U.S. Department of the Interior
Geological Survey

Northern Rocky Mountain Science Center
2011 Annual Report

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Welcome! What follows is the annual report of the science and research at the Northern Rocky Mountain Science Center (NOROCK) for 2011 Our science partnerships and collaborations continue to grow and we look forward to working with you. We hope you'll find the information 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.nrmsc.usgs.gov/.

Jeff Kershner, Center Director

About the Center

The Northern Rocky Mountain Science Center (NOROCK) is part of the Rocky Mountain Area of the USGS. Scientists from the Center work in the northern Rocky Mountains of the United States and throughout the western U.S. Many of our scientists work throughout the world on issues as diverse as global climate change, aquatic ecology, wildlife diseases, bison ecology, and large carnivores. Researchers work with partners from the Department of the Interior including the Bureau of Land Management, Bureau of Reclamation, National Park Service, and the U.S. Fish and Wildlife Service. Researchers also work in collaboration with state resource agencies throughout the United States and other federal agencies such as the U.S. Forest Service. We are co-located at Montana State University.

Mission

The mission of the Northern Rocky Mountain Science Center is to produce and disseminate scientific information needed to manage and restore the ecosystems and associated plant and animal communities of the Northern Rockies.

Vision

The Center will generate and communicate unbiased, scientifically sound information needed to address issues of critical importance to natural resource managers of the region. The Center will be recognized for its ability to anticipate and address key issues effectively through research and information transfer, and for its collaborative approach to problem solving. Whenever feasible, the Center will continue to pursue integrated, interdisciplinary science within the USGS, with universities, other agencies, and non-governmental organizations.

Current Staffing

Our science staff includes ecologists, zoologists, wildlife biologists, aquatic biologists, statisticians, plant ecologists, and geographers, plus a science support staff of biologists, physical scientists, biology and hydrology technicians, and administration.

- 31 Federal Staff
- 4 Center Management
- 12 Research scientists
- 9 Science Support
- 3 Admin Support
- 3 SCEP graduate students

- 60 Non-Permanent Staff
- 27 STEP
- 12 TERM Appointments
- 21 Other Temp

To see our complete Center Staff, visit: http://nrmsc.usgs.gov/staff

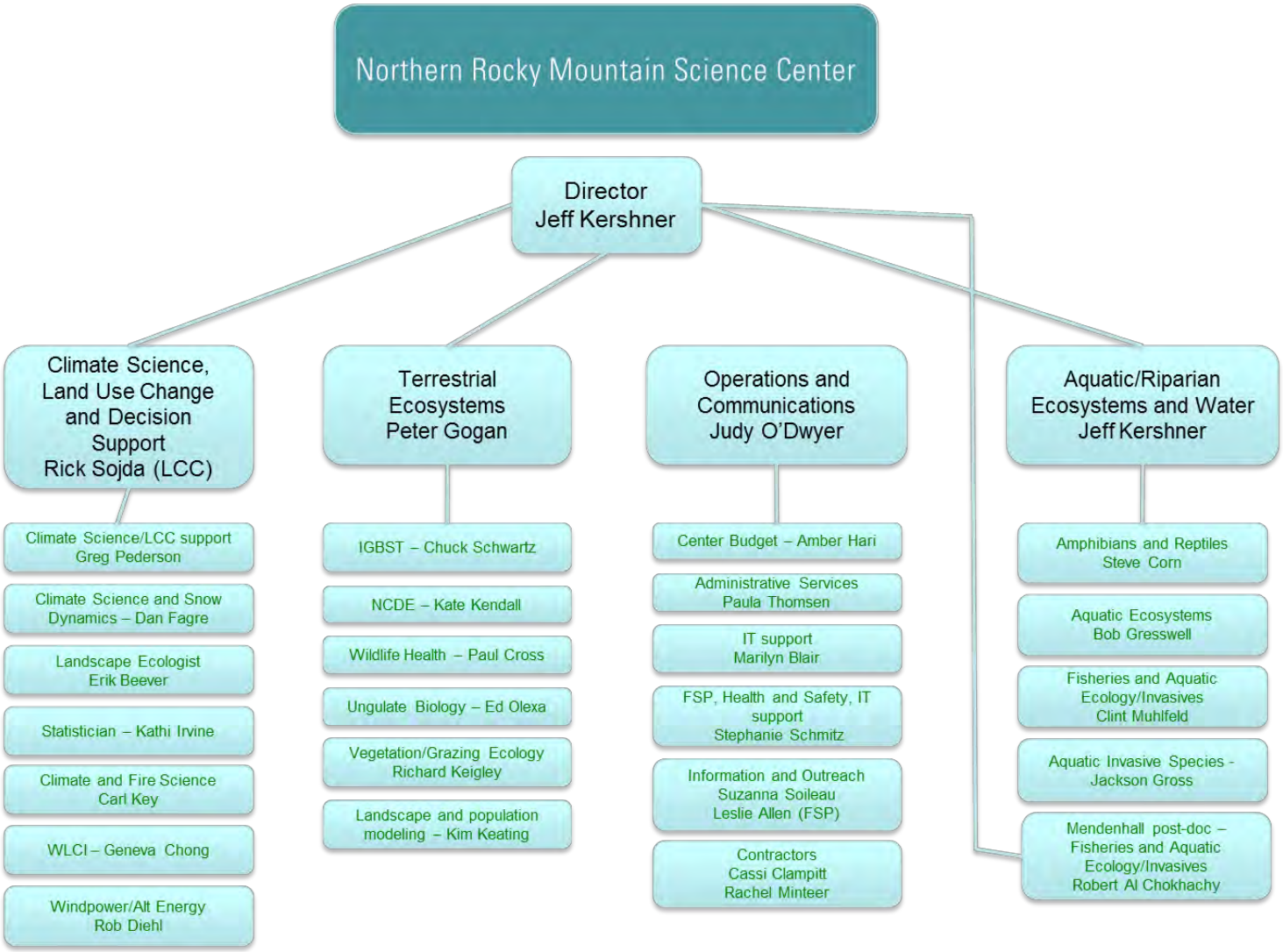
History

The Northern Rocky Mountain Science Center is one of 18 biological science and information technology centers within the USGS. The Center was formed in January 2000 by the U.S. Geological Survey to conduct integrated, interdisciplinary research in support of natural resource management in the Northern Rocky Mountains. Researchers are based at Bozeman, Montana with field stations at West Glacier and Missoula, Montana and a duty station in Jackson, Wyoming. Researchers work in collaboration with Federal, state, and International agencies, Native American tribes, academic institutions, and organizations to produce and disseminate scientific information needed to support natural resource management decisions.

NOROCK display at the visitation by Montana Senator Max Baucus.

Partners

Major partners include Montana State University, USGS Montana Water Center, USGS Montana Cooperative Fisheries Research Unit, the National Park Service, the U.S. Fish and Wildlife Service, the Bureau of Land Management, Bureau of Reclamation, the U.S. Forest Service, NASA, NOAA, the University of Montana, Montana Department of Fish, Wildlife and Parks, Wyoming Game and Fish Department, and Idaho Department of Fish and Game. Researchers also collaborate with numerous partners through the Interagency Grizzly Bear Committee, Greater Yellowstone Coordinating Committee, Great Northern Landscape Conservation Cooperative, Plains and Prairie Pothole Landscape Conservation Cooperative, Greater Yellowstone Interagency Brucellosis Committee, Rocky Mountain Cooperative Ecosystem Studies Unit, Northern Yellowstone Cooperative Wildlife Working Group, Trout Unlimited, Pacific Flyway Council, Montana Wetland Council, Big Sky Institute, Intermountain Joint Venture, and other joint ventures. Our role in all of these activities is to provide objective scientific information that can be used by others in making natural resource management decisions.



*Direct reports are shown in this figure. Other staff exist in a number of programs including full time scientists, technicians, post-docs and graduate students.

NOROCK Research Emphases

In 2007, the USGS developed a new science strategy outlining major natural-science issues facing the Nation and focusing on areas where natural science can make a substantial contribution to the well-being of the Nation and the world. These areas include global climate change, water resources, natural hazards, energy and minerals, ecosystems, and data integration. Science accomplishments of the Northern Rocky Mountain Science Center are based on government goals specific to protection and conservation of natural resources and fall under these new programming areas. Our Center function and biological science focuses around four main themes: Climate Science, Land Use Change and Decision Support; Terrestrial Ecosystems; Aquatic/Riparian Ecosystems and Water; and Operations and Communications.

Climate Science, Land Use Change and Decision Support:

The increasing pressure of private land development adjacent to public lands, expanding energy production, and continued commodity extraction on world class wildlife resources requires more complicated analyses to identify potential consequences and trade-offs of management alternatives. Couple that with global climate change, and resource managers face unprecedented challenges in the management of natural resources. We work collaboratively with managers in the northern Rockies and elsewhere to evaluate these changes and predict their impacts on terrestrial and aquatic ecosystems. We work closely with the Great Northern Landscape Conservation Cooperative and the Plains and Prairie Pothole Landscape Conservation Cooperative to cooperatively identify needed research and to help translate this research in ways that are useful to managers. We are developing models and decision support tools that use this information to display the effects of management alternatives on the resource goals identified by managers and the public.

Terrestrial Ecosystems:

The Northern Rockies are blessed with an abundance of plant and animal species that have remained relatively intact since the Lewis and Clark expedition in the early 19th century. Energy development, increasing human population pressures, and the continued demand for more water make the management of wildlife more complicated than ever. We work with partners to study key life history and habitat needs of these species. Our scientists develop work on a variety of research topics including wildlife habitat and population modeling, wildlife disease, ungulate browsing effects on vegetation, and plant community and habitat interactions.

Aquatic/Riparian Ecosystems and Water:

Native fish and amphibian populations have declined drastically throughout North America over the past century as a consequence of habitat degradation and nonnative species introductions. Although management actions have improved the probability of persistence of the these taxa in some areas, recent invasions of nonnative species (e.g., lake trout, rainbow trout, New Zealand mud snails, bull frogs, and Asian carp) present challenges to the persistence of native species. We work closely with managers to understand the most pressing management issues and to develop research that supports their efforts.

Operations and Communications:

To ensure the efficiency and efficacy of our science, our Operations staff works directly with Center researchers to help meet the functionality and staffing needs of each program. In addition, the Science Information and Education Team ensures that Center science is highlighted and accessible in various media formats and “stands-out” to both regional and national audiences.

Climate Science, Land Use Change, and Decision Support

Developing models and decision support tools to display the effects of management alternatives on the resource goals identified by managers and the public.

Paleoclimate and Climate Impacts on Natural Resources

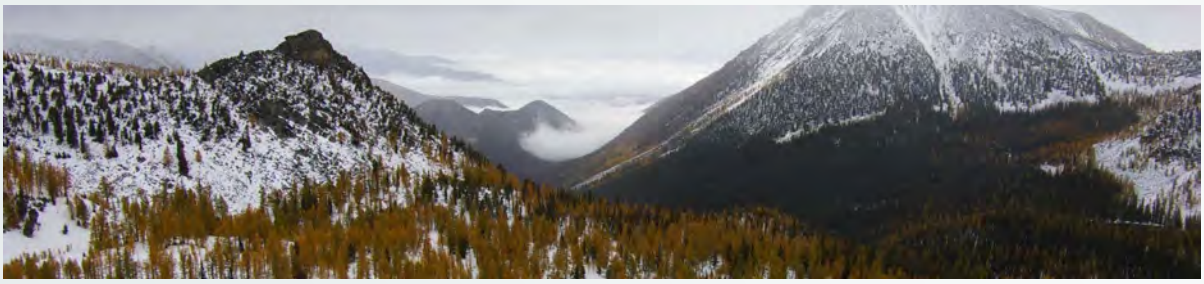
Lead: USGS Ecologist Greg Pederson
http://nrmsc.usgs.gov/staff/gpederson/research

This research is focused primarily on climate variability and its role in driving biological and physical components of mountainous ecosystems of western North America. In addressing these issues, instrumental and tree-ring based records of climate is used to assess the time intervals and spatial scales over which these processes operate. Of particular interest is the influence of interdecadal climate regimes, long-term temperature trends, and ocean-atmosphere connections in driving observed changes in mountain snowpack, streamflow, glaciers, and forest disturbance events. Recent studies have addressed the susceptibility of natural resources within national parks and protected areas to climate variability and change, and sought to apply both the modern and paleoclimatic records to present day resource management problems.

Featured Science: Unusual Nature of Recent Snowpack Declines in the North American

In western North America snowpack has declined in recent decades, and further losses are projected through the 21st century. We evaluated the uniqueness of recent declines using snowpack reconstructions from 66 tree-ring chronologies in key runoff generating areas of the Colorado, Columbia and Missouri River drainages. Over the past millennium, late-20th century snowpack reductions are almost unprecedented in magnitude across the northern Rocky mountains, and in their north-south synchrony across the cordillera. Both the snowpack declines and their synchrony result from unparalleled springtime warming due to positive reinforcement of the anthropogenic warming by decadal variability. The increasing role of warming on large-scale snowpack variability and trends foreshadows fundamental impacts on streamflow and water supplies across the western USA.

This science was delivered to the Secretary of Water and Science along with congressional staffers working for the Secretary of Homeland Security on issues of climate change and water resource availability. Additionally, this product was featured in a DOI press release with Secretary of the Interior, Ken Salazar, commenting "This scientific work is critical to understanding how climate change is affecting western water supplies. It helps land managers adapt to changing conditions on the ground, assists water managers with planning for the future, and gives all of us a better understanding of the real impacts that carbon pollution is having on our resources and our way of life."



Pederson, G.T., S.T. Gray, C.A. Woodhouse, J.L. Betancourt, **D.B. Fagre**, J.S. Littell, E. Watson, B.H. Luckman, and L.J. Graumlich. 2011. The unusual nature of recent snowpack declines in the North American Cordillera. Science, 15 July 2011: 333 (6040), 332-335. Published online 9 June 2011 [DOI:10.1126/science.1201570]

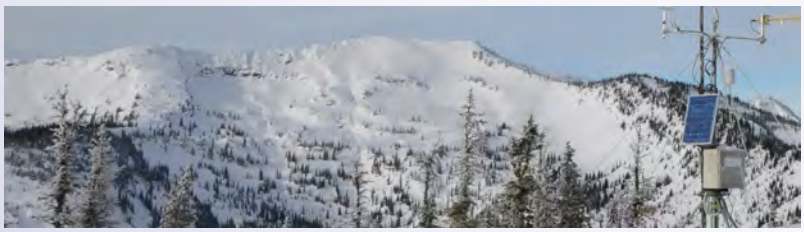
Climate Change in Mountain Ecosystems Program

Lead: USGS Research Ecologist Dan Fagre
Staff: Lisa Mckeon, Lindsey Bengtson, Erich Peitzsch, Blase Reardon
http://nrmsc.usgs.gov/research/global.htm

Climate change is widely acknowledged to be having a profound effect on the biosphere with many and diverse impacts on global resources. Mountain ecosystems in the western U.S. and the Northern Rockies in particular are highly sensitive to climate change. In fact, the higher elevations of the Northern Rockies have experienced three times the global average temperature increase over the past century. These same ecosystems provide up to 85% of the water humans depend on as well as a host of other ecosystem services such as snow-based recreation, timber, unique flora and fauna, and critical habitat for rare and endangered species such as bull trout and grizzly bear. Climate change poses special problems for mountain protected areas, such as national parks and wilderness areas, because most of the land area within their boundaries is at higher elevations. What will be the effects of continued climate change on mountain resources and our national parks? How should managers monitor and react to climate change? To answer these questions, we have been monitoring, conducting research, and modeling ecosystem responses to climatic variability since 1991, first at Glacier National Park but eventually throughout the western U.S. in collaboration with other scientists. Coordination with scientists around the world have led to mountain research networks to expand our understanding of how mountain ecosystems respond to climate change

Featured Science: Alpine Climatology of Glacier National Park

Glacier National Park is a topographically diverse region, making localized effects of elevation, aspect, and cold air drainage several of many important factors that necessitate a diversity of long-term climate monitoring sites. Additionally, many studies have shown more rapid warming at higher elevations across the Intermountain West, but with relatively few high-elevation stations available in the region it's difficult to estimate the magnitude of these changes along with the suite of potential impacts on montane to alpine ecosystems. We used our network of valley to high-elevation meteorological stations that are arrayed across Glacier National Park, and have been in operation since 1993, to identify trends and variability in biophysically important hydroclimatic metrics. We also took a closer look at potential surface feedback processes associated with the presence or absence of snowpack, and specifically the timing of its meltout. Change and variability in metrics such as temperature, wind, net solar radiation, snow depth/cover, and relative humidity are assessed at daily to decadal scales and will be integrated into ongoing projects monitoring changes in alpine vegetation, snowpack, and glacier mass balance. Meteorological measurements have been collected at the 21sites for various periods of time since 1993 and these data can be accessed at http://www.nrmsc.usgs.gov/AlpineClim_GNP. Data are essential for ongoing ecological monitoring and modeling projects, addressing wildlife habitat and disease related issues, and informing current and potential future resource management practices.



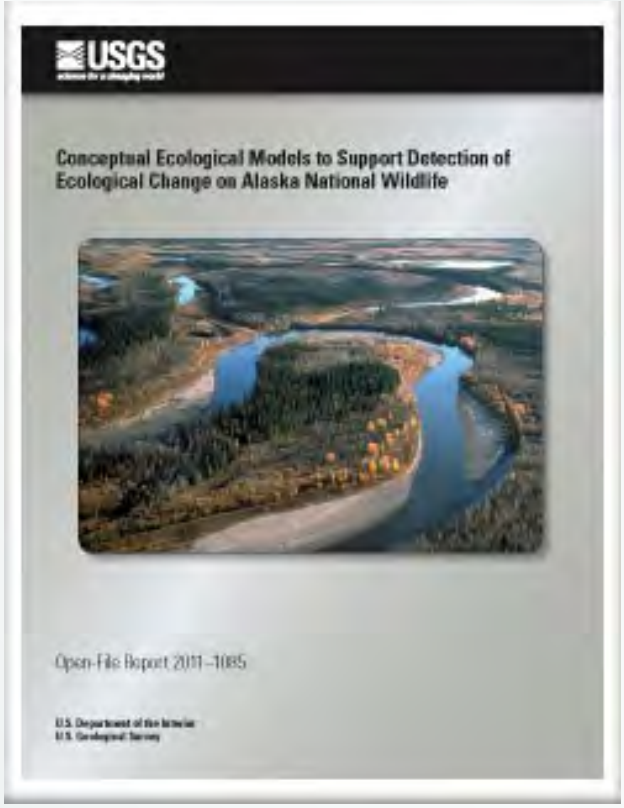
Landscape Ecology

Lead: USGS Ecologist Erik Beever
http://www.nrmsc.usgs.gov/staff/beever/research

This research examines disturbance ecology, mechanisms of biotic responses to climate change, and monitoring in conservation reserves, all at community to landscape scales. Most research examines montane mammals such as the American pika, but also looks at plants, soils, reptiles, amphibians, and ants within these ecosystems.

Featured Science: Long-term Ecological Inventory and Monitoring for National Wildlife Refuges in Alaska

Although nine National Wildlife Refuges (NWR) in Alaska were established in 1980 through the Alaska National-Interest Lands Conservation Act (ANILCA), NWRs in Alaska have been conducting a variety of natural-resource studies and surveys for over 50 years. The refuges currently plan and conduct much of their work fairly independently of each other. Although questions and issues may be similar across refuges, sampling design and field protocols vary across the region, thus limiting the ability to share data among refuges and extrapolate results across ecoregions. USGS assisted the U.S. Fish and Wildlife Service (FWS) through analysis of past efforts, conceptual modeling of ecosystems, and organization of a forum that informed FWS efforts to initiate region-wide monitoring. This assisted FWS as they designed and implemented refuge-specific Inventory and Monitoring (I&M) plans and a Regional Inventory and Monitoring Program for Alaska refuges. The specific objectives of the project were to strengthen the science and effectiveness of the inventory and monitoring activities conducted by Alaska refuges. This was accomplished by incorporating our expertise in science relating to ecological status and trends. Results of this study has subsequently served as the scientific foundation for broad-scale monitoring by FWS across Alaska, and even served as a valuable resource within FWS' new national I&M office.



Woodward, A., and E.A. Beever. 2010. Framework for ecoregional monitoring on National Wildlife Refuges and other federal lands in Alaska. U.S. Geological Survey Open-File Report 2010-1300. 94 pp. http://pubs.usgs.gov/of/2010/1300/

Fire Science

Lead: USGS Geographer Carl Key
http://nrmsc.usgs.gov/science/fire/burn_severity

The ecological significance of wildfire is now recognized globally, and needs to monitor and predict variations due to fire are widely accepted. Goals to sustain natural systems and biodiversity, enhance habitat, and mitigate unnatural fuel buildups are tempered by potential impacts from global biomass burning, and risks to human life and property where developments encroach on large natural areas. In addition, the potential influence of climate change in wildfire are not well known. Our scientists are building capabilities for the remote sensing and evaluation of burns to understanding how climate may control burn patterns and heterogeneity, and influence subsequent responses in western U.S. forest ecosystems. Working with diverse institutions and individuals in fire science and information technology, we are advancing mutual interests of fire science partners by undertaking relevant research and by disseminating findings through coordination and technology transfer.

Featured Science: Comprehensive Approach to Defining a Normal Fire Year

Fire frequency, area burned, and fire severity are important attributes of a fire regime and we examined whether these three metrics could provide land managers with a more comprehensive summary of a given fire year than examining any single metric. We looked at interrelationships among these parameters in evaluating a fire year by using the Landsat data archive to examine all 347 (prescribed fires and wildfires) greater than 98 acres from 1984 through 2009 for regions surrounding Yosemite National Park, Sierra Nevada Mountains, California; Glacier National Park, Rocky Mountains, Northern Montana; and Yukon-Charlie Rivers National Preserve, East-Interior Alaska, USA. We calculated mean fire frequency and mean annual area burned from a combination of field- and satellite-derived data, and a continuous probability distribution of the differenced Normalized Burn Ratio (dNBR) values was also developed to describe fire severity. Results show that for fires greater than 98 acres, fire frequency, annual area burned, and cumulative severity were consistent only half od the time, but all pair-wise comparisons among these fire regime attributes were significant. Climate scientists defined "fire normals" to be the 26 year means of fire frequency, annual area burned, and the area under the cumulative probability distribution of dNBR. In our study, fire severity normals were significantly lower when they were aggregated by year compared to aggregation by area. Results indicate that the three metrics examine together may allow more comprehensive modeling of climate-severity and area-severity relationships.

Lutz J.A., C..H. Key, C.A. Kolden, J.T. Kane, J.W. van Wagtendonk. 2011. Fire frequency, area burned, and severity: A quantitative approach to defining a normal fire year. Fire Ecology 7(2).

Statistical Analysis

Lead: USGS Statisticial Kathi Irvine
http://www.nrmsc.usgs.gov/staff/irvine

Research in this area focuses on investigating adaptive sampling designs and spatial models for predicting plant distributions, Bayesian hierarchical spatial models for trend analysis, model selection for graphical models.

Featured Science: Statistical assistance to the National Park Service Inventory and Monitoring Program

Programs that monitor entire multispecies assemblages require a method for determining the power of multivariate statistical models to detect trend. We provided a method to simulate presence–absence species assemblage data that are consistent with increasing or decreasing directional change in species composition within multiple sites. This is an important development for many, and a recent study provided guidance on determining the required sampling effort and suggestions for the appropriate statistical methods to analysis temporal trends in species composition.

Irvine, K.I, E.C. Dinger, and D. Sarr. 2011. A power analysis for multivariate tests of temporal trend in species composition. Ecology 92(10): 1879-1886

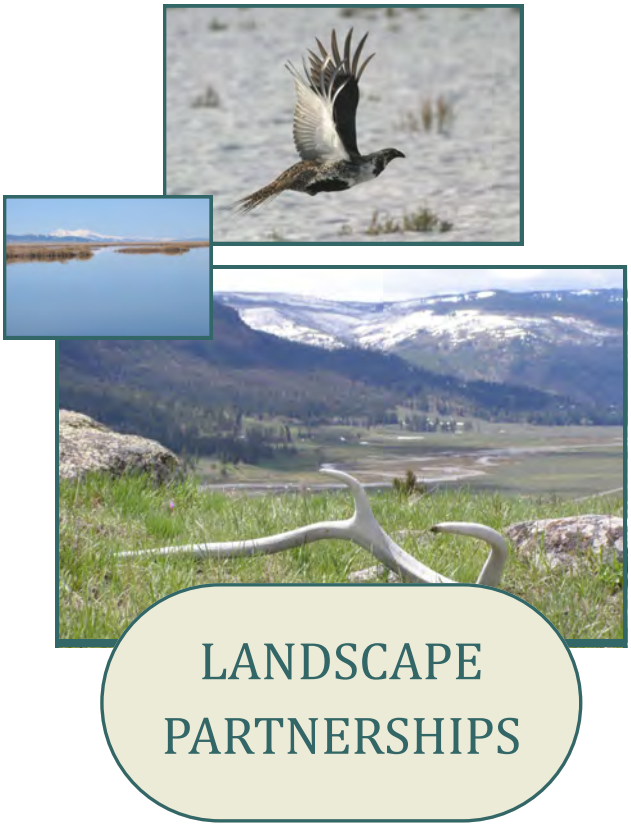
Terrestrial Invasive Species

Lead: USGS Research Ecologist Geneva Chong
http://nrmsc.usgs.gov/staff/gchong/research

Ecosystem change results from multiple, interacting factors, and many of those factors may be human-influenced such as climate, grazing, fire, flood, and land-use. Non-native species are one factor in ecosystem change that interacts with all other factors and provides a model system for not only monitoring ecosystem change but also for forecasting components of ecosystem change such as changes in species composition and structure, which, in turn, alter habitat and disturbance processes. We are actively cultivating relationships with management agencies to promote the use of comparable vegetation monitoring methods to facilitate ecosystem-level analyses of ecosystem change.

Featured Science: Phenological Monitoring for the WLCI

As part of efforts to support research priorities of the Wyoming Landscape Conservation Initiative (WLCI), we gathered a time series of remotely sensed scenes at two different resolutions to compare near-surface versus remotely sensed greenness indices for monitoring phenology (including start of green-up, maximum and duration of green-up and senescence). Near-surface reflectance and incoming solar radiation sampling platforms were re-established near the Fall Creek Elk Feedground in Pinedale, WY, and a subset of sensor platforms were established to monitor cheatgrass and native vegetation on the National Elk Refuge in Jackson, WY. Preliminary results indicate that the near-surface sensing platforms are able to capture phenological events, and partners at Colorado State University have developed software to automate management and analyses of the near-surface reflectance data. Preliminary analyses of National Elk Refuge sensor and field data confirm our ability to capture flowering and senescence of the species monitored. Study findings should be helpful regarding non-native species management and control. For example, treatment can be targeted during phenological opportunities (e.g., when the non-natives are active and the natives are dormant). Automated sensing of early green-up could signal the ability to end feeding of elk on feedgrounds to reduce the transmission of the disease brucellosis. Correlations between plot, near-surface, and remotely sensed data may provide resource managers with easy to acquire indicators of phenology and productivity.



Wyoming Landscape Conservation Initiative

The WLCI is a long-term science based effort to enhance aquatic and terrestrial habitats at a landscape scale in Southwest Wyoming, while facilitating responsible development." (http://www.wlci.gov/). The WLCI study area encompasses the southwest corner of Wyoming where extensive energy development is impacting wildlife, vegetation, air, land, water and human social structures including agriculture. NOROCK scientist Geneva Chong and her WLCI partners established near-surface reflectance, incoming solar radiation, air temperature and soil moisture sampling platforms in conjunction with remotely-sensed information (greenness) and ground-truth vegetation plots (multi-scale and photo). These data were used to determine reasons for anomalous green-up on the Jonah Oil Field, WY and effectiveness of cheatgrass control. Additionally, our Science Information Specialists coordinated the development of the USGS-WLCI fact sheet template and the USGS-WLCI fact sheet series.

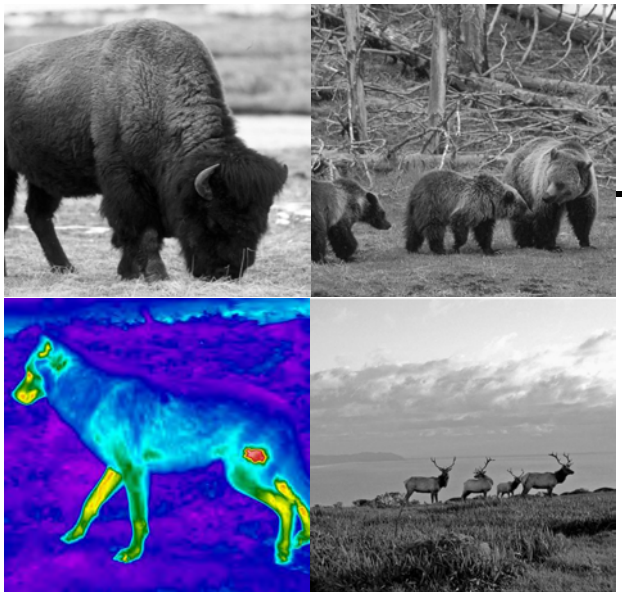
Great Northern Landscape Conservation Cooperative

The Great Northern Landscape Conservation Cooperative (GNLCC) is a partnership-directed conservation alliance focused on providing collaboration and coordination for strategic landscape conservation (http://nrmsc.usgs.gov/gnlcc). The GNLCC was jointly convened by U.S. Fish and Wildlife Service and the National Park Service in the spring of 2010. Federal, State, Tribal, Provincial and non-government organizations have been invited to participate. The GNLCC is working towards landscape conservation across the middle to northern Rocky Mountains and interior Columbia Basin. The GNLCC is connected with a number of landscape-level conservation partnerships within the Great Northern area to identify conservation priorities and related science and information needs within three eco-geographic areas: Rocky Mountain, Columbia and Sage - Steppe. The Northern Rocky Mountain Science Center has contributed significant resources to this effort including the role of GNLCC Science Coordinator, held by USGS Wildlife Biologist Rick Sojda. Additional staff assisting in GNLCC science needs include USGS Research Ecologist Erik Beever and USGS Statistician Kathi Irvine. Our Science Information Specialists also work on the GNLCC communication and outreach efforts.

Science Team about Energy and Prairie Pothole Environments

In the United States, the Williston Basin occupies 143,000 square miles and includes portions of Montana, North Dakota, and South Dakota. Superimposed over this landscape is the Prairie Pothole Region (PPR) which includes critical wetland and grassland habitats of importance to breeding, nesting, and migrating waterfowl, and wetland and grassland birds. A potential impact of oil field activities on these important habitats is brine contamination from co-produced waters that leach from oil well reserve pits, injection wells, and transport lines. Previous studies have identified contamination of wetlands and groundwater resources, including drinking water aquifers, located on U.S. Fish and Wildlife Service (USFWS), tribal, and public lands, and numerous groups have expressed concern over the potential risk of contamination. Currently, the extent of such contamination across the Williston Basin is unknown, and there is a need for scientific-based information to assess this threat.

The USGS has placed a focused effort on providing a comprehensive understanding of the Nation's energy and mineral resources and the environmental effects of their use. In response to this, a collaborative initiative known as Science Team about Energy and Prairie Pothole Environments (STEPPE) has been developed between USGS scientists from the NOROCK, Northern Prairie Wildlife Research Center, Montana Water Science Center, and the Crustal Imaging and Characterization Team (http://steppe.cr.usgs.gov/). STEPPE is working to identify areas within the Prairie Pothole and Williston Basin region of Montana, North Dakota, and South Dakota that are most at risk to contamination from energy development. The group is also assessing the extent of past and current oil well development in the region and the potential impacts on aquatic resources.



Terrestrial Ecosystems

Developing work on a variety of research topics including wildlife habitat and population modeling, wildlife disease, ungulate browsing effects on vegetation, and plant community and habitat interactions.

Wildlife Health

Lead: USGS Disease Ecologist Paul Cross
Staff: Mike Ebinger (Montana State University) and Emily Almberg (Pennsylvania State University)
http://nrmsc.usgs.gov/staff/pcross/research

Much of the interest in disease ecology and wildlife health has been prompted by the emergence, or resurgence, of parasites that move between livestock, wildlife, and/or humans. Almost 75% of all emerging human infectious diseases are zoonotic and many livestock disease issues are associated with repeated introductions from wildlife species. However, parasites are also passed in the other direction from domestic hosts to wildlife hosts and these parasites may affect the long-term conservation of wildlife species. Unprecedented human population abundance and distribution combined with anthropogenic environmental change has resulted in dramatic increases in human-animal contact, thus increasing the intimate linkages between animal and human health. Our scientists collaborate with a number of partners including Wyoming Game and Fish Department, Montana State University, University of Montana, Penn State University, Yellowstone National Park and Montana Fish Wildlife and Parks. Together, we are working on some of the most pressing wildlife health issues around the Greater Yellowstone Ecosystem.

Featured Science: Modeling Routes of Chronic Wasting Disease Transmission

Chronic wasting disease (CWD) is a fatal disease of deer, elk, and moose caused by an infectious prion protein which can remain infectious in the environment for at least a couple of years. CWD is known to be transmitted through direct, animal-to-animal contact, and indirectly, via environmental contamination. Considerable attention has been paid to modeling direct transmission; however, we used simulation models to demonstrate how indirect transmission and prion survival may affect the long-term dynamics of CWD in North American deer populations. We used existing data from Colorado, Wyoming, and Wisconsin's CWD epidemics to define plausible short-term outcomes and associated parameter spaces. Resulting long-term outcomes range from relatively low disease prevalence and limited host-population decline to host-population collapse and extinction. Our models suggest that disease prevalence and the severity of population decline is driven by the duration that prions remain infectious in the environment. Despite relatively low epidemic growth rates, the basic reproductive number may be much larger than expected under direct-transmission because the infectious period can vastly exceed the host's life span. High prion persistence is expected to lead to an increasing environmental pool of prions during the early phases of the epidemic. As a consequence, over this period of time, disease dynamics will become more heavily influenced by indirect transmission, which may explain some of the observed regional differences in age and sex-specific disease patterns. This suggests that as CWD epidemics progress, management interventions, such as culling or vaccination, may become increasingly less effective.

Almberg, ES, PC Cross, D Heisey, CJ Johnson & BJ Richards. 2011. Modeling routes of chronic wasting disease transmission: Environmental prion persistence promotes deer population decline and extinction. PLoS ONE: e19896. doi:10.1371/journal.pone.0019896

Interagency Grizzly Bear Study Team

Lead: USGS Research Wildlife Biologist Chuck Schwartz
Staff: Mark Haroldson, Shannon Podruzny, Karrie West, Chad Dickinson
http://nrmsc.usgs.gov/research/igbst-home.htm

The Interagency Grizzly Bear Study Team (IGBST) is an interdisciplinary group of scientists and biologists responsible for long-term monitoring and research efforts on grizzly bears in the Greater Yellowstone Ecosystem (GYE). The team is composed of representatives from the U.S. Geological Survey, National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, Wind River Fish and Game, and the States of Idaho, Montana, and Wyoming. This interagency approach ensures consistency in data collection and allows for combining limited resources to address information needs throughout the GYE. We annually monitor the grizzly bear population and habitat in the GYE. Examples include:

- Distinguishing unique females with cubs of the year.
- Radio-collaring a representative sample of bears to estimate rates of reproduction and survival, movement patterns, habitat use, and denning chronology.
- Documenting distribution of females with young throughout the ecosystem.
- Documenting where, when, and how many bears die (mortalities) annually in the GYE.
- Monitoring annual trends in key foods including winter-killed bison and elk, spawning cutthroat trout, whitebark pine cone production, and bear use of cutworm moth aggregation sites.

Featured Science: Monitoring Whitebark Pine Cone Production

The IGBST performs annual analysis of whitebark pine cone production as part of the National Park Service's Inventory and Monitoring Program. Whitebark pine seeds are arguably the most important fattening food available to grizzly bears during late summer and fall. We annually monitor cone production throughout the GYE on 19 transects. Cone production is highly variable from year to year and our studies have demonstrated a relationship between cone counts and bear mortality. In years of poor cone production, bear conflicts and deaths increase. Understanding such relationships is useful in predicting and preventing future problems. Ironically, whitebark pine is potentially threatened in the GYE by an introduced fungus, white pine blister rust, which could significantly reduce pine abundance. Blister rust has already decimated whitebark pine in northwest Montana, and though infection occurs in the GYE, it has yet to caused extensive tree mortality.

http://www.nrmsc.usgs.gov/research/igbst/wbp

Northern Divide Grizzly Bear Project

Lead: USGS Research Biologist Katherine Kendall
Staff: Amy Macleod (University of Montana)
http://nrmsc.usgs.gov/research/NGSbear_monitoring.htm

The Northern Divide Grizzly Bear Project monitors grizzly bear populations in northwest Montana— one of the last strongholds of the grizzly bear in the lower 48 states. The project is studying two of the six established grizzly bear recovery zones— the Northern Continental Divide Ecosystem (NCDE) and the Cabinet-Yaak Ecosystem (CYE). These are the third and forth largest recovery zones, respectively, and may harbor the greatest number of grizzly bears. These areas are also contiguous to Canadian grizzly bear populations. Little information exists about the bears in these zones and as agencies strive to recover the threatened grizzly bear, it is clear that there is a need to assess the grizzly bear population in both the NCDE and CYE. Managers and biologists are working to identify population size, trend, survival, and the corridors that link separate populations. Advances in genetic technology allow us to address these parameters through the identification of species, sex, and individuals from DNA extracted from bear hair without ever handling a bear.

Featured Science: Cabinet-Yaak Grizzly Bear Project

Grizzly bears once roamed most of the North American continent. Habitat destruction and direct conflicts with humans have reduced their range by 99% in the lower 48 states. In 1975 grizzly bears were listed as threatened under the Endangered Species Act. The Cabinet-Yaak Ecosystem (CYE) in northwest Montana and northeast Idaho is one of six recovery zones defined in the Grizzly Bear Recovery Plan (U.S. Fish and Wildlife Service 1993). Estimates place the total number of grizzlies that remain south of the Canadian border at fewer than 1100. It is thought there are between 30-40 animals within the 2,600 square-mile Cabinet-Yaak recovery zone. The goal of this research project is to use sign surveys and systematic hair snag stations to obtain an estimate of the number of grizzly bears in the CYE in northwest Montana and northeast Idaho. In addition, a genetic database will be developed for grizzly bears in the CYE to assess genetic diversity and degree of relatedness of the grizzly bear population.

http://www.nrmsc.usgs.gov/research/CYEbeardna_detail

Ungulate Biology

Lead: USGS Wildlife Biologist Ed Olexa
http://nrmsc.usgs.gov/staff/eolexa/research

Our research is assessing the impact of land management activities on the spatial and temporal distribution of ungulate populations and identifying the impact of ungulate herbivory on Department of Interior managed areas. Current research involves identifying spatial and temporal aspects of elk distribution to be used in resource protection on protected areas administered by the National Park Service and assessing elk response to land management activities on BLM grazing allotments.

Featured Science: Development and Evaluation of Synthetic High Resolution Satellite Imagery for Effectiveness Monitoring

Federal land management practices such as livestock grazing, prescribed fire, and sagebrush control are often designed to alter range conditions and may influence available forage for wildlife and livestock. A lack of data on vegetation dynamics often results in the use of static metrics to document changes in plant biomass resulting from habitat altering activities. Our collaboration with partners resulted in the opportunity to examine the relationship between elk spatial ecology and dynamic range conditions on public lands in southwest Wyoming. Satellite based remote sensing systems might provide the fine-resolution spatiotemporal data required to measure the response of sagebrush dominated vegetation to management activities in the Wyoming Basins ecoregion. The spatial and temporal scales of satellite measurements often determine the effectiveness of remote sensing data to describe biophysical characteristics. Sensor choice is often a compromise among aspects of spatial scale (i.e., grain and extent), temporal scale (i.e., interval and duration), and imagery costs. Investigations covering large spatial extents often utilize imagery with low spatial resolution. Recent advances in data fusion permit calculation of surface reflectance values at Landsat level spatial resolution (30m) and daily temporal resolution. A relative measure of plant biomass (Normalized Difference Vegetation Index) can be derived from these reflectance values and used to document changes in plant biomass.

North American Bison Research

Lead: USGS Research Wildlife Biologist Pete Gogan
http://nrmsc.usgs.gov/staff/pgogan/research

North American bison (*Bison bison*) once roamed the plains of North America from northern Mexico to Alaska in numbers of tens of millions. Today, there are about 430,000 bison roaming throughout the US, with the vast majority in private ownership and around 20,000 in conservation herds managed by federal and state agencies. Though they are not in danger of extinction, there are indications that the present populations are threaten by both genetic hybridization with domestic cattle – a result of efforts to breed a more robust "beefalo" breed in the early 1900s – and exposure to livestock diseases.

Featured Science: Genetics of Yellowstone Bison

To better understand the biology of Yellowstone bison, we investigated the potential for limited gene flow across this population using multilocus Bayesian clustering analysis. Two genetically distinct and clearly defined subpopulations were identified based on both genotypic diversity and allelic distributions. Genetic cluster assignments were highly correlated with sampling locations for a subgroup of live capture individuals. Further, a comparison of the cluster assignments to the two principle winter cull sites revealed critical differences in migration patterns across years. The two Yellowstone subpopulations display levels of differentiation that are only slightly less than that between bison populations elsewhere which have been geographically and reproductively isolated for over 40 years. The practice of culling Yellowstone bison without regard to possible subpopulation structure has the potentially negative long-term consequences of reducing genetic diversity and permanently changing the genetic constitution within subpopulations and across the Yellowstone bison metapopulation. Population subdivision is a critically important force for maintaining genetic diversity, and yet has been assessed in only a handful of species to date. The identification of cryptic population subdivision of the magnitude identified in this study exemplifies the importance of genetic studies in the management of wildlife species.

Halbert, Natalie D., Peter J. P. Gogan, Philip W. Hedrick, Jacquelyn M. Wahl, And James N. Derr.2012. Genetic Population Substructure in Bison at Yellowstone National Park. Journal of Heredity 2012:103(3):360–370.

Landscape and Population Modeling

Lead: USGS Research Wildlife Biologist Kim Keating
http://nrmsc.usgs.gov/staff/kkeating/research

Ecosystems increasingly show signs of stress from multiple causes. Global climate change, land development, invasive species, and altered fire regimes are but a few of the factors that threaten large-scale ecological change. Our research is aimed at understanding the species-habitat relationships central to ecosystem structure and function, and at developing the mathematical methods and models needed to predict consequences of impending changes over broad landscapes. Field studies address wildlife-habitat relationships for ungulates and large carnivores—species that commonly exhibit long-distance movements, and which require relatively intact ecosystems with large areas of suitable habitat to sustain healthy populations. This fieldwork is complemented by research to develop improved statistical methods for modeling wildlife-habitat relationships over large ecosystems. Such models provide an important decision-support tool for resource managers seeking to identify key habitats or predict impacts of management alternatives.

Featured Science: Bighorn Sheep Ecology and Conservation in Waterton-Glacier International Peace Park

Despite its pristine appearance, the Waterton-Glacier area harbors a fauna that has been greatly affected by human activities. Historical periods of trapping, mining, logging, agriculture and unregulated hunting resulted in the extirpation of some species, while greatly reducing numbers and distributions of others. Today, human population growth and tourism have led to accelerated rates of land development and increased recreational use in and near both parks, further affecting critical ungulate habitats and the populations dependent on them. Bighorn sheep are among those species that face serious risk of further decline. Bighorns occupy patchily distributed habitats, particularly during the critical winter period. Decades of fire suppression have decreased the size and increased the insularity of many of these habitat patches, while disease has caused recurrent catastrophic mortality, exacerbated by legal and illegal hunting. Such factors have combined to extirpate bighorn sheep from some important historical winter ranges in and adjacent to the parks, and are a continuing concern into the future. To provide park managers with a better understanding of bighorn populations, this study documents seasonal ranges and migration routes, evaluates patterns of habitat use and selection, and models bighorn-habitat relationships to predict occurrences of critical habitats and provide managers with rigorous decision-support tools to aid planning and impact assessment. In 2011, five new collars were deployed on rams in the Chief Mountain and East Flattop areas, as part of a project extension aimed at better understanding movements and social structure of rams subjected to hunting along the Glacier Park-Blackfeet Reservation Boundary. Efforts to complete habitat modeling (the major objective of the original project) resumed late in the year, with an anticipated completion date sometime late in 2012.

Aquatic Ecosystems and Water

We work closely with managers to understand the most pressing management issues and to develop research that supports their efforts. In aquatic ecosystem conservation.

Amphibians and Reptiles

Lead: USGS Research Zoologist Steve Corn
Staff: Blake Hossack
http://nrmsc.usgs.gov/rarmi

The Department of the Interior's Amphibian Research and Monitoring Initiative (ARMI) is designed to determine where populations of amphibians are present, to monitor specific populations and to investigate potential causes of decline and deformity. The Rocky Mountain Region of ARMI encompasses Montana, Wyoming, Colorado, and New Mexico. Two USGS Science Centers initiate and develop ARMI projects in this region—NOROCK and Fort Collins Science Center (FORT), Colorado. Information from surveys in the Rocky Mountains is used to determine the occupancy of species of amphibian in a target area. These data are compiled at the national level where the information will be used in designing new surveys and framing hypotheses to be tested about amphibian presence, amphibian decline, and other related issues such as deformity and disease.

Featured Science: Acoustic Monitoring of Amphibian Populations

Unattended recording of amphibian breeding choruses has the potential to provide large amounts of data on behavior, including breeding phenology, which may be sensitive to changing climates. As part of the USGS Amphibian Research and Monitoring Initiative, we have established amphibian listening posts in Montana, North Dakota, Wyoming, and Colorado. Current sites represent pilot studies for possible larger scale deployment. Studies have monitored boreal chorus frog populations in northern Colorado since 1986, including acoustic monitoring since 1994. Recent studies analyzed whether estimates of calling intensity can be used as an index to abundance. We compared both a single index value, such as would be collected by a manual calling survey, and a value derived from all the recordings made daily at the site to capture-recapture based estimates of the numbers of male frogs present. Single call index values did not discriminate among different-sized populations. The average synthetic call index was higher at the pond with the larger mean frog population, but the annual call index did not do a good job of predicting the chorus frog population size. In parts of the United States and Canada, the North American Amphibian Monitoring Program conducts manual calling surveys each spring, and there has long been a desire to determine whether the values recorded can be used as an index to abundance. This study suggests that the call index values should not be used in this manner, at least for chorus frogs. The index values generated from the automated recordings may be useful in some analyses, but should not be considered as direct surrogates for population size.

Corn P.S., Muths E, Kissel A.M., Scherer R.D. 2011. Breeding chorus indices are weakly related to estimated abundance of boreal chorus frogs. Copeia 2011:365–371.

Landscape-Scale Impacts on Native Trout and Salmon

Lead: USGS Research Biologist Bob Gresswell
Staff: Robert Al-Chokhachy
http://nrmsc.usgs.gov/staff/bgresswell

Fishery biologists and managers are increasingly consumed with the recovery and restoration of native trout and salmon throughout the western United States. These fish historically inhabited a variety of freshwater habitats, but have declined due to habitat degradation, fragmentation, and introductions of nonnative species. Complicating these issues is global warming and associated climate change, which are likely to increase air and water temperatures, increase the risk of catastrophic fire, change the timing and quantity of water from snowpack, increase winter flooding in some areas, and provide habitat conditions that favor introduced species.

Featured Science: Conserving Yellowstone Cutthroat Trout and Improving Lake Trout Suppression in Yellowstone Lake

Yellowstone Lake once supported what was believed to be the largest genetically unaltered population of Yellowstone cutthroat trout (YCT) in the world. Introduced lake trout were initially reported in Yellowstone Lake in 1994, and subsequently, YCT have become the major prey of lake trout. Recent evidence suggests that this aggressive predator has substantially altered the abundance and demography of Yellowstone cutthroat trout in the lake and currently threatens its long-term presence. The National Park Service has been actively attempting to reduce the numbers of lake trout in Yellowstone Lake since 1996, primarily by passive capture using gill nets in addition to electrofishing. Efforts to increase direct removal and utilize innovative techniques for destroying lake trout embryos and larvae require knowledge regarding lake trout movement patterns and accurate information concerning the location of spawning areas. We are utilizing acoustic transmitters implanted in adult lake trout to document movement patterns in Yellowstone Lake. This will assist with active netting activity and identification of spawning areas that can subsequently be targeted for embryo destruction. These data are critical for expanding management options for suppressing invasive lake trout.

In addition, understanding the factors associated with the current distribution of YCT trout is an imperative step in the design and implementation of future conservation and management strategies, particularly given emerging potential stressors associated with regional climate change. To address this need, we developed a stream temperature model for the range of YCT, and then use this model within multiple modeling approaches to better understand how landscape attributes, natural and anthropogenic disturbance, and climate are associated with the distribution of YCT. The results from our modeling suggest disturbance, land use, and land cover as the strongest predictors influencing the distribution of YCT. The impacts of climate varied considerably across management unit, suggesting that historical factors and non-native species have likely played a larger role in describing where YCT are distributed currently. Within the context of climate change, our results indicate the benefit of conservation actions related to land management in the immediate future, particularly as the impacts of land management are likely to become exacerbated under future climate predictions for the Greater Yellowstone Ecosystem.

http://www.nrmsc.usgs.gov/files/norock/products/YS_LakeTrout_2011.pdf

Fisheries and Aquatic Ecology

Lead: USGS Research Ecologist Clint Muhlfeld
Staff: Vin D'Angelo, Joe Giersch, Carter Fredenberg, Leslie Jones, Brady Miller
http://nrmsc.usgs.gov/staff/muhlfeld/research

Part of our Aquatic Ecosystem Program is located at Glacier National Park, Montana. This program focuses on various aspects of aquatic ecology, fisheries biology, and conservation of native aquatic biota. Research spans a range of research questions and conservation issues. We are examining the impacts of hybridization and competition between native and non-native salmonids, assessing life history diversity and genetic structure of native fishes, investigating the impacts of hydroelectric dams on aquatic ecosystems, and developing quantitative bioenergetics and population viability models for fish populations and aquatic communities.

Featured Science: Rare Alpine Insect May Disappear with Glaciers

Climate warming in the mid- to high-latitudes and high-elevation mountainous regions is occurring more rapidly than anywhere else on Earth, and understanding how species are likely to respond to climate change is critical for conservation and management strategies. In a recent study we illustrated that alpine aquatic insects can be good early warning indicators of climate warming in mountain ecosystems. The glaciers in Glacier National Park are predicted to disappear by 2030 and, as its name infers, the meltwater stonefly (*Lednia tumana*) prefers to live in the coldest, most sensitive alpine stream habitats directly downstream of disappearing glaciers, permanent snowfields and springs in the park. Prior to this research little was known on specifically how climate impacts may threaten this rare species and many other enigmatic alpine aquatic species worldwide. During 14 years of research, results documented that the meltwater stonefly inhabits a narrow distribution, restricted to short sections of cold, alpine streams directly below glaciers, permanent snowfields, and springs. Our simulation models suggest that climate change threatens the potential future distribution of these sensitive habitats and the persistence of the meltwater stonefly through the loss of glaciers and snowfields. These major habitat reductions imply a greatly increased probability of extinction and/or significant range contraction for this sensitive species. Results of this study were used in the recent determination by the U.S. Fish and Wildlife Service that the meltwater stonefly warrants the protections of the Endangered Species Act due to climate-change-induced glacier loss. Our research showed that mountaintop aquatic invertebrates are ideal early warning indicators of climate warming in mountain ecosystems and that additional research on alpine invertebrates is urgently needed to avoid extinctions and ecosystem change. Consequently, this research has resulted in the expansion of a long-term research and monitoring program in Waterton-Glacier International Peace Park on alpine stream biota, including ecological and vulnerability assessments on two other petitioned invertebrates.

Muhlfeld, C.C., **J.J. Giersch**, F.R. Hauer, **G.T. Pederson**, G. Luikart, D.P. Peterson, C.C. Downs, and **D.B. Fagre**. 2011. Climate change links fate of glaciers and an endemic alpine invertebrate. Climatic Change 106:337-345

Aquatic Invasive Species

Lead: USGS Biologist Jackson Gross
Staff: Andrew Ray and Adam Sepulveda
http://nrmsc.usgs.gov/staff/jgross/research

Aquatic Invasive Species (AIS), also known as aquatic nuisance species, are non-native invasive species that negatively impact aquatic ecosystems and human services. AIS have impacted nearly every aquatic ecosystem in the United States, posing risks to native species within those ecosystems, as well as human and wildlife health. Our research on aquatic invasives is exploring new and innovative mechanisms of aquatic invasive species control and eradication for the conservation of aquatic ecosystems. These studies will help provide managers with appropriate data to conduct suppression and eradication efforts on aquatic invasive and nuisance species.

Featured Science: Use of Seismic Technology to Manage Asian Carp

In the 1960's oil exploration companies began towing seismic air gun technology behind large vessels to explore the composition of the ocean floor using pulse pressure technology. Later in the early 1980s the water gun was developed to generate a cleaner signal by eliminating the interference produced by the air gun. Although water guns were developed as an alternate means of seismic exploration, they were quickly discontinued because they were less efficient at producing low frequency energy, and there were concerns about their effect on aquatic life. Today, it is those same properties of water guns that may provide the means to establish an acoustic barrier deterrent for Asian carp. Research is focused on developing sound energy barriers to prevent the expansion of two types of invasive Asian Carp in the Great Lakes ecosystem, bighead carp and silver carp. Preliminary experiments have been conducted on Asian carp and non-target organisms to evaluate behavioral and physiological responses to the sound energy levels produced by water guns. Our studies in 2011 were directed at the establishment of stationary and mobile barriers and the characterization of frequencies and energy levels that will divert Asian carp in the Chicago Sanitary and Shipping Canal. Pulse pressure technology is currently being evaluated as a means to control other aquatic invasive species throughout the US. This research will expand our knowledge of water gun technology and other potential uses for the protection of our infrastructure and the conservation of our fishery resources.

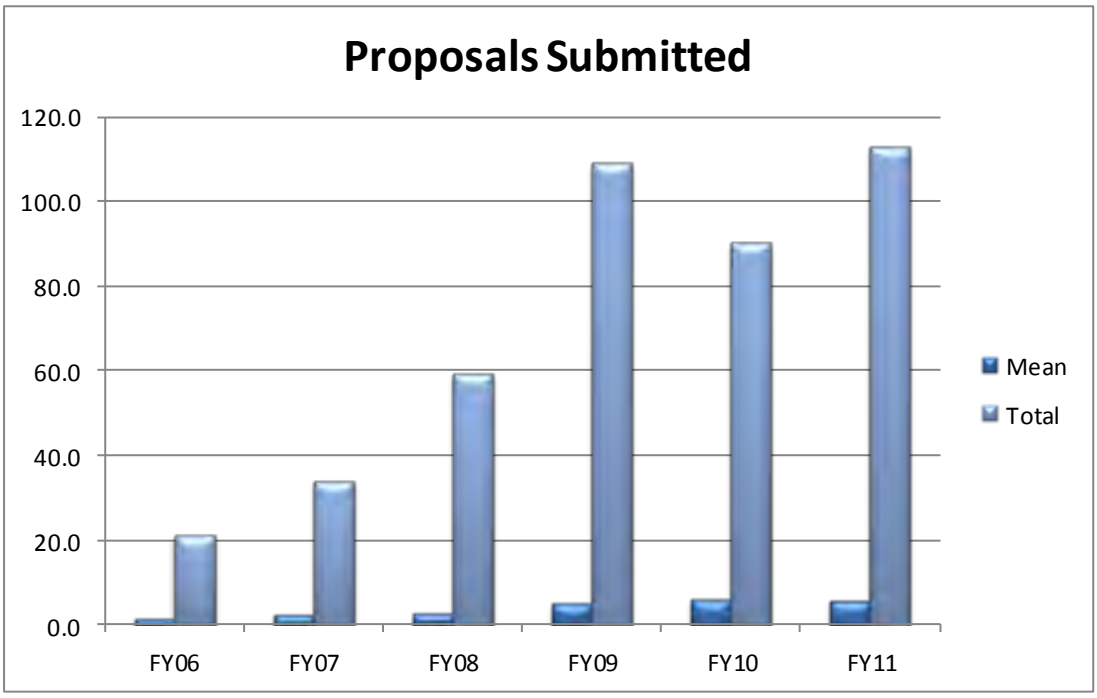
http://www.nrmsc.usgs.gov/research/Asian_carp

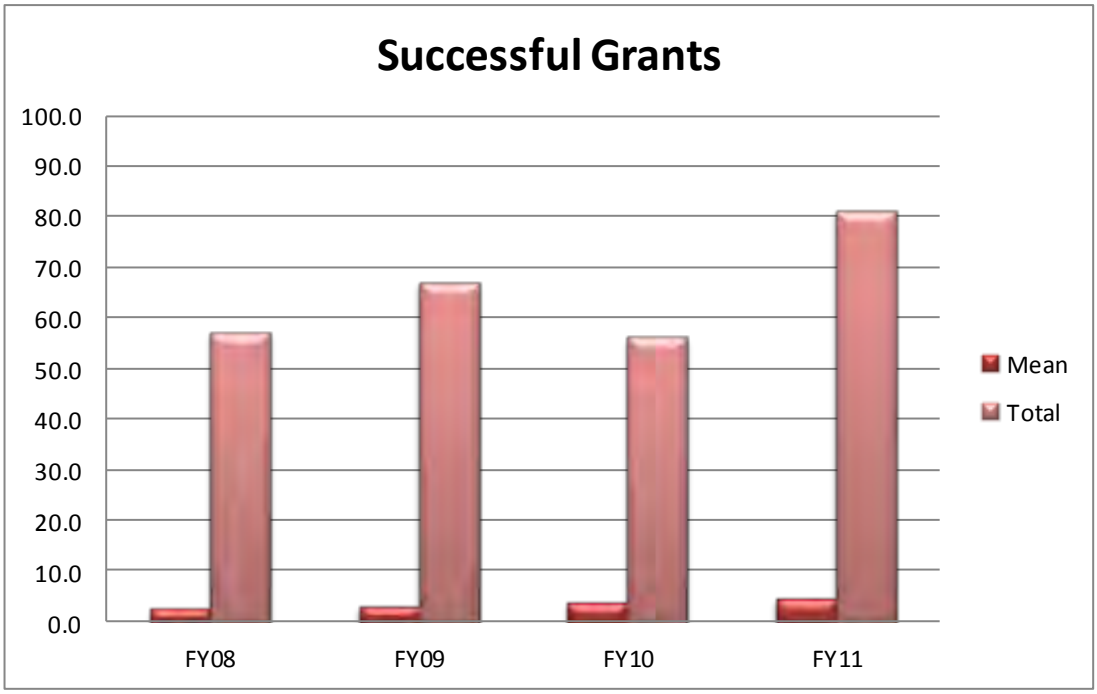
Center Productivity

Center science is highlighted and accessible in various media formats and "stands-out" to both regional and national audiences.

New Projects

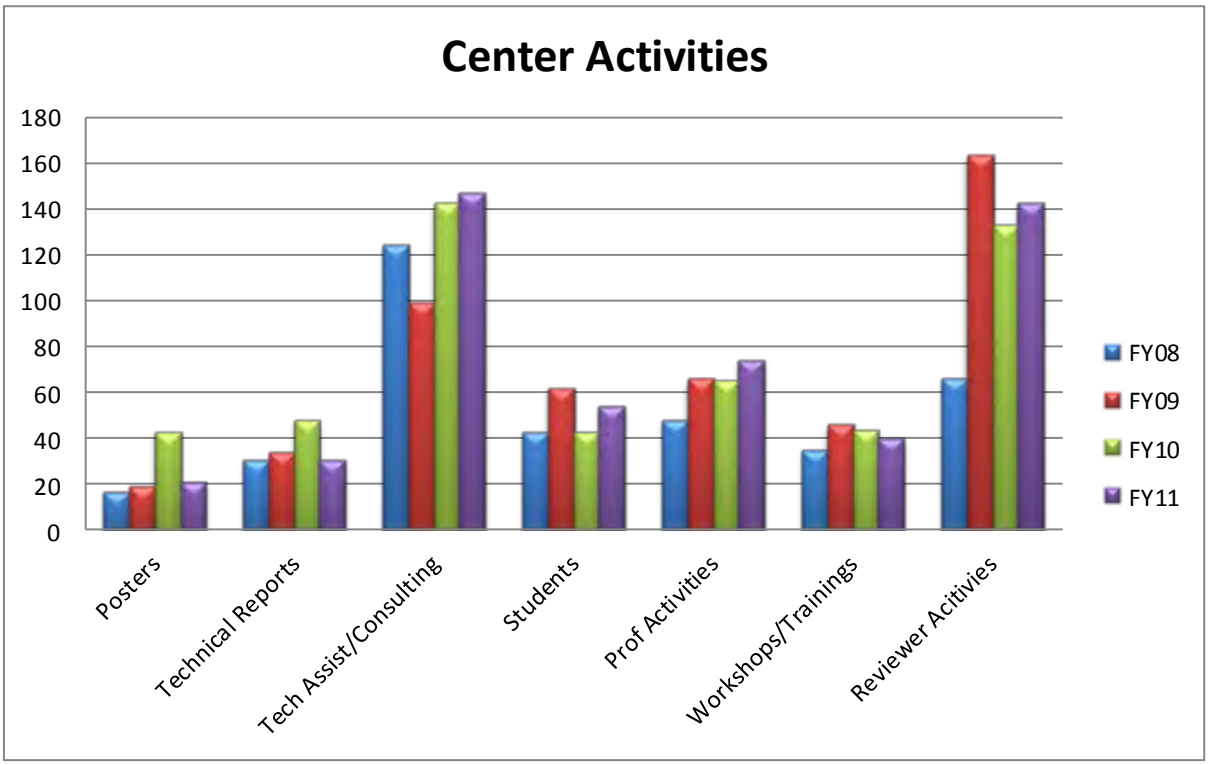
In 2011 our researchers were awarded approximately $5.7 million in grant funding to support ongoing and emerging research in and around the Northern Rocky Mountains.





NOROCK Activities

Our research yields multi faceted opportunities to present our findings, as well as provide consultation and technical service to our partners. In addition we mentor and advise future scientists pursuing undergraduate and graduate degrees in natural resource science. The chart below illustrates activity in 2011.

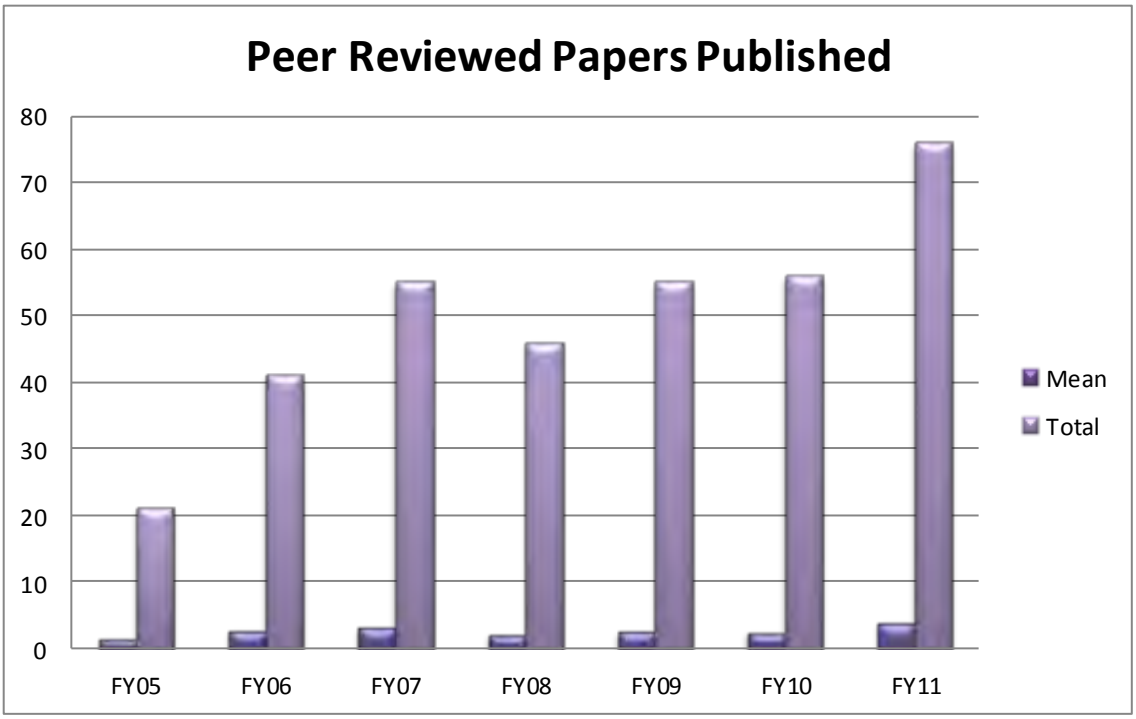


Specific examples of our activities include:

- Provide technical resources and discussion points to other Department of the Interior partners to assist in land management decisions such as opening of the Going to the Sun Road in Glacier National Park, elk management on DOI lands in Wyoming, and Asian carp eradication in the Great Lakes Region.
- Scientific review for various professional journals and interagency ecosystem management plans, as well as provide data and graphics for various publications such as technical reports, posters, brochures and multi-media outlets.
- Coordination of regional and National natural resource conferences and seminars.
- Provide mentorship and guidance to over 50 Undergraduate, Masters and Doctoral students seeking a career in natural resource and ecosystem sciences.
- Provide data and research summaries to Congressional Delegates.
- Serve as invited speakers or panelist for national and international conferences and meetings.

Publications and Technical and FSP Review Activities

Our researchers published 76 peer reviewed journal articles in FY 2011. In addition our scientists provided over 140 reviews for technical publications. Examples include Journal of Wildlife Management, Forest Ecology and Management, Conservation Biology, Conservation Genetics, Environmental Monitoring and Assessment, Remote Sensing of Environment, Western North American Naturalist, Journal of the American Water Resources Association, Ecology, Ecological Monographs, Ursus, Molecular Phylogenetics and Evolution, Diversity and Distributions, Ecological Applications, Transactions of the American Fisheries Society, Climatic Change, and International Journal of Wildland Fire.

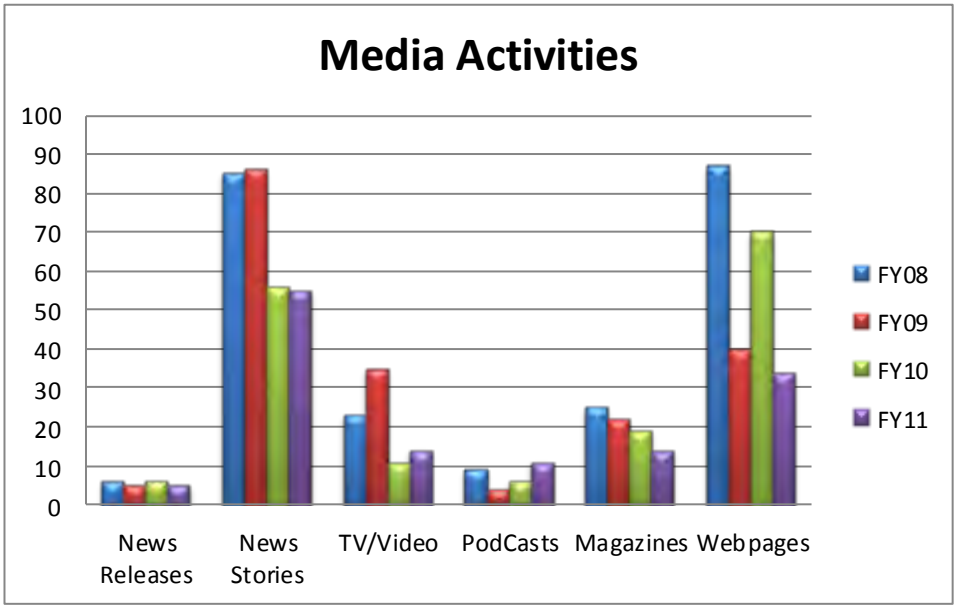


NOROCK Awards and Recognition

In 2011 our scientists received honors for excellence in research and development within their individual disciplines. Several staff received the USGS Performance Award and USGS Star Award. Other awards for 2011 included the USGS Best Paper in Biology Award which went to Paul Cross. Lisa McKeon and Erich Pietzsch also took awards in the 2011 USGS Photo Contest.

NOROCK in the National Spotlight

We produce a dynamic array of products based on our research which include information sheets, annual reports, journal articles, and books. The purpose of these resources is to provide information on the Center's wide range of research projects to both natural resource managers and the public. Our publications can be found in many public venues such as interpretive centers within the National Park Service, Forest Service, Bureau of Land Management, and academic institutions throughout the northern Rocky Mountain region. This chart summarizes our media activity for 2011.



USGS News Releases, Media Advisories

- 6/9/2011. USGS Study Finds Recent Snowpack Declines in the Rocky Mountains Unusual Compared to Past Few Centuries
- 5/25/2011. Environmental Persistence of Chronic Wasting Disease Exacerbates Deer Population Declines .
- 4/4/2011. Rare Alpine Insect May Disappear with Glaciers.
- 3/9/2011. Native Trout Fare Best When Dams Use Natural Stream Flow Management Practices

2011 Publications:

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