The RESEARCHER

IDAHO NSF EPSCoR

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Anna Roser (L) - Remote Sensing Analyst and Valorie Marie (R) - BSU SARE undergraduate student using remote sensors to distinguish invasive species from native plants. Photo Credit: UI Photographic Services A newsletter publication of the Idaho EPSCoR Office

RESEARCHER

Andy Kliskey

Project Director akliskey@uidaho.edu | 208-885-6499

Rick Schumaker

Assistant Project Director rschumak@uidaho.edu | 208-885-5742

Ashley Bogar

Evaluation Director ashley@uidaho.edu | 208-885-1295

Sarah Penney

Diversity, Outreach, and Communication Coordinator sarahp@uidaho.edu | 208-885-2345

Tami Noble

Finance Director tnoble@uidaho.edu | 208-885-5842

Vanessa Henry

Administrative Financial Specialist vanessa@uidaho.edu | 208-885-7102

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Track 1 GEM3 Website idahogem3.org

Track 1 MILES Website idahoecosystems.org







LETTER FROM THE DIRECTOR



Idaho truly is a "living laboratory" for social-ecological research, based in part on its ecological and geographic diversity. Known as the "GEM State," more than 70 types of precious stones can be found in Idaho. It is also home to the lentil capital of the world, and to Hells Canyon on the Snake River, that is deeper than the Grand Canyon. In fact, elevations range from 710 ft. above sea level at the confluence of the Clearwater and Snake Rivers to 12,662 ft. at Borah Peak in the Lost River Range.

Andy Kliskey

The research infrastructure improvement

strategies of the Idaho NSF EPSCoR Track-1 award, Genes by Environment: Modeling, Mechanisms, and Mapping (GEM3), make use of this diversity to help better understand the observable characteristics of a species based on what we know about its genetics and environment. For example, elevation gradients are physical features that mimic temperature change and allow our teams to design experiments to understand how trout and sagebrush adapt to different environmental conditions.

This issue of *the Researcher* showcases many of the GEM3 research sites located across Idaho. In many ways, these sites serve as laboratories from which our discoveries will come. Thanks to the many efforts of our research and communications teams, we are pleased to show you what many of these sites look like and why they are so unique and important for building nationally and internationally acclaimed academic research and education programs. These sites highlight our GEM3 research and why Idaho's landscapes are a key asset in Idaho's EPSCoR research infrastructure improvement strategy. Finally, these sites are all featured in our Sep 8-9, 2021 virtual Site Visit with NSF.

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Unless otherwise noted in feature byline, articles and features in this publication are written by Sarah Penney with editing and content contributions by EPSCoR administrative team.

@IdahoEPSCoR

GEM3 Research

Idaho EPSCoR had an active summer with GEM3 research taking place at numerous locations around the state. As we prepare to enter year four of the project, the GEM3 team has been busy sharing progress though video interviews and photos. With over 200 active GEM3 research sites within Idaho, we want to provide a glimpse into GEM3 summer research in an effort to share progress; promote public, stakeholder, and student awareness and interest in GEM3 research; and to prepare a diverse, well-trained STEM workforce and scientifically informed citizenry.

University of Idaho-Hagerman Fish Culture Experiment Station

The University of Idaho-Hagerman Fish Culture Experiment Station is where the GEM3 common garden fish rearing is taking place. Research at this site is helping to address thermal and hypoxia tolerance (response to temperature and oxygen levels in water) across redband trout ecotypes and

populations from select Idaho streams. What makes this research unique is the availability of isolated fish populations living at opposite temperature extremes and facilities to conduct common garden research addressing these physiological, behavioral, and genetic constraints.



undergraduate student) and Rebekah Windover (UI SARE undergraduate student), Jon Masingale (UI graduate student), and Brian Small (UI faculty) Photo Credit: UI Photographic Services

GEM3 Research

BSU Genomics Lab and Greenhouse

The GEM3 genomics research team is working towards producing a reference genome for sagebrush (*Artemisia tridentata*). The team is seeking to understand how genetic diversity and phenotypic plasticity affect sagebrush's response to environmental change, specifically drought, shaping both population response and adaptive capacity. Understanding mechanisms underpinning drought adaptation require a genome to phenome approach. This approach requires a reference genome representing genotypes adapted to particular environmental conditions. The team is currently working towards the goal of having several hundred plantlets to be able to sequence the large sagebrush genome, as well as maintain lines of genetically identical plantlets for future research. Ultimately, the team's goal is to develop tools and resources, such as the sagebrush genome and lines of genetically identical plants, to facilitate the study of how sagebrush responds to drought and better predict how the species will respond to climate change.



Top L-R: Sven Buerki (BSU faculty), Carlos Dumaguit (BSU graduate student), Sven Buerki and Anthony Melton (BSU Post-Doc), and Bottom: Peggy Martinez (BSU lab technician) Photo Credit: Boise State University

Sagebrush Research - Castle Rocks field site

Castle Rocks State Park (CRSP) is situated in a natural ecotone, that is, a transitional zone between distinct ecosystems. This interdisciplinary research is unique and groundbreaking in multiple ways. The unique characteristics of this ecotone, which comprises multiple subspecies and different ploidy levels within a small area, provides an excellent opportunity to study hybridization in this system. It is the first application of community genetics methods and theory to the sagebrush ecosystem and has the potential to create a new model system in community genetics. Moreover, linking plant genetics, ploidy level and chemical properties to hyperspectral imagery is a novel approach and will provide valuable insights for remote subspecies identification of a complex plant system.

GEM3 research at this site combines the strengths of multiple research teams in ways that assess the ecosystem from different perspectives and provide new insights, as well as foster collaboration within the GEM3 project. Research at this site will be directly applicable to management decisions, as we will be able to provide detailed information about sagebrush subspecies and their effects on associated species. This will guide seed selection and aid in successful restoration.



L-R: Madison Anderholm (UI SARE undergraduate student), Jen Forbey (BSU faculty), Harrah Friedlander (UI SARE undergraduate student), Paul Hohenlohe (UI faculty), Lukas Grossfurthner (UI graduate student), Ellie Higgins (UI SARE undergraduate student), Molly Garrett (UI graduate student), Andrii Zaiats (BSU graduate student), and Donna Delparte (ISU faculty) Photo Credit: UI Photographic Services

Dry Creek, Boise Foothills

Leonora Bittleston, Assistant Professor, Department of Biological Sciences, and team are collecting sagebrush leaves from Dry Creek in the Boise, Idaho foothills for later culturing and sequencing of the associated microbes. The team is investigating which microbes live on and inside of sagebrush leaves to understand more about their microbiome. The sagebrush microbiome is particularly intriguing because the plant produces many antimicrobial chemicals, and these microbes somehow manage to avoid or metabolize these compounds. They could also be helping to produce them! The leafassociated microbes may impact how other animals are able to consume the leaves, and have potential for supporting the plant's drought or temperature tolerance.

All plants are filled with unseen microbes, which have the potential to support the plant's health, just as our own microbiome supports our health. It is currently unknown which microbes associate with sagebrush, and this work will characterize these communities, and also identify potential environmental (e.g., temperature, humidity) and host characteristics (e.g., chemistry, phenology) that are driving microbial community assembly.



L-R Group Photo: Jacob Heil (BSU graduate student), Aubrey Osorio (BSU SARE undergraduate student), Rachel Capezza (BSU undergraduate student), Leonora Bittleston (BSU faculty), and Miranda Striluk (CWI faculty) Photo Credit: Boise State University

GEM3 Sagebrush Mapping: Initial Point Field Site (Kuna, ID)

Megan Cattau, Assistant Professor Department of Human-Environment Systems, Anna Roser, Remote Sensing Analyst, and Valorie Marie, undergraduate student in biology, are working with Unmanned Aircraft Systems (UAS) sensors to detect invasive species. The overall goal is distinguishing the phenological signal of invasive species from native plants, with the potential to scale to satellite imagery using a 10 band sensor to collect data approximately biweekly. The invasive species of interest are bur buttercup, russian thistle, and cheatgrass.



L-R group photo: Valorie Marie (BSU SARE undergraduate student), Megan Cattau (BSU faculty), and Anna Roser (Remote Sensing Analyst) Photo Credit: Boise State University

GEM3 Research

Other GEM3 Research Around the State



Photo Credit: UI Photographic Services



Skylar Benson, BSU VIP student

Photo Credit: Kelly Hopping

The GEM3 Informal Trails Mapping project, led by Boise State faculty, Kelly Hopping, is working to respond to the Owyhee Stakeholder Advisory Group's interests in how recreation is impacting their region. Work for this project was supported by the GEM3 Environmental Sustainability Vertically Integrated Project (VIP) at Boise State University.



Clara Buchholtz, BSU graduate student

Photo Credit: Kelly Hopping

Research cont.



Photo Credit: Chris Caudill

Tawa Giwa, CWI SARE undergraduate student and part of GEM3 team, sampling for drifting invertebrates while measuring flow and turbulence at GEM3 Trout Mechanisms Field Site at Big Jacks Creek. Spencer Roop, GEM3 Graduate Student at Idaho State University, discussing research addressing the adaptive capacity of Big Sagebrush in riparian areas at the Marsh Creek Field Site.



Photo Credit: Idaho State University



Photo Credit: Lisette Waits





Caudia Maldonado, GEM3 SARE undergraduate student

In the shadow if the Teton mountains, the Latinx community of the beautiful Teton Valley faces challenges, both cultural and economic, that researchers at Idaho State University (ISU) are working to address. Being competitive in today's world requires resources that are not available to everyone.

Claudia Maldonado, a recent graduate of ISU who grew up in the small city of Blackfoot, Idaho, takes these challenges personally.

"Things are becoming more expensive and harder for them, and they work in a lot of these places. But if they can't live there, how are they going to maintain a livelihood? They need a job, or they can't live in the area."

In high school Claudia wasn't sure how to navigate her next steps, but she knew she was passionate about immigration law and policy. "I'm a first-generation college student, so trying to decide where to go to college was a big pain. I had no idea." But with the help of a few high school teachers Claudia found herself at ISU and she loved it.

Claudia majored in Political Sciences, Global Studies, The United States and World Affairs Concentration and Spanish Option 1, with a minor in Advocacy. During her studies, she had two professors that helped her hone in on her interests in a way she never had thought of, through research.



Photo Credit: UI Photographic Services

Sarah Ebel, in the Anthropology Department, as well as Morey Burnham, in the Sociology, Criminology, and Social Work Department were able to suggest a funding opportunity through the NSF EPSCoR GEM3 program, to which they encouraged Claudia to apply. Through the Summer Authentic Research Experiences (SARE) program, Claudia was able to make herself acquainted with the research process and help develop a funded project. Idaho EPSCoR's GEM3 SARE is designed to engage Idaho undergraduates in the science, technology, engineering, and mathematics (STEM) fields related to GEM3 research, which is Genes by Environment: Modeling, Mechanisms, Mapping, and increase the number, diversity and preparation of skilled scientists and engineers in GEM3 fields.

"It was interesting for me to see the other people that were talking about the Latinx community and what's going on with it. There was research being done on my community and how they live their lives, and that was significant for me because I was like, okay, I have a spot in Academia."

The project Claudia helped design aims to gain a better understanding of the Latinx experience in Teton Valley and tries to understand the changes taking place, whether that involves access to resources such as food, interpreting services, or affordable housing; or more generally, gauging the level of integration and belonging that the Latinx population feels and displays in this region. The research team partnered with a nonprofit organization, the Community Resource Center of Teton Valley (CRCTV), to design and conduct a survey that would include questions of interest and benefit to their organization. CRCTV works to provide resources and knowledge of resources for the residents of Teton Valley. This survey is designed to render helpful insight as to where services are successful, and where services could be improved to meet their goals.

The pandemic of last year delayed completing the study, but Claudia has continued her work with ISU even after graduating in May. "It was really cool seeing how I could take my perspective as a first-generation student and my Mexican American background and apply it to a research project."

As Claudia looks for graduate programs and contemplates her future, she reflets back on the experience she gained. "The project focuses on gaining resources and access to resources, and I think that's something that's really important, whether I become an attorney or a Foreign Service Officer. But either way it's important to know what the lives of these minority communities are [like], especially in the Teton Valley. It helped me enforce my career goals and see what I can do to give back to my community."

By Brooklyn Schumaker

Chair of the Publications Committee for Minorities in Agriculture Natural Resources and Related Sciences

Idaho EPSCoR

University of Idaho 875 Perimeter Drive MS 3029 Moscow, ID 83844-3029

208-885-7102 idahoepscor.org





Photo Credit: Idaho State University

Georgia Hart-Fredeluces is a Post-Doc at Idaho State University. She and partners are investigating how climate change and invasive species may be impacting camas plants at Camas Prairie Centennial Marsh, as well as the potential for bulb harvest and fire to help protect plants from these threats.



Photo Credit: Manuel Gomez Navarro

GEM3 student researchers assisting with point line surveys at the Soda Fire restoration field site to assess density and recovery of sagebrush after fire.