Investigator: Mike Mitchell

Project Duration: 2010 – 2013

Fund Source:

- Idaho Department of Fish and Game

Project summary

In 2005, we launched the Ungulate Ecology Project. An important initial objective was to simply take a demographic and ecological "snapshot" of representative mule deer and elk populations in 12 study areas across Idaho. Results have provided wildlife managers with important background information, including adult female survival rates and cause-specific mortality, pregnancy rates, body condition, and general movement patterns.

More recently, the emphasis has shifted to 2 contrasting focal areas (Lowman, GMUs 33, 34, 35; and North Fork, GMUs 10, 12) where the objective is to understand the dynamics and mechanics of the elk/ wolf system. The goal is to develop predictive models to estimate elk populations based on elk/wolf ratios and covariates such as topography, habitat, alternate prey species and density, and weather. These models will reduce the need for intensive radio-collaring and monitoring efforts in each GMU of interest, resulting in significant efficiencies. This project requires intensively monitoring elk, moose, and wolves in study areas, investigating mortalities, and significant data management challenges.

Furthermore, there is a strong link between the Ungulate Ecology Project and the Wolf Monitoring Project (Nez Perce Tribe is an additional collaborator). The primary initial funding for the Wolf Monitoring Project was provided through the Nez Perce Tribe, though UM has played a leadership role in that research effort via the Coop Unit. Results and techniques from this work are integrated into the Ungulate Ecology Project and management programs as they become available. The UEP provides logistical support and continual feedback.

These projects will provide decision tools to wildlife managers that strive to balance natural processes with social and economic realities.

Proactive management of pneumonia epizootics in bighorn sheep in Montana

Obligated funding: $49,000

Student: **Sarah Sells**

Degree: M.Sc. – Wildlife Biology Candidate

Advisor: Mike Mitchell

Project Duration: 2011 – 2013

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding Sources:

- Montana Fish, Wildlife, and Parks
- Montana Cooperative Wildlife Research Unit

Preparing to receive ewe – Yellowstone National Park

Objectives

Pneumonia epizootics are a major challenge for management of bighorn sheep (*Ovis canadensis*). Half of the 50 populations in Montana have suffered die-offs since 1980, most due to pneumonia and rarely with <50% mortality. The result may ultimately be extirpation due to direct pneumonia mortality and other stochastic and density-related factors. Many studies have investigated the cause of these epizootics, and pathogen transmission from domestic to bighorn sheep is the only supported hypothesis in experimental trials. Yet disease processes are often influenced by complex environmental interactions. Various stressors may influence health and immune response, but it is unknown what stressors influence pneumonia in bighorn sheep. Ultimately, poor understanding of wildlife diseases usually results in reactive crisis management. In contrast, proactive management would integrate health management with day-to-day wildlife management, reducing need for reactive crisis response.

Our goal is to use pneumonia epizootics as a case study for development and application of risk and decision models for statewide, proactive programs so that wildlife health can be managed as an integral facet of general wildlife management. A set of models that identify risk of pneumonia epizootic and the best management decisions given that risk would be of great value for proactive management of pneumonia in bighorn sheep. Thus, our objectives are to:

- **Design a risk model** to predict risk of pneumonia epizootics for herds in Montana through statistical analyses of hypothesized risk factors.
- **Design a proactive decision model** for management of pneumonia epizootics that incorporates estimates of pneumonia risk using Structured Decision Making (SDM) to help evaluate costs and benefits of alternative actions appropriate to risk estimates.

The resulting models will help MFWP predict risk of pneumonia under various management alternatives and evaluate relative efficacy of management alternatives in reducing the effect of pneumonia in bighorn sheep herds. The models will thus be a complete toolset for proactive management of pneumonia epizootics in Montana. Ultimately, this project will also demonstrate development and application of risk and decision models for proactive management of other wildlife diseases.

Spatial and temporal scales of population performance in grizzly and black bears in the Northern Continental Divide Ecosystem, Montana

Obligated funding: $56,230

Student: Jeff Stetz

Degree: Ph.D. Candidate

Advisor: Mike Mitchell

Project Duration: 2009-2013

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding Sources:

- U.S. Forest Service
- U.S. Geological Survey

Objectives

My primary interests are in investigating habitat selection and population performance across the sympatric grizzly and black bear populations in the Northern Continental Divide Ecosystem (NCDE) in the Northern Rocky Mountains of Montana. I am also interested in evaluating the ability of noninvasive genetic sampling (NGS) to detect fine-scale demographic processes in these populations. The specific questions that I am currently exploring include:

1. How does habitat selection vary in space and time for grizzly and black bears in this region? To answer this, I will use a combination of occupancy modeling and spatial interpolation methods using detection data from noninvasive genetic sampling projects.
2. How do habitat selection patterns vary between the sympatric grizzly and black bear populations in the NCDE? I will use the results of Question 1 to identify habitat factors that are shared versus specific to each species. This answer could inform grizzly bear reintroduction/augmentation programs if we determine that, for example, high black bear densities may lead to reduced grizzly bear density.
3. Why do we see such dramatic differences in capture probabilities of grizzly bears in certain NGS methods across populations? I will use detection data from 3-4 distinct populations to model capture probabilities in a meta-analysis framework. These results could be useful in designing future monitoring programs.
4. How can we use NGS methods to detect fine scale population performance (i.e., population growth rates)? I will use simulations with spatially-explicit mark-recapture methods to explore the conditions under which intra-population (e.g., source-sink) dynamics can be identified.

Progress and Status

In 2012 I completed my required coursework and successfully completed my comprehensive exams. I have continued to work with biometricians to develop models for analyzing my data related to two of my proposed chapters. I have pursued a number of grants to aid in model development and acquire computing resources. I also was a teaching assistant in fall 2012 and spring 2013 terms.

The bulk of the data to be used in my dissertation research was collected in 1998-2000, 2004, and 2009-2012 during our two research projects. I have obtained access to datasets from the Russian Far East, Banff National Park, and Greece for Question 3. Ongoing research in Montana is in year 3 of 4, with approximately 30 field technicians conducting repeated surveys of over 5,900 sampling sites across nearly 3.6 million ha in the Northern Rockies. For example, in 2009, our start-up year, 9,200 hair samples were collected, with 258 grizzly bears detected; these numbers will increase each year as more sampling sites are activated.

Can camouflage keep up with climate change? Connecting down-scaled climate models to adaptation for a key forest species

Obligated funding: $412,290

Student: **Marketa Zimova**

Advisor: L. Scott Mills

Project Duration: 2009 – 2012

UM Affiliation: Wildlife Biology Program
Montana Cooperative Wildlife Research Unit

Funding Source:

- U.S. Geological Survey Climate Change Research Work Order 95

Objectives

Most examples of seasonal mismatches in phenology span multiple trophic levels, with timing of animal reproduction, hibernation or migration becoming detached from peak food supply. The consequences of such mismatches are difficult to link to specific future climate change scenarios because the responses across trophic levels have complex underlying climate drivers often confounded by other stressors. In contrast, seasonal coat color polyphenism creating camouflage against snow is a direct and potentially severe type of seasonal mismatch if crypsis becomes compromised by the animal being white when snow is absent. It is unknown whether plasticity in the initiation or rate of coat color change will be able to reduce mismatch between the seasonal coat color and an increasingly snow-free background.

Progress

We find that natural populations of snowshoe hare exposed to three years of widely varying snowpack have plasticity in the rate of the spring white-to-brown molt, but not in either the initiation dates of color change or the rate of the fall brown-to-white molt. Using an ensemble of locally downscaled climate projections, we also show that annual average duration of snowpack is forecast to decrease by 29-35 days by mid-century and 40 - 69 days by the end of the century. Without evolution in coat color phenology, the reduced snow duration will increase the number of days that white hares will be mismatched on a snowless background by 3 – 8 fold. This novel and visually compelling climate-change induced stressor likely applies to >9 widely distributed mammals with seasonal coat color.

POPULATIONS

Grizzly Bear Family
Kananaskis, Alberta, Canada
Photo by D. Ausband

Long-term population monitoring of Columbia spotted frogs

Obligated funding: $ 12,050

Principal Investigator: Lisa Eby

Project Duration: 2010-2012

UM Project Affiliation: Wildlife Biology Program

Montana Cooperative Wildlife Research Unit

Funding Source:

- U.S. Geological Survey – Research Work Order 98

Objectives

In order to begin to determine how montane amphibian populations will be impacted by climate change in the Rocky Mountain west, we need a better understanding of their demography, the variance in their vital rates, and the climate drivers of those vital rates. Long-term studies of amphibian populations are rare but provide data on variation in demographic variables and responses to environmental influences that are impossible to obtain in any other manner. Initial analyses of the existing data set suggest that such populations have negative population growth in most years, but that predicted less severe winters, particularly lower snowpack, may benefit some high elevation populations.

Our initial analyses indicated above, a few years are driving much of the relationship. Continuing data collection in the Little Rock Creek Basin is necessary to pull apart correlated predictor variables and improve our understanding of the relationships between climate and status of montane amphibians. Thus, the continuation of this data set will be key understanding these key variables. The USGS Amphibian Research and Monitoring Initiative conducts intensive population studies at several locations in the Rocky Mountains. These apex site studies, include the Columbia Spotted Frog population in the Little Rock Creek Basin. Studies have been conducted there continuously since 2000 in collaboration with the University of Montana. The objective of this proposal is to compile information on variation in demographic parameters and the environmental conditions that may influence them by extending data collection through the 2012 field season.

Our goal was to continue this dataset so we can begin to answer key questions, including, what proportion of the annual variation in survival can be explained by climate variables? Which are the most important climate variables driving variation in breeding and survival? Maintaining this long-term data base to deconstruct population trends and stage-specific survival is key to understanding and predicting what might be happening with frog populations in high-elevation sites into the future as both climate and habitat heterogeneity change.

Methods

We collected demographic data from 2010-2012 in the Little Rock Creek basin, Ravalli County, Montana (Figure 1). We conducted systematic searches for egg masses in late spring and early summer in 2010. We searched all shallow water environments for egg masses over three weekends and recorded counts of egg masses at each water body. We used a robust design capture-mark-recapture method to monitor juvenile and adult frogs (Pollock 1982). For this method, we captured animals for multiple consecutive secondary sessions (days) within the primary sampling period (year). We monitored three female life stages; juveniles were frogs that were too young to be sexed, subadults were frogs that were larger than the size at which secondary sex characteristics of males were present but smaller than the smallest documented breeding female, and adults were frogs large enough to breed. During each primary sampling period, we systematically surveyed all the ponds and lake shores in the basin each year and captured animals by hand or net. We individually marked animals by clipping unique combinations of toes using an alphanumeric coding system and weighed and measured snout-vent length. We also recorded the general location of all new and recaptured animals at each

session. After examining the survival probability across stages from previous data, in 2011 we stopped marking frogs less than 30mm SVL.

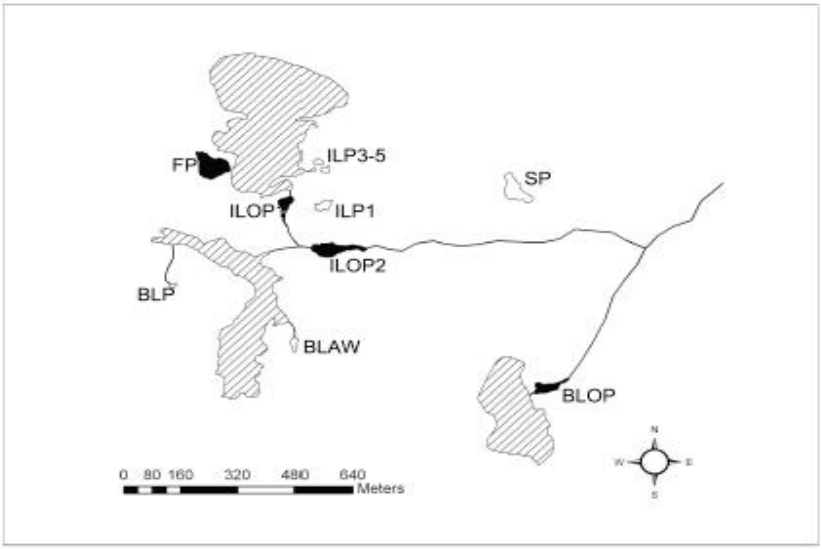


Figure 1. Distribution of the lakes and wetlands in the upper basin at Little Rock Creek. This basin contains three lakes (lined), four permanent breeding ponds (black), and seven ephemeral breeding ponds (white).

Progress and Status

In 2010, we conducted egg mass surveys over three different sampling events (6/26, 7/5, and 7/17). Shallow pond had 1 egg mass, BLOP had 12-14 egg masses, ILP1 had 5 egg masses, Frog Pond had 4, and BLAW east had 2 egg masses. No egg masses were left on 7/17/10 but tadpoles were found in all five of the ponds above. In addition, there were small adult frogs, adult frogs, and garter snakes across most of the sites.

As proposed, we performed capture-mark-recapture surveys in 2010, 2011, and 2012. In each year, the upper basin was sampled four times and the lower basin was surveyed three times (Table 1).

Table 1. Results from the summertime capture-mark-recapture surveys from 2010-2012.

		UPPER BASIN*		LOWER BASIN*		
Year	Survey dates	Total # of captures	Total # of new animals marked	Total # of captures	Total # of new animals marked	NOTES
2010	8/4-8/11	272	62	83	43	All new animals captured were marked
2011	8/13-8/20	477	85	117	58	Only animals >30 mm SVL were marked, those <30 mm SVL were given a batch mark (and show up in total captures)
2012	8/18-8/23	251	42	58	22	Only animals >30 mm SVL were marked; those <30 mm were not captured or marked.

**In each year: in upper basin each pond was surveyed 4 times; the lower basin was surveyed 3 times*

Description of Educational Training Experience

This project included temporary employment to wildlife biology students (and recent graduates). These students were trained in field techniques for study of amphibian populations.

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

Obligated funding: $165,843

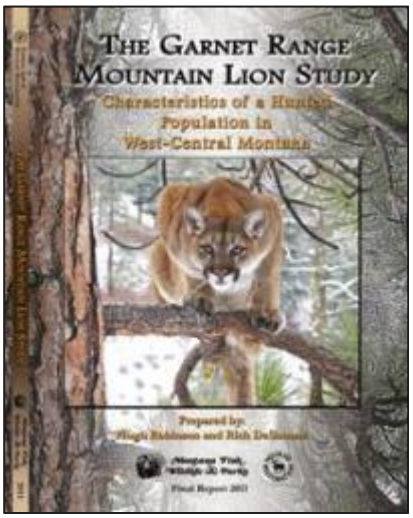
Post Doc Researcher: Hugh Robinson

Project Duration: 2009 - 2013

UM Affiliation: Montana Cooperative Wildlife Research Unit

Funding Source:

- Montana Fish, Wildlife and Parks



Objectives

In Montana a combination of limited entry and quotas are used by the Department of Fish Wildlife and Parks (MTFWP) 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 MTFWP, I propose to produce spatially explicit models of mountain lion resource selection, survival, densities, and population dynamics. This research will be directed towards aiding MTFWP personnel in developing local harvest strategies and a statewide mountain lion management plan.

Progress and Status

This project began in September 2009. The first fall was spent obtaining data sharing agreements with collaborators, data acquisition and management. In January 2010 Montana Fish Wildlife and Parks (FWP) added a second component to this project; the completion of a final report for Garnet cougar study conducted by FWP staff from 1997 to 2007. The Garnet final report was completed in December 2010, published by the State and available here:
http://www.panthera.org/content/garnet-range-mountain-lion-study-characteristics-hunted-population-west-central-montana

The metapopulation project is nearing completion with draft report currently in review by state regional biologists.

Genetic Analyses of Native Sauger and Introduced Walleye in the Missouri River Drainage

Obligated funding: $104,236

Project Director: Robb F. Leary

Project Duration: 2009 – 2013

Affiliation: Montana Fish, Wildlife & Parks; UM-DBS

Funding Source:

- Montana Fish, Wildlife and Parks

Abstract

Sauger and nonnative walleye and hybrids inhabit the upper Missouri River drainage of Montana and Wyoming. Because of perceived declines in sauger throughout the drainage and the possibility this may partly be due to the presence of walleye, in 2011 Montana Fish, Wildlife & Parks and the Wyoming Game and Fish Department collaboratively agreed to replace the stocking of nonnative walleye in the Bighorn River drainage with native sauger. Presumed sauger collected from the Bighorn River were spawned in 2011 (N=66) and 2012 (N=100). Based on analysis of 11 microsatellite loci that distinguish sauger and walleye, all spawned fish were genetically identified as being sauger. Thus, their progeny were stocked back into the Big Horn River. This process will be repeated in 2013.

Presumed walleye were collected from Fort Peck Reservoir (N=43), Lake Sakakawea (N=50), and the Yellowstone-Tongue River (N=39) during spring 2012 for population genetic comparisons. Data from 11 microsatellite loci indicated all fish were walleye except for one collected from the Tongue River. The latter fish appeared to be a first generation back cross to walleye. When the hybrid was eliminated from the data, significant allele frequency differences existed between the Lake Sakakawea and the other samples suggesting the walleye in Lake Sakakawea represent a genetically divergent population. The magnitude of the differences, however, was not large. Allele frequency differences only accounted for 0.83 percent of the total genetic variation detected between the Lake Sakakawea and Fort Peck Reservoir samples and only 0.22 percent of the total genetic variation detected between the Lake Sakakawea and Yellowstone-Tongue River samples. No evidence of genetic differences were detected between the Fort Peck Reservoir and Yellowstone-Tongue River samples. This, not surprisingly, suggests that the stocking of walleye from Fort Peck Reservoir and/or escapees from the Miles City State Hatchery has had a significant genetic influence on the introduced walleye in the Yellowstone River drainage. All of the fish in the Yellowstone-Tongue River sample were tagged in the spring of 2012. Subsequently, eleven of these fish were recaptured by anglers in Lake Sakakawea suggesting some walleye that spawn in the lower Yellowstone River move downstream and reside in Lake Sakakawea later in the year.

AWARDS AND RECOGNITIONS

David Ausband	Shikar Safari Club Scholarship
Jessie Golding	Montana Fish, Wildlife and Parks –Graduate Student Grant
Mark Hurley	George E. Bright Memorial Scholarship in the amount of March 2013.
Joseph LaManna	Environmental Protection Agency - Science to Achieve Results (STAR) Fellow, awarded August 2012.
Thomas Martin	Alden and Loye Miller Award (+ silver medal) Lifetime Achievement Award, Cooper Ornithological Society.
Thomas Martin	Keynote Lecture – Symposium on predator-prey interactions, Turku, Finland – 2012.
Thomas Martin	Elected to Board of Directors, Cooper Ornithological Society, 2013-2016.
Maggie Riordan	Colorado Chapter of The Wildlife Society Grant Recipient Audubon Society of Greater Denver Lois Webster Fund Grant Recipient
Sarah Sells	George & Mildred Cirica Scholarship – April 2012 Best Student Poster - Montana Chapter of The Wildlife Society Conference. Whitefish, Montana. February 2013
Jeffrey Stetz	2012 Montana Institute on Ecosystems Fellow (NSF EPSCoR grant) 2012 Awarded Bertha Morton Scholarship

PRESENTATIONS AND POSTERS

Ausband, D.E. Developing a wolf population monitoring framework for southwest Alberta. Pincher Creek Library Lecture Series. Pincher Creek, Alberta, Canada. January 2013.

Ausband, D.E. et al. Home alone: influence of individual, pack, and environmental variation on pup attendance behavior in gray wolves. Montana Wildlife Society Annual Conference. Whitefish, Montana. February 2013.

Ausband, D.E. et al. Home alone: influence of individual, pack, and environmental variation on pup attendance behavior in gray wolves. Idaho Wildlife Society Annual Conference. Coeur d' Alene, Idaho. March 2013.

Boyce, A.J., T.E. Martin. The Fight for Space: Examining the roles of competition and physiological tolerance in limiting elevational distributions of tropical birds. Oral Presentation to the North American Ornithological Conference (NAOC). August, 2012. Vancouver, BC.

Crandall, R.H., B.E. Bedrosian and D.E. Craighead. 50-Year Golden Eagle Nesting Trends in South Central Montana. North American Ornithological Conference. Vancouver, British Columbia, Canada. August 2012. (Poster)

Crandall, R.H., B.E. Bedrosian and D.E. Craighead. Factors Influencing Presence and Reproductive Success of a Breeding Golden Eagle Population. The Wildlife Society Montana Chapter Annual Meeting. Whitefish, Montana. March 2013.

Cross, T.B. *Linking genetics to habitat to identify conservation priorities.* NRCS – Sage Grouse Initiative: Montana NRCS Sage Grouse Partner Meeting. Billings, Montana. April 2012.

Fierro-Calderón, K. Biotic factors affecting the distribution of territories in four ground-nesting birds over time. 5th North American Ornithological Conference. University of British Columbia, Vancouver. August 2012.

Haynam, R., **R.H. Crandall**, and B.E. Bedrosian. GPS Transmitter Bias of Greater Sage-Grouse Survival. North American Ornithological Conference. Vancouver, British Columbia, Canada. August 2012. (Poster)

LaManna, J. A., George, T. L., Saracco, J. F., Nott, M. P., & DeSante, D. F. Spring migration precipitation influences survival of migrant songbirds. Oral presentation to the North American Ornithological Conference, Vancouver, Canada. August 2012.

Martin, T. E. Intrinsic versus extrinsic influences on life history evolution. Departmental Seminar, The Ohio State University, Columbus, Ohio.

Martin, T. E. Metabolism versus ecology and parental care on tropical versus temperate life histories. New Mexico State University, Albuquerque, NM.

Martin, T. E. Consequences of nest predation for demography, parental behavior, and community ecology. Predator-Prey Symposium, Turku, Finland.

Mitchell, M. Western Elk Research Collaborative. Untangling Rocky Mountain elk ecology and population dynamics: a regional synthesis across the northwestern U.S. Annual meeting, Montana Chapter, The Wildlife Society, Whitefish, Montana. February 2013.

Oteyza, J. C. and **T. E. Martin**. Do helpers influence offspring size? A test of the concealed helper effects hypothesis in a cooperatively breeding tropical passerine. The 5th North American Ornithological Conference (NAOC-V), Vancouver, Canada. August 2012. (Poster).

Riordan, M.M., P.M. Lukacs, V.J. Dreitz, and K.P. Huyvaert. Examining sex ratio bias in mountain plovers. North American Ornithological Conference, Vancouver, BC. August 2012.

Sells, S.N., **M.S. Mitchell**, N.J. Anderson, J.M. Ramsey and J.A. Gude. Proactive management of pneumonia epizootics in bighorn sheep in Montana: Project update. Montana Chapter of The Wildlife Society Conference. Whitefish, Montana. February 2013. (Poster)

Stetz, J.B. *Bear ecology, management, and research in Montana*. Invited speaker. Animal Investigation class – spectrum. University of Montana. Missoula, Montana, USA. June 2012.

Stetz, J.B. *Black bear density in Glacier National Park*. Invited speaker, 11th Western Black Bear Workshop. Coeur d'Alene, Idaho, USA. May 2012.

Stetz, J.B. *Bear ecology, management, and research in Montana*. Invited speaker. Northwest Connections. Condon, Montana, USA. June 2012.

Stetz, J.B. *Bear ecology, management, and research in Montana*. Invited speaker. Swan Ecosystem Center. Condon, Montana, USA. August 2012.

Stetz, J.B., and M.A. Sawaya. *Black bear research and monitoring options in the Northeast*. Northeastern Black Bear Technical Committee Annual Meeting. Becket, Massachusetts, USA. August 2012.

Stetz, J.B. *That's a good question?* Wildlife biology graduate seminar. Missoula, Montana, USA. March 2013.

Ton, R., and **T.E. Martin**A comparative field test of the metabolic rate hypothesis for nestling growth rates among temperate and tropical passerines. Fifth North American Ornithological Conference. Vancouver, B.C. **.** August 2012.

SCIENTIFIC PAPERS AND REPORTS

Arriero, E., A. Majewska, and **T. E. Martin**. In press. Ontogeny of constitutive immunity: maternal versus endogenous influences. Functional Ecology.

Auer, S.K. and **T.E. Martin.** 2013. Climate change has indirect effects on resource use and overlap among coexisting bird species with negative consequences for their reproductive success. Global Change Biology (2013) 19, 411–419

Ausband, D.E., **S.B. Bassing**, **M.S. Mitchell**, and C. White. In Press. No trespassing: using a biofence to manipulate carnivore movements. Wildlife Research.

Bedrosian, B.E., D.E. Craighead, and **R.H. Crandall**. 2012. Lead Exposure in Bald Eagles from Big Game Hunting, the Continental Implications and Successful Mitigation Efforts. PLoS ONE 7(12): e51978. doi:10.1371/journal.pone.0051978.

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