GREAT LAKES NEWS FROM
MICHIGAN SEA GRANT COLLEGE PROGRAM

upwellings

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HOLDING GROUND

upwellings

An upwelling occurs in a lake or ocean when strong, steady winds push warm in-shore surface water away from shore causing colder, nutrient-rich water to rise.

upwellings is published quarterly by the Michigan Sea Grant College Program, a cooperative effort of the University of Michigan and Michigan State University. The program supports understanding and stewardship of the Great Lakes through research, outreach and education.

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COVER ILLUSTRATION: MARSEE/BRENNER


MARSEE


LAPORTE

KEEPING THE NATIVE CHARACTER OF THE GREAT LAKES ALIVE

By Jim Diana, Michigan Sea Grant Director

Most people in the Great Lakes are familiar with invasive species. Almost daily we read information about threats of new invasive species moving into the Great Lakes basin. At this point, it should not be a big surprise—invasive species continue to shape the Great Lakes ecosystem. Yet, just because we hear about them and they have become more common doesn't make it any less important of an issue.

Overall, more than 180 non-native aquatic organisms of all types—including plants, fish, algae and mollusks—have become established in the Great Lakes since the 1800s.

Some were introduced intentionally, like the common carp, brought to the U.S. as a food fish in the 1880s and now is probably the most damaging invasive fish species throughout the country. Others on the non-native list include those that found their way through a variety of other means, such as hitchhiking in the ballast water of ocean freighters or arriving as packing material.

Regardless of how a species was introduced, limiting the spread of invasive species is something we can all take on as a personal responsibility. It only takes one careless individual to contribute to the movement of invaders. For example, boaters know that plants should be removed from the boat trailer, the bilge should be drained and flushed and the boat should be washed before transferring it from one body of water to another.

A number of other things should be done to limit the spread of existing invasive species and prevent new invaders from becoming established. In addition to implementing a common and effective approach to ballast water management, it is imperative to stress that the Great Lakes basin has unique species and conditions that do not exist anywhere else.

Sea Grant and many other organizations invest in education and outreach about preserving Great Lakes resources, including native plants, fishes, mussels and other species. An appreciation of our native fauna and flora—and an ethic to fight for their conservation—should be an important concern of all residents of the Great Lakes basin. Nurturing such an ethic will go a long way toward solving the problem of more non-native species becoming introduced within the Great Lakes.

That is what this issue of *upwellings* aims to do: remind readers that invasive species are still out there and that by each of us doing our part, we can help prevent the introduction of new non-native species and better manage the invasive species that are now part of the Great Lakes ecosystem—our greatest natural resource.

Michigan Sea Grant is funded by the National Oceanic and Atmospheric Administration and the State of Michigan.
Michigan State University and the University of Michigan are equal opportunity/affirmative action institutions.

FIRST ENCOUNTERS
OF AN INVASIVE KIND

MICHIGAN SEA GRANT STAFF MEMBERS RECALL THEIR FIRST (OR MOST MEMORABLE) EXPERIENCES WITH INVASIVE SPECIES.

JIM DIANA, Director

Encounter: Pickled fish on the basketball court.

Details: Probably my oddest interaction with invasive species came here in Michigan. I was playing basketball, and often played with (and still do today) Dave Jude, fisheries scientist. One day he came in to the court with a bottle of pickled fish and asked me what I thought this one fish was. It looked sort of like a Sculpin but did not match what a Sculpin should be. Later Dave determined it to be a Tube Nosed Goby – the first collected in the Great Lakes. I got to see the first evidence of this invasive fish, but in a very odd place.

LYNN VACCARO, Project Coordinator

Encounter: Hot and sweaty days with Phragmites.

Details: For my master's research project, I surveyed the vegetation of about 30 wetlands around Lake Erie and Lake Ontario. On the western end of Lake Erie, I really became familiar with Phragmites, aka the Common Reed.

Wearing chest waders and carrying a soil core, GPS and clipboard, my field assistant and I had to walk from the wetland edge into about three feet of water, identifying plants. I am very familiar with stands of cattails, but this did not prepare me for the challenges a stand of Phragmites presents. In several wetlands around Lake Erie we occasionally had to walk through 300 square feet of 11-12 foot tall Phragmites stands. Usually we were glad for a few low-diversity plots (sections made up of only a few different types of plants) because it made our work easier, but plot after plot of this one species became really depressing.

Not to mention that working in dense stands of sharp, 12-foot-high Phragmites is completely disorienting, hot and humid. My arms would be totally cut up by the end of the day from forcing my way through the grasses. Thank goodness we were using a GPS.

At first I blamed nutrient run-off from the urban and agricultural areas surrounding the wetlands, but I later began to see it was the plant itself to blame.

SONIA JOSEPH, Outreach Coordinator

Encounter: Edible zebra mussels?

Details: The first time I remember being aware of invasives was in my early teens when my friend's parents kept talking about zebra mussels and what they were doing to Lake St. Clair and how they were affecting boats, marinas, etc. At first I thought it was something edible – because they were mussels – until my friend showed me a rock that was covered with them. Later that year I started hearing more and more about zebra mussels and their impact on surrounding bodies of water.

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ILLUSTRATION: MARSEE/BRENNER

HOLDING GROUND

By Stephanie Ariganello

ILLUSTRATION: MARSEE/BRENNER

INVASIVE SPECIES ARE STILL AN ISSUE IN THE GREAT LAKES AND BEYOND

On one side of the field, the opponents are rallying. They are planning an attack. They have traveled great distances. They're hungry and ready for a fight.

On the other side of the field, the home team has studied the films. They are mounting a defense. Some of the opponents are bigger, meaner and sharper spined. The home team has some players down—sick and injured—but they're still fighting.

It's a clash of the tritons, so to speak, that has been taking place in the Great Lakes longer than most modern football rivalries.

Native fish, plants, animals and plankton have been holding their ground, but with the frequent introduction of new non-native species, they continue to be under siege.

Non-native species have threatened the Great Lakes ecosystem since the 1800s. More than 180 non-native plants, fish, algae and mollusks, have become established in the Great Lakes. And the rate of introduction of non-native species has increased. More than one-third of the non-native organisms have been introduced in the past 30 years—a surge coinciding with the opening of the St. Lawrence Seaway, specifically the Welland Canal.

While there is greater awareness now, it doesn't mean the case is closed.

Managing invasive species is very much like a chess game. We need to understand how all of these species interact and affect the ecosystems—which are always changing—before we can respond effectively.

— Kevin Frailey, Michigan Department of Natural Resources Education and Outreach Manager

"People should know that invasive species are one of the most serious threats to the health and economic vitality of the Great Lakes and their effects are irreversible," said Emily Finnell, Environmental Quality Analyst with the Michigan Office of the Great Lakes.

"Every individual has an important role to play to prevent the introduction and spread of invasive species in their daily activities whether it be boating, fishing, gardening or disposing of an unwanted pet."

The "ah-ha" moment for most in Southeast Michigan was in 1989. It was then that a combination of zebra mussels and frazzle ice (needle-like crystals or thin, flat circles of ice that quickly form) clogged the Monroe municipal water intake pipe in Lake Erie, leaving the town without its water source for three days.

"The situation in Monroe certainly got attention for invasive species," said Carol Swinehart, Michigan Sea Grant Extension Communicator and Aquatic Invasive Species Specialist. "That's a real problem if my hospital can't get water and the restaurants are shutting down. I think people were able to relate to the issue through that kind of interaction."

While large-scale reform has been taking place within the shipping, fishing and aquaculture industries to limit the spread of invasive species, on-the-ground efforts to educate residents, boaters and anglers have been a focal point.

"People seem to think that we can just fix it," said Kevin Frailey, Michigan Department of Natural Resources Education and Outreach Manager. "There are things you can do, but once something is here, it's pretty much here. Education goes a long way. We try to educate kids and adults so that hopefully, when they have a chance to make a difference—whatever that may be—they make the right decision."

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Learning About Great Lakes Native and Invasive Species

FLOW
FISHERIES LEARNING ON THE WEB

This learning guide features native and invasive species of the Great Lakes. Also included are tear-out cards that can be used in the car, classroom or nature center. The information was adapted from *Fisheries Learning On the Web*, Michigan Sea Grant's free online curriculum, aligned to state content expectations and national benchmarks. See: www.projectflow.us

SAMPLE NATIVE SPECIES IN THE GREAT LAKES

YELLOW PERCH *(Perca flavescens)*

Yellow Perch's role in the food web and their reputation as a tasty eating fish makes them both ecological and commercially valuable in the Great Lakes. They travel in schools, preferring relatively shallow waters near shore. Unlike many Great Lakes fish species, Perch remain active all winter long under the ice in both shallow and deeper water, making this a popular species for ice fishing.

Characteristics

- Split dorsal fin. Body has distinct vertical bands.
- Important food and sport fish throughout southern part of Great Lakes region.
- Habitat encompasses a variety of locations, like quiet ponds, streams with little current and large and small lakes, including the Great Lakes.
- Average adult length is 4-10 inches with weight of 4-10 ounces, although size is quite variable.

Facts, behaviors, threats

- Yellow Perch populations were severely crowded and reduced in the late 1960s by the invasive Alewife, though populations have recovered somewhat since.
- Compete with the invasive Eurasian Ruffe for food and territory.
- The most commonly caught sport fish in Michigan.

LAKE STURGEON *(Acipenser fulvescens)*

Lake Sturgeon live at water depths of 15-30 feet. They feed along lake bottoms, eating a variety of small animals, including snails, crustaceans, aquatic insects, mussels and small fish. Most caught today weigh between 30-100 pounds and are 3-6 feet long. Lake Sturgeon live longer than any other fish species in Michigan. Male Lake Sturgeon live an average of 55 years; females live 80-150 years. It takes between 8-12 years for male Sturgeon to reach reproductive maturity and 20-25 years for females. Females spawn once every 3-7 years, while males spawn every 1-4 years. The age of maturity coupled with infrequent spawning contributes to the population's slower rate of recovery.

Characteristics

- No scales – they have five rows of bony plates (scutes).
- Taste buds on and around barbels near rubbery lips and sucker-like mouth. Extends lips to vacuum up food, which it swallows whole.
- Ancient family of fishes recognized since the Upper Cretaceous period (136 million years ago).
- A single dorsal fin, far back near the tail that some say resembles a shark fin.

Facts, behaviors, threats

- Considered endangered or have protected status in 19 of the 20 places where they naturally occur, including Michigan.
- Once an abundant species in the Great Lakes and used as a primary food source by the Native Americans in the region.
- Now, less than one percent of the original population of Lake Sturgeon exists in the Great Lakes due to habitat loss, pollution and over-harvesting.

LAKE TROUT *(Salvelinus namaycush)*

The Lake Trout or "Salmon Trout" is the largest trout native to the Great lakes and other Michigan lake waters. This restless denizen of the cold, deep water is a wanderer, often ranging many miles in search of prey. A relentless hunter, the Lake Trout feeds primarily on other fish. Lake Trout are prized as food fish, as well as sport fish.

Characteristics

- The average adult is usually 17-27 inches in length and weighs in at 9-10 pounds, but some individuals weigh up to 50 pounds.
- Prefer water temperatures of 45-55 degrees F. May be found 10-15 feet deep in spring and fall, but follow cold water temperatures to depths of 100-200 feet in the summer and winter.
- Particularly feed on Ciscoes, but also concentrate on Alewives, Smelt or Sculpin (dead or alive), and sometimes crustaceans, insects, other fish and small mammals.

Facts, behaviors, threats

- An unusual form of Lake Trout called a Siscowet, occurs in the deep waters of Lake Superior. This "fat trout" spawns at depths greater than 300 feet and is usually edible only when smoked.
- Sea Lampreys severely reduced Lake Trout populations in Michigan between 1935 and 1965. Chemical contaminants and over-fishing also contributed to the decline.
- Better fish stocking programs, control of Sea Lamprey and reducing pollution have helped increase populations of the native Lake Trout.

BURBOT *(Lota lota)*

These elongated, cylindrical, freshwater codfish are native to the Great Lakes, as well as other northern areas of the United States. They can be found in lakes Michigan, Huron, Ontario, Erie and Superior, but are uncommon in Erie. In the U.S., Burbots have long been overlooked as a food fish. However, when boiled and buttered, the sweet flavor of Burbot has earned it the title of "poor man's lobster."

Characteristics

- Generally range in length from 15-22 inches and weigh 1-3 pounds.
- Similar in appearance to the invasive Snakehead fish. However, a Burbot can be identified by its characteristic barbel on the lower jaw and split dorsal fin.
- Coloring is mottled olive-green to shades of brown on back and cream-colored underneath. Markings create a lacelike pattern of dark brown or black.

Facts, behaviors, threats

- Common Names: American burbot, ling, eelpout, loche, freshwater cod.
- In the mid-1900s, Burbot populations in the Great Lakes dramatically declined under the onslaught of the Sea Lamprey.
- Today Burbot are returning to the Great Lakes in increasing numbers.


E. DAMSTRA

MUSKELLUNGE *(Esox masquinongy)*

Often called Muskie, these relatively rare freshwater fish are the largest member of the pike family. The name Muskellunge comes from the Ojibwe word maashkinoozhe, roughly translating to "ugly pike." They closely resemble the Northern Pike in both appearance and behavior. Their bodies are elongated with flat heads and dorsal, pelvic and anal fins set far back of the head. A Muskie has large powerful jaws shaped like a duckbill, armed with numerous fang-like teeth.

Characteristics

- Size varies greatly by lake, but range from 2-5 feet and average 20 pounds. Large fish can weigh 40-60 pounds.
- Great Lakes Muskie are a light silver, brown or green with dark vertical markings, which tend to break up into spots. In contrast, Northern Pike have dark bodies with light markings.
- To tell a Muskie from a Northern Pike, count the pores on the underside of the jaw. A Muskie has six or more. A Pike never has more than five.

Facts, behaviors, threats

- Second only to Sturgeon as the Great Lakes' largest fish.
- Commonly known as "the fish of 10,000 casts" to anglers because it can take an average of 50-80 hours of fishing time to get one on the line.
- Hunt by staying motionless and when prey swims by, they pierce it with their large canines, rotate it and swallow it head first.


E. DAMSTRA

LONGNOSE GAR *(Lepisosteus osseus)*

The Gar can be found in all of the Great Lakes except Superior. Gar have remained largely the same since the days of the dinosaur. An inhabitant of warm, quiet waters, the Gar is known for its sharp teeth and aggressive nature. They catch their prey sideways in their toothy jaws by staying motionless or slowly stalking prey. The Gar slashes its beak from side-to-side like scissors when it grabs prey, sometimes cutting it in half.

Characteristics

- Has a thin, long body covered with hard diamond-shaped scales. Its pointy mouth is filled with teeth.
- Average fish is about 30 inches long, about 20 pounds and can live to be about 20 years old.

Facts, behaviors, threats

- Historically, Native Americans used the heavy, tough rhomboid scales of the gar for arrow points, ornament, and other instruments.
- Can take in oxygen by swimming to the surface and gulping air into their swim bladders. This characteristic allows them to survive in water that has almost no oxygen and they can live out of water for hours, as long as their bodies stay moist.


KURT STEPNITZ, MSU

PLAIN POCKETBOOK MUSSEL *(Lampsilis cardium)*

The pocketbook is a native mussel found in lakes, streams and rivers, in mud, sand and gravel. In Michigan, the pocketbook is found throughout both the Upper and Lower peninsulas. Mussels like the plain pocketbook need fish to help them develop. Fertilized eggs are grown into larvae inside the female mussel. The larvae, called glochidia, are then released into the water where they must attach to a host fish, The larvae live on the gill filaments or the body of a host fish for a few days or weeks and are then sloughed off as free-living organisms.

Characteristics

- The periostracum (outer shell layer) is smooth, yellow to yellow-green with green rays, although sometimes rays are absent.
- The pocketbook is up to 7 inches long, and is round or quadrate in shape.
- In Michigan, this species can be confused with other native mussels like the mucket, fat mucket, or wavy-rayed lampmussel.

Facts, behaviors, threats

- Female has a distinct mantle flap, which resembles a minnow. The minnow mimic lures fish to chew on the flap and break the membrane, releasing the mussel larvae and helping in the reproductive cycle.
- Can be colonized and smothered by the invasive zebra mussel.
- Competes with zebra and quagga mussels for food.


BRENNER

PRICKLY WILD ROSE *(Rosa acicularis)*

This native rose grows in gravel, sandy shores, dunes, moist thickets and swamps. It can also be found inland mixed into sandy oak and jack pine stands. It is the only rose native to Michigan that can also be found in Europe and Asia and has the largest range of all the rose species. True to its name, the stems have many slender, unequal prickles. It generally flowers from late May to late July with smooth fruits – or rose hips – developing in the late summer.

Characteristics

- Flowers have five pink or deep rose-colored petals.
- Many of the shrubs grow together because they are clonal – meaning groups of plants share underground connections.
- Grows low to the ground and helps stabilize the shifting sands of the beach.
- Moderately fire resistant. Can sprout from the base of fire-killed stems or from rhizomes.

Facts, behaviors, threats

- Many animals and birds eat the fruits of the plant, which stay on the stems well into the winter months. The ruffed grouse is particularly fond of eating the hips.
- People make the rose hips into jellies, syrups and teas and they have also been used in mixtures to treat things like bee stings, cough, colds, diarrhea, sore eyes and stomach problems.
- Also used to ward off witchcraft.

Sources: *Guide to Great Lakes Coastal Plants* - by Ellen Elliott Weatherbee, *Fisheries Learning on the Web* (FLOW), The Great Lakes Fishery Commission, Michigan Natural Features Inventory, U.S. Department of Agriculture, Minnesota Sea Grant and Wisconsin Sea Grant.

ACTIVITY

Tear out cards, mix up with Invasive Species cards, and work with a group to complete the information on the back.

COPY MASTER


E. DAMSTRA


E. DAMSTRA


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E. DAMSTRA


E. DAMSTRA


BRENNER


KURT STEPNITZ, MSU

SAMPLE NATIVE SPECIES IN THE GREAT LAKES www.projectflow.us

FLOW
FISHERIES LEARNING ON THE WEB

FLOW
FISHERIES LEARNING ON THE WEB

SAMPLE NATIVE SPECIES IN THE GREAT LAKES www.projectflow.us

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- Do these fish like to swim alone or in schools?
- True or false: This fish stops eating in the winter.
- How large does an average specimen get?

Michigan Sea Grant | www.projectflow.us

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- Discuss: How is this fish different from other fish in the Great Lakes?
- How big do they get? What is an average size?
- How long do they live? How does that affect the population?
- What are some major threats to this fish?

Michigan Sea Grant | www.projectflow.us

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- What does this fish like to eat?
- What other species devastated this population of fish?
- Do these fish like cold water? How do we know?

Michigan Sea Grant | www.projectflow.us

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- What are some other names for this fish?
- Where can this species be found?
- Can you describe its fin structure?

Michigan Sea Grant | www.projectflow.us

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- What do anglers call this fish? Why?
- How can you tell this species apart from other similar fish species?
- True or false: This is the largest fish in the Great Lakes.

Michigan Sea Grant | www.projectflow.us

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- What is special about the way this fish breathes?
- What is it known for?
- Does it have soft scales or hard scales?

Michigan Sea Grant | www.projectflow.us

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- Where is this species of mollusk found?
- What other species is a problem for this mollusk?
- How does it reproduce?

Michigan Sea Grant | www.projectflow.us

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- Where might you find this species?
- What purpose does it serve?
- What did people use it for?

Michigan Sea Grant | www.projectflow.us

COPY MASTER

ACTIVITY

Tear out cards, mix up with Native Species cards, and work with a group to complete the information on the back.


E. DAMSTRA


BRENNER

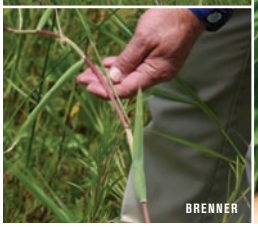

E. DAMSTRA


E. DAMSTRA


DAVE JUDE


SIMON VAN MECHELEN


VACCARO


BRENNER


LAPORTE


BRENNER

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- These organisms are distantly related to what?
- When clumps of these get caught on a fishing line, what does it feel like when you touch them?
- Are these easy to spot floating around?
- Do fish like to eat them?

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- On average, one of these fish species can destroy how many pounds of fish?
- How does this affect the aquatic ecosystem?
- They especially like what other kinds of fish?
- Are their populations growing or shrinking in the Great Lakes?

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- What is the average size of these fish?
- How can you tell them apart from other similar fish?
- Do they cause problems for other fish species? How?
- Where can they be found and how did they get there?

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- Where will you likely find these fish?
- Will they only swim in clean water?
- They resemble some other aquatic creature. What is it?
- How aggressive is this species?

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- Is this species solitary or do they appear in clusters?
- True or false: they can grow to be up to 10 inches in length.
- How did these enter the Great Lakes?
- Discuss how this species filters the water.

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- What other species are related to this one?
- Name three ways this species is different from that relative.
- When was this species discovered in the Great Lakes?
- When these organisms move into an area, how do they impact the surrounding ecosystem?

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- How tall can this plant species grow?
- Is this plant a good source of food for animals?
- Are these plants still available at garden centers and in seed mixtures?
- What impact does this plant have on other plants?

Name: _____

Scientific name: _____

Native to the Great Lakes? _____

- What is another name for this plant?
- The majority of a mature plant can be found where – above ground or below ground?
- True or false: the only way these plants spread is through their seeds.
- What makes these plants particularly damaging to other plants?

SPINY WATER FLEA *(Bythotrephes longimanus)*

The spiny water flea and the similar fishhook water flea are distantly related to shrimp, lobster and crayfish. A microscope is needed to see them clearly. The spiny water flea was discovered in Lake Huron in 1984. The fishhook water flea was discovered in Lake Ontario in 1998.

Characteristics

- Zooplankton that have long, barbed or hooked tails.
- Tails often catch on fishing lines and downrigger cable, creating problems for anglers.
- Clumps of these zooplankton look and feel like gelatin or cotton batting.

Impacts

- Eat small plankton, reducing food for native Great Lakes zooplankton.
- Not a good food source for native fish because their barbed tail spines are hard to digest.

SEA LAMPREY *(Petromyzon marinus)*

The Sea Lamprey is an aggressive parasitic fish with a toothed, round sucking mouth and rasping tongue that's used to bore into the flesh of other fish to feed on their blood and body fluids. They are primitive, jawless and look like eels.

Native to the Atlantic Ocean, they entered the St. Lawrence River and eventually the Great Lakes when the Welland Canal was modernized around 1920. Today, Sea Lampreys are found in all the Great Lakes and many tributaries, with the largest population in northern Lake Huron. Through control measures, their once-exploded population has been significantly reduced – in some areas up to 90 percent of what it once was.

Characteristics

- Eel-like fish that attach to other fish and feed on body fluids.
- Adults grow 12-20 inches long.
- Round, suction disk mouth is filled with sharp teeth.

Impacts

- Can destroy 40 pounds of fish during its life.
- Often kills large, predator fish, like Lake Trout and Whitefish, causing populations of smaller fish to grow too large.
- Has contributed to declines in native fish populations in the Great Lakes.
- The U.S. Government spends an average of $10-15 million a year to control Sea Lamprey.

EURASIAN RUFFE *(Gymnocephalus cernuus)*

This small, aggressive fish (pronounced "rough") with sharp spines on top and bottom fins, is native to Europe and Asia. It was first discovered in Minnesota's St. Louis River, the main tributary to western Lake Superior, in 1986. It arrived in the ballast water of an ocean-going vessel.

Characteristics

- Grows rapidly and loves to eat.
- Can tolerate a range of water conditions.
- The average Ruffe is 4-6 inches in length.
- Resembles Yellow Perch or small Walleye. Can be distinguished by its fin structure, sharp spines and the lack of scales on its head.

Impacts

- Makes up an estimated 80 percent of the fish caught in the St. Louis River.
- Has spread to other areas in western Lake Superior and Thunder Bay on Lake Huron.
- Because of its sheer numbers and the variety of food it eats, the Ruffe will reduce food sources for many native fish, such as Walleye and Perch.

ROUND GOBY *(Neogobius melanostomus)*

This fish is originally from the Black and Caspian seas. They hitched a ride to the Great Lakes in the ballast water of ocean-going vessels. Round Gobies were discovered in the St. Clair River around 1990. They've now spread to all of the Great Lakes, with the greatest numbers in Lake Erie, Lake St. Clair and southern Lake Michigan.

Characteristics

- Small, bottom-dwelling fish that resembles a large tadpole.
- Anglers are often first to know when Gobies have invaded, as they are known to steal fishing bait and are frequently caught.
- Likes to live in rocky places and can survive in poor water quality.
- Usually 3-6 inches in length, but can grow up to 10 inches.

Impacts

- Displaces native fish, eats their eggs and young, and takes over optimal habitat.
- Spawns multiple times per season. Population grows rapidly.
- Can become the most numerous fish in a given area.

ZEBRA MUSSELS *(Dreissena polymorpha)*

These small, striped mussels are native to the Caspian and Aral Seas of Eastern Europe and Western Asia. They traveled to the Great Lakes in the ballast water of ships. Zebra mussels were discovered in Lake St. Clair in 1988 and have spread to all five Great Lakes and many inland lakes. They spread primarily by attaching to boat hulls, aquatic plants, nets, fishing equipment, or in water and can survive for days out of the water given the right conditions.

Characteristics

- Look like small clams with a yellowish or brownish D-shaped shell, usually with dark and light-colored stripes like a zebra.
- Live in colonies that attach to anything solid under water such as submerged rocks, dock pilings, boat hulls and even native clams and mussels, often smothering them.
- Can be up to 2 inches long, but most are about the size of a fingernail, usually grow in clusters and are generally found in shallow (6-30 feet), algae-rich water.

Impacts

- Filter (eat) large quantities of plankton (small plants and animals), reducing food for many native species.
- Capacity to filter water promotes excessive growth of aquatic plants and algae as the clearer water allows more sunlight to penetrate without as much plankton.
- Large clusters clog water intake pipes, boat motors and pumps, costing millions of dollars to control each year.
- Can wash up on shore, littering beaches with their sharp shells and creating unpleasant smells.
- Have quickly spread from the Great Lakes to many other states in the nation.

SAMPLE INVASIVE SPECIES IN THE GREAT LAKES

QUAGGA MUSSELS *(Dreissena bugensis)*

The quagga mussel is a close relative of the zebra mussel. They were first discovered in the Great Lakes region in 1989. However, the distinction of the quagga mussel as a separate species did not happen until 1991. Quagga mussels are native of the Caspian Sea – particularly the Ukraine. They were most likely introduced into the Great Lakes region from ballast water of ocean-going ships. They can survive in a wide range of water temperatures, remain active throughout the year and negatively impact the food chain when they move into an area.

Characteristics

- Have dark concentric rings on the shell and are pale in color near the hinge; similar in size to zebra mussels but their shells are rounder and without ridges.
- Commonly found in waters more than 90 feet deep.
- Can live in waters ranging from warm and shallow to deep and cold, able to tolerate brackish (a mixture of salt and fresh) water and can live directly on a muddy or sandy bottom.
- A single mature female mussel can produce more than one million eggs in a spawning season.

Impacts

- Damage the food chain by non-stop consumption of food sources of native species, negatively impact fisheries and clog water intakes.
- As a filter feeder, accumulates pollutants and passes them up the food chain (bioaccumulation).
- Quagga and zebra mussels are likely the reason *Diporeia*, a small shrimp-like species that serves as a food source for larger fish, is no longer abundant. The food chain is affected; for example, Lake Whitefish that feed on *Diporeia* are growing to less than half of their expected size.

PURPLE LOOSESTRIFE *(Lythrum salicaria)*

Early settlers brought purple loosestrife to North America from Europe. They liked the plant's eye-catching purple flowers. From its humble beginnings as a garden plant, purple loosestrife quickly invaded wetlands in nearly every U.S. state and Canadian province.

Characteristics

- Tall, flowering perennial plant that can grow 3-7 feet high.
- Often found on the edges of wetlands, roadside ditches and other moist areas.
- Bright purple flowers bloom during midsummer and spread seeds quickly. A mature plant can produce more than 2.5 million seeds each year.
- Can still be found in some garden centers and in wildflower seed mixes – usually reported on labels.

Impacts

- Competes with native wetland plants and gradually replaces them. On mature plants, rootstocks are extensive and can send out up to 30-50 shoots, creating a dense web that chokes out other plant life.
- Not a good food source. When this plant takes over a wetland, ducks, fish and frogs may leave or die.
- Dense stands of this plant block access to water.
- Garden varieties of loosestrife (once thought to be sterile) have cross-pollinated with wild purple loosestrife, further spreading this invasive plant.

PHRAGMITES *(Phragmites australis)*

Phragmites (pronounced frag-MY-teez), also known as common reed, is a perennial, wetland grass. While some Phragmites are native to Michigan, an invasive variety is becoming widespread, threatening the ecological health and diversity of wetlands and Great Lakes coastal shorelines. It is thought to have been introduced to North America in the early 20th century from packing material and ballast on ships from Europe that were frequently dumped in coastal marshes.

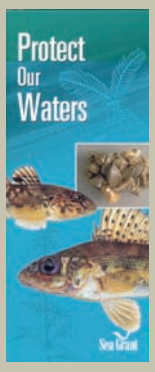
Characteristics

- Plants range from 6-20 feet tall above ground. Below ground plant is a dense mass of roots and rhizomes that may reach deeper than 6 feet.
- Has a distinctive purple-brown seed head with plumes appearing by late July.
- Turns a tan color in the fall and most leaves drop off, leaving only the stalk and plume-topped shoot commonly seen throughout winter.
- Rhizomes (roots) broken by actions like waves, dredging or digging quickly take root in new locations.

Impacts

- Creates extremely tall, dense stands that crowd out native plants and animals.
- Blocks shoreline views, reduces access for swimming, fishing, and hunting and can create fire hazards from dry plant material.
- Actively secretes gallic acid to kill off other species of plants, making this a very aggressive invader.
- Sharp edges and deep roots of mature plants makes removal by hand impossible.

LEARN MORE ABOUT NATIVE AND INVASIVE SPECIES



Protect Our Waters

For many of us, fishing in cool clear lakes, rivers and streams is one of life's pleasures. Today, these waters are under attack by Round Goby, Ruffe, zebra mussels, purple loosestrife, eurasian watermilfoil. Learn how to prevent these aquatic invasive species from spreading to other lakes.

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in the field

NOTES ON MICHIGAN SEA GRANT-FUNDED RESEARCH

By Lynn Vaccaro

Michigan Sea Grant recently awarded a total of $409,417 to researchers from universities around the state. These new projects are focusing on wind power, regional economics along Lake Huron, and restoring natural river flow in the Clinton River watershed. The research projects began this year and will be funded until 2012.

"We are excited to support these projects that will assist state agencies, communities and others in making challenging decisions," said Jim Diana, Michigan Sea Grant Director. "These efforts will have a positive economic impact on Michigan's coastal areas." Here's a snapshot of the 2009-2012 projects:

HELPING COASTAL COMMUNITIES EVALUATE WIND DEVELOPMENT OPTIONS

Principal Investigator: Dr. Soji Adelaja, Professor and Director of the Land Policy Institute (LPI) at Michigan State University; Outreach Coordinator: David Bidwell, bidwell2@msu.edu

Michigan is recognized as a state with strong wind energy potential and coastal communities are likely to face pressure to develop wind farms. The Integrated Assessment project aims to help community leaders in coastal regions understand the possible benefits and consequences of wind energy development for their communities, businesses and environment. Researchers will work closely with stakeholders in three regions of Michigan: the Essexville area, the Rogers City area, and the Upper Peninsula, including Keweenaw, Houghton, Marquette and Baraga counties. Project goal: To build expertise among Michigan residents, decision-makers and other wind energy stakeholders in order to make informed decisions for coastal communities.

IDENTIFYING WAYS TO RESTORE THE CLINTON RIVER WATERSHED

Principal Investigator: Donald D. Carpenter, Associate Professor of Civil Engineering and Director of Hydraulics and Hydrology Laboratory at Lawrence Technological University; Outreach Coordinator: Sanjiv Sinha, ssinha@ectinc.com

The 80-mile long Clinton River in Southeast Michigan flows through heavily urbanized parts of southern Oakland and Macomb counties, eventually draining into Lake St. Clair. Although water quality in the Clinton River has improved over the last 30 years, the river still faces a number of environmental challenges, including extreme fluctuation of water flow and poor coordination among the 21 dammed lakes. Researchers will work with stakeholders to evaluate the impact of potential river regulation policies on: water quality, fish and wildlife habitat, recreational opportunities in and along the river, flood control, property values and insurance costs, taxes and income, and the effect on lakes downstream. Project goal: To promote a more comprehensive, holistic approach to water level management along the river.

EVALUATING POTENTIAL WIND POWER CONFLICTS IN WESTERN MICHIGAN

Principal Investigator: Erik Nordman, Assistant Professor of Natural Resources Management at Grand Valley State University; nordmane@gvsu.edu

Although the possibility of harnessing wind energy has received a lot of attention recently, wind farm development might present challenges for tourism-dependent lakeshore communities. Wind farms may interfere with other uses of the coast, like recreation, commercial fishing and nature preservation, and not all towns are prepared to manage these conflicts. Researchers will work with stakeholders to explore the potential environmental, social and economic conflicts with locating wind power facilities in coastal areas of Muskegon, Ottawa, and Allegan counties. Project goal: To give communities information and tools that will help to avoid conflicts over wind energy development.

HELPING THE THUMB AREA RESPOND TO A CHANGING ENVIRONMENT AND ECONOMY

Principal Investigator: Christine Vogt, Associate Professor of Tourism Studies at Michigan State University; Outreach Coordinator: Mary Bohling, bohling@msu.edu

The declining recreational Chinook Salmon fishery in Lake Huron has hurt the economies of communities in the Michigan Thumb Area – a part of Michigan's east coast from Tuscola County to Port Huron in St. Clair County. Historically, individual port towns and coastal businesses in the Thumb Area have worked in isolation, but a regional assessment could help communities work collaboratively to adapt to economic and ecological changes. Project goal: To inventory existing cultural and ecological resources and identify sustainable economic development opportunities.

Interested in participating in upcoming project meetings? Contact the research team using the email provided for more information.

SUPPORTING RESEARCH

Policy-relevant environmental research is central to the mission of Michigan Sea Grant, which has provided $34 million in research grants since the program began in 1969.

WHAT IS INTEGRATED ASSESSMENT, ANYWAY?

Michigan Sea Grant and the Graham Environmental Sustainability Institute produced a guide to Integrated Assessment, a unique research approach. *Solving Wicked Problems through Integrated Assessment: A Guide for Decision Makers, Project Leaders and Scientists.*

INTEGRATED ASSESSMENT IN ACTION

Researchers and specialists recently published the *Northeast Michigan Integrated Assessment Final Report*. The report provides an assessment of the socioeconomic characteristics, cultural assets, ecological resources, and other issues related to the Northeast portion of Michigan. It also acts as a case study on Integrated Assessment methods and demonstrates how a project is carried out.

See Reports: www.miseagrant.umich.edu/research/projects/nemia

ILLUSTRATION: MARSEE/BRENNER/ILCO

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Finnell agreed that education is key to preventing new introductions and that the Great Lakes will likely see more educational initiatives in the next few years.

"We have made some major strides forward through regional collaborations; however, we continue to face some serious threats such as the close proximity of Asian Carp in the Chicago Sanitary and Ship Canal," she said. "We are in the stages of mass education on all fronts about the importance of this issue to the Great Lakes and the region's economy and now have some new inspiration through President Obama's proposed Great Lakes Restoration Initiative which will provide significant new funding to address aquatic invasive species in the Great Lakes."

INVADERS MOVING WEST

Within the last five years, some of the invasive species the Great Lakes have been dealing with for decades have made their way cross-country.

Zebra and quagga mussels, for example, have recently been confirmed in 26 states including places as far west as Utah, Nevada, Colorado, Texas and California. The introduction of the mussels is predicted to have far-reaching effects, with authorities worried about the impact the mollusks can have on structures like the Hoover Dam and the California aqueduct systems.

"I remember when the *San Francisco Chronicle* published a letter to the editor in which the writer wondered how important it was to conduct research on the 'zebra's muscles,'" said Swinehart. "Unfortunately, people in California are not laughing anymore."

As other states try to figure out how to deal with the invaders, they turn to the Great Lakes for advice. Within the past six months, Michigan Sea Grant has received many requests to use images from the invasive species photo library from western states and even other countries.

One such request came from Leslie McGaha, Conservation Director for the South East Texas Bass Federation Nation in Spring, Texas. In August, the Texas Parks and Wildlife Department confirmed the presence of zebra mussels in several lakes in the state, north of Dallas – and warned of a possible likely spread to two linked watersheds. The infestation in the western states is thought to have come from boats that had been in Great Lakes waters.

McGaha said she has been aware of encroaching invasive species for awhile and worked to help fight against the invasive plant giant salvinia, an aquatic fern that reproduces rapidly, shutting down once-prolific Bass fishing spots and modifying the aquatic ecosystem.

McGaha said part of her mission is to let people know—particularly anglers and boaters—that they can play a role in averting invasive takeovers.

INVASIVE SPECIES FACTS

- As of 2007, more than 180 nonindigenous species have been reported to have reproducing populations in the Great Lakes basin, (e.g., lakes Superior, Michigan, Huron, St. Clair, Erie, Ontario), and their connecting channels and water bodies within their respective drainages.
- The two most recent invasive species reported and verified established in the Great Lakes basin are viral hemorrhagic septicemia (VHS), and *Hemimysis anomala*.
- It is likely that there have been invasions by other species that have not yet been detected.
- Species native to one part of the basin (e.g., Lake Ontario) may be considered invasive to other portions of the basin.

To see a list of non-native species and when each was introduced into the Great Lakes: www.glerl.noaa.gov/res/Programs/ncrais

Source: Great Lakes Aquatic Nonindigenous Species Information System

CONTINUED FROM PAGE 14

"We are the ones who are going to have the most impact when it comes to preventing the spread—or unfortunately the opposite of that too—contributing to spread."

Bass fishing in Texas is big money, said McGaha, so when invaders move in, it has more than just an effect on access to the water. Like in Michigan, towns with economies built on the industry start to suffer.

"We are just really hoping to get stakeholders mobilized, to talk about this problem, to properly address it and to learn from your experiences there in the Great Lakes. The big question is, how do we protect our resources now that we have this monster here?"

Finnell said strengthening partnerships—from the local populace to the federal government—has and will continue to be critical.

"Through these combined efforts, we will continue to move forward to protect a resource so many of us cherish," she said.

FIRST ENCOUNTERS OF AN INVASIVE KIND

CONTINUED FROM PAGE 3

STEVE STEWART,
Southeast Extension Educator

Encounter: Learning intentional vs. invasive.
Details: My first "alien encounter" in the Great Lakes may well have been in the late 1970's, when Chuck Pistis (Extension Program Leader) and I took the Badger over to Wisconsin to visit, and fish with a buddy from grad school. First time I had been salmon fishing, and that's when I learned the story about how and why the salmonids had been stocked in the lakes. Given the success of our charter trip, I became an instant fan of intentionally introduced species. Unfortunately, I subsequently learned about all of the unintentionally introduced species that can be devastating to the Great Lakes ecosystems as well.

Note: Coho and Chinook Salmon were initially introduced to the Great Lakes in the 1870s but didn't survive. They were again introduced in the 1960s to boost the sport fishing industry and to help curb the overabundance of the Alewife, an invasive forage fish that entered the Great Lakes in the 1950s, following completion of the Welland Canal.

TODD MARSEE,
Senior Graphic Designer

Encounter: An unintentional garden guest.
Details: My first up close and personal experience came when friends went out of the country, and I was watching their house, watering the garden, etc. When I was watering, I came across purple loosestrife. I was surprised to see it in their garden – but then remembered that is how it got here, as a flower that was once popular to plant. But also one that gets out of control, spreading to the wild easily. I was about to pull it out but thought I'd better wait since it wasn't my garden. I left them a note to call me when they got home because I noticed an invasive plant in their garden. Luckily they were happy to pull it out, as it had always been there when they bought the house. I was glad to be able to spread the word.

CAROL SWINEHART,
Extension Communication and AIS Specialist

Encounter: Gluey substances and exploding bottles of zebra mussels.
Details: My memory is a little cloudy on when I first encountered invasive species in the Great Lakes context. I grew up in the South hearing about kudzu vine, and certainly was aware of Sea Lamprey from my earliest days in Sea Grant (25 years ago), if not sooner. However, I can offer a couple vignettes about my experiences with invasive species:

- I got a phone call one day in the early 90's from someone asking about a "gritty sort of gluey" substance attached to the hull of their tugboat in Lake Michigan. I referred them to their nearest Sea Grant Extension educator Chuck Pistis as I recall – and didn't realize until months later that the substance was very likely zebra mussel veligers settling in to develop their shells.
- I also vividly remember when Sea Grant Extension conducted a program about zebra mussels for marina owners and managers. One of our DNR colleagues brought samples in bottles to distribute to participants. Within a few weeks, we learned that they weren't properly preserved because the bottles exploded in various offices...including the Sea Grant office at UM and an Extension staff member's office at MSU.

NIKKI KOEHLER, Education Specialist

Encounter: Up close with writhing Lampreys.
Details: I know it wasn't the first time I was aware of invasive species or more specifically Sea Lampreys, but it's certainly the most memorable. As part of the COSEE Lake Huron Exploration workshop for teachers, we visited Roger Bergstedt at the USGS Hammond Bay Biological Station in Millersburg, Mich. Roger conducts Sea Lamprey research and develops management techniques. In addition to learning about the ecology of Sea Lamprey, we had the opportunity to get up close and personal, handling the Lamprey. My ah-ha moment was when I learned that Sea Lamprey are now considered the top predator in the Great Lakes.

Editor's note: This was very similar to one of my first up close and personal invasive moments. I attended the Knight Center Great Lakes Environmental Journalism Training Institute one year and the group toured the Hammond Bay Station. Roger surprised us all when he stuck the toothy maw of a Lamprey dead center on his forehead, where it stayed suctioned for a good 10 seconds. When he plucked it off, he said something like: "Aw man, that's going to leave a mark..." And it did. A big one.

— *Stephanie Ariganello*

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Educators: This poster series is aligned with state and national education standards and is an extension of Fisheries Learning on the Web. See: www.projectflow.us

Find the posters and other great Sea Grant publications online at:
www.miseagrant.umich.edu/store

FEATURED WEBSITE: MICHIGAN SEA GRANT

See: www.miseagrant.umich.edu

Michigan Sea Grant has completed a total makeover of the program website. New education resources, and information about current research projects focusing on wind power, the Clinton River and Lake Huron, are just the tip of the virtual iceberg.

Four reasons you should visit the new and improved Michigan Sea Grant website:

1. **Find cool facts and lessons.** Materials include books, posters, fact sheets and downloadable photos. Sign up for a free copy of *upwellings* newsletter (published quarterly).

2. **Integrate your knowledge.** Find out what Integrated Assessment is all about and review a case study from Northeast Michigan. Join our researcher mail list to receive funding announcements.

3. **Satiate curiosity.** Learn more about commercial fishing nets (e.g., trap nets); and check if your marina is a certified Michigan Clean Marina.

4. **Do your part.** Become a Coastal Steward, pledge to protect Michigan's coastal areas and Great Lakes; and review what you can do to help prevent the spread of invasive species.

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