Limnology News

Center for Limnology

College of Letters & Science
UNIVERSITY OF WISCONSIN–MADISON

FLAMe Illuminates New Way of Looking at Rivers and Lakes

by Adam Hinterthuer

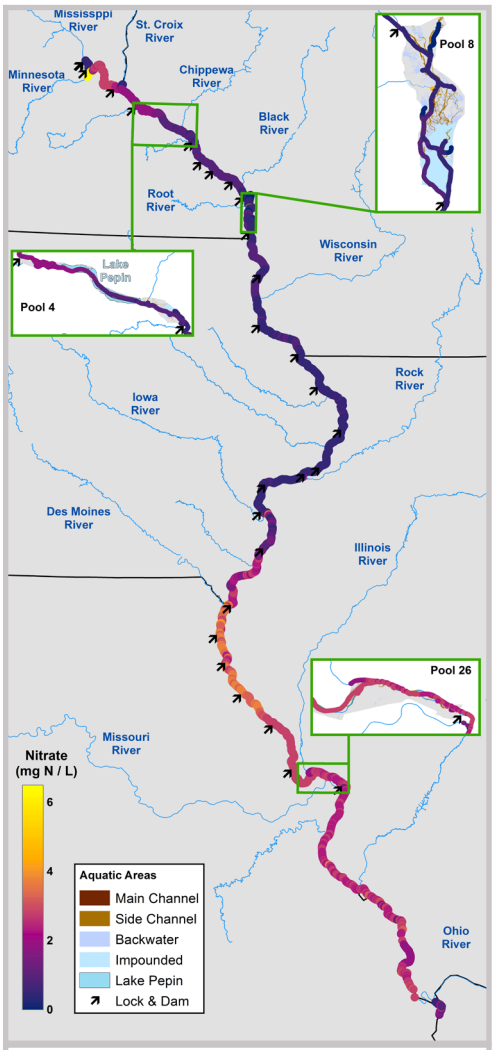
On the first day of August, at Hidden Falls Regional Park in St. Paul, Minnesota, Center for Limnology (CFL) graduate student Luke Loken boarded an 18-foot-long Boston Whaler and headed upstream. At the Washington Avenue Bridge, the starting line of his research adventure, he pointed the boat downriver, where his final destination lay – only two weeks, 26 lock and dams, and 900 river miles away.

The trip, financed by the United States Geological Survey's (USGS) "Land Carbon Project", would be the biggest test yet for a research tool designed by Loken and USGS post doctoral researcher, John Crawford (PhD, 2014). Called the FLAMe, short for "Fast Limnological Automated Measurements," the contraption consists of a water pump, a series of pipes and tubes and $100,000 worth of sensors. As their boat moved across the surface of the Mississippi, a continuous stream of water would be sucked into the FLAMe and passed over sensors recording everything from turbidity to temperature to nitrate levels, before being discharged back into the river.

"At the heart of the FLAMe are these automated sensors that are commercially available and widely used by limnologists everywhere," says CFL faculty member, and Loken's advisor, Emily Stanley. "But what [researchers] usually do is park them on a buoy or put them in a particular place in a stream and they get really good data at that site over time. With the FLAMe, instead of parking these devices in one place, we bring the water to the devices and take the devices everywhere."

Instead of datasets over long time series, says Stanley, the FLAMe produces maps over large areas. "We don't have that spatial understanding of our ecosystem in the same way that a terrestrial ecologist does," she says. "The FLAMe gives us a whole new way of seeing lakes and rivers that we just haven't had before."

Part of that new look is now a map of Loken's journey, showing how the river chemistry and conditions changed as the crew passed through different pools of the river or encountered tributaries flowing into the main channel. Loken was joined for the trek by Crawford; Washington State University postdoc Steve Powers (PhD, 2012); and a handful of other scientists from the USGS and University of Minnesota.



The FLAMe takes real-time samples at large spatial scales-like 900 Mississippi miles of nitrate concentrations.

"We had two main objectives," says Loken. "One was [to] shoot all the way down the middle of the main navigation channel, lock through the dam and then just keep going. The second was to spend more time in a subset of pools, and head into the backwaters and explore some of the lateral variability of the river."

The end result of the trip was mountains of data points, one gigantic gas bill and affirmation of the vast possibilities of the FLAMe.

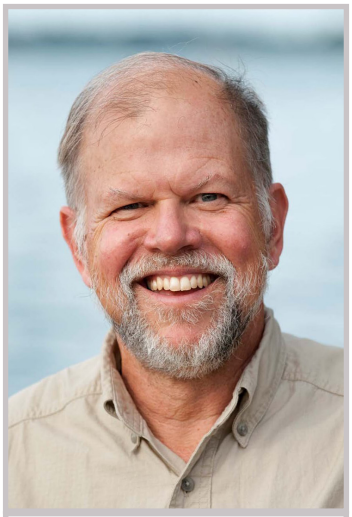
The FLAMe project began early in the summer of 2014 when Loken and Crawford, who was then a graduate student, started thinking about ways to better bring spatial variability into their data collection.

(FLAMe article continued on page 3)

Notes From the Director

by Stephen Carpenter @FreshwaterSteve

Safe Operating Spaces for Lakes, Young Scientists and CFL



Stephen Carpenter, Director, UW-Madison Center for Limnology. Photo courtesy of UW Communications.

Liminality was everywhere in 2015. Any resemblance to the word "limnology" is mere coincidence; "liminality" comes from a different root, the Latin word for "threshold." It refers to the state of ambiguity in the middle of a transition, when the old is in flux and has not yet become the new.

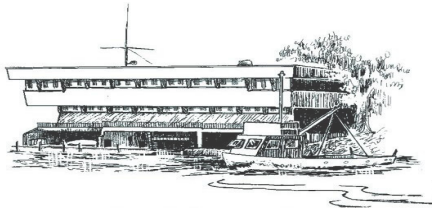
Life in the liminal can be a time of creativity and experimentation. Graduate students, living in the gateway between their undergraduate experience and future career, often show bursts of creative energy that drive innovation at CFL. Examples are sprinkled throughout this newsletter. In a unique collaboration, five graduate students (Chelsey Blanke and Ali Mikulyuk from CFL, Helen Bullard and Jojin Van Winkle from Art, and Sigrid Peterson from Sociology) are exploring liminality in art and science. After meetings at Trout Lake Station (TLS) and the "Imagining Resilience" conference in Uruguay, the students embarked on co-evolving art and science projects during this academic year. Together they will investigate whether engagement with art changes science, and vice-versa.

In ecology, thresholds are doorways between sharply different kinds of ecosystems. Ecological change, whether gradual or abrupt, is central to most of the basic science at CFL. In natural resource management, thresholds bound healthy ecosystems from failing ones. In this context, thresholds outline a safe operating space for healthy natural resources. Earlier this year, CFL alumnae Elena Bennett, Reinette Biggs, and I published a new estimate of the safe operating space for the global phosphorus and nitrogen cycles. Unlike previous estimates based on ocean hypoxia, our estimates are based on water quality of the world's lakes and suggest a much lower threshold for phosphorus runoff on the planet. As we think globally about local choices, research on safe operating spaces helps managers find strategies to maintain healthy lakes and watersheds in the face of changing global climate.

Here in Wisconsin, we're also working on ecological thresholds, as CFL faculty, students and postdocs collaborate with UW-Stevens Point, Wisconsin Department of Natural Resources (WDNR) and USGS to launch a new project to find a safe operating space for walleye fisheries in northern Wisconsin.

Healthy institutions also have safe operating spaces. This year the University of Wisconsin System received unprecedented budget cuts from the state combined with a cap on in-state tuition. These cuts triggered the cancellation of more than 300 courses with about 9,000 seats for students and the permanent loss of about 100 faculty and staff positions in the College of Letters & Science alone. The legislature also shifted responsibility for faculty tenure and shared governance from the state to the University system. At UW-Madison, tenure and shared governance will continue to operate as they have in the past. Although the impacts are severe, particularly for undergraduate education, the safe operating space for UW-Madison and the CFL is intact. Unfortunately the media have reported a disaster scenario for UW-Madison. Sometimes a change is not a threshold. To paraphrase a certain novelist with limnological leanings, "Reports of our collapse are greatly exaggerated."

Nonetheless, the safe operating space for the CFL will depend increasingly on private gifts as state support for education dwindles away. CFL faculty continue to compete for agency research dollars, but superb research training programs cannot be supported by government grants alone. We are fortunate to have many friends who support our initiatives, including the projects reported in this year's newsletter. Thanks for helping CFL live in the liminal, always moving forward to provide transformative experiences for future generations of undergraduate, graduate and postdoctoral limnologists.



Zebra Mussels Found in Lake Mendota

by Adam Hinterthuer

In the fall of 2009, a group of UW-Madison undergraduates made a startling discovery in the waters off the campus shoreline. Spiny water fleas, a type of invasive zooplankton believed to be suited only to cooler lakes in more northern climates, turned up in their nets as they collected samples for their lab session.

This October, Zoology 316, the popular undergraduate limnology lab, struck again: zebra mussels, the Great Lakes' most infamous invasive species, have arrived in Lake Mendota.

While the discovery of the spiny water flea left scientists wondering how a cold-water animal was thriving in a warm-water lake, the big question surrounding zebra mussels is "what took them so long?"

This zebra mussel, with its telltale striped pattern and D-shaped shell, was collected from rocks just off the Hasler Lab pier.

"I would have predicted that they would have gotten here earlier," says Jake Vander Zanden, a professor at the CFL and expert on aquatic invasive species. "It's not that it's inevitable our lakes get invaded, but we've known that Mendota is a good candidate for a long time."

To read more about the discovery, and to see videos, slideshows and more content about how CFL faculty and students are researching zebra mussels in Lake Mendota, head over to our blog – www.limnology.wisc.edu/blog - and search for "zebra mussels."

FLAMe, continued from page 1

The first version of the FLAMe consisted of about $50 worth of PVC pipes and miscellaneous hardware and measured carbon dioxide and methane, the two sensors Crawford already had. But, after a few runs across Lake Mendota, Loken and Crawford put together a map that showed the high variability of gas emissions at any given time. When they showed those maps to CFL faculty, Loken says, "we instantly saw a light bulb going off." Then, he says, "we started finding the other instruments to go along with it, because if you're going to measure one thing, you might as well measure all the other things you can."

That initial success led to requests for FLAMe-collected data on other projects, like CFL director Steve Carpenter's work on ecosystem regime shifts in northern lakes. And that momentum led to an intense 2015 field season where the FLAMe sampled 84 different lakes and more than a 1,000 miles of rivers.

That's a lot of ground covered, but the FLAMe is far from a finished project, says Stanley. "We want to take FLAMe to a new level," she says, "where we can drive the boat and almost see the map [of conditions] as we drive." But first, "We need to overcome some of the technical hurdles [Loken and other colleagues] exposed this summer by driving all over northern Wisconsin."

That's why Stanley and Loken recently collaborated with the UW-Madison's Physical Sciences Lab, where some of the same engineers who worked on the UW's vaunted Ice Cube project in Antarctica took a look at the FLAMe, upgrading it with stainless steel and anodized aluminum components.

Luke Loken and the FLAMe on the Mississippi River.

With this new, improved version, Loken anticipates doing weekly runs on Lake Mendota next year in the hopes of catching dynamics like changing oxygen levels, water chemistry and algal blooms and, essentially, making a movie of the always shifting surface of the lake from spring to fall.

Even with the all-new FLAMe, though, there's a catch. "It depends on how much gas they let us burn," he laughs. "We kind of maxed out [our] gas card last summer."

Lake Invaders Raise the Cost of Conservation Efforts

by Adam Hinterthuer

Jake Walsh spends his days at the CFL chronicling an all-out war in Lake Mendota. He's now ready to put a price tag on the collateral damage.

The battle is between two tiny species of zooplankton – *Daphnia pulicaria*, a voracious native grazer of algae in our lakes and *Bythotrephes longimanus*, or the spiny water flea, a voracious invasive predator of our algae-grazing friends.

The invasive spiny water flea has researchers wondering-what's the price of green water?

The problem, says Walsh, is that "as phosphorus pollution leads to algae blooms and lower water quality, we are also losing the critters that keep that algae at bay." When their numbers are abundant, *Daphnia pulicaria* can eat algae almost as fast as it grows. In fact, this leads to the "clear water phase" we often experience each spring in our lakes.

But, since a group of undergraduate limnology students first discovered spiny water fleas on a Lake Mendota field trip in 2009, says Walsh, "we've lost over 80% of our *Daphnia pulicaria*, the big *Daphnia* that eat a ton of algae. I used to pull in hundreds of thousands of [them] in a single sample during fall sampling. This fall, I often only found a single tiny individual in my net."

The result is murkier waters. Since 2009, CFL scientists have documented a 3-foot loss of water clarity in Lake Mendota, which is where the price tag comes in.

According to previous economic surveys, the value of 3 feet of water clarity in Lake Mendota is, at a county level, $140 million. That number seems big, but clear water affects almost every way that we experience a lake. It means better fishing, better boating, better swimming, more valuable lakeshore property, and fewer harmful algae blooms.

Making matters worse, the 2013 Yahara CLEAN engineering report estimated that restoring 3 feet of water clarity – primarily by reducing agricultural runoff - could cost upwards of $170 million. That's nearly a third of a billion dollars to get a single lake's water quality back – all thanks to one tiny crustacean.

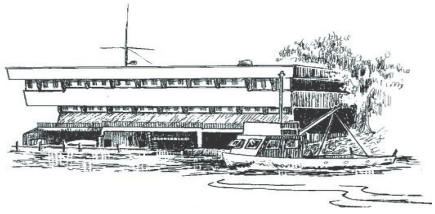
How can microscopic crustaceans add up to such a steep bill? The answer lies in what may seem like an unrelated problem. Being "the dairy state" comes with its own price tag, which we often pay for in the form of water clarity. Cows create a lot of solid waste and that manure is loaded with nutrients. Dairy farmers spread manure on fields to fertilize corn and soybean crops, but some runs off into nearby waterways and downstream to our lakes. While there are other sources of phosphorus in our waters, studies have linked more than 80% of the input to these agricultural sources. In our lakes, those nutrients, primarily phosphorus, are just as good at growing algae as they are at growing crops. And now there are fewer *Daphnia* to eat it.

Walsh is currently working on a number of projects, including coring the lake sediment to see how far back the invasion extends. He's already found water flea eggs preserved in sediment from before 2009. He's also designed a population model that could help researchers figure out where and when the spiny water flea might become abundant in other Wisconsin lakes. "If we can figure out where spiny water flea is most likely to become abundant and have problems," Walsh says, "we can be more efficient with where we allocate our money."

Jake Walsh taking a sediment core on Lake Gogebic on the Upper Peninsula of Michigan.

Photo: Carol Warden

Considering the steep cost of dealing with the aftermath, it's an important pursuit. For anyone who loves a lake, Walsh's work reinforces the message of cleaning boats and fishing tackle and not transferring live bait from lake to lake – all measures that can help keep the spiny water flea from hitting our lakes, and our wallets, quite so hard.



FishWorks Helps Break Down Barriers, Get "Bigger Bang for Your Buck"

by Kelly April Tyrrell

A few years ago, researchers, led by the CFL's Pete McIntyre, created the first map of all the road crossings and dams blocking rivers and streams that feed the Great Lakes. These tributaries serve as migratory highways, providing fish like walleye and lake sturgeon access to headwater breeding grounds.

"It painted a pretty horrifying picture of what it's like to be a fish in the Great Lakes Basin," says McIntyre, an assistant professor in the Center, who led that study. "Seven out of eight river miles are completely inaccessible to the fish."

A new study from the same team, published earlier this year in the Proceedings of the National Academy of Sciences, describes a new model to help decision makers maximize the cost-effectiveness of barrier removal projects that restore migratory fish habitat. Recent years have seen growing efforts to chip away at the 7,000 dams and 230,000 road crossings that disrupt the basin's 661 tributaries.

Notes Tom Neeson, lead author of the study, "If you're going to spend money on barrier removal projects, isn't it critical to know which projects are going to give you the biggest bang for your buck?"

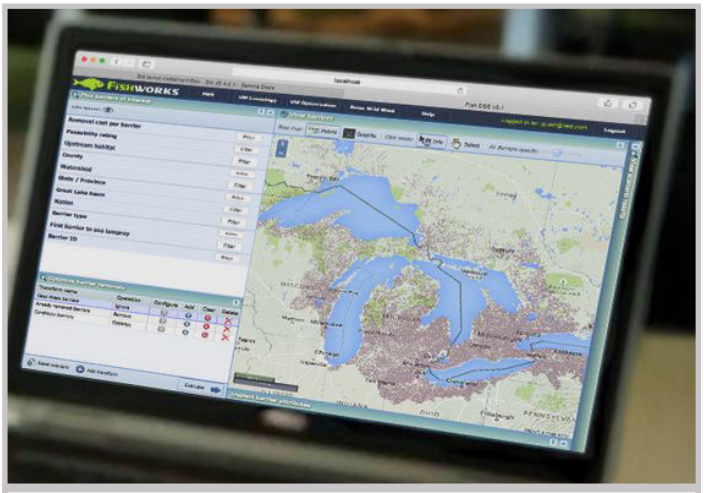
For example, a $70 million investment to remove 299 dams and 180 road crossings — coordinated across the entire Great Lakes Basin — could double the amount of habitat accessible to migratory fish, the model finds. That is roughly the amount spent for such projects over the last decade.

"The bottom line is, you don't have to spend that much money to get a massive return in terms of the amount of habitat accessible for fish," says McIntyre.

McIntyre's group used the model to launch a free, online tool, called FishWorks, to help select barrier removal projects that open more fish habitat at lower cost.

Marrying high-quality data with high-power computing, the researchers found that for a given amount of money, barrier removal projects coordinated across the entire basin are nine times more cost-effective than projects completed at county or local watershed levels.

"It works fine for decisions about Lake Michigan and Lake Superior to be fairly independent of one another," says McIntyre. "But as soon as you get below that level of coordination — to the county or watershed scale where a lot of decisions are made — the funding gets spread too thinly, and the model shows you're going to underperform drastically."



FishWorks will let scientists and resource managers prioritize removal efforts.
Courtesy: Wisconsin Institute for Discovery

The study also showed that annual distribution of funds over a decade is 10 times less efficient than a single payout of the same amount.

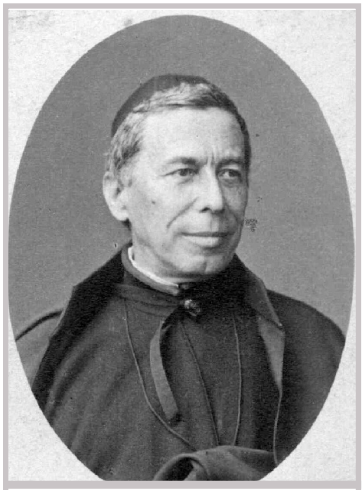
McIntyre illustrates this with an example: "You can give a fishery manager a chunk of funding from a major restoration initiative, but if in year one she can't afford to tackle the dam at the mouth of the river, then what good is it to upgrade an affordable road crossing upstream when all the fish are still bumping their noses against the dam?"

While coordinating projects can present challenges, it is not unprecedented in this region, where diverse partnerships under the Great Lakes Water Quality Agreement and the Great Lakes Fishery Commission have been very successful, the researchers say. Major restoration efforts have also been coordinated under the Obama administration's Great Lakes Restoration Initiative, which has provided almost $1.4 billion since 2010.

Note: Tom Neeson was a CFL postdoc when this study was originally published. He is now a new father and Assistant Professor at Univ. of Oklahoma. Currently, CFL postdocs Allison Moody and Austin Milt work in the McIntyre group on FishWorks projects.

150 Years of Clarity: Celebrating the Secchi Disk

by Adam Hinterthuer



Pietro Angelo Secchi. Courtesy: United States Navy

On April 20th of this year, the Secchi disk, that black and white plate at the bottom of many a limnologist's rope, turned 150 years old. In 1865, Pietro Angelo Secchi, an Italian Jesuit priest, deployed his new invention in the waters of the Mediterranean, dropping the disk in over the side of the papal yacht. But, before Secchi made his indelible mark on our field of study, he made waves in another field.

Secchi was a prolific scientist, publishing more than 700 papers in his lifetime (1818-1878). But the bulk of those papers were in his true discipline – astrophysics. Secchi is credited with developing the first spectral classification system for stars. He also discovered a comet (named after him), drew one of the earliest maps of Mars and served as a professor of astronomy at the Roman College in the Vatican.

Luckily for limnology (if not for Secchi), the Jesuits were expelled from Rome in 1848, an exile that eventually led Secchi to Georgetown University in Washington D.C. There he befriended Commander Matthew Fontaine Maury, who would become superintendent of the United States Naval Observatory. This friendship led Secchi to devote at least a little bit of his attention to aquatic, rather than astronomic, matters. This served him well when, as one of the scientific advisers to the Pope, Secchi was asked to quantify water clarity in the Mediterranean Sea. The rest, as they say, is history.

While water clarity measurements undoubtedly pre-dated Secchi by many, many years, he was the first to standardize the procedure and, crucial to anyone's scientific legacy, publish his results. Hence, we now use a disk named after him to this day.

Of course, new technology exists that can provide more accurate water clarity readings but, since people have been using Secchi disks for 150 years, continuing the practice allows us to track water clarity trends over long periods of time with a standardized measurement. Plus, since anyone can use a Secchi disk, Pietro Angelo's namesake device is now in the hands of citizen scientists across the globe, allowing scientists to ask big picture questions across immense amounts of space and time.

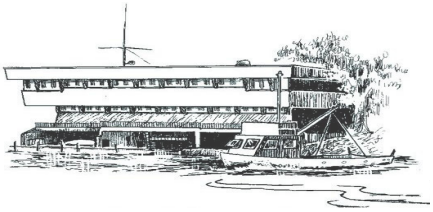
In fact, just this spring, CFL graduate student, Jake Walsh started a "Monitor Mendota" campaign. It looked like spiny water flea predation on *Daphnia* was going to keep the lake's annual clear water phase from even happening for the second year in a row. But, right as we thought the window had closed, the waters cleared.

Walsh quickly put out a call for folks all around Lake Mendota to send measurements of water clarity to the CFL. Soon pictures and Secchi depths were trickling in to our inbox, proving that Secchi's legacy is alive and well.

150 years later, scientists still use the Secchi disk for water clarity measurements. Photo: Adam Hinterthuer

Here's to 150 more years of one of our favorite limnological tools – and a big thank you to the Jesuit priest who started it all.

Happy 150th anniversary, Secchi!



Field Samples: Postdoc and Graduate Student Research

Chelsey Blanke (MS, Vander Zanden) @chelseyblanke

Chelsey is a graduate student in the Freshwater and Marine Sciences (FMS) program who, until recently, spent her days feeding swordfish to guppies and walleye to perch. It wasn't some weird "Island of Dr. Moreau" thing, though. Chelsey was trying to use isotopic analysis of the resulting fish tissue to see if it properly reflected each fish's spot in her experiment's crazy food web. "The idea is that you should be able to go out and grab a fish from any lake, even one you've never studied before, and use this analysis to predict where [that fish] sits in the food web," she explains, which would obviously be huge for our understanding of freshwater ecosystems. Chelsey is a local and spent her summer, among other things, collaborating on a cool art/science project and hiking Wisconsin trails whenever possible.

Hilary Dugan (Postdoc, Hanson) @hildug

Hilary studies how terrestrial and atmospheric changes, such as a warming air temperatures or land use patterns, alter biogeochemical fluxes and aquatic processes in inland waters. While she's currently working on northern Wisconsin lakes, one of her past research sites was Lake Vida in Antarctica, where she found that the brine beneath the ice was home to some hardy microbes. Hilary's life in Madison is sedate compared to camping and playing Frisbee on Antarctic lakes, but she's still up for adventure. In fact, she recently biked from Minneapolis to Madison (well, Elroy, long story) just for fun! Hilary calls Canada "the land of three million lakes" home, but doesn't want to think about leaving the CFL. "I have been here a little over a year and loved every minute of it. I'm not ready to leave, so don't ask me what's next," she says.

Etienne Fluet-Chouinard (PhD, McIntyre)

Etienne's work at the CFL focuses on wetland degradation, freshwater ecosystem stressors and conservation at the global scale. If it sounds like a big job, it is, which is why Etienne used his masters degree to get a better look at the problem, creating a new, higher-resolution map of the world's freshwater. The resulting maps zoomed freshwater data points in from 25 square kilometer pixels to data points 500 square meters in size. "That gives you more resolution, and also allows you to distinguish between distinct water bodies and features – which for ecologists is important," he says. Etienne came to the CFL from McGill University in Montreal.

Luke Loken (PhD, Stanley) @lokenluke

As seen previously in this newsletter, Luke had a busy summer, sampling 84 lakes and 1,000+ miles of river. His main fascination is "understanding how biology, geology, and chemistry interact" with aquatic ecosystems. What we see in the water, he explains, is the result of numerous complex processes and as humans continue to directly and indirectly affect aquatic resources, we must understand how these systems respond and will behave in a changing future. Although he hails from South Dakota, Luke hopes to wind up in an agency job in the Pacific Northwest. Luke's love of freshwater sciences came naturally, he says. "I study rivers and lakes because I have always enjoyed being near them. Some of the best memories growing up were paddling down rivers or spending time along lakes. Why not make a career that allows you to enjoy the places you love?" Can't argue with that!

Catching Up With Alumni

Tim Essington
(PhD 1999, Kitchell)

Tim Essington is a Professor at the University of Washington School of Aquatic and Fishery Sciences. He is presently the Associate Director of the School, and the Director of the Quantitative Ecology and Resource Management Interdisciplinary Research program. His office is situated immediately between CFL alumuni Daniel Schindler (PhD) and Julian Olden (Postdoc), so their portion of the hallway comprises the "CFL West Campus." His current work is focused on the improved application of ecological principles into the management of marine fisheries, and developing a better understanding of how novel stressors (hypoxia, ocean acidification, climate change) will alter coastal marine food webs. He presently serves on several advisory bodies, including the Technical Advisory Board of the Marine Stewardship Council (the world's largest seafood eco-labelling organization), the Puget Sound Partnership Science Panel, and is on more editorial boards than he cares to admit.

Doug Beard
(PhD 2002, Carpenter)

Doug completed his PhD in 2003, while working for the WDNR as the treaty fisheries program manager. In 2003, he moved to the USGS Headquarters in Reston, VA, starting as manager of the National Aquatic Gap and Fisheries Informatics program manager. He moved on to manage the entire Fisheries program for USGS and over the last five years, was asked by the USGS to lead the development of the National Climate Change & Wildlife Science Center (NCCWSC). His main task during this time was to lead the Department of Interior's Climate Science Centers, a priority initiative for DOI. He just completed a seven month stint as the Associate Director for Climate and Land Use, where most of this time was spent on the Land Sat satellite program in USGS. Now back to his job as chief of NCCWSC, he looks forward to spending more time on a global inland fisheries initiative that he's co-leading with the U.N. Food and Agriculture Administration and Michigan State University.

Additional alumni news...

Reinette (Oonsie) Biggs (PhD 2008, Carpenter) has published a new textbook *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems.*

Julian Olden (Postdoc 2004-2006, Vander Zanden), Associate Professor, School of Aquatic and Fishery Sciences is co-director of the new Center for Creative Conservation at the University of Washington.

Brian Roth (PhD 2005, Kitchell), Associate Professor, Fisheries & Wildlife, appears in the June 2015 Delta Sky magazine ad for Michigan State University.

Daniel Schindler (MS 1986, PhD 1990, Frost and Magnuson, Postdoc 1991, Kitchell) was named the 2015 Frank Rigler Award recipient.

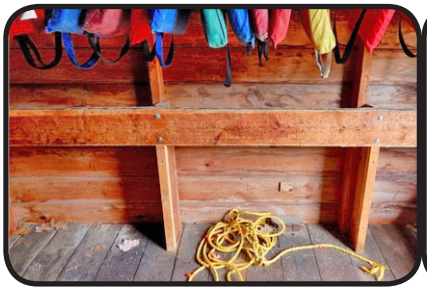
Pat Soranno (MS 1991, PhD 1995, Carpenter, Postdoc 1995-96, Kratz) has been appointed as the founding Editor-in-Chief of ASLO's *Limnology & Oceanography Letters*.

Alumni:

Please let us know about address updates, job changes, and other noteworthy events!

limnology@mailplus.wisc.edu

608-262-3014



TWO Artists in Residence at TLS

Photo Left: ***Leslie Fedorchuk***

Read An Incantation to be Spoken Lakeside (edgeeffects.net/incantation-to-be-spoken-lakeside) by ***Heather Swan***

In Memoriam - Dr. Philip A. Cochran (1955-2015)

by John Lyons

Philip A. Cochran (PhD 1984), a CFL alumnus and former student of James Kitchell, died unexpectedly of a stroke on March 4, 2015. At the time, he was professor and chair of the Biology Department at St. Mary's University in Winona, Minnesota. Although best known as a lamprey specialist, Phil had very broad interests and he taught and conducted research on many species and scientific topics over his career, producing over 100 peer-reviewed scientific papers and nearly as many semi-technical reports and popular publications.

Phil was born in the suburbs of Chicago, Illinois, in 1955 and grew up fascinated by the natural world. In 1973 he entered St. Mary's University, studying biology. As an undergraduate he worked on a project sampling fish communities in backwaters of the Mississippi River and completed a thesis on the spiny softshell turtle. He graduated from St. Mary's in 1977 with a BA in Biology and Environmental Science, awarded with high honors. Phil then moved to the University of Minnesota-Twin Cities where he completed an MS in Fisheries Science in 1980, studying largemouth bass. In 1980 he started at the CFL with James Kitchell. There he began his work on lampreys, focusing for his doctorate on the bioenergetics and feeding ecology of parasitic lampreys, particularly the invasive sea lamprey and the native chestnut lamprey. He also teamed with Dr. James Rice (MS 1983, PhD 1985; Kitchell) to use the largemouth bass data from his MS thesis to carry out the first field validation of the "Wisconsin" fish bioenergetics model, and with Dr. Frank Rahel (MS 1977, PhD 1982; Magnuson) and Dr. John Lyons (MS 1981, PhD 1984; Magnuson) to participate in the lively debate over the relative roles of stochastic versus deterministic processes in structuring fish communities. Phil received his PhD in Zoology in 1984.

Phil began his professional career as a professor of biology at St. Norbert College in DePere, Wisconsin, in 1984. There he expanded his work on lampreys, often in collaboration with John Lyons, continuing his lifelong studies on feeding by parasitic lampreys but also looking at lamprey spawning and zoogeography and taxonomy. In 1991, during a sabbatical, he journeyed to central Mexico to help carry out the first comprehensive studies of the distribution, status, morphology, and ecology of the threatened non-parasitic Jacona lamprey and the endangered parasitic Chapala lamprey. In addition to his lamprey research, Phil also collaborated with UW-Madison, St. Norbert, and Notre Dame researchers on the "Cascade" food-web project at the University of Notre Dame Ecological Research Center in the Michigan Upper Peninsula. Additionally, he was a co-author of the book *Wisconsin Fishes 2000: Status and Distribution in 2000*.

In 2000, Phil took a new job as professor at his alma mater, St. Mary's University, where he remained until his untimely death. There he continued studying lampreys as well as other fishes (papers on 18 non-lamprey taxa over his career) plus his other passion, reptiles and amphibians (56 technical and popular publications). He also published on aquatic and terrestrial invertebrates, teaching methods, and even plants. All of his studies were carried out in partnership with students, and he was recognized as an inspiring teacher. He also was an effective administrator, becoming Chair of the Biology Department in 2004, and acting as Associate Dean of Science and Mathematics in 2011-2012. In his spare time, Phil took advantage of the fact that there was a trout stream on campus and developed into an excellent trout angler. And as he did everywhere he lived, he became an expert on the local flora and fauna.

Phil is survived by his wife, five children, and two young grandchildren. His legacy is also carried on by the hundreds of students he taught over a 30-year career, many of whom have gone on to productive careers in biology and natural resources conservation. He will be greatly missed.

New Faces and Transitions at CFL

We welcome the following new staff to the CFL, as well as new appointments for continuing staff:

Alison Appling, Research Associate (Stanley)

Courtney Becks, Librarian

Jessica Corman, Research Associate (Stanley)

Julia Hart, Research Assistant (Hanson)

Austin Milt, Research Associate (McIntyre)

Rob Mooney, Research Assistant (McIntyre)

Eric Pedersen, Research Associate (Vander Zanden)

Martin Perales, Research Assistant (Vander Zanden)

John Rodstrom, Research Assistant (McIntyre)

Michael Spear, Research Assistant (Vander Zanden)

Stay in Touch!

- **Website:** limnology.wisc.edu
- **Blog:** limnology.wisc.edu/blog
- **Facebook:** facebook.com/centerforlimnology
- **Twitter:** @WiscLimnology

Recent Degrees and Transitions

Ben Beardmore (Postdoc, Stanley) is a Research Scientist at the Wisconsin Department of Natural Resources.

Alex Latzka (PhD, Vander Zanden), thesis *Landscape-scale patterns in aquatic invasions: Prevalence, colonization, establishment, and impacts,* took a Postdoctoral Associate position at McGill University.

Tom Neeson (Postdoc, McIntyre) is an Assistant Professor in the Department of Geography & Environmental Sustainability at the University of Oklahoma.

Elliott Shuppy (MA, Librarian) is in New Orleans freelancing as an IT, systems, and record manager for a couple of local community development groups and an adult literacy center.

Craig Snortheim (MS, Hanson), thesis *Meteorological drivers of oxygen depletion in Lake Mendota*, is working at CH2M in Chicago.

To give to the Center for Limnology...

Friends may give online through our web site: http://limnology.wisc.edu/support.php, or mail a check payable to "University of Wisconsin Foundation" to: University of Wisconsin Foundation, U.S. Bank Lockbox, PO Box 78807, Milwaukee, WI 53278-0807. Please be sure to reference the Center for Limnology and include your home address and email (optional) and if you wish to remain anonymous. **All contributions are tax deductible.**

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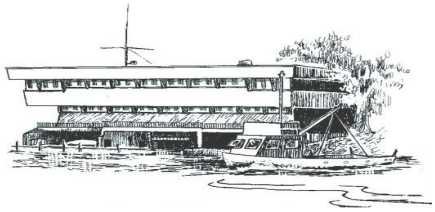

Awards

Anna Grant Birge Memorial Scholarships were awarded to Botany student Kristin Michels; Environmental Chemistry and Technology students Megan McConville and Robin Rohwer; Freshwater & Marine Sciences (FMS) students Vince Butitta, Etienne Fluet-Chouinard, Malgorzata Golub, Cristina Herren, Luke Loken and Andy Stevens (also in Water Resources Management); Geoscience student Elisabeth Schlaudt (also in Water Resources Management); Microbiology student Alexandra Linz; and Zoology student Jake Walsh.

Undergraduate Thomas Shannon was the recipient of a Chase-Noland Scholarship.

Undergraduate Ben Kranner was awarded the William F. Huffman Scholarship.

Jean B. and E.T. Juday Awards were given to undergraduates Ellen Albright and Patrick Dowd.

Undergraduates Annakathryn Kruger and Michael Webber, and FMS graduate student Colin Smith, were awarded John and Patricia Lane Summer Research Scholarships.

The Kenneth W. Malueg Limnology Scholarship was awarded to Zoology student Jake Walsh.

FMS student Ben Kraemer was the recipient of a Charlotte Stein Student Travel Award.

Undergraduate Anders Uppgaard was awarded the Lee Zinn Scholarship.

Steve Carpenter was named on the 2014 Highly Cited Researchers list, ranking among the top 1% most cited for environment/ecology.

Steve Carpenter was the recipient of the Association for the Sciences of Limnology and Oceanography 2015 John H. Martin Award.

Adam Hinterthuer, University Relations Specialist, was a recipient of the L&S Academic Staff Excellence Early Career Award for 2014-2015.

Emily Stanley was a recipient of a Kellett Mid-Career Faculty Researcher Award.

Zoology student Jake Walsh received the Graduate Student Peer Mentor Award and the Award for Mentoring Undergraduates in Research, Scholarly and Creative Activities.

Supporting Research Through Traineeships and Scholarships

by Marilyn Larsen

The CFL reached a couple of milestones in 2015. The 100th Research Experiences for Undergraduates (REU) was appointed and over $1 million has been awarded to students through traineeships and scholarships.

REUs are traineeships funded by the National Science Foundation that provide opportunities for students to pursue summer research projects. Since 1996, the CFL has awarded at least one REU per summer. To date, 102 REUs have been awarded providing nearly $396,000 in support of undergraduate education and training.

The CFL's endowment funds provide research and travel support to students interested in limnology and environmental sciences. Through the generosity of friends of the CFL, 356 undergraduate and graduate students received over $641,000 since the CFL was established in 1982.

See limnology.wisc.edu/support.htm for information on how you can support the CFL in its research, educational and service missions.

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Limnology News

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In This Issue

Why is Jake making Colin dive in the cold October water?

Find out inside.