CSMI Cooperative Science and Monitoring Initiative

Surveying the Lakescape

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Eat or be eaten: it's the primary rule of the animal kingdom, from microscopic amoebas eating bacteria in a water puddle to lions hunting gazelles on the Serengeti. In the biological sciences, the pattern is formalized into food webs, a comprehensive look at who eats what in a given natural environment. Food webs map how energy flows through a system and can also illustrate how pollution travels between different organisms, making them an important tool for managers and researchers trying to understand the environments they're working in.

Scientists from the U.S. Geological Survey's (USGS) Lake Erie Biological Station in Sandusky, along with researchers from a wide range of universities, other government agencies and private companies, collected information on a variety of information about Lake Erie, from nutrient content to fish diets and everything in between. The survey, which takes a more comprehensive look at the overall ecosystem instead of focusing on smaller aspects of it, provides baseline data for management efforts and further research into the health and protection of Lake Erie.

Because of how its basin is structured, conditions in Lake Erie change across an east-west gradient that hasn't been studied much in its entirety. The shallow western basin is usually highly enriched with nutrients, most contributed by the Maumee River, which get used by organisms living in the lake as the water moves east. The central basin tends towards medium nutrient levels, while the deep eastern basin is generally low in nutrients.

That gradient tends to be reflected in and affect the overall ecosystem, including the food webs that track who eats what within the lake. The researchers on this sampling survey wanted to look at the whole lake seasonally (except for some winter months when ice cover prevented them from sampling) to collect information on how food webs correlate with water quality and the presence of algal blooms. One of their goals, aside from gathering information that had been missing from data sets before, was to ensure their data would be useful for resource managers assessing environmental protection strategies.

Resource managers often use computer models to predict possible effects of changes in, say, a rule about fertilizer runoff, which can fuel algal blooms. Modeling tools allow managers to see whether a proposed rule is likely to have the desired impact on the lake ecosystem and aid managers in making decisions about how to mitigate potentially harmful impacts of nutrient runoff. The more comprehensive the data sets are that inform the model, the more accurate the model's predictions will be. And with samples spanning everything from tiny phytoplankton to large fishes and ranging through most of the year, this data

set captures a huge portion of the Lake Erie ecosystem, something that generally isn't possible without extensive cooperation between agencies and academic institutions.

The comprehensive nature of this CSMI investigation also emphasizes the deep interconnectedness between Lake Erie plants, animals and general water conditions. Water clarity and nutrient levels control algae growth, which in turn feed the phytoplankton that small fish depend on for survival. And without those smaller fish, the sport fish that form the basis of Lake Erie's $1 billion sport fishery wouldn't be particularly well fed.

One major use for the models will be forecasting the size and location of harmful algal blooms, which can produce toxins that make drinking water drawn from Lake Erie unsafe. The models, created both by agency personnel and by academic researchers using data from this project, look at the algae already present in the lake, along with nutrients coming in from tributaries like the Maumee River, to determine whether that input is likely to cause rapid growth in blue-green algae that leads to blooms. If that's the case, water treatment plant managers can adjust water intake locations and treatment within the plant to make sure the water that reaches consumers isn't affected. Models will also be used to investigate potential impacts of algal blooms and other changes on fish populations, an important concern for anglers. In addition to eating algae or the zooplankton and smaller fish that depend on algae, sport fish like walleye need oxygenated water to thrive. When algal blooms die off and decompose, they contribute to the dead zone, an area of low or no oxygen that develops in the central basin in the late summer. Previous research has shown that these hypoxic or anoxic areas can push fish away from their usual habitat, making them harder to find for anglers. In addition, fish kills can result when schools of fish are trapped in shallower areas without a way to escape the anoxic water and suffocate.

The researchers are making the data available to the public and to other scientists via an online database called ScienceBase, which is an open-source data-sharing website for a wide range of research projects. The website includes data from USGS research as well as other government agencies, encouraging sharing of information across institutional boundaries. Some of the data are already in use in follow-up projects from collaborating scientists.