It’s a mystery to set a coastal engineer’s heart aflame. Why are the steel piers, cofferdams, pilings and walls that form the bones of the largest port on the Great Lakes—the Duluth-Superior Port—corroding at an accelerated rate? The plot thickens when you consider that the corrosion levels were significantly higher than typically seen in fresh water and that other Great Lakes ports had not yet seen evidence of this in their own structures.

In fact, this mystery has set Gene Clark’s ticker racing as he teamed with colleagues to get to the bottom of this premature, extensive and costly infrastructure failure mechanism. Pits and holes, some as large as a softball, dot the harbor structures. The first assessments identified 13 miles of corroded steel sheet piling and structures requiring replacement, estimated at $1,500 per lineal foot or $120 million in all.

The Duluth-Superior Port annually moves more tonnage than any other Great Lakes port. The projected value is $12.6 billion, supplying 73,719 jobs and representing $3.2 billion in personal income (figures from a 2011 study by Martin Associates). Something had to be done!

“I recall when I first learned about the problem, back in 2004,” said Clark, Sea Grant’s coastal engineer. “I was at a port meeting sitting next to Jeff Gunderson, then the assistant director at Minnesota Sea Grant. At the end of the engineer’s...
A long and proud tradition in nautical history calls for naming the vessels that ply fresh and salty waters. The Aquatic Sciences Center would be remiss if it didn’t also name its craft. Last year, the center’s Information Systems Engineer James Grandt put his skills to use and built an underwater remotely operated vehicle (ROV) from an open-source kit.

Now, it’s an open-call contest. This proud little craft needs a name. Send suggestions via email to linda@aquawisc.edu or through the U.S. Postal Service to the attention of Linda Campbell, Aquatic Sciences Center, 1975 Willow Drive, Madison, Wis. 53706. Suggestions must be received by Jan. 31, 2015. All suggestions will be entered in a random drawing to win an annual pass to Wisconsin’s State Park System.

The ROV is a popular fixture at public events, including the annual Grandparents University at the University of Wisconsin-Madison, the Wisconsin State Fair and the Wisconsin Science Festival. ROVs can navigate to underwater places where human divers can’t and help gather photos and/or water samples.

Watch a lively video at ASC’s YouTube channel, go.wisc.edu/31003l, documenting the ROV’s construction.

"We weren't out there to study this," said Steven Loheide, an associate professor of civil and environmental engineering with the University of Wisconsin-Madison, and his then-undergraduate student Matthew Weber went out to a stream in Barneveld to collect some general data on its flow.

"It made us wonder—what's going on?" Loheide asked.

Several weeks of observation and data collection gave them the beginnings of an answer. The stream's dynamics were being heavily influenced by frequent ice formation and ice melt. It turned out that the formation cycle was occurring one out of every four days between December and February, and it was causing the stream depth to increase more than 100 percent as the ice cover slowed down the in-stream water velocity.

"We weren't out there to study this," said Loheide. "This is a process unrecognized in the literature. It's a big gap. We don’t know the full importance, but we know it's definitely affecting in-stream hydraulics and potentially inducing hyporheic exchange."

Loheide is referring to the hyporheic zone, a mixed zone in a stream bed where surface and groundwater mix, creating critical chemical exchanges that have an effect on both the stream itself and the surrounding aquifer by filtering out contaminants and providing habitat for benthic organisms.

"Because it's happening in winter, we wouldn't expect this to have a big impact on nutrient cycling," said Weber. "But if it's happening frequently—as it seems to be—the stage fluctuations will have an impact on streambed morphology and potentially affect benthic organisms like overwintering fish eggs and macroinvertebrates in the stream itself." The dynamic could also have positive effects. One possibility is that increased winter ice regimes could be backing water up into the landscape, creating a reservoir and making more water available for ecosystems long after the ice is gone.
This year a record three Wisconsin graduate students were selected for the Dean John A. Knauss Fellowship—Caroline Mosley, Catherine Simons and Kristina Surfus. This competitive program matches highly qualified graduate students with "hosts" in the legislative and executive branches of government located in Washington, D.C., for a one-year paid fellowship. All three are graduates of UW-Milwaukee’s School of Freshwater Sciences (SFS), and all three are tremendously bright and ambitious. They’ve come to the program from different directions, but each has extensive academic and field experience. To meet them, read on.

CAROLINE MOSLEY

Given that even her advisor has trouble keeping up with Caroline Mosley, Washington may want to think about preparing itself.

For the last two years, she’s been helping Harvey Bootsma, an associate professor with SFS, with his research on the effects aquatic invasive species are having on Lake Michigan’s ecosystem.

“Well, that and maybe just a few things more,” said Bootsma. “What impresses me about Caroline is her initiative and confidence,” said Bootsma. “Over the two years we have worked together, Caroline has repeatedly surprised me by taking the lead on a number of high-profile outreach and service activities, including the organization of a Run4Water day, serving as president of the UW Student Water Council, representing students on our school’s Planning and Governance Committee and traveling to Guatemala to work with Engineers Without Borders on a water supply project.”

“I can’t keep up with all these initiatives,” he added. “I usually learn about Caroline’s involvement after the fact.”

Did we mention that Mosley’s also fluent in German and ran the Boston Marathon this year?

She was born in West Bend, Wis., and she dual-majored as an undergraduate at Creighton University in Nebraska. She began her educational career with designs on medical school, until sophomore year when a freshwater ecology course shifted her interests to environmental science.

“Basically, I’m looking at mussel poop,” she joked.

Her timing couldn’t have been more opportune. She arrived on our school’s Planning and Governance Committee and traveled to Guatemala to work with Engineers Without Borders on a water supply project.”

She’s spent the last two years examining the process of phosphorus recycling by profundia quagga mussels.

“I’m happy there’s a program like this for people like me,” she said.

“Dirty Hands and Clean Water
Wisconsin Sends a Record Three Knauss Fellows

continued on next page...
Kristina Surfus is drawn to water. It’s something she’s always known about herself, but it was recently driven home as she searched for photographs of herself in response to a writer’s request. Everything she found included or was related to water: A picture of her kayaking on the tranquil Milwaukee River. A picture of her struggling through falling water in the Julian Alps in Slovenia. Even a professional photo of her taken in Milwaukee backdrops her against a window showing rain falling on the streets of the city; a subtle echo of her interests in sustainable urbanism and water management.

That love of water continues to drive her life, and it’ll soon sweep her toward Washington, D.C. Surfus already has some Beltway experience under her belt—while she was an undergrad at Boston University, she served as an intern in the office of Oregon Senator Wyden, where she got some first-hand experience with policy making.

“I’m excited to apply what I’ve learned in a legislative setting,” she said of her return to her nation’s capital. “I’m looking forward to getting more working experience in coastal resource management and a stronger sense of how it all comes together in the policymaking world.”

When she began at Boston, she was a tentative biology major, unsure of her path. By the time she was done, she held degrees in international relations and environmental analysis and policy.

Surfus was born and raised in Milwaukee, but when it came to her post-graduate academic and professional development—a focus on urban planning and water resource management, please—she figured she’d have to search elsewhere, maybe toward the east coast again, to find just the right program.

But it turned out that it was in her front yard all along. SFS gave Surfus the opportunity to delve into freshwater economic policy. Most recently, Surfus has been working side-by-side with SFS Professor Sandra McCallan on a project examining the causes and economic impacts of degraded beaches in Milwaukee.

“Kristina’s making great contributions to our Sea Grant project,” said McCallan. “She does everything from dropping current meters into the lake to working on the economic analysis that will tell us what a healthy beach is worth. Her background and personality have allowed her to jump into all these activities and get results.”

It’s been a blast for Surfus as well. “I’ve really appreciated the chance to work in a lab and do more of the research and lab work than I thought I would,” she said. “It’s been pretty remarkable how it’s all worked out. I’m really excited to be exactly where I’m at.”

Fresh on the heels of graduating from SFS with a master’s degree in freshwater science, Surfus dove in to complete a second master’s degree in economics, also at UW-Milwaukee, while continuing her research.

“Kristina exemplifies a truly interdisciplinary researcher who will be able to address some of our biggest challenges because she has a well-rounded experience in both the natural and social sciences,” said McCallan.

Surfus is aiming for a career that combines coastal research policy and management, and she’d love to return to the Great Lakes region to pursue it.

“I have a real passion and appreciation for the region,” Surfus said.

From interning for a senator to completing two master’s degrees (freshwater science and economics) and then to Sandra McLellan’s lab at SFS, Kristina Surfus has the range of experience and education to make her an excellent candidate for a career in coastal research policy and management.

Katherine Simons operates her life by a fairly simple and determined principle: If something looks like it’s never going to work, make a way. It’s what she’s used to navigating her winding and far-flung career road, a path that’s taken her from rural Boscod, Wis., to Minnesota and Tanzania.

Immersing herself in the intricacies of the federal government's policy wing is something Simons has had her eye on for some time. She knew she had to bolster a social-science background with some hard science to reach her professional goals.

“It was an intentional leap to get my hands dirty with the science,” she said. “I wanted to pursue something scientifically rigorous but [that] had policy implications.”

That’s what led her to SFS. Simons was listening to National Public Radio when she heard Jenny Kehl, director of SFS Center for Water Policy, talking about international freshwater concerns. She realized she found her ideal academic advisor.

Over the next few years, the two would team up on several projects related to international trans-boundary water-use issues, as well as Simons’ master’s thesis, which compared the water quality of tap and bottled water in ten major cities, including Milwaukee.

Simons also assisted UW Sea Grant social scientist Jane Harrison in surveying anglers about their reactions to massive cleanup efforts in the Sheboygan River Area of Concern.

“Catherine shows a strong commitment to environmental policy, practice, science and governance,” said Kehl. “Her combined interests in science and policy are innovative, and she has high abilities in both, which is a rare combination.”

Simons’ interest in international economic and water issues actually began at a young age, inspired by a visit her family took to spend with her uncle, who was working at the time as an international development consultant in Malawi. Simons would return to Africa after graduating from high school in Manitoba, Canada, spending a year in Zambia working with street children infected with HIV.

While in Africa, she took several side trips, including a jaunt to Tanzania. It was like a bolt of lightning for Simons. “I got off the train and was blown away,” Simons recalled. “This is the most beautiful place I’ve ever seen.”

Simons was especially drawn to the elegance of Swahili, Tanzania’s national language. It’s one of the reasons she chose to matriculate at the University of Minnesota, one of the handful of American universities that included it in the language program.

Wisconsin Sends a Record Three Knauss Fellows

The University of Wisconsin-Milwaukee has sent a record three students to the National Oceanic and Atmospheric Administration (NOAA)’s Knauss Legislative Fellowship Program, the program’s largest number of fellows ever from Wisconsin. It’s something she’s always known about herself, but “I like expanding my horizons,” she said. “So it’ll be interesting to learn about the legal and policy side of things. I just keep finding more things to do.”

CATHERINE SIMONS

Catherine Simons

Katherine Simons operates her life by a fairly simple and determined principle: If something looks like it’s never going to work, make a way. It’s what she’s used to navigating her winding and far-flung career road, a path that’s taken her from rural Boscod, Wis., to Minnesota and Tanzania.

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Minnesota also offered an unusual international student exchange program with the main university in Dar es Salaam, Tanzania’s capital city. Simons filled out the appropriate forms (“It was probably more writing than I did for the Knauss program,” she joked) and got accepted—only to discover that security issues in Tanzania caused the program to be cancelled.

So again, she found a way.

Under the guidance of sociologist Ron Aminzade, Simons developed her own undergraduate research project, eventually winning a $1,700 grant to travel it with her own savings and spending eight months researching the effects of invasive water hyacinth and decreased water levels on local communities living on the shores of Lake Jipe, a lake straddling the borders of Tanzania and Kenya.

“There were many complex issues beyond Lake Jipe’s obvious environmental degradations,” she said. “One of the challenges being the divergent priorities of local stakeholders, the Tanzanian and Kenyan governments, regional industries and international NGOs,” she said. “I learned that science and policy go hand in hand.”

Since graduating from SFS with her master’s degree in water policy in May, Simons has taken a trip to Turkey and Greece during which she attended an international economics conference, and she’s eager to be back in Washington, D.C.—all the better to move toward one of her career goals: working for the United Nations.

“I’m anxious to get going on what my career path will be,” said Simons. “If it involves international and water, I’d be set.”

Kristina Surfus is a true interdisciplinary student exemplifying a truly interdisciplinary researcher who will be able to address some of our biggest challenges because she has a well-rounded experience in both the natural and social sciences, said Professor Sandra McCallan.
Tackling the Problem of Ghost Nets

Once they break free, they drift unrestrained, buoyed, submerged and battered by the wild waters and shifting ice sheets of Lake Superior. Yet they continue to entrap fish, waterfowl and marine debris, even though no fishermen will come to claim and clear them.

They’re called ghost nets, and they’re a problem in Lake Superior, where commercial and tribal fisheries depend on gill nets for their livelihood. In the Apostle Islands area alone, there are hundreds of commercial and tribal fish nets, spanning tens of miles. Sometimes, these nets come unmoored, creating hazards for wildlife and for recreational boaters and anglers.

To tackle the problem, Wisconsin Sea Grant has partnered with the Apostle Islands Sport Fisherman’s Association (AISA) and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Law Enforcement Team. Using a two-year, $25,000 investment from the National Oceanic and Atmospheric Administration’s (NOAA) Marine Debris Program, the three groups will spend the next year organizing proper tool use and implement a GPS-based system for identifying, tracking and reporting ghost nets, as well as creating a series of public workshops aimed at educating commercial and tribal fishers, and their importance to the economy, and it’s certainly not their fault that nets break free. We can cooperate and make the whole situation better.”

Seilheimer agreed. “It’s a win-win for both sides,” he said. “Recreational anglers don’t want to get entangled. For the commercial side, not losing your gear is a good thing.”

Production on the first educational video is underway, and workshops are scheduled to begin early in 2015. — ABO

Dioxin Exposure—Dramatic Effect on Fish Sexual Development, Harm to Nose Tissues

Wisconsin Sea Grant-funded researcher Michael Carvan (right) and his research team fed both young rainbow trout and zebrafish food containing different levels of TCDD (tetrachlorodibenzo-p-dioxin) over a six-week period. Carvan, Shaw, Associate Scientist at the University of Wisconsin-Milwaukee School of Freshwater Sciences, said their technique “more closely mimics actual environmental exposure to dioxin.”

They found that 28 days of exposure to high doses of TCDD (100 parts per billion) caused lesions in the zebrafishes’ noses, livers, kidneys, intestines and ovaries. The lesions in the fishes’ nose tissue are concerning because fish use their noses to navigate through water and to find streams for spawning. While testing whether the fishes’ sense of smell was impaired by dioxin exposure was not part of Carvan’s research, he’d like to follow up to see if lesions lead to behavioral problems and impeded spawning success.

Another surprising finding was that dioxin acted as an endocrine disruptor.

“It had a dramatic effect on the development of the female zebrafish reproductive tract,” said Carvan. “Histopathic Alterations Associated with Global Gene Expression Due to Chronic Dietary TCDD Exposure in Juvenile Zebrafish,” published on July 2 in PLOS ONE. go.wisc.edu/tqk963

For more information, see these articles:

■ “Histopathic Alterations Associated with Global Gene Expression Due to Chronic Dietary TCDD Exposure in Juvenile Zebrafish,” published on July 2 in PLOS ONE. go.wisc.edu/tqk963

■ “Gene Expression and Pathologic Alterations in Juvenile Rainbow Trout Due to Chronic Dietary TCDD Exposure.” go.wisc.edu/ z309p published in 2013 in Aquatic Toxicology — MEZ
Clean, Drain, Dry: On the Fishing Tournament Circuit With Jeremy Jones

For the past two summers, Jeremy Jones has been on the front lines of Wisconsin Sea Grant’s efforts to partner with fishing tournament organizers to raise awareness of the ways these events, and the anglers who participate in them, can prevent the spread of aquatic invasive species. In states like Minnesota, Michigan, Arkansas and, of course, Wisconsin, he’s given AIS talks at tournament rules meetings, run boat washing stations and worked to recruit and train local support groups to run them. We caught up with him at the end of the summer, and here’s a short excerpt of the conversation.

For the full interview, see go.wisc.edu/6983ks.

So what have you seen change since you began this outreach project? I think what we’ve seen is an evolution in the thought pattern behind the tournament organizers, who are their own set of people. These are people who have to run a business—that’s important to realize. They have a thin line to make any money and make sure it’s a safe and fun tournament that also generates revenue for their anglers. These guys have evolved in their thinking—they view the AIS message very positively and they see it as something they want to embrace because they want to prevent any more regulation, and they also want to show they’re good stewards of the resource. They also believe that AIS issues can affect the fishing itself, whether it’s tarnishing the reputation of the tournament or through tarnishing the fishing itself.

I think that anglers are also continuing to embrace the message, continuing to try to get it. More and more, as we work longer with it, they’re more willing to talk about it and more willing to talk with us, which is a huge stride. There’s a pretty big gulf between the pro tournament anglers and the research that goes into AIS, and this outreach project has really bridged that gap. So their patterns are evolving, and the hope is really in reaching the younger folks.

Where does the effort need to go from here? In terms of where we need to go from here, I think the essential message is out there. It is, at times, hard to find support groups, volunteers to take on the actual AIS prevention steps like running boat wash stations. Tournament organizers are our partners in this, and they’re enthusiastic. The support group part is evolving—sometimes the support groups are there and sometimes they’re not. As long as they get trained and they have some fun, learn a little bit about AIS and give some service, they tend to come back. If they’re not there to begin with, they’re tough to find. That’s where the work is—ABC.

Surface and Groundwater

On larger rivers, this type of ice-formation process creates troublesome ice dams and ice jams that can wreak havoc on docks and shoreline structures. In a small stream like the one in Barneveld, the effect isn’t nearly as easy to see.

“The question we’re pursuing is, how does it affect surface-groundwater connections?” Loheide asked. “We [scientists] haven’t looked at how ice level affects that.”

Having discovered the phenomenon in a small single stream, Loheide and a new graduate student will use funding from the UW Water Resources Institute to see if it occurs—and if so, how often and how it varies—in other geographic areas around the state.

“The new project looks at the bigger picture,” said Weber. “What are the other conditions that allow for this to occur?”

More specifically, beginning in fall, the new student will pore over raw historical data collected by the U.S. Geological Survey using stage and ice regime changes to identify long-term trends. The second stage of the study, which won’t begin until next winter, will involve measuring the ice regimes at five different sites in Wisconsin, looking specifically at the quantity of water exchanged between the stream and the adjacent aquifer. Finally, Loheide and his student will take what they’ve gathered back into the lab and model it. Given that the stream dynamics are tied to the length and severity of winters, which in turn are tied to the discussion on climate change, Loheide’s work takes on an added significance.

“The exciting part of this project is that it’s so new,” Loheide said. “This is not like working out the third decimal point of a discovery that’s already been documented. This is an entirely new process.”—ABC.

Through DNA analysis, researchers pinpointed the process by which specific iron-oxidizing bacteria attach to carbon steel, creating tubercles of biomass and corrosion products. Conditions beneath these tubercles cause copper dissolved in harbor water to precipitate and adhere to the iron. When ice chunks scrape against those pilings each winter, the tubercles break, exposing the copper-covered iron to oxygen. This causes the steel in those pitted areas to corrode at a faster rate.

Clark noted, “One of the nagging questions we had during the early stages of the studies was why is the steel corroding faster now than in the past? It turns out that the corrosion has accelerated since the 1970s, which is when we really started to clean up our harbor thanks to the Clean Water Act. The bacteria and the copper were always present, but perhaps we created the ‘perfect storm’ by providing for a cleaner environment in which the bacteria thrive.”

Other Lake Superior freshwater ports have begun to see structural deterioration. Deeply pitted steel has been found in Two Harbors, Minn.; Ontonagon and Houghton, Mich.; Ashland and Bayfield, Wis., and Thunder Bay, Ontario. Thanks to past work, Clark now knows how to advise those port managers.

Mystery solved. Money saved. Jobs protected. Award won. Plus, there’s a coastal engineer with a now-normalized heart rate, unless you count his pleasure with the national accolades.

“The award is certainly a surprise and greatly appreciated. And this successful team effort of applying sound science to a very difficult problem and coming up with solutions that will save our Lake Superior ports millions of dollars is our greater reward,” said Clark.—SMH
CALENDAR OF EVENTS

JAN. 21, 2015
The River Talks
Superior, Wis.
seagrant.wisc.edu

FEB. 22-27, 2015
Association for the Sciences of Limnology and Oceanography
Granada, Spain
sgmeet.com/aslo/granada2015/

FEB. 8, 2015
Lake Sturgeon Bowl
Milwaukee
glwi.uwm.edu/sturgeonbowl

FEB. 19 – 22, 2015
Aquaculture America 2015
New Orleans
bit.ly/1p5w1

MARCH 5-6, 2015
American Water Resources Association – Wisconsin Section Meeting
Oconomowoc, Wis.
awra.org/state/Wisconsin

PUBLIC NOTICE:
Federal Review of the University of Wisconsin Sea Grant College Program

Wisconsin Sea Grant will undergo a program review by a site review team convened by the director of the National Oceanic and Atmospheric Administration-National Sea Grant College Program on April 21 and 22, 2015.

Members of the public are invited to email comments on the management aspect of the Wisconsin program or its engagement with stakeholders on or before March 21, 2015. Comments should be sent to oar.sg.feedback@noaa.gov.