Limnology News

Center for Limnology

College of Letters & Science
UNIVERSITY OF WISCONSIN–MADISON

The Way Home: Art Hasler's Son Shares Stories from His Father's Life

by Adam Hinterthuer

Fritz Hasler presents at fall seminar.

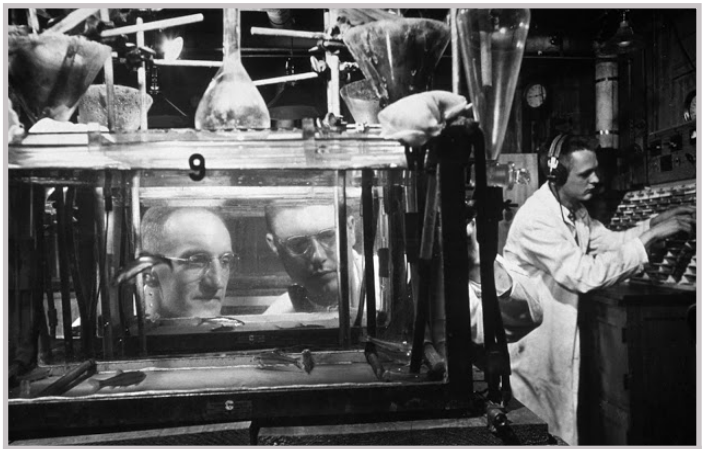
On a gray, rainy afternoon in mid-September, room 102 in the Water Science and Engineering Laboratory was filling up fast. Students, faculty, staff and a handful of other visitors crammed the room to capacity and dozens of other attendees were watching live online from the conference rooms at the Center for Limnology's (CFL) Hasler Lab and Trout Lake Station (TLS). The big attraction was a talk entitled "The Way Home," and everyone was about to hear the story of the life of Arthur Hasler (PhD 1937, Juday), namesake of our lab and irreplaceable figure in limnological history. The speaker was none other than Art's son, Fritz.

Fritz has spent the last several years archiving his father's history. He spent weeks in the Hasler Lab library converting old slides into digital files. He listened to every second of the amazing oral history collected by the UW Archives. And Fritz has scoured the photo albums and family histories of all of his brothers and sisters, as well as the genealogical records collected by the family's Mormon church. The result is a testament both to the accomplished scientist who helped build the CFL and to the immense respect of a son for his father's legacy.

"I'm going to tell you the story of Arthur D. Hasler better than it's ever been told before," Fritz promised the crowd – which included CFL alumni and many of Hasler's other children. And Fritz delivered. His presentation was fascinating, funny and filled with amazing pictures from the life of a man who steered the Center for Limnology toward an incredible future. Here are a couple of highlights:

Art's Seminal Scientific Achievement

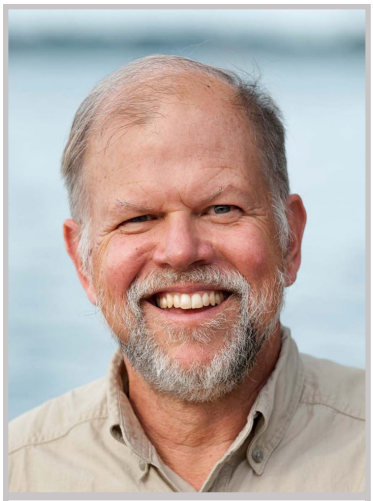
Hasler is best known in scientific circles for uncovering how salmon find their way home after a lifetime at sea. What many may not know is that a hike in the Rocky Mountains played a pivotal role in this work. As he was hiking in Utah's Wasatch mountains, Fritz said, a breeze carrying a familiar mixture of smells washed over Art and, even though he was well out of sight of his favorite waterfall, he could suddenly and vividly picture the falls he'd come to love on childhood hikes. Could smells be similarly imprinted on salmon? Hasler wondered. The idea soon had him plugging the noses of some unlucky salmon and tracking their travel up a Western stream, as well as building a sort of fish "maze" in the lake



Art and grad student, Warren Wisby, examine the experimental set-up that would help them discover how salmon find their way home. CFL Archives

(The Way Home article continued on page 3)

Notes From the Director: Water@UW-Madison: Building a New Water Network for the University and the State *by Stephen Carpenter @FreshwaterSteve*



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

Water is a defining feature of Wisconsin's landscape. Our state is bordered by the two largest Laurentian Great Lakes and one of the world's great rivers. Wisconsin boasts one of the world's highest concentrations of inland lakes, with over 15,000, in addition to 82,000 miles of rivers and streams. Our groundwater resources are estimated at about 1.2 million billion gallons, enough to submerge the state in 100 feet of water if it were above ground. Water resources not only underpin the economy, but in many ways characterize the people and places of Wisconsin. Likewise, human activities strongly affect the quantity and quality of our water. This interaction between people and diverse types of water resources and systems represents an array of challenges as well as associated study and inquiry.

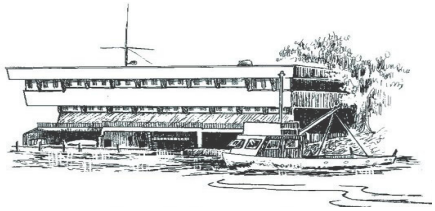
Readers of this newsletter know that the University of Wisconsin-Madison has a rich tradition of scholarship on freshwater topics. Origins trace to traditions of limnological research established by E.A. Birge and Chancey Juday from 1875-1944. Based in the Zoology Department, Birge and Juday collaborated with botanists, chemists, geologists, microbiologists, physicists, and soil scientists in diverse departments of the University. The field of groundwater hydrology is traced back to UW-Madison through the pioneering work of Thomas Chrowder Chamberlin, Franklin H. King, and Charles Sumner Slichter in the late 19th and early 20th centuries. From the water engineering perspective, Daniel W. Mead became head of the department of hydraulic and sanitary engineering in 1904, and is credited with the first textbook in hydrology. G. Fred Lee started the first and only graduate degree program in water chemistry in the U.S. in 1962.

Today, UW-Madison has well over 100 principal investigators, mostly faculty, engaged in scholarship focused on freshwater. This remarkable level of research activity is scattered among more than a dozen departments in at least five colleges of the University. The breadth and diversity of these research programs is a great strength of UW-Madison. However, our freshwater research may be less than the sum of its parts because we miss opportunities to collaborate and raise the visibility of UW-Madison's programs.

Recognizing the need for stronger self-organization among freshwater scholars, a group of faculty volunteers from across campus has launched Water@UW-Madison (water.wisc.edu). The goal of Water@UW-Madison is to improve opportunities for collaboration among freshwater scholars and raise the visibility of freshwater scholarship in the university, the state, and beyond. Water@UW-Madison is not an administrative superstructure; instead it connects the strengths of existing campus institutions and individual investigators to improve networking, collaboration, and outreach. For example, we produce a weekly newsletter of campus events on freshwater, and organize campus-wide events on freshwater scholarship. Water@UW-Madison is overseen by faculty volunteers and a staff position based at the CFL and funded through the Vice Chancellor for Research and Graduate Education.

The CFL, meanwhile, continues to thrive. 2016 was "the year of toxic algae blooms" in the Northern Hemisphere; CFL researchers (and, unfortunately, blooming Wisconsin waters) are at the center of this crisis. This year we gained insight on Wisconsin's walleye decline through our collaborative research with USGS, WDNR, and UW-Stevens Point scientists. CFL researchers made key contributions to understanding migrations of aquatic organisms, both wanted (such as spawning migrations of native fishes) and unwanted (such as invasions by non-native species). Our scientists expanded the use of high-frequency sensors to analyze large-scale patterns in big rivers and early warning signals of algae blooms. You can read about these findings and more in this newsletter and on our blog.

Just like the early work of Birge and Juday, much of what we've accomplished this year was in collaboration with other UW departments. We hope that Water@UW-Madison can maintain and grow this culture of collaboration and look forward to many more years of working alongside our fellow freshwater-affiliated colleagues.



CFL spends World Fish Migration Day at Chicago's Shedd Aquarium

by Adam Hinterthuer

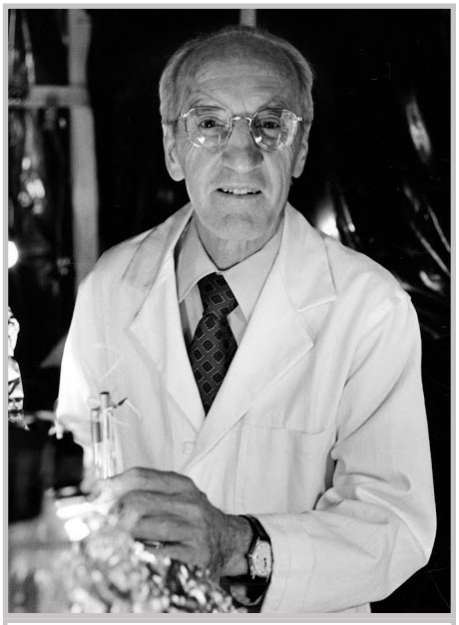
On a beautiful Saturday in May, a team of CFL students and faculty woke up extremely early to drive down to Chicago. There they gathered at the Shedd Aquarium for an event celebrating "World Fish Migration Day," an annual date when such events are held across the globe to raise awareness about open rivers and migratory fishes. Close to 40 million people participated in the day worldwide and 10,000 of them were at the Shedd. Thanks to our volunteers, a lot more people know a lot more about the existence and struggles of some amazing fishes!

The Way Home, continued from page 1

lab at the end of Park Street on the UW-Madison campus. There, Hasler and graduate student, Warren Wisby (MS 1950), released chemicals into specific channels of the "maze" and trained fingerlings to follow their nose to a food reward. Hasler's children often visited their dad at the lab and, Fritz joked when looking at a picture of that particular experiment, "if I could smell that lab again, it would definitely trigger memories!"

Art's Misadventures in Landscape Demolition

A lot of science, as we know, is learning from mistakes. A hypothesis proven wrong is still one step closer to getting at a theory. That is, of course, if you don't blow yourself up first. Perhaps one of Fritz's funniest recollections was the story of Art being convinced that dynamite, not the backbreaking labor of digging, could excavate some research ponds he wanted to install in the UW Arboretum. The tale was caught on tape in a series of interviews for the UW Archive's oral history project. After packing the prescribed amount of dynamite into their preferred pond sites, Art's team retreated a safe distance and flipped the switch. The explosion, while impressive, failed miserably. "The force lifted the peat straight in the air and it cascaded right back down," Hasler says on the tape. This became known in Arboretum circles as "Hasler's Folly," proving that even scientific luminaries can have a bad day!



Art Hasler. CFL Archives

These and all sorts of stories, pictures and audio recordings have been meticulously collected by Fritz and are available on his blog. If you'd like to see everything from pictures of Art feeding a dolphin to letters home on confiscated Nazi stationary during his stint in the U.S.'s Strategic Bombing Survey, it's a fascinating resource. (haslerhistory.blogspot.com/)

Ice Data from Early "Citizen Scientists" Confirms Warming Since Industrial Revolution

by Adam Hinterthuer

In 1442, fifty years before Columbus "sailed the ocean blue," Japanese priests began keeping records of the annual freeze date of a nearby lake.

Woodblock print of Lake Suwa, Japan, site of the earliest "citizen scientist" ice records in history. Photo courtesy: Brooklyn Museum, Online Collection

Along a Finnish river, starting in 1693, local merchants recorded when the ice broke up each spring. They are the oldest inland water ice records in human history and, according to a study published this year in Nature Scientific Reports, the recordkeeping of these historical "citizen scientists" reveals increasing trends toward later ice-cover formation and earlier spring breakup since the start of the Industrial Revolution.

"These data are unique," says John Magnuson, director emeritus at the Center for Limnology. "They were collected by humans viewing and recording the ice event year after year for centuries, well before climate change was even a topic of discussion."

Magnuson and Sapna Sharma, (Postdoc 2009-11, Vander Zanden), who is now an associate professor at York University, co-led the study.

The records from Lake Suwa in the Japanese Alps, says Magnuson, were collected by Shinto priests observing a legend about a male god who crossed the frozen lake to visit a female god at her shrine. A local merchant began data collection on Finland's Torne River because the river, and its frozen-or-thawed status, was important to trade, transportation, and food acquisition.

Ice seasonality, or when a lake or river freezes over in winter or thaws again in spring, is strongly related to climate, says Magnuson. And, while such a long-term dataset is remarkable in and of itself, the climate trends they reveal are equally notable. "Even though the two waters are half a world apart and differ greatly from one another," he says, "the general patterns of ice seasonality are similar." For example, from 1443 to 1683, Lake Suwa's annual freeze date was moving almost imperceptibly to later in the year – at a rate of 0.19 days per decade. From the start of the Industrial Revolution, however, that trend grew 24 times faster, to 4.6 days per decade. On the Torne River, there was a corresponding trend for earlier ice break-up in the spring, as the speed with which the river moved toward earlier thaw dates doubled.

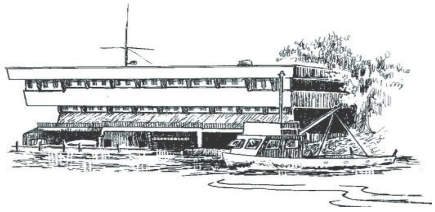
"Although there are local factors that are influencing both systems," says Sharma, "climate changes associated with increasing carbon dioxide emissions and air temperatures are important, perhaps overarching, factors explaining the trends."

In recent years, she notes, both waters have exhibited more extreme ice dates corresponding with increased warming. Before the Industrial Revolution, Lake Suwa froze over 99 percent of the time. More recently, it does so only half the time. On the Torne River, early ice break up used to occur in early May or later 95 percent of the time. Now those "extreme" dates are primarily in late April and early May.

John Magnuson at Lake Mendota, which is also seeing later "ice on" and earlier "ice off" dates. Photo courtesy: Clean Lakes Alliance

The consequences of less ice span ecology, culture and economy. For example, Sharma says, "decreasing ice cover erodes the 'sense of place' that winter provides to many cultures, with potential loss of winter activities such as ice fishing, skiing, and transportation." In addition, less ice cover can lead to more evaporation and lower water levels while warmer water contributes to more algal blooms and impaired water quality.

The team of researchers are planning follow-up studies to better understand how lake and river ecosystems are impacted as the number of days they spend "on ice" continues to melt away.



Finding a Common Thread: The CFL Explores the Confluence of Science and Art

by Adam Hinterthuer

In 2014, the CFL and UW-Madison's Department of Art received funding to foster collaboration between artists and scientists as they explored long-term ecological change in our world.

CFL graduate students Alison (Ali) Mikulyuk (MS candidate, Vander Zanden) and Chelsey Blanke (MS 2016 Vander Zanden) each teamed up with an artist to explore a Wisconsin waterway and try to meet at the confluence of science and art.

As 2016 comes to a close, both women are starting to see results. Chelsey has begun performances with artist, Helen J. Bullard, as they present stories about the cultural and environmental history of Lake Michigan – told with voice, music, video animation, and images – at events across the state.

The Secret Life of Crystal Bog," by Terry Daulton, traveled the country as part of the LTEArts "Drawing Water" exhibition.

"As we worked on this, we didn't want it to be just science communication," Chelsey says, "We wanted it to be a celebration of the lake and people's connections to it. It has no agenda necessarily, other than hoping people will think about this."

Originally titled "Uncertain Legacies" (edgeeffects.net/confluence-art-science/), the collaboration Chelsey and Ali set out to foster is most certainly unique – but it's not all that uncommon at the CFL.

In 2005, then CFL director, John Magnuson and TLS director, Tim Kratz along with the UW School of Forest Ecology and Management and departments like Soils, Climatology and Geology worked with artists in northern Wisconsin on a collaboration exploring climate change in the Northwoods.

The project was the brainchild of a Northwoods painter named Terry Daulton, and entitled "Paradise Lost?" (drawingwater.weebly.com/paradise-lost.html)

"Creative thinking is the catalyst for the work of both artists and scientists, yet they rarely find themselves in the same circles," Daulton explains. "If you look to history, during times of enlightenment and change the arts and sciences have often influenced each other."

After the success of Paradise Lost? other CFL collaborations with artists were launched. The LTEArts project brought exhibits featuring poetry and art about the Long-Term Ecological Research program to places throughout Wisconsin and even to lawmakers in Washington D.C. It continues as a collection entitled "Drawing Water" and one component is TLS's "Artist-in-Residence" program, where an artist spends a week or more on station each summer. (drawingwater.weebly.com)

Earlier this year, CFL research professor Paul Hanson got into the act, featured in Madison weekly, the *Isthmus*, for musically interpreting the large amounts of data taken from buoys and using them as a new way of hearing the trends and conditions of freshwater systems across the world. (hanson.limnology.wisc.edu/music/)

"Although society often separates art and science," says TLS's interim director, Susan Knight, "we seek to bring together artists and scientists to tell the story of the complex and ever-changing Northwoods and more successfully reach the public at large."

That public, says Mikulyuk, is already primed to receive these sorts of meditations on the places they love. Ali worked with filmmaker, Jojin Van Winkle, on a series of short videos about the Namekagon River in northwest Wisconsin – a waterway once championed by Aldo Leopold. Their website is live and more stories will be added to it throughout the year.

"I was really amazed by how easy it was to build connections with individuals in a community organized around a watershed," she says. " We discovered this network of citizens working to protect a place they loved and it was like, 'Oh my gosh, are these everywhere? Is there a fabric that connects people to the land and to each other that exists but that we don't really know about? And how do you love land?' There are so many different ways but there are common threads among everyone."

Ali talks with a kayaker on the Namekagon River about the "Voices of the Namekagon" project. Photo by Jojin Van Winkle, 2016

On Lake Forecasts and Why Limnologists Can't Be Everywhere at Once

Q & A with CFL Distinguished Professor of Research, Paul Hanson by Adam Hinterthuer

Here at the CFL, we dream of a future where we're able to predict harmful algal blooms in the waters right outside our lab's window and alert the public to unsafe conditions before they occur. Unfortunately, says CFL's research professor, Paul Hanson, we're still a long way off. But, he says, collecting data through a combination of collaborative research, automated buoys and citizen-scientists has the potential to get us closer to that future.

We talked with Paul about lake forecasting, big data, and how scientists are working to get more information more frequently from more places.

Paul Hanson on the remote sensing buoy on Trout Lake. Photo courtesy: Jeff Miller, UW-Madison Communications

So it's safe to say we're not going to be predicting algae blooms any time soon?

I think most ecologists are willing to admit that predicting phytoplankton [algae] blooms is extremely difficult, perhaps impossible. Being able to say with precision that "next week we expect something bad to happen" is what ecologists have kind of given up on at this point.

What we feel like we still can do, is to try to determine what's the probability of something bad happening [to water quality] across different time scales. We might not be able to tell you we know the exact day a bloom will happen during the summer, but we might be able to give you the probability that there will be a bad event.

That sounds sort of like meteorologists forecasting the weather.

It's a lot like weather forecasting, but even more difficult because of the biological element to it!

What do we need, then, to make better forecasts?

To do a better job of forecasting, we need really good data and we need really good models. So, we have high frequency data coming off the buoy [anchored in the middle of Lake Mendota each season] but that represents just one part of the lake and we've done research here at the CFL to show that, at least in the broader timescales like weeks and seasons, data from the middle of the lake gives you a different picture than data from the edges of a lake. (Note: This work was part of CFL alumna, Amanda Stone's (MS 2012, Carpenter & Hanson), thesis.)

You know, if you go look at our pier out front, you might have a different view than if you were over at one of the beaches. Or if you look at data from beach closures, not all the beaches close at the same time. So there is spatial variability of water quality along the shoreline. So to improve data, we really need more observations in more places.

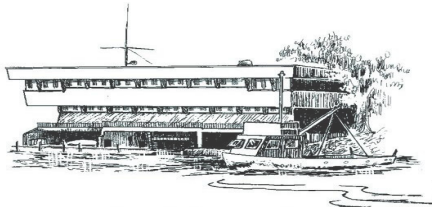
Obviously limnologists can't be everywhere at once and buoys are expensive. How do we get that data?

Well, it's difficult to deploy our really expensive equipment to lots of different places. We just don't have the money or the resources or people power. So that's where some citizen science and water quality apps can come into play.

There are two apps that I'm aware of – one is the NTL Lake Conditions app that was developed here by two students working for Corinna Gries. But that app is about conveying the Lake Mendota data we've already collected to the general public.

The one I'm aware of that collects data from citizen scientists is called the Lake Observer App and was developed by Kathie Weathers' group at the Cary Institute of Ecosystem Studies. That app asks users to look at water quality in the lake or river they're on and submit observations. There's also the water quality measurements made around Madison's lakes by Clean Lakes Alliance volunteers for their lake forecast program.

Citizen engagement and mobile technology is really coming together to provide more data on water quality for lakes. And those data are sort of collecting and queueing up and providing this important repository that we'll be able to go back to and mine. What is certainly true about ecosystems is that they are highly variable, complex, and difficult to predict. So the data that's been collected will be put to really great use, because we need tons of it.



Field Samples: Postdoc and Graduate Student Research

(Dom CIruzzi (PhD, Loheide) @domciruzzi

When he wasn't helping coach aspiring undergraduate researchers as a mentor at TLS this summer, Dom was out bending trees - driving stakes into the ground, shimmying up to a properly high point, tying a strap around a tree and then winching the whole set-up down toward the ground. It was all part of his PhD research on how forests respond to changing climates, specifically in groundwater-forest interactions and the attributes that allow some plants to reduce their vulnerability to drought. When he wasn't in the woods, Dom could often be found indulging in other creative pursuits. He's an avid musician – playing sax, piano, ukulele and even steel drums – and also dabbles in oil and digital painting. Unfortunately for Dom's drought research, this was a wet year for Wisconsin's Northwoods. The good news is that it means he "has" to go back to bending trees next summer.

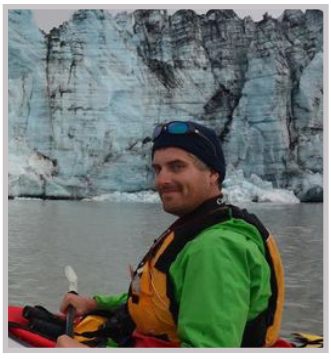
Jessica Corman (Postdoc, Stanley) @limnojess

Jess studies nature through the lens of chemistry, combining techniques from biogeochemistry and ecosystem ecology to understand how elements flow through ecosystems – particularly those vulnerable to nutrient pollution. This year, Jess decided to take that research global, winning a seed grant from the UW's Global Health Initiative to explore what's driving the decline of water quality in Africa's Lake Victoria. 30 million people live along its shore and Jess is excited at the chance to do "awesome, impactful" science in a social context. "[People] are getting their drinking water from the lake, they're eating fish from the lake, they recreate on the lake. They want clear water, obviously, so [this project] is a nice way to combine basic science with endeavors to better communities," she says. Considering that Jess often reminisces about the warmer climate of her grad school days in Arizona, we can't help but think this project may also offer her a nice fieldwork site this winter!

Eric Pedersen (Postdoc, Vander Zanden) @ericpedersen

Eric has been a postdoc at the CFL for two years, where he's spent his time being, as he puts it, "fascinated" by how the dispersal of species drives changes in populations and how human activity shapes ecosystems. These interests have led to his own long migration. Originally from Saskatchewan, Eric completed a PhD at McGill University in Montreal before coming to Madison. Now he's headed off to a new job pretty much at the easternmost point in North America – St. John's on the coast of Newfoundland. This time, he'll be modeling the dispersal of and helping manage aquatic invertebrates – chiefly shrimp and lobster fisheries – as a scientist with Fisheries and Oceans Canada at their Northwest Atlantic Fisheries Centre. Eric jokes that he fears for his safety, as populations of both invertebrates are declining and he'll be helping set fishing regulations but, knowing that he's both a really nice guy and a veteran of scientific research on the Atlantic's cod population, we think he'll be okay!

John Rodstrom (MS, McIntyre) @migratoryfishes



John's current research focuses on species of fishes that spend their adult life in the Great Lakes but must migrate up tributaries in order to reproduce. Which was why he spent the spring wading upstream of dams and road crossings in cold Lake Michigan tributaries "ground truthing" the McIntyre lab's maps of the fish barriers in the Great Lakes Basin. "What we're doing," he says, "is surveying during migration to see how many of these barriers fish are able to pass by. We want to know which barriers are truly barriers to fish migration." After the spring run, John was back on the road this summer surveying almost 500 dams in the Lake Michigan watershed to further improve the map. It meant a lot of knocking on doors and asking permission to access property, living out of a suitcase and logging well over 5,000 miles on state vehicles. "The only way work like this gets done," he says, " is with a grad student."

Catching Up With Alumni

Cailin Huyck Orr
(MS 2002, PhD 2005, Stanley)

Cailin Huyck Orr, following postdoc positions at the University of North Carolina and the University of Minnesota, spent 5 years as an assistant professor in the School of the Environment at Washington State University. Returning to her alma matter in 2014, she is now the Assistant Director of the Science Education Resource Center (SERC) at Carleton College. SERC works with partners from 2- and 4-year institutions across the US to improve Science, Technology, Engineering, and Mathematics (STEM) teaching and learning at the undergraduate level. Cailin's current work is focused on supporting faculty in making program-scale changes to meet institutional goals such as increasing diversity of STEM majors, producing workforce-ready graduates and incorporating evidence-based practices into teaching. More information about this work, professional development opportunities, and teaching resources can be found on the SERC website (serc.carleton.edu/index.html).

Norman Mercado - Silva
(PhD 2005, Vander Zanden)

Norman joined the Center for Research in Biodiversity and Conservation at the Universidad Autónoma del Estado de Morelos, in Cuernavaca (City of Eternal Spring), Morelos, Mexico, as a Research Professor in 2015. He was part of a multidisciplinary legal team awarded the Conservationist of the Year Award from the Arizona-New Mexico Chapter of the American Fisheries Society for helping in the protection of streamflows in Cherry Creek and Aravaipa Creek, Arizona in 2016.

Reinette (Oonsie) Biggs
(PhD 2008, Carpenter)

Oonsie took up a postdoc after completing her PhD, and later a full-time research position at the Stockholm Resilience Centre in Sweden. Here she led the development of a systematic synthesis of regime shifts (regimeshifts.org) and their impacts on ecosystem services and human well-being. Growing from her involvement in the Resilience Alliance Young Scientists network, Oonsie also led an edited volume that synthesized and critically assessed seven key principles for building resilience in social-ecological systems (published by Cambridge University Press in 2015). In 2012 she picked up her research connections back home in South Africa by initiating the Southern African Program on Ecosystem Change and Society (www.sapecs.org), linked to the international Programme on Ecosystem Change and Society (PECS) (pecs-science.org/) program which is a core project of Future Earth. In 2015 Oonsie was nominated for and awarded a prestigious South African Research Chair in Social-Ecological Systems and Resilience, and is now based in Stellenbosch University close to Cape Town, in a new flagship centre of the university, the Centre for Complex Systems in Transition. She retains a joint appointment at the Stockholm Resilience Centre and continues to be actively involved in collaborative grants and the PECS program. If you are ever in South Africa, please visit!

Additional alumni news...

Elena Bennett (MS 1999, PhD 2001, Carpenter) was awarded the Natural Sciences and Engineering Research Council of Canada's E.W.R. Steacie Memorial Fellowship.

Alumni:

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

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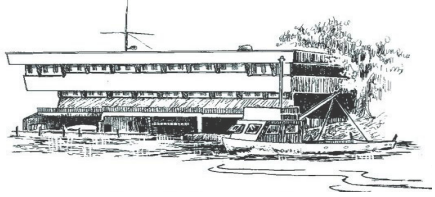

Global Warming, Not Fishing, Blamed in Decline of Fisheries of Africa's Largest Lake

by Mari N. Jensen and Adam Hinterthuer

The decrease in fishery productivity in Africa's largest lake is a consequence of global warming rather than just overfishing, according to a report published in August in the Proceedings of the National Academy of Sciences(pnas.org/content/113/34/9563).

Situated mainly between Tanzania and the Democratic Republic of the Congo, Lake Tanganyika was already becoming warmer in the late 1800s – the same time that abundance of fish began declining, the team found. The lake's algae – fish food – also started decreasing at that time. However, large-scale commercial fishing did not begin on Lake Tanganyika until the 1950s.

The fact that Lake Tanganyika's fishery has been in decline since before commercial fishing began, says Ben Kraemer (PhD 2016, McIntyre), a co-author of the paper, is at the "heart of this study." Lake Tanganyika yields up to 200,000 tons of fish annually and provides about 60 percent of the animal protein for the region's population.

Kraemer has spent a large portion of the last several years in Tanzania researching temperature changes and fishery impacts. "The fish are not just a huge protein source for people, they're also a huge part of the livelihood and income of people involved in the fishing trade," he says.

Ben Kraemer and his group of volunteer limnologists prepare to head out on Lake Tanganyika. Photo: Ben Kraemer

While Kraemer and the paper's other authors acknowledge that overfishing is one cause of the reduction in catch, they suggest sustainable management of the fishery requires taking into account the overarching problem that as the climate warms, algae – which is the basis for the lake's food web – will decrease.

And it won't just be fish food that decreases, but fish habitat as well. In fact, the warming of the lake has reduced the suitable habitat for many species by 38 percent since the 1940s, the team found.

Local fishers on Lake Tanganyika. Photo credit: Saskia Marijnissen

In tropical lakes, increases in water temperature reduce the mixing between the oxygenated top layer of the lake and the nutrient-rich but oxygen-free bottom layer of the lake. Fewer nutrients in the top layer mean less algae and therefore less food for fish.

Those rising temperatures also mean less space for fish, says CFL faculty member and another co-author of the report, Pete McIntyre. In fact, based on instrumental records of oxygen in the lake water, the study's researchers calculated that since 1946 the amount of oxygenated lake-bottom habitat decreased by 38 percent.

That's because, unlike temperate lakes in North America, the oxygen in a deep tropical lake like Lake Tanganyika doesn't go all the way down to the bottom. Instead, says McIntyre, there's a "floor" within the water column and, beneath that floor, there is no more oxygen in the lake. Over the last 150 years, that floor has been rising in Lake Tanganyika.

"Whether you're a snail living on the bottom, or a fish swimming in the middle of the lake, you have less oxygenated habitat to operate in than you used to," he says.

This shrinking habitat is reflected in cores of bottom sediments. The remains of fish, algae, molluscs and small arthropods are preserved in the annual layers of sediment deposited in the bottom of Lake Tanganyika. By examining these cores, the team reconstructed a decade-by-decade profile of the lake's biological history going back 1,500 years.

The team found that as the lake's temperature increased, the amount of fish bits, algae and molluscs in the layers of sediment decreased.

You can think of the story playing out in Lake Tanganyika like a play, says McIntyre, "It's not that the cast is changing, it's that the amount of stage they have to work with is being reduced. That means fewer fish for people to catch and less habitat to support viable populations of the amazing diversity of life in Lake Tanganyika."

New Faces at the CFL

We welcome the following new staff to the CFL:

Sarah Collins, Postdoctoral Research Fellow (Stanley)

Jack Cotrone, Project Assistant, Water@UW-Madison (Carpenter)

Madeline Magee, Research Associate (McIntyre)

Paul Schramm, Research Assistant (Stanley)

Recent Degrees and Transitions

Alison Appling (Post Doc, Stanley) took a position as a Data Scientist with the Office of Water Information at USGS in Tucson, Arizona.

Becks, Courtney (graduate student, Library and Information Studies) took a Project Assistant position with the American Indian Studies Program.

Chelsey Blanke (MS, Vander Zanden), thesis *Compound-specific stable isotope analysis of amino acids from the laboratory to the Great Lakes*, is a Natural Resources Research Specialist at the CFL in collaboration with the Wisconsin Department of Natural Resources.

Daisuke Goto (Post Doc, Vander Zanden) accepted a research fellow position at the University of Toronto.

Grace Hong (Outreach Specialist, Hanson) accepted a Research Program Coordinator position at the University of Florida's Advanced Computing and Information Systems Laboratory.

Tim Kratz (Associate Director – Trout Lake Station) is serving his second year as Program Director of the Division of Biological Infrastructure at the National Science Foundation.

Ben Kraemer (Post Doc, McIntyre) accepted a Postdoctoral Associate position at the Leibniz-Institute of Freshwater Ecology and Inland Fisheries in Berlin, Germany.

Peter Levi (Post Doc, McIntyre) is an Assistant Professor of Environmental Science and Policy at Drake University in Des Moines, Iowa.

Paul Schramm (Associate Research Specialist, Stanley) is a Research Assistant at the CFL.

Andy Stevens (MS, McIntyre), thesis *Mercury in Wisconsin fishes: Pathological and consumption implications,* accepted a fish biologist position with the US Fish and Wildlife Service in Ashland, WI.

Jake Walsh (PhD, Vander Zanden), thesis *Massive impacts on ecosystem services and processes due to an invasive species outbreak*, took a Postdoctoral Associate position at the CFL.

To give to the Center for Limnology...

Friends may give online through our web site: http://limnology.wisc.edu/support.htm, 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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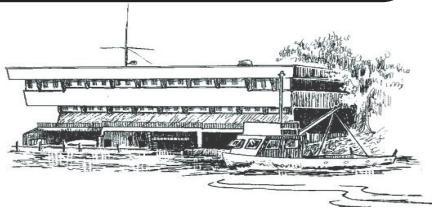

Awards

Anna Grant Birge Memorial Scholarships were awarded to Civil and Environmental Engineering student Carolyn Voter; Environmental Chemistry and Technology student Benjamin Peterson; Freshwater and Marine Sciences students Julia Hart, Cristina Herren and Michael Spear; Geological Engineering student Dominick Ciruzzi; and Zoology students Robert Mooney, Tiago Ribeiro and Jake Walsh.

Jean B. and E.T. Juday Awards were given to undergraduates Emily McParlane and Luke Maillefer.

Graduate student Dominick Ciruzzi and undergraduates Margaret Sobolewski and Keith Lyster were awarded John and Patricia Lane Summer Research Scholarships.

The Kenneth W. Malueg Limnology Scholarship was awarded to Zoology student Aaron Koning.

Freshwater and Marine Sciences student Alison Mikulyuk was the recipient of a Charlotte Stein Student Travel Award.

Undergraduate Brandon Dobraska was awarded the Lee Zinn Scholarship.

The Dorothy Powers Grant and Eugene Lodewick Grant Memorial Scholarship was awarded to Freshwater and Marine Sciences student Luke Loken.

Amelia Flannery, Nicholas Framsted, Anna Krieg, Thomas Shannon and Mykala Sobieck were selected to receive Research Experiences for Undergraduates (REU) awards funded by the National Science Foundation.

Steve Carpenter was named a Thomson Reuters Highly Cited Research in 2015 and listed in the 2015 World's Most Influential Scientific Minds. He was also named a Wisconsin Academy 2016 Fellow by the Wisconsin Academy of Sciences, Arts & Letters.

Etienne Fluet-Chouinard was awarded a Scott Kloeck-Jenson Fellowship.

Jim Kitchell's co-authored 1981 paper on forage fishes and their salmonid predators was recognized in *Fisheries* for being prescient and stimulating a broad range of new research efforts.

Tim Kratz was among the authors to receive the John H. Martin Award from the Association for the Sciences of Limnology and Oceanography (ASLO).

Jake Vander Zanden was selected as a Fulbright US Scholar, which supported his spring 2016 sabbatical at Waikato University in New Zealand.

Mike Pecore Retires

by Susan Knight

Mike Pecore started at the CFL in 1987. Mike's formal position description has been Facilities Repair Worker Advanced, but no job description could include everything Mike does for us at TLS. While Mike's responsibilities include many routine tasks, his indispensability comes from his pride in TLS and his incomparable work habits. We could make a very long list of everything Mike does, but the bottom line is that he sees what needs to be done, and he simply does it, including the most mundane and unsavory tasks. Mike always has a plan as to what he will be doing once he finishes the current task, with no one else's suggestion or even recognition. He anticipates what will be needed not only for the day, but for the upcoming weeks and seasons.

While his specific tasks may not seem grand, Mike's pride in the appearance of the station and concern that everything be right, and not just merely "done", is what sets him apart. If we took a poll at the lab, I have no doubt that he would be the one the year-round staff is happiest to see in the morning. His friendliness and steadiness creates a calm and an "all-is right-with-the-world" feeling in the lab. I am not sure how we will manage without Mike, but no one is more deserving of a long and happy retirement. So long Mike!

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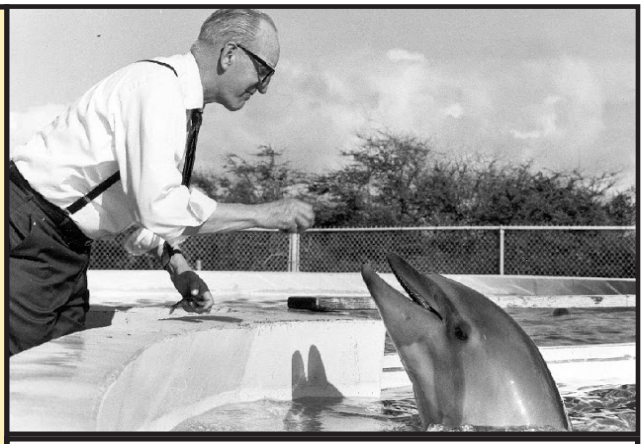

Where did we get the picture of Art Hasler feeding a dolphin?

Find out inside.