The Sea Grant Files

Three Projects to Watch
May 8, 2018

Hi, I'm Jesse Schomberg and you're listening to The Sea Grant Files.

I'm excited to announce that the University of Minnesota Sea Grant College Program is funding three new research projects starting in July. The projects involve:

- Beavers, streams and steelhead,
- Perfecting an enzyme coating to reduce biofouling, and
- Defining and forecasting dangerous currents on Lake Superior's south shore

These projects will span the next two years and together the results will inform natural resource policies, support coastal communities, and save lives and money. Sea Grant's investment of over $1 million in scientific inquiry includes $400,000 to support graduate research assistants. The funding comes through the National Oceanic and Atmospheric Administration's Sea Grant Program and the University of Minnesota.

Karen Gran, associate professor in the University of Minnesota's Department of Earth and Environmental Sciences, is leading the study on beavers, streams and steelhead. Gran's team is examining how beaver dams influence water temperatures, stream flow and the movement of sports fish in the Knife River, a Minnesota tributary to Lake Superior.

Experts estimate the Knife encompasses 70 percent of North Shore spawning habitat for steelhead, a migratory strain of Rainbow Trout. The Minnesota Department of Natural Resources routinely removes ten to 20 beaver dams a year along the Knife and its branches. They remove more along another area river, the Blackhoof. They do this to ensure steelhead can reach their spawning habitat. The DNR is collaborating with Gran's team on an experimental design that will leave some dams in place in some reaches of the Knife River watershed. This will clarify how beaver activity influences water temperature and stream flow while also tracking whether the dams actually limit trout migration. The research team is particularly interested in what happens in late summer, when streams are typically at their warmest and the streams can be nearly dry.

Streams that lack significant groundwater inputs, like the Knife and many others along the north shore, are sensitive to alterations in the exchange of surface water and groundwater associated with beaver dams and changing weather patterns.

Fisheries managers will use the information Gran expects to provide to refine fisheries management policies in cold-water trout streams.

Now, brace yourself. I'm going to leap from the Knife River to the Duluth-Superior Harbor, where Mikael Elias, Assistant Professor in the Department of Biochemistry, Molecular Biology and Biophysics, and the BioTechnology Institute at the University of Minnesota Twin Cities, is leading a new Sea Grant project that is testing an eco-friendly, 100% biodegradable *AND* non-toxic antifouling enzyme his research team discovered. If everything goes well, this enzyme could become *THE* ingredient that is added to underwater coatings to prevent fouling by creatures like zebra mussels.

Biofouling, a situation that occurs when things like mussels, limpets and algae attach to underwater surfaces, is the bane of shipping and other industries tied to the Great Lakes and oceans.

The researchers pursuing this project, including Randall Hicks, professor of biology at the University of Minnesota Duluth, have been working with a new family of enzymes that hijack bacterial communication in a way that prevents films of microorganisms from forming. Without a film of microorganisms, marine and freshwater life are far less likely to attach to surfaces.

Elias says one enzyme in particular, *Sso*Pox, is a promising ingredient for antifouling coatings. *Sso*Pox is derived from a microorganism that lives in harsh conditions … an extremophile collected on Mount Vesuvius, the volcano that violently erupted and buried Pompeii in AD 79.

But that's a different story. The story I want to tell is what the researchers have already done with *Sso*Pox. They've conducted proof-of-concept experiments suggesting that an engineered variant of *Sso*Pox's lactonase is capable of preventing biofouling in seawater and can reduce accelerated corrosion rates related to thin coatings of bacteria by 50 percent after two months in the water of the Duluth-Superior Harbor. Antifouling coatings using this enzyme are also 1,000 times less toxic than the popular copper-based coatings currently under scrutiny worldwide. Elias won the 2017 Early Innovator Award from the University of Minnesota, in part for developing this technology that disrupts the way bacteria attract each other.

With Sea Grant funding, the researchers are conducting longer-term tests of enzyme-based coatings in the Duluth-Superior Harbor. Among other things, they expect to improve the coatings by optimizing enzyme activity, stability, durability and release. By 2020, the researchers expect to relate changes in microbe fouling

rates associated with the enzyme-based coating to changes in the composition of bacterial communities. This new coating technology could reduce biofouling more effectively and with far fewer environmental consequences than other methods.

The University of Minnesota's MnDrive Initiative is supporting complementary work to investigate the enzyme's effectiveness against biocorrosion and fouling by plants and animals.

And the last project? This one I'm extra keen on because I'm involved. For those who know me and my role in educating people about Great Lakes rip currents, you'll understand why I'm enthusiastic about defining and forecasting dangerous currents on Lake Superior's South Shore. This project is co-led by Lian Shen, Professor in the Department of Mechanical Engineering and Director of the St. Anthony Falls Laboratory at the University of Minnesota Twin Cities and Chin Wu, Professor in the Department of Civil and Environmental Engineering at the University of Wisconsin – Madison. I and a host of colleagues are collaborating on this project. Dangerous currents on the south shore of Lake Superior have imperiled lives and even killed people. The project team expects to improve dangerous current advisories and to make these safety messages easily accessible to recreationalists and communities along the Minnesota and Wisconsin coasts. The team is using remote sensing analysis, field measurements and cross-scale modeling to characterize dangerous currents and to better understand the mechanisms generating them. We're also developing an Integrated Nowcast-Forecast Operational System for dangerous currents in Lake Superior. This system, which integrates real-time water observations and a nearshore circulation model, will predict present (nowcast) and future (forecast) dangerous currents. By 2020, we expect that recreationalists and communities along Lake Superior's south shore will be more aware of dangerous currents and will be using the nowcasts and forecasts. This project is jointly funded by Wisconsin Sea Grant.

And … this episode of the Sea Grant Files was produced by Rachel Wachtler, Sharon Moen, Maija Jenson, KUMD, and me, Jesse Schomberg. For more information or to listen to more episodes of The Sea Grant Files visit Minnesota Sea Grant at www.seagrant.umn.edu. You can also follow Minnesota Sea Grant on Facebook or Twitter. Thanks for listening.