The
IISG RESEARCH REPORT

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Illinois-Indiana Sea Grant (IISG) works with local planners, policy makers, citizens, and other stakeholders to help inform their strategies and actions, but the foundation for all this outreach is research. Indeed we like to say that we bring data to decisions.

One of 33 Sea Grant programs in the U.S., IISG is focused on the southern Lake Michigan region—104 miles of heavily urbanized and industrialized shoreline in Illinois and Indiana. But our work goes beyond the lakefront, following rivers and streams that carry pollutants but also support livelihoods and recreation in the two states.

Researchers in the Great Lakes region strive to understand issues of environmental and economic sustainability, natural resource planning, and sweeping changes to ecosystems. Every year, IISG has stories to tell about research that the program funded, took part in, or otherwise supported. In 2015, we learned new information about aquatic invasive species, climate change, pharmaceuticals in the environment, and more.

CLIMATE CHANGE MAY BE A KEY DRIVER IN *NUTRIENT POLLUTION*

Illinois, with its many acres of farmland and its major municipalities, is a key contributor to nutrient pollution in the Gulf of Mexico. Researchers at the Illinois State Water Survey set out to better calculate nutrient levels in waterways, the dynamics of when nutrient pollution happens, and what this means in the face of a changing climate.

Hydrologist Momcilo Markus and his team looked at years of data from 14 rural and suburban watersheds in Illinois, Indiana, and Ohio to get a better understanding of the factors that influence pollution rates.

Typically, for most waterways, monitoring is infrequent—several data points are extrapolated for a year. Using a rich data source where there is as much as 38 years of daily measures from 10 streams in Ohio, Momcilo's team modified their calculations, and were able to make estimates of nutrient loading in Illinois and the Midwest more accurate.

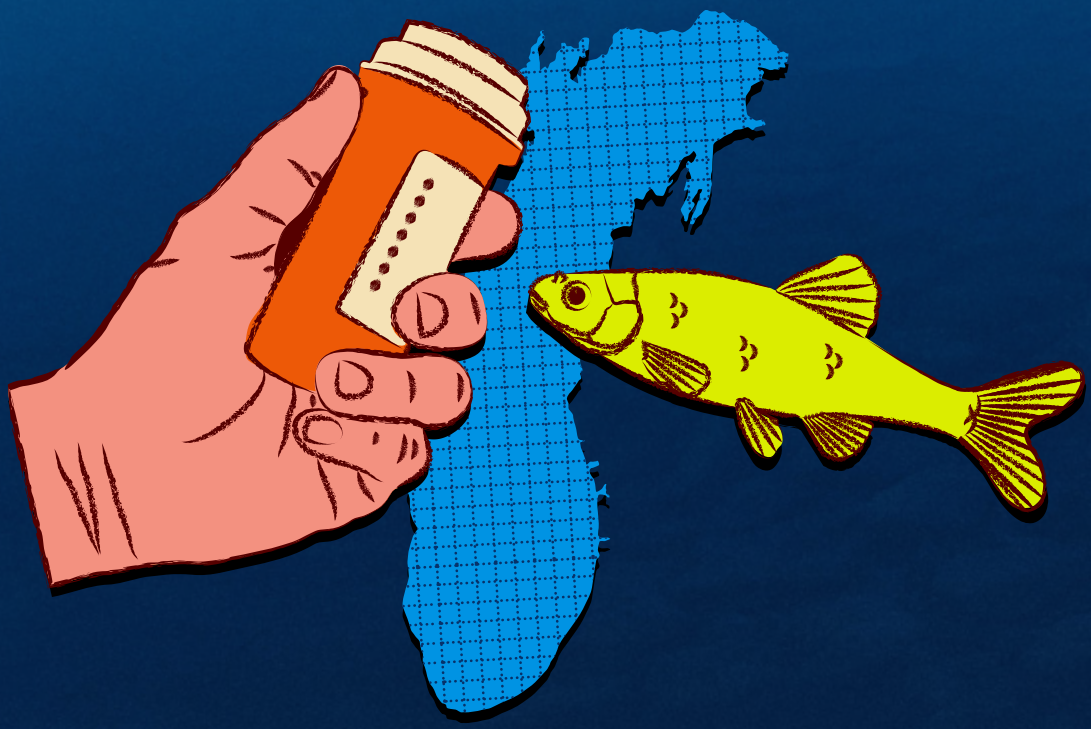
The study also reveals key patterns in nitrate, phosphorus, and sediment pollution. For example, although there is more precipitation in summer, river flows and nutrient levels are at their highest in winter and spring, when there are fewer plants to help prevent erosion and absorb nutrients. In fact, the five largest river flow events in a watershed carry more than half of the nutrients that run off it each year.

"More precipitation, on average, in a given year doesn't necessarily lead to an increase in pollution. The increase is tied to heavy precipitation," said Markus.

The consensus of climate models shows that by mid-century in northern Illinois, there may well be a 15–30 percent increase in intensity and frequency of heavy storms. "We can speculate that there will be more pollution, so management strategies that work today may not down the road," said Markus. IISG funded this study through the Great Lakes Restoration Initiative.

MEDICINES IN LAKE MICHIGAN IMPACTS

MINNOW EMBRYOS



A Purdue University ecotoxicologist found that the mixture of pharmaceutical and personal care products present in Lake Michigan can have significant negative effects on fathead minnow embryos.

Maria Sepúlveda studied two chemicals found in previous research in Lake Michigan: triclocarban, an antibacterial compound, and cotinine, a metabolite of nicotine.

The researchers created realistic field concentrations in the laboratory, examining effects of the chemicals both individually and in a mixture. They also examined acute and chronic toxicity of field-observed levels of chemicals on four organisms from different parts of the food chain: green algae, diatoms, zooplankton (water flea, Daphnia magna), and fathead minnow embryos.

When the organisms were tested with individual compounds at levels similar to those found in Lake Michigan, they remained largely resistant with the exception of the fathead minnow embryo, which was slightly affected by the triclocarban. And organisms at the bottom of the food chain—diatoms, zooplankton, and *Daphnia magna*—when exposed to the mixtures, were not affected even at high levels.

However, the hours-old fathead minnow embryo proved to be significantly susceptible to the contaminants. “This is not surprising since embryos are known to be more sensitive to most contaminants compared to adults,” said Sepúlveda . “The fish embryos were more sensitive than anything else we tested.”

BIGGER SHRIMP CAN MEAN BIGGER PROFITS

Shrimp is the number one seafood consumed in the United States, and Indiana, of all places, is a leader in inland shrimp farming. One reason is that Kwamena Quagrainie, IISG aquaculture marketing specialist, is providing these producers with practical information on how to maximize their profits.

Quagrainie studied the economics of raising Pacific white shrimp indoors and found that turning a profit can depend on being a little patient. “Because demand is high, the temptation is to sell smaller shrimp. But if the producers wait until the shrimp are bigger, they can charge more,” he said. “The value you can set by growing them to a larger size far outweighs the cost.”

His study revealed that marine shrimp are more profitable if grown to at least 26/30 count per pound. It also pays to wait until the shrimp are bigger before moving them from the nursery to the growing tank. This can help boost the survival rate.

Indiana has 11 shrimp farmers in the state who sell their product on-site directly to consumers or to nearby restaurants. “People are looking for food that is fresh and the shrimp market has benefited from the local foods movement,” said Quagrainie. The majority of shrimp consumed in the U.S. is imported from farms in Southeast Asia, Ecuador, and Mexico.

In addition to IISG, this study was funded by Indiana State Department of Agriculture as well as from Purdue Extension, and Indiana Soybean Alliance, and in partnership with the Indiana Aquaculture Association Inc.

WE'RE GOING TO NEED

BIGGER PIPES

Chicagoland sewers built to take on storms from days gone by are no match for today's rainfall that lands mostly on parking lots, streets, and sidewalks instead of being absorbed into fields and patches of forest. What's more, a National Sea Grant Office-funded study found that climate change predictions for Cook County are coming true—larger storms are becoming more common.

This work was part of a larger project to assess the flooding vulnerability of critical facilities, such as hospitals, utilities, and public service centers. The project team has developed an assessment tool for building managers to determine a facility's risk based on a number of factors, from its proximity to a floodplain, to the location of key systems, like backup generators and computer servers.

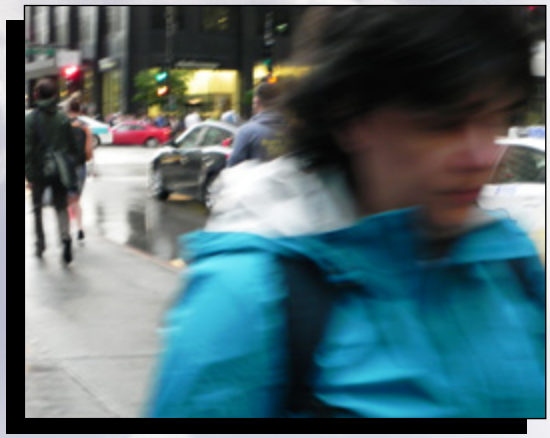
As part of this project, the research team used historical records to analyze Cook County storms. Using years of data from O'Hare Airport, they found that between 2002 and 2013, large storms—specifically, 5–8 inch rain events—happened more frequently than in the previous 36 years.

"We brought our findings to facility managers to provide them with concrete information as they plan for their future needs," said Molly Woloszyn, Extension climate specialist with IISG and the Midwestern Regional Climate Center.

The researchers also looked at defined storm sizes, called rainfall return periods. They range from 1-year to 100-year storms, which are used for stormwater management decisions. In fact, engineers commonly use the 2- and 5-year event thresholds as guides for sizing sewer pipes.

Cook County rainfall data since 1990, when the Illinois thresholds were established, shows that many of the thresholds may now be too low. For example, 2-year and 5-year storms were 4.6 and 5.8 percent larger, respectively, than the defined levels. Using predicted rainfall rates from an Illinois State Water Survey study for the coming century, the research team found that the difference may continue to increase, for example 5-year storms may be as much as 23.8 percent larger.

"If our storm sewer systems are designed to hold the 10-year storm based on the current thresholds, these storm sewers may be overtopped more often in the future," said Woloszyn. "Flooding, in particular urban flooding, could become a bigger issue. Even more than it is today."



INDIANA COASTAL *ECOSYSTEM BENEFITS* ARE MANY

We depend on nature for our health and well-being in what seems countless ways—from food, medicine, and shelter, to our quality of life. Yet when decision makers plan for a community's future, there may be no concrete value ascribed to natural areas. An IISG study supported by NOAA through the Indiana Department of Natural Resources and Indiana Lake Michigan Coastal Program, has begun the process of defining the value of Indiana's aquatic ecosystems.

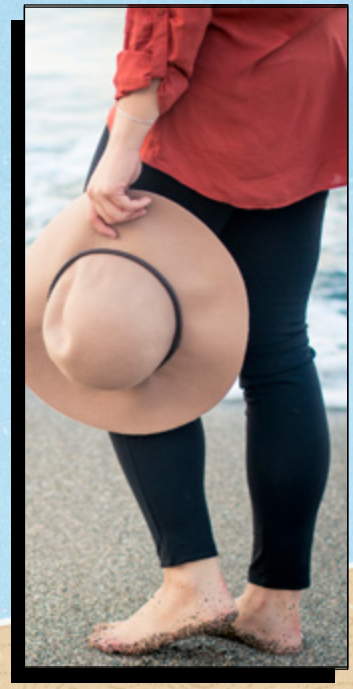
"Ecosystem services are the benefits that people, communities, and economies receive from nature," said Leslie Dorworth, IISG aquatic ecology specialist. "For example, a healthy food web in Lake Michigan is part of a thriving ecosystem, but it can also provide a benefit to those who engage in fishing."

Dorworth, and Margaret Schneemann, IISG resource economist, sat down with 10 Indiana natural resource managers and decision makers to define coastal ecosystem services in the region. They identified the biggest threats to natural areas as nutrient pollution from a variety of sources, climate change, and physical changes to water bodies or water flow. The participants prioritized ecosystem services, including water purification, native flora and fauna, spiritual and aesthetic recreation, and the combination of erosion, sediment and flood control.

The list of priority coastal ecosystem benefits developed in this process became the driver for Dorworth and Schneemann's literature search of studies in the Great Lakes region. They reviewed available economic value estimates of these coastal ecosystem services, finding only a few that included Indiana.

"We also found a mismatch in what ecosystem services were prioritized by coastal zone managers and those that are studied," said Schneemann. "For example, there is a lack of research on spiritual and aesthetic values of the coastal zone, which is a top ecosystem service as identified by stakeholders along the Indiana coast."

"The next step in this process is to work with Indiana coastal resource managers to refine research questions that when answered, will help them make decisions that are informed by what is important to people," she added.



PEOPLE USE *RAIN BARRELS* FOR PRACTICAL REASONS

It's no secret that rain barrels are an environmentally good way to control stormwater runoff and improve water quality. So then why do some people use them while others don't even hook-up the one they have?

Linda Prokopy, a natural resources social scientist at Purdue University, asked that question in the Salt Creek Watershed in northwest Indiana. She studied residents who received a rain barrel through a cost-share program facilitated by Save the Dunes, a local non-profit organization. Data were collected through both surveys and interviews with these residents.

Typical outreach approaches tout rain barrels as environmentally friendly water quality alternatives, but that wasn't necessarily the reason people chose to install one. Those who liked having one and maintained it were people who saw a personal value to the practice.

Gardening was an important predictor of rain barrel maintenance. Gardeners reported that they were motivated by saving money on water usage.

"They saw a benefit to themselves, not just to this abstract, nebulous concept of water quality," said Prokopy.

This IISG-funded study lends insight into what motivates people to adopt and change behaviors concerning environmental practices.

"If we really want to see long-term changes in environmental conditions, we need people to not only adopt practices, but continue to use them," Prokopy said.

GETTING TO THE BOTTOM OF ANOTHER *QUAGGA MUSSEL* IMPACT

Descend 55 meters to the floor of Lake Michigan and you'll find the bottom carpeted with tens of thousands of one of the most prolific invasive species in the Great Lakes—the quagga mussel. Researchers have long known that these voracious filter feeders impact water quality in the lake, but their influence on water movement had remained largely a mystery.

Purdue University PhD candidate David Cannon, working with hydrodynamicist Cary Troy, used water velocity sensors to determine the filtration effects of quagga mussels in the deep waters of Lake Michigan near Milwaukee, Wisconsin. The project was supported by a grant from IISG and Wisconsin Sea Grant.

"Quagga mussels filter by 'sucking in' the water around them and then 'spitting out' what (nutrients and particles) they don't want," said Cannon. "While they're doing this, they're able to directly move a very small amount of water around them—only about 10 cm above the lake bed."

Their finding that quaggas cause movement in the thin layer immediately above the lake bed—a phenomenon consistent throughout the year thanks to stable temperatures at the bottom of Lake Michigan—is an element missing from most mussel filtration models.

"Although Lake Michigan is already infested with these mussels, an accurate filtration model would be imperative for determining the fate of substances like nutrients and plankton in the water," Cannon said.

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