the RESEARCHER

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Members from GEM3 research team planted seedlings during the first week of May 2020, taking into account new COVID-19 safety measures set by Idaho State University. New standards were easy to address as rows of seedlings are placed two meters apart which is good for shrubs and convenient for social distancing.

(Photo credit: Maria Pacioretty, Idaho Department of Fish and Game)

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the
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LETTER FROM THE DIRECTOR

Dr. Andy Kliskey

The Idaho EPSCoR GEM3 program is entering its mid-phase as we progress from the set-up and establishment of teams, experiments, curricula, and models to analysis, synthesis, and discovery. This is a very exciting time of knowledge generation, and of knowledge co-production with our agency partners and stakeholders. It is also that phase where the sleeves get rolled up to support the hard work that is being done - this is demonstrated in our September 2020 Newsletter with highlights of the sagebrush common garden work, the trout simulation modeling efforts, and the remote sensing and mapping. Each of these elements of GEM3 explore different aspects of landscape and environmental change including response to change, adaptation to change, and persistence under change. We also find ourselves at a very challenging time globally, nationally, and in the State where Idaho EPSCoR must be responsive and adaptive in order to support project participants as best we can during this COVID-19 pandemic. To each of you involved in the project, please know that we place your well-being and that of your family first, and we will navigate and adapt the research, education and workforce development demands of GEM3 with you as needed.

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GEM3 Research

Gardens are Great for Science

By Dr. Keith Reinhardt

Sagebrush seedlings in the greenhouse. (Photo credit: Maria Pacioretty, Idaho Department of Fish and Game)

Idaho NSF EPSCoR GEM3 researchers have been working collaboratively during year two to investigate the role genetics play in the responses of sagebrush to environmental change in Idaho.

Dr. Keith Reinhardt, Associate Professor in Plant Physiological Ecology at Idaho State University (ISU), along with Spencer Roop, a PhD student at ISU in Dr. Reinhardt's lab, and Tierin Osterfeld, former field technician and GEM3 Summer Authentic Research Experience (SARE) student, have been taking physiological data from the Orchard Common Garden, located just outside of Boise, for the past two summers.

The Orchard Common Garden was started several years ago by Dr. Matt Germino, United States Geological Survey (USGS), and Dr. Bryce Richardson, United States Forest Services (USFS), who are both agency partners with EPSCoR on the current GEM3 project.

A common garden is a garden where plants of the same species are planted, however, the plants come from different locations (in this case, throughout the Western U.S.). Plants are monitored during this process and if differences are observed in growth rates, flowering, etc., the team can surmise that the differences "might" be due to genetics, and not based upon climate/soil conditions, etc. where the shrubs naturally grow, since the shrubs are growing in the same location.

Physiological data, or data on how plants function, includes the comparison of hydraulic and gas exchange measurements between different populations of shrubs growing in the Orchard Common Garden. Gas exchange is the photosynthesis, respiration and transpiration of plants. Hydraulic measurements include branch hydraulic conductivity (the efficiency in which water can move through the plant), and branch water potentials (energy required to transport water throughout plant).

In summer 2020, the team constructed dry down "vulnerability curves" to help quantify differences in drought resistance in branches among populations. Vulnerability curves help to quantify the degree of drought resistance in plants. The team cuts branches from shrubs and allows them to dry out in the lab. At different levels of dryness,

Research cont.

the team measures hydraulic conductivity. Differences in the shape and steepness of the dry-down curves inform us about how drought resistance differs in shrubs from different seed-source locations. Hence, vulnerability to drought.

This work builds upon research done in summer 2019, which included gas exchange measurements aimed at assessing differences in heat-stress tolerance taken by Spencer Roop and Andrii Zaiats, a GEM3 doctoral student at Boise State University (BSU). Additionally, aerial measurements (hyperspectral and thermal imagery) were taken by Dr. Donna Delparte, Associate Professor of Geosciences at ISU, and leaf samples were collected for chemical analysis by Dr. Jennifer Forbey, Professor of Biological Sciences at BSU.

Additionally, in the spring of 2020, a new common garden of big sagebrush was established at the Sterling Wildlife Management Area (Idaho Department of Fish and Game) near Aberdeen, ID, using seedlings from populations of subspecies *A.t.wyomingensis* and *A.t.tridentata.*

While the original idea was to compare physiological differences between the three recognized subspecies of big sagebrush; the team found very few differences in the initial measurements that were made. They did observe differences among the populations of big sagebrush and this has shifted the focus away from subspecies differences. Instead, the team will be focusing on differences based on population (seed source location), local adaption and plasticity.

Local adaptation is a suite of genetically-linked traits that promote "performance" such as plant growth and reproduction success, for a certain site. For example, sagebrush in Arizona might have some genetically-linked traits that improve performance in these more southern locations (warmer temperatures, differences in daytime sun, less precipitation) compared to sagebrush in Canada (cooler temperatures, less daytime sun, more precipitation). If we transplant shrubs from Canada to Arizona or vice versa and see no differences in performance, then there is no local adaptation.

Plasticity is the amount of variability of a certain trait. Sagebrush, for example, has blue-green leaf coloring and a very characteristic "sage" scent. This scent is caused by chemicals in the leaf which are used as defense compounds against insects and animals that might try to eat it. Part of the team's focus will be on examining the variability in the color of sagebrush leaves and how much the sage scent differs among shrubs. If sagebrush is "always" the exact same blue-green coloring and exact same scent, it has low plasticity. However, if the color of leaves is highly variable and if the scent is variable, this suggests a lot of variability in these traits, which is partly rooted in genetics.

The team's future plans include developing manipulation tests to be performed in the common gardens to assess plasticity and population differences in response to things like warming temperatures and droughts.

COVER PHOTO:

The team planted seedlings during the first week of May 2020, taking into account new COVID-19 safety measures set by Idaho State University. New standards were easy to address as rows of seedlings are placed two meters apart which is good for shrubs and convenient for social distancing.

(Photo credit: Maria Pacioretty, Idaho Department of Fish and Game)

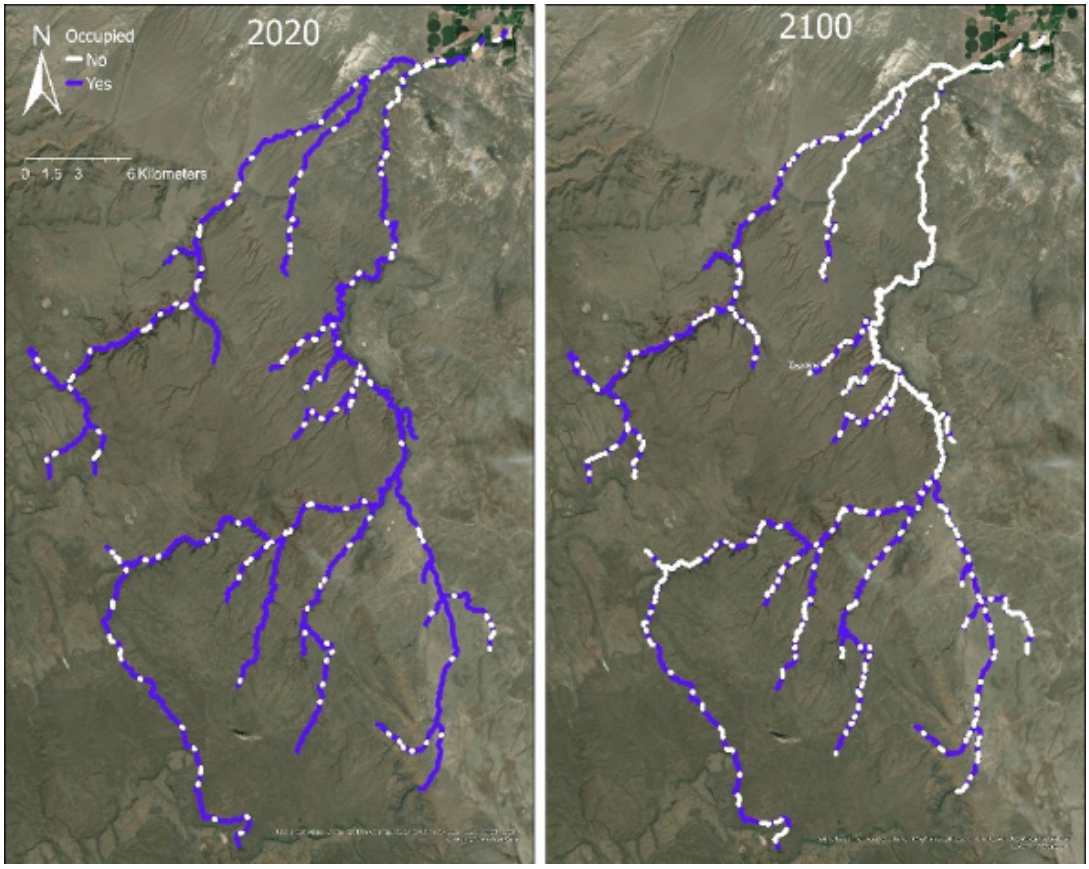
Simulating Trout Distribution to Understand Environmental Change

By Dr. Travis Seaborn and Dr. Chris Caudill

With environmental change, organisms can either move or remain in the areas they live. If they remain, the environmental change may cause extinction. GEM3 researchers have started simulating hundreds of thousands of individual redband trout on the landscape to better understand locations of streams which might 1) not sustain trout in the future or 2) result in isolated populations.

Early models highlight that the persistence of trout depends on local adaptations and the individual movements of fish. These simulations, run using University of Idaho (U of I) IBEST Computational Resources Core, combine information on Idaho stream conditions, trout movement, behavior, demographics, genetics, and the interaction of the environment with genetics. The first round of models are focused on the Jack's Creek system, a desert stream in south Idaho where previous work by GEM3 members has shown genetic adaptation to warm stream temperatures.

The models will serve as the linkage across the GEM3 trout projects, using historical data and data currently being collected by several research teams across Idaho to address questions such as, "Will the genetic composition of trout populations allow them to adapt to warmer streams?", "Can thermal refuges on the landscape allow trout to persist in a stream by moving among habitats each season?", and "Can individual trout adjust their phenotypes to the environment they experience (phenotypic plasticity) and, if so, how much plasticity is needed to allow persistence?" Thus, the simulations will assess how complex biological traits and a changing environment processes affect measures of adaptive capacity such as the abundance, distribution, genetic diversity, and persistence of redband trout. The simulations will be refined using new data collected from the field. This will allow future management and conservation strategies to be explored, such as the effects of translocation or riparian management, along with the general features of the social-ecological system that confer adaptive capacity.



Simulation of trout presence (blue) and absence (white) in a southern Idaho stream network under predicted carbon emissions scenario (IPCC RCP 6.5, with peak emissions in 2080)

Research cont.

The trout modeling is being led by Dr. Travis Seaborn, a post-doctoral researcher with U of I, and Dr. Christopher Caudill, a professor at U of I. Accurate, large modeling efforts require a large team of interdisciplinary scientists to work on collecting data in the field. Although the trout modeling is a small team, it would not be successful without "boots on the ground" ecologists and physiologists working as part of the broader Mechanisms team.

The team also includes students from GEM3's Vertically Integrated Program (VIP) which is the education and workforce development component of the GEM3 project. VIP courses on "Models and Mapping of Species' Spaces to Understand Mechanisms in Idaho's Aquatic Species" is one approach to exploring species-habitat relationships through modeling and mapping with publicly available data. The courses aim to integrate learning objectives centered on integrating data science and biology across educational levels while creating a large dataset for novel research questions.

This work will occur in three phases. The first phase, to take place during fall of 2020, includes training graduate students, post-docs, and faculty on programming and computer skills in R (a computer programming language necessary for data science) with a focus on spatial data, including the use of machine-learning. Students will also be focused on building a toolbox of coding-centric modules for implementation for future phases. The best of these lab and homework modules will then be enacted by students, providing the opportunity to teach their work. During the spring of 2021 a one-credit undergraduate course will be available. The one-credit course would be dedicated to building models of the aquatic species in Idaho, including redband trout, by using existing data from Idaho Department of Fish and Game.

Preliminary models, as shown in the map above, have been developed using an existing agent-based modeling simulation software program. In a novel contribution, the team collaborated with the program developer to update the software to include behavioral plasticity. The early model results and software was presented at the International Association of Landscape Ecologists-North America (IALE-NA) virtual conference in June of 2020. The publication for the plasticity modeling software is in preparation and will be published as a combination of theoretical and empirical work.

Future plans include model development and application. Although behavioral plasticity may occur in response to temperature, other aspects of habitat quality may be important. This expansion to the software is currently underway. In addition, behavioral plasticity is only one form of plasticity, and the team is interested in expanding to other traits. The team will also be using the new software modules of theoretical landscapes to consider when local adaptation and phenotypic plasticity may evolve in tandem. Next, the team will be expanding the model to new areas, such as cool montane streams, where they will investigate different climate scenarios. Lastly, the team will be looking to integrate a variety of empirical data and social-ecological systems information from social scientists to explore how management actions affect trout persistence on the landscape.

GEM3 Trout Working Group Summit at Hagerman Aquaculture Research Institute during Fall 2019. (Photo credit: Jana Cole, Hagerman Fish Culture Experiment Station)

Mapping Fish Habitat from the Sky

By Dr. Youngwoo Cho and Dr. Donna Delparte

The GEM3 Mapping team has been very active surveying desert streams to evaluate the habitat quality and to model adaptive capacity of redband trout in desert and montane streams.

The Mapping team has been working collaboratively with other GEM3 faculty, including fish ecologists, to understand the seasonal variability of stream temperature and identify thermal refugia for redband trout species using thermal infrared (TIR) imagery. Thermal refugia are stream areas that maintain water temperatures favorable to fish.

Dr. Donna Delparte, Associate Professor in the Department of Geosciences at ISU, serves as the mapping team co-lead and oversees Unmanned Aerial Systems (UAS) flights, analysis and integration of UAS data, and stream flow modeling. Dr. Youngwoo Cho, Remote Sensing Postdoctoral Researcher at ISU, leads data processing and analysis.

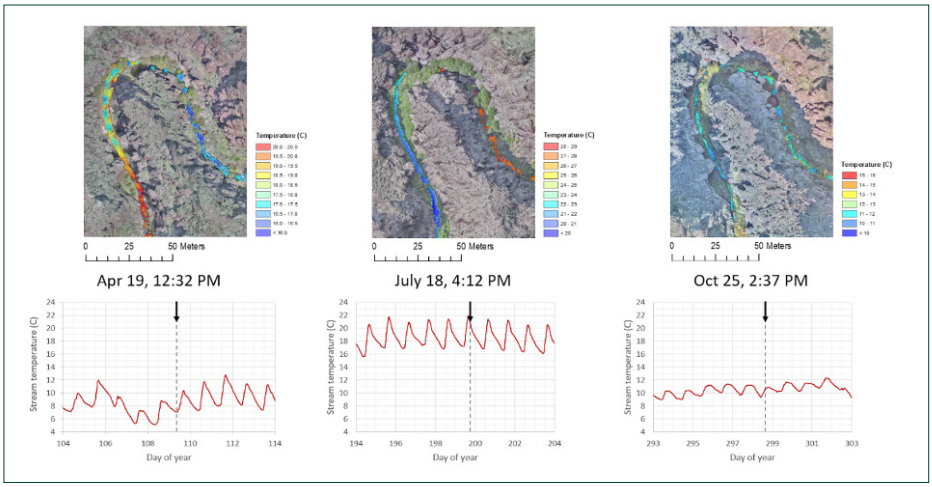
They work closely with other members of the GEM3 team including Dr. Ernest Keeley, Professor of Fish Ecology at ISU, who, along with the field team (Anna Ringleman - MSC Bio ISU, and others), collect data for stream temperature, underwater topography (bathymetry), flow speed, etc. Dr. Chris Caudill, Associate Professor of Fisheries at U of I, and Jon Masingale, graduate student in U of I College of Natural Resources, focus on genetics, thermal response and characteristics.

In 2019 through 2020, the mapping team created data products including digital surface models, stream temperature, and bathymetry from datasets they have collected by performing UAS-based mapping in montane and desert streams. The datasets have been collected using UAS thermal imaging sensors which allow team to take images in visible- and thermal infrared (TIR) bands. They also started mapping desert streams in Horseshoe Bend area in Little Jacks Creek in Spring 2019 and have expanded study areas to include more stream reaches in Little Jacks and Big Jacks Creeks.

Two stream reaches in Duncan Creek and multiple montane stream reaches in Mann and Keithley Creeks were surveyed as well in the Fall 2019 campaign. This year, the team continued surveying desert streams that were surveyed in 2019 with multispectral sensors allowing for imagery to map riparian vegetation.

Early outcomes are promising for fish thermal habitat mapping. The team produced data products including digital surface models, stream temperature, and bathymetry for desert streams in Little Jacks, Big Jacks, and Duncan Creeks.

Next year the team will collaborate with GEM3 fish ecologists on bioenergetic modeling of fish habitat quality to understand what factors affect the spatial and temporal distribution pattern of thermal refugia of redband trout. The team will also identify what factors affect the distribution of thermal refugia, what factors affect the seasonal shift of thermal refugia, and how environmental constraints govern the spatial and temporal distribution pattern of thermal refugia of redband trout and their adaptive capacity to changes in stream temperatures.



The stream temperature products draped on 3-dimensional digital surface models over and under the water surface showed how the spatial distribution of thermal refugia changed seasonally and how the thermal refugia are connected.

Laticia Herkshan Works to Build Tribal Research Partnerships

Laticia Herkshan, Idaho State University doctoral student

Laticia Herkshan, a member of the Shoshone-Bannock Tribe and current doctoral student at Idaho State University (ISU), was first introduced to Idaho EPSCoR as an undergraduate student as a participant in the MILES Undergraduate Research and Internships (MURI) Program. She was involved in several research experiences and stated that initially, her goal was simply to learn more about how to engage in, and do, good research.

Now, her focus has expanded. Hershan, who has continued to stay engaged with EPSCoR through her work on GEM3, is currently analyzing the research relationship between the Shoshone-Bannock Tribes and Idaho State University. As Herkshan states, "Historically, Tribes across the nation have long been subjected to extractive research, where they were not involved with the research process and usually did not directly benefit from it. The overarching goals of this research are to explore the lived experiences of researchers and research participants to inform ISU researchers about best ethical practices and protocols for engaging in collaborative research, as well as to inform researchers from both entities about mitigating challenges for successful research partnerships."

Herkshan's efforts include collaborating with the ISU Department of Sociology Department of Sociology with GEM3 mentors, Dr. Morey Burnham, Assistant Professor, and Dr. Georgia Hart-Fredeluces, post-doctoral fellow.

Herkshan also works closely with Dr. Liz Redd-Kickham from the Department of Anthropology. They have also been working closely with the Shoshone-Bannock Tribal Business Council and Research Working Group, presenting their research and requesting permission to conduct research with Tribal member citizens, which is part of the Tribe's protocol for outside research collaborations.

Some outcomes she is hoping to achieve include development of a database of past and current research projects involving both ISU and the Shoshone-Bannock Tribes. "We are scoring projects along many criteria including the degree of community engagement that occurred during the project," Herkshan states. "We also aim to submit a thorough report of results to the ISU Tribal University Advisory Board, the Shoshone-Bannock Tribal Business Council, and the Shoshone-bannock Research Working Group to not only assist in creating training for other researchers regarding Tribe's research protocol, but will also aid both ISU and the Shoshone-Bannock Tribes in navigating successful research partnerships in the future."

Herkshan's future career goals include advocating for and creating better access to education for Native and Indigenous scholars. "We can commit ourselves, to doing better, more inclusive research that is truly collaborative and/or Native-led and that benefits Tribes more than ourselves," noted Herkshan. "I believe this project is a small piece of a larger conversation that requires research and academic institutions in Idaho and across the nation to reflect on their history and relationships with Native and other minority populations." EPSCoR has given her a strong research foundation which has proven helpful in her journey. "I am grateful to the EPSCoR program." Herkshan stated. "My experiences through EPSCoR have provided me with greater knowledge of how to do good research, how to seek and secure funding and support, and ultimately the importance of addressing issues and engaging in projects that can benefit Native and Indigenous peoples and their communities."

SARE Program Gives ISU Undergraduate Alyssa DeSmit the Research Opportunity to Help Unravel Mysteries

By Andrew Taylor, ISU University Communications and GEM3 Communications Fellow

POCATELLO – On many mornings this summer, Idaho State University (ISU) geosciences undergraduate student Alyssa DeSmit has been hiking up the Gibson Jack Creek, often accompanied by ISU geosciences Masters student Thane Kindred, to measure the quality of the creek's headwaters.

"Our study is looking at the electric conductivity of Gibson Jack and its tributaries, trying to figure out what the geochemistry of the stream is," said DeSmit, a native of Lumberton, North Carolina.

DeSmit with Gibson Jack drainage in the background. (Photo by Eric Gordon, ISU Photographer)

On a typical research day, she and Kindred meet at the Gibson Jack trailhead just out of Pocatello in the Caribou National Forest, and walk up several miles, for as long as 2 or 2-1/2 hours, to get to sites to sample water. On the creek's higher reaches the stream channel is dry in spots, so the pair walks along the stream channel, trying to find water to sample, using two different types of sensors.

"Electrical conductivity is a measure of the amount of electrical current the water can carry or its ability to carry a current," DeSmit said. "It can teach you where the water is coming from."

Water that dissolves the rock tends to be saltier, like the hard water in our taps, and it can transmit current really easily. By contrast, really pure water that hasn't dissolved much rock will not be as salty and won't transmit the electrical current well. Because there are lots of different kinds of rocks in Gibson Jack, the different headwater streams actually have really different natural water quality, because some rocks, like limestone, are a lot easier to dissolve than others.

DeSmit is participating in the Idaho EPSCoR's GEM3 Summer Authentic Research Experience (SARE) Program, which is part of a five-year, multi-million-dollar National Science Foundation grant being undertaken by Idaho's universities and colleges to study sagebrush and redband trout, and their environments, to help provide evidence-based information for resource management and policies. The full title of the GEM3 project is *Genes by Environment: Modeling, Mechanisms, Mapping.* SARE is designed to give undergraduates paid summer research experience in an effort to increase the number of people and the diversity of people entering STEM research fields.

For DeSmit, the program is living up to its expectations.

Student Research cont.

"It has been my first real research project," said DeSmit, who is scheduled to earn her undergraduate geosciences degree this month. "I've done other projects similar in my classes, but not to this extent. I have loved this opportunity. It has really helped me solidify what I want to do and helped me realize I am on the right path."

DeSmit is one of six students, five from ISU and one from the College of Western Idaho, who participated in the program this summer under the guidance of ISU faculty. The program was scheduled to run from mid-June to mid-August, although some project schedules were changed because of the coronavirus pandemic.

"The SARE program is meant to provide students with exposure to authentic research experiences where they can get out into the field, as is the case with most of our students, but some of them are in labs as well," said Janet Loxterman, chair of the ISU Biological Sciences Department and an administrator for the GEM3 SARE program at ISU. "They can be helping with modeling and mapping activities, the major aspects of GEM3, so there are all kinds of activities they can be involved with, but it is really important to provide them research experiences working with graduate students and faculty collecting real data."

And in the case of DeSmit's work on Gibson Jack Creek, she is collecting "real" data. She is working under the direction of Sarah Godsey, ISU associate professor of geosciences, who has a couple of ongoing studies taking place on Gibson Jack drainage, including studies related to the GEM3 project.

"The gist of the study that Alyssa is working on is that we are really interested in understanding how the interaction between streams drying at their headwaters can influence the water quality downstream," Godsey said. "Basically, throughout most of Idaho, most of us rely on mountain water for our water supply so what happens in mountain

DeSmit taking water samples on Gibson Jack Creek. (Photo by Eric Gordon, ISU Photographer)

streams can have a really big impact on the water we drink and use. What Alyssa's project is trying to do is characterize how variable that water is in those mountain headwater streams."

DeSmit's work will help Godsey and her collaborators know where to put instrumentation, where to sample and where to study the streams in Gibson Jack. The work is also part of larger-scale projects Godsey is involved with that seek to characterize how much the landscape in intermittent headwater streams actually influences downstream water quality because of in-stream changes versus disconnections from the landscape.

"Alyssa's is a preliminary project to help us know what to do at the next steps," Godsey said. "Basically, she is out in the field walking a large number of miles, covering some ground with her sensors, sticking them into the stream at strategic places to understand how variable headwater stream chemistry really is."

Working with a graduate student has been a benefit for DeSmit – it means she is not going out alone and she is getting mentorship from a graduate student as she considers going to graduate school. DeSmit's current plan is to work for a couple of years in her field, determine her study focus and then attend graduate school.

The coronavirus pandemic affected DeSmit's summer in a number of ways. She had originally planned to attend the ISU geology field camp at the Lost River Field Station north of Mackay, a "five-week, six-credit capstone course in field geology," but it was largely cancelled, although a portion of it was held virtually. Instead, she was able to land her SARE research position.

However, because of the pandemic, her research started later in the summer than planned, and will run later, until Sept. 1. In addition, DeSmit and Kindred have been taking COVID-19 precautions, driving separately to the field location and maintaining social distancing in the field.

"We've learned how to make the field research work safely," Godsey said. "They are meeting in the field and keeping their distance, but keeping an eye on each other so they are safe out there. But it means she is getting a good bit of experience of doing field research."

Reverse Site Visit

Idaho Team Passes First Major GEM3 Milestone for External Accountability

Most people can probably remember what it was like to take an important mid-term exam. A significant part of a final grade can depend on mid-term performance. While NSF EPSCoR awards don't receive letter grades, the accountability structure for the large $24 million NSF EPSCoR Track-1 awards (including non-federal matching funds) is similar to a mid-term exam.

In fact, the national EPSCoR Office uses two such post-award events to ensure that each state that receives a Track-1 award is making adequate progress toward the research and education goals stated in their strategic plans and that the project teams get feedback and recommendations to maximize success. These exams are known as Reverse Site Visits (RSV) and Site Visits, conducted in the second and fourth years of each five-year Track-1 award respectively. The term "Reverse" is used because under normal circumstances a team from the Idaho GEM3 project would travel to the NSF in Alexandria, VA to meet in-person for an entire day with a panel of experts to describe the project's progress and to respond to live questions from the panel.

This high level of accountability is also related to the fact that the large Track-1 awards such as GEM3 are not grants; they are Cooperative Agreements. These agreements require substantial involvement between the NSF and the awardee. The RSV and Site Visit have proven to be effective ways for NSF to provide thorough oversight of Track-1 awards throughout a project.

Reverse Site Visit Cont.

However, 2020 has not been a normal year. Idaho's RSV for the GEM3 award was held on April 2, 2020. The NSF (and the Idaho team) had to respond quickly to the growing threat of COVID-19 early in the year when the RSV was being planned. Idaho was among the first set of EPSCoR states to have the day-long RSV conducted entirely online using videoconferencing – neither on-site nor "Reverse." After months of preparation, everyone involved had to quickly adapt to change. The GEM3 team is to be commended for the great work that allowed the RSV to occur and for representing Idaho's project so very well.

The result of this process was a 20-page RSV report to the Idaho EPSCoR Project Director and GEM3 team with observations, suggestions, and formal recommendations.

In response, the Idaho team has drafted action plans to ensure that the advice and recommendations from the RSV report are followed. Progress will be reported annually to NSF and to another panel of external experts at the future Site Visit two years from now. In the meantime, the GEM3 team will continue to pursue discovery, learning, and enhanced research capacity to understand the genetic and environmental mechanisms that contribute to adaptive and resilient species and landscapes.

The RSV Report and Idaho RSV Response Action Plans are available to all participants on the GEM3 website.

New Awards

ISU Professor Hale Lands Two NSF Grants to Study Stream Carbon Cycles at Gibson Jack Creek, SLC areas

By Andrew Taylor, ISU University Communications and GEM3 Communications Fellow

POCATELLO – Researchers at Idaho State University (ISU) are studying Gibson Jack Creek, located at a well-known and popular outdoor recreation area just outside of Pocatello, and a Salt Lake City-area stream to get a better insight on how streams cycle carbon – which has large implications for understanding climate change.

The carbon cycle is what scientists describe as how carbon, a life-sustaining element, transfers back-and-forth between the atmosphere, oceans and organism, and understanding this cycle is key for maintaining a stable climate and carbon balance on earth. The role streams play in understanding the carbon cycle has not received enough attention, according to Rebecca Hale, an assistant professor in the ISU Department of Biological Sciences.

"In just the last 10 or 15 years have we really realized just how important streams are for carbon cycling," Hale said. "So when we think of all the biomass in terrestrial ecosystems, about half of that ends up in streams. They end up being really important even though they only cover about one percent of the land surface."

"If we assume," she continued, "that carbon is just being stored on the land surface and it is really being exported by streams, then when we have more carbon emissions we are going to get the mass balances all wrong."

Hale has received two National Science Foundation Grants from its Ecosystem Science Program to study the carbon cycle in streams. Her focus is helping to correct some poor

assumptions about how streams cycle carbon, namely that streams have water in them all the time and that people don't have influence on what is going on in streams.

"These two projects are really addressing those two big blind spots in our understanding of how streams process organic matter that they are ultimately receiving from terrestrial systems," she said.

The first grant, which she and other ISU researchers have already started on, is funded for $200,000 and it focuses on streams with intermittent flow, meaning portions of them don't always have water and dry up. That research effort is occurring on Gibson Jack Creek and the co-investigator on it is Sarah Godsey, ISU geosciences associate professor.

"In the past, when researchers have studied the role of streams in the carbon cycle, they ignored streams that don't have water in them all the time," Hale said. "However, over 50 percent of streams dry occasionally so if you are ignoring half the streams you aren't getting an accurate picture."

The second NSF grant is for $1.4 million and is much larger in scope and it focuses on streams in five urban areas across the United States, Salt Lake City, Boston, Atlanta, Miami and Portland, Oregon.

"Studies have assumed people don't have any influence on what is going on in the streams (with regard to carbon) and this is a bad assumption," Hale said. "A lot of stream systems are indirectly touched by human activity like global climate change, but a lot of them are directly influenced by human activity, largely through agriculture, but also by urbanization and patterns of development."

ISU's portion of the second grant is $934,000 and it is the lead institution on this collaborative project with the University of Massachusetts, Florida International University, University of Georgia, Portland State University and the U.S. Geological Survey. ISU researchers will focus on streams in the Salt Lake City area and researchers will be getting out next spring to start this study.

"A lot of the nitty-gritty aspects of the projects are similar," Hale said. "In both of these projects, we are seeing how intermittence and urbanization affect the sources of organic carbon, the fluxes of organic carbon and the processing of organic carbon in streams through these

Dr. Rebecca Hale (pictured) is an Assistant Professor of Social Ecological Sciences at ISU. She was recruited in 2015 through Idaho's recent Research Infrastructure Improvement (RII) Track-1 award, Managing Idaho's Landscapes for Ecosystem Services (MILES). Providing competitive levels of support to hire new faculty with expertise in Idaho's strategic research themes is a key strategy for expanding Idaho's contributions to scientific discovery, innovation, and learning.

(Photo by Eric Gordon, ISU Photographer)

very dense spatial samplings and linking that back to landscape characteristics to understand how patterns of development are affecting carbon sources and processing, and how patterns of stream flow intermittence are affecting patterns of organic matter concentrations and sources."

In both projects, the researchers are also using high-frequency water-quality sensors in different locations to understand patterns of dissolved organic carbon fluxes and trying to connect that information to other temporal patterns like stream temperature and discharge.

"Streams only cover a very small proportion of the land surface," Hale said. "It is really important to understand what they are doing so that we can get carbon budgets right."

The official titles of Hale's current NSF grants are: "Collaborative Research: Scales and drivers of variability in dissolved organic carbon across diverse urban watersheds," referring to the Salt Lake City-area study, and "Network-scale streamflow intermittence controls on dissolved organic carbon concentrations and processes," referring to the Pocatello-area study.

GEM3 Faculty

Meet New BSU GEM3 Faculty: Dr. Jen Cruz

Dr. Jen Cruz, Assistant Professor in Population Ecology in Department of Biological Sciences

Dr. Jen Cruz is joining Boise State University and the GEM3 team this fall as an Assistant Professor in Population Ecology and will also serve as a Quantitative Population Ecologist for the GEM3 research team.

Cruz completed her PhD in Ecology from the University of Queensland in Australia, studying the impacts of invasive predators on native brushtail possums. She was born in Colombia and moved to Australia during high school, and attended Monash University for her Bachelor in Environmental Science with Honors.

Cruz was a postdoctoral researcher at the University of Wisconsin-Madison where she researched interactions among recovering raptors. Prior to that she worked at Landcare Research Institute in New Zealand quantifying interactions among native and invasive species.

Cruz is leading the Quantitative Conservation Lab: **https://www.quantitativeconservationlab.com**

Research in the lab will sit at the intersection of conservation, population ecology, and statistics. The team's aim is to provide innovative, data-driven knowledge to guide conservation and strengthen species' resilience via three research avenues: 1) improving long-term ecosystem recovery by quantifying and forecasting how multiple species interact during recovery; 2) understanding how to incorporate and harness inter- and intra-specific variability of species in conservation efforts; 3) minimizing threats from invasive species through an improved understanding of how they interact, and the conditions under which native communities are able to thrive.

The team tackles research avenues using diverse forms of data from monitoring programs, remote sensing, and field studies; collected at scales ranging from microhabitats to continents. The team will use emerging quantitative approaches (e.g. integrated population models, multispecies occupancy models), often in a Bayesian framework, and coupled with rigorous model evaluation. The aim is to collaborate to ensure maximum benefits to conservation and wildlife management.

"I am excited to learn more about the work being done by colleagues with GEM3 and to establish future collaborations that address overlapping research interests."

GEM3 Invests in New Research Projects

As part of Idaho's statewide NSF EPSCoR GEM3 award, the project provides seed funding to allow project leadership and the Idaho research community to respond quickly and effectively to new opportunities as well as pursue high impact, potentially transformative research. Its principal objective is to catalyze new research on focal species, species interactions, ecosystems, genomics/phenomics, and other emerging areas related to the scope of the GEM3 award.

Funding is aimed at groups or individuals that emphasize the collaborative development and testing of important ideas and theories, cutting-edge analysis of recent or existing data and information, and/or investigation of social ecological systems issues. Results of seed funding enable the submission of proposals to NSF and other funding agencies, and/or result in conference presentations and publication of papers in peer reviewed journals, and/or other data products or innovations. It is also an important mechanism to broaden participation of institutions, faculty, and students from underrepresented groups.

Seed funds are intended to catalyze projects in emerging areas that are clearly related to (but do not duplicate) the research and education scope of the current EPSCoR RII Track-1 GEM3 award. This year GEM3 awarded seed funding in three categories: Large (GEM3 research related), Small (GEM3 research related), and Workforce Development (WFD). Recipients of the awards are:

GEM3
Genes by Environment
Modeling · Mechanisms · Mapping

Year 2 Awards

- Leonora Bittleston, BSU; Kathryn Turner, ISU; Carolyn Dadabay, CoI - Time travel with the sagebrush microbiome: connecting microbial composition with chemistry and adaptive capacity over three magnitudes of time; $149,770 direct cost (Large)
- Jocelyn Aycrigg, U of I; Tracey Johnson, U of I - Toward understanding interactions between large herbivores and abiotic factors on plant species distributions in sagebrush systems: a pilot study to validate predictive spatially explicit models of forage; $41,501 direct cost (Small)
- Marie-Anne de Graaff, BSU; Allison Simler-Williamson, BSU; Trevor Caughlin, BSU; Leonora Bittleston, BSU - Local adaptation to biotic drivers: Integrating the evolutionary consequences of soil microbial communities into sagebrush population dynamics; $49,997 direct cost (Small)
- Yolanda Bisbee, U of I - STEM Scholars Program; $30,000 direct cost (WFD)
- Colden Baxter, ISU; Rex Force, ISU; Henry Evans, ISU; Kitty Griswold, ISU; Lethanial Loley, ISU - A Cooperative Faculty Position Bridging Between Idaho State University and the Shoshone-Bannock Tribes; $100,000 direct cost (WFD)
- Dennis Becker, U of I - Visiting Tribal Scholars Program; $100,000 direct cost (WFD)

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About NSF EPSCoR

Idaho EPSCoR Part of Team Receiving NSF Funding to Develop Statewide STEM Ecosystem

Recently, Idaho EPSCoR was part of a team, led by the STEM Action Center, that was awarded a $99,500 National Science Foundation (NSF) INCLUDES Planning Grant to help guide the development of the new Idaho STEM Ecosystem, a network of Idaho STEM partners and stakeholders working to build awareness of and increase access to STEM.

INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science) is designed to support planning efforts necessary to build capacity to establish future centers, alliances, or other large-scale networks endeavoring to address a broadening participation challenge in STEM at scale.

The Idaho NSF EPSCoR program has been working collaboratively with Idaho STEM Action Center for a number of years to help implement many of the goals and objectives of the RII Track I GEM3 project. The STEM Action Center, established under the Executive Office of the Governor, works to address Idaho workforce needs and provide STEM learning opportunities and will serve as the backbone organization for the new Ecosystem.

The new funding will support additional strategic planning meetings scheduled for this fall and next spring to create successful metrics for STEM education and programming. They will also establish a leadership structure, regional STEM hubs, and communication protocols. In addition, the network has identified the need to develop a statewide strategic plan focused on broadening participation in STEM. The group, which has been meeting virtually to lay the foundation via various working groups, is hoping to build awareness of and ensure equitable access to STEM opportunities and careers through the new ecosystem.

Learn more at https://stem.idaho.gov/idaho-stem-ecosystem