University of Montana

Report on the Wildlife Biology Program

Sept. 2016

LETTER *from the Director*

It's with great pleasure that I share with you some of the recent accomplishments and activities of the Wildlife Biology Program at University of Montana. Our program is defined by the actions of a dedicated group of students, faculty and staff who work tirelessly every day to meet high academic standards, advance knowledge and serve society in any number of ways.

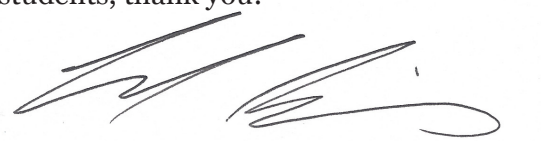
Our faculty place a high priority on teaching to ensure that students emerging from the program are prepared, each in their own way, to address society's most significant wildlife and natural resource challenges. Our faculty and graduate students likewise excel as researchers, recognizing that strong science advances education and is the foundation upon which sensible wildlife conservation and management decisions are made. Through a common commitment to excellence, our faculty have become demonstrated leaders in wildlife biology, whether it be through development of national conservation strategies, locally-driven partner-based conservation solutions, scientific achievements or educational outreach. We've highlighted a few examples of this work herein.

This is an exciting time for wildlife biology at University of Montana. Our program was recently acknowledged by Academic Analytics as the top wildlife biology program among leading research universities in the United States and Canada. We have also been recognized as one of three Programs of National Distinction (PoND) at UM by the university administration.

We recently filled both of our endowed chair positions: Jedediah Brodie is our new John J. Craighead Chair of Wildlife Biology and Joshua Millspaugh is our new Boone and Crockett Professor of Wildlife Conservation. We were also fortunate to have long-time wildlife biology faculty member, Scott Mills, return to University of Montana as the Associate Vice President of Research for Global Change and Sustainability, after a three-year stint at North Carolina State University. We presently have an extremely talented group of faculty working across a wide spectrum of wildlife issues. Collectively, this work advances basic science and addresses our most pressing applied conservation and management challenges, covering everything from molecular biology to global ecology.

Our undergraduate enrollment remains strong, with 320 to 350 enrolled students during recent academic years. Roughly two-thirds of those students come to UM from outside of Montana, which is the highest percentage of out-of-state students of any academic program at UM. This diversity of students enriches the learning environment and broadens the outreach of UM wildlife biology graduates, who accept graduate and professional positions with universities and employers across the nation and world. Our graduate student enrollment likewise remains strong, with roughly 50 high-caliber graduate students. These students were selected following a rigorous selection process, where numerous qualified students were vetted across a variety of factors. I am routinely impressed with the quality of research and teaching performed by our graduate students. We are also fortunate to have multiple post-doctoral fellows conducting research and mentoring students alongside our regular faculty.

Many of our successes are made possible as a result of generous support from donors. To close, I'd like to extend my sincere thanks to everyone who has contributed their resources to build and strengthen this Program, which now ranks among the very best in North America. On behalf of the faculty, staff and students, thank you!



Chad Bishop, *Director, Wildlife Biology Program*

September, 2016

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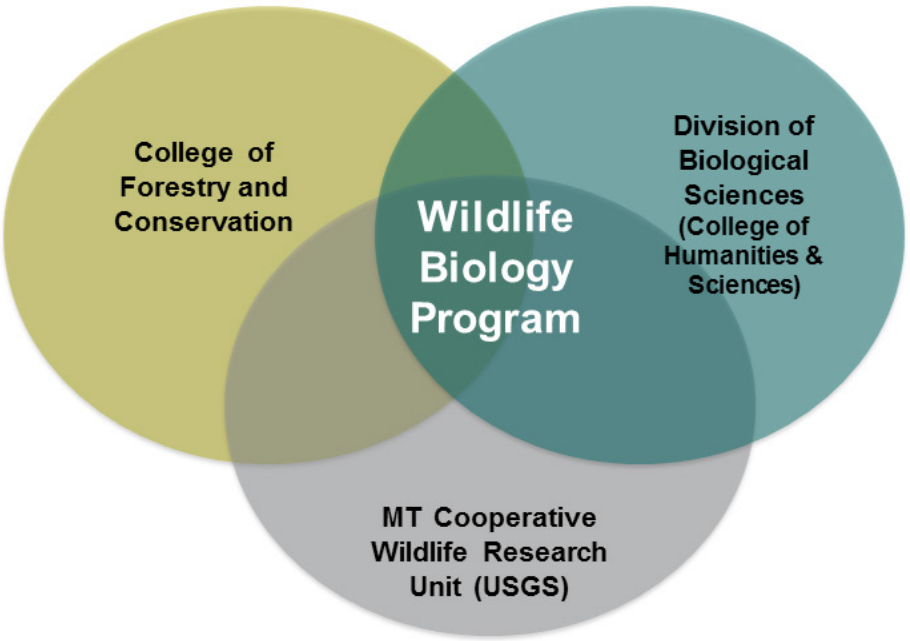
Read our blog: wildlifebiologymontana.tumblr.com

The Wildlife Biology Program is an interdisciplinary program tailored to meet the needs of students and to promote collaboration across the spectrum of biology, ecosystem science and conservation. We are a joint program of the College of Forestry and Conservation, the Division of Biological Sciences in the College of Humanities & Sciences and the Montana Cooperative Wildlife Research Unit.



FACULTY

Fred Allendorf, *Regents Professor Emeritus*

Chad Bishop, *Director, Wildlife Biology Program*

Creagh Breuner, *Professor*

Jedediah Brodie, *John J. Craighead Chair of Wildlife Biology*

Ray Callaway, *Professor*

Zachary Cheviron, *Assistant Professor*

Vicky Dreitz, *Assistant Professor, Director, Avian Science Center*

Lisa Eby, *Associate Professor*

Kerry Foresman, *Professor Emeritus*

Jeffrey Good, *Associate Professor*

Erick Greene, *Professor*

Mark Hebblewhite, *Associate Professor*

Richard Hutto, *Professor Emeritus*

Winsor Lowe, *Professor*

Gordon Luikart, *Professor*

Angela Luis, *Assistant Professor*

Paul Lukacs, *Associate Professor*

Thomas Martin, *Assistant Unit Leader, Montana Cooperative Wildlife Research Unit*

Alex Metcalf, *Research Assistant Professor*

Elizabeth Covelli Metcalf, *Associate Professor*

Scott Mills, *Associate Vice President of Research for Global Change and Sustainability*

Joshua Millspaugh, *Boone and Crockett Professor of Wildlife Conservation*

Mike Mitchell, *Unit Leader, Montana Cooperative Wildlife Research Unit*

Dave Naugle, *Professor*

Dan Pletscher, *Professor Emeritus*

Michael Schwartz, *Director, National Genomics Center for Wildlife and Fish Conservation*

Andrew Whiteley, *Assistant Professor*

STAFF

Jeanne Franz, *Academic Advisor*

Robin Hamilton, *Administrative Associate*

RESEARCH *Highlights*

Stress and reproduction in the tree swallow – *Professor Creagh Breuner*

Professor Creagh Breuner is working to understand the roles that stress hormones play in balancing how much energy animals spend on reproduction. When conditions are too stressful, stress hormones inhibit reproductive effort (laying eggs, incubating and feeding young). However, slight elevations in these stress hormones can assist with mobilizing energy to do more foraging necessary to raise those young.

Creagh is measuring reproductive effort of female tree swallows, and comparing that to the pattern of hormones circulating at the peak of reproductive effort. Working with UM undergraduate Kenzie Prichard, she followed tree swallow nests from original building through egg lay, incubation, feeding young and fledge. With these data Creagh and Kenzie can evaluate parental effort against the stress hormones measured on day 12 of the nestling period. These data will provide insight into how high stress hormone levels have to be before they repress reproductive behavior, and over the long term will help in setting limits to stress hormone levels that are acceptable in free living birds generally.

This work is being done in collaboration with MPG ranch; fortunately, the ranch has several different levels of restoration. Creagh was able to evaluate how the level of restoration affected tree swallow nesting success. In future years she expects to be able to measure the change in reproductive success as restoration levels increase across the landscape.

In general, Professor Breuner's work aims to incorporate stress physiology into conservation biology. The emerging field of conservation physiology allows for the incorporation of health metrics into determining the impact of human and natural disturbance into the health and success of wild populations.

Creagh Breuner has received numerous grants from the National Science Foundation for her work, including, most recently, an NSF CAREER grant and a Noyce NSF grant.

Photos: Left - tree swallows; photo by Allison Bernheisel. Right top - Newly hatched tree swallow. Right bottom - day-old tree swallow; photos by Creagh Breuner.

Wolves and Elk in Yellowstone National Park – *PhD candidate Matt Metz*

Matt Metz's PhD research, under Mark Hebblewhite and in collaboration with the National Park Service, focuses on understanding how large carnivores influence large ungulate abundance, a topic of central importance in the conservation and management of ecological systems. Yellowstone National Park is the epicenter of this issue, where the successful reintroduction of wolves has been associated with dramatic ecological changes, including the decline of the northern Yellowstone elk herd from approximately 20,000 to approximately 6,000. However, we're still not entirely sure of the effect of wolves on elk population abundance and there is significant debate over the effect of wolves on vegetative communities. Two decades of research give us an ideal opportunity to test important questions about how wolves influence prey (elk) populations.

Using a 22-year dataset (Matt assisted in data collection for the last 15 years), Matt is looking at how seasonal and annual variation in wolf predation dynamics influences elk population abundance in this iconic system of northern Yellowstone National Park. Following wolf reintroduction, wolves almost exclusively killed and fed upon elk for about 15 years. In recent years, however, as the bison population has increased concurrent to the decline of elk, wolves have increasingly used bison, primarily through scavenging. We need to understand how this use of alternative prey (bison) has and will affect the strength of wolf predation on elk abundance. This increased use of bison may stabilize elk abundance, as suggested by the observation that elk population abundance has generally fluctuated between approximately 5,000 and 6,500 for about half of the last decade.

Additionally, the changing abundance of elk in northern Yellowstone over the last two decades allows us to evaluate how density-dependent elk habitat selection may also influence the strength of wolf predation. Matt's dissertation work also evaluates how spatial predation risk varies among elk type (calf, adult female, adult male) during periods (seasons, years) with differing conditions. A vital aspect of this work is determining if and how spatial predation risk differs at varying abundances of elk. The availability of increased "refuge" areas to individual elk is predicted to increase at lower levels of elk abundance, which could lead to decreases in the rate that wolves kill elk and may also play a critical role in stabilizing wolf-elk dynamics.

Matt's dissertation research will provide essential information about how spatial and time-varying predation dynamics affect the expected abundance of wolves and elk in northern Yellowstone. We are evaluating how variation in wolf predation dynamics influences the stability of northern Yellowstone wolf and elk population abundances, which is information managers at Yellowstone National Park and Montana Fish, Wildlife, and Parks want to know. Matt's dissertation research is also broadly applicable as the debate of how large carnivores affect prey abundance is ongoing and widspread.

From ocellated turkeys to white-tailed deer – *Postdoctoral fellow Jon McRoberts*

If you value wildlife and you don't already live in Montana, it stands to reason that you're trying to find a way to make Montana home. Just as you might pick the gray haired pilot to fly aerial wildlife surveys or have the new guy open the ranch gate during the winter months, Jon McRoberts says that like any other good wildlife biologist, he's always longed to get to our state. Happily, he recently arrived at the University of Montana as a postdoctoral fellow.

His trail to Big Sky country began when he first met professor Josh Millspaugh as a freshman at the University of Missouri. Before their first conversation was complete, Jon was hooked on a career in wildlife. After finishing his undergraduate degree, Jon worked in western China with the Smithsonian Institution to assist with a giant panda reproductive study. As a doctoral student, he spent two years in the jungles of Mexico's Yucatan Peninsula studying ocellated turkeys, a colorful species endemic to southern Mexico and northern Guatemala and Belize. His study was the first to use GPS technology to track the species and his research results have helped shape wildlife policy in Mexico. He also hasn't forgotten sharing a study site with jaguars, toucans and boa constrictors. He is still involved with ocellated turkey research in Mexico, with the goal of intertwining wildlife conservation with the needs of local communities.

Jon now coordinates a large-scale white-tailed deer research project in Missouri. The team, led by Boone and Crockett Professor Josh Millspaugh, is in the second year of a five year study investigating survival rates, movement patterns and habitat use. They have already captured over 500 deer, worked with several hundred private landowners and are approaching the half-million mark of GPS locations collected from collared deer. Their results will enable science-based management of a socially and economically important species not only in Missouri, but throughout the Midwest.

Jon's professional interests remain grounded in applied wildlife conservation and in promoting sustainable management of wildlife resources through organized and responsible use. He is a strong proponent of the Roosevelt Doctrine – that wildlife management decisions should be grounded in science – and he is eager to become involved in wildlife research and conservation in the western states. Jon says, "The road to the University of Montana has been a memorable journey, and I feel that the best is yet to come."

Josh Millspaugh is an internationally recognized wildlife conservation researcher and educator who joined us in August as Boone and Crockett Professor of Wildlife Conservation.

Millspaugh holds a doctorate in wildlife ecology from the University of Washington and has been at the University of Missouri since 1999, serving as the Pauline O'Connor Distinguished Professor of Wildlife Management for four years.

His research centers on the study of vertebrate population ecology at three scales: physiological processes, individual space use and resource selection and population-level dynamics. He has received a superior graduate faculty award, the Missouri Governor's Award for Excellence in Teaching and the USDA National Teacher of the Year award, among other recognitions for his teaching.

Millspaugh also is a fellow in The Wildlife Society.

Understanding the cutbow – *Master's student Jeff Strait*

Native westslope cutthroat trout are not only Montana's state fish, but also a fish of conservation concern throughout its range. This status is primarily driven by habitat loss and fragmentation, as well as its interactions with exotic species. Rainbow trout have been stocked into Montana rivers for over fifty years (ending in the 1970s) – leading to cutbows (a cross between a cutthroat and a rainbow).

Although cutbows live, grow and reproduce in the rivers, biologists are uncertain if cutbows have the same growth potential and long-term viability as either a pure cutthroat or a pure rainbow trout. In order to conserve these cutthroat trout populations (prized by fishermen and important to our state economically, ecologically and culturally) and these ecosystems, we have to understand what biological differences might exist between cutthroat, cutbows, and rainbow trout. Our research focuses on timely and high profile questions regarding the effects of cutthroat and rainbow trout interbreeding (hybridization) and climate change on viability and persistence of native fish populations.

It is crucial to understand the varied ways hybridization is impacting cutthroat across different environmental conditions because rainbow and cutthroat interbreed across most of cutthroat's range. Our project is located in the North Fork Flathead River, Montana, a system that has seen a rapid expansion of cutbows and rainbow trout in the last 30 years.

Since 2013, we have been collecting data in three tributaries that differ in environmental conditions (e.g., temperature and flow) that might be important for the success or failure of cutbows by influencing traits such as individual growth, survival, lifetime reproductive success and dispersal. We are first asking if interbreeding with rainbow trout affects an individual cutthroat's growth rate. We're also looking for certain rainbow trout genes that might be influencing these differences in growth. With this same dataset, we will be able to determine if interbreeding with rainbow trout affects survival and reproduction as well. These traits are all important for the long-term persistence of a healthy trout fishery.

This project will lead to improved understanding and a biological meaning of rainbow trout interbreeding in our Montana waters. A more complete understanding of the consequences of rainbow interbreeding on traits such as growth, survival and reproductive success may help explain differences in landscape patterns such as the abundance of trout and the presence of cutbows in certain systems.

Meriwether's favorite woodpecker – *Master's student William Blake*

Every day for three months William Blake was lucky enough to conduct his research in a place that Lewis and Clark set eyes upon 211 years ago. The Bitterroot Valley is prime breeding habitat for his study species, the Lewis's woodpecker. Meriwether Lewis wrote about the bird on his famous journey so it now bears his name.

The Lewis's woodpecker is a species of concern in Montana because its population is declining in most portions of its range and there isn't much biological information about it. The Lewis's is distinguished from other woodpecker species by its bright red vermillion chest and face and, unlike most of its close relatives, it actively catches insects in mid-air.

Lewis's woodpecker can be hard to find, as it nests sporadically throughout the west. The Bitterroot Valley is a Montana hot spot for the nesting populations. William's research focuses on differences in nesting success and abundance of Lewis's woodpecker between burned and floodplain forest. In order to monitor enough nests in different populations he has eight different field sites spread throughout the Bitterroot Valley.

William spent the summer hiking through tough terrain and going to isolated areas of the Bitterroot. He started each day before sunrise setting up video cameras to capture nesting activities. He and the rest of the crew also used peeper cameras to look into nests. Lewis's woodpeckers' nests are an average of 40 feet up in trees so they used cameras on extension poles to look into the nest to follow the development of their young.

By the middle of July, the season wound down and the crew heard nestlings screaming impatiently for parents to bring food. William says, "I'm now back to the computer screen and excited to analyze all this data and will be looking forward to another field season next year!"

Catch 22: Isolation versus connection in current westslope cutthroat conservation – *Associate professor Lisa Eby*

Westslope cutthroat trout are often threatened by either competition or hybridization with exotic species, such as brook trout and rainbow trout. Managers often place fish barriers to protect cutthroat from exotic species. However, isolating small populations of cutthroat creates a new set of conservation concerns. Students in Lisa Eby's Aquatic Ecology and Fisheries Lab are working to understand trade-offs of isolation versus connection for westslope cutthroat trout conservation and evaluate options to better inform management.

Magnus McCaffery looked at landscape characteristics that promote cutthroat persistence in the face of brook trout on connected landscapes for his dissertation. He found that beaver ponds in a watershed not only improved late-season flows, but resulted in higher cutthroat growth rates, greater reproductive potential and improved the probability of cutthroat population persistence when they co-occur with exotic brook trout. McCaffery is currently an endangered species biologist with Turner Enterprises.

Along with brook trout, non-native rainbow trout were stocked across the inland west, interbreeding with cutthroat trout populations. Matt Corsi found demographic differences in growth rates, size and age of maturity, reproductive potential, as well as life history strategies (migratory versus resident) between pure cutthroat trout and those that have hybridized with rainbow trout. His dissertation research compared population-level impacts associated with hybridization versus isolating cutthroat populations from migratory, hybridized fish in the Jocko River Basin. Corsi is currently a fish biologist with Idaho Fish and Game.

Kellie Carim examined the isolated cutthroat populations to examine the quantity and quality of habitat necessary to improve population viability and avoid genetic inbreeding in conservation populations for her dissertation. Interestingly, many of the cutthroat populations in small habitats with low genetic diversity have unique life history characteristics that promote demographic persistence. This potential local adaptation is a critical finding as many of these populations are considered candidates for adding fish from other systems to avoid inbreeding depression. As part of her post-doc with the USFS Conservation Genomics Lab and UM, she is following up on the potential for local adaptation in isolated populations.

Professor Lisa Eby and former PhD student Mike LeMoine, along with colleagues at the U.S. Forest Service Rocky Mountain Research Station discovered a new fish species while doing their research. The cedar sculpin live in the upper Columbia River Basin and were previously thought to be their more common relative, the shorthead sculpin.

World-class teaching and research – *Professor Erick Greene*

While in high school in Quebec, Erick Greene was offered a great job as a field assistant in the Galápagos Islands for most of a year. After seriously weighing the pros and cons for about five minutes, he dropped out of high school and went to live in some of the most biologically amazing spots in the world, while helping with pioneering studies on the ecology and evolution of Darwin's finches.

Now as a professor here at UM, he has found the perfect place to continue studying wildlife and making a difference in conservation biology. Greene notes that within an hour's drive of campus he and undergraduate students can be in the middle of a bighorn sheep herd, watching them establish their dominance hierarchies, they can examine the effects of invasive plants on native plant communities, they can measure the effects of climatic variation on plant distribution or they can see how different types of caddis flies and other aquatic invertebrates reflect differences in aquatic habitats.

He also does interesting and important research locally, regionally, nationally and internationally. For example, he and graduate students have studied how bright plumage and song characteristics influence breeding success in lazuli buntings, a neon-colored bird that nests on the Palouse prairie hillsides behind the UM campus. Further afield, he monitors heavy metal and mercury contamination in osprey in several river systems in Montana that have been polluted by decades of copper and gold mining. Other research takes Erick to Cornell's Lab of Ornithology, where he collaborates with them on studies of how birds use alarm calls to warn other birds about predators. One student took this research to New Zealand, where she recorded kiwi calls as a way to census this highly endangered and secretive bird.

Professor Greene also gives students the opportunity to be involved in real-life conservation. One year, his ecology students studied plant succession in Greenough Park, a small riparian area about two miles from campus. The native black cottonwood trees were being out-competed by non-native Norway maples, and the oldest cottonwoods were dying and not being replaced. The students presented their results to the Missoula City Council and the Greenough Park Advisory Committee. Based on the students' recommendations, the park is now managed differently; Norway maples are being removed and new cottonwoods are being planted, ensuring that the native riparian forest survives.

Erick says, "Great faculty and an outdoor research lab that is second-to-none make the Wildlife Biology Program unique. Students learn the basic scientific underpinnings of wildlife biology and also have valuable opportunities to get hands-on experiences that reinforce those lessons and prepare them for a future in wildlife management and conservation."

Photo of Erick Greene by Jeremy Roberts.

Erick Greene's research has been featured recently in the New York Times ("When Birds Squawk, Other Species Seem to Listen" and on NPR's Morning Edition ("Squirrels Mimic Bird Alarms to Foil the Enemy") among other stories — about his research on predator alarm calls.

His work with the Montana Osprey Project has also garnered recognition, including a an award from the Missoula Conservation Roundtable.The Osprey Project is a long-term study of osprey ecology and heavy metal contamination in Montana's upper Clark Fork River and its tributaries.

As part of their work, they run two live-streaming nest cams in Missoula (Hellgate Canyon) and Lolo (Dunrovin Ranch.)

A passion for disease ecology – *Assistant professor Angela Luis*

Growing up in a small town in Oklahoma, Angela Luis spent most of her weekends on her family's property outside of town, playing in the creek, overturning rocks to discover salamanders and crawling under the roots of the snag that grew over the gully watching spiders build their webs. This began her life-long love of nature.

Luis found her calling studying infectious diseases in wildlife. Understanding diseases in wildlife is important for both animal conservation and human health. Her research embraces the wide fields of population, community and disease ecology to answer big questions such as: What leads to outbreaks? What are the environmental triggers? Can we predict when outbreaks will occur? How does transmission from animals to humans work? She uses a range of tools to address these questions, from fieldwork and lab work to statistical and theoretical modeling.

She does research on the role of bats as reservoirs of nasty viruses. Angie has shown that bats host more viruses per species than rodents (another important host group). Some ecological characteristics of bats appear to play a role: Bat species that live in very large colonies have ample opportunities for transmission between bats of the same species and bats of different species; and bats that migrate are important in spreading viruses from one region to another. However, bats provide important ecosystem services such as pollinating crops and eating pest insects. Therefore, we need to promote policies that aim to decrease contact between bats and humans including leaving their native ecosystems intact.

Angie is also currently studying hantavirus — a deadly virus passed from deer mice to humans. She and her graduate students are examining the importance of climate and biodiversity on driving hantavirus outbreaks in the reservoir host, the deer mouse. Their recent work combines fieldwork with mathematical models to show that, by monitoring mouse population numbers, they can predict times of increased risk of human infection in a particular area. She is currently working to broaden the scope of this model to larger areas using remote sensing. They're also looking at how small mammal diversity affects hantavirus and are finding that areas with greater small mammal diversity have less hantavirus. Angie and students are performing experiments with mice in the wild to explore possible mechanisms.

Luis says, "I am thrilled to be part of the amazing Wildlife Biology Program at the University of Montana. It is the perfect place to blend a love of nature and rigorous, cutting-edge science."

PARTNER-BASED *Conservation*

The Wildlife Biology Program recognizes the importance of working with a host of partners, especially private landowners, in accomplishing conservation on the ground. Program faculty work in a variety of ways to ensure that the results of their research is used to inform conservation and management strategies. Two prime examples of UM's focus on partner-based conservation include Vicky Dreitz's work through the Avian Science Center and Dave Naugle's work with the Sage Grouse Initiative.

Vicky Dreitz

Vicky is an assistant professor and director of the Avian Science Center (ASC), the only Montana university-based center focusing on birds to promote decision making for conservation of natural resources. ASC conducts partnership-based conservation using bird species to inform the impacts of human activities on natural resources and works with multiple stakeholders including natural resource managers, conservation practitioners and agricultural producers. In general, ASC works to understand the interplay of modern day activities on the ecological characteristics of ecosystems, using birds.

Prior to UM, Vicky spent seven years as a Research Scientist for Colorado Parks and Wildlife. She credits this experience as providing her the foundation to effectively conduct partnership-based conservation. Her engagement in a partner-based conservation effort was the 2005 Award recipient for the Department of Interior Conservation Service Award.

Dave Naugle

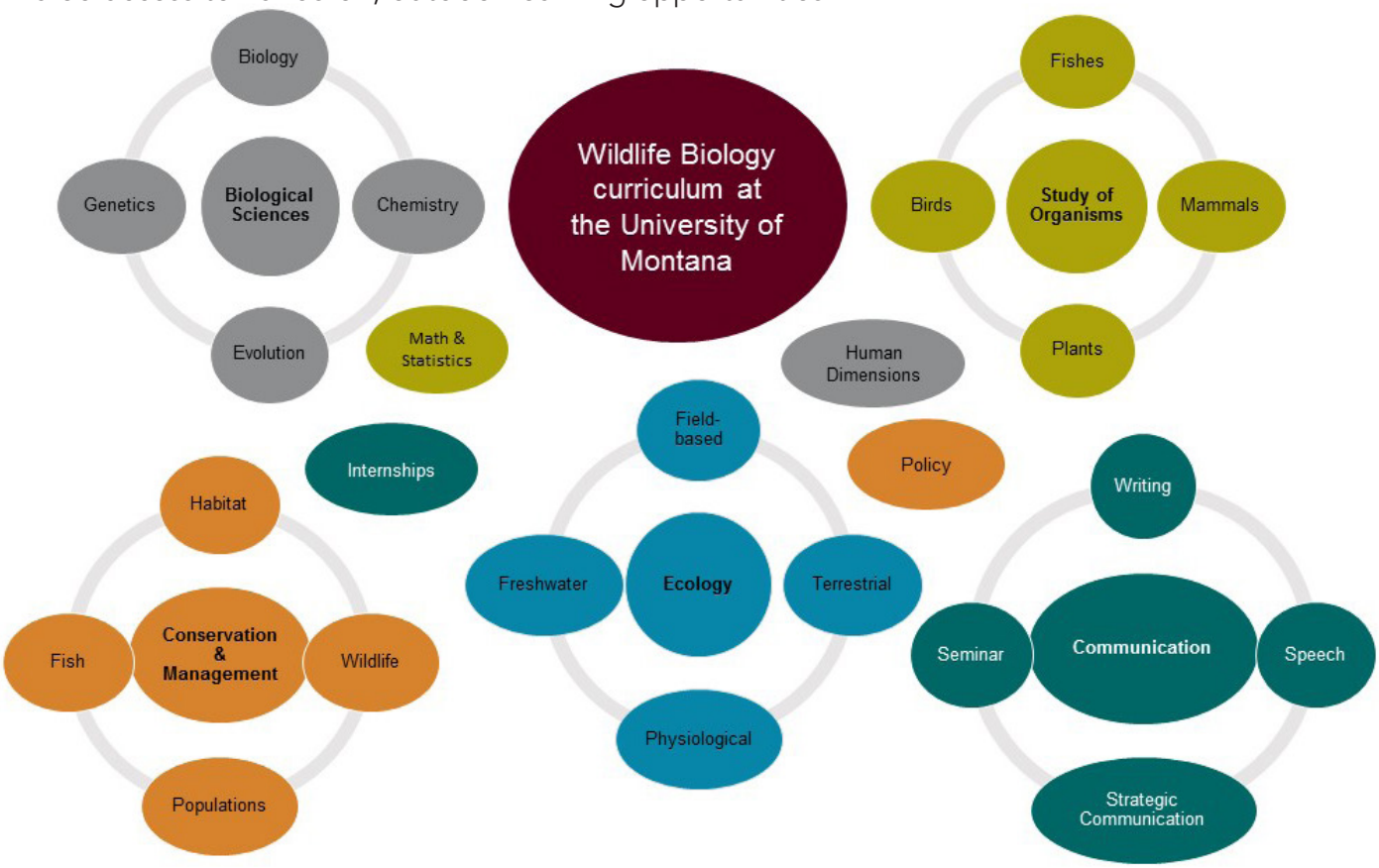
Dave is a professor whose applied science emphasizes biological planning and outcome-based evaluations in landscape conservation. Seventeen years spent investigating energy and wildlife issues culminated in his 2011 book with Island Press, Energy Development and Wildlife Conservation in Western North America. In his former life, Dave mostly fought industry, but he now seeks innovative solutions to balance energy and biodiversity futures — the focus of this new book. Since 2010, Dave also has served as US Department of Agriculture's Science Advisor to the Natural Resources Conservation Service-led Sage Grouse Initiative, where he helps guide a half-billion dollar Farm Bill investment to achieve wildlife conservation through sustainable ranching. In 2016, Secretary Tom Vilsack selected Dave and his colleagues to receive USDA's Abraham Lincoln Award for innovations in conservation.

EDUCATING *The Next Generation*

We are educating our students to be leaders in wildlife biology, management and conservation.

Students benefit from:

- Our faculty's outstanding teaching, knowledge and experience
- An enthusiastic and diverse student body drawn from across North America
- Unrivaled access to hands-on, outdoor learning opportunities



Students practicing telemetry on the UM campus; Student field trip to learn how a local neighborhood is enhancing wildlife habitat near Missoula.

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Photo of white-tailed deer by student Carly Muench.

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