MONTANA NSF EPSCoR

Fall 2015

RESEARCHERS TO STUDY CARBON INTERACTIONS ACROSS NORTH AMERICA

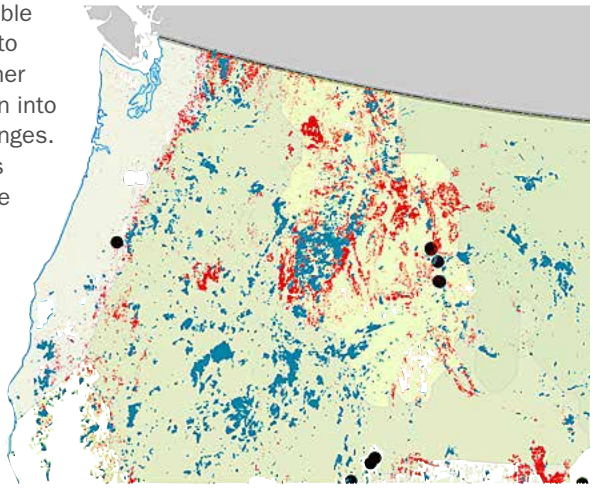
UM and MSU faculty collaborate to earn NSF grant

NSF EPSCoR new hires **Ashley Ballantyne** and **Ben Poulter,** are part of a team that received a $300,000 grant from the **National Science Foundation** to study ecosystem carbon production and consumption. Ballantyne, a **University of Montana** assistant professor in bioclimatology, is the principal investigator and recipient of the award, coming from NSF's Early Concept Grants for Exploratory Research and its **National Ecological Observatory Network (NEON)** programs. The award will allow Ballantyne and collaborators to study the relationship between disturbance (fire, insects, etc.) and the natural world's ability to absorb carbon.

The idea behind this research is that keeping track of carbon levels—what is emitted, what is absorbed—is of paramount importance to ensuring global and regional stability. Plants and microorganisms are assumed to absorb up to 25% of human-generated carbon dioxide. This role is critical, and Ballantyne wants to investigate how susceptible this carbon absorption system is to ecosystem disturbance and whether these carbon absorbers might turn into carbon producers under such changes.

Says Ballantyne, "Disturbance is clearly affecting the carbon balance of ecosystems, especially across the western U.S. By the end of the two-year research project, we hope to use model simulations to help optimize observation networks for detecting impact of disturbance on ecosystem carbon balance."

Collaborating on this research project is Poulter, an assistant professor in the ecology department at **Montana State University**. Poulter will be using ecosystem modeling tools to estimate CO2 fluxes in forest and grassland, with different disturbance regimes. Both faculty are affiliated with the Institute on Ecosystems.



A graphic created by UM graduate student Annie Cooper shows the extent of ecosystem disturbance across the Western U.S. from 2000 to 2012. Blue shows the cumulative ecosystem area affected by fires, while red shows insect damage. The ecosystem disturbance is superimposed on NEON eco-climatic domains (green polygons) and NEON project sites (points).

MONTANA CLIMATE ASSESSMENT AIMS TO HELP MONTANANS PLAN, RESPOND

The Montana Climate Assessment (MCA) is a collaborative effort convened by the Institute on Ecosystems (IoE) to synthesize and share credible scientific information about climate and climate change impacts on the economic, environmental and social systems of Montana. With support from the Montana NSF EPSCoR RII Track-1 award, the MCA is a stakeholder-driven initiative, motivated by the interests of Montana's ranchers, farmers, foresters and water users for information on recent and future climate trends.

The first version of the statewide assessment is organized around three topics: water resources, forestland, and agriculture. IoE-affiliated researchers have been meeting with stakeholders in each of these areas to better understand their climate-relevant decisions and information needs. These interactions are foundational to the MCA's goal to be a project that links Montanans to credible, timely, and useful scientific information.

The MCA team is also aligning with other regional and national assessment efforts. This coordination will enable state and national comparisons, provide opportunities to build on ongoing work by other groups, and broaden visibility for Montana on the topic of climate change.

In the next two years, the MCA will synthesize and share information that can help Montanans plan and respond to different aspects of climate change. The first version of the MCA aims be an easily accessible, regularly updated, user-friendly system to access assessment information. Over the long term, the MCA will build a sustainable framework that allows stakeholders and the scientific community to work together to understand future climate change and its impacts in the state.

Collaborators on this project include **Montana NSF EPSCoR, Institute on Ecosystems**, **OneMontana** (a Bozeman-based non-profit), the **Montana Climate Office**, **Montana Water Center, MSU Extension,** state agencies, non-profits, and many invested stakeholders across the state.

UPCOMING **EVENTS**

November 1–4, 2015: 24th National NSF EPSCoR Meeting (Portsmouth NH) With the theme "Collaboration: Advancing the Role of Science in the Service of Society," the 2015 national conference focuses on advancing collaborative capacity within, across and beyond EPSCoR jurisdictions. **http://www.nsfepscor2015.org/**

Wednesdays at noon through Dec. 9. Rough Cut Science series. MSU-Bozeman and online: montanaioe.org/events/rough-cut-science

Dec. 9, 7pm, Bozeman. Dr. Michael Mann, Penn State University, presents "The Hockey Stick and the Climate Wars: Dispatches from the Front Lines." Presented in partnership with MSU Extension.

For a full schedule of IoE events, visit http://montanaioe.org/

READY, VALETT NAMED ASSOCIATE DIRECTORS

Rich Ready

Maury Valett

Drs. **Richard Ready** (MSU) and **Maury Valett** (UM) have been named associate directors of the statewide Montana Institute on Ecosystems. The IoE, which is supported by Montana NSF EPSCoR, is a community of scholars and partners with a shared vision of advancing integrated environmental sciences and related fields.

Ready is a professor in agricultural economics whose expertise is in environmental economics, with a focus on how individuals and businesses benefit from the services that ecosystems and the environment provide and how individual behavior affects the quality of the environment.

Valett is a professor in UM's Division of Biological Sciences and is director of UM's Systems Ecology Intercollegiate Graduate Program. His research focuses on freshwater aquatic systems, including streams, rivers, groundwater systems and floodplain riverscapes.

Cathy Whitlock currently serves as MSU's IoE director and **Ray Callaway** is the IoE director at UM.

UM-AFFILIATED FIRM WINS XPRIZE FOR OCEAN DEVICE

photo courtesy oceanhealth.xprize.org/

Sunburst Sensors LLC, a Missoula company resulting from **University of Montana** research, won $1.5 million in XPRIZE funding in July for producing the best device to affordably, accurately and efficiently measure ocean chemistry.

"It's gratifying to have Sunburst Sensors' employees recognized for their commitment and hard work," said **Mike DeGrandpre**, the UM chemistry professor and oceanographer who launched Sunburst Sensors in 1999. "This XPRIZE competition is focused on ocean acidification, and it is rewarding to help raise awareness of this critical issue."

XPRIZE competitions are designed to encourage innovative solutions for pressing issues from the world's brightest minds. The Wendy Schmidt Ocean Health XPRIZE competition challenged teams of engineers, scientists and innovators worldwide to create a precise pH sensor that would measure ocean chemistry from its shallowest waters to deepest depths. The competition was designed to incentivize creation of these sensors for the study and monitoring of ocean acidification's impact on marine ecosystems and ocean health, driving the industry forward by providing the data needed to take action and produce results.

James Beck, CEO of Sunburst Sensors, said the winning device sucks in sea water, puts in a dye that changes color depending on the water's pH – much like litmus paper – and then shines a light through the dye. The resulting color of the water reveals the acidity.

"It's exciting to see a dedicated and hard-working faculty member from our University receive national recognition for the fruits of his research," said **Scott Whittenburg,** UM vice president for research and creative scholarship. "It also demonstrates how investments in university-based research can lead to companies that produce jobs and products that can have such a positive impact – like protecting the water in our oceans, lakes and rivers."

For several years Sunburst Sensors was nurtured at MonTEC, a UM business incubator located in Missoula. For more info, visit **www.sunburstsensors.com**

FACULTY RECEIVE $2M TO HELP FARM & RANCH PROFITABILITY

Several NSF EPSCoR new hires and Institute on Ecosystems affiliates are part of a team seeking to increase the profitability of Montana's farms and ranches. They were one of several projects funded by the **Montana Research and Economic Development Initiative** (MT REDI), which seeks to leverage university-based research into strategic advancements for Montana's economy. Headed by Dr. **Barry Jacobsen** of **Montana State University**'s College of Agriculture, the project focuses on three main areas. The first goal focuses on intensifying cover crop production on land that is left fallow between crops. Currently, thousands of acres of agricultural land in Montana waits between use years so that it accumulates water, thereby allowing crops to grow every other year. The goal of this focus is to improve soil and water resources so that this land, often receiving only 12"-15" of rain per year, can be cropped annually, or at least, every three out of four years. If successful, this change could make areas produce revenue that are currently unable to do so.

The other two goals are to work with stakeholders to develop new, improved products and crops; and to increase the usage and efficiency of precision agriculture—specifically, helping to make on-farm systems straightforward and able to be easily integrated into an agriculturist's current operating system. This project has statewide involvement from agencies, individuals, and the Montana University System.

Other EPSCoR-supported faculty and IoE affiliates receiving REDI funding for this and other initiatives include: **Clem Izurieta, Kelsey Jencso, Marco Maneta, Bruce Maxwell, Rob Payn, John Peters, Joe Shaw,** and **Carl Yeoman.**

Montana EPSCoR
PO Box 173142
Bozeman, MT 59717-3142
406-994-7658
mus-epscor@montana.edu

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Youtube.com/MontanaEPSCoR
IoE webpage: Montanaioe.org
EPSCoR webpage: mtnsfepscor.org

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STUDENTS PRACTICE THE CRAFT OF **COMMUNICATING ECOSYSTEM SCIENCE**

Four graduate students at Montana State University are part of a pilot program called Communicating Ecosystem Science. Working with outreach staff from MSU Extended University's (Montana NSF EPSCoR's outreach partner), the students discuss how scientists communicate their work to the public, and study presentations, data visualization, writing, citizen science and more. The students were selected for the program after being awarded an EPSCoR Fellowship by the MSU Graduate Dean. A six-week program will run in Spring 2016. Below are research briefs and images submitted by each student.

How many pallid sturgeon can rivers support? • Eric Scholl

Pallid sturgeon are large-bodied fish that have lived in Montana's Missouri and lower Yellowstone Rivers for millions of years. In the span of two human generations, pallid populations have declined to the brink of extinction. Current efforts to restore populations rely on a conservation propagation program, and the survival of hatchery-raised fish is thought to be high. However, researchers don't know how much food (macroinvertebrates such as stonefly and mayfly larvae) is required to maintain populations of hatchery-raised fish in the two rivers. Without this crucial information, watershed managers are unable to gauge how many pallids the rivers can support.

I study the distribution of ecologically important in-stream habitat types, and ultimately the amount and types of macroinvertebrate food resources in the highly altered Missouri and largely natural Yellowstone Rivers. Because sturgeon are able to move across the riverscape over large distances, my goal is to come up with resource estimates that cover the same spatial extent.

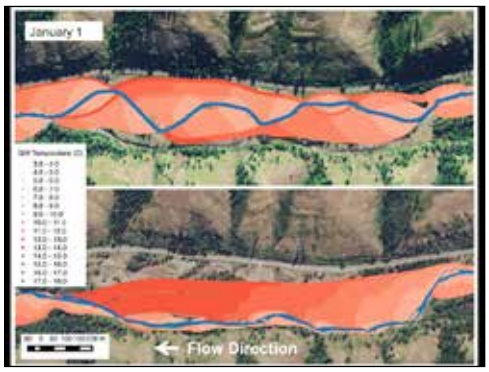
Feedbacks between climate-fire-vegetation in the GYE • Kristen Emmett

Pony Fire area in Beaverhead - Deerlodge National Forest.

Scientists predict that fire severity, fire occurrence, and burn area in the western U.S. will drastically increase due to the effects of climate change. These predicted changes in wildfire regimes threaten the resilience of forested ecosystems, potentially causing dramatic shifts to new plant communities and grassland/shrubland vegetation. In my doctoral research, I use computer modeling to investigate the relationships and interactions between climate, fire and vegetation, aiming to address the following questions: What are the critical thresholds of climatic conditions and fire activity that if exceeded, would shift land cover to an alternative state (e.g. forested to shrubland)? To what extent will specific vegetation processes and fire characteristics contribute to these landscape-scale transformations? and, What is the potential effectiveness of management strategies aimed at maintaining desirable vegetation patterns and fire activity?

Stream restoration and water temperature • Byron Amerson

Stream restoration projects are usually designed to enhance aquatic habitat. While many studies have helped us understand how stream restoration affects habitat, little research exists on how restoration affects water quality. One important aspect of water quality is temperature, and stream temperatures are rising throughout the West due to climate change. Water above 70° F is lethal for salmon, so managing water temperature is important for their long-term survival. I have been studying the effects of channel restoration on stream temperatures for the last few years, and I have discovered that the shape of a stream directly affects water temperature. In other words, surface water and groundwater in a straight stream might be warmer than that in a "wiggly" stream.



The figure above shows the temperature distribution in the floodplain of Meacham Creek, Oregon before and after restoration efforts. Temperatures in the floodplain of the unrestored stream (top) are less diverse compared to the stream after restoration. These findings will help guide strategies for salmon habitat recovery.

Lidar helps researchers measure plankton from the air • Mike Roddewig

I study freshwater ecosystems using airborne laser radar (lidar). Lidar works by sending a pulse of light into the water, which is then reflected by various objects and organisms in the water. By measuring how the light is reflected and the amount of light reflected we can determine the type of object or organism that reflected it and the approximate size.

Marine lidar has many applications in the study of freshwater ecosystems, including plankton, fish, bubbles, and aquatic bacteria. We use our lidar to study the location and extent of plankton layers in lakes and how plankton layers form where rivers meet lakes. Because our work is done from a plane, we are able to quickly cover large portions of the lake, an advantage lidar has over surface-based studies. Much of our work is done locally, including locating invasive lake trout in Yellowstone Lake, and studying both plankton and fish in Flathead and Yellowstone Lake.

CROSS-INSTITUTIONAL PROJECT COMBINES RESEARCH, EDUCATION AND K-12 OUTREACH

Researchers from the **University of Montana**—including an undergraduate student—combined forces with a high school biology teacher and a research team from Hungary to study the impact of an invasive plant on its non-native range compared to its home turf.

The team compared Canada goldenrod (*Solidago canadensis*) in its native range (North America) to its non-native range (Europe) to see how the plant's presence affected the species diversity surrounding it. Invasive species often wreak havoc on the new habitats they occupy, though, according to the authors, ecologists have yet to adequately quantify these impacts in native and non-native ranges.

In the case of *Solidago*, the team found that increasing density of *Solidago* suppressed native diversity more in the non-native range than in its native range. The impact was more pronounced in Europe (where *Solidago* was introduced) than in its home range in North America. The team's results indicate that the biogeographic origin of a species can have important effects on plant interactions and community organization.

The research team included **Robert Pal** (then of University of Pecs, now at **Montana Tech**); Montana NSF EPSCoR director and UM professor **Ray Callaway**; **Kim Ledger** (then a UM undergraduate); and **Patrick Murphy** (a Missoula Hellgate High School biology teacher who was serving as a Murdoch Fellow in Callaway's lab). Their results were published in the July 2015 edition of *Plant Ecology*.

Left to right Kim Ledger (UM); Robert Pal (then of University of Pecs, Hungary, now of Montana Tech); and Patrick Murphy (Hellgate High School biology teacher and Murdoch Fellow) pose in Hungary, where they measured the impact of an invasive species on its non-native range compared to its native range. Along with Ray Callaway and others, they published results in *Plant Ecology*.

MUS GRAD SCHOOLS WORK TO INCREASE NATIVE AMERICAN STUDENTS IN STEM

Across the U.S., very few American Indian/Alaska Natives (AI/ANs) are earning doctoral degrees. According to the National Science Foundation's Survey of Earned Doctorates, just 0.16% of STEM PhDs in 2013 were awarded to AI/AN students; however, more than 15% of the population in Washington, Idaho, and Montana is comprised of people who self-identify as Hispanic, American Indian, or more than one race. Together, these states are home to nearly 200,000 American Indians, a population that has increased by more than 24% since the year 2000.

The **University of Montana**, **Montana State University** and **Montana Tech** were awarded $1.19 million of a $2.4 million NSF Alliances for Graduate Education and Professoriate – Transformation track (NSF AGEP-T) grant that, in addition, includes Washington State University, University of Idaho, Heritage University, **Salish Kootenai College**, and Northwest Indian College. The alliance was formed to share resources, knowledge and opportunities for Native American students interested in STEM graduate degrees. An important feature of the alliance is to create pathways of support for students from the tribal colleges and Montana Tech to pursue doctoral degree programs at PhD-granting institutions.

The overall goals of the *Pacific Northwest Alliance Circle of Success: Mentoring opportunities in STEM* (PNW COSMOS) are to: 1) develop a model facilitating discipline-focused, culturally relevant recruitment pathways and a culturally congruent mentoring program to support the unique needs of AI/AN STEM graduate students; 2) implement the model by developing new alliance activities, interventions, and coordination of existing activities and resources; and 3) study the effectiveness of the model through ongoing assessment.

Montana NSF EPSCoR Diversity Coordinator **Aaron Thomas** is working on creating culturally appropriate strategies to recruit Native American and Alaska Native students to graduate programs in STEM. Thomas is Director of Indigenous Research and STEM Education (IRSE) at the University of Montana, and an associate professor of chemistry and biochemistry.

"The reality is that the numbers of indigenous students in STEM fields obtaining graduate degrees, in particular doctoral degrees, continue to be very small," UM Graduate School Dean and principal investigator **Sandy Ross**, who is also an NSF EPSCoR hire (EPS-0091995), said. "Our hope is that the Pacific Northwest AGEP will help start and support a positive change. This makes the PNW COSMOS a unique, important effort."

"These students bring rich knowledge and culture to us," MSU Graduate School Dean and principal investigator **Karlene Hoo** said. "It's up to us to recognize it, accept it and make the best use of multiple voices and cultures to really be successful."

Vice Chancellor for Research and Graduate Studies at Montana Tech **Beverly Hartline**, who is leading the effort on the Montana Tech campus added, "It is a great opportunity for us to contribute not only to the education of American Indians in STEM, but also to develop a model that will accelerate their success with advanced degrees and improve our approach to graduate education at the same time. We look forward to our students and faculty engaging with the mentoring model as it develops."