A closer look at how Asian carp impact food webs

Researchers have long known that Asian carp pose a threat to native fish because they compete for microscopic plankton that form the base of the food chain. But less is known about what happens to the larger food web when these invaders take up residence in a river or lake. Jonathan Freedman and his colleagues at the Illinois Natural History Survey set out to get a clearer picture of just how Asian carp impact food supplies.

They compared current food webs in the Illinois River, now overrun by Asian carp, with what existed before the invasion. To reconstruct the river's historical food web, researchers took tissues samples from fish collected before Asian carp arrived in the early 1990s. They used the chemical make-up of these tissues to determine just what had been eating what.

They found that Asian carp do more than compete for food. They actually force native fish to change their diets, feeding on species lower on the food chain than they naturally would. In a healthy food web, filter-feeders, like gizzard shad and paddlefish, eat a variety of plankton species, leaving enough food to go around. But Asian carp have all but wiped out the larger zooplankton in the Illinois River, pushing fish that have historically relied on that food source to eat smaller zooplankton and phytoplankton. As the number of Asian carp in an area grows, more and more native fish are left competing for a smaller supply of plankton.

"Asian carp are really knocking back the food resources, especially in the lower river where they are most abundant," said Freedman. "And it is not just plankton-eaters that are affected. Virtually all juvenile fish feed on plankton at some point in their development. So, Asian carp force all fish, at some point, to move down the food chain to compete for food."

Courtesy of Jonathan Freedman

Online access to fish consumption advisories

Fish consumption advisories for recreationally caught fish are nothing new in Indiana, where state environmental and health agencies have been monitoring the safety of fish in water bodies for more than 30 years. Typically, advisories were distributed in a small number of booklets that were difficult to find and even harder to use. That is, until Purdue University researcher Charles Santerre partnered with Indiana agencies to develop an online, real-time database that gives Hoosiers direct access to information on how much and how often recreational fish can be consumed safely.

Angling Indiana visitors can use the database to find information in English or Spanish for specific counties and water bodies. Separate advisories also help pregnant or nursing women, who are more susceptible to contaminants commonly found in fish.

For years, Santerre's group has been manually converting statewide advisory booklets into single-page county fact sheets. This took time and often meant that consumers were getting information as much as two years after the data was collected. Now, the same fact sheets are automatically created when someone accesses the website and are updated immediately after being certified by state agencies.

"We knew this was an important thing to do, and we needed to find a better way to do it," said Santerre. "It is important that pregnant and nursing women can easily access this information. This cooperative effort is making important strides to protect babies."

Visit the database at www.fish-4health.net and click on Indiana.

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Discovery Grant Projects II

Just as a gardener hopes that their scattered seeds will eventually bloom into a lush garden, Illinois-Indiana Sea Grant (IISG) awards Discovery Grants, or "seed" grants, to a number of projects in the hopes that the initiatives will grow into something larger. This publication highlights some results from recently funded projects.

Discovery Grant projects cover a broad range of topics and address some of the biggest concerns facing the Great Lakes.

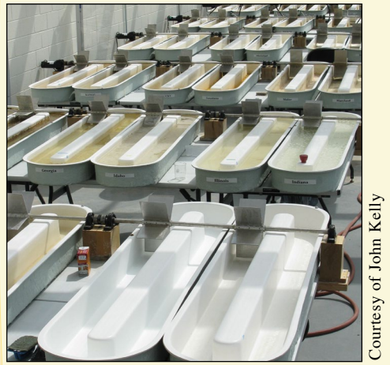
Several researchers used IISG funding to develop new sampling techniques and technologies. Purdue University's Paul Brown, for example, found that species at the bottom of the food chain can be identified by the chemical by-products of processes like digestion and respiration. This method could be a significant boost to efforts to map Great Lakes food webs, saving researchers time and providing greater insight into lower food web communities. Robert Nerenberg from University of Notre Dame discovered a more cost-effective way to treat water that could help midwestern aquaculture facilities maintain sustainable practices while still competing in a global market.

Some projects improved our understanding of Great Lakes ecology. Andrew DeWoody from Purdue University examined the life history of lake sturgeon. He and his team identified genetic traits that may help resource managers protect this species of concern.

And Zahra Golshani, a graduate student at University of Illinois, received funding to identify obstacles to adopting climate change adaptation strategies in Chicago with the goal of improving the city's Climate Action Plan.

Turn the page to read the results and implications of featured Discovery Grant projects.

Nanomaterial changes stream bacteria



Courtesy of John Kelly

John Kelly, a biologist from Loyola University Chicago, saw an opportunity for researchers to get a jump on a new pollution source while levels are still low. He and his colleagues from Loyola and Northwestern University designed a study to learn how bacteria living on stream floors are affected by a nanomaterial common in cosmetics and sunscreen.

What they found could be used to prevent nanomaterials from damaging aquatic environments.

The researchers used artificial streams (see photo) to study what happens when bacterial communities taken from a Chicago-area stream are exposed to nanotitanium dioxide (NTD), the most commonly used nanomaterial. The extremely small size of NTD makes it both useful and potentially dangerous. Nanomaterials are more reactive than their larger counterparts and can easily penetrate and kill cells. In this study, NTD changed the makeup of bacterial communities, wiping out species sensitive to the material while leaving ones with greater resistance to flourish. Additional DNA tests are underway to confirm this discovery.

For aquatic environments, shifts in bacterial populations can be significant. Different species of bacteria play different roles, everything from producing oxygen to breaking down leaves and branches that fall in the water. The wrong mix of bacteria could leave aquatic life without the nutrients they need to survive.

“Research like this could guide the development and production of nanomaterials, and maybe even the laws regulating them, before they are in the environment at problematic levels,” said Kelly. “We could see the opposite of what happened with PCBs, where we didn’t know the impact they have on aquatic environments until they were already there.”

Stream contaminants travel via salmon

The biggest source of pollution in streams that flow into Lake Michigan is probably not what you would expect. In some of these areas, salmon bring high levels of contaminants to resident fish.

This is the conclusion David Janetski, a graduate student at

Courtesy of David Janetski

University of Notre Dame at the time, reached after testing fish living in streams throughout the Great Lakes region. In areas with spawning salmon, fish, like brook trout and sculpin, had higher concentrations of toxic chemicals, such as PCBs, in their body tissues than where salmon are blocked by dams—high enough in some places to potentially merit state warnings against eating the fish. Contaminant levels were highest in Lake Michigan streams, where salmon are more abundant and have higher PCB levels than in other lakes.

The key to the salmon’s potency lies in its lifecycle. Unlike other migratory fish, salmon die soon after spawning. When fish eat dead salmon or their eggs, they also ingest the chemicals that have built up in the salmon over its lifetime.

Janetski’s findings may have important implications for state efforts to ensure food safety. The high chemical concentrations suggest that states along Lake Michigan need to closely monitor streams with salmon.

“One of the most important conclusions from this study is that brook trout in certain streams may require some kind of consumption advisory,” said Janetski, now a researcher at Michigan’s Grand Valley State University. “States do not usually monitor brook trout, but tests should be done to see whether an advisory is needed.”

The results could also complicate any future dam removal projects. Tearing down dams would restore the natural river flow and open new habitats. But it would allow salmon to spread contaminants to new environments.

Consumers would pay more for U.S. seafood

The majority of seafood in American grocery stores and on our dinner plates today is imported from China and other Asian countries. But research shows that U.S. aquaculture producers can expand the market for domestically-grown products.

David Ortega, a graduate student at Purdue University, used survey data to investigate how much American consumers would be willing to pay for seafood products with a variety of safety and quality features. He found that consumers would pay the most for seafood grown in the U.S. and more for imported seafood when safety practices are U.S.-certified.

“China is getting a negative reputation, and consumers are aware of this,” said Ortega. “Domestic aquaculture producers can capitalize on that reputation. American consumers are always going to have a preference for domestically-grown aquaculture products.”

People are willing to pay between $5.41 and $10.65 per pound for shrimp from the U.S., depending on growing and safety testing methods used. In contrast, they will pay only $3.71 and $4.12 for Chinese and Taiwanese shrimp that passed rigorous safety screenings.

And while buyers are wary of im-

ported seafood, the survey showed a willingness to pay as much as $6.02 per pound for Chinese tilapia that has been certified by the U.S. government.

Large sprawling yards can lead to more runoff

Protecting water quality by converting low-density residential neighborhoods into urban areas sounds counterintuitive, but that is exactly what a researcher at University of Wisconsin-Eau Claire recommends after spending two years studying the relationship between land use practices, climate change, and water quality.

Cyril Wilson’s study used simulations of different land use and climate scenarios to see what pollution levels in the Chicago-area Des Plaines River Watershed may look like in 2020 and 2030. Although results varied, the study reveals that changing climate patterns will increase the concentration of pollutants like phosphorous and sediment that enter waterways from soil erosion, stormwater runoff, and industrial waste.

Sediment levels are expected to be at their highest in winter months and in low-density areas, where there is less infrastructure designed to channel stormwater runoff and more open spaces where sediment washes away in storms.

“When you get outside of the city, there are more undeveloped spaces and homes with large yards,” Wilson said. “There is more sediment to be flushed into waterways. The more developed an area is, the less sediment there is to wash away.”

For aquatic life living in the Des Plaines River Watershed, increased sediment means rising water temperatures and less oxygen to support biological diversity. Particulates can also clog fish gills, decrease resistance to disease, and reduce reproduction rates by suffocating eggs and newly-hatched larvae.