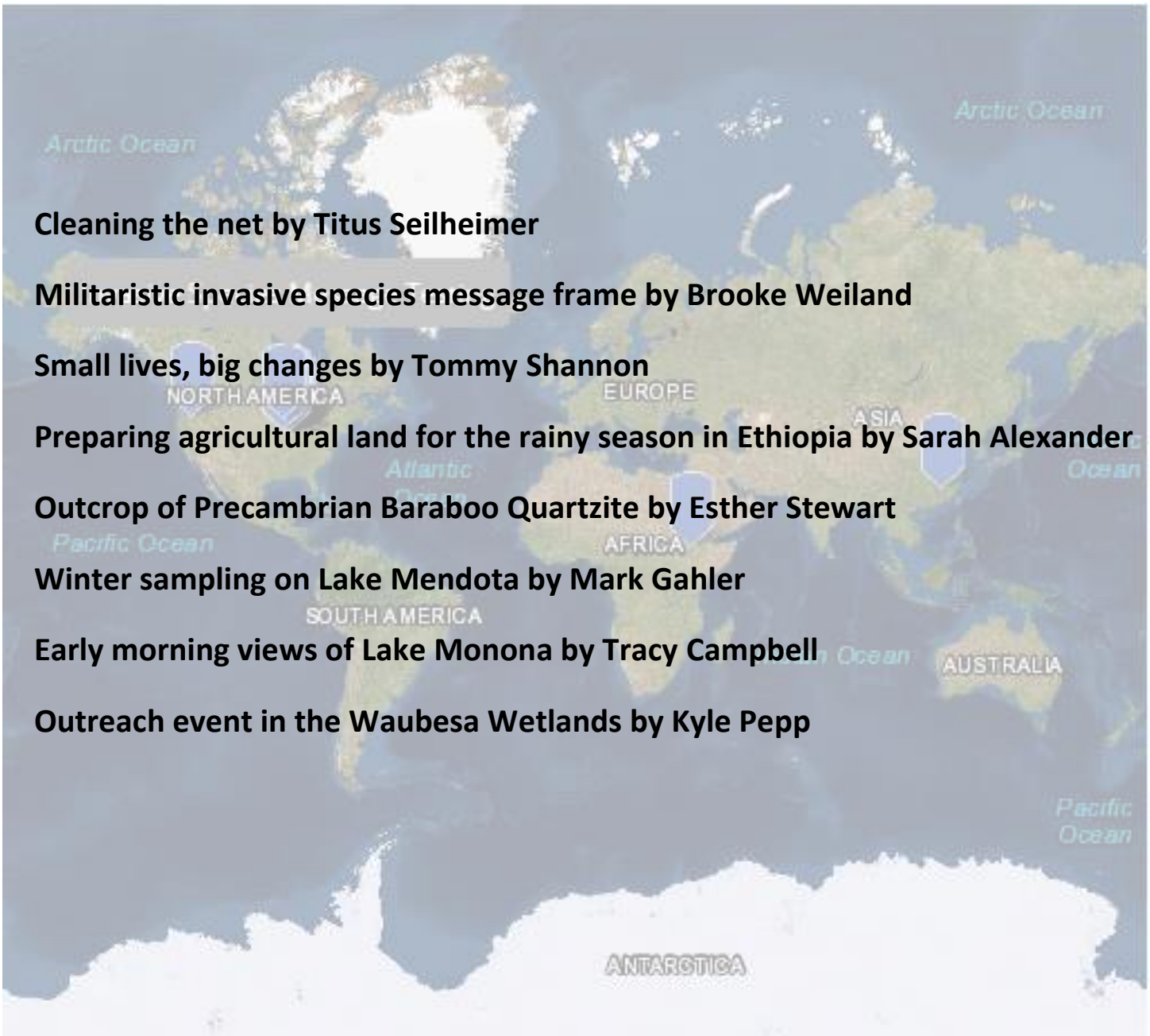
Water Research Image Contest Winners

Images were submitted to Water@UW-Madison Story Map of water-related research project PLUS a short description.

water.wisc.edu/story-map-project/



Cleaning the net by Titus Seilheimer

Militaristic invasive species message frame by Brooke Weiland

Small lives, big changes by Tommy Shannon

Preparing agricultural land for the rainy season in Ethiopia by Sarah Alexander

Outcrop of Precambrian Baraboo Quartzite by Esther Stewart

Winter sampling on Lake Mendota by Mark Gahler

Early morning views of Lake Monona by Tracy Campbell

Outreach event in the Waubesa Wetlands by Kyle Pepp

Cleaning the net by Titus Seilheimer

Lake Michigan Bycatch Study

PROJECT OVERVIEW
Title: Impacts on non-target species by trawling for Lake Whitefish in Lake Michigan under normal fishing conditions.
Location: Lake Michigan
Status: Current

RESEARCH TEAM
People: Titus Seilheimer (Fisheries Specialist)
Programs: University of Wisconsin Sea Grant Institute

PROJECT DETAILS
What's the problem?
Fouling of trap nets and other fixed gear is a challenge for Lake Michigan's commercial fishery. Allowing new and more flexible gear, like trawling, may increase efficiency and also reduce entanglement of anglers in commercial nets.

What are we doing?
This study is assessing the impacts to non-target species (bycatch) associated with lake whitefish trawling. For three years we have cooperatively worked with the WI DNR and commercial fishers to quantify bycatch in commercial trawls.

What have we found?
Trawling is an efficient gear for harvesting legal lake whitefish, while less than 3% of the catch is non-target species. Bycatch is mainly lake trout and small lake whitefish.

Militaristic invasive species message frame by Brooke Weiland

Invasive Species Message Testing

PROJECT OVERVIEW
Title: Aquatic Invasive Species Message Frame Testing
Location: Madison, WI
Status: Current

RESEARCH TEAM
People: Bret Shaw (Faculty), Tim Campbell (Aquatic Invasive Species Outreach Specialist)
Programs: Department of Life Sciences Communications, UW-Extension Natural Resources Institute; University of Wisconsin Sea Grant Institute

PROJECT DETAILS

What's the problem?

Many different metaphors and message frames are used to talk about invasive species, including militaristic, nativist, scientific, nurturing, and hitchhikers message frames. However, little is known about the impacts of using these message frames when communicating about invasive species issues. We believe that while some message frames might be more engaging, they may have unintended consequences for invasive species management.

What are we doing?

We worked with a graphic designer to produce drawings that consistently portray five different commonly used invasive species message frames. We then used that art as the basis for a series of paid Facebook A/B message tests that track numerous metrics including cost per click and post engagement. The advertisements were shown to people that were interested in lakes, boating, or fishing. We ran five separate message tests and then compiled the data for analysis.

What have we found?

We found that there were differences among the invasive species message frames across many of the tracked metric. The scientific message frame had the lowest cost per click, but also was shared the least and generated the least conversation. The nativist and militaristic frames had moderate cost per click values but generated the most conversation and page likes. The hitchhiker and nurturing message frames had the highest cost per click but were shared the most by Facebook users. We hope that we can use these results to refine communications and use message frames that can help lead to desirable management outcomes.

Small lives, big changes by Tommy Shannon

Zebra Mussel Ecosystem Impacts

PROJECT OVERVIEW
Title: Impacts of invasive Zebra Mussels on aquatic community structure and energy dynamics
Location: Lake Mendota, Madison, WI
Status: Current

RESEARCH TEAM
People: Jake Vander Zanden (Faculty), Mike Spear (Graduate Student), Rex Lowe (Professor Emeritus), Tommy Shannon (Undergraduate Student), Petra Wakker (Undergraduate Student), Ella Norris (Undergraduate Student)
Programs: Department of Integrated Biology, Center for Limnology

PROJECT DETAILS
What's the problem?
Zebra mussels are a notorious freshwater invasive species which have recently taken hold in Lake Mendota. Zebra mussels are bottom filter feeders that grow on rocks. They consume the nutrients and algae from the water that would otherwise feed the native plants and animals at the base of the lake's food chain. Besides drastically altering the way that energy flows in an aquatic ecosystem, zebra mussels are detrimental to humans because they clog pipes and will slice bare feet if stepped on.

What are we doing?
We have been tracking the growth and colonization rates of the zebra mussels since they were first detected, allowing us to understand how they impact the ecosystem at all stages in the invasion. We have taken a wide approach, monitoring the populations of many aquatic communities like the zooplankton, plants, bottom-dwelling invertebrates, and algae to see how each of these communities might change in response to the invasion and shifts in food availability. To study many of these communities we must scuba dive down to find them! Most studies on zebra mussels only occur once the invaders are well established, so we are lucky that we can see how the lake's other inhabitants are responding before, during, and after the mussels take hold.

What have we found?
Although we are still processing and analyzing our data, there seem to be some clear trends in the lake. As the zebra mussels became more densely populated, native species that preferred the open water became less prevalent, and species which lived in or near the bottom of the lake became more abundant. In the algae community, the open-water species' populations were reduced by half and populations of bottom-dwelling species doubled, just within two years of the invasion beginning. We believe that the zebra mussels are causing these shifts by pulling nutrients out of the open water and excreting them on the lake bottom, making them more available for other organisms.

Preparing agricultural land for the rainy season in Ethiopia by Sarah Alexander

Taming Water in Ethiopia

PROJECT OVERVIEW
Title: Taming water in Ethiopia: An interdisciplinary approach to improve human security in a water-dependent emerging society
Location: Blue Nile Basin, Ethiopia
Status: Current

RESEARCH TEAM
People: Paul Block (Faculty), Sarah Alexander (Graduate Student), Jonathan Lala (Graduate Student)
Programs: Department of Civil and Environmental Engineering, Water, Systems, and Society Group

PROJECT DETAILS

What's the problem?

Hydroclimate conditions in the Blue Nile Basin, Ethiopia are integral to many facets of the domestic economy, given the reliance on rain-fed agriculture. Greater climate variability in the region alters quantity and timing of precipitation, which exacerbates Ethiopia's vulnerability. In Ethiopia, the potential for advancing irrigated agriculture and hydropower management, and subsequently economic growth, is substantial.

What are we doing?

The PIRE project integrates research, education, training, and outreach to enhance water and economic security by leveraging knowledge and resources across engineering and the social sciences. Through linking sociological and engineering methods, the project aims to provide water resource managers with seasonal forecasts at an applicable scale, identify political institutional barriers to the uptake of forecasts, and educate an international team of experts. The multi-year collaborative will provide relevant decision-making tools in a people-centered approach to addressing the human, climate, water, agriculture, energy nexus in the Blue Nile Basin, Ethiopia.

What have we found?

Results indicate that season-ahead forecasts at the local, decision-making scale have skill, particularly using statistical methods. Further, forecasts of precipitation or streamflow can be used to predict the inflow to local reservoirs during the dominant rainy season. Given advanced information on the coming season may assist both rain-fed and irrigated agricultural decisions (e.g. preparation of land, seed allocation). This multi-year collaborative research project is ongoing; the Blue Nile Basin, Ethiopia is highly vulnerable to variabilities in climate, and future outcomes aim to understand how the translation of climate information may serve to increase economic security in a water-dependent region.

Outcrop of Precambrian Baraboo Quartzite by Esther Stewart

Aquifer Base, Southern Wisconsin

PROJECT OVERVIEW
Title: Mapping the base of the Cambrian Aquifer, southern Wisconsin
Location: South-central Wisconsin
Status: Current

RESEARCH TEAM
People: Esther K. Stewart (Faculty), Joe Rasmussen (Graduate Student), John Skalbeck (Faculty), Latisha Brengman (Faculty), Eric Stewart (UW-Baraboo), Madeline Gotkowitz (Faculty), Basil Tikoff (Faculty)
Programs: Department of Environmental Science, Wisconsin Geological & Natural History Survey, UW-Extension

PROJECT DETAILS
What's the problem?
Wisconsin's sandstone aquifer covers most of WI, serving as the principal bedrock aquifer for large portions of southern and western Wisconsin. The lower boundary to this groundwater system is the Precambrian basement. Basement topography exerts strong control on aquifer thickness, the volume of groundwater stored in the system, and the geometry of a no-flow boundary to the aquifer. Accurate interpretation of the aquifer thickness therefore supports groundwater management and protection.

What are we doing?
We undertake coupled 2-dimensional modeling of gravity and aeromagnetic data, integrated with drill core, well construction reports, and drill cuttings logs to constrain Precambrian geology and topography. This effort is complimented by geologic mapping and detailed petrographic analysis of a regional Precambrian iron formation (the Freedom Formation), as well as complimentary geophysical techniques such as collection of active seismic and refraction data.

What have we found?
Modeling supports geologic mapping that documents (1) The Baraboo Quartzite and conformable units are overlain by a younger quartzite across an angular unconformity; (2) regional-scale Precambrian folds and faults. A regional fault bisects Columbia County with slightly older Precambrian units present to the north, and higher-density units present at depth mostly on the south side of the structure. This fault likely extends northeast through northwestern Dodge County and into Fond du Lac County, where it may control variation in Precambrian topography near the city of Waupun and south of Lake Winnebago.

Winter sampling on Lake Mendota by Mark Gahler

Microbes Under Ice in Lake Mendota

PROJECT OVERVIEW
Title: Microbes and their role in nitrogen cycling under ice in Lake Mendota
Location: Lake Mendota, Madison, Wisconsin
Status: Current

RESEARCH TEAM
People: Patricia Tran (Graduate Student), Katherine McMahon (Faculty), Emily Stanley (Faculty)
Programs: Department of Bacteriology, UW-Center for Limnology

PROJECT DETAILS

What's the problem?

In lakes, microbes play an important role in transforming and distributing nutrients so that other organisms in the food chain can access them. Traditionally, lakes were thought to be dormant during the winter, so limnological research has focused on what happens during warmer months. Yet recent studies have shown phytoplankton blooms and active microbes under ice, providing evidence that disregarding a season that account for 1/4 of the year limits our understanding of the overall lake ecology.

What are we doing?

Among the ways microbes influence their ecosystem is by being central players in global biogeochemical cycling. In this study, we wanted to do which microbes live under the ice, and how do they process nitrogen, an important compound for all life forms. To do this, we performed depth-discrete sampling of Lake Mendota every week during winter, and until ice-off. We took profiles of environmental characteristics such as nitrate, oxygen, and temperature. We also brought water back to the lab for DNA sequencing, which allows us to identify the microbes. Then, we took some water and performed incubations experiments to measure the rate (how fast) the microbes process various forms of nitrogen.

What have we found?

Overall, we found that microbes that live in the upper layer of oxic waters of the lake can quickly denitrify (convert ammonia to nitrite). In addition, we found that within the oxic layer, nitrification rates are very similar. In the hypoxic (low oxygen) layer however, the rates of N activity (denitrification: converting nitrite to nitrogen gas) was more variable. Our study demonstrate that nitrification happens quickly under the ice-cover in lakes, and has implications for the nitrogen availability at the start of spring, which is essential for other larger organisms to grow. This study improves our understanding of microbial diversity and their role in biogeochemical cycling, which contributes to our understanding of healthy lakes.

Early morning views of Lake Monona by Tracy Campbell

Evaluating Water Quality in the Yahara Watershed

PROJECT OVERVIEW
Title: Evaluating Water Quality in the Yahara Watershed under Future Changes in Land Cover, Land Management, and Climate
Location: Yahara Watershed, WI
Status: Current

RESEARCH TEAM
People: Tracy Campbell (Graduate Student), Chris Kucharik (Faculty), Eric Booth (Research Scientist)
Programs: Department of Agronomy, Department of Civil and Environmental Engineering, Kucharik Lab

PROJECT DETAILS

What's the problem?

The Yahara Watershed exemplifies many of the current challenges regarding the impact and interaction of climate change, land cover, and nutrient management experienced in the Midwest US. Water quality of the Yahara watershed is of specific concern, as decades of research have established agriculture's impact on nutrient loading within the chain of lakes, which contributes to the development of algal blooms, decreased water clarity, and alterations to aquatic life.

What are we doing?

To evaluate the impacts of changes and in land cover and reduced crop nutrient applications on ecosystem services in a changing climate, we used scenario development and ecosystem modeling. We chose this approach as it allows us answer questions about the future that would be impractical, or impossible to answer based only on field studies. We generated 48 scenarios projected to the year 2070 using the Agro-IBIS agroecosystem model. Agro-IBIS simulates biophysical processes in the soil-plant-atmosphere system and allows us to make projections on an array of ecosystem services. It is our goal to provide growers, stakeholders, and policy makers with tools and information to prevent further water quality degradation.

What have we found?

Model output suggests inaction leads to further environmental degradation with surface water quality declining between 7-23% depending on climate conditions. By incorporating transformative land management changes, water quality could be improved by 50%. However, improvements of 50% only came after 50 plus years of investment in transformative land management changes, and with trade-offs to other ecosystem services. Based on our findings, current water quality improvement efforts are insufficient for combating the influence of climate change and legacy nutrients. Moving forward, it will be crucial policy decisions reflect the large-scale and time intensive approaches required for water quality improvements in the Yahara watershed.

Outreach event in the Waubesa Wetlands by Kyle Pepp

Waubesa Wetlands Watershed

PROJECT OVERVIEW
Title: Assessing Land Use Change and Promoting Community Engagement in the Waubesa Wetlands Watershed
Location: Fitchburg, WI; Dunn, WI
Status: Current

RESEARCH TEAM
People: Water Resources Management 2017 - 2018 Cohort: Anita Thompson (Faculty), Sharon Long (Faculty), Courtney Botelho (MS), Mitch Buthod (MS), Stephanie Herbst (MS), Lianna Johnson (MS), Rachel Johnson (MS), Nemesis Ortiz (MS), Kyle Pepp (MS)
Programs: The Nelson Institute for Environmental Studies, Water Resources Management, Capital Area Regional Planning Commission, Wisconsin Department of Natural Resources

PROJECT DETAILS
What's the problem?
The Waubesa Wetlands are a 150-hectare state natural area located on the southwestern toe of Lake Waubesa in Dane County, Wisconsin. The high-quality wetlands have unique hydrogeology, are extremely diverse, support many rare plants and animals, and provide important ecosystem services. The upstream land that drains to the wetlands, through Swan and Murphy's creeks, has current and future land development that could affect the ecological integrity of the wetlands.

What are we doing?
We are working to understand the current conditions of the Waubesa Wetlands watershed. Our methods include monitoring the water quality of the streams feeding the wetlands, and assessing ecosystem services like flood abatement, sediment retention, wildlife habitat, and nutrient reduction. With our data, we are modeling future development, land use change, and climate to understand how the watershed could be impacted under different scenarios. Our goal is to provide recommendations for how watershed land use can be planned and managed to protect the wetlands. We are also working to engage community members and watershed residents through an informational website, outreach events, and the creation of a Friends of Waubesa Wetlands group.