Video #2:
What Lies Beneath: The Base of Lake Ontario's Food Web
https://youtu.be/Z2DdloFzpVQ

Voiceover: **"Together, the Great Lakes form an immense ecosystem, and scientists have learned a great deal about the Great Lakes over the past several decades. To get a better understanding of this complex ecosystem the United States and Canada committed to a collaborative, binational scientific effort in the Great Lakes in 2002. The effort, known as the Cooperative Science and Monitoring Initiative, or CSMI, rotates from lake to lake on a 5-year cycle and aims to unify different groups conducting research and monitoring. The objective is to provide the best information possible to help develop Lakewide Action and Management Plans under the Great Lakes Water Quality Agreement.**

In 2013, CSMI was focused on Lake Ontario, with an emphasis on:

1. **Sources and levels of nutrients such as nitrogen and phosphorus,**
2. **The abundance and distribution of primary producers - such as microscopic phytoplankton - and secondary producers - like zooplankton and other large invertebrates that consume these species**

Scientists studied these factors and how they form the base of food web in Lake Ontario. Changes in human activity over the past 200 years has changed the structure of the food web, and efforts like CSMI are helping scientists understand how.

Scientists studied these factors and how they form the base of food web in Lake Ontario.

Changes in human activity have altered the structure of the Lake Ontario food web. One of the biggest influences humans have had is changing nutrient loading. Excess nutrient inputs to the Great Lakes from human activity were common leading into the 1970's. But in 1972, the Clean Water Act was developed along with regulations to improve water quality. One goal of this legislation was to reduce the inputs of nutrients such as phosphorus into the Great Lakes. In particular, the offshore areas of Lake Ontario have responded to this management action, and efforts like CSMI are helping scientists understand how.

Dove speaks: "Phosphorous is the growth limiting nutrients and right now phosphorous is actually extremely low throughout the Great Lakes. In the last twenty years, the phosphorus concentrations have further declined. If you're not growing enough algae, you're not growing enough phytoplankton, you're not growing enough zooplankton, you're not feeding the small fish, you're not feeding the big fish, it can have that kind of a cascading influence of ultimately affecting the fishery."

Weidel speaks: "How many nutrients are being loaded into the lake either through the streams, or local runoff or the groundwater? Those long-term time series really help us gauge both the indication of what's happening in the lake, but how what we as humans doing on the landscape influence the lake. The pelagic invertebrates, zooplankton, little microorganisms that are eating algae out there, there's

quite an effort to track them through time, as well as the same type of invertebrates that live on the bottom. The benthic mussels, as well as small antipodes. We understand how human changes and challenges the environment have changed those indicators."

Voiceover, **"Scientists have stations throughout the lake to monitor the status of nutrients and organisms that rely on them"**

Dove speaks: "And then we look at trends over times indicate whether you know which direction things are going, if they're getting better or worse. For some things like contaminants, you can't have a value that is too low. For other things like nutrients, there's probably really an optimal range within which you want to keep."

Voiceover, **"Ongoing monitoring efforts by scientists have given them an understanding of how some areas in Lake Ontario are very different compared to others"**

Boyer speaks: "If there's a dramatic difference between what happens in the nearshore zones and what happens in the offshore zones, and historically, you know most of our monitoring was, well lets look off shore you know because we don't we can get a good number of what the nutrients are in the offshore. And really it's almost getting to the point where in many cases people are suggesting that the offshore environment is nutrient depleted. There's not enough nutrients offshore to support the fisheries that we really want. Whereas on the nearshore environment we got way too many nutrients and we have these nuisance algal blooms that are washing up on the beach."

Voiceover, **"Algal blooms were increasingly common in the Great Lakes leading into the 1970's as nutrient inputs escalated, but as a result of regulation, nutrient inputs and algal blooms declined as we moved into the 21st century. However more recently, algal blooms have begun to occur more often in some areas of the Great Lakes."**

Boyer speaks: There's really two categories. There are harmful algal blooms. These are usually cyanobacteria or blue green algae that produce toxins, which are a direct threat to the ecosystem or to humans through drinking water and we have what we refer to now as nuisance algal blooms. These are things like *Cladophora* on the beach that can certainly be a threat to human health through the fact that they have a lot of biomass. You can get e-coli that grows in these things, you can get avian botulism and things like that. But the algae them self don't directly produce a toxin. We have what we call Nabs and Habs."

Zelansky speaks: “We are looking at algal blooms in the nearshore and we’re wondering well why did it happen in this particular location last year but it didn’t happen this year. You know what has changed just between two different years that could have resulted in avoiding these algal blooms and could we learn something from that.”

Boyer speaks: “Sodus Bay 2010 had a huge harmful algal bloom. One of the things that we’ve identified as a causal factor is the water column stability. So these blooms usually happen in embayments and places where you get a very stable water column right. One of the immediate spinoffs of that identifying that as a causal factor is many of the local marinas and residents have de-ice bubblers that they use to keep ice from breaking up their docks and so they have now started to turn on their de-ice bubblers in the summer. It circulates the water around their docks and marinas and at least it appears to really have disrupted that water column stability enough that these blooms are not forming in the same magnitude.”

Weidel speaks: “The food web has not only been changed by the Clean Water Act and the differences in those nutrient loadings, but it’s also been strongly shaped by the invasive species or non-native species.”

Elgin speaks: “So invasive species are species that have arrived in the area usually aided by a human activity and a lot of species in the Great Lakes that are introduced here through ballast water in ships. Maybe they’ve been imported through trade and people have released these species into the water.”

Weidel speaks: “Some of the most notable species are, most people are familiar with the zebra and/or quagga mussels.”

Elgin speaks: “They come from a similar region in the called the Ponto Caspian area it is the Caspian and Black Sea and those seas have a similar environment to the Great Lakes so they do very well here and they are capable of almost blanketing the bottom of the lakes and since their numbers are so large even though each mussel is very small they are capable of filtering the water. And when they filter the water they take out, think of the bottom of the food web. They take out all the small floating plants, the phytoplankton in the water and by doing that they reduce food for every level in the food web above that. Mussels are actually able, they can take in phytoplankton and if it’s a species they don’t want to eat, they can expel it out and this comes into play for harmful algal blooms that are common in the Great Lakes and the mussels will ingest the algae and the cyanobacteria that makes the harmful algal blooms. And if it’s a species they don’t prefer, they will spit it out and they don’t prefer the more toxic species. So in this way they are reducing the other cyanobacteria and increasing the numbers of the harmful toxic cyanobacteria.”

Weidel speaks: “Quagga mussels still continue to dominate the lake bottom but what’s also interesting is the Round Goby has been introduced and that species consumes those mussels and moves that energy up into sport fish and native fisheries supporting those populations that people like to fish for and provide an ecosystem service.”

Voiceover, **Lake Ontario has experienced dramatic changes over the past forty years, especially related to invasive species and nutrient inputs. These factors work together to form what we see in Lake Ontario today.**

Boyer speaks: “So really what you’re going to have to do is look at nutrient loadings and things like that and really I think where the research community can really benefit or interact with management is deciding what levels or what loads, what nutrient targets should we really be shooting for.”

Voiceover, **Through the work of CSMI and ongoing efforts by scientists, we now realize that Lake Ontario is a system that can benefit from a proper balance of nutrients to form the base of the food web. Lake Ontario will continue to change as native and non-native species interact with their changing environment and nutrient inputs. Monitoring and understanding how changes in nutrient loads and food web structure may influence the lake will help managers and stakeholders forecast and prepare for, what the future might hold for Lake Ontario and the organisms that call it home.**