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Alaska EPSCoR

Alaska NSF EPSCoR is a partnership dedicated to growing Alaska's scientific research capacity, funded by the National Science Foundation and the State of Alaska.

Big States, Tiny Research

Scientists from Alaska, Idaho, Nevada and Wyoming EPSCoRs team up to study gut microbes

Alaska can't offer much in the way of sagebrush or pygmy rabbits. What it does have is burgeoning capacity to study microbes, which is why a consortium of Western EPSCoR states is partnering with UAF on a study of how the gut bacteria of desert animals enable them to digest toxic plants.

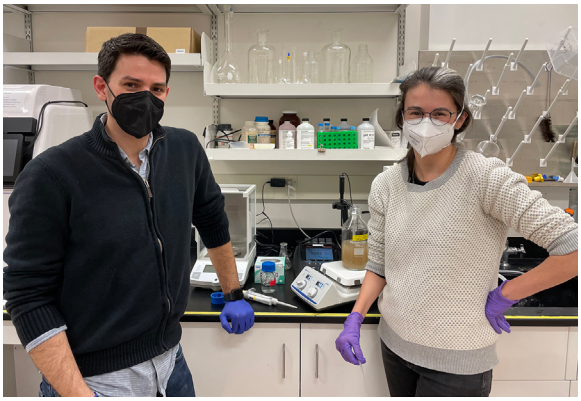

Photo courtesy Stephanie Galla

UAF Assistant Professor of Microbiology Mario Muscarella and Boise State University PhD student Jessica Bernardin in Muscarella's lab in the UAF West Ridge Research Building.

"It's really trying to explore this arms race between plants and the defensive compounds they make and their consumers, meaning animals," said Mario Muscarella, an Assistant Professor of Microbiology at UAF and the main Alaska partner in the enterprise. "The part of the project that I contribute to is thinking about how the gut microbiome helps animals detoxify the plant compounds."

Muscarella is the newest partner in "Genomics Underlying Toxin Tolerance (GUTT)", an EPSCoR Track-2 project that began in 2018 with the goal of better understanding the relationship between toxic plants and herbivores. Campuses in Idaho, Nevada and Wyoming have been collaborating on the $7 million project, which to this point has mainly focused on the toxic plant sagebrush and three animals that can digest it: Greater sage-grouse, pygmy rabbits, and wood rats. "These are plants that not a lot of animals can eat, but these animals rely on them, especially during certain times of year when it's snowy," noted Stephanie Galla, a postdoctoral researcher at Boise State University working on the effort.

The sprawling GUTT project tackles plant-animal interactions from a number of different angles – an approach the research team calls "culture-omics" - and now involves researchers from six different campuses. Muscarella said he got involved in the project last year when project lead Jennifer

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From the PI

Brenda Konar, Principal Investigator

Hello everyone,

I know I'm not alone in looking forward to the day when we can all meet in person again.

Unfortunately, that day has yet to come. But I'm pleased to report that, despite an unavoidable last-minute pivot to a virtual format, we just concluded an informative and fruitful 2022 All Hands Meeting. We had some novel elements this year, including the integration of student "flash talks" into the research presentations, and a constructive session with the members of our new Industry Advisory Board. But perhaps the most promising innovation was a session on integrative papers, in which four researchers pitched their paper ideas to the assembled researchers to foster collaborations. This sort of activity tends to happen informally at in-person meetings, so I'm happy we found a way to accommodate it in Zoom.

The meeting also featured an update on the next EPSCoR proposal, "Glaciers to Gulf." We continue to make progress on G2G, which will address the question of how

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Gut Microbe Research

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Forbey of Boise State approached him about injecting his own techniques, which entail culturing gut microbes and studying them through the lenses of physiology and genomics.

"Mario's coming in with a lot of skillsets for culturing that we wouldn't necessarily have at Boise State," said Galla, who visited Muscarella's lab in late January along with Boise State grad student Jessica Bernardin. "There are a lot of tools here where you're able to culture and measure the physiology - not just understand the genetics, but what the microbes are actually doing." She also noted another appeal of UAF is its infrastructure for culturing and preserving specimens, including both excellent lab facilities and expansive liquid nitrogen tanks at the UA Museum of the North.

Galla and Bernardin spent much of their recent visit learning culturing techniques at Muscarella's West Ridge Research Building lab. But they also had another goal: there are plans to expand the study to some Alaska fauna,

Photo courtesy Stephanie Galla

Boise State University postdoctoral researcher Stephanie Galla displays samples of moose droppings preserved in liquid nitrogen.

such as wood rats from Southeast and ptarmigan and moose in the Interior. So the two visitors ventured out onto the North Campus trails to (easily) locate some moose droppings, which they are experimenting with storing in various media. "I like to tell people we really leverage the power of poop in our work," Galla noted. "We collect fecal samples from a lot of our organisms, and that is being used as a proxy to understand what's in the gut."

Photo courtesy Stephanie Galla

Research Professional Amanda Stromecki and Boise State University postdoctoral researcher Stephanie Galla collect moose droppings on the UAF North Campus trails.

The project is slated to continue through September 2023. Muscarella has hired a research professional to help with the project and plans undergraduate summer hires, and the project will also enable him to enhance the research content of his undergraduate microbiology course. Future research visits are planned to and from the other states working on the project, and Institute of Arctic Biology researchers led by Knut Kielland and Link Olson are also developing plans to extend the project to the aforementioned Alaskan flora.

Muscarella is excited about the project's potential for advancing basic science, and both he and Galla suggested practical applications for the work as well. Galla noted the research will be useful to land managers working on potentially reseeding areas with sagebrush or translocating animals to bolster their populations. And Muscarella said the findings have potential medical and pharmaceutical applications.

"(An animal gut biome) might produce chemical 'x' and that might reduce inflammation when they consume a toxic compound," he noted, "and now we know about that molecule and the organisms that produce it, and we could potentially use that in an applied setting."

For more information please visit the GUTT website.●

Hunting for Data

Williamson

A Fire & Ice undergraduate reached back almost a century to help validate some modern climate modeling software.

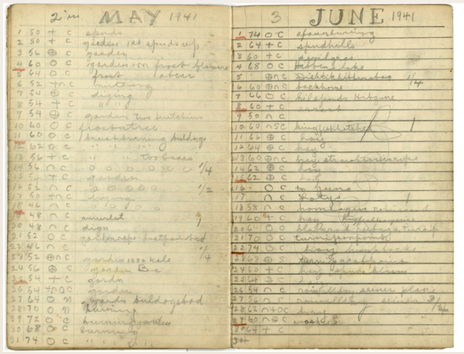
UAF Ocean Sciences major Emily Williamson is lead author on a recent paper published in the PeerJ journal entitled "Independent validation of downscaled climate estimates from a coastal Alaska watershed using local historical weather journals." Williamson and her co-author, UAF PhD candidate Chris Sergeant, tested the accuracy of ClimateNA climate-modeling software by comparing its results to temperature and precipitation data recorded from 1926-1954 by Allen Hasselborg, a homesteader on Admiralty Island outside of Juneau.

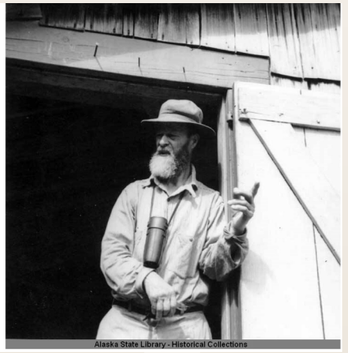
"If you're using the ClimateNA model for a project in a really remote area, you really have no way of knowing how accurate the model is because there are not a lot of opportunities to test it against long-term, consistent weather data," explained Williamson. "It was a rare opportunity to do that."

Sergeant came up with the idea for the article after a packraft and hiking trip across Admiralty Island that passed near the Mole Harbor homestead of Hasselborg, a renowned bear hunter who also collected many specimens of Alaskan fauna for scientists. When Sergeant learned that Hasselborg had kept meticulous daily journals of precipitation and temperature, he hatched the idea of using the data to model historic streamflow – and recruited Williamson to help.

"I was a fisheries student at the time, and it seemed like it would be a good experience to learn about models," Williamson said. "And I'm also really interested in natural history, so it seemed like a cool opportunity."

Williamson received a Fire & Ice travel award to travel to Juneau in 2019, where she scanned the journals in page by page at the Alaska State Library, then transcribed them all. "There were around 279 usable months of data, so it was a really long time period, 1926 to the '50s, and the author was pretty consistent," she said. "It took quite a long time to transcribe it all."





Alaska State Library - Historical Collections

Pages from Allen Hasselborg's weather journals, and Hasselborg at his homestead in 1941. From Williamson and Sergeant, 2021; right image accessed through Alaska's Digital Archives.

She and Sergeant ultimately decided to directly compare the temperature and precipitation data in addition to generating a streamflow model. They used ClimateNA to model temperature and precipitation for the period and location of the journals and compared the findings. They found a high correlation between modeled and observed measurements of monthly precipitation (0.74) and monthly mean of the maximum daily air temperature (0.98). The modeled streamflow showed more moderate correlation (0.55). Williamson said the results largely validate ClimateNA. "In general the trends are the same, they increase at the same time, they decrease at the same time," she said. "And a lot of times the numbers are really similar."

ClimateNA is a climate downscaling model, which means it uses data from weather stations – in this case, stations in places like Juneau and Sitka, far from Hasselborg's homestead – and combines them with circulation patterns to estimate climate data for specific points on the map. By helping validate ClimateNA's estimates, Williamson said the results could aid researchers studying remote sites. "It's showing that you can use downscaled climate data to make relatively accurate historical time series for anywhere in Alaska, no matter how remote it is."

In addition to the travel award, Williamson has also been involved with the Fire & Ice project as a researcher. In summer 2019 she conducted fieldwork in Kachemak Bay, and in summer 2020 she processed phytoplankton samples, an effort that formed the basis for her senior thesis. She plans to graduate in spring 2022. ●

A Summer of Science

In summer 2021, 18 high-school aged Alaskan girls piled into kayaks and packrafts and emerged with both new ecological knowledge and more confidence in themselves.

That's the idea behind "Girls in the Water" and "Girls in the Forest," two EPSCoR-sponsored summer experiential learning programs. In July, nine 16- and 17-year-old girl-identified youths from across the state took part in "Girls on Water," a week-plus scientific kayak expedition in Kachemak Bay. Then in August, nine "Girls in the Forest" packrafted the Chena River and learned about fire science along the way.

As kayak guide Laura Jackson noted, the **Girls on Water** dove right into their expedition, literally and figuratively. "These girls were incredible, most of them coming into this program having had no kayak experience, and jumping in boats and then flipping them right back over on day two," she said, describing a kayak drill.

The group kayaked from their base at Kasitsna Bay – across Kachemak Bay from Homer – to the head of Tutka Bay and back, camping along the way. When they weren't paddling on the roughly 40-mile roundtrip, they had art and science lessons and gathered scientific data. "We did a lot of different ecological surveys in the intertidal, learning how to use quadrats, and making different observations in the intertidal zone, looking at the different plants and animals that live there," explained instructor (and UAF PhD student) Steffi O'Daly.

Photo by Courtney Breese/Alaska NSF EPSCoR

Girls on Water students study marine life.

Photo by Sarah Clement/Inspiring Girls Expeditions

Girls in the Forest students float down the Chena River.

At expedition's end, the participants put together three science-fair-style poster presentations of their findings, then recorded the presentations to display online. O'Daly called the quality of the presentations "amazing" given the short time period the students had to prepare them. And Sutton noted that they were created without access to the Internet. "All of the background information, all of the conclusions that they came up with were from each participant being a critical thinker, which is one of the most important things I think you can do as a scientist."

The **Girls in the Forest** also traveled by boat, but they had their minds in the trees. The nine students who explored the Chena River State Recreation Area east of Fairbanks in August looked at the impacts of some of the area's forest fires.

"We learned about boreal forest ecology in Interior Alaska and how fire plays a really important role in those forest ecosystems, and we learned about the surface vegetation, underneath the surface and what's up in the trees," explained lead instructor Klara Maisch.

Participants floated different sections of the Upper Chena River, hiked the Angel Rocks and Mastadon Creek trails, and visited the sites of both the 2004 Tors Fire and the 2019 Nugget Creek Fire to establish transects and collect data. Halfway through the trip the weather turned from 'idyllic' to 'sopping,' which enabled the group to also visit the site of the recent Munson Creek Fire, which had been subdued by the rain.

Girls in the Forest participants turned their studies into a set of online science slideshows. After the expedition, the students spoke about learning to function as part of a team, to be more open-minded, and to push themselves. "I learned that getting out of my comfort zone can get me a lot further than I expected," noted one. "I learned that when I just open up to learning something new and don't worry about the possible outcomes, the activity can be a lot more fun," said another.

Both programs are run out of the UAF International Arctic Research Center and are affiliated with the Inspiring Girls Expeditions program.●

Sampling by Packraft

By Jordan Jenckes, UAF Geological Sciences Ph.D candidate

During the 2021 field season, myself and other members of the Coastal Margins Kachemak Bay Stream Team participated in two packraft float trips down the Wosnesenski River ("the Woz"), located in Kachemak Bay State Park across from Homer. The purpose of both trips, which were funded by an EPSCoR student research seed grant, was to gather water samples along the length of the river.

Screenshot from a video Jenckes made of the expeditions.

For each trip, myself and a fellow researcher flew from Homer to the proglacial lake at the headwaters of the Woz, then gathered water samples from the headwaters to the ocean. For the first trip, which took place in June, I was accompanied by McKinley Wallace, our lab and field technician. I was accompanied by recent University of Massachusetts-Amherst MS graduate Aeon Russo for the second trip, which took place in September. Both McKinley and Aeon have extensive experience floating rivers, however; I am a novice rafter and relied heavily on their experience.

In addition to sampling the main stem of the river, we sampled its three main tributaries. The Woz is roughly 20 km long and each trip took us 6-7 hours to complete. Along the way we collected nine total water samples, six in the main stem of the Woz and one sample from each of the three tributaries. We then analyzed all of the water samples for concentrations of trace metals in both the dissolved and the suspended load. The main goal of this sampling was to characterize the trace metal concentration and flux along the length of the Woz, which helps us to study the degree to which receding glacier coverage within the Woz watershed and throughout the Gulf of Alaska may be altering the fluxes of trace metals to the ocean. Glaciers have stored atmospheric inputs of trace metals, which are now being released as glaciers recede. Glacial recession is also exposing mineralized bedrock once shielded from the atmosphere enhancing the release of solutes and trace metals. Some of these metals, such as iron, are important nutrients for primary producers, while other metals like chromium and nickel may be harmful to the primary producers.

The Stream Team normally samples the Woz every month from March to October at a location near its outlet to Kachemak Bay. By supplementing this with longitudinal (headwaters to ocean) sampling efforts, we can better understand watershed processes that control the generation of dissolved and suspended loads of trace metals. We selected sampling times in June and September to attempt to identify different seasonal sources of trace metals: in June the streams in the Woz watershed are primarily fed by melting snow and ice, while in September the streams are fed by a combination of ice melt, stored water, and variable amounts of precipitation. We hope to show how different sources of water contribute to the flux of trace metals and to better anticipate how fluxes of these trace metals may change in the future.

Screenshot from a video Jenckes made of the expeditions.

We had incredible weather for each trip and we all enjoyed the perspective of experiencing and viewing the upper portions of the Woz. Floating and sampling the river and its tributaries provided helpful context for our research. Each tributary of the Woz has different characteristics and being able to see and sample those was special. The Woz water characteristics and streambed morphology change drastically from the headwaters down the ocean, and these changes cannot be appreciated fully from satellite imagery or from our normal sampling site. I am grateful for the seed grant for the opportunity it afforded our team to conduct these trips.

Click here to watch a video Jenckes made about the expeditions. ●

Dar's Trek

In mid-July, members of the Fire & Ice remote sensing team played host to Dar Roberts, a Professor in the Department of Geography at the University of California, Santa Barbara. Roberts has been working with hyperspectral remote sensing since 1984 and is a renowned expert in the field, as well as one of four members of Fire & Ice's External Advisory Council.

Photo by Naomi Hutchquist/Alaska NSF EPSCoR

Visiting scholar Dar Roberts and PhD student Anushree Badola take readings with the PSR+ spectroradiometer at Bonanza Creek Experimental Forest outside of Fairbanks.

During his weeklong visit Roberts got to meet with remote sensing researchers and accompany them on visits to various field sites around Fairbanks.The purpose of the week's fieldwork was to use a portable PSR+ spectroradiometer to collect spectral data on a variety of boreal trees and shrubs, as well as

Photo by Naomi Hutchquist/Alaska NSF EPSCoR

Members of the Fire & Ice remote sensing team gather data on the board-walk at Bonanza Creek Experimental Forest. Left to right are technician Chris Smith, visiting scholar Dar Roberts, PhD student Anushree Badola and faculty Santosh Panda.

materials like leaf litter, dry needles, tree bark, and branches. The data will be used to assist in mapping boreal vegetation from airborne hyperspectral data; in simulating hyperspectral data from multispectral data; and in creating a spectral library of boreal vegetation.

Field sites that Roberts and the researchers visited included the UAF North Campus, Caribou-Poker Creeks Research Watershed; Bonanza Creek Experimental Forest and Creamer's Field Migratory Waterfowl Refuge. They also had the opportunity to inspect the Cessna 185 that researcher Martin Stuefer flies to collect aerial hyperspectral data. •

Letter from the PI

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changing land-ocean connections alter the living ocean resources used in mariculture and harvested by rural communities. The 5-year (2023-28) proposal is coalescing around three research themes, one focused on the terrestrial aspects of the land-ocean connection, one on the marine aspects, and a third on the human dimensions of the topic. We're putting together a rough first draft of the proposal for early March and are in good shape to meet the submission deadline, which we expect to be in late summer. We received a planning grant from NSF EPSCoR to help with the effort, which we're principally using to support travel to meet with community stakeholders.

And even as we make plans for the next phase of our research, we're still steaming ahead with our current one, preparing to launch our fourth and final summer field season. We've been publishing in earnest and another season of data will serve to solidify some of our conclusions and help us to reach some new ones as well. For a look at how far our research has come since 2018, check out our new 2022 Update - it's an absorbing look at our progress and accomplishments.

I'd also like to take this opportunity to bid a fond farewell to Data Visualization Specialist Cassidy Phillips, who recently stepped down from EPSCoR to be a stay-at-home dad to his two children. We'll all miss Cassidy and his countless contributions to Fire & Ice, but he leaves our visualization efforts in the capable hands of Naomi Hutchquist, as well as a new student intern we're in the process of hiring.

Finally, I want to remind everyone that we still have rolling travel funding available. These awards can be used both for in-person travel or for remote attendance at events, so no matter what COVID throws at us next (hopefully nothing!) we've got you covered.

Sincerely,

Brenda Konar

EPSCoR in Brief

Sitka Fellowships

Alaska NSF EPSCoR is providing professional education opportunities to its researchers through a collaboration with the Sitka Sound Science Center.

Researchers Courtney Hart, Julie Schram, Joannna Young and Scott Gabara were selected as Scientists in Residency, who spend a month in Sitka furthering their research and taking part in outreach. Grad students Anushree Badola, James Currie and Hannah Myers were selected as Scientists in the Schools, who spend a week in Sitka collaborating with K-12 researchers and educators.

Hart, a UAF Fisheries Ph.D student, is in Sitka already, and has received rave reviews for her activities, including a snorkel survey search for sun stars (pictured) in terrible weather as well as public events at SSSC, Highliner Coffee, Harbor Mountain Brewing Company, and online. You can learn more about Hart in this KCAW radio spot.

Track-4 Awards

Two UAF researchers just received NSF EPSCoR Track-4 awards, which fund early-career faculty to make extended visits to research centers across the country.

Phylicia Cicilio, a Research Assistant Professor with the Alaska Center for Energy and Power, received $176,688 for her project, "Isolated Amorphous Microgrid Design with Accelerated Power System Analysis and Network Layout (IMPALA)." Cicilio was funded to work with researchers at the Laboratory for Energy and Power Solutions (LEAPS) at Arizona State University.

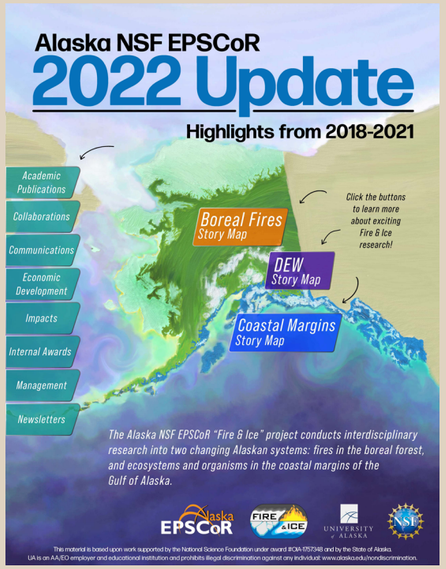
Benjamin Gaglioti, a Research Assistant Professor with the Institute of Northern Engineering Water and Energy Research Center, received $112,967 for his project, "Does Warming-driven Root Damage Lead to Drought Stress in Declining Yellow Cedar Trees?" Gaglioti was funded to work with the Laboratory of Tree-Ring Research at the University of Arizona.

2022 Update

We're pleased to bring you the "EPSCoR 2022 update," a multifaceted report that encapsulates the progress and findings of the Fire & Ice project through 2022.

The update is based around an interactive PDF, which in turn links to three "Storymap" narratives, one each for the Boreal Fires, Coastal Margins and DEW components. The PDF also leads to various sections of the Fire & Ice website that have been freshly updated to reflect accomplishments throughout the project.

It's a great way to catch up with the progress the project has made on multiple fronts as it heads into its final year and a half. "Fire & Ice" will conclude on Sept. 30, 2023. •



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If you wish to be added to (or removed from) the EPSCoR newsletter mailing list or listserv, please contact Tom Moran at tmoran3@alaska.edu or (907) 474-5581.