2012-2013
Annual Science Brief of the
Northern Rocky Mountain Science Center
2012 was a productive year for the Northern Rocky Mountain Science Center (NOROCK). Our scientists continued to produce ground-breaking work in the areas of invasive species, grizzly bears, climate science, and explored the application of newer technologies like weather radar and infrared cameras to investigate wildlife problems. We are working closely with our partners to develop research and technologies that will help them understand how to control invasive lake trout in Yellowstone and Glacier National Parks, assess the importance of whitebark pine to grizzly bears in Yellowstone, and develop plant-monitoring strategies in the gas fields of Wyoming. These are just a few of the projects that you’ll find in our report. As our science partnerships and collaborations continue to grow, we look forward to working with you, if not now, then in the near future.

We hope you’ll find the information in this report useful and if you would like to have reprints or copies of the publications mentioned, or would like more information on our projects, please feel free to contact us or visit our website at: http://www.nrmisc.usgs.gov/. Thanks, and I look forward to seeing you down the road.

All the best,

Jeff Kershner, Center Director
Invaders threaten many of our native species and there is no doubt that invasive species are one of the most important threats to ecosystems world-wide. To complicate matters, the spread of invasive species is, in some cases, exacerbated by impacts of climate and land use change. Over the past decade, NOROCK has developed a strong research emphasis in the early detection and eradication of terrestrial and aquatic invasive species. These efforts include examining the role of oil and gas development on the spread of invasive plants, the consequences of non-native species like Lake trout in Yellowstone and Glacier National Parks and Asian carp on aquatic systems, and how to develop innovative new control technologies to combat the spread of Zebra mussels and New Zealand mudsnails. Our team is examining the efficacy of traditional removal techniques such as gill netting and electrofishing, as well as contemporary methods in the field of ecotoxicology such as carbon dioxide toxicity, and biological tracking of non-native species using environmental DNA. Our efforts reinforce the idea that there is no “silver bullet” in aquatic invasive species management and instead illustrate the idea that multiple tools are needed to address each type of invader because the impacts and the effectiveness of detection and treatment methods are specific to the stage of the invasion and the type of invader - a concept that scientists have likened to the medical community’s staging process in fighting cancer. In a recent paper published in American Scientist, a team of NOROCK researchers led by Adam Sepulveda argues for a new approach, one that is modeled after the American Cancer Society’s “staging” of disease. They argue that early detection and the treatments used to combat invasives at this stage need to be very different than those used during “Stage IV” or the latter stages of an invader where they have a rapidly expanding foothold in the ecosystem.

For more details see the May-June 2012 issue of American Scientist - Aquatic Invasive Species: Lessons from Cancer Research-The medical community’s successes in fighting cancer offer a model for preventing the spread of harmful invasive species.

NOROCK’s Aquatic Invasive Team includes Bob Gresswell, Clint Muhlfeld, Jeff Kershner, Adam Sepulveda, and Robert Al-Chokhachy. To learn more about their innovative and exciting research visit http://www.nrmsc.usgs.gov/AIS

This work was funded by the USGS Aquatic Invasive Species Program and Midwest Region, and our partners with U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, and the Bureau of Reclamation.

“Medicine often finds inspiration from the natural world, so it is perhaps no surprise that scientists now look to medical science to find new strategies to help the natural world in the epic battle against invasive species.”

Former USGS Director Marcia McNutt in USGS new release featuring NOROCK research published in American Scientist.
Research supporting the conservation of grizzly bears is a focus of much of NOROCK’s work involving wildlife monitoring. Our scientists not only monitor the population and health of grizzly bears, but we are also examining the broader effects of climate and land use change on their habitats. We provide wildlife managers sound science to support the management of grizzly bears throughout their range in the continental U.S. and provide a dynamic array of published scientific literature that is useful to wildlife conservation efforts throughout the world. Our science has been critical to the recovery efforts of grizzly bears and our biologists work with partners to research and monitor grizzly populations in the Greater Yellowstone (GYE), Northern Continental Divide (NCDE), and Cabinet-Yaak (CYE) Ecosystems. We use a combination of traditional telemetry monitoring through trapping and collaring of bears, and techniques considered “non-invasive” such as wire and rub tree hair sampling surveys. Our data has been used to estimate the number of bears within the GYE and NCDE, and is currently being collected to estimate the grizzly bear population in the CYE. We also examine potential genetic linkages between distinct bear populations, examine potential climate change impacts on bears and their habitat, study major food sources, and assess how human encroachment is impacting bear behavior and habitat. In a recent paper published in *Wildlife Biology*, Chuck Schwartz and co-authors illustrate that even extremely low densities of residential development create sink habitats, or areas where bears die at higher rates due to proximity of human activities. These findings are fundamental for land use planning and management as healthy bear populations begin to expand into previously unoccupied habitat. This and other factors are currently being assessed for the GYE bear population at the request of the Interagency Grizzly Bear Committee. The resulting document will inform the U.S. Fish and Wildlife Service and key partners as to the current status and trend of grizzly bears in the region in the face of whitebark pine decline, and aid in their decision regarding whether or not to petition for delisting in 2014.

To read more about human development and its impact on grizzly bears in the Greater Yellowstone Ecosystem, check out Volume 18, Issue 3 of *Wildlife Biology* - Impacts of rural development on Yellowstone wildlife: linking grizzly bear (*Ursus arctos*) demographics with projected residential growth.

NOROCK’s bear research team includes Frank van Manen, Mark Haroldson, Kate Kendall, Karrie West, Chad Dickinson, Mike Ebinger, and Amy Macleod. To learn more about their research visit http://www.nrm.sc.usgs.gov/science/bears

This work was funded by the USGS Ecosystems Program, the U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service, State and Local governments of Montana, Wyoming, and Idaho, Department of Homeland Security, and our partners in the Interagency Grizzly Bear Committee.

“The work of the (USGS) Interagency Grizzly Bear Study Team has been fundamental. The science they provide is the foundation for management decisions on bears.”

U.S. Fish & Wildlife Service Grizzly Bear Recovery Coordinator
Chris Servheen

In 2012, NOROCK researchers published 57 peer reviewed journal articles.
Climate change is having a profound influence on many ecosystems and species across the western landscape. How these changes interact with existing impacts from land management activities is an important research emphasis for NOROCK scientists. Our flagship studies have involved the changes in snowpack dynamics in western mountains and their effects on streams and stream organisms, and how changes in snowpack may influence the dynamics of wildlife populations that live in high-elevation mountain habitats. Recently, a new paper in Geophysical Research Letters by Greg Pederson and his co-authors found that western snowpack has been declining and spring temperatures have been rising since the 1930s. These findings have important implications for western water managers who may be forced to make hard decisions regarding water allocations to downstream users. These changes in mountain stream flows are also having profound effects on organisms like the meltwater stonefly that is completely dependent on the cold, glacially-fed alpine streams in Glacier National Park for its habitat. A research team led by Joe Giersch and his co-authors found that meltwater stonefly habitat is decreasing rapidly in Glacier National Park, prompting managers to consider listing the species under the Endangered Species Act. Species like the threatened bull trout are also increasingly affected by warming stream temperatures in the summer and early fall. In a recent paper by Leslie Jones and her co-authors she found that climate warming has had a significant influence on stream temperatures in northern Montana.

Changes in snowpack can also play an important role in the population-level ebb and flow of species that live in high alpine environments. In a new paper published in Ecology, Erik Beever discusses an animal he has studied most of his career – the American pika – and how climatic factors such as snowpack, temperature, and precipitation are playing an increasingly important role in their abundance in the mountains of the Great Basin. Across this vast region, researchers are recording pikas’ shifting distribution, and finding their population trends increasingly responsive to climate change but often difficult to predict. The research also suggested that climate change may be adding another filter for the suitability of habitats – specifically the timing and amount of precipitation and temperature. “Precipitation appears to be important because it can influence the amount of food available for pikas in the summer, and because an insulating snowpack can minimize exposure of pikas to extreme cold-stress in the winter,” Beever said.

For more about warming spring temperatures and snowpack decline, see Volume 40, Issue 9 of Geophysical Research Letters - Regional patterns and proximal causes of the recent snowpack decline in the Rocky Mountains, U.S.

In 2012, NOROCK scientists submitted 73 research proposals and were successfully awarded 58 - yielding $2.8 million in research funding.
NOROCK is participating in pioneering exploration in the use of historical and traditional technologies in new and innovative ways to benefit the science community. Tools traditionally used for things such as seafloor mapping, weather forecasting and military reconnaissance missions are now being implemented to monitor wildlife behaviors and habitat, as well as broad-scale environmental changes. In southwest Wyoming we are testing the effectiveness of high-resolution satellite imagery to monitor changes in plant types and biomass at a spatial and temporal resolution not previously possible. As part of the USGS National Unmanned Aircraft Systems (UAS) Project Office in Denver, NOROCK’s pilot team operates the Raven and T-Hawk small UAS aircraft to monitor vegetation cover and landscape changes over time, as well as invasive plant and animal species in places such as Haleakala National Park, HI. Our work with seismic water gun technology to control aquatic invasive species was initiated in the Chicago Shipping Canal to deter invasive Asian carp away from electric barriers and is now being studied in Alaska as a potential means to control invasive northern pike in order to protect and conserve Pacific salmon. And a recent study by Clint Muhlfeld and his co-authors promoted the examination of strontium isotopes in water and in fish earbones as a useful way to describe the movements of trout wholly within a freshwater system. We are also utilizing thermal imagery to advance biological research on the impacts of wind energy on flying animals such as bats. Robb Diehl and his partners are using the camera to study bat behavior during night flight in the vicinity of structures like wind turbines to better understand why they suffer higher mortality than birds near these structures. Currently proposals are pending to examine how animals respond to energy facilities in Hawaii and California. And finally, infrared cameras are also being used to capture images of free roaming wolves in Yellowstone that are infected with mange. Thermal imagery of wolves allows scientists like Paul Cross to not only document the extent of hair loss caused by mange, but the actual loss of heat associated with the different stages of infection. These data will be used to assess the energy it takes for the animal to stay warm with and without hair loss in Yellowstone’s harsh winter environment.

Aeroecology is an emerging discipline that relies on radar and other kinds of remote sensing technology to understand the behavior and ecology of flying animals. Radar designed decades ago to monitor weather now provides a huge archive of data on what is in the airspace. Researcher Robb Diehl and his partners are now taking advantage of this established data repository to gain information on the biology of flying animals such as birds, bats, and bugs. The information provided by radar includes habitat use and habitat preference, how those animals are distributed in the airspace and a wide range of foraging and movement behaviors. This information can have important implications for understanding flying animals as hazards to civilian and military aviation, as well as how tall human structures such as wind turbines may be hazardous to flying animals. In addition, radar insight can provide interesting information for pest management by revealing factors on how some flying species (i.e. bats) forage on pest insects.

Read more about how radar is being used to study animals in the airspace in Volume 93, Issue 5 of the Bulletin of the American Meteorological Society - Partly cloudy with a chance of migration: weather, radars, and aeroecology.

NOROCK scientists working with innovative technologies include Robb Diehl, Paul Cross, Todd Preston, Ed Olexa, and Adam Sepulveda. To learn more about their innovative and exciting research visit http://www.nrmsc.usgs.gov/science

This work was funded by the USGS Ecosystems, Energy and Minerals, and Environmental Health Programs.
Energy development in the western U.S. has expanded rapidly in the past several decades. NOROCK scientists are examining how natural resource development such as wind, oil and gas production is impacting vegetation and groundwater resources, and if these impacts have greater implications on wildlife such as bats and wildlife habitat of threatened species such as sage grouse, or if they will be exacerbated by existing climate change conditions. In the Midwest, Robb Diehl is currently working with his partners to examine the impact wind energy fields may have on flying animals such as bats. In southwestern Wyoming diverse landscapes provide habitat for an array of plant and wildlife species, as well as harbor vast reserves of mineral and natural resources that are actively undergoing development. Geneva Chong has been working with partners of the Wyoming Landscape Conservation Initiative (WLCI) to use phenology (greenness and productivity) monitoring to assess the effectiveness of well pad reclamation in the Jonah Field. Her team compared phenology of reclaimed sites to the performance of the native vegetation. The results of this study suggest that reclaimed areas do not contain the same species that were present prior to disturbance and are not functionally reclaimed. The phenology of native vegetation is longer lasting and thus provides consistent forage/cover for native species such as sage-grouse, pronghorn, and mule deer. In the plains and Prairie Pothole Region of northeastern Montana and northwestern North Dakota, Todd Preston and his partners with the Science Team about Energy and Prairie Pothole Environments (STEPPE) are examining the magnitude and extent of brine contamination from oil and gas development. Preliminary results from this work are currently influencing how the U.S. Fish and Wildlife Service (USFWS) partners are evaluating the risk of potential brine contamination on USFWS lands and how to focus monitoring and reclamation efforts. This work is also being expanded to examine the relationship between oil production and invasive plant species within the Williston Basin.

For more about findings on water quality and energy development in the Prairie Pothole Region, see the USGS Open-File Report: Water-Quality and Geophysical Data for Three Study Sites within the Williston Basin and Prairie Pothole Region.

NOROCK scientists working on issues related to energy development in the west include Geneva Chong, Robb Diehl, Rick Sojda, Todd Preston and Tara Chesley-Preston. To learn more about their research visit http://steppe.cr.usgs.gov/ and http://www.nrmsc.usgs.gov/staff/gchong/research

This work was funded by the USGS Ecosystems Program, STEPPE, WLCI, and the Plains and Prairie Pothole Landscape Conservation Cooperative.

“The STEPPE program is an invaluable resource for Medicine Lake National Wildlife Refuge in evaluating and mitigating impacts of oil and gas development.”

Mike Borgreen, U.S. Fish and Wildlife Service
NOROCK takes great pride in fostering long-lasting, productive research partnerships. We share research space with the Great Northern Landscape Conservation Cooperative and contribute significant resources to their efforts including the role of GNLCC Co-Science Coordinator, held by Rick Sojda, as well as science support via Ecologist Erik Beever and Statistician Kathi Irvine. We also support the North Central Climate Science Center with administrative assistance provided by Judy O’Dwyer and Geneva Chong serves as a Program Manager. We are actively involved in numerous research partnerships including the Interagency Grizzly Bear Study Team, Wyoming Landscape Conservation Initiative, Science Team about Energy and Prairie Pothole Environments, Montana Institute on Ecosystems, NPS Inventory and Monitoring Network, USGS National Research Program in Water, and the Amphibian Research and Monitoring Initiative. In Yellowstone National Park, Bob Gresswell and his partners are using acoustic biotelemetry to improve Lake trout suppression efforts in Yellowstone Lake, identified as the primary resource priority in the Park. And, in Charles M. Russell National Wildlife Refuge, Montana, Rick Sojda is beginning a coordinated effort in connecting greater sage-grouse managers and scientists to develop an adaptive management program for sage-grouse and their sagebrush steppe habitat that addresses climate change. Our scientists have many research projects on National Park Service lands throughout the country including Yellowstone, Glacier, Grand Teton, Rocky Mountain, Haleakala, and Channel Islands national parks, as well as Fossil Butte National Monument and Point Reyes National Seashore. And, our work can be found on Forest Service or Bureau of Land Management lands in almost every western state and Alaska.

In 2012, NOROCK researchers documented 119 technical assistance activities and 200 collaborative partnerships.
Farewell to Our Friends and Colleagues

We would like to thank the following NOROCK scientists for their many years of dedication and commitment to ecosystem science and wish them all well on their future endeavors!

To Kim Keating who showed us where the bighorn roam and captured spectacular images along the way.

To Kate Kendall who found out how many bears there are in the woods and what they like to scratch on.

To Carl Key who humbly catalogued and delivered information on hundreds of fires across the nation.

To Chuck Schwartz who dedicated his career to the conservation of grizzly bears with great success.

“"The outstanding scientific discovery of the twentieth century is not television, or radio, but rather the complexity of the land organism. Only those who know the most about it can appreciate how little we know about it. The last word in ignorance is the man who says of an animal or plant: “What good is it?” If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.”

Aldo Leopold, Round River

In 2012-2013, NOROCK research was featured in 9 news releases and mentioned in over 80 news articles.

For more information or a copy of this report, contact us at:
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Image credits:

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Page 3 Rainbow over NOROCK headquarters in Bozeman, Montana. (Mike Ebinger, MSU)
Pages 4-5 A native bull trout swims in the cool waters of the Flathead River near Glacier National Park, Montana. (Jonny Armstrong, USGS)
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