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Flood Prevention vs. Salmon Migration in Oregon

Photo: Lynn Ketchum, OSU EESC

FONDRIEST
ENVIRONMENTAL

Table of Contents

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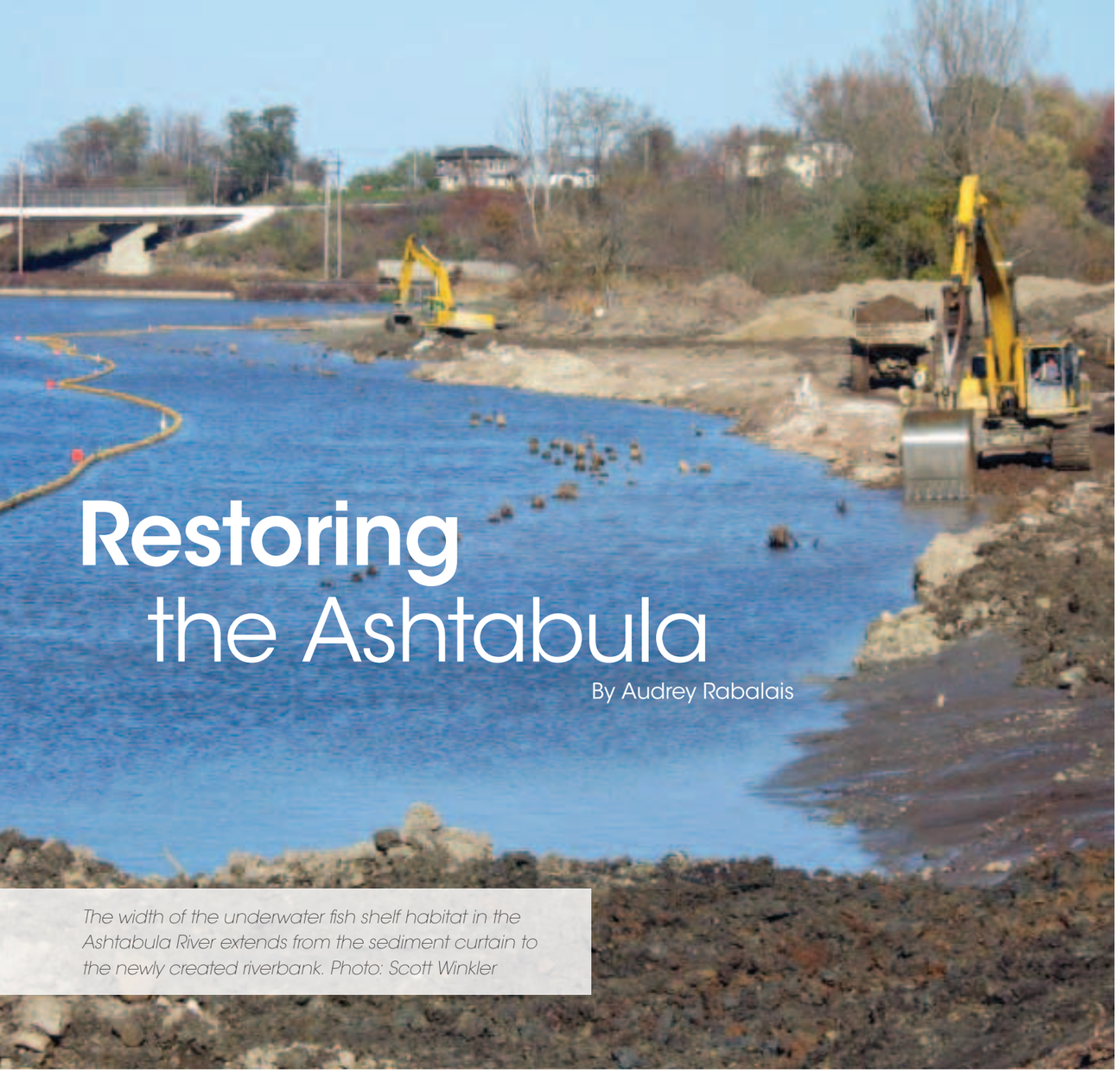
Welcome...

In this issue of *Environmental Monitor*, projects cross the United States. From measuring the flow of the Rio Grande to making equipment improvements to protect salmon runs in Oregon, monitoring technology is employed in a multitude of ways. Also featured is new insight into the causes of Lake Erie algal blooms and a ray of hope for river reclamation. From coast to coast, whatever the research goal, we showcase the technology and projects in the real world. For more information on monitoring systems, contact a Fondriest applications engineer. We're always happy to answer questions and brainstorm new solutions.

Located in Beavercreek, Ohio, Fondriest Environmental is the trusted partner you can turn to for help with environmental monitoring projects. We can assist in everything from planning and monitoring to systems integration, equipment calibration and even staff training. Our application engineers assemble, integrate, and calibrate all equipment – when you get it, it's ready to use. Our specialists have years of experience developing and deploying remote systems and working with leading suppliers such as YSI, Hach, Thermo Scientific, In-Situ, Solinst, NexSens, and many more.

Restoring the Ashtabula

By Audrey Rabalais



The width of the underwater fish shelf habitat in the Ashtabula River extends from the sediment curtain to the newly created riverbank. Photo: Scott Winkler

The Ashtabula River may soon be off the list of the Environmental Protection Agency's (EPA) areas of concern (AOC), thanks to the efforts of a 23-year remediation project that is nearly complete. The last stage will create nearly half a mile of fish shelf habitat in the middle of the 2-mile Ashtabula River AOC, known as the 5 ½ Slip site. The project should be completed by summer 2012, according to the Ohio EPA.

Originally christened by the Iroquois as "river of many fish" the Ashtabula has been mismanaged and polluted for the last 70 years. The river's sensitive aquatic ecosystems were damaged by unregulated chemical discharge from World War II ship building and industrial waste in the latter part of the 20th century. As a result, all recreational activities were halted in the lower portion of the river. In 1988, the Ohio EPA helped form the Ashtabula River Remedial Action Plan (RAP) Advisory Council, which oversees improvements to the AOC. The council found six beneficial use impairments in the Ashtabula River AOC, including degradation of fish populations, loss of fish habitat, fish tumors and deformities and restrictions on fish consumption.

The 5 ½ Slip site is a channel that ends on land and was used as a place to demolish old freighter ships. Because it is not fully connected to the river, the area has no water current and low dissolved oxygen levels. When the river was first designated as an AOC, many of the fish had deformities due to polluted, stagnant water.

"They were finding tumors, particularly on the bullheads," said Fred Leitert, chairman of the Advisory Council. "We had fish that were sick, that's for sure."

The restoration project will connect the slip back to the river to restore water currents and life-supporting oxygen levels. Upstream of the AOC, the watershed is designated as a State Scenic River where northern pike, muskellunge and largemouth bass flourish. These fish populations, coveted by fly fishermen, could begin to spawn downstream in the restored habitat. It will also provide a resting place for migrating steelhead trout, opening up recreational opportunities for locals and visitors alike.

"It's a healthy river and people come from all over the United States and Canada to fish for steelhead trout," Leitert said.

Despite the overall health of the river, the 2-mile stretch identified as an AOC contained deposits of chemical waste. In 2007 the Great Lakes Legacy Act (GLLA), a federal program founded to clean sediment in AOCs, funded dredging that extracted nearly 500,000 cubic yards of contaminated sediments. The next year, the Water Resource and Development Act sponsored a second dredging, removing another 130,000 cubic yards of sediment. An estimated 25,000 pounds of PCBs were removed, along with uranium, radium and thorium.

Chemical hazards were not the only obstacle to restoration of the fish habitat. The Ashtabula River was originally used as a port for coal cargo ships which, over time, ruined the slope of the riverbank. The sharp drop-offs of the banks stood in contrast to the gradual slopes fish need to spawn. Leftover funding from the GLLA allowed for the construction of more than 800 feet of fish habitat shelf last year. Another 1,500 feet of habitat shelf will be completed in the summer of 2012 thanks to a $1.5 million grant from the Great Lakes Restoration Initiative. The restored riverbank slope provides a shallow area suitable for spawning.

"We are nearly tripling the amount of constructed habitat in the Area of Concern and expect it will result in significantly improved fish populations," said Ohio EPA director Scott Nally in a news release.

A map showing the 5 ½ Slip location, the fish shelf location and natural and armored riverbanks in the Ashtabula River Area of Concern. Photo: Scott Winkler

According to the the RAP Advisory Council, when finished, the restoration plan will create 2,700 feet of fish habitat shelf and four acres of wetlands for local birds and mammals.

The RAP Advisory Council expects the 5 ½ Slip site restoration will put the Ashtabula River AOC closer to delisting status. In order to be removed from the AOC list, a site must first resolve each beneficial use impairment, and the 5 ½ Slip section alone will have a significant impact on that assessment.

To be delisted for loss of fish habitat, Ashtabula River AOC will need a qualitative habitat evaluation index (QHEI) score of 60 or higher and a Lake Erie QHEI score of 55 or higher. The Ohio EPA developed the QHEI as a measure of fish habitat quality based on physical factors in the ecosystem. The QHEI gives a score to six different parameters including water flow and erosion. With the new fish habitat shelves, the Advisory Council expects a Lake Erie QHEI score of at least 70, allowing the AOC to be delisted for degradation of fish habitat.

Leitert and other Advisory Council members know that when this project is finished, there will be more habitats to create and other aquatic areas to improve. However, Leitert has enjoyed the success of the Ashtabula River restoration from the seat of his own bass boat that he bought last summer.

"Looks like a turnaround in fish," he said. " We feel that we have done a sufficient amount of work." ■

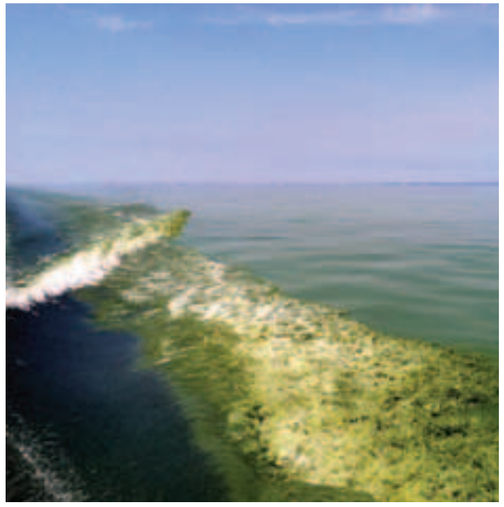
From River to Lake:
Studying the Source of Lake Erie's Algae Woes

By Jeff Gillies

Ohio's Maumee River, long known to ferry phosphorous-laden runoff into Lake Erie where it fuels huge blooms of harmful algae, is also delivering a dose of the algae itself, according to a recent study.

"It's kind of like the river is supplying both the firewood and the spark," said Tom Bridgeman, assistant professor of environmental sciences at the University of Toledo.

Bridgeman is the lead author of a study published recently in the *Journal of Great Lakes Research* that describes extensive sampling of western Lake Erie and the main stem of the Maumee before, during, and after a large bloom of the blue-green algae Microcystis. The blooms are a recurring problem that turn huge swaths of western Lake Erie green each summer and have the potential to produce dangerous toxins and oxygen-sucking dead zones.



Blooms fueled by Nutrient-rich runoff flowing in from Lake Erie's tributary rivers turn square miles of water green. Photo: NOAA

The research tracked which types of phytoplankton and forms of phosphorous were most prevalent in the river and lake and how that changed over the bloom season. Though scientists have tracked phosphorous levels in the Maumee for years, there has been very little study on which phytoplankton species live in the river, said Doug Kane, assistant professor of biology at Defiance College. Kane is a co-author of the Maumee study and part of a similar project that tracked Microcystis in the main stem and tributaries of the Maumee and Sandusky rivers.

"What we found when we started these projects was that there wasn't much data on phytoplankton algae for the rivers, so we really didn't know it was there to begin with," Kane said.

Rivers aren't typically known to foster large algae populations, Bridgeman said. River water is always moving and often muddy, which doesn't give algae the time or sunlight needed for growth. So even though they suspected they would find some Microcystis in the river, they were surprised by how much they found.

"We were surprised that we found Microcystis almost everywhere, almost all the time," Kane said. "Very small tributaries to the main stem of the river, even in early spring."

The researchers identified the Microcystis with a German instrument called a FluoroProbe, which can identify different groups of algae in a mixed sample based on their pigments. Bridgeman said the tool has limitations, but can be very useful if you keep those in mind.

"It allows you to get a much quicker measurement than if you had to do the traditional microscopy, when you're looking at a sample under a microscope and just counting everything," he said.

It isn't yet clear what role the river's Microcystis population plays in the huge summer blooms on Lake Erie, but it could complicate scientists' old assumption that the bloom springs entirely from algae cells sitting in the lake awaiting nutrients from the rivers to fuel their wild growth. It's possible, Bridgeman said, that the cells from the river give the bloom a head start, kicking off the bloom season a little earlier than if it relied on lake cells alone.

But there are also signs that the river Microcystis may not be all that important. For example, not all strains of Microcystis can produce the toxins that can sicken people who drink or swim in tainted water. Preliminary genetic testing seems to indicate that the river strains are nontoxic, Bridgeman said.

The 2011 algae bloom in western Lake Erie, visible in this image captured from a satellite, was one of the biggest on record. Photo: NOAA

"We still don't really know how much to blame the Maumee River Microcystis for the blooms in the lake," he said. "On one hand, yes, it's contributing Microcystis. It might act as a seed population to the Microcystis in the lake. On the other hand, the Microcystis in the river seems to be a different genetic strain than mostly what goes out in the lake."

Whatever the source of the Microcystis, the bigger problem is the phosphorous fueling its growth. The study also tracked different forms of phosphorous in the lake and river, which is important because some forms are more bioavailable, or readily usable to help algae grow, Bridgeman said.

The study found that the most prevalent form of the nutrient in June in the river and lake was dissolved organic phosphorous—phosphorous that has recently been part of living tissue that could come from manure or sewage treatment plants. Bridgeman said dissolved organic phosphorous isn't generally considered to be very bioavailable, and in a standard scientific analysis is often lumped into the same category as particulate phosphorous, which describes the nutrient when it's stuck to grains of sediment or already within algae cells.

But even though dissolved organic phosphorous isn't immediately ready to fuel algae growth, it might only take a day or two to transform into a more bioavailable form, Bridgeman said. And the fact that they found so much of it could mean that this is a more important form of phosphorous than previously thought.

"The phosphorous coming down the river, there's more that's going to be available to plants either right now or very soon than probably we might have thought," he said. "That's a pool of phosphorous that we were kind of missing before."

Though the study focused on the phosphorous and Microcystis in the lake and river, Bridgeman and Kane agree that the solution to Lake Erie's harmful blooms must ultimately unfold on the land.

"Whether (the algae) is growing in the river and being transported to the lake or growing in out in the lake, the nutrient issue is what has to be addressed on the land," Kane said. "Either of those two things, it's going to be the same fix: prevent nutrients from running off the land into the water." ■

A Gated Community: How Flood Prevention Affects Fish Migration

By Alexandra Hazlett

Coho salmon swim in Eagle Creek, a tributary of the Columbia River. Photo: Oregon Department of Fish and Wildlife

When the state of Oregon was settled more than 150 years ago, its coastal areas were brackish marshes and wetlands prone to flooding. Draining these areas benefited pasture grazing in a state covered by lush timber forests. The delicate balance of the environment was poorly understood by early settlers, and the seemingly limitless abundance of natural resources provided few incentives for caution.

As a result, it has taken a century for the dots to be connected between timber, pastures, marshes, and one of the iconic animals of the Pacific Northwest: salmon.

In the early 2000s, in a favorable year, Oregon coastal salmon runs were between 11% and 19% of historical levels (defined as before 1850). In a bad year, of which there were many because of pollution, runs were between 3% and 6% of past highs. Other stocks along the Pacific Coast have similar, and sometimes worse numbers. While exact estimates vary, the EPA and ecologists state with certainty that some fish stocks have gone extinct and many more remain threatened.

Environmental changes have many causes that interact in complicated ways, but perhaps no single invention encapsulates Oregon's history of environmental trade-offs and their effect on salmon better than the tide gate.

Tide gates, also known as flood boxes, have been used since the middle ages for flood protection and mosquito control. While low-lying areas can be protected from river overflows by berms, dikes or levees, they may still be affected by water flows from upstream sources. In these places, there needs to be a way for water to drain out into the river, but not flow back into the lowlands and flood. Tide gates, which are hinged flaps that cover drainage outlets, are rigged so ebbing water can open the gate and escape, but flow (incoming) tides shut the gate. And while tide gates have been effective at controlling lowland flooding, their wider implications are poorly understood.

"There isn't a whole lot of science behind tide gates," said Ryan McCormick, a fish pathogen screening engineer for the Oregon Department of Fish and Widlife.

The tension between competing land use needs is illustrated by a unique project on the Siuslaw River. An old drainage ditch running parallel to the Siuslaw River keeps surrounding real estate from being flooded. A 4-foot-wide pipe covered by a tide gate allows for outgoing water flow but prevents river water from inundating homeowners. The partly natural, partly man-made channel serves as a resting area for fish seeking a refuge from the high turbidity of the Siuslaw waters.

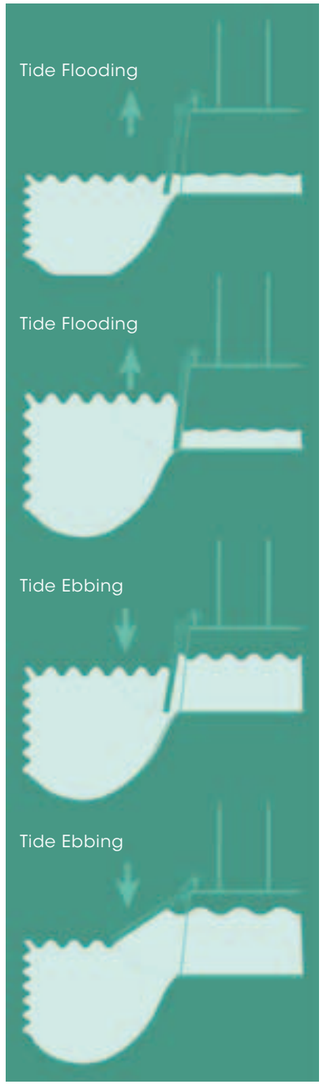
McCormick, who lead the project and instrument installation, said that the goal is to "understand how this particular tide gate creates hydraulics" that may or may not be good for fish. Instrumentation on both sides of the pipe measures water depth, temperature, salinity, and levels of dissolved oxygen and pH. The units are set to take simultaneous measurements every 30 minutes. Inside the drainage pipe, a SonTek Argonaut unit measures water depth, velocity and temperature. Ron Nauman, of HydroScientific West, which supplied the equipment, said there is also a tilt sensor to measure the angle of gate opening.

"This is the first attempt to understand how this particular installation works," McCormick said.

Eventually the data may be used to make changes to Oregon's fish passage rules. In the long run, the project and others like it may lead to a more conscientious balancing of competing land uses.

The most basic effect a tide gate has on fish passage is as a barrier to swimming. Fish use marshlands as an escape from high or fast moving river waters, and as a source of food and shelter from predators. When a tide gate is closed, no water can move up the channel, and neither can fish. The length of time that a gate is open is a function of water pressure and the weight of the gate. (The graph at right shows the cycle of a tide gate opening.) However, weather conditions or equipment malfunctioning can result in the gate being open for less time than assumed, or in some cases, not at all. New types of side hinged tide gates, and other designs billed as fish-friendlier, are being introduced. Other designs may be integrated with regulators or flotation devices to ensure that the gates are open for enough time to allow for fish passage.

Even when the gate is open, the channel size of the drainage culvert will increase the outgoing water velocity, potentially creating another obstacle for fish.



The full cycle of a tide gate, which opens during ebb tide, and closes during a flood tide, preventing water from moving upstream. Photo: Jon Souder, Coos Watershed Association

The segmentation of water flow created by tide gates affects the ecology of the channel. Incoming flood waters are usually brackish, and salt water is heavier than fresh water, so it sinks the bottom and creates a "wedge" of saltwater moving up the channel. Tide gates interrupt this water circulation by controlling the upland flooding, altering the turbulence and velocity of outgoing freshwater. The gate also increases sedimentation upstream and blocks the mixing of waters of different temperatures. Water that would normally become gradually warmer upstream is instead drastically different on either side of the gate.

Salinity is also affected by tide gates. The salinity of estuarine water varies by the day and season as the tide ebbs and flows. This in turn affects the plant life in the environment - plants that serve as important food sources and habitat for young fish. Without the mixing of brackish and fresh water, oxygen depletion can occur in upstream channels, further harming aquatic plants and animals.

Only recently have scientists started studying in earnest the effects of tide gates on salmon migration. For most of the 20th century, salmon stocks were so abundant as to mask the extent of the problem, explained Guillermo Giannico, an associate professor at Oregon State University who studies the issue.

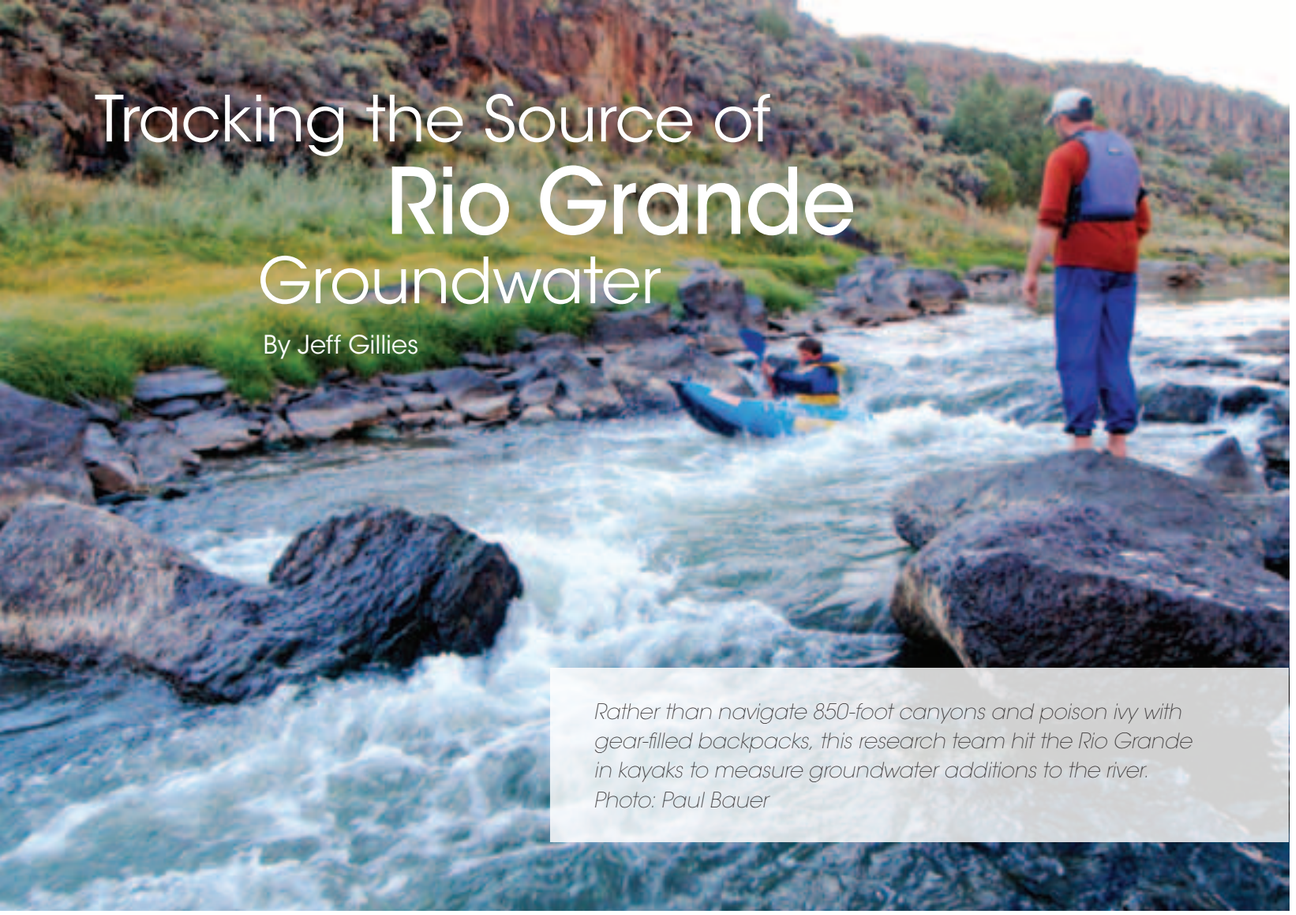
"People never thought to connect the dots," he said. "Resources seemed to be endless."

One developing solution, according to Giannico, is for communities to reevaluate land use decisions on a case-by-case basis. Development choices made 50 or more years ago may no longer be the best option. Economists are starting to study the holistic worth of environmental resources: timber, grazing, agriculture, fishing, birding and hunting are all valid and profitable land uses. Dairy production in Oregon is a billion-dollar industry. The trick is to determine which land can be used most effectively for which purpose.

"We need to study each ecosystem individually, because they are all different," Giannico said. ■

Tracking the Source of Rio Grande Groundwater

By Jeff Gillies



Rather than navigate 850-foot canyons and poison ivy with gear-filled backpacks, this research team hit the Rio Grande in kayaks to measure groundwater additions to the river. Photo: Paul Bauer

When a group of researchers in inflatable kayaks heard a hissing sound in the midst of a three-day float down the Rio Grande River, they thought they were in trouble.

"We were thinking, 'Oh my god, somebody's boat sprang a leak,'" said Kristoph Kinzli, assistant professor in Florida Gulf Coast University's department of environmental and civil engineering.

Kinzli and eight colleagues were on the upper Rio Grande in 2008 to measure how much groundwater flows into the river after it crosses the Colorado border and flows into New Mexico. It's a dry region with ever-increasing demand for water, so tracking every cubic foot of current counts. The group chose boats over hiking in part because this remote, 30-mile stretch carves through 850-foot canyons and poison ivy-lined banks, making the water nearly inaccessible. Losing a boat would be a problem.

Luckily, the hiss wasn't coming from hole in a boat. Rather, it was a hole in the river bed where a huge spring blasted fresh groundwater into the stream with enough force to lift inch-wide stones up into the water column. What they heard was the churning plume of gravel that hovered over the spring—the muted sound of stones continuously tumbling and colliding underwater.

The researchers expected to see springs, but nothing this big, Kinzli said. Though they weren't the first humans to see it, the spring was scientifically undocumented until recently.

"To see the magnitude of that was amazing," Kinzli said. "It's a pretty significant contribution to the river."

Measuring groundwater contributions to the Rio Grande is what brought the team to the river in the first place. The Rio Grande flows from its headwaters in Colorado through New Mexico and into Texas, and all three states depend on the river and its groundwater resources for irrigation, drinking water, and wildlife habitat. A legal agreement called the Rio Grande Compact makes sure each state gets its share of water while leaving enough for the next state downstream.

"When states don't meet what they're supposed to send downstream, you get some pretty heated court battles," said Kinzli. "In drought years, it gets really bad."

Research like this helps states comply with the compact, said Rolf Schmidt-Petersen, Rio Grande basin manager for New Mexico's Interstate Stream Commission, a state agency that regulates water resource issues.

Understanding groundwater is important because it's less vulnerable to climate fluctuations than melting snow, which is the major source of river water in the West. Officials already knew that groundwater flows into this stretch of the Rio Grande, but they wanted a better estimate of how much and where it was getting in, said Schmidt-Petersen, who was also part of the kayak expedition.

"We were trying to do a better job of quantifying spring inflow," he said. "We wanted to get a real feel for where those were coming in."

The research helped squash a homespun theory amongst some in Colorado that groundwater originating in their state was flowing under the border and entering the river in New Mexico. Their argument was that Colorado wouldn't have to restrict their water use so tightly if the state could get credit for delivering water to New Mexico underground. But, Schmidt-Petersen said, the team's measurements and other chemical analyses helped show that the groundwater flowing into the river in New Mexico originates in the nearby mountains, not Colorado.

As the researchers floated down the river they stopped at six sites to measure the current with an acoustic Doppler current profiler and another two sites with a standard propeller meter. By measuring the discharge at one site and subtracting an earlier discharge measurement at an upstream site, the researchers were left with how much groundwater had entered the river between the sites.

For example, around 20 miles into the trip, the crew measured the current near Sunshine Valley at 80 cubic feet per second (CFS). Twenty hours earlier, this water was still flowing past the Colorado border, and a stream gauge there read only 60 CFS. That extra 20 CFS came from groundwater flowing through springs or seeping into the channel.

In all, the 30-mile stretch of the river downstream from the Colorado border gains 22 CFS of groundwater, according to the study results published in the journal River Research and Applications. That's within the range calculated by previous studies, but Kinzli said he puts more stock in this study than past estimates because the Doppler profiler is so much quicker and more accurate than other methods.

Measuring current with a hand held propeller meter can take two hours at a single site, where the Doppler profiler can do the work in ten minutes, he said.

"It just collects so much more data so much more quickly than historical meters that were used," he said. "It is a night and day difference."

> **"It just collects so much more data so much more quickly than historical meters that were used. It is a night and day difference."**

Kinzli did discover one design flaw with the ADCP model he used: The data-logging handheld computer wasn't waterproof. The team lost out on a few days of high-quality ADCP data when Kinzli left the computer on a rock on a windy day.

"I just had it running and this 60 mile-an-hour gust came in and hit the PC and blew it off the rock. It hit the shore, bounced and landed in the water."

The lesson, Kinzli said, was that no matter how advanced the equipment, it won't work when the electronics are wet. ■

The crew's pulley system towed the ADCP back and forth across the channel for quick measurements that would have taken hours with a traditional meter. Photo: Paul Bauer

Pursuing Ecology's
'Digital Revolution'

Automated Water Quality Stations

By Mike Voellmecke

Designing and installing a reliable water quality station requires careful upfront planning and proper component selection. With the right approach, these stations can provide high quality data and offer years of reliable service.

The process begins with a detailed understanding of data collection requirements, including parameters to be measured, methods for recording and transmitting the data, and plans for sharing the data.

Measurement Parameters
Water quality monitoring stations may require measurement of a wide variety of physical, chemical, and biological parameters. Both individual sensors and multi-parameter sondes are available for integration.

Single parameter sensors with either analog or digital outputs are affordable and simple. Digital 'smart' sensors store calibration constants in local memory. This enables sensors to be calibrated in traceable, controlled laboratory environments and quickly exchanged in the field.

Multi-parameter sondes incorporate common sensors into a single package. Typical measurements include: temperature, conductivity, pH, dissolved oxygen, and turbidity. Other optical sensors such as chlorophyll and blue-green algae are also available. Recent advances in luminescent sensors have greatly improved the long-term deployment performance of dissolved oxygen sensors. Most multi-parameter sondes feature this new technology.

Michael Durkalec with Cleveland Metroparks services a water quality sonde at a stormwater monitoring site.

In addition to water quality sensors, weather and hydrology sensors provide researchers with a broader view of environmental conditions.

Data Logging and Telemetry
Environmental data loggers are classified as either weather-resistant or submersible. Weather-resistant data loggers are deployed in shore-side applications. Submersible data loggers are ideal when systems are exposed to extreme wave action, floods, or underwater deployment. Submersible data loggers eliminate the potential for accidental flooding when installed in and around coastal waters, lakes and rivers.

Newly developed data loggers simplify the interface of multiple sensors from multiple vendors, which has historically been one of the more challenging aspects of setting up water quality stations. These data loggers support a wide variety of sensor interface types such as RS485 Modbus, SDI-12, analog, pulse count and frequency.

Wireless telemetry minimizes site visits and makes data available on desktop computers or mobile devices. Common methods include land-line telephone, VHF, UHF or spread spectrum radio, cellular, WiFi, Ethernet and Iridium satellite.

The most effective telemetry method depends upon site location and conditions. Radio telemetry is ideal for short-distance transmissions when the monitoring site is located within a few miles of the base station. Direct line-of-sight may be required for low power radios. More remote sites may require cellular telemetry, assuming coverage is available. Iridium satellite telemetry enables two way remote access anywhere on earth, but can be cost-prohibitive when large amounts of data are transmitted.

Batteries and Solar Charging
AC voltage is not available at many remote sites, so most automated water quality stations are battery powered.

Batteries range in size and type from small VRLA (valve regulated lead acid) to deep cycle marine batteries. Absorbed glass mat (AGM) technology utilizes fiberglass mats in which the electrolyte is absorbed, providing a reliable and low maintenance power source.

Low power electronics coupled with innovative power management techniques in software have greatly extended battery life. However, battery replacement or continuous recharge is required. Solar panels with voltage regulation are used to maintain the batteries.

A detailed power budget including electrical specifications for each device and sensor ensures reliable system performance.

Land-Based and Open Water Platforms
Harsh field conditions and the potential for vandalism make the design of a monitoring platform the single most important aspect of setting up an automated water quality station.

Solar powered data buoy deployed in a Midwest reservoir.

Land-based systems are typically pole or bridge mounted with the data logger located above flood stage and the sensors suspended into the water. Perforated pipes with locking caps provide a secure deployment with adequate water flow around the sensors yet offer access for routine maintenance.

Open water deployments on buoy platforms are becoming more widely used. New buoy designs are optimized for specific applications and are becoming easier to deploy and service.

Integral solar panels, marine batteries and submersible data loggers with underwater connectors simplify setup and facilitate deployment. Stealthy designs minimize the effects from wave energy and reduce the possibility of vandalism.

Software & Data Sharing
A computer with specialized software connects to a single station or network of stations for system setup and data collection. With the computer operating continuously, data is automatically collected, processed and then published.

Automatic data processing, data validation using preset rules, and reports generated in real-time provide access to information as it is collected. Web-based datacenters facilitate the process and provide data displays and trends on any web browser. ■

Product Spotlight:
Water Level

ENO SCIENTIFIC Well Watch 1100

State-of-the-art, semi-permanent well water monitoring instrument

The Eno Scientific Well Watch 1100 Water Level Monitor simplifies the process of measuring distance to water though a well pipe or bore hole.

The Well Watch 1100 is capable of monitoring water level depths from 9 to 2,000 feet. Once the device is powered up, the first reading is available in approximately three seconds; data is captured and stored immediately.

The Well Watch 1100 includes both a control unit and probe. The non-contact probe integrates a speaker, microphone and temperature sensor in the probe tip; its tapered body is designed to easily fit in and attach to a standard well cap opening. The probe transmits a low frequency (50 hz) acoustic pulse into the pipe or bore hole opening and then measures the water depth based on the time until the returned echo of the emitted sound waves. Distance to water is automatically calculated based on sound speed, time, and temperature, eliminating depth measurement errors due to well temperature variations.

The control unit contains the driver electronics, processor, display, and keypad. Its internal, non-volatile memory records system settings and calibration data, and can log over 14,000 data points. The unit also has a real-time clock and calendar to time stamp stored data. Logging rate options from 1-second to 60-minute intervals are available.

The RS-232 port can be set to output data to a nearby data logger or be used as a bi-directional communications interface to a computer for remote programming and data download. A power jack allows the unit to be run from either an AC power supply or a 12 VDC battery.

The Well Watch 1100 logging software has the ability to compensate for methane gas or measurement in small tubes, and can measure flow rates and recovery rates while the well is pumping down. Available for free download online, the Well Watch 1100 software was designed specifically for Eno Scientific units to graphically display extracted data. ■

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Product Spotlight:
Survey & Navigation

MAGELLAN EXPLORIST Pro 10 GPS System

A reliable GPS that supports multiple software and connectivity options

Accurate, flexible, and affordable, the Magellan eXplorist Pro 10 GPS System is a simple solution for survey and mapping applications. Within its robust system, data is collected and plotted effortlessly in a minimal amount of time.

The Pro 10 can deliver three to five meter accuracy in real time using its internal SiRFstar III GPS receiver. It has both a three-axis compass and built-in barometric altimeter to provide accurate three-dimensional measurements and elevation readings. It can also work with a supported Bluetooth-enabled GPS receiver to achieve sub-meter or one to three meter accuracy. The built-in Bluetooth technology also makes it easy to receive background map data from the Internet using a Bluetooth-enabled cell phone.

A waterproof casing protects the device against water immersion for 30 minutes at a one-meter depth. It weighs just 6.9 oz, and has an easy-grip, impact-absorbing case that can withstand a one-meter drop to a concrete floor.

The system features include a Samsung 533MHz processor, 128 MB RAM on-board memory, and 4GB non-volatile internal flash data storage. The compatible Windows Mobile v6.5 operating system allows the user to choose a software solution based on their needs.

The eXplorist Pro 10 includes a three-inch touch screen and 3.2 megapixel digital camera, WMV video, and picture/video viewer; the unit is also equipped with a sealed speaker and microphone for hands-free note taking. The system can read up to a 32-gigabyte micro SD card and can play MP3 music files using the multimedia application supplied with the Windows Mobile Operating System.

Optional accessories include an all-purpose mount, belt clip, vehicle kit with windshield mount and vehicle power adapter, handlebar mount, and 50cm lanyard.

A Magellan warranty covers the receiver for a period of one year from the date of purchase. ■

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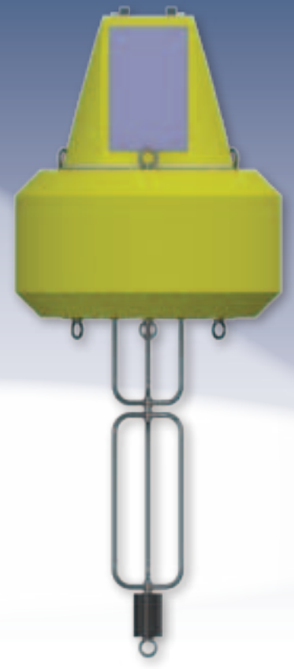
Product Spotlight:
Data Logging

NEXSENS CB-500 Coastal Data Buoy

A tough, versatile buoy designed for long-term coastal monitoring



The NexSens CB-500 Coastal Data Buoy is a multi-purpose environmental monitoring buoy designed for years of service in coastal water monitoring applications, including harbors, estuaries, and other freshwater or marine environments. Its versatility allows for quick deployment of a wide range of sensors for monitoring weather, air and water quality, waves and currents.

The CB-500 platform supports both topside and subsurface environmental monitoring sensors with options for spread spectrum radio, cellular, and satellite data transmission to shore. A true "plug-and-play" connection is offered with industry standard digital and analog sensor interfaces, including: RS-485, SDI-12, 1-wire temp string, and pulse count, among others. Each sensor port offers a UW receptacle with double O-ring seal for a reliable waterproof connection.

The buoy's hull is constructed of cross-linked polyethylene foam and coated with a robust and indestructible polymer skin. All hardware, including battery and instrument well, tower, and mooring/lifting eyes are made of corrosion resistant stainless steel. This rugged frame supports both single- and multi-point moorings.

A topside plate supports both a beacon and weather station; the hinged foam hood beneath offers quick access to instrumentation for calibration and maintenance. The buoy hood also includes three solar panels along with three internal 5 A-Hr rechargeable battery packs for powering the data logger and sensors. Three 4" diameter holes with female NPT threads allow for quick connection of instrument deployment pipes and custom sensor mounts.

NexSens iChart Software is recommended to simplify and automate many of the tasks associated with acquiring, processing, analyzing, and publishing data received from the CB-500. The software is a Windows-based program for interfacing both locally (direct-connect) and remotely (through telemetry) to a single data buoy or network of data buoys. ■

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Product Spotlight:
Water Quality

PONSEL DIGISENS Sensors

French company's digital sensors are a reliable and economical solution

PONSEL's line of physiochemical sensors measures multiple water parameters, including pH, conductivity, turbidity, and dissolved oxygen.

The PONSEL PHEHT is a watertight combination pH/ORP (oxidation reduction potential) and temperature sensor. It features a field-replaceable sensor cartridge and a long-life Plastogel reference. The PHEHT is designed to perform under hard conditions ranging from pure water with a conductivity as low as 20 us/cm to wastewater, often higher than 200 mS/cm.

The PONSEL conductivity sensor simultaneously measures temperature, conductivity, salinity, and total dissolved solids (TDS). It features four electrodes (2 graphic, 2 platinum), and calculates within a range of 0 to 200 mS/cm.

Approved by the American Society for Testing and Materials (ASTM) International Method D888-05, the PONSEL OPTOD optical dissolved oxygen sensor measures DO using highly accurate, non-consumptive luminescent technology. It features a stainless steel, corrosion-resistant housing for use under harsh conditions in long-term monitoring applications. The OPTOD functions within a range of 0-20mg/L or 0-200%.

The PONSEL Turbidity sensor features an ISO 7027 compliant IR optical sensor with optical fibre. It functions within a 0-4000 NTU range. The non-consumptive PVC sensor requires very little maintenance and is designed for long-term monitoring applications.

Each sensor is waterproof (IP68), compact, and robust, and includes built-in Modbus RS-485 and SDI-12 outputs for interfacing with many popular devices. CALSENS Software offers a user-friendly interface for calibrating the sensor using any Windows-Based PC, and calibration history is stored within the sensor for plug-and-play connection without the need to recalibrate. ■

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Field Station Provides River Education, Research

By Dr. Chris Lorentz

The Thomas More College Biology Field station was built in 1915, as one of 51 wicket dams along the Ohio river. Photos: Thomas More College

This past summer, Thomas More College announced that it has raised more than $1.6 million for its Biology Field Station and related environmental sciences program, surpassing the $1.5 million goal originally set two years ago. With the money raised through these efforts, Thomas More College will be able to significantly improve and expand the facilities and research capabilities for our students, and be able to provide the community with a variety of science outreach programs including field trips, seminars, camps and workshops. A particular focus will be on improving STEM (science, technology, engineering and math) education throughout the region.

The money raised will be used to upgrade lab facilities both on the main campus and at the field station. Specifically at the station, the funds are being used to:

- Build a new LEED-certified education conference center and residential facility
- Construct a new analytical chemistry and molecular biology laboratory
- Purchase new environmental monitoring and other laboratory equipment and supplies
- Expand the STEM outreach programs for K-12 students

The Thomas More College Biology Field Station is a 20-acre teaching and research facility located on the banks of the Ohio River in California, KY, just upstream of Cincinnati, OH. The station was the previous site of the U.S. Army Corps of Engineers Lock and Dam 35, built in 1919, and one of 51 wicket dams along the Ohio River. Since acquiring the property in 1967, the Biology Department has transformed the facility into a state-of-the art science and technology center and established the Center for Ohio River Research & Education in 1998. The faculty and staff at the center offer visitors opportunities to enhance their knowledge of the natural world through field courses, research projects and outreach programs that focus on the ecology of the Ohio River. The center is open to students from grade school to graduate school and the general public.

Research is at the heart of the Biology Field Station. Beginning in 1971, the faculty there established a long-term ecological monitoring program on the Ohio River. For over 40 years, this research has examined the water quality, habitat and fish populations around two coal-burning power plants currently operated by Duke Energy. The primary objectives of these studies are to assess the aquatic ecosystem around the plants by examining the current composition of the fish community, the spatial variation between the fish populations upstream and downstream of the plant, and the hydrological, chemical, and physical characteristics of the Ohio River near the plant.

For the past several years, the field station has collaborated with the United States Environmental Protection Agency (USEPA) on the deployment of a stand-alone, stream side water quality monitoring station (WQMS) incorporating chemical, physical, and biological water quality monitoring technologies with data telemetry, data analysis, and water sampling capabilities on the Ohio River. The first pilot WQMS is located at the Biology Field Station. This station provides monitoring criteria and design information for streamside WQMSs that could potentially be incorporated into early warning systems (EWS). These systems could be strategically placed throughout the Ohio River watershed as a part of a future source water protection network.

In 2006, the field station partnered with the Sanitation District No. 1 (SD1) and established the Environmental Academy. SD1 is responsible for the collection and treatment of Northern Kentucky's wastewater, as well as regional stormwater management. Through the Academy, Thomas More students assist SD1 biologists with their Illicit Discharge Detection Program and Watershed Management Program. Students work alongside SD1 scientists in the field to inventory outfalls, assess habitats and conduct water quality assessments. The Station has also recently partnered with The Ohio State University and the Freshwater Mussel and Conservation Research Center, operated by OSU and the Columbus Zoo & Aquarium, to understand the basic biology of imperiled mussels and assist in the recovery efforts of threatened/endangered mussel species. Freshwater mollusks are arguably North America's most threatened and endangered group of animals. For this research, biologists from the Newport Aquarium built a 720-gallon tank which serves as a holding facility for various fish species that are examined as potential hosts for the larval stages (glochidia) of native mussels. As viable fish hosts are identified, management plans can be established to restore mussel populations back to the Ohio River and nearby tributaries. In 2010 *Micropterus punctualatus*, spotted bass, was positively identified for the first time as a host for *Lampsilis fasciola*, the wavy-rayed lampmussel, a species of special interest in Ohio, Indiana, and Michigan and listed as endangered in Illinois.

Most recently, the Station began working with Dr. Jim Lazorchak and others at the USEPA to establish a new aquatic culture and testing facility at the Field Station. The development included designing and installing a system to treat and deliver well water to various culture tanks for the propagation of aquatic organisms commonly used in toxicity testing. Pimephales promelas, fathead minnow, is the primary species cultured in this system. Adult fish are bred and used to supply eggs, which are then hatched and reared out for use in toxicity testing and to supply additional spawners for the system.

Continued on page 18...

System Description

The monitoring system at Thomas More's Biology Field Station contains instruments to measure both weather and water quality. A Vaisala multi-parameter weather station is mounted on the roof to monitor air temperature, humidity, barometric pressure, precipitation, wind speed and wind direction.

Housed within the Field Station, a YSI 6920 multi-parameter water quality sonde measures temperature, specific conductivity, dissolved oxygen and pH in the river. The instrument is mounted in a flow-through chamber, which continuously pumps water from the Ohio River and brings fresh sample to the sensors.

Both the weather station and water quality sonde are connected to a nearby NexSens iSIC data logger. The iSIC logs data from both instruments at a 10-minute interval and sends it to a nearby computer running iChart Software. Back at the computer, students and staff are able to create automatic reports, set alarms for pre-defined thresholds, and remotely make changes to the instrument configuration.

For remote data access, the Software automatically sends the data via File Transfer Protocol (FTP) to a remote NexSens server and makes the data available on a web datacenter called WQData. Here, data is organized and displayed for easy viewing from any web browser or Smart Phone. The interactive website allows the user to view project maps, create statistical summaries, or post a comment on the community forum. A web applet is also embedded on the College's website for a quick snapshot of the weather or river conditions.

Dr. Lorentz describes the water quality station.

(Continued from page 17) As the system develops, the freshwater invertebrates *Daphnia magna, Ceriodaphnia dubia, Hyalella azteca, Chironomus tentans* and *Lumbriculus variegates* will be cultured as well. Meghann King the laboratory manager, oversees the aquaculture program and supervises the mussel research and the summer undergraduate interns.

In addition to the research programs, the Field Station offers a wide array of field courses for college students and outreach programs for K-12 schools. Throughout the fall, spring, and summer months, Olivia Lantry, the field station outreach coordinator, and Thomas More students develop science activities for grade school field trips, high school summer camps and teacher workshops. Through hands-on, inquiry-based teaching methods, Olivia and her staff educate and engage students about the Ohio River ecosystem and surrounding watershed, teach the value of the watershed to those who live within it, and empower students to make a positive impact on the River and surrounding environment. This past year, the Station hosted over 2,500 students and teachers from throughout the tri-state area.

Further information about the Center for Ohio River Research & Education at the Thomas More College Biology Field Station can be found at www.thomasmore.edu/fieldstation. ■

Monitoring Buoys Aid Beach Pollution Study

By Paul Nieberding

Pollution at Great Lakes beaches makes beachgoers sick and has massive economic impacts, as water recreation brings billions of dollars to the region. In 2009, as many as 10% of Great Lakes beachgoers complained of getting sick after swimming at open beaches. That brings to light the problems facing the current methodology to establishing beach closures and advisories.

The Great Lakes Ocean Research Priorities Plan, formed by a collaboration of U.S. Geological Survey (USGS) researchers from the Water Science Centers and Great Lakes Science Center, aims to refine the techniques and science used to asses recreational water quality in the interest of providing managers with better data with which to make beach closure decisions and protect the public from illness. A network of Great Lakes buoys will help gather real-time data for the study.

Current practices for monitoring beach water quality rely on culturing fecal-indicator bacteria, a process that can take 18-24 hours, meaning the results often come too late to protect beachgoers. Moreover, according to the USGS, "sources of fecal contamination in recreational waters are often unknown and/or of nonpoint origins."

USGS researchers are trying to get a better sense of how hydrologic properties influence these pathogens and their transport patterns. Aiding in the research is a real-time monitoring network that includes near shore NexSens MB-300 buoys with data loggers and cellular telemetry packages. Absolute level transducers are suspended beneath the buoys to measure information on wave energy.

With a fast enough sampling rate, these pressure transducers are capable of monitoring wave frequency and height data. The sensor is fixed to the lake bottom and measures the height of the water column above it. As a wave crest passes by, water column height increases; when troughs approach, it decreases. The resulting record of surface elevations can be used to calculate wave energy data.

The wave measurements will be combined with other real-time data, such as turbidity, and on-shore photosynthetically active radiation (PAR) and precipitation. This data will be analyzed along with routine water quality sampling at a number of beach sites. ■

Technology Update

Wave Monitoring

Using NOAA's National Data Buoy Center's guidelines for wave measurements, NexSens Non-Directional Wave Systems provide consistent, accurate wave data with real-time access via web browser or Smart phone. The system consists of an absolute pressure sensor, data logger with wireless telemetry, software for data acquisition and wave calculations, and web-based datacenter for user access.

The sensor is fixed to the seafloor where it measures absolute pressure to determine fluctuations in the water surface. The data logger samples 1,024 data points at 4 hertz over a four to five minute period. The data logger transmits the raw data by spread spectrum radio or cellular telemetry to a remote computer running iChart Software. The software then calculates and outputs wave height and period for a defined interval.

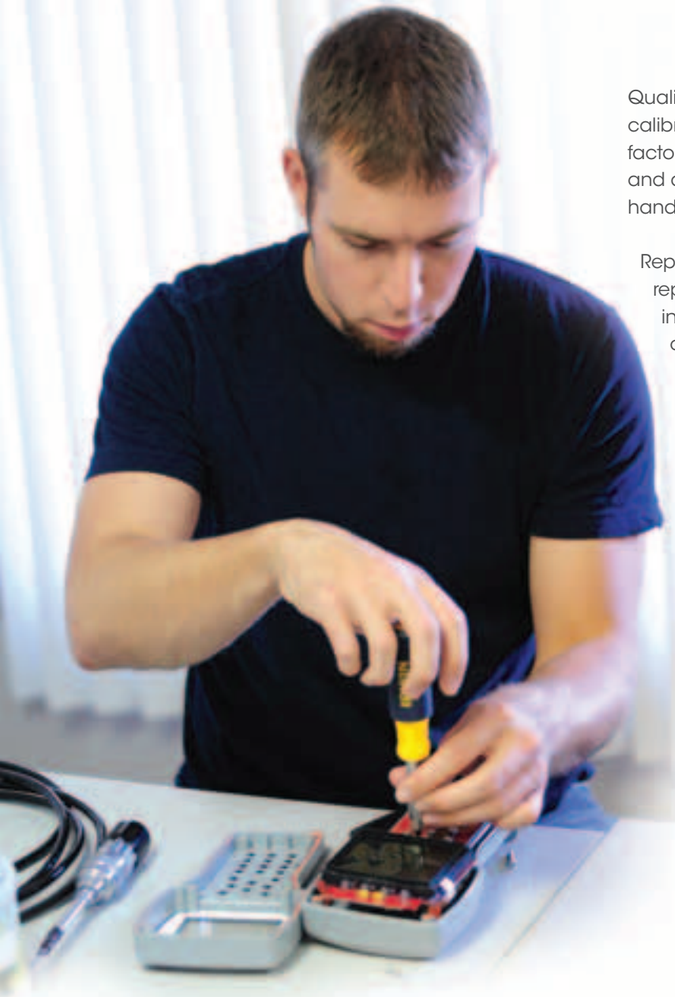
The calculation follows NOAA's National Data Buoy Center format by determining the distance between the crests and troughs. The significant wave height is calculated as the average of the tallest one-third of the waves. The dominant (maximum energy) wave period is determined by a Fast Fourier Transform (FFT). The real and imaginary parts are scaled by half the number of points and the non-directional spectrum is calculated. Next, the spectrum is scanned for the frequency with the most energy. This frequency is then converted to and displayed as dominant wave period.

NexSens Non-Directional Wave Systems are available in a pole-mount or buoy-based platform. Pole-mount configurations include all hardware housed in a weatherproof enclosure for installation above flood stage or maximum water level. In locations where a fixed platform is not available, buoy-based systems are completely integrated to include a submersible data logging system with alkaline battery power or solar charging.

The AccuStage Non-Directional Wave Sensor is available with a stainless steel or titanium construction. The sensor is accurate to +/-0.1% full scale with a range of 1 to 275 meters. The sensor includes a Hytrel-jacketed and shielded cable with optional anti-chafing armor for extended deployments in harsh conditions. A variety of mounting options are available to fix the sensor to the seafloor.

For data on the go, WQData is a web-based datacenter that offers real-time wave data via web browser or Smart phone. For more information, visit Fondriest.com or call 888-426-2151. ■

Sensor Repair and Calibration



Quality data depends on monitoring equipment that is routinely calibrated and repaired. Fondriest Environmental offers a unique factory-certified maintenance program for YSI 6-Series sondes and displays, YSI 556 multi-parameter meters, and all other YSI handheld water quality meters.

Repair technicians will perform a free evaluation, send a repair quote via email to the point of contact, and repair the instrument based on the user's feedback. Fondriest's factory-certified repair center is staffed by trained technicians who have performed thousands of calibrations and maintenance procedures. Their experience guarantees that equipment will be efficiently and correctly repaired, allowing for the continued delivery of reliable data.

Instrument check-up, characterization, and certification are recommended on a semi-annual basis. In addition to improved data quality, the useful life of the monitoring instrument is extended with regular service.

Fondriest is pleased to offer tune-up specials on YSI 6-series sondes, YSI 556s, and all other handheld meters. Call **(888) 426-2151** or email **customercare@fondriest.com** for more information.

Fondriest's service and repair center offers excellent turn-around times and low service costs on instrument repairs and annual maintenance services. Technicians can also visit the field to repair and calibrate equipment on site.

YSI Sonde and Handheld
Tune-Up Special

Fondriest Environmental is once again offering the YSI tune-up service. Upon return, your equipment will meet factory specifications and be ready for the spring monitoring season. Beat the rush and schedule service today!

6-Series Sonde	556 & Pro Series	Handheld Meter
$149	**$129**	**$99**

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when your research demands quality data

While it often makes sense to purchase systems outright, many short-term monitoring projects make it cost-prohibitive. Fondriest offers many real-time monitoring systems with weekly and monthly rental rates to meet project requirements.

Fondriest offers an extensive range of competitively-priced instruments for rent. Leasing on equipment for water quality testing, soil sampling, weather monitoring, and much more is available. Fondriest's rental equipment includes the latest monitoring technology, along with the field supplies needed to get the job done.

The Fondriest Preferred Rental Program simplifies and expedites the process of environmental monitoring equipment rental, offering the following benefits:

- Schedule your rental by phone or email. We'll assign an account manager to ensure you get personalized service and your equipment needs are handled professionally and quickly.
- Reserve equipment up to 30 days in advance with a signed rental agreement and credit card or purchase order; we'll hold it until your project begins.
- Shipping costs can be added to the quoted rental price, or we can ship using UPS, FedEx, or DHL shipping accounts.
- We offer flexible time frames to meet your project requirements. If you need to extend the lease, simply call or email your rental account manager.
- You won't have to tell us your rental preferences every time you reserve equipment. We keep a detailed record of your rental history.
- We keep your project shipping address and contact information on file, thus simplifying your order process.

This personalized approach to the rental business lets you focus on the project at hand — we take care of the rest. Contact us at 888-426-2151 to learn more about how we can assist with your next monitoring project.

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University of North Dakota Devil's Lake Project

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NEXSENS technology