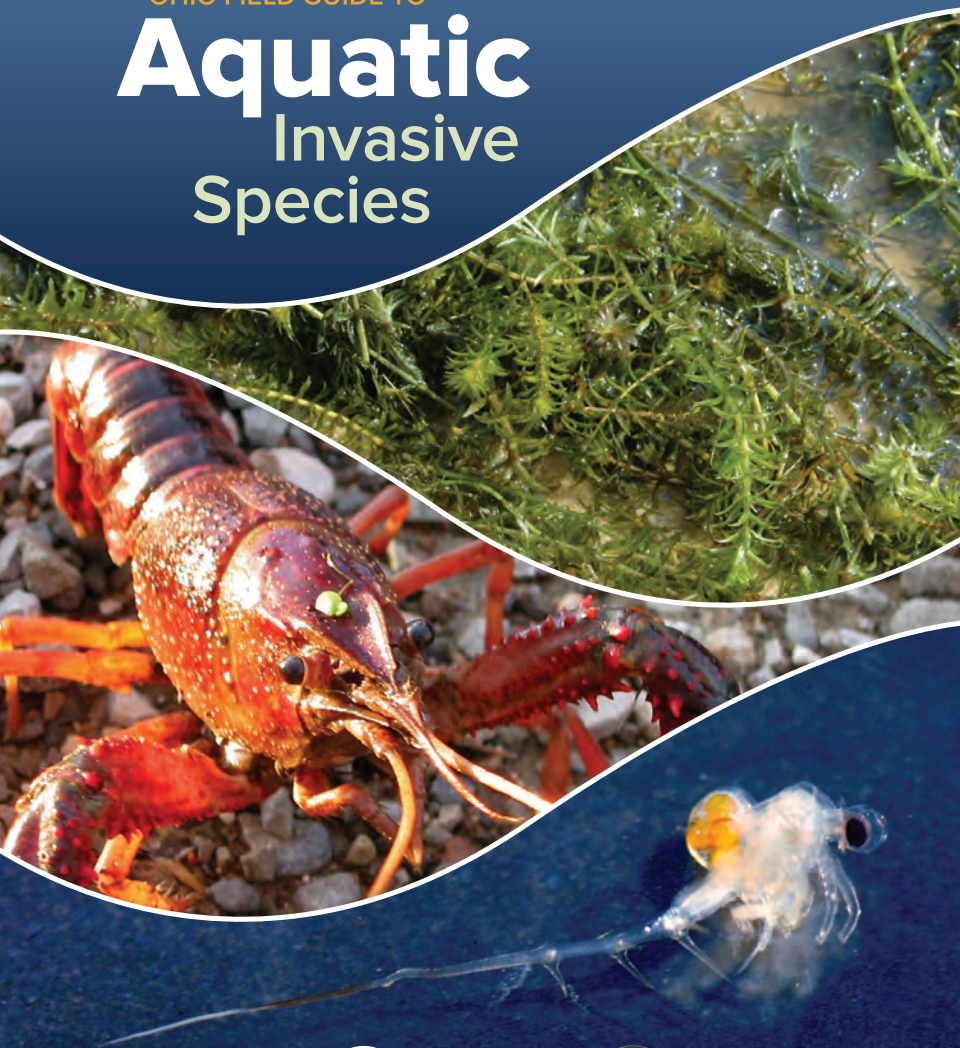
OHIO FIELD GUIDE TO

Aquatic Invasive Species



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OHIO AIS FIELD GUIDE

Table of Contents

Introduction

Preventing the introduction and spread of aquatic invasive species (AIS) is a top priority in Ohio. The state has more than 66,000 miles of streams, 262 miles of Great Lakes shoreline, and nearly 2,000 inland lakes and reservoirs, while sharing major watersheds with other states and Canada. Once invasive species become widely established, controlling their spread is both technically difficult and expensive, making eradication nearly impossible.

Global trade, human activities, recreation, and climate change are helping invasive species spread at accelerated rates. As a result, they are changing the health and natural diversity of watersheds across the state. In the Great Lakes region alone, nearly 200 non-native species from around the world have been recorded, with a continuing trend of one new non-native species introduction every six to eight months.

Identifying and preventing the introduction and spread of AIS are the keys to averting long-term ecosystem damage and ensuring the highest probability of effective control. This field guide is designed to aid natural resource professionals and other interested individuals in AIS early detection and reporting. This reference guide can help watercraft and wildlife officers, regional biologists, volunteer monitors, resource managers, educators, students, consultants, and others working in Ohio's waters. It includes general information for AIS identification, collection, verification, and reporting.

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Using the Field Guide

The purpose of this guide is to help slow or stop the spread of invasive species in Ohio. Therefore, in addition to identification, it includes sections on prevention, reporting, and collecting specimens.

The focus of the first section is prevention, since it is important that readers understand how to avoid AIS introduction and spread to new locations. It highlights significant vectors of spread for AIS and describes preventative actions that can be taken.

The second section focuses on how to report species. It is important that new infestations are reported quickly and accurately, and that specimens are collected correctly so that subsequent control or management actions can be taken. Information described in the ODNR State Management Plan for Aquatic Invasive Species, which can be found at www.ohiodnr.gov/ais/publications, is used to ensure species are collected according to recommended guidelines and reported to the appropriate jurisdictional authorities.

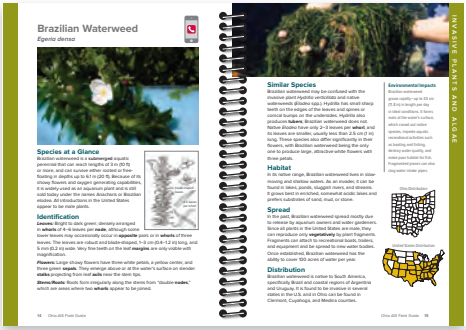
The last section contains “species profiles” that highlight important characteristics to help distinguish AIS from other species.

Species are grouped together by taxonomy, with a different color representing each:

- **Plants and Algae (green)**
- **Invertebrates (orange)**
- **Fish (purple)**

Species are ordered alphabetically by common name. Each profile contains photographs, illustrations, maps, and narrative descriptions to highlight important facts or features of that species.

Profiles follow the general format below:



Species at a Glance: Brief overview and interesting facts, including whether or not to report this specific organism

Identification: Key characteristics for identifying the species

Similar Species: Methods for distinguishing invasive species from native look-a-likes

Habitat: Description of the preferred environment

Spread: Highlights pathways and vectors in which the species can be transferred to new locations

Distribution: Native and invasive range information, including distribution in the United States and Ohio – ***Note: Distribution information was taken from the USGS Non-Indigenous Aquatic Species database and the USDA NRCS plants database and represents data from 2017. This information may not be completely accurate and may quickly go out of date. Please use additional resources to verify species locations in your area.***

Impacts: Potential or documented influence on biodiversity, the economy, or human health

Additional tips for using the guide:

- At the beginning of each taxonomic grouping is a reference section with important information for identification.
- Each reference section contains images and diagrams highlighting important anatomical structures and features of the species within that group. Reviewing these features may be helpful in identifying species.
- Definitions for words in **bolded letters** can be found in the glossary on page **155**.
- The back cover of the field guide can be used as a ruler to help measure specimens in the field.

Prevention

Preventing the arrival and spread of species into Ohio's waterways remains the number one line of defense in the battle against AIS. By taking precautionary steps, the harmful ecological, economic, and health impacts associated with AIS introduction could be prevented.

AIS can hitchhike on boats, trailers, equipment, fishing tackle, motors, clothing, diving gear, and boots, or in bait buckets, bilges, and live wells. Some species can survive out of the water on damp clothing or equipment for several days to weeks, and some are so small they are nearly impossible to detect.

The following section describes common ways that humans can spread AIS through their activities and outlines the prevention measures that can be taken to reduce AIS spread.

Boating and angling

Boats, boat trailers, fishing equipment, waders, and other gear that comes in contact with water can transport AIS from one waterbody to another. Microscopic AIS, such as zebra mussel **veligers** or didymo cells, may be lurking in bait buckets, live wells, or bilges, waiting to be discarded into a new area. Plants tangled around boat motors and trailers can be released into new environments, transforming valuable fishing and boating areas into mangled mats of weeds. Some species may even harm boats and equipment, jam steering components, and ruin boat engines.

Follow these guidelines to protect Ohio waterways:

- Clean off visible aquatic plants, animals, and mud from watercraft, motor, trailer, and all equipment including waders, footwear, ropes, anchors, bait traps, dip nets, downrigger cables, fishing lines, and field gear before leaving water access.
- Scrub hull and footwear using a stiff brush.
- Rinse equipment and boat hulls (with high pressure, hot water when possible)
- Rinse interior compartments of boats with low pressure, hot water (120°F)
- Flush motor with hot water (120°F) for 2 minutes (or according to owner's manual)
- Drain watercraft, motor, bilge, bladder tanks, livewell, portable bait containers, and other water-containing devices before leaving water access.
- Dry everything for at least five days or wipe with a towel before reuse.

For anglers, the additional step of dispose is recommended:

- Dispose of unwanted bait, worms, fish parts, and packing materials in the trash; do not dump them in the water or on land. When keeping live bait, drain bait container and replace with spring or dechlorinated tap water.

Other key actions:

- Use non-felt soled boots to further reduce the risk of spreading AIS.
- Fish caught for eating or taxidermy should be cleaned at designated fish cleaning stations or placed on ice.
- Never dump live fish or other organisms from one water body into another.

Diving and swimming

- Clean off visible plants, animals and mud from wetsuit, dry suit, mask, snorkel, fins, buoyancy compensator (BC), regulator, cylinder, weight belt, watercraft, motor, and trailer before leaving water access.
- Soak gear used in saltwater dives in 5% dishwashing liquid solution (1 cup/gallon), or gear used in freshwater dives in 3.5% salt solution, (½ cup/gallon) for 30 minutes.
- Rinse inside and outside of gear with hot water, when possible.
- Drain water from BC, regulator, cylinder boot, watercraft, motor, and any water-containing devices before leaving water access.
- Dry everything five days or more, unless otherwise required by local or state laws, when moving between waters to kill small species not easily seen, or wipe with a towel before reuse.

Aquarium and water garden animals and plants

Never release unwanted pets or aquarium plants into the environment. If a pet or plant is no longer wanted, or can no longer be cared for, choose from one of the following alternatives:

- Contact a local retailer for proper handling advice or for possible returns.
- Give/trade with another aquarist, pond owner, or water gardener.
- Donate to a local aquarium society, school, or aquatic business.
- Seal aquatic plants in plastic bags and dispose in trash.
- Contact a local pet store, humane society, veterinarian, or other expert for guidance on appropriate and humane disposal options.

In addition, never dump live plants and/or aquatic animals into storm drains. Storm drains lead to rivers, lakes, or wetlands, which are all integral components of larger watersheds.

For more information, visit www.habitattitude.net.

Researchers, managers, volunteer monitors and those working in Ohio's waterways and wetlands

To reduce potential AIS spread, field workers should take the following precautionary measures during activities such as monitoring, collecting, surveying, and fish stocking:

- Inspect and remove aquatic plants, animals, seeds, and mud from boat, trailer, anchors, waders, boots, nets, and all equipment, paying particular attention to cracks and crevices.
- Drain lake or river water from motor or jet drive, bilge, live well, tubs, tanks, and sampling equipment before leaving water access.
- Dispose of unwanted plants, fish, worms, crayfish, snails, clams, and other organisms in the trash.
- Wash boat, motor, trailer, personal gear (waders, boots, scuba gear, etc.), and field sampling equipment (nets, bottles, ropes, tubs, etc.) with high pressure, hot tap water (120°F), OR
- Dry boat, motor, and trailer in the sun for at least five days and equipment for at least 10 days, or freeze for at least two days before reuse.

Visit www.stopaquatichitchhikers.org for more information on AIS prevention.

Reporting and Collecting

REPORTING A SIGHTING

It is paramount that AIS that currently have a limited range or are not yet present in the state are reported accurately and immediately. For these species you will see this phone indicator:

However, some AIS are already established throughout the state and reporting their presence is not necessary. For these species the indicator will be absent.

Take the following steps to ensure proper early detection and response for potential new AIS discoveries:

Carry documentation tools to accurately document your finding in the field:

- Digital camera
- A way to identify the latitude/longitude, such as a map of the area or GPS unit
- Notebook and pen for taking notes
- The Ohio AIS Field Guide for assistance in species identification
- Smart-phone identification apps such as the Great Lakes Early Detection Network app (www.go.osu.edu/GLEDN)

Gather and document information accurately:

- Note the exact location of the discovery, including latitude and longitude, if possible.
- Make notes about the location, habitat, and environmental conditions of the discovery site.
- Take note of species size and the extent of the area it covers.
- Write down a detailed description of unknown specimen(s).
- Take digital photographs of the unknown specimen(s), as well as the immediate environment. Include key landmarks to assist in finding the site.
- Include commonly known items (coins, eyeglasses, or a camera lens cover, etc.) in the photo for a size comparison.
- Use this field guide to help identify the species.

Verify identification and submit report:

- Fill out as much information as possible in the Ohio Department of Natural Resources Division of Wildlife AIS Reporting Form: www.ohiodnr.gov/reportais
- For more information and additional guidance on reporting new AIS infestations in Ohio, refer to the ODNR State Management Plan for Aquatic Invasive Species found at www.ohiodnr.gov/ais/publications.

COLLECTING A SPECIMEN*

Only collect a specimen if it is requested by the agency with authority over the AIS in question. When a sample specimen is needed to assist in identification, it is important to **keep the specimen secure to avoid spreading the collected species, or any organisms that might be attached to it.** Please keep a record with the specimen of the location and date that it was collected. Beware that animal specimens may carry disease organisms. Use appropriate prophylactic measures (gloves, handling with forceps, etc.).

** Please note: It is currently illegal to possess or transport certain aquatic invasive species in Ohio. Please review Ohio's Injurious Aquatic Invasive Species List before handling or transporting (www.ohiodnr.gov/invasive-species/aquatic-invasives/injurious-aquatic-invasive-species). The Ohio Department of Agriculture has implemented an invasive plant rule. It is now illegal to "sell, offer for sale, propagate, distribute, import or intentionally cause the dissemination" of any plant species listed under section 901:5.30.01 of the Ohio Administrative Code (codes.ohio.gov/oac/901:5-30).*

Collecting specimens:

Aquatic and terrestrial plants:

- Specimens should include the stem with intact leaves, and if available, intact flowers and/or **fruits** and roots.
- Be very careful when collecting a plant specimen, as **fragmentation** could result in spreading the plant to other areas.
- Wash the plant in clean water to remove all debris; do not allow the plant to dry out, and keep cool if possible.
- Use care when handling, as some plants may cause skin irritation and other ailments.

Invertebrates (shellfish, worms, or insects):

- Store specimens in a closed vial or jar with enough rubbing alcohol to keep the tissues moist.

Vertebrates (fish):

- Seal securely in double plastic bags and freeze.

Mailing specimens:

When an outside source is needed for identification, refer to the following guidelines for mailing:

Plants:

- Place the plant in a water-tight plastic bag (such as a Ziploc bag) with enough water to cushion the plant and keep it wet.
- Place the tightly sealed bag in a small box with newspaper packing. Padded envelopes do not work well.

Invertebrates:

- Package the specimen securely in a small box with plenty of packing materials to ensure the jars are not broken.

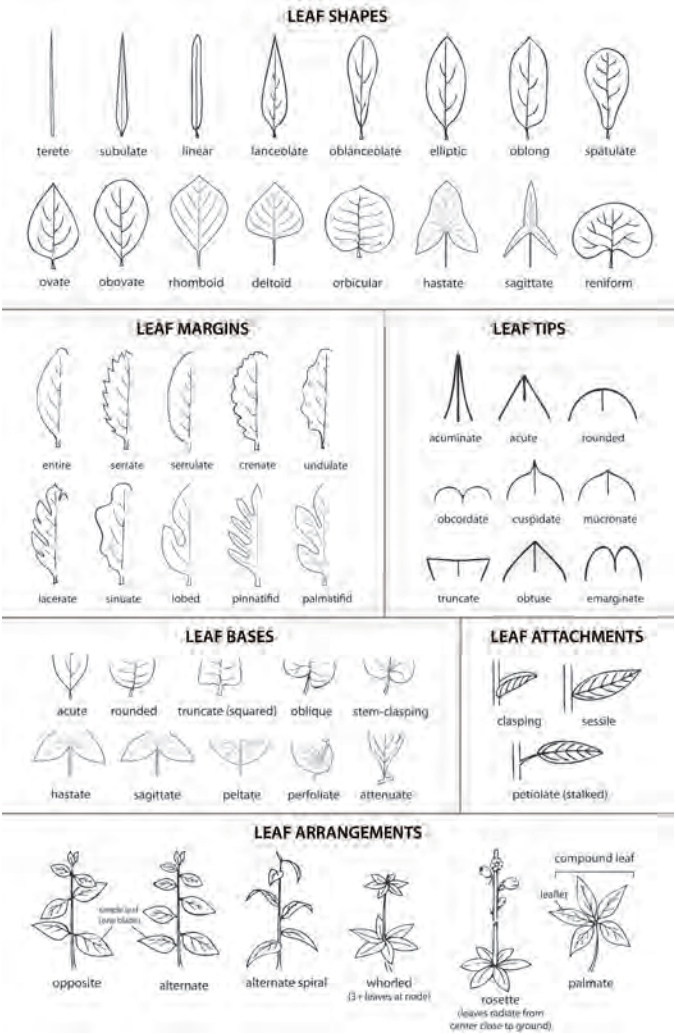
Vertebrates:

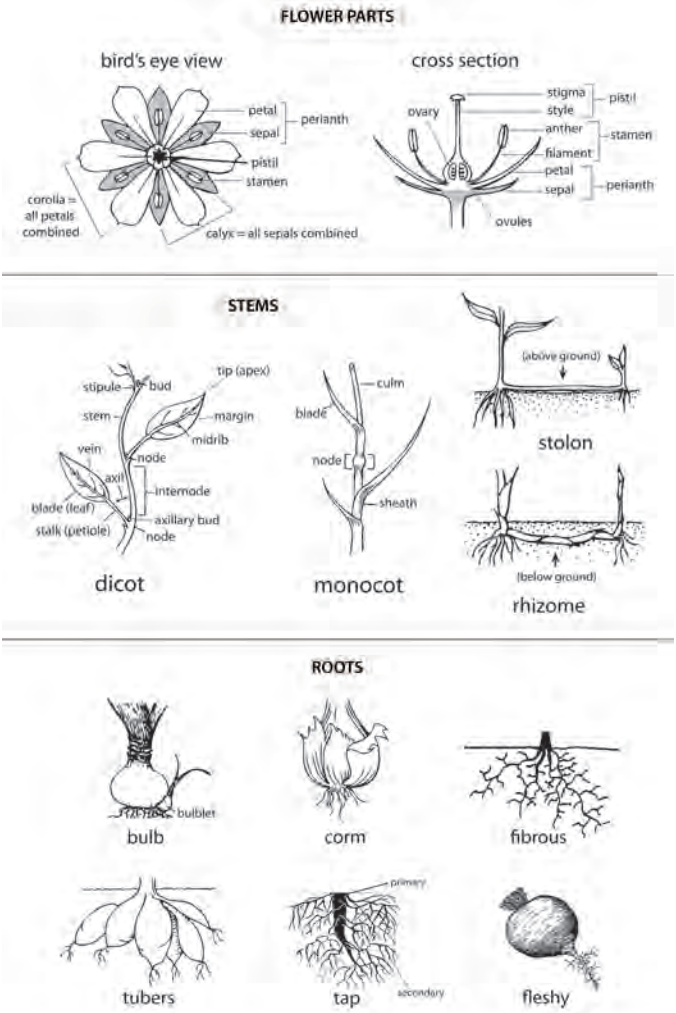
- The United States Postal Service has specific standards and requirements regarding the shipment of hazardous materials such as formalin and dry ice. If shipment to a taxonomic expert is necessary for identification, work with the recipient and the postal service to determine the best and safest method for shipping the specimen.

BE SURE TO PROVIDE CONTACT INFORMATION

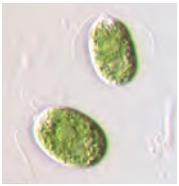
Always include a copy of your name, address, E-mail address, telephone number, and a copy of the notes you made when collecting the specimen in the mailed package.

Plant Structure



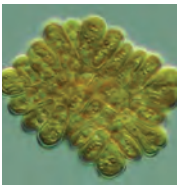

FLOWER PARTS
bird's eye view
petal
sepal
perianth
pistil
stamen
corolla = all petals combined
calyx = all sepals combined
cross section
stigma
style
pistil
ovary
anther
filament
stamen
petal
sepal
perianth
ovules
STEMS
tip (apex)
stipule
bud
stem
margin
midrib
vein
node
axil
internode
blade (leaf)
axillary bud
stalk (petiole)
node
dicot
culm
blade
node
sheath
monocot
(above ground)
stolon
(below ground)
rhizome
ROOTS
bulblet
bulb
corm
fibrous
tubers
primary
tap
secondary
fleshy

Algae Group Descriptions



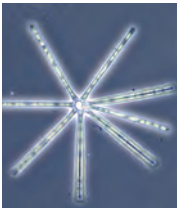
Green algae (Chlorophyta): This large and diverse group of algae can range from small, single-celled organisms to large, multi-cellular organisms and colonies. They are considered the closest ancestors to the land plants because they share common features, including the photosynthetic pigments chlorophyll a, chlorophyll b, beta carotene, and cellulose-rich cell walls. They are also the only algal group to produce starch for food stores.

Blue-green algae (Cyanobacteria): Notorious for forming blooms (some of which are toxic), these organisms are not really algae, but rather aquatic bacteria that obtain their energy through photosynthesis. Like other bacteria, the cells are prokaryotic and therefore lack nuclei, **chloroplasts**, mitochondria, and **flagella**. Cyanobacteria may be single-celled or colonial, with colonies forming filaments, sheets, or even hollow balls.

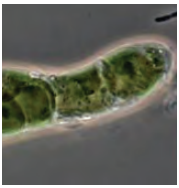


Golden-brown algae (Chrysophyta): Mostly abundant in freshwater, this large group of algae is typically found in waters with a neutral or slightly acidic pH, low conductivity and nutrient levels, and colder temperatures. They are particularly important in lakes, where they may be a primary source of food for zooplankton. In many species, the cell walls are composed of cellulose with large quantities of silica, similar to the diatoms.

Dinoflagellates: These typically unicellular flagellates have armored cell walls made of thick plates that fit tightly together to form a continuous covering for the cell. Half the dinoflagellates are colorless predators that consume their food. The other, pigmented half are usually a golden brown in color. Out of the several thousand species of dinoflagellates, only a couple hundred are found in freshwater habitats.



Diatoms: These single-celled organisms are characterized by beautiful and intricate shapes. Most diatoms exist singly, although some join to form colonies. Diatoms can be fresh or salt-water and appear in the greatest abundance early in the year in the phenomenon called the “spring bloom,” when both light and nutrients are highly available. The cell walls are made up of silica, which persists in the environment after the cells have died, creating an extensive fossil record.



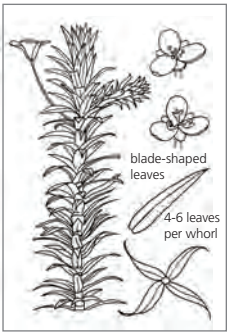
Euglenoids: This small phylum consists of mostly freshwater, unicellular aquatic algae. Some euglenoids contain **chloroplasts** with photosynthetic pigments, and others are heterotrophic, meaning they can ingest or absorb their food. The most characteristic genus is *Euglena*, common in ponds and pools, especially when the water has been polluted by runoff from fields or fertilized lawns.

Brazilian Waterweed

Egeria densa

Species at a Glance

Brazilian waterweed is a **submerged** aquatic perennial that can reach lengths of 3 m (10 ft) or more, and can survive either rooted or free-floating in depths up to 6.1 m (20 ft). Because of its showy flowers and oxygen generating capabilities, it is widely used as an aquarium plant and is still sold today under the names Anacharis or Brazilian elodea. All introductions in the United States appear to be male plants.



Identification

Leaves: Bright to dark green; densely arranged in **whorls** of 4–6 leaves per **node**, although some lower leaves may occasionally occur in **opposite** pairs or in **whorls** of three leaves. The leaves are robust and blade-shaped, 1–3 cm (0.4–1.2 in) long, and 5 mm (0.2 in) wide. Very fine teeth on the leaf **margins** are only visible with magnification.

Flowers: Large showy flowers have three white petals, a yellow center, and three green **sepals**. They emerge above or at the water's surface on slender **stalks** projecting from leaf **axils** near the stem tips.

Stems/Roots: Roots form irregularly along the stems from "double **nodes**," which are areas where two **whorls** appear to be joined.

Similar Species

Brazilian waterweed may be confused with the invasive plant *Hydrilla verticillata* and native waterweeds (*Elodea* spp.). *Hydrilla* has small sharp teeth on the edges of the leaves and spines or conical bumps on the undersides. *Hydrilla* also produces **tubers**; Brazilian waterweed does not. Native *Elodea* have only 2–3 leaves per **whorl**, and its leaves are smaller, usually less than 2.5 cm (1 in) long. These species also differ significantly in their flowers, with Brazilian waterweed being the only one to produce large, attractive white flowers with three petals.

Habitat

In its native range, Brazilian waterweed lives in slow-moving and shallow waters. As an invader, it can be found in lakes, ponds, sluggish rivers, and streams. It grows best in enriched, somewhat acidic lakes and prefers substrates of sand, mud, or stone.

Spread

In the past, Brazilian waterweed spread mostly due to release by aquarium owners and water gardeners. Since all plants in the United States are male, they can reproduce only **vegetatively** by plant fragments. Fragments can attach to recreational boats, trailers, and equipment and be spread to new water bodies. Once established, Brazilian waterweed has the ability to cover 100 acres of water per year.

Distribution

Brazilian waterweed is native to South America, specifically Brazil and coastal regions of Argentina and Uruguay. It is found to be invasive in several states in the U.S. and in Ohio can be found in Clermont, Cuyahoga, and Medina counties.

Environmental Impacts

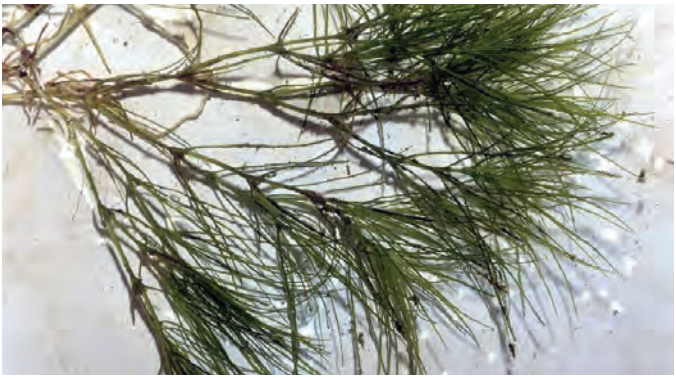
Brazilian waterweed grows rapidly—up to 30 cm (11.8 in) in length per day in ideal conditions. It forms mats at the water's surface, which crowd out native species, impede aquatic recreational activities such as boating and fishing, destroy water quality, and make poor habitat for fish. Fragmented pieces can also clog water intake pipes.

Ohio Distribution

United States Distribution

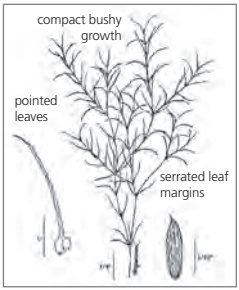
Brittle Naiad

Najas minor



Species at a Glance

Brittle naiad, also called brittle waternymph, is a **submerged** aquatic herb native to Europe and Asia. It gets its name from its fragile stems that can easily break into small pieces and cling to boats, equipment, and waterfowl and be moved to new locations.



Identification

Leaves: Dark green leaves are pointed, **oppositely**-paired, and become stiff and recurved as they age. Growth appears compact and bushy. The leaves measure about 1 mm (0.04 in) wide and 0.5–3.5 cm (0.2–1.25 in) long. The leaf **margins** are **serrated** with 7–15 small but conspicuous teeth along each side. The base is **truncate** or lobed with fine teeth on the upper **margin**.

Flowers: Small, inconspicuous flowers grow in the leaf **axils** in late spring and early summer.

Fruit/Seeds: Single-seeded **fruits** mature throughout summer and late fall. They are 1.5–3.0 mm (0.06–0.1 in) long and are slightly curved with rectangular-shaped **areolae** arranged in longitudinal rows.

Stems/Roots: Slender stems may reach up to 2.5 m (8 ft) long and are profusely branched near the **apex**.

Similar Species

Brittle naiad is difficult to differentiate from our native naiads (*Najas* spp.). The leaves of brittle naiad are somewhat stiff, with tips often curved

downward and bases more sharply lobed than most of our native species. Slender naiad (*N. gracillima*) has more finely **serrate** leaf margins when viewed under magnification. Brittle naiad may also be confused with coontail (*Ceratophyllum* spp.) and muskgrass (*Chara* spp.). It can be distinguished from coontail by its **oppositely**-paired, unbranched, strap-like leaves. Coontail occurs in **whorls** of 4–5 which are forked at the tips. It can be distinguished from muskgrass by breaking the stems; brittle naiad stems will remain swollen.

Habitat

This species prefers calm waters such as ponds, lakes, and reservoirs but may also be found in streams and rivers. It can occur at depths of up to 5 m (16 ft) and tolerate water temperatures over 8°C (46°F). Because it is tolerant of degraded habitats, brittle naiad may have a competitive advantage over many native species.

Spread

Brittle naiad spreads both by seeds and **fragmentation**. Fragments can cling to boats, trailers, fishing gear, other recreational equipment, and waterfowl and can be spread to new locations. It is also a preferred food source for waterfowl, which consume the seeds and excrete them unharmed in new locations.

Distribution

Brittle naiad is native to North Africa, Japan, Turkey, India and central and eastern Europe. It was first reported in the United States in the Hudson River in 1934, and it may have been intentionally introduced into Cayuga Lake, New York in 1935; although, the reason for introduction is unknown. The Ohio distribution map is likely incomplete as it can be found throughout the state.

Environmental Impacts

Brittle naiad forms thick **monotypic** mats that can shade out other native plant species and reduce the recreational and aesthetic value of lakes, ponds, and rivers. It has even been known to outcompete other harmful invasive plants like *Hydrilla*.

Ohio Distribution

United States Distribution

Common Reed (Phragmites)

Phragmites australis

Species at a Glance

Phragmites is a long-lived perennial grass that can grow 1.8–4.6 m (6–15 ft) high in stands that exclude almost all other vegetation. While *Phragmites* is native to North America, the introduction of a non-native strain from Europe rapidly and aggressively expanded throughout the United States, replacing much of the native reed.

Identification

Leaves: Broad, pointed, elongate and typically 20–60 cm (7.9–24 in) long and 1–5 cm (0.4–2 in) at their widest point. Leaves arise from thick vertical **stalks**. Foliage is gray-green during the growing season.

Flowers: Bushy clusters called **panicles** grow 15–40 cm (5.9–16 in) long in late July and August and are usually purple or golden in color. As seeds mature, the **panicles** begin to look "fluffy" due to hairs on the seeds, and they take on a gray sheen.

Stems/Roots: Rigid stems that feel rough to the touch often reach 4.6 m (15 ft) in height next to dead stems from previous growth. Below ground, phragmites forms a dense network of roots several meters in depth and includes **rhizome runners**, which can grow 3 m (10 ft) or more in a single season.

Similar Species

Both the native (*Phragmites australis* subsp. *americanus*) and invasive strains of *Phragmites* may be present in Ohio. Typically the native strain is lighter in color, has a more delicate stem that can be a reddish color near the base, and sheds its leaf **sheaths** easily compared to the invasive. However, these characters may not be definitive in the field, so it is best to consult an expert.

Reed canary grass (*Phalaris arundinacea*) has a similar appearance to phragmites but is much smaller and has a membranous **ligule**. Giant reed (*Arundo donax*) also has a similar appearance and habitat but has a hairy **lemma** and a hairless **spikelet stalk**.

Habitat

Phragmites is abundant along the borders of lakes, ponds, and rivers, in tidal and non-tidal, brackish, and freshwater marsh communities, wet meadows and praries, fens, roadsides, and disturbed areas. It does not tolerate rapidly moving water.

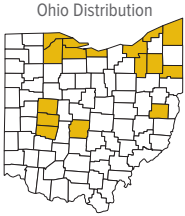
Spread

Spread occurs mainly through vegetative means such as **rhizome** and **stolon** fragments. **Rhizomes** can break off and be washed downstream, becoming established in new areas. Phragmites also produces an abundance of wind-dispersed seeds, although seed viability is typically low. Heavy machinery may transport phragmites along roadsides between sites.

Environmental Impacts

Dense stands of invasive phragmites can crowd out native plant species, alter marsh hydrology, alter wildlife habitat, and increase fire potential. It blocks light to other plants and emits an **allelopathic** toxin that allows it to outcompete native species, quickly turning once biologically diverse wetlands into monocultures.

Ohio Distribution



United States Distribution

Distribution

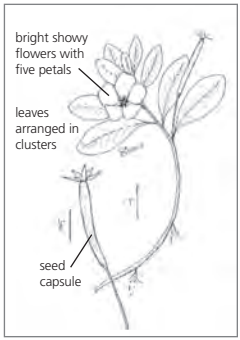
Invasive strains of phragmites, which were introduced in the late 1800s, are now widespread throughout the lower 48 states and southern Canada. The Ohio distribution map is likely incomplete, as it can be found in multiple counties throughout the state, particularly those along Lake Erie.

Creeping Water-primrose

Ludwigia peploides

Species at a Glance

Creeping water-primrose, also called floating primrose-willow, is an herbaceous, perennial, wetland plant whose sprawling stems usually grow flat along mud or a water surface. Although native to parts of North America, this species has become invasive outside of its native range, including Washington State where it is listed as a Class A noxious weed because of its ability to form dense floating mats that can displace native aquatic plants and wetland grasses.



Identification

Leaves: **Alternately** arranged leaves are clustered together and vary in size and shape from long and slender to round or egg shape. They are up to 9 cm (3.5 in) long. Leaf bases taper to a **stalk** that ranges from 2.5–4 cm (1–1.5 in) long. The leaves have smooth **margins** and are either hairless or have long, soft hairs. The leaves are dark green with light green **pinnate** veins.

Flowers: Showy flowers have five bright yellow petals that are 1–1.5 cm (0.4–0.6 in) long and bloom late July to August. The flowers occur on long **stalks** arising from the leaf **axils**.

Fruit/Seeds: Capsules contain many small (1 mm) seeds.

Stems/Roots: Flowering stems are either floating or lying on the ground. Sprawling stems, which can reach a length of 2.7 m (9 ft), are fleshy, reddish in color, and either hairless or slightly hairy.

Similar Species

Similar species include the marsh seedbox (*Ludwigia palustris*), which has flowers without petals; true forget-me-not (*Myosotis scorpiodes*), which has blue flowers and a distinct **mid-rib** with less apparent branching veins; and water smartweed (*Polygonum amphibium*), which has similar floating leaves to water-primrose, but the flowers are thick **spikes** of bright pink flowers.

Habitat

This species grows along freshwater shorelines and sprawls across the water's surface. It typically inhabits still or slow-flowing freshwater habitats including the margins of wetlands, lakes, ponds, ditches, and streams in depths of up to 3 m (10 ft). It is very adaptable and can grow under a variety of nutrient, water quality, and substrate conditions. Its roots are able to absorb atmospheric oxygen, allowing it to survive in low oxygen waters, grow up on land, and tolerate dry periods.

Spread

While it produces viable seeds, creeping water-primrose spreads mostly through **fragmentation**. Small pieces of stem can be spread to new areas by wind, water flow, or animals where it grows roots and develops into new plants.

Distribution

Creeping water-primrose is native to South America, Central America, parts of the United States, and possibly Australia. In the United States, it is generally considered invasive in the Great Lakes region. There are currently several records in Ohio.

Environmental Impacts

Dense floating mats of creeping water-primrose can outcompete native plants and clog waterways, increasing the risk of flooding and affecting recreation, fishing, and navigation. This species also alters the chemistry of the aquatic environment, reducing dissolved oxygen levels by shading out **submerged** plants, impacting pH, phosphate, and nitrate levels, and making the habitat unsuitable for some native species.

Ohio Distribution

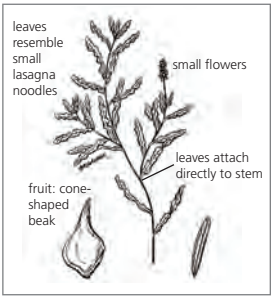
United States Distribution

Curly-leaf Pondweed

Potamogeton crispus

Species at a Glance

Curly-leaf pondweed is an invasive aquatic perennial that can grow off-shore in depths of up to 4.6 m (15 ft). It has a unique ability to form new plants under the ice in winter, making it one of the first nuisance plants to emerge in the spring.



Identification

Leaves: **Submerged**, oblong, slightly translucent, olive-green to reddish-brown leaves have rounded tips, narrowing towards the base. They are **alternately** arranged and directly attached to the stem. They are 4–10 cm (1.6–4 in) long and 5–10 mm (0.2–0.4 in) wide, with distinct wavy and finely toothed edges that resemble lasagna noodles.

Flowers: Small and tightly arranged flowers at the end of a slender, sometimes curved **stalk** appear above the water's surface from June through September.

Fruits: Have a prominent cone-shaped beak and a bumpy crown-like ridge.

Stems: Slightly flat, reddish-brown stems grow from 0.3–0.9 m (1–3 ft) long and emerge from slender **rhizomes**, often branching as they grow, giving it a bushy appearance.

Similar Species

This species may be confused with other pondweeds, many of which have both floating and **submerged** leaves. Curly-leaf pondweed has only **submerged** leaves. Other pondweeds also lack the tiny but visible serrations along the edges of the leaves.

Habitat

Curly-leaf pondweed prefers soft substrates and shallow water depths in alkaline and high nutrient waters. It tolerates still or flowing water and is able to survive in low light conditions and water temperatures. It can grow in shaded, polluted, disturbed, or turbid waters where many native plants cannot.

Spread

Burr-like winter buds called **turions**, which fragment and move around with water flow, spread this plant vegetatively. Plants can also reproduce by seeds and can be spread by waterfowl that ingest them. Recreational activities such as boating and fishing, and intentional plantings for wildlife habitat also aid in its spread.

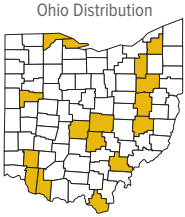
Distribution

Native to Eurasia, Africa, and Australia, curly-leaf pondweed was introduced into U.S. waters by hobbyists who used it as an aquarium plant. It has since spread to all states, and the Ohio map is likely incomplete as it is widespread in the state.

Environmental Impacts

Curly-leaf pondweed's tolerance of low light and temperature conditions allows it to grow sooner than native plants in the spring. It forms dense surface mats that can impede recreational activities such as boating, swimming, and fishing. When it dies off in mid-summer, it may create anoxic conditions and increase nutrient content that can cause harmful algal blooms.

Ohio Distribution



United States Distribution

Didymo

Didymosphenia geminata

Species at a Glance

Didymo, also called “rock snot,” is a single-celled diatom found in the cool waters of northern Europe and North America. Since the mid-1980s, it has begun to take on the characteristics of an invasive species, forming massive blooms that blanket stream and river bottoms, threatening a variety of aquatic systems.

Identification

Beginning as small circular brown blotches on rocks and other substrates, didymo can grow in two stalked forms – short stalked and long stalked. The short form generally appears as a coating on hard substrates, while the long stalked form can take on the appearance of wet fiberglass or toilet paper. Didymo has also been mistaken for raw sewage. The extracellular stalk material can form thick nuisance mats that can be over 20 cm (8 in) thick. While it appears slimy, it is actually rough to the touch, like wet wool, and is very difficult to pull apart and detach from rocks. When determining if a suspect specimen is didymo, squeeze out as much water as possible and rub between the fingers.

Similar Species

Unlike other species of algae, didymo does not break apart when rubbed between your fingers, nor does it feel slimy to the touch.

Habitat

Didymo is both epilithic (attaching to stones) and epiphytic (attaching to plants) and can thrive in a wide range of physical and chemical conditions within lakes and rivers. It prefers relatively shallow, clear, moderately-flowing and nutrient-poor waters with rocky substrates and plenty of sunshine. Nuisance blooms are only known to occur in cool, flowing water.

Spread

Anglers, kayakers, canoeists, and boaters can accidently spread this microscopic hitchhiker, which can cling to fishing gear, waders, boots, and boats. Felt-soled waders are especially good at transporting didymo because they can stay wet for longer periods of time, and didymo can survive outside of a stream in a cool, damp environment for at least 40 days. Only one cell is needed for it to spread.

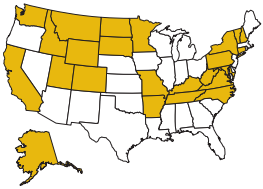
Distribution

Historically, didymo was found in cooler waters in the northern hemisphere and was considered a rare alga in the United States. However, in recent years it has exhibited a much greater tolerance for different water chemistry conditions and has expanded to diverse areas, including parts of Canada, New Zealand, and scattered areas in the United States, including New England, the Mid-Atlantic Region, and the western United States. In October 2007, didymo was first discovered where the east and west branches of the upper Delaware River meet along the New York and Pennsylvania border. To date, it has not been found in Ohio.

Environmental Impacts

Didymo cells can create large amounts of stalk material that form thick mats that are capable of completely engulfing a stream bottom, covering substrates, smothering aquatic organisms, and ultimately reducing fish habitat and food. Didymo does not appear to affect the safety of drinking water, does not produce an odor, and while aesthetically unappealing, does not appear to be a threat to human health.

United States Distribution

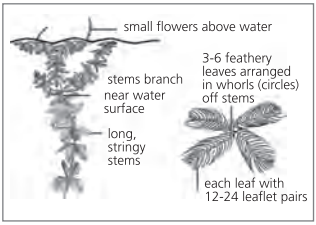


Eurasian Watermilfoil

Myriophyllum spicatum

Species at a Glance

Eurasian watermilfoil is a feathery **submerged** aquatic plant that was once commonly sold as an aquarium plant. Generally found in water less than 6.1 m (20 ft) deep, it quickly forms thick, damaging mats that are causing harm in shallow areas of rivers and lakes throughout North America.



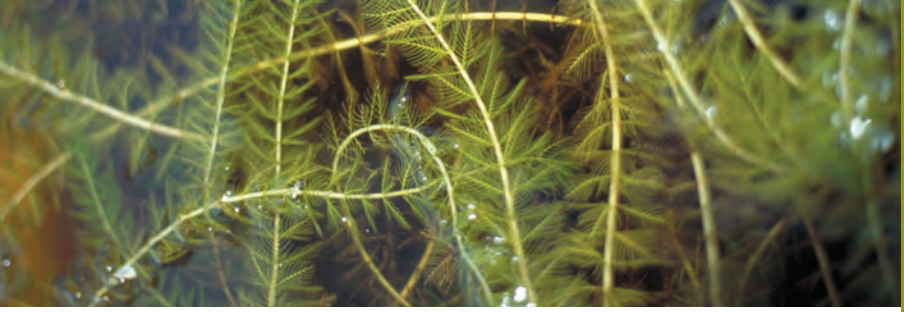
Identification

Leaves: Feathery **whorls** of 3–6 leaves (four leaves per whorl is common) are openly spaced along the stem, with 1–3 cm (0.3–1.2 in) between **nodes**. Leaves are threadlike, uniform in diameter, and have 12–24 pairs of **leaflets**. They are aggregated into a **submersed terminal spike**, and tips of leaves often have a blunt, snipped-off appearance. Note that the occasional Eurasian watermilfoil leaf may have as few as five **leaflet** pairs. For this reason it is always advised to count **leaflet** pairs on several leaves, taken from various points along the stem.

Flowers: Tiny **whorls** of flowers are located on floral **bracts** atop slender **spikes** that rise above the water's surface. Flowers either have four petals or are without petals.

Fruits: Hard segmented capsules contain four seeds.

Stems: Slender stems, which often curve to lie on top of the water's surface, begin to thicken before blooming and double their width further down.



Similar Species

Without **fruits** or flowers, it is difficult to distinguish Eurasian watermilfoil from the Ohio endangered northern milfoil (*Myriophyllum sibiricum*). It may be confused with other **submerged** plants with pinnate leaves including bladderworts (*Utricularia* spp.) and mermaid weed (*Proserpinaca palustris*), which generally have fewer than 14 **leaflet** pairs. Counting **leaflets** can provide helpful identification clues.

Habitat

This extremely adaptable plant can thrive in a variety of conditions. It grows in a wide temperature range in still to flowing waters and even survives under ice. It grows best in fertile, fine-textured sediments and high light conditions, and prefers nutrient-rich lakes but readily inhabits disturbed lakebeds.

Spread

It does not rely on seeds for reproduction, but instead reproduces by **fragmentation**. Plant fragments break off and float via water currents, allowing it to disperse long distances and hitchhike on boats, boat trailers, motors, and fishing equipment.

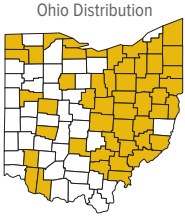
Distribution

Native to Europe, Asia, and northern Africa, Eurasian watermilfoil was first discovered in the eastern United States in the 1940s, but may have arrived as early as the late 1800s. It is now established in nearly every U.S. state and at least three Canadian provinces. The Ohio range map may be incomplete, as it is common in lakes, ponds, and rivers in all regions of the state.

Environmental Impacts

Eurasian watermilfoil forms thick mats that can interfere with swimming, fishing, waterfowl hunting, and boating, as plant fragments become wrapped around propellers. Fish and wildlife are also impacted because nutrient-rich native plants are displaced, and the economy is impacted as these infestations reduce local property values.

Ohio Distribution



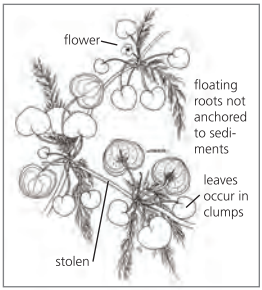
United States Distribution

European Frog-bit

Hydrocharis morsus-ranae

Species at a Glance

European frog-bit is an herbaceous aquatic plant that resembles a miniature water lily. It has been found in the Great Lakes since the 1930s, but is now spreading inland into streams and lakes within the basin.

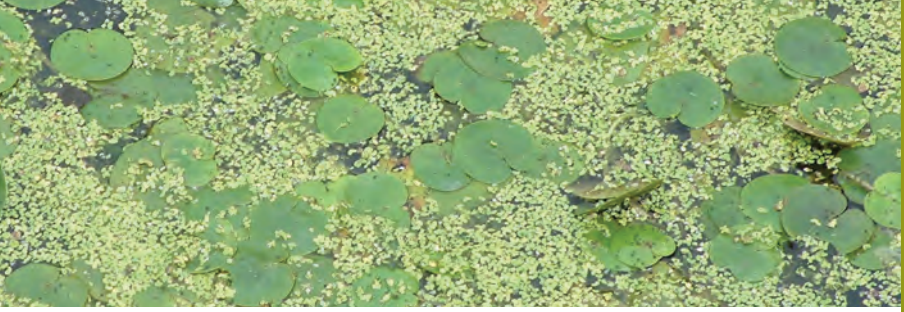


Identification

Leaves: Small, thick, heart-shaped, and leathery leaves (1.5–6.5 cm [0.6–2.6 in]) long occur in clumps and are not anchored to the bottom sediment. They have smooth edges resembling those of a miniature water lily. A dark purplish-red spongy coating is present on the underside of the leaves, allowing it to float on the water's surface.

Flowers: Small, white, and showy flowers are about 1 cm (0.4 in) in diameter. Each flower has three petals and a yellow center, and flowers show up in early summer. Plants are **dioecious** and therefore seldom produce seeds.

Stems/Roots: Stem-like extensions called **stolons** run from the center of the plant to produce juvenile plants. These **stolons** also produce **turions** (vegetative winter buds) that break free and sink to the water bottom to lie dormant for the winter. Numerous free-floating, unbranched roots grow up to 30.5 cm (12 in) in length. Plants form thick mats with tangled roots and **runners**.



Similar Species

While it is often mistaken for water lily species (family Nymphaeaceae), European frog-bit leaves are distinctly heart-shaped, leathery, and usually smaller. Water lily flowers are much larger, with more than three petals. It may also be confused with American frog-bit (*Limnobium spongia*), spatterdock (*Nuphar advena*), and watershield (*Brasenia schreberi*).

Habitat

Prefers quiet, still, calcium-rich areas such as marshes, fens, swamps, backwaters, bays, sheltered coves, slow-moving shorelines of rivers, streams and lakes, and poorly drained ditches.

Spread

European frog-bit can spread to new areas by plant fragments, or by **turions**, which float to the surface and begin to grow in the spring. A single plant can produce 100 to 150 **turions** in one season. It can hitchhike on boats, trailers, waterfowl, and flowing currents. It may also be spread deliberately by humans that purchase it as an aquarium plant or for water gardens.

Distribution

Native to Europe and northern Asia, but introduced intentionally in the United States as a commercial ornamental, European frog-bit escaped cultivation and spread to the Canadian shorelines of Lake Erie, Lake Ontario, the St. Lawrence River in New York, and Lake Champlain in Vermont. Populations are also present in Michigan and Washington. In Ohio this species was first found in 2004 at Cedar Point National Wildlife Refuge and has since spread from this location and occurs in Erie County.

Environmental Impacts

European frog-bit populations increase rapidly, forming dense mats that decrease the amount of nutrients, dissolved oxygen, and light penetration into the water, limiting the growth of any native vegetation beneath. These mats can also inhibit the movement of waterfowl and fish and limit recreational activities; however, it can serve as a food source for some types of water birds, fish, and insects.

Ohio Distribution

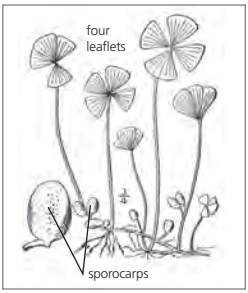
United States Distribution

European Water-clover

Marsilea quadrifolia

Species at a Glance

European water-clover, also called European water fern or water shamrock, is a perennial herbaceous fern that gets its name from its clover-shaped leaves. It poses a threat to ecosystems as dense stands form and crowd out native wetland plants.



Identification

Leaves: Leaves are divided into four triangle-shaped **leaflets** that are approximately 0.6–2.5 cm (0.25–1 in) long. They are either slightly **submerged**, floating, or **emergent**. Both the upper and lower surfaces of the **leaflets** are pale green or bluish-green. **Emergent leaflets** may fold together at night and spread outward during the day.

Flowers: This species is a fern and has no flower.

Stems/Roots: Thin **petioles** are typically 5–10 cm (2–4 in) long and form from **creeping rhizomes**. They are straw-colored to light green, circular in cross section, and are usually smooth. **Submerged petioles** often curve upward, while **emergent petioles** have a tendency to lean or sprawl.

Spores: Near the base of the **petioles** are small spore-bearing bodies called **sporocarps**. They are 0.35–0.5 cm (0.1–0.2 in) long, oval, thick, reddish-brown, dark brown, or dark purple in color, and somewhat flattened in shape. They are typically arranged in groups of 2–3, although there can be anywhere from 1–5. Young **sporocarps** are hairy but become smooth as they age.

Similar Species

European water-clover may resemble species of wood sorrel (*Oxalis* spp.) or clover (*Trifolium* spp.), but it is a spore-producing fern rather than a flowering seed plant. Wood sorrel and clover can be distinguished by their **trifoliate** leaves and terrestrial habits, while European water-clover has **quadrifoliate** leaves and is primarily aquatic.

Habitat

Although this species is capable of growing on wet ground, it is typically found growing in shallow and slow-moving waters of lakes, ponds, and creeks.

Spread

European water-clover is a popular water garden plant, giving it the potential to spread into natural areas through intentional release or accidental escapes. Once introduced, it can easily spread by **rhizomes** and **sporocarps** that can float downstream on water currents or be moved to new locations on boats, trailers, or on waterfowl. The **sporocarps** can remain dormant for decades until conditions are favorable to release the spores.

Distribution

Native to parts of southeastern Europe and Asia, this species was introduced into North America during the 19th century as an ornamental plant. In Ohio, it is currently found in Fairfield County where it was intentionally planted.

Environmental Impacts

While ecological threats of the European water-clover are somewhat unknown, this species is capable of forming **monotypic** stands that can outcompete native aquatic plants for available sunlight and habitat. These stands can also persist during the winter seasons because of the underground **rhizomes**.

Ohio Distribution

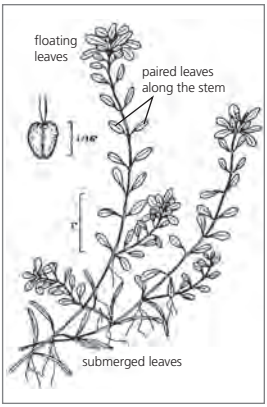
United States Distribution

European Water-starwort

Callitriche stagnalis

Species at a Glance

European water-starwort, also known as common or pond water-starwort is a small, delicate, aquatic perennial herb that roots to the substrate in shallow water. The appearance of this species can vary slightly depending on its habitat and growing conditions.



Identification

Leaves: **Opposite** leaves are arranged in pairs along the stem and are both floating and **submerged**. Floating leaves are oval-shaped, have 5–7 veins, and are up to 2 cm (0.8 in) long. **Submerged** leaves are typically narrow and linear, have a single vein, and grow 4–10 mm (0.2–0.4 in) in length; however, they can also be broader and more closely resemble the floating leaves.

Flowers: Tiny, simple flowers don't have **sepals** or petals and are typically located right next to one another in the leaf **axils**. The flowers can have 0–4 (but usually two) small, white **bracts** at their bases, which may help the flowers float on the water and aid in pollination.

Fruit/Seeds: Rounded **fruits** are 1.5–2 mm (0.06–0.08 in) thick with a thin wing extending from the base to the head of the **fruit**. Four compartments, each containing one seed, do not split when ripe.

Stems/Roots: Elongate and branched stems can grow from 10–30 cm (4–12 in) in length, rising or sprawling to the surface.

Similar Species

May be confused with native water-starworts (*Callitriche* spp.); however, the mature **fruits** of other species are not round in shape and lack the distinctive wing on the **fruits**. Due to the variability in leaf shape and size, mature **fruit** must be examined for positive identification of all water-starworts. European water-starwort may also be confused with other **opposite**-leaved delicate plants when not in **fruit**, such as shortseed waterwort (*Elatine brachysperma*) or horned pondweed (*Zannichellia palustris*).

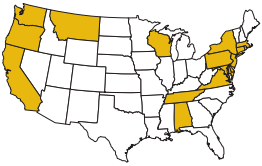
Habitat

This species is typically found in shallow waters of lakes, ponds, rivers, and streams. It can tolerate some salinity such as brackish waters or salt marshes and flats.

Environmental Impacts

European water-starwort is capable of forming dense mats of vegetation that may crowd out and displace native aquatic vegetation.

United States Distribution



Spread

European water-starwort was first recorded in New York in 1861, most likely brought over in the ballast water of ships. Once introduced, it became a popular aquarium plant and subsequent escapes and releases have contributed to its spread throughout North America. It spreads through both seeds and plant fragments. Seeds can pass through the digestive tracts of birds and be released in new locations, and plant fragments and stems can easily attach to boats, trailers, and other aquatic recreational equipment.

Distribution

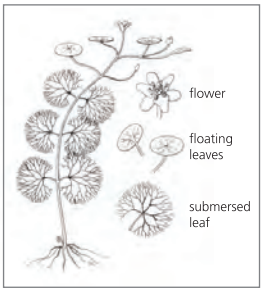
Introduced from Europe and North Africa, this species is found in the Pacific Northwest, in the Mid-Atlantic region, and has scattered populations in Tennessee, Alabama, Montana, and Wisconsin.

Fanwort

Cabomba caroliniana

Species at a Glance

Fanwort is a **submersed** freshwater perennial that can often be found rooted or floating. Stems may reach lengths of up to 6 m (20 ft). It is persistent, aggressive, and competitive, bringing with it the potential to take over waterways where it is not native.



Identification

Leaves: Two types of leaves include **submersed** and floating. **Submersed** leaves are delicate, fan-shaped, and usually green in color, averaging 5 cm (2 in) in diameter. They are finely divided and arranged in **opposite** pairs along the stem. Floating leaves, which are not always present, are narrow, small (less than 1.3 cm [0.5 in]), oval to diamond in shape, and arranged in an alternating pattern.

Flowers: Small white, pink, or purple flowers with a diameter less than 1.3 cm (0.5 in) grow from the tips of the stems and float on the water's surface.

Shoots/Stems: Usually green in color ranging from grass to olive green and sometimes reddish brown. Shoots are upturned extensions of the horizontal **rhizomes** and may reach lengths of up to 6m (20 ft).

Similar Species

Fanwort is often confused with watermilfoils (*Myriophyllum* spp.), Beck's water-marigold *(Megalodonta beckii)*, some bladderworts (*Utricularia* spp.), and mermaid weed (*Proserpinaca palustris*). The leaves of watermilfoils are **whorled**, and the plants have small flowers growing from where the leaves meet the stem. Beck's water-marigold has yellow, **composite flowers** and **sessile** leaves, while fanwort has white flowers and slender leaves. Water marigold also has **opposite** leaves that attach directly to the stem with no **petiole** between the leaf and stem.

Habitat

This very hardy plant is usually found rooted in muddy areas of slow moving waters such as streams, small rivers, lakes, and ponds. It can establish in a wide variety of environments and tolerate a wide range of temperatures, allowing it to overwinter in frozen lakes.

Spread

Fanwort is thought to have spread from intentional and unintentional release in the aquarium trade. Its fragile stems break off easily, and most pieces can re-sprout and grow into new plants.

Distribution

Native to the sub-tropic areas of North and South America and Gulf of Mexico regions of the United States, fanwort has been introduced to regions in the Northeast and the Pacific Northwest. It is considered native to parts of southern Ohio, but occurrences in the north of the state are considered invasive.

Environmental Impacts

Fanwort is highly competitive and persistent, forming dense mats at the water's surface that block sunlight into the water column, negatively impacting native plant species, biodiversity, and water quality. It can also clog waterways, impacting recreational activities such as boating, fishing, and swimming.

Ohio Distribution

Orange - Invasive Green - Native

United States Distribution

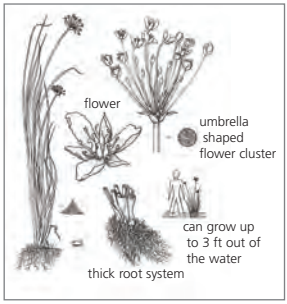
Orange - Invasive Green - Native
Blue - Both Native & Invasive

Flowering-rush

Butomus umbellatus

Species at a Glance

Flowering-rush is a perennial aquatic herb that can grow both as an **emergent** plant along shorelines and a **submersed** plant in lakes and rivers. It often goes fairly unnoticed among other wetland plants until it blooms a distinctive spray of attractive flowers in late summer and early fall.



Identification

Leaves: **Emergent** leaves are stiff, narrow, green, and can grow up to 0.9 m (3 ft) above the water's surface. Leaf tips may be spirally twisted. **Submersed** leaves are limp under water and do not flower.

Flowers: Grow in umbrella-shaped clusters (i.e., **umbels**) on a long **stalk,** with each flower made up of three petals, three **sepals,** and red **anthers**. Flowers are approximately 2.5 cm (1 in) across and are typically white, pink, or purple in color. Flowering occurs in late summer to early fall, and only occurs on **emergent** plants.

Fruits: **Pistils** ripen into a dark brown **fruit** filled with tiny seeds.

Stems/Roots: Green stems are triangular in cross section. The extensive root system is a thick, **creeping rhizome**. **Bulblets** that form on the **rhizome** can easily break off when disturbed and form a new plant.

Similar Species

Leaves of flowering-rush resemble bur-reed (*Sparganium* spp.), another shallow water plant; however the leaves of the bur-reed are V-shaped, and its female flowers appear as small spiked balls. Bur-reed grows 0.3–1.2 m (1–4 ft) tall.

Habitat

Flowering-rush prefers shallow and slow moving waters but will inhabit deeper waters. It grows well in riparian zones, watercourses, and wetlands such as ditches, marshes, lakes, or streams. It cannot grow in shade and requires wet soil.

Spread

Once in a watershed, flowering-rush spreads locally by underground **rhizomes**, root pieces, and seeds. Wildlife, water movement (water or ice), anglers, and boaters can carry this plant to new areas. Its use as a water garden plant could have also contributed to its spread over long distances.

Distribution

Native to Europe and Asia, flowering-rush was brought to North America as a garden plant. It is present in states along the U.S./Canadian border, extending north to the tip of Quebec, and south to Illinois. Flowering-rush is prohibited in many Great Lakes states and is a widespread invasive to Ohio, especially along Lake Erie's coastal marshes.

Environmental Impacts

Flowering-rush can easily crowd out native species. The large amount of underground **rhizomes** can harm fish and other wildlife by destroying food sources and habitats. It can also interfere with recreational activities such as swimming and boating.

Ohio Distribution

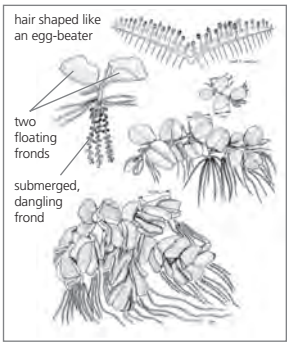
United States Distribution

Giant Salvinia

Salvinia molesta

Species at a Glance

Giant salvinia, also known as water fern and kariba-weed, is a floating fern native to southern Brazil. This species is capable of very high growth rates depending on its habitat conditions, potentially doubling in volume every 7–10 days and quickly forming dense mats on the surface of the water.



Identification

Leaves: Because it's a fern, leaves are referred to as **fronds**. Two floating **fronds** appear at each **node** of the stem with a third frond that dangles under the water. Floating **fronds** are oval, folded, green, about 2 cm (0.8 in) long, and are covered in 4-pronged hairs on the upper surface that join at their tips to resemble an egg-beater. The purpose of these hairs is to repel water and provide buoyancy. In the early stages of life, the **fronds** will lie flat on the water's surface, but as they age they fold up and compress into chains. The underwater **frond** is brown, highly divided, and is sometimes mistaken for a root; however, the plant has no true roots. It also acts to conceal the spores.

Flowers: Salvinias have no flowers.

Spores: Round, **nut**-like **sporocarps** trail beneath the plant and produce infertile spores.

Stems/Roots: A horizontal **rhizome**, which lies just below the water's surface, ranges from grass to olive-green and sometimes reddish-brown. Shoots are upturned extensions of the horizontal **rhizomes** and may reach lengths of up to 6m (20 ft).

Similar Species

Often confused with common salvinia (*Salvinia minima*), this species is the larger of the two, and can be distinguished by the hairs on the **fronds** that form the distinct "egg-beater" structure.

Habitat

Giant salvinia thrives in slow-moving, nutrient-rich, warm, fresh waters such as ditches, ponds, lakes, slow rivers, and canals. It will only tolerate freshwater and cannot grow in brackish or marine environments. While it can withstand freezing air temperatures, it will not survive under ice.

Spread

Giant salvinia was most likely introduced by intentional and unintentional releases due to its use in aquariums and water gardens. Once introduced, it can spread by vegetative fragments that hitchhike on recreational boats and equipment and on the feathers of waterfowl and fur of wildlife. Each small plant fragment is capable of growing into a new plant. In addition, each **node** has several lateral buds, which can remain dormant through times of stress and drought until conditions are right for growth.

Distribution

Native to southeastern Brazil and northern Argentina, giant salvinia was introduced as an ornamental aquatic plant and was first found in the United States in South Carolina in 1995. It is now scattered throughout the southern U.S. from California to Virginia.

Environmental Impacts

Giant salvinia forms dense mats of vegetation that reduce water flow and lower the light and oxygen conditions in the water. This stagnant, dark environment shades out native plants and creates bare spots in the habitat below, altering the diversity and quality of the ecosystem. Invasions of this species also threaten socio-economic activities dependent on open flowing water such as hydro-electricity generation and fishing and boating transport.

United States Distribution

Golden Alga

Prymnesium parvum

Species at a Glance

Golden alga is a naturally occurring, one-celled, microscopic organism that can be found worldwide on every continent except for Antarctica, though there is some debate as to its native range. Toxins produced by the alga have caused extensive kills of aquatic animals, resulting in severe ecological and economic harm.

Identification

Golden alga is a tiny organism about the size of a human blood cell. It is very mobile and uses its two "tails," called **flagella**, to move through the water. A short, stiff, hair-like structure called a **haptonema** is used to attach the cell to other cells or objects. A yellow-green, C-shaped **chloroplast** wraps around the middle of the cell and can be seen under a microscope. During a typical bloom, the water turns yellowish, yellowish-copper, or a brownish tea color. Foaming at the surface of the water in areas where there is a lot of wave action is another sign. Exposed fish may swim slow or erratically just below the surface, lie inactively along the bottom in shallow areas, or show no avoidance to human presence. Other visible signs include redness or hemorrhaging at the base of the fins, around the mouth area, under the chin, and along the belly.

Similar Species

The conditions typical of a golden alga bloom may come from other sources and do not always indicate a golden alga bloom.

Habitat

Generally found in brackish waters, golden alga cells can thrive in a variety of environmental conditions, including a salinity range of 1–40 PSU (Practical Salinity Unit) and a temperature range of 5–35°C (41–95°F). Other factors that affect its growth include phosphorus and nitrogen levels, cationic substance levels, and pH. Toxic blooms typically occur at salinity levels of 1–12 PSU, temperatures of 10–25°C (50–77°F), and at fairly high phosphorus and nitrogen levels.

Spread

A single drop of water may contain over 2,000 golden alga cells. Unintentional spread may occur by water currents or as cells stick to the feathers of waterfowl and fur of wildlife. Under stressful conditions, golden alga is able to form into dormant cysts that can hitchhike to new areas in live wells, bait buckets, recreational boating and fishing equipment, or equipment used during water withdrawals.

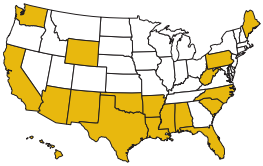
Distribution

First identified in the United States in Texas in 1985, golden alga has since spread to 18 states. It's nearest occurrence to Ohio has been Drunkard Creek, spanning the Pennsylvania–West Virginia border, where it caused a substantial fish kill.

Environmental Impacts

Golden alga is fast growing, resilient, and uses nutrients more effectively than other kinds of algae. Bloom situations can cause extreme die-offs of native threatened and endangered species. Serious economic consequences for affected communities have also been well documented. At-risk waters can include those with high salinities and those being affected by mineral resource extraction, such as natural gas. There is currently no evidence that golden alga has toxic effects on non-gill breathing organisms or humans.

United States Distribution

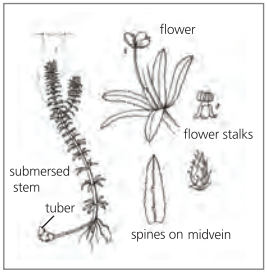


Hydrilla

Hydrilla verticillata

Species at a Glance

Hydrilla is a **submerged** aquatic perennial that could be considered nature's "perfect weed." It comes in two forms, **dioecious** and **monoecious**. Both forms grow and spread at a very fast rate, covering the surface of water bodies and restricting boating, fishing, swimming, and other recreational uses. Stands of **dioecious** *Hydrilla* in Florida constitute the only aquatic plant known to have developed resistance to an herbicide.



Identification

Leaves: While morphological characteristics can vary, leaves are typically strap-like and pointed, with small sharp teeth on the edges that are difficult to see with the naked eye. Spines or conical bumps are sometimes found on the mid-rib on the underside of the leaf; however, these are not always present. The underside of the **mid-rib** can also be red. They are generally 2–4 mm (0.08–0.2 in) wide, 6–20 mm (0.2–0.8 in) long, and occur in **whorls** of 3–8.

Flowers: Small (10–50 mm [0.4–2 in] long), white flowers which float on the water's surface are attached at the leaf **axils** and are clustered towards the tips of the stems.

Stems/Roots: Long and branching stems form intertwined mats at the water's surface. Plants are usually rooted to the lake bottom, growing upward from the substrate in water up to 3.7 m (12 ft) deep. During the late growing season, small white **tubers**, which are used for energy storage, are formed on the plants root's, allowing it to overwinter.

Similar Species

Hydrilla closely resembles Brazilian waterweed (*Egeria densa*) and common elodea (*Elodea canadensis*). Brazilian waterweed typically has **whorls** of 3–6 leaves, is usually 2–3 cm (0.8–1.2 in) long, and has minute teeth on the **margins** with no conical bumps on the **mid-rib** below. The native common elodea has leaves that occur in **whorls** of three and is usually a much smaller plant. Neither common elodea nor Brazilian waterweed produces the **tubers** or **turions** found on *Hydrilla*.

Habitat

Hydrilla grows in a wide variety of still and flowing water, including freshwater lakes, ponds, rivers, impoundments and canals. It tolerates a wide range of pH, nutrient, and light levels and is somewhat winter-hardy, but optimum temperature for growth is 20–27°C (68–81°F).

Spread

Because *Hydrilla* reproduces primarily vegetatively, even the smallest living plant fragment can float downstream and form a new plant. While it was imported to the United States as an aquarium plant, recreational activities now help it spread.

Distribution

While it is unknown where *Hydrilla* originated, possible native ranges include Asia, Africa, and Australia. It continues to spread and is listed as a federal noxious weed in the United States. While the **dioecious** form appears to spread from South Carolina south, the **monoecious** form is spreading both north and south and is typically the form found north of North Carolina. The Ohio range map data is incomplete; it was first reported in the Cleveland area and has now spread along the Ohio waters of the Ohio River. Care should be taken by boaters on the river to not inadvertently transport this aggressive invasive plant.

Environmental Impacts

Hydrilla's dense thick mats interfere with commercial activities by clogging water intake pipes and filters and hindering irrigation. It also restricts recreational uses and prevents sunlight from reaching other species growing beneath it. As the mats die and decay, bacteria deplete oxygen from the water, impacting fish and other aquatic organisms.

Ohio Distribution

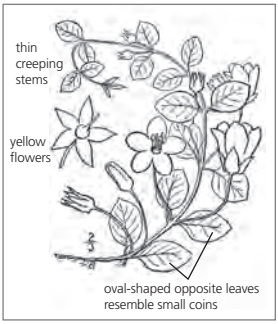
United States Distribution

Moneywort

Lysimachia nummularia

Species at a Glance

Moneywort, also called pennywort and creeping jenny, is an herbaceous low-growing perennial that is part of the primrose family. It forms a thick **creeping** ground cover with stems that can reach up to 0.6 m (2 ft) long and form a mat-like growth about 5–10 cm (2–4 in) tall.



Identification

Leaves: Evergreen to semi-evergreen leaves are simple, **opposite**, and oval in shape, resembling small coins that typically reach 0.6–4 cm (0.25–1.5 in) in length. Upper surfaces of the leaves have widely scattered, glandular, red to black dots.

Flowers: Small, cup-shaped, yellow flowers have five petals and small dark reddish to black spots. They are **hermaphroditic** and typically solitary in the leaf **axils**. Blooming usually occurs from June to August, but some may not bloom at all.

Fruit/Seeds: Small seeds are located within capsular **fruits** that are about as long as the **sepals**.

Stems/Roots: Smooth stems are thin, reddish, and **creep** along the ground, rooting where the leaf **nodes** come in contact with the soil. The stems branch frequently and often form mats.

Similar Species

Native partridgeberry (*Mitchella repens*) is similar to moneywort in that it is an herbaceous low growing perennial with oval to round dark green leaves that forms **creeping** mats on streambanks, woodland floors, and other areas. However, partridgeberry flowers are white instead of yellow.

Habitat

While it can grow in a variety of habitats, moneywort grows best in moist areas like wet meadows, swamps, floodplain forests, stream banks, roadside ditches, and along the banks of small water bodies. It tends to prefer moist, rich, and shaded soils.

Spread

Moneywort can spread rapidly both by **creeping** stems and seed dispersal. Seeds spread naturally through flood waters; however, they can also be spread through human activities. The extent to which seeds are dispersed by animals is not fully known, but this may be another method of transport.

Distribution

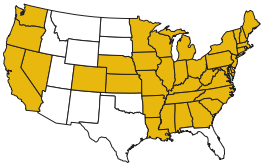
Introduced from Europe and southwest Asia as early as 1739, moneywort was historically used for ornamental purposes and as a ground cover. It escaped cultivation by 1900 and is now found throughout the United States, including Ohio and all Mid-western states.

Environmental Impacts

Little is known about the direct ecological impact of moneywort; however, it has been known to become a nuisance in gardens, pastures, and lawns due to its fast vegetative spread. There is concern that the dense mats formed by this plant could prevent the growth of more desirable native plants.

Ohio Distribution

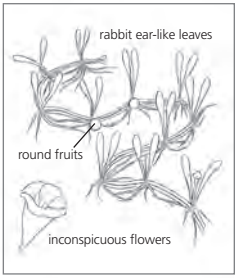
United States Distribution



Mudmat

Glossostigma cleistanthum

Species at a Glance



Mudmat is a low-growing, mat-forming, aquatic invasive plant that has remained largely under the radar due to its small size and the public's lack of familiarity with it. The plant itself is usually less than 2 cm (0.8 in) high and can be found **submerged** in the water or emerging above the water's surface.

Identification

Leaves: Bright green paired leaves resemble tiny rabbit ears. They are narrow, about 1–4 cm (0.4–1.6 in) in length and are slightly expanded at the tip; they taper to the base and may be **sessile** or **stalked**. Leaf **margins** are smooth.

Flowers: Small, 1–3 mm (0.04–0.1 in) wide flowers are inconspicuous in leaf **axils** at the base of the plant. They emerge when the water recedes in the summer months. Color ranges from mauve, lilac, blue, and bluish-white to white. Closed, self- fertilizing flowers called **cleistogams** are also produced underwater in the soil among the roots.

Fruits: Round, thin-walled capsules are divided into two cavities that contain many small, dark brown seeds.

Stems: **Creep** horizontally just below the soil surface and root along the **nodes**.

Similar Species

Native mudwort species (*Limosella* spp.) closely resemble mudmat. It may also be confused with **emergent** leaf forms of the bladderworts (*Utricularia* spp.).

Habitat

Mudmat prefers conditions with low pH, conductivity, and phosphorous in shallow waters, swamps, and periodically flooded areas with little wave action.

Spread

Initial introduction of mudmat probably occurred by aquarium release, and its subsequent spread may have been mediated by both human activities, such as recreational boating, and by natural means, such as hitchhiking on migrating geese or other waterfowl.

Distribution

Native to Australia, New Zealand, India, and east Africa, mudmat was discovered in the United States in 1992 at a single location in southern Connecticut. Because of its small size, it may have a wider distribution than what is currently known.

Environmental Impacts

Mudmat forms thick carpet-like mats that smother the lake bottom from the shoreline to depths of greater than 2 m (6.6 ft). It spreads very rapidly, covering prime shoreline habitat, reducing biodiversity, and threatening native plant and animal communities.

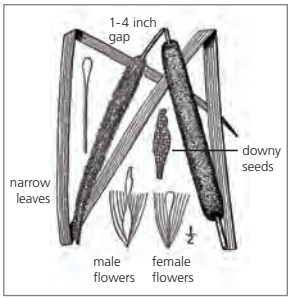
United States Distribution

Narrowleaf and Hybrid Cattails

Typha angustifolia, Typha x glauca

Species at a Glance

Cattails are aquatic perennials that grow in wetland areas and produce distinct velvety brown **spikes** of flowers. The two most widespread species in the United States are the native common cattail, also called the broadleaf cattail *(Typha latifolia)* and the non-native narrowleaf cattail *(Typha angustifolia)*. The hybrid cattail is produced when these two species cross, giving it characteristics of both species.



Identification

Leaves: Long, narrow (5–15 mm [0.2–0.6 in]), flat leaves originate at the base of the stem from each shoot and spread outward as they rise into the air, reaching 0.9–1.8 m (3–6 ft) in height.

Flowers: Dense, fuzzy, cylindrical **spikes** are located at the end of the stem. The flower **spike** is divided into two distinct male and female **inflorescences**, separated by a 3–10 cm (1.2–3.9 in) gap. Lighter brown male flowers (**staminate**) are located above the female (**pistillate**) flowers, which are often green during bloom, turning dark brown during seed maturation.

Fruits: Cigar-shaped **fruits** about 5–15 cm (2–5.9 in) long contain soft, downy seeds about 1 mm (0.04 in) in size.

Stems: The flowering **stalks** are light green, stiff, round in cross-section, and grow up to 3 m (10 ft) tall.

Similar Species

Both the narrowleaf and hybrid cattails can be easily confused with the native common cattail, and the hybrid can backcross producing highly variable clones that are difficult to identify. However, the common cattail has both male and female flower types directly next to each other, whereas the invasive cattails have a clear separation of male and female flowers, and the leaves are narrower, deeper green, and typically extend beyond the **spike**.

Habitat

Stands of non-native cattail can be found in a wide variety of wetland habitats, including marshes, fens, lakeshores, river backwaters, and roadside ditches. This prolific plant can grow in disturbed areas, as well as brackish and polluted waters of depths nearing 0.9 m (3 ft).

Spread

The **inflorescence** of the parent plant can produce 250,000 seeds, which can remain viable for up to 100 years, waiting for the right amount of water and sunlight to germinate. Seeds are dispersed by wind, and once established, additional spread occurs through an extensive underground root system.

Distribution

Narrowleaf cattail is believed to have originated from the dry ballast of European ships on the Atlantic seaboard. The hybrid cattail may occur wherever both the native and the narrowleaf species are present. These plants have spread throughout the United States, and all three cattail taxa are currently found in Ohio.

Environmental Impacts

Cattails grow in dense monocultures that can dominate shorelines near open water areas, eliminating habitat and replacing native plants important for waterfowl and wildlife. They are also thought to be **allelopathic**, meaning they produce chemicals which prevent the growth of other plant species.

Ohio Distribution

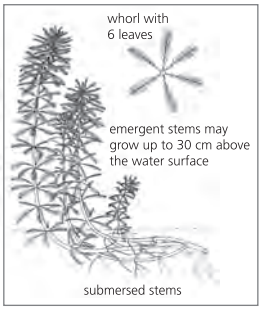
United States Distribution

Parrotfeather

Myriophyllum aquaticum

Species at a Glance

Parrotfeather, also called Brazilian watermilfoil, is an herbaceous aquatic perennial and member of the watermilfoil family. It gets its name from its bright green feather-like leaves, which are **whorled** around the stem and can form thick suffocating mats.



Identification

Leaves: **Emergent** leaves are robust, vibrant green, feathery, and covered with a waxy coating. They are arranged around the stem in **whorls** of 4–6 and are 2.5–5 cm (1–2 in) long with 10–18 **leaflet** pairs. Leaves become more closely arranged toward the growing tips of the plant. Limp **submerged** leaves are brownish to reddish, often appearing deteriorated. They are 1.5–3.5 cm (0.6–1.4 in) long with 20–30 pinnae per leaf.

Flowers: Small (1.5 mm [0.06 in]), white-pinkish flowers appear between leaf **axils** of female plants in the spring. Only female plants have been found in North America.

Stems: Long unbranched stems reach heights of 30 cm (12 in) above the water surface. When attached to a bank, they can extend out several yards over the water surface.

Similar Species

Close relatives, other watermilfoils (*Myriophyllum* spp.), are easily mistaken for the **submerged** leaves of parrotfeather. Other look-a-likes include bladderworts (*Utricularia* spp.) and mermaid weed (*Proserpinaca palustris*). The **emergent** stems and leaves are the most distinct characteristics of parrotfeather, as they can grow up to a foot above the water surface and resemble small fir trees.

Habitat

Parrotfeather is hardy but prefers shallow, nutrient-rich, and slow-moving waters. It is most common in shallow water as a rooted plant but can also be found as a floating plant in deeper, nutrient-enriched lakes.

Spread

Since all parrotfeather plants in the United States are female, they spread exclusively by **fragmentation**. Therefore, human activities such as water gardening, boating, and fishing can easily spread fragments to new locations where they can grow into new plants.

Distribution

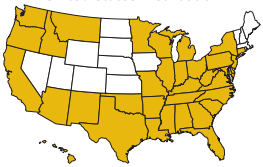
Native to South America in the Amazon River, parrotfeather was introduced as a garden plant in the 1800s and has since spread throughout the United States. Within Ohio, it has only been found in Burr Oak Lake in the southeast of the state.

Environmental Impacts

Parrotfeather forms thick mats that can shade out native plant and algae species, impact water flow, clog recreational waterways and irrigation canals, and alter the physical and chemical characteristics of lakes and streams.

Ohio Distribution

United States Distribution

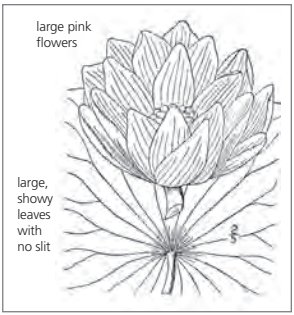


Pink Lotus

Nelumbo nucifera

Species at a Glance

Pink lotus, also called sacred lotus and Asian lotus, is a showy aquatic perennial that resembles a water lily, although the two are not related. It is considered invasive outside of its native range due to the dense colonies it can produce in natural areas.



Identification

Leaves: Medium green to blue-green leaves either float at the surface of the water or are held up to 1.5 m (5 ft) above the water by their **petioles**. Circular leaf blades are hairless with smooth edges that may undulate up and down. Leaves are large, showy, and water resistant, spanning 0.2–0.9 m (0.5–3 ft) across with many radiating veins.

Flowers: Large, fragrant flowers are held up to 2 m (6 ft) above the water. They have 12–15 pink petals with showy yellow **stamens** around a central large **receptacle**. Flowers are 10–25 cm (4–10 in) across. The blooming period occurs during the summer and can last about two months. The short-lived flowers open up in the morning and begin to lose their petals by the afternoon.

Fruit/Seeds: After the flowers drop, a seed pod remains in the center of the flower with many small openings that resemble a shower head. These pods turn from green to dark brown in color. Individual seeds form in the pod and may remain viable for centuries.

Stems/Roots: Thick **rhizomes** have fibrous roots and allow the plant to aggressively re-grow new plants.

Similar Species

Pink lotus is very similar to the native American lotus (*Nelumbo lutea*); however, it can be distinguished by the color of the flowers. American lotus has yellow flowers instead of the characteristic pink. Cultivars of these two species tend to have whitish-pink flowers. Pink lotus is also similar to water lily (*Nymphaea* spp.); however, the leaves of the pink lotus lack the characteristic slits found on water lily leaves.

Habitat

Pink lotus prefers full sun and water up to 2 m (6 ft) deep in mucky **submerged** soils with little exposure to wind and waves. It thrives in small ponds, lagoons, marshes, and shallow areas of lakes and rivers.

Spread

Colonies of pink lotus can spread aggressively by both seeds and **rhizomes**, giving them the capability to rapidly establish and spread throughout water bodies.

Distribution

Native to southern and eastern Asia, pink lotus is the national flower of India and Vietnam, and has multiple medicinal and culinary uses. It was most likely introduced into the United States as an ornamental, which escaped cultivation and established into natural areas. In Ohio, the only current records are from Butler and Gallia counties in the southern part of the state.

Environmental Impacts

Dense mats of floating pink lotus can inhibit the growth of other native aquatic vegetation, decreasing biodiversity and impacting the wildlife that depend on native plants for food and shelter. In addition, these floating mats can negatively impact recreational activities like boating, angling, and swimming.

Ohio Distribution

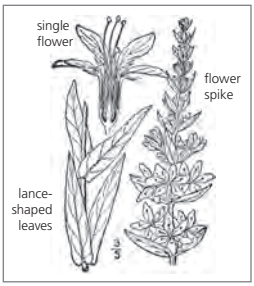
United States Distribution

Purple Loosestrife

Lythrum salicaria

Species at a Glance

Purple loosestrife is an upright perennial herb that can grow 0.9–3 m (3–10 ft) high, depending on environmental conditions. While gardeners might enjoy the brilliant purple display, its attractiveness doesn't outweigh the serious threat it poses to ecosystems in Ohio.



Identification

Leaves: The body of the leaf is lance-shaped or oblong, while the base is usually heart-shaped or rounded. Leaves are **stalkless** with smooth edges and are sometimes covered in fine, downy hairs. They reach 4–10 cm (1.6–3.9 in) in length and are usually paired and **opposite** each other down the stem, but can also be **whorled** in groups of three.

Flowers: Paired, or clustered into 10–40 cm (3.9–16 in) long magenta colored **spikes**. Each flower is complete, containing five to seven petals that can range in color from pink to purple-red, and blooms from June to September.

Fruits: Two valve-shaped capsules that burst at maturity release seeds usually in late July or August.

Stems/Roots: Mature plants can have 1–50 square, woody stems arising from a large central taproot. Stems are 4–6 sided, green to purple in color, and are often branching, giving the plant a bushy or woody appearance.

Similar Species

It's best to identify purple loosestrife during its long period of bloom when the characteristic reddish-purple flower masses can be easily seen. It is often confused with blue vervain (*Verbena hastata*), which has toothed instead of smooth leaves; blazing star (*Liatris* spp.), which only has one flowering **stalk**; winged loosestrife (*Lythrum alatum*), which has smaller, single flowers at well-separated leaf bases; and other species of loosestrifes.

Habitat

Purple loosestrife occurs in freshwater and brackish wetlands, riparian corridors, ditches, and other moist soil areas. It is a successful colonizer and potential invader of any wet, disturbed site in North America.

Spread

A long flowering season allows purple loosestrife to produce an estimated two to three million seeds per year from its 30–50 flowering stems. It can also reproduce **vegetatively** through underground stems at a rate of about 0.3 m (1 ft) per year.

Distribution

Native to areas of Europe and Asia, purple loosestrife was brought to North America in the early 1800s for ornamental and medicinal uses. It has since spread to almost every state in the U.S. and is widespread in Ohio.

Environmental Impacts

Purple loosestrife quickly establishes and spreads, outcompeting and replacing native grasses and other flowering plants that provide high quality food and habitat sources for wildlife. It forms dense stands that restrict native wetland plants and alter the structural and ecological values of wetlands.

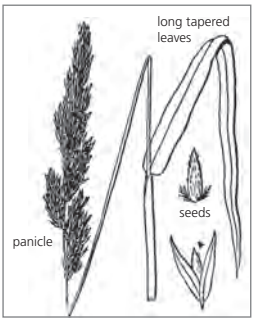
Ohio Distribution

United States Distribution

Reed Canary Grass

Phalaris arundinacea

Species at a Glance



Reed canary grass is a large, cool-season perennial that grows 0.6–2.7 m (2–9 ft) in height and forms large **monotypic** stands that can dominate an area. Two virtually indistinguishable ecotypes are thought to exist in the United States, including a native ecotype and a more aggressive Eurasian one.

Identification

Leaves: Long, gradually tapering leaves with flat blades have a rough texture on both the upper and lower surfaces. Size ranges are 9–25 cm (3.5–9.8 in) long and 0.5–2 cm (0.2–0.8 in) wide. Coloration can be light green to a straw color. A transparent, thin, membranous outgrowth called a **ligule** is also present at the junction of the leaf and **stalk**.

Flowers: Densely packed clusters called **panicles** are generally 7.5–15 cm (3–5.9 in) in length and arise from the stem high above the leaves from May to mid-June. At first, they appear a green to purple color, but gradually change to beige over time.

Stems: Sturdy, often hollow, hairless stems are 1 cm (0.4 in) in diameter and have some reddish coloration near the top.

Similar Species

The highly transparent **ligule** is helpful in distinguishing reed canary grass from the non-native orchard grass (*Dactylis glomerata*), which has leaves with wider blades, and more narrow and pointed clusters of flowers. Additionally, the native Canada bluejoint grass (*Calamagrostis canadensis*) may be mistaken for reed canary grass in areas where orchard grass is rare.

Habitat

A wetland plant, this species typically occurs in soils that are saturated for most of the growing season but where standing water does not persist for extended periods. Ideal conditions typically occur in roadside ditches, rights-of-ways, river dikes and levees, shallow marshes, and meadows.

Spread

Seeds and **creeping rhizomes** help reed canary grass spread aggressively. Seeds can be moved from one wetland to another by waterways, animals, humans, or machines.

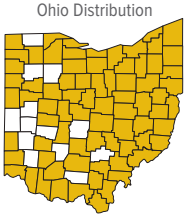
Distribution

Native range of this plant is debated; it is native to Europe and possibly parts of Asia, and also parts of the United States. Aggressive behavior that is exhibited in many parts of North America may be a result of escaped cultivars, bred for their persistence for forage and erosion control. It is found throughout the northern half the of United States and is widespread in Ohio.

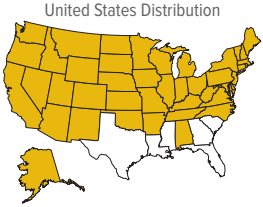
Environmental Impacts

Reed canary grass forms large, **monotypic** stands that harbor few other plant species and are of little use to wildlife. Once established, it dominates an area by building up a seed bank that can eventually erupt, germinate, and recolonize treated sites.

Ohio Distribution



United States Distribution



Starry Stonewort

Nitellopsis obtusa

Species at a Glance

This **submerged** green **macroalga** is native to Eurasia and is often mistaken for a true plant due to the appearance of stems. It owes its name to the tiny white star-shaped **bulbils** it produces for vegetative reproduction. Its ability to degrade ecologically sensitive areas and proliferate rapidly makes it a highly invasive species.

Identification

Starry stonewort is a light green, relatively large alga that can grow up to 2 m (7 ft) tall at the main stem, which is smooth in texture. Along the length of the stem there are **nodes** from which **whorls** of 4–6 long, generally straight branchlets arise. The most distinguishing character of starry stonewort is the white, star-shaped **bulbil** that appears along clear threads called **rhizoids** coming from the base which help the alga attach.

This alga is **dioecious**, with individuals having either male (**antheridia**) or female (**oogonia**) reproductive structures, but not both. When present, these reproductive structures can be found along the branchlets near a long **bract cell** and appear as a red to orange ball (**antheridium**) or egg-shape (**oogonium**). At this time, it appears that no females have been documented in the U.S., with spread occurring via **bulbils** or fragments of male individuals.

Similar Species

Starry stonewort is similar in appearance to native green **macroalgae** called *Chara*, or musk-grasses (*Chara* spp.) *Chara* often has a distinct musky smell and most species have a rough, textured feel to the stem whereas

starry stonewort is smooth. It can also be confused with *Nitella* (*Nitella* spp.) Starry stonewort is stiffer and generally maintains its shape when taken out of the water, whereas *Nitella* is more relaxed and branches may lay down. Compared to native stonewort species, starry stonewort is much larger. Of all these species, only starry stonewort produces white, star-shaped **bulbils**.

Habitat

This species has been found at depths from 1–8 m (3–26 ft) in lakes and slow moving rivers, often near docks or marinas where boat traffic may be a source of introduction. It can survive in fresh or brackish water and prefers low light conditions and waters rich in calcium and phosphorus. It can grow on a variety of substrates including silt, sand, and **detritus** and has been recorded in the Great Lakes region in water temperatures ranging from 0–24° C (32–75° F).

Spread

Starry stonewort was likely introduced through ballast water. Where both males and females are found, it can produce fertilized egg cells that may be spread from movement of mammals and waterfowl from infested areas. No females have been documented in the U.S., but it also reproduces **vegetatively** by both **bulbils** and fragments which can be easily spread by humans in recreational and research gear such as bait buckets, boat trailers, nets, and other equipment.

Distribution

Native to Eurasia from Europe to Japan, starry stonewort was first found in the U.S. in 1978. The first documented occurrence was in New York along the St. Lawrence River and it has since spread to Indiana, Michigan, Minnesota, Pennsylvania, Vermont, and Wisconsin. In 2017 it was found in Ohio's waters of Lake Erie in Erie County near Cedar Point.

Environmental Impacts

Starry stonewort can form dense mats on the bottom of a waterbody, suppressing native vegetation through **allelopathy** and altering habitat for fish and other aquatic life. These mats can also detach and float to the surface, interfering with recreational activities such as boating, fishing, and swimming. Management and control of infestations may incur substantial economic costs.

Ohio Distribution

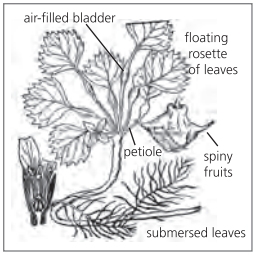
United States Distribution

Water Chestnut

Trapa natans

Species at a Glance

Water chestnut is a rooted aquatic plant, very different from the one you find in Chinese take-out. It can dominate ponds, shallow lakes, and rivers because it grows in thick, dense colonies and can grow as much as 4.8 m (16 ft) in length.



Identification

Leaves: Come in two distinct forms: floating and **submersed.** Floating leaves are triangular or fan-shaped with noticeably toothed **margins** on the outer edges. They are roughly 1–3 cm (0.4–1.2 in) long and are arranged in large floating **rosettes**. The upper leaf surface is glossy, while the underside is covered with soft hairs. These leaves are kept afloat by spongy, inflated bladders attached to long stems called **petioles** (up to 15 cm [5.9 in]), which connect the leaves to the **submersed** section of the plant. The **submersed** leaves are green and feathery and whorl around the cord-like stem.

Flowers: Small flowers, about 1 cm (0.4 in) long, with four white petals are located in the center of the leafy **rosette** and usually appear in mid to late July.

Fruits: Black **nut**-like structures have four spiny projections that are so sharp they are capable of penetrating shoe leather.

Roots: Numerous finely branched roots develop along the lower stem, which assist in anchoring the plant to the substrate.

Similar Species

None.

Habitat

Water chestnut can grow in any freshwater setting, but prefers nutrient rich waters less than 4.8 m (16 ft) deep in ponds, lakes, slow moving streams, and rivers.

Spread

Water chestnut has a high reproductive rate, with each plant producing up to 15 **nuts** per season. Each **nut** can sink to the bottom and remain viable for up to 12 years. It can also spread vegetatively when the **rosettes** of floating leaves break apart and fragments attach to boats and trailers or float to new locations.

Distribution

The native range of water chestnut includes Europe, Asia, and Africa. It was brought to the United States by water gardeners in the 1800s and quickly established, with the first known occurrence in Massachusetts. It has since spread to the waters of many Mid-Atlantic and Northeastern states. There are currently no records from Ohio, but there are multiple records from Pennsylvania and western New York.

Environmental Impacts

The dense floating mats of water chestnut can choke a water body, limiting light and oxygen, and impede boating and other recreational activities. Colonies of this plant can outcompete native organisms for nutrients and space, and they offer little nutritional value for wildlife.

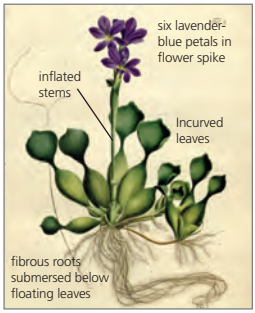
United States Distribution

Water Hyacinth

Eichhornia crassipes

Species at a Glance

Water hyacinth is a free-floating flowering perennial that forms dense "rafts" of plant material in the water that can cover a lake surface from shore to shore. Its beauty makes it a popular ornamental plant for ponds; however, its fast growth makes it one of the worst aquatic weeds in the world, as it can double its population in as little as six days.



Identification

Leaves: Oval, rounded, circular, or elliptical leaves are arranged in **rosettes** on **stalks** that can rise 0.9 m (3 ft) above the water's surface. They are thick, glossy, waxy green, waterproof, and typically up to 15 cm (6 in) wide. The sides are gently incurved and often undulate, and leaf bases are heart-shaped, square, or rounded with dense veins.

Flowers: Multiple flowers (8–15) form in a single showy **spike** that can be up to 30 cm (12 in) long atop a thick **stalk**. Each flower in the **spike** has six lavender-blue petals. The uppermost petal is somewhat larger with a bright yellow, blue-bordered, central spot.

Fruit/Seeds: A three-celled capsule contains many seeds.

Stems/Roots: Spongy, inflated stems can grow up to 0.5 m (1.5 ft) long. The stems are filled with air spaces, which gives them a spongy appearance and allow them to stay afloat. Fibrous roots hang **submersed** beneath the floating leaves. They are dark purple to black and have a feathery appearance.

Similar Species

Water hyacinth can be confused with American spongeplant (*Limnobium spongia*) because of its similar looking leaves; however, American spongeplant is not found in Ohio, has white roots instead of black, and has slender, ridged stems instead of bulbous, inflated stems. It can also be confused with water lettuce (*Pistia stratiotes*), which has large ribbed leaves and doesn't have the showy flowers characteristic of water hyacinth.

Habitat

This species grows in shallow temporary ponds, wetlands, marshes, sluggish flowing waters, lakes, reservoirs, rivers, and ditches of temperate climates. It can tolerate extremes in water level fluctuations and seasonal variations in nutrients, pH, temperatures, and toxins. It is not winter hardy and needs temperatures above 12°C (54°F) to survive.

Spread

Because of its attractive purple flowers, water hyacinth is a popular plant among ornamental pond and water garden enthusiasts. As a result, escape from water gardens as well as deliberate releases have been major modes of dispersal. Once introduced, its high growth rate has allowed it to quickly establish and spread. It reproduces both by **fragmentation** and by forming plantlets at the end of a shoot that grows from the base of the stem.

Distribution

Native to South America in Brazil, water hyacinth is now found in more than 50 countries on five continents. It is believed to have been introduced to the United States in 1884 for the Cotton States Exposition held in New Orleans. Because of its beauty, it was given as gifts to attendees who took it home to add to backyard ponds. By 1900 it had escaped cultivation to become a serious pest. It has been recorded in several Ohio counties, though none of these populations have persisted through the winter.

Environmental Impacts

Water hyacinth forms thick mats that block waterways and limit boat traffic, swimming, fishing, and other recreational activities. In drainage and irrigation canals, it impedes flow which can result in flooding and clogged pumps. Dense mats prevent sunlight and oxygen from reaching the water column and the **submerged** plants below, shading out native species and reducing biodiversity.

Ohio Distribution

United States Distribution

Water Lettuce

Pistia stratiotes

Species at a Glance

As its name implies, water lettuce is a floating perennial plant that resembles an open head of lettuce. It forms in colonies of **rosettes** that link together to blanket the water's surface, blocking waterways and disrupting natural ecosystems.

Identification

Leaves: Thick, soft, light green leaves are formed in **rosettes** with no leaf stems. **Rosettes** can occur by themselves or connected to others by short **stolons**. Leaves are large, up to 16 cm (6 in) long with parallel ridges (veins) covered in short hairs. Leaf **margins** are wavy and the top **margins** are scalloped.

Flowers: Flowers are inconspicuous and hidden in clusters in the center amongst the leaves. They form on a small **stalk** with a single female flower and a **whorl** of male flowers above.

Fruit/Seeds: The **fruit** arises from the female flower as a many-seeded green berry.

Stems/Roots: Roots are light-colored and feathery and hang **submersed** beneath the floating leaves.

Similar Species

Water lettuce may be confused with water hyacinth (*Eichhornia crassipes*); however, water lettuce has large ribbed leaves and it doesn't have the showy flowers characteristic of water hyacinth.

Habitat

Mostly occurring in slightly acidic lakes, rivers, ponds, and canals in temperate climates, water lettuce has also been found to survive in mud. It is not winter hardy, requiring temperatures above 15°C (59°F) for growth; however, submerged seeds can survive water that is 4°C (39°F) for at least two months.

Spread

While some believe water lettuce is a native to Florida, others believe it was brought over in the ballast water of ships from the tropical and subtropical regions of Asia, Africa, and South America. It is also commonly sold through the aquarium industry and additional introductions have occurred as plants are intentionally released or escape from ponds and water gardens. This plant can spread by **fragmentation**, by daughter plants that form on the **stolons** of the mother plant, or by seeds.

Distribution

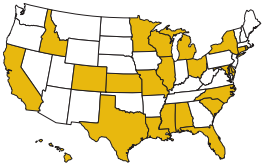
Water lettuce has been present in Florida since at least 1765; however, it has since spread throughout the southeastern United States north to the Great Lakes region and westward to Texas, Arizona, and California. There are records from several Ohio counties and multiple records occur within the Lake Erie watershed from Michigan, New York, and Ontario.

Environmental Impacts

The large mats formed by water lettuce negatively impact boating, fishing, and swimming. They also make navigation difficult, hinder flood control efforts, and clog hydroelectric turbines. The colonies of **rosettes** decrease biodiversity by blocking sunlight and oxygen from penetrating into the water column, thereby altering the native plant and animal communities below.

Ohio Distribution

United States Distribution

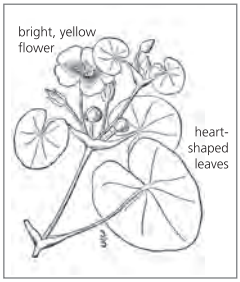


Yellow Floating Heart

Nymphoides peltata

Species at a Glance

This aggressive aquatic perennial was introduced as a garden ornamental from eastern Asia and has since spread throughout the United States and Canada. It forms dense mats of vegetation in the water that exclude native species and alter the ecology of waterways.



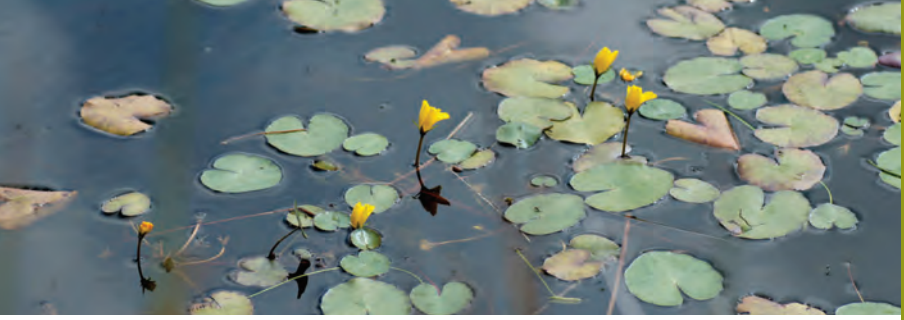
Identification

Leaves: Shiny, green, heart-shaped or nearly circular leaves are 5–15 cm (2–6 inches) long and are set on **stalks** that float at the water's surface. Leaves are frequently seen with reddish-purple blotches and are slightly wavy or rippled. They are **alternately** arranged along the main stem and **oppositely** arranged on the flower stems.

Flowers: Occur from June to October and are produced on **stalks** just above the water's surface. They can be either solitary or in clusters of up to five. Flowers have five yellow petals that have distinctive fringed edges, five **sepals**, and five **stamens**.

Fruit/Seeds: 2.5 cm (1 in) long **fruit** capsules contain numerous flat, oval seeds with "hairy" edges. When ripe, they split open, releasing the seeds to float on the surface of the water.

Roots: Bottom-rooted with long branched stems that reach about 1 m (3 ft) or more.



Similar Species

Yellow floating heart may be confused with the native spatterdock (*Nuphar advena*) or watershield (*Brasenia schreberi*). Spatterdock has larger leaves that grow to 30 cm (12 in) or more and has yellow flowers in the shape of a ball with six or more petals. Watershield has distinctive oval-shaped leaves, an inconspicuous purple flower, and can be easily recognized by a gelatinous slime that covers the stem and underside of the leaves.

Habitat

Most commonly found in slow-moving waters about 0.5–4 m (1.5–13 ft) deep, such as rivers, lakes, reservoirs, ponds, and swamps, and can even grow on damp mud.

Spread

Because of its popularity in the aquarium trade, yellow floating heart can be easily purchased on the internet. Spread can occur when it escapes outdoor water gardens during flooding events, or when it is intentionally discarded into waterways. Since it spreads both by seed and **fragmentation**, pieces of plant and seeds with stiff hairs can be moved to new areas on water currents or as they hitchhike on the feathers or fur of waterfowl and other wildlife.

Distribution

Native to Eurasia and the Mediterranean region, yellow floating heart was introduced as an ornamental plant into the United States. In Ohio it has been reported in several counties throughout the state.

Environmental Impacts

Yellow floating heart grows in dense patches that negatively impact wildlife habitats by outcompeting ecologically important native plants and creating stagnant areas of low oxygen under the mats. These mats also make recreational opportunities such as angling, boating, swimming, and paddling difficult.

Ohio Distribution

United States Distribution

Yellow Iris

Iris pseudacorus

Species at a Glance

This exotic member of the iris family, also called the yellow flag, is commonly found in wetlands in many regions of the United States. It is an **emergent** aquatic perennial with showy yellow petals that can grow on average 0.3–0.9 m (1–3 ft) tall, although some can reach up to 2.1 m (7 ft).

Identification

Leaves: Long, broad, flattened, and sword-shaped; usually dark green in color, pointed at the ends and overlapped at the base. Can grow up to 2.5 cm (1 in) wide.

Flowers: There are usually 2–3 flowers on each **stalk** that have bright yellow to cream-colored petals with **sepals** outlined in purple and brown. They are 8–10 cm (3.1-3.9 in) in diameter and bloom June through August.

Seeds: Numerous smooth, flattened seeds grow in small oblong shaped capsules, roughly 5 cm (2 in) long. Capsules grow in clusters at the base of the flower and have the ability to float.

Roots: Fleshy and form from a single-branched stem. They are 10–30 cm (3.9–12 in) long.

Similar Species

Native look-a-likes include the cattail (*Typha* spp.), bur-reeds (*Sparganium* spp.), American sweetflag (*Acorus americanus*), and the blue flag iris (*Iris versicolor*). Cattails look similar during spring growth, except that their leaves are arranged in rounded layers rather than flat like the yellow iris. Native irises have thinner leaves and blue-purple flowers instead of yellow.

Habitat

Found mainly in wetland areas like marshes and the shores of lakes, ponds, and streams; however, they have a high tolerance for drought and can survive long periods in dry, acidic, and low-oxygen soils.

Spread

The yellow iris reproduces vegetatively through horizontal underground stems called **rhizomes**, which form into roots, allowing it to re-grow new plants.

Distribution

Native to Europe, western Asia, northern Africa, and the Mediterranean region, yellow iris was brought to the United States as an ornamental plant that quickly spread to uncultivated areas and is now established in over 40 states. The Ohio range map is incomplete as it is known to occur in multiple counties throughout the state.

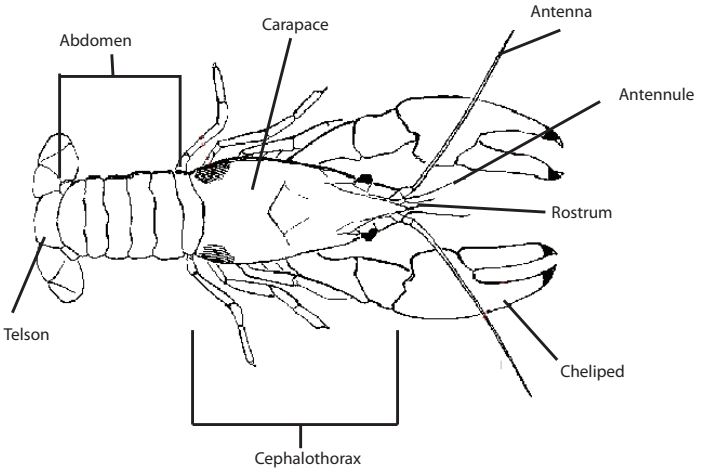
Environmental Impacts

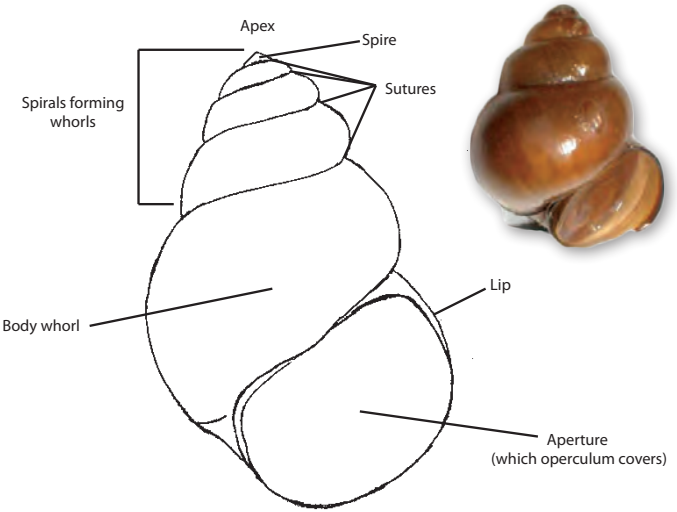
The roots of the yellow iris are sturdy and connect hundreds of flowering plants underground, congesting water flow and leaving no room for native wetland plants to grow. It is also poisonous, harming fish and animals that touch or eat it. It can cause skin irritation when touched, so caution should be used when trying to remove it.

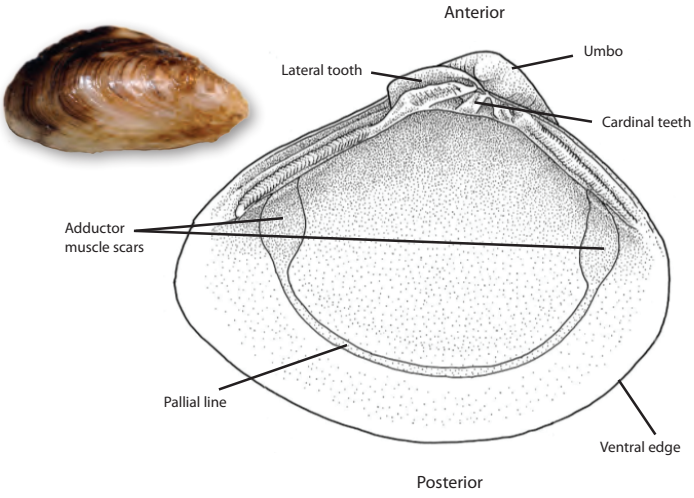
Ohio Distribution

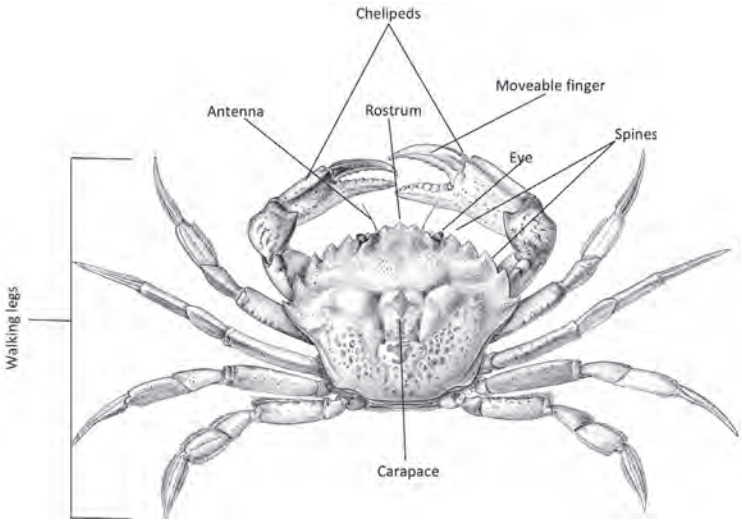
United States Distribution

Invertebrate Anatomy






Anterior
Umbo
Lateral tooth
Cardinal teeth
Adductor
muscle scars
Pallial line
Ventral edge
Posterior

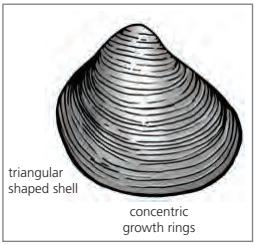

Chelipeds
Moveable finger
Antenna
Rostrum
Spines
Eye
Walking legs
Carapace

Asian Clam

Corbicula fluminea

Species at a Glance

The Asian clam, also called the Asiatic clam, pygmy clam, or gold clam, is a small freshwater bivalve with two thick-hinged shells that rarely exceed the size of a quarter. It was first introduced to the west coast of the United States in 1924, possibly as a food item. By the 1970s, it occupied most of the Mississippi River Basin, the Gulf Coast, and the eastern United States.



Identification

The shell is typically yellow-green to brown; however, darker **morphs** exist, usually in the southwestern United States. While the small shell averages 2.5 cm (1 in), it can reach up to 6.5 cm (2.6 in) long. The shell is thick, triangular in shape, and displays coarse, concentric growth rings. The inside of the shell is layered with white to light purple polished **nacre** and the teeth are finely **serrated**. Microscopic juveniles called **veligers** appear under a microscope in a D-shape less than 1 mm (0.04 in) in length.

Similar Species

Introduced fingernail and pea clams have smooth, instead of **serrated**, teeth and are generally smaller, with thinner shells and less prominent growth rings than the Asian clam.

Habitat

The Asian clam prefers running water with a sand or gravel substrate. It can be found in streams, rivers, ponds, lakes, and man-made canals. Although it is a freshwater species, it can withstand slightly brackish waters and is also tolerant of degraded waters.

Spread

Because it is **hermaphroditic**, the Asian clam is capable of self-fertilization. In warmer waters it can spawn year round, and a single clam can release hundreds to thousands of free-floating, microscopic **veligers** per day. These juveniles are then spread by water currents and human activity. Asian clams attach to boating, fishing, and scuba diving equipment, and **veligers** can be transferred in bait buckets or live wells.

Distribution

While native to the temperate and tropical regions of Asia and Africa, the Asian clam is widespread in the United States and spans the entire state of Ohio.

Environmental Impacts

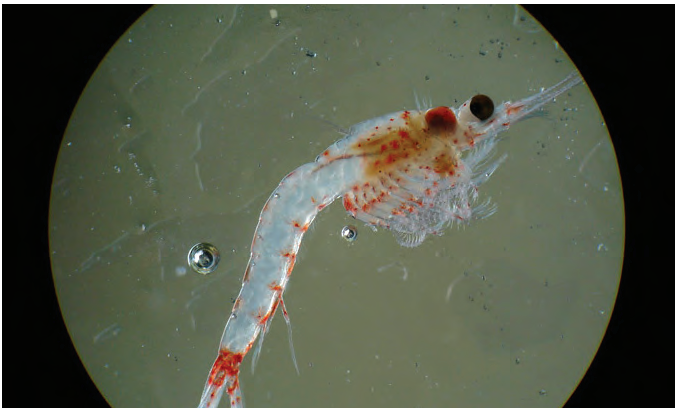
The Asian clam is a known **biofouler** that blocks water flow to power plants and industrial water systems, and causes problems in irrigation canals and pipes. It also increases clarity in the water column by filtering suspended matter, leading to excessive plant growth and altered nutrient and water quality. This clam may also compete with native mollusks for food and habitat.

Ohio Distribution

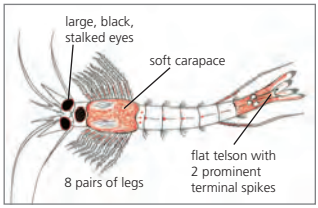
United States Distribution

Bloody-red Shrimp

Hemimysis anomala



Species at a Glance



The bloody-red shrimp is a tiny freshwater crustacean in the order Mysidacea, more commonly referred to as mysids. Mysids are also sometimes called opossum shrimp because females typically carry their eggs in a pouch. The impact of this shrimp on the Great Lakes is unknown, but based on its history of invasion across Europe, significant impacts are possible.

Identification

Bloody-red shrimp are very small; males reach only 8–10 mm (0.3–0.4 in) and females reach 11–16 mm (0.4–0.6 in). They are ivory or translucent, but pigmentation can appear bright red to orange. Their eyes are large, black, and stalked, and they have 8 pairs of legs. A soft **carapace** covers the head and thorax. Under a microscope, the **telson** (the small, central segment of the tail) will be flat with two prominent **terminal** spikes. While these animals bear live young, juveniles are not easily visible to the naked eye. Its unique swarming behavior is unlikely to be confused with anything else in the Great Lakes. During daylight hours, especially in late summer, it may be observed forming reddish swarms in the shadows of piers, boats, or break walls. At night swarms disperse, but in clear, calm waters, they may be detected by shining a bright light on the water; the shrimp will rapidly swim away from the light.

Similar Species

The native Great Lakes opossum shrimp (*Mysis diluviana*) also has stalked eyes and overlapping size ranges. The best way to tell these species apart is by the shape of the **telson** (using a microscope or hand lens). The native opossum shrimp will have a deeply forked **telson** instead of a distinct flat **telson**.

Habitat

This species typically aggregates and hides in rocky crevasses and shadowed areas during the day and disperses to deeper water at night. It typically avoids soft bottoms and vegetation, but can be found in fresh or brackish water over hard bottom surfaces such as rocks and shells.

Spread

It was most likely introduced into the Great Lakes through ballast water discharges from transoceanic ships. Inter-basin transfer is most likely facilitated by bait buckets, live wells, bilges, boat motors/trailers/hulls, or other equipment used in the water.

Distribution

While native to the Ponto-Caspian region of eastern Europe, the bloody-red shrimp was first reported in 2006 in Lake Michigan waters. The shrimp's current distribution includes lakes Michigan, Ontario, and Erie. In Ohio, the only records are from Lake Erie in Ottawa and Ashtabula counties.

Environmental Impacts

The bloody-red shrimp is considered "high risk" for invasion of inland lakes in the Great Lakes region. Its history of invading canals, streams, lakes, and reservoirs throughout Europe also indicate the potential for significant impacts to our inland lake systems.

Ohio Distribution

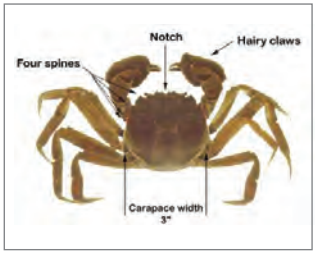
United States Distribution

Chinese Mitten Crab

Eriocheir sinensis

Species at a Glance

The Chinese mitten crab is a medium-sized burrowing crab from East Asia. It made its way to the United States in parts of San Francisco, the Great Lakes region, and the Mid-Atlantic region. It can tolerate both fresh and salt water, and its aggressive nature has allowed it to become a costly and environmentally damaging invader in these areas.



Identification

Size of the Chinese mitten crab ranges from 30–100 mm (1.2–4 in), with legs about double the length of the torso. It gets the name "mitten crab" from the dense patches of hairs covering the claws, resembling mittens. These hairs are more common in males than females, and juveniles may not have any hair. The tips of the claws are typically white. Four pairs of spines are located on the side edges of the **carapace**. Color ranges from a light brownish-orange to a greenish-brown. There is also a small notch present between the eyes.

Similar Species

None.

Habitat

While the Chinese mitten crab is the only crab found in the fresh waters of the United States, it migrates to salt water to reproduce. This crab is very skillful at walking on land, especially during upstream migration, allowing it to bypass dams and other natural obstructions.

Spread

The Chinese mitten crab has most likely spread in the ballast water of ships and as it clings to the hulls of barges during transport. It is becoming popular in the seafood market, especially in New York, and may have been released by purchasers into new areas. It is not expected to become established in Ohio as it requires salt water for reproduction.

Distribution

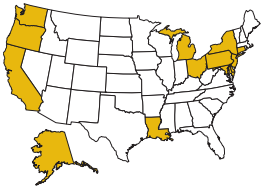
This species was first identified in eastern Asia and subsequently spread throughout Europe. It was discovered in the United States in 1962 in the Great Lakes and has since been reported along the Gulf Coast, San Francisco Bay, Chesapeake Bay, the Hudson River, and other East Coast areas. There is no evidence they are established in the Great Lakes, but specimens have been collected in the Detroit River and Lake Erie, including Ohio waters off of Erie and Lorain counties.

Environmental Impacts

The burrowing behavior of the Chinese mitten crab causes erosion of stream banks and damage to embankments, as well as clogged drainage systems. It is also becoming a nuisance for recreational and commercial anglers when it becomes tangled up in nets.

Ohio Distribution

United States Distribution



Faucet Snail

Bithynia tentaculata

Species at a Glance

The faucet snail is an aquatic snail native to Europe that threatens waterfowl, food webs, and can clog water intakes. It can quickly spread to inland waters, often reaching high densities and outcompeting native snails.

Identification

The shell is shiny, oval in shape, and ranges from light brown to black in color. The **spire** is relatively large and rounded, consisting of 5–6 somewhat flattened **whorls**. Adults can grow up to 12–15 mm (0.5 in) in length, but are generally smaller. A tough plate called the **operculum** tightly covers the shell opening (**aperture**). It is teardrop-shaped and displays concentric rings on adults. The **aperture** is on the right side when the shell is pointed up, and is less than half the height of the shell.

Similar Species

Native snails and young nonnative mystery snails can look similar to the faucet snail and can be difficult for non-experts to identify conclusively.

Habitat

Commonly found in freshwater ponds, shallow lakes, and canals, the faucet snail attaches to objects in the water. It prefers gravel, sand, clay, mud, or the undersides of rocks as substrate in the fall and winter, and aquatic plants in warmer months. It can be found in depths of up to 5 m (16 ft).

Spread

This snail can spread by attaching to aquatic plants, waterfowl, boats, anchors, other recreational gear, and equipment placed in the water. It can also live in the water of livewells, bait buckets, and bilges. The faucet snail can live for up to one month in dry mud, so proper cleaning of equipment is essential before moving to a new water body.

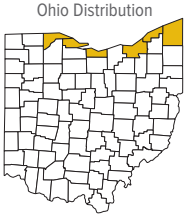
Distribution

Native to Europe, the faucet snail was introduced to the Great Lakes in the 1870s. It was most likely brought to North America unintentionally in the solid ballast of larger timber transport ships or in vegetation used in packing crates. It is established throughout the Great Lakes region, and records in Ohio are confined to Lake Erie adjacent counties.

Environmental Impacts

The faucet snail competes with native snails for food and resources and can clog water intake pipes and screens in municipal water systems. It is also an intermediate host for three intestinal trematode parasites that can kill waterfowl. These parasites do not pose a risk to humans consuming cooked fish or waterfowl.

Ohio Distribution



United States Distribution

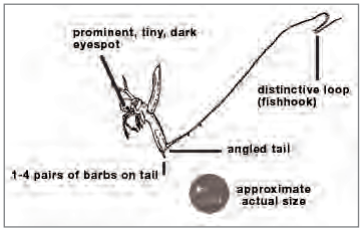
Fishhook Waterflea

Cercopagis pengoi

IN OHIO RIVER BASIN

Species at a Glance

The fishhook waterflea is a tiny freshwater crustacean that consumes native plankton and collects in cotton-like masses on fishing lines and downrigger cables. It has the potential to outcompete native fish larvae and can threaten a lake's entire ecosystem.



Identification

This species is not actually a flea, but rather a predatory **cladoceran** that sticks on fishing lines and forms clumps that look and feel like gelatin with tiny black spots (eyes). Magnification is needed to see the transparent body, which is about 10 mm (0.4 in) in length, with the tail making up 80 percent of the total length. The tail spine is strongly angled at 90° away from the body, with 1–3 widely spaced pairs of barbs and a unique loop or "hook" at the tip. The head is composed primarily of a single large **compound eye**. The dorsal egg pouch is elongated and pointed.

Note: This species does have another **morph**, which usually occurs earlier in the spring season, but has a much shorter tail that lacks the loop at the end and has up to four paired barbs.

Similar Species

The spiny waterflea (*Bythotrephes longimanus*) is larger, with a similar delicate spine; however, it lacks the distinctive looped hook at the end of the tail. In addition, it has a bulbous balloon-shaped brood pouch, which is more elongated and pointed in the fishhook waterflea. The two species are difficult to identify without magnification.

Habitat

While it can tolerate a wide range of temperatures, from 8–30°C (46–86°F), it prefers open, deep waters and is typically found in the upper, warmer water layer.

Spread

Fishing, boating, and other recreational equipment can transport fishhook waterfleas and their eggs to new waters. In the absence of males, the females reproduce by a process called **parthenogenesis**. Enacting stricter ballast water regulations, avoiding the release of bait, rinsing boats and equipment with hot water sprayed at high pressure, and drying boats and equipment for five days before reentering the water could help prevent further invasion of this species.

Distribution

While native to Europe and Asia, the fishhook waterflea was most likely brought to the Great Lakes in the ballast water of ships traveling internationally. It was first found in 1998 in Lake Ontario but is now found in all of the Great Lakes, including the Ohio portion of Lake Erie with confirmed reports from Lake and Lucas counties.

Environmental Impacts

Expansion of the fishhook waterflea into the Great Lakes continues to decrease populations of native zooplankton species. It competes directly with juvenile and small fish for food and is considered a nuisance to fishermen because the barbed tail can hook onto and clog fishing lines, nets, trawls, and other equipment used for recreational and commercial fishing.

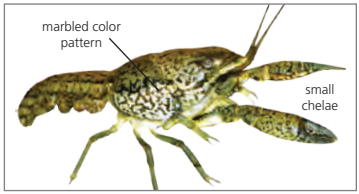
Ohio Distribution

United States Distribution

Marbled Crayfish

Taxonomy currently under review.

Species at a Glance



The marbled crayfish, also called the marmokrebs (which is German for "marbled crayfish"), is a **parthenogenic**, all-female crayfish thought to be a form of the slough crayfish (*Procambarus fallax*). Therefore, it has been designated an informal subspecies, although some researchers have proposed a new species designation, *Procambarus virginalis*. There are no known native populations of this crayfish, and the only known cases of it in the wild are where it has been introduced by humans.

Identification

This medium-sized crayfish has a distinct marbled color pattern and small pincer-like claws called **chelae**. Coloration can differ depending on its diet, occasionally showing blues or greens. The total length is up to 13 cm (5 in), but it is more often less than 10 cm (4 in). The upper side of the **carapace** is smooth, while the sides are slightly granulated.

Similar Species

The marbled crayfish is thought to be closely related to the slough crayfish (*Procambarus fallax*), which is widely distributed across Florida and has similar coloration and general appearance. Distinguishing these species can

be difficult because only female marbled crayfish exist, making it difficult to use identification keys that rely on characteristics of the male **gonopods**.

Habitat

Since there are no indigenous populations of the marbled crayfish, its habitat requirements are often assumed from its probable closest relative, the slough crayfish. This crayfish can occur in streams and rivers, but seems to prefer still or slow-flowing habitats and is typically found in marshes, wet prairies, and sloughs with organic soils. It also inhabits temporary wetlands where it can retreat into burrows during dry periods.

Environmental Impacts

Because of its high reproductive rate and the need for only one individual to start a population, this species is considered a serious future threat to aquatic biodiversity in regions where it becomes established. It is a voracious feeder and consumes a broad range of aquatic plants and invertebrates, putting it in competition with native aquatic flora and fauna.

Spread

Spread of the marbled crayfish through the pet trade increases the probability of it being released into natural ecosystems. It is the only known decapod crustacean species to reproduce through **parthenogenesis**, and therefore, all individuals are female and only one is needed to establish a new population. Because each crayfish is genetically identical, easy to care for, and has high reproductive rates, it is also popular in labs as a model organism for studying development.

Distribution

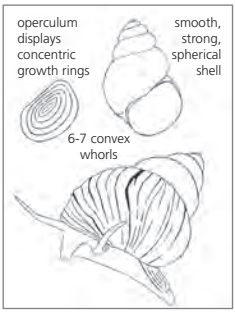
The marbled crayfish was discovered in Europe in the 1990s. It has since been introduced to multiple countries on several continents, including Germany, Sweden, Hungary, the Netherlands, Italy, Slovakia, Madagascar, Japan, Croatia, the Czech Republic, and Ukraine. While some believe the marbled crayfish originates from the southeastern United States, indigenous populations have never been reported and there are no confirmed introduced populations of this species in the United States.

Mystery Snails

Species of the genus *Bellamya* (*Cipangopaludina*)

Species at a Glance

Chinese and Japanese mystery snails are large freshwater snails commonly sold for use in freshwater aquariums and garden ponds. Their popularity in the aquarium industry has contributed to their spread across the United States, allowing them to form dense populations and outcompete native species for food and habitat.



Identification

Both species have a large shell reaching 6.5 cm (2.6 in) in height. It is smooth, strong, and spherical with convex **whorls** separated by highly-indented **sutures**. Coloration is usually dark olive-green to black for adults and lighter for juveniles. Some adults are greenish-brown, brown, or reddish-brown. The outer lip of the shell is round or oval-shaped and black. An oblong-shaped **operculum** (or "trap door") displays concentric growth rings and allows the snail to close the opening of the shell when water conditions are unfavorable or when predators attack. These two snails are often confused with each other, and many consider them the same species.

Similar Species

The native brown mystery snail (*Campeloma decisum*) has a width to height ratio smaller than both the invasive mystery snails, making it much smaller and narrower with less convex **whorls**. The introduced banded mystery snail (*Viviparus georgianus*) is generally smaller (up to 3.5 cm [1.4 in] in height) and has prominent dark horizontal bands.

Habitat

These invasive snails inhabit shallow quiet waters of lakes, ponds, marshes, irrigation ditches, rivers, and slower portions of streams with some vegetation and muddy or sandy substrate.

Spread

Introduction of these snails probably occurred through the aquarium industry and importation for Asian food markets. Once in a body of water, they can be spread by recreational water activities, bait buckets, and water holding areas on boats.

Distribution

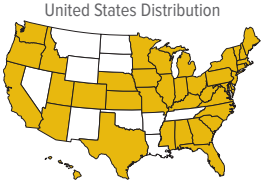
While native to Asia, the Chinese and Japanese mystery snails were introduced to the United States in the 1800s and into the Great Lakes basin in the 1930-40s. They now occur throughout the United States and sporadically in Ohio, including Lake Erie, Salt Fork Lake, and Findley Lake. They also are associated with major cities including Cincinnati, Cleveland, Columbus, and Toledo.

Environmental Impacts

Invasive mystery snails can serve as vectors for transmitting parasites and diseases, and are a known host for some parasites that can infect humans. They can also clog water intake pipes and compete with native snails for food and resources.

Ohio Distribution

United States Distribution

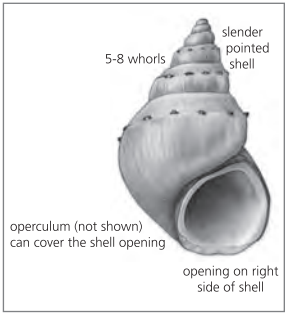


New Zealand Mudsnail

Potamopyrgus antipodarum

Species at a Glance

The New Zealand mudsnail is a tiny aquatic snail that multiplies quickly and disrupts the food chain. Its small size makes it easy for anglers and boaters to unknowingly transport it from one body of water to another, and since it reproduces **asexually**, it takes only one snail to start a new population.



Identification

The shell is long, narrow, and coiled to the right in up to eight **whorls** that come to a point at the top of the shell. Each **whorl** is separated by deep **sutures**. Some **morphs**, such as those in the Great Lakes, can have either smooth shells or shells with a **keel** in the middle of each **whorl**. Other **morphs** have small spine-like sculpture on the periphery of the shell. Average adult size in an invasive population is only 3–6 mm (0.1–0.2 in). Color varies from gray to light and dark shades of brown. An ear-shaped **operculum** covers the opening of the shell.

Similar Species

While it can resemble many different species of native snail, the New Zealand mudsnail is usually more narrow, longer, and has more **whorls** than most native snails in the same genus.

Habitat

The New Zealand mudsnail is known to inhabit freshwater ponds, streams, rivers, lagoons, lakes, ditches, and reservoirs. It has a wide range of tolerances for substrate, temperature, and salinity.

Spread

The **operculum**, which is a small cover that can be used to close the opening of the shell, allows the New Zealand mudsnail to survive out of water and hitchhike on recreational boating or fishing equipment, the feet of wildlife, feathers, and fur. It can also pass through the digestive system of predators alive and undigested.

Distribution

Native to New Zealand, this mudsnail was accidently introduced into the United States in the 1980s, possibly with the transfer of fish eggs and live game fish or in the ballast water of transoceanic ships. The only occurrences in Ohio have been in the middle of Lake Erie north of Vermillion in Lorain County.

Environmental Impacts

The New Zealand mudsnail reproduces rapidly, displacing native species of mollusks and invertebrates, altering the food web, and impacting food sources for native fish, while offering them little nutritional value in return. It also impacts water quality by altering natural cycles, such as the nitrogen cycle.

Ohio Distribution

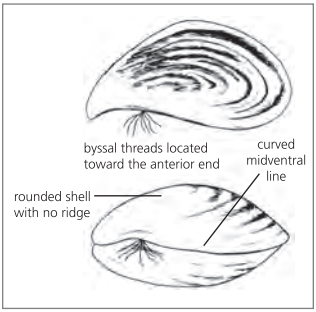
United States Distribution

Quagga Mussel

Dreissena bugensis

Species at a Glance

The quagga mussel is a small, fingernail-sized, freshwater mollusk considered one of the most intrusive, prolific, and costly aquatic invaders in North America. Some feel this species is even more harmful than its close relative the zebra mussel (*Dreissena polymorpha*). Quagga and zebra mussels are both in the genus *Dreissena*, which makes them unrelated to our native mussels.



Identification

The shell is rounded, fan-shaped, and attached by a hinge. It is smooth and lacks ridges, although it typically has dark concentric rings that fade to a pale coloration near the hinge. While usually 3 cm (1.2 in) long, some individuals can reach up to 5 cm (2 in). The sticky thread-like projections called **byssal threads** are located toward the anterior end of the shell and help it to attach to other objects. Eggs hatch into round, microscopic larvae called **veligers** that free-float in the water column for up to five weeks before settling.

Similar Species

While the zebra mussel is similar, it has a more prominent ridge on its **ventral margin** that allows it to sit upright. The quagga mussel is more rounded and

would topple over if placed on its **ventral margin**. The midventral line is also straight in the zebra mussel while curved in the quagga mussel, and the **byssal threads** are located in the middle of the shell in the zebra mussel instead of at the anterior end.

Habitat

The quagga mussel is found in both shallow, warm waters and deep, cool waters of freshwater lakes, reservoirs, ponds, quarries, and slow-moving or sluggish rivers. Its **byssal threads** attach to rocks, docks, cement, wood, and vegetation, but unlike the zebra mussel, it can also live and thrive directly on muddy or sandy bottoms. The quagga mussel can reproduce at low water temperatures as cold as 4–9°C (39–48°F).

Spread

One female can produce up to one million eggs in a breeding season. The free-floating **veligers** can be scooped up undetected and transferred in bait buckets, bilge water, and live wells. Because dreissenid mussels can survive out of water for up to five days, they are easily transported to other waterways on recreational boating and fishing gear.

Distribution

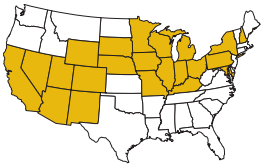
While native to the Black, Azov, and Caspian sea drainages, the quagga mussel first appeared in the Great Lakes in Lake Erie in 1989 in contaminated ballast water. It has since spread throughout all of the Great Lakes, the Mississippi River drainage, and many inland lakes. In Ohio, they have been found in Lake Erie and in the Ohio River near Cincinnati in Hamilton County, but that range may be expected to expand.

Environmental Impacts

Like the zebra mussel, the quagga mussel clogs water intake pipes and damages equipment at power and water facilities. It also harms fisheries, alters water quality, and increases the growth of harmful algae. It decreases food sources for native species by filtering large amounts of microscopic plants and animals from the water, and it can accumulate contaminants in its fatty tissues. Economic impact is in the billions of dollars.

Ohio Distribution

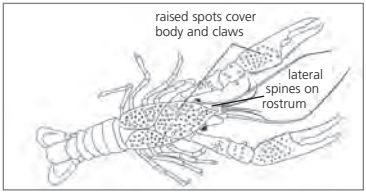
United States Distribution



Red Swamp Crayfish

Procambarus clarkii

Species at a Glance



The red swamp crayfish, also known as the red swamp crawfish, Louisiana crawfish, or mudbug, is a large and aggressive crayfish whose native range extends from northern Mexico to Florida and north to southern Illinois. Often used in classrooms and as a popular food item, this highly adaptable crayfish has escaped to invade the Midwest and beyond, impacting aquatic ecosystems by chewing up vegetation, outcompeting native species, and altering water quality.

Identification

Adult red swamp crayfish are a dark red color with raised bright red, white, or black spots (**tubercles**) covering the body and claws. On the claws, the **tubercles** are a lighter red color than the background. Juveniles are a uniform gray sometimes overlain with dark wavy lines. Occasionally, a genetic mutation may turn the body and/or claws blue. A distinctive characteristic of this species is that the **areola** is linear to obliterate (invisible or indistinct). The pincers are narrow and long and the **rostrum** has lateral spines or notches near its tip. Size is typically 5–13 cm (2–5 in).

Similar Species

The red swamp crayfish most closely resembles the white river crayfish (*Procambarus acutus*) which it often overlaps in range and is native to Ohio. On adult claws, white river crayfish have dark red **tubercles** on a lighter

background whereas red swamp crayfish have lighter red **tubercles** on a darker background. White river crayfish also have an **areola** that is narrow but never obliterated, and the juveniles typically have spots on the **carapace** instead of wavy lines. White river crayfish can also be found in streams and ditches with a stronger flow than what's preferred by the red swamp crayfish.

Habitat

The red swamp crayfish is tolerant of a wide range of habitats, including low oxygen levels, extreme temperatures, pollution, and areas with large water level fluctuations. It prefers marshes, swamps, ponds, and slow-moving rivers and streams where the soils are high in organic content and there is plenty of organic debris such as logs, sticks, or water soaked leaves. In times of drought or cold, the red swamp crayfish can burrow into the sediment until conditions are more favorable.

Spread

Because this species is widely available through the seafood industry and aquarium trade, it is most likely spread when it is intentionally or unintentionally released. Aquarists who keep them as pets, teachers and students who use them as live study specimens, and consumers who purchased them from live food markets often release this species into the wild. The red swamp crayfish is also able to crawl overland for long distances at night and during wet weather.

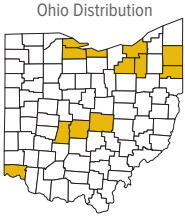
Distribution

Native to the Gulf Coast and the Mississippi embayment up to Illinois, the red swamp crayfish has spread widely throughout the United States, including much of Ohio.

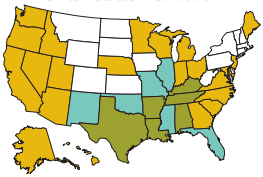
Environmental Impacts

The red swamp crayfish can quickly dominate lakes, ponds, rivers, and wetlands. It feeds heavily on plants, snails, fish, and amphibians, competing with native crayfish and other species for food and habitat. It can also carry crayfish fungus plague which can lead to declines in native crayfish. In addition, its burrowing behavior can be problematic to levees, dams, and irrigation systems.

Ohio Distribution



United States Distribution



Orange - Invasive Green - Native
Blue - Both Native & Invasive

Rusty Crayfish

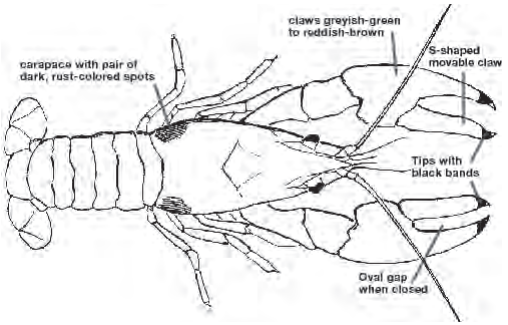
Faxonius rusticus

Species at a Glance

The rusty crayfish is a large, aggressive crustacean that can devastate aquatic ecosystems with its huge appetite and outcompete native crayfish for food and shelter.

Identification

Adult rusty crayfish are typically 8–13 cm (3–5 in) long, with large, black-tipped claws, and smooth mouthparts. They are typically grayish-green to reddish-brown in color, with a set of dark rusty orange spots on the anterior edge of each side of the **carapace**, which is the most distinguishing feature. Due to the **hybridization** habits of male rusty crayfish with females of other crayfish species, these spots may not always be present or well developed.



Similar Species

The rusty crayfish may be confused with other native and invasive crayfishes, including the calico crayfish (*Faxonius immunis*), virile crayfish (*F. virilis*), and northern clearwater crayfish (*F. propinquus*). However, these crayfishes generally have smaller claws and lack the rusty orange spots present on the **carapace**. Rusty crayfish are most similar to the Norwood River crayfish (*F. raymondi*), but the two can be distinguished using the mandibles which are smooth in the rusty crayfish and **serrated** in the Norwood River crayfish.

Habitat

Rusty crayfish are pollution tolerant and often found in silt, clay, or gravel substrates and prefer areas with adequate rock, log, and debris cover; however, they can survive in a variety of habitats, including lakes, rivers, ponds, and streams. They are most active at temperatures above 8°C (46°F).

Spread

Anglers using rusty crayfish as bait are one of the most common ways they have spread to new regions. It is not necessary to have both males and females to establish a new invasion; a female carrying viable sperm could begin a new population if released into a suitable environment.

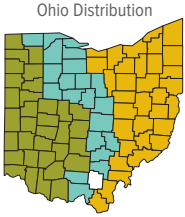
Distribution

While their native range extends throughout the Ohio River basin in southwestern Ohio, Kentucky, Tennessee, Illinois, and Indiana, rusty crayfish have become invasive in Michigan, Missouri, Iowa, New Mexico, New York, New Jersey, Pennsylvania, the New England states, and areas of Ontario, Canada. They have also become established in Europe, China, and Japan. In Ohio, they are generally considered native to most of western Ohio in both the Ohio River and Lake Erie drainages, though this is undergoing further investigation.

Environmental Impacts

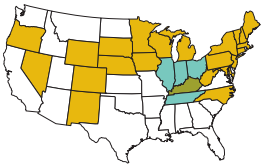
Rusty crayfish reduce native crayfish populations by competing for food and daytime hiding locations. They are very aggressive and voracious eaters, destroying aquatic plant beds and reducing food, shelter, and spawning sites for other organisms, including valued sport fish.

Ohio Distribution



Orange - Invasive Green - Native
Blue - Both Native & Invasive

United States Distribution



Orange - Invasive Green - Native
Blue - Both Native & Invasive

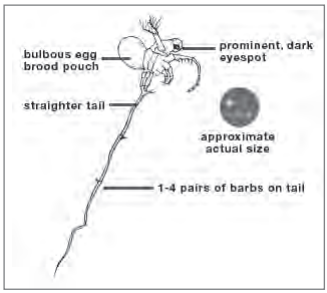
Spiny Waterflea

Bythotrephes longimanus

IN OHIO RIVER BASIN

Species at a Glance

The spiny waterflea is a tiny freshwater crustacean that consumes native plankton and collects in cotton-like masses on fishing lines and downrigger cables. It has the potential to outcompete native fish larvae and can threaten a lake's entire ecosystem.



Identification

This species is not actually a flea, but rather a predatory **cladoceran** that sticks on fishing lines and forms clumps that look and feel like gelatin with tiny black spots (eyes). Magnification is needed to see the transparent body, which ranges from 6–16 mm (0.2–0.6 in) long. The single long, straight tail, which makes up to 70 percent of its length, has several spikes or barbs. The ball-shaped head with a large compound eye is clearly distinct from the body.

Similar Species

The fishhook waterflea (*Cercopagis pengoi*), which is smaller, also has a similar delicate spine; however, its tail has a distinctive looped hook at the end. It also has a more elongated and pointed brood pouch, in contrast with the spiny waterflea's bulbous, balloon-shaped brood pouch. The two may be difficult to identify without magnification.

Habitat

Prefers large, deep, clear lakes with summer bottom temperatures of 10–24°C (50–75°F), but can also be found in wetlands, estuaries, and marinas. Spiny waterfleas do not tolerate warm lake temperatures.

Spread

Fishing, boating, and other recreational equipment can transport spiny waterfleas and their eggs to new waters. In the absence of males, the females reproduce by a process called **parthenogenesis.** Enacting stricter ballast water regulations, avoiding the release of bait, rinsing boats and equipment with hot water sprayed at high pressure, and drying boats and equipment for five days before reentering the water could help prevent further invasion of this species.

Distribution

While native to Europe and Asia, the spiny waterflea was most likely brought to the Great Lakes in the ballast water of ships traveling internationally. It was first found in 1984 in Lake Huron but is now found in all of the Great Lakes, including the Ohio portion of Lake Erie and a couple inland records in the state.

Environmental Impacts

The spiny waterflea decreases populations of native zooplankton and competes directly with juvenile and small fish for food although it can be a food source for several freshwater fish. Anglers consider it a nuisance because the tail spines hook onto and clog fishing lines and downrigger cables.

Ohio Distribution

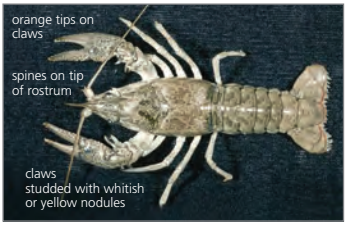
United States Distribution

Virile Crayfish

Faxonius virilis

IN OHIO RIVER BASIN

Species at a Glance



While native to the United States in the Missouri, Mississippi, Ohio, and Great Lakes drainages, the virile crayfish, also called the northern crayfish, has been introduced to new locations throughout the United States via the live pet and bait trades. In these areas, it has competed with and displaced native fish and crayfish and reduced populations of snails, macroinvertebrates, and aquatic plants.

Identification

Adult virile crayfish reach about 13 cm (5 in) long, with males typically growing larger than females. The body is reddish-brown, olive-brown, or green without any prominent markings. The pincers are green or blue-green with orange tips and are conspicuously studded with whitish or yellow nodules in adults. Paired dark blotches run lengthwise along the abdomen. The **rostrum** has conspicuous notches or spines near its tip.

Similar Species

The virile crayfish is most often confused with the calico crayfish (*Faxonius immunis*). The calico crayfish differs in having pincers that are gray, purple, or pink, a pale lengthwise stripe along the middle of the abdomen, and a **rostrum** without lateral notches or spines.

Habitat

This species inhabits rivers, streams, lakes, marshes, and ponds that are permanent and well oxygenated. It prefers warm waters of moderate **turbidity** with cobble or rocky substrates and abundant logs, rocks, vegetation, and other debris to use as cover. It is also known to dig burrows in river banks and under rocks when water levels are low. It doesn't tolerate poor water quality or high salinity waters.

Spread

Because it is commonly used as bait and sold in bait shops and aquarium stores, many introductions of virile crayfish have probably occurred through intentional or accidental release from these pathways.

Distribution

Native to the Missouri, Mississippi, Ohio, and Great Lakes drainages of the United States, the virile crayfish has been introduced to many states outside of its native range. Its native range in Ohio is under investigation, but currently there are records considered non-native in several counties in the eastern portion of the state.

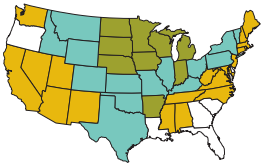
Environmental Impacts

The virile crayfish can alter aquatic habitats by decreasing the abundance and diversity of aquatic plants and competing with native species for food and habitat. It has been known to negatively impact species of native crayfish, fish, frogs, snails, insects, and macroinvertebrates. Its burrowing behavior also impacts water quality and clarity by increasing **turbidity**, as well as impacting irrigation networks and levees.

Ohio Distribution

Orange - Invasive Green - Native

United States Distribution

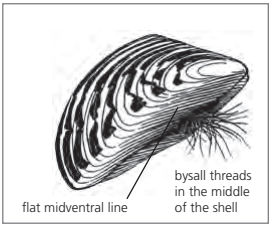


Orange - Invasive Green - Native
Blue - Both Native & Invasive

Zebra Mussel

Dreissena polymorpha

Species at a Glance



The zebra mussel is a small, fingernail-sized, freshwater mollusk that attaches to hard objects and costs billions of dollars to control and remove. Since its discovery in the Great Lakes, it has quickly spread to become one of the most intrusive, prolific, and costly aquatic invaders in North America. In many open-water environments, they can be virtually impossible to eradicate once established. They are closely related to the invasive quagga mussel as both belong to the genus *Dreissena*, which makes them unrelated to our native mussels.

Identification

Although the zebra mussel is named for the alternating light and dark bands present on the shell, color patterns can vary between black, brown, beige, and tan with white to yellow stripes or zigzagged patterns. The shell is triangular or D-shaped, with a straight midventral line and a prominent ridge on each valve that allows the mussel to sit upright on its **ventral margin**. While size is typically 2–2.5 cm (0.8–1 in) in length, some mussels can reach up to 5 cm (2 in). The sticky, thread-like projections, called **byssal threads**, are located toward the middle of the shell and help it attach to hard substrates. Eggs develop into round, microscopic larvae called **veligers** that free-float in the water column for up to five weeks before settling. Under polarized light, **veligers** appear to be marked with a dark “X”.

Similar Species

A close relative, the quagga mussel (*Dreissena bugensis*) is also fingernail-sized but more rounded or fan-shaped, lacking the prominent ridges and flat **ventral margin** that allow the zebra mussel to sit upright. A quagga mussel would simply topple over if placed on its **ventral margin**. Also, the midventral line of the quagga mussel is curved, and the **byssal threads** are located toward the anterior end of the shell.

Habitat

The zebra mussel can be found in lakes, rivers, reservoirs, ponds, and quarries. It requires enough calcium for shell production and water temperatures over 10°C (50°F) for reproduction. It can be found attached to hard surfaces such as rocks, wood, concrete, steel, and even other organisms like native mussels and crayfish.

Spread

One female zebra mussel can produce up to one million eggs in a breeding season. The free-floating **veligers** can be scooped up undetected and transferred in bait buckets, bilge water, and live wells. Because it can survive out of water for up to five days, this mussel is easily transported to other waterways on recreational boating, fishing, and diving gear.

Distribution

While native to the Black, Azov, and Caspian sea drainages, the zebra mussel first appeared in the Great Lakes in Lake St. Clair in 1988, probably imported in contaminated ballast water. It has since spread throughout all of the Great Lakes, the Mississippi River drainage, and many inland lakes. In Ohio, they have been found in Lake Erie and numerous inland reservoirs, rivers, and diving quarries throughout the state.

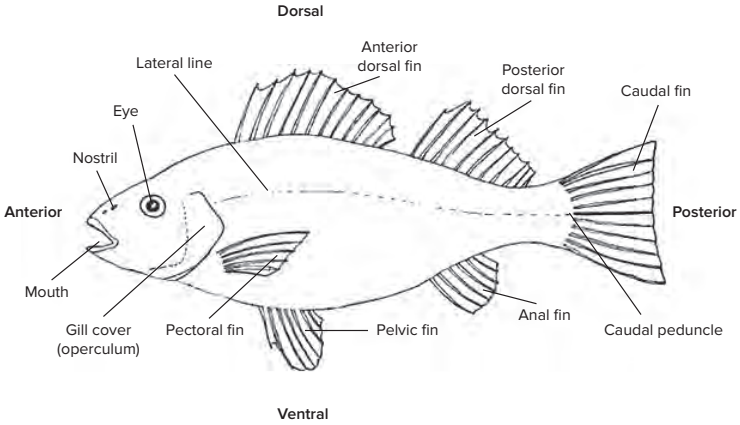
Environmental Impacts

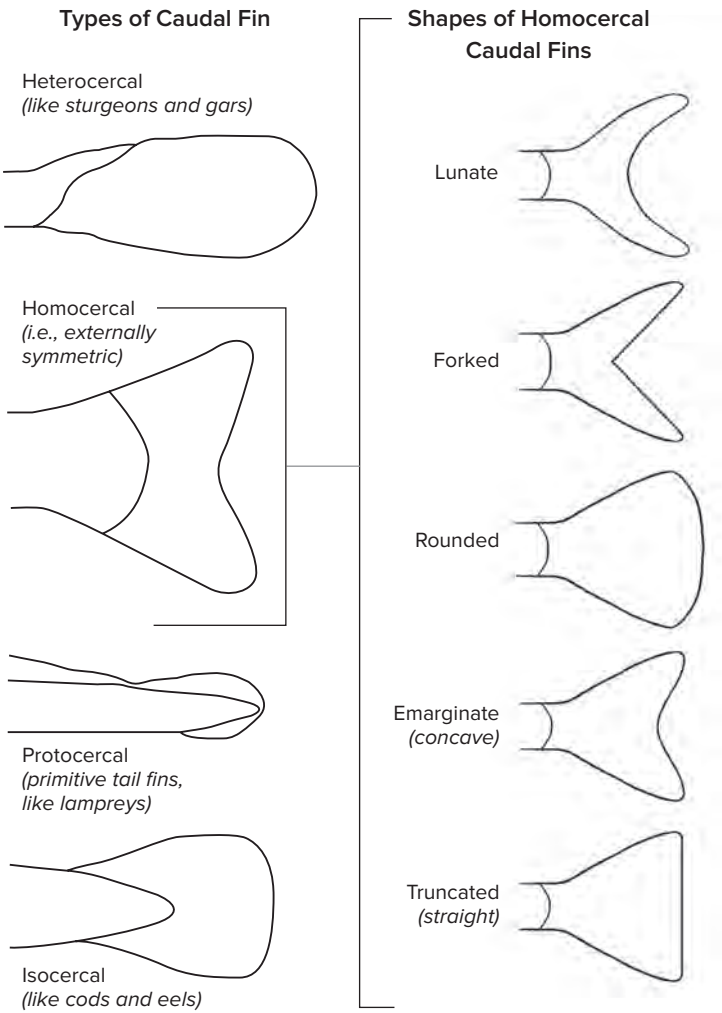
The clustering behavior of the zebra mussel causes it to clog water intake pipes and damage equipment at power and water facilities, making it very expensive to remove and control. It also harms fisheries, alters water quality, and increases the growth of harmful algae. It decreases food sources for native species by filtering large amounts of microscopic plants and animals from the water, and it accumulates contaminants in its fatty tissues. The economic impact of zebra and quagga mussels in the U.S. is estimated in the billions of dollars.

Ohio Distribution

United States Distribution

Fish Anatomy



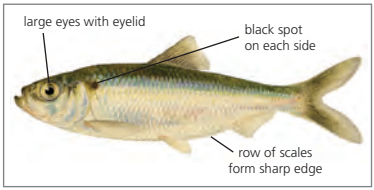

Types of Caudal Fin
Heterocercal
(like sturgeons and gars)
Homocercal
(i.e., externally
symmetric)
Protocercal
(primitive tail fins,
like lampreys)
Isocercal
(like cods and eels)
Shapes of Homocercal
Caudal Fins
Lunate
Forked
Rounded
Emarginate
(concave)
Truncated
(straight)

Alewife

Alosa pseudoharengus

Species at a Glance

The alewife is a small forage fish that belongs to the herring family. It migrates long distances from the ocean to fresh water to reproduce in the spring and returns to the ocean in the fall; however, some populations have become landlocked and are restricted to inland waters.



Identification

Alewife size can range from up to 38 cm (15 in) in coastal populations to less than 25 cm (10 in) in inland populations. Their typically silver body is small, slender, and **laterally compressed**, but individuals entering freshwater often have a copper-sheen color. Eyes are relatively large, with an obvious eyelid. A single black spot is present on each side just behind the head. A row of scales, called **scutes**, which form a sharp edge along the mid-line of the belly, are responsible for its family nickname “sawbelly”.

Similar Species

The alewife is closely related to the gizzard shad (*Dorosoma cepedianum*), which is native to Ohio. Alewives have a more streamlined body profile and **terminal** mouth; gizzard shad have a deeper body, **subterminal** mouth, and the last ray of their **dorsal fin** is elongated and thread-like

(but that is sometimes broken off). Also, an alewife's **peritoneum** is pale with dusky spots, while the gizzard shad's is black to dusky in color.

Habitat

This **pelagic** species is found in marine waters or open lake waters except during the breeding season when they can be found in large rivers, small streams, ponds, and large lakes over a wide range of substrates, including gravel, sand, **detritus**, and **submerged** vegetation. Because alewives are sensitive to the osmotic stresses of freshwater, disturbances such as severe changes in water temperature can cause the fish to die with large numbers washing up on beaches.

Spread

The Welland Canal most likely gave the alewife access to the Great Lakes, and it has continued to spread through waterway connections. Because it looks very similar to native members of the herring family, accidental transfer is possible through the release of live bait. It has also been intentionally introduced by some state agencies into inland lakes to increase the forage base for popular sport fish.

Distribution

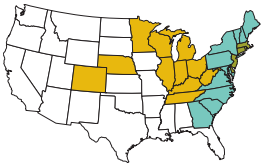
Native to the Atlantic coast and its tributaries from South Carolina northward, alewives are found from Nova Scotia to the Carolinas, with landlocked populations in the Great Lakes and in lakes and ponds along the East Coast. In Ohio, they are invasive in Lake Erie and its adjacent counties, Pymatuning Reservoir, and several records occur in the Ohio River.

Environmental Impacts

Alewives feed primarily on zooplankton, which puts them in direct competition with native fish and invertebrates for limited food resources. Large densities of alewife in Lake Erie have been blamed for the disappearance of native salmonid species.

Ohio Distribution

United States Distribution



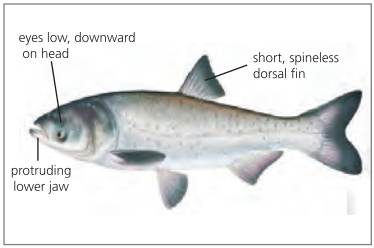
Orange - Invasive Green - Native
Blue - Both Native & Invasive

Bighead Carp

Hypophthalmichthys nobilis

Species at a Glance

The bighead carp is a member of the Asian carp complex, which also includes silver, black, and grass carps. As of 2011, its presence in Ohio has been limited to a handful of individuals, and they are not yet established. Any potential sightings should be reported immediately.



Identification

The body of the bighead carp is large, reaching 1–1.5 m (3.3–4.9 ft) in length and can weigh over 100 pounds. It is broad, **fusiform**, and **laterally compressed** with a solid dark gray top blending to white underneath. It has many irregular gray-black blotches on its sides. Its large head lacks scales and its big **terminal** mouth lacks barbels and teeth. The lower jaw also protrudes out farther than the upper jaw. The eyes are situated low on the head and are positioned downward. The short **dorsal fin** lacks spines, and contains 7–10 rays. Scales are very small and resemble those of a trout.

Similar Species

The bighead carp most closely resembles the invasive silver carp (*Hypophthalmichthys molitrix*). However, the **keel** of the bighead carp runs from the **pelvic fins** to the **anal fins**, while the silver carp has a midventral **keel** that is more extensive and runs from the **anal fins** up to the base of the gills. Silver carp also lack the dark blotches characteristic of bighead carp.

Bighead carp may also resemble the common carp (*Cyprinus carpio*), which has barbels on either side of the mouth, or species of suckers (*Catostomidae*), which have thick lips containing small folds or nipple-like bumps. Small, juvenile bighead carp also look superficially similar to native gizzard shad.

Habitat

Bighead carp are exclusively freshwater fish that prefer large river systems with flowing water, which they need for spawning; however, they will inhabit lakes and ponds.

Spread

Once introduced to open waters, bighead carp readily spawn and disperse themselves. Because the juveniles resemble some common baitfish species, they may be unintentionally spread through the use of live bait. Spread can also occur as they are sold through the Asian food market.

Distribution

Native to eastern Asia, the bighead carp was intentionally introduced into the United States to control algae growth in aquaculture ponds. During flooding in the early 1980s, it escaped into the Mississippi River and has since moved upstream towards the Great Lakes. There is evidence of reproducing populations in the middle and lower Mississippi and Missouri Rivers and in the Ohio River. Bighead are in the Illinois River, which is connected to the Great Lakes via the Chicago Sanitary and Ship Canal. Although several adults have been collected in Lake Erie, currently no established populations have been recorded in the Great Lakes. They have been collected in several Ohio counties in the Ohio River watershed.

Environmental Impacts

The bighead carp can consume up to 40 percent of its body weight in plankton and **detritus** per day, competing with native filter feeders and juvenile fish for food. This impact on the food web and trophic structure of an ecosystem could result in large population declines, impacting biodiversity as well as commercial and recreational fishing.

Ohio Distribution

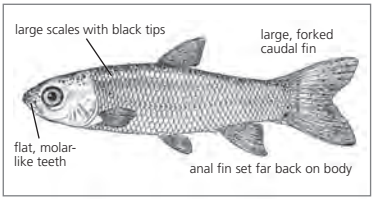
United States Distribution

Black Carp

Mylopharyngodon piceus

Species at a Glance

The black carp is a member of the Asian carp complex, which also includes silver, bighead, and grass carps. This molluscivore has powerful **pharyngeal teeth** that allow it to crack open mussels, snails, and other hard-shelled organisms.



Identification

The elongate, **fusiform**, slightly compressed body of the black carp averages 1–1.5 m (3.3–4.9 ft) in length. Color can vary but is usually dark brown to black on the back and sides, with some white on the underside, with dark fins. The mouth is small, **terminal**, and lacks barbels. **Pharyngeal teeth** are strong, flat and molar-like, and are arranged in rows of 4–5 on each side. The scales are very large and have black tips, giving it the appearance of cross-hatching. Fins lack spines. The **anal fin** is set far back on the body, and the **caudal fin** is large and forked. Average weight is about 33 lbs, but some black carp can reach up to 150 lbs.

Similar Species

The best way to distinguish the black carp from the grass carp (*Ctenopharyngodon idella*) is by looking at the **pharyngeal teeth**. Black carp's teeth appear molar-like, whereas the grass carp's teeth have deep parallel grooves. Black carp may also resemble the common carp (*Cyprinus carpio*), which has barbels on either side of the mouth, and species of suckers (Catostomidae), which have thick lips containing small nipple-like bumps.

Habitat

Black carp are exclusively freshwater and prefer large river systems and embayments in temperate to sub-tropical climates.

Spread

The availability of black carp in the live fish market may have created a risk for accidental or unlawful release. Additional introduction and spread occurs as fish escape from holding facilities and naturally disperse to new areas.

Distribution

The black carp is native to eastern Asia from southern Russia to northern China. They were brought to the United States to control snail populations in aquaculture facilities and escaped from holding ponds during flooding in 1994. Individuals have since been found in the lower part of the Mississippi River basin. There are no reports of black carp in Ohio.

Environmental Impacts

Black carp pose a considerable threat to native mussel and snail populations. They can live up to 15 years, consuming several pounds of mollusks each day, competing with native fish, turtles, birds, and some mammals for food. Black carp may also be a vector for parasites and disease affecting native species.

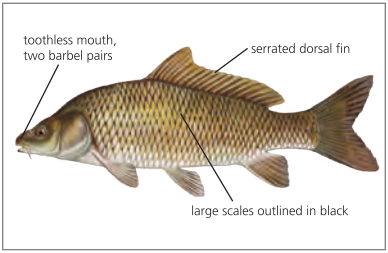
United States Distribution

Common Carp

Cyprinus carpio

Species at a Glance

The common carp, which can live up to 50 years, is omnivorous, has a voracious appetite, and is one of the largest members of the minnow family. Varieties of common carp include mirror carp, leather carp, and koi, which is a type of common carp popular in small ponds and water gardens.



Identification

These bronze, brassy, or yellow fish have spine-like rays at the front of the **dorsal** and **anal fins**, and are easily identified by two pairs of barbells on each side of the upper jaw. The body is heavy and stout, with large scales usually outlined in black. The head is short, with a rounded snout and a toothless, sucker-like mouth. Their average length is 25–55 cm (10–22 in) and they typically weigh 1–10 lbs, although some can reach up to 122 cm (48 in) long and weigh up to 40 lbs or more.

Similar Species

Common carp resemble the smallmouth buffalo (*Ictiobus bubalus*), bigmouth buffalo (*I. cyprinellus*), grass carp (*Ctenopharyngodon idella*), and other species of carp. The best way to identify common carp is the two barbels on each side of the mouth, and the long **dorsal fin**.

Habitat

This species generally inhabits lakes, ponds, and the lower sections of rivers (usually with moderately flowing or standing water). It is also found in brackish-water estuaries, backwaters, and bays, and is often seen in the spring in shallow water during spawning.

Spread

Once established in a body of water, common carp can escape from the point of introduction and move to other connected bodies of water. Transfer of the species to different water bodies can also occur by anglers using juvenile carp as bait.

Distribution

Native to Europe and Asia, common carp were intentionally introduced into United States waters as a game fish in the 1880s. They are now very prevalent throughout the United States including Ohio.

Environmental Impacts

The common carp's tendency to destroy vegetation and increase water **turbidity** by dislodging plants impacts native species spawning sites and decreases water quality. They also release phosphorus that increases algae abundance and production.

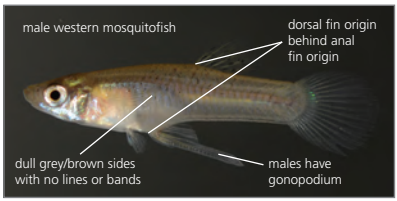
Ohio Distribution

United States Distribution

Eastern & Western Mosquitofish

Gambusia holbrooki and Gambusia affinis

Species at a Glance



Eastern and western mosquitofishes have a reputation for feeding on mosquito larvae, leading to introductions across the U.S. and the world for mosquito control. Western mosquitofish are more cold tolerant and are established throughout Ohio, where they compete with native species that feed on aquatic invertebrates.

Identification

Mosquitofish are small fish with a flattened head, rounded **caudal fin**, and an upward pointed mouth for feeding on the surface. The **dorsal fin** is set relatively far back towards the tail, and the **dorsal fin** origin is behind the **anal fin** origin. Males have a **gonopodium** (modified **anal fin**) used for internal fertilization. Mosquitofish are uniform dull grey to brown in color with no bars or bands on their sides. They usually have small dark specks on their fins. Both species are live-bearing, and newly born fish swim and feed similar to adults. Females can be two to three times larger than males and have a hatchet-shaped body. Females can reach 7.5 cm (3 in) in length, while males can reach 3.5 cm (1.5 in).

Similar Species

Several small species occupy a similar niche and may be confused with mosquitofish. In Ohio the native western banded killifish (*Fundulus diaphanus menona*) has 12–15 vertical bands on the side (6–8 in front of the **dorsal fin** origin), and the invasive eastern banded killifish (*F. d. diaphanus*) has more than 15 vertical bands (8–10 in front of the **dorsal fin** origin). The blackstripe


eastern mosquitofish

topminnow (*F. notatus*) has a horizontal black stripe that runs from the lips to the tail. Mosquitofish do not have bands or stripes on their sides.

Habitat

Mosquitofish prefer ponds, wetlands, and backwaters of tributaries with clear water and thick vegetation. Neither species is considered cold tolerant, but the western mosquitofish is more-so as it is established in multiple areas of Ohio while the eastern mosquitofish has not. In Ohio, they are most widely distributed in our largest rivers where they can be found in calm areas along shorelines sheltered from swift currents.

Spread

Mosquitofish continue to be spread throughout the world for biological control of mosquitos and associated diseases, though studies show they may not be as effective as native species that consume insect larvae. Often escaping from water gardens and farm ponds where they are stocked, populations can expand rapidly as they can spawn once a month from May through September with females carrying around 40 young at a time.

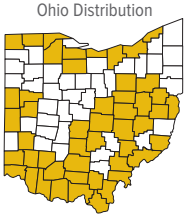
Distribution

The eastern mosquitofish is native to the Atlantic and Gulf Slope drainages, while the western mosquitofish is native to the lower Mississippi River and Mobile River basins. Both species were introduced to Ohio in Lucas County in 1947. The western mosquitofish quickly became established and has since been introduced multiple times, as it is still offered by private and public entities for mosquito control. All current populations in Ohio are thought to be western mosquitofish. Records are likely incomplete, and they are thought to be established in every Ohio county.

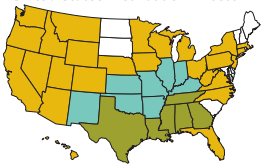
Environmental Impacts

While mosquitofish do eat mosquito larvae, they feed indiscriminately on a variety of zooplankton and small invertebrates and may actually be less effective at controlling mosquitos than native species. Their voracious appetite and high reproductive rate allows for rapid population increase, altering the food web and displacing native species of fish and predatory invertebrates through direct competition for food and habitat.

Ohio Distribution

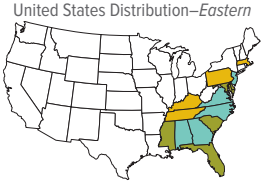


United States Distribution–*Western*



Orange - Invasive Green - Native
Blue - Both Native & Invasive

United States Distribution–*Eastern*

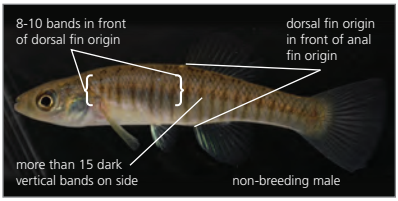


Orange - Invasive Green - Native
Blue - Both Native & Invasive

Eastern Banded Killifish

Fundulus diaphanus diaphanus

Species at a Glance



The eastern banded killifish is a small topminnow that feeds on zooplankton, insect larvae, and other invertebrates. One of two subspecies of the banded killifish present in Ohio, the eastern banded killifish is invasive in the state while the western banded killifish (*Fundulus diaphanus menona*) is native and endangered.

Identification

Eastern banded killifish have a long, slender body, a pointed snout with an upturned mouth, and a rounded **caudal fin**. The **dorsal fin** is set relatively far back towards the tail, and the **dorsal fin** origin is in front of the **anal fin** origin. They have more than 15 dark vertical bands along their sides, and 8–10 are found in front of the **dorsal fin** origin. These bands remain separate and narrow on the **caudal peduncle**. Breeding males have silvery blue sides contrasting with the vertical bands, and lack a dark spot on the **dorsal fin** which is present in the western banded killifish. They are typically around 5 cm (2 in) in length, but can reach 9 cm (3.5 in).

Similar Species

Eastern banded killifish are very similar to western banded killifish, but western banded killifish have only 12–15 dark vertical bands with 6–8 in front of the **dorsal fin** origin. These bands become shorter and wider on the **caudal peduncle**, often fusing into a lengthwise stripe. Breeding male western banded killi-fish have a black spot on the **dorsal fin**. The blackstripe topminnow (*Fundulus notatus*) is similar in size and general appearance, but instead of vertical bands has a solid horizontal black stripe that runs

breeding male eastern banded killifish, INVASIVE

breeding male western banded killifish, NATIVE & ENDANGERED

from the lips to the tail. The eastern and western mosquitofish (*Gambusia holbrooki and G. affinis*) do not have bands or stripes on their sides.

Habitat

Quiet backwaters, slow moving mouths of streams, and lakes with abundant vegetation are preferred habitat for banded killifishes. They are found over various bottom substrates including sand, gravel, and boulders. Based on current records, it appears eastern banded killifish can withstand turbid water and less vegetated areas better than western banded killifish.

Spread

Introduced intentionally to the Ohio River drainage, the eastern banded killifish population has expanded downstream throughout Ohio's portion of the Ohio River. They are attractive, and thus may be spread by collectors via aquarium release. Due to their habitat, they can also be collected by anglers with bait-fish and subsequently released into new bodies of water. Never release aquarium organisms or live bait. Rehome or humanely dispose of aquarium pets and plants, and dispose of bait in the trash or freeze for later use.

Distribution

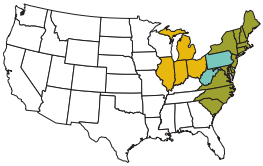
Native to the Atlantic Slope and the East Coast of the U.S., eastern banded killifish were transplanted to eastern Ohio and western Pennsylvania from the Delaware River drainage in the 1930s. They have since spread down the Ohio River with reports in almost every Ohio River county. Other populations in Ohio include Ashtabula and Conneaut harbors, parts of the Mahoning River basin, Pymatuning Reservoir, and Piedmont Lake.

Environmental Impacts

As an invasive predator of zooplankton, insect larvae, and other invertebrates, the eastern banded killifish can outcompete native fish and organisms that rely on the same food source, disrupting local food webs where present. The biggest impact could be directly competing with the closely related western banded killifish if the ranges were to overlap, as the western banded killifish is state endangered.

Ohio Distribution

United States Distribution



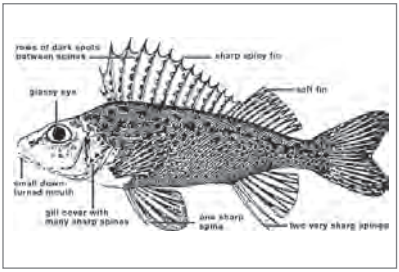
Orange - Invasive Green - Native
Blue - Both Native & Invasive

Eurasian Ruffe

Gymnocephalus cernuus

Species at a Glance

The Eurasian ruffe is an aggressive member of the perch family that was brought to the United States in the ballast water of ocean-going ships. Its high growth rate, adaptability, and high reproductive success make it a serious threat to commercial and sport fishing.



Identification

This small fish has a fairly deep and compressed body reaching 11–15 cm (4.3–5.9 in) in length. The body, which is very slimy when handled, is greenish-brown above, with dark patches on lighter brown sides. The yellowish belly has rows of prominent dark spots on the **dorsal** and **caudal fins**. The **dorsal fin** has a spiny fin and a soft fin that are connected. Sharp spines on their gill covers, **dorsal** and **anal fins** make them undesirable to predators. Their head lacks scales and their small downturned mouth resembles a frown.

Similar Species

While it may be confused with native yellow perch (*Perca flavescens*), the native trout perch (*Percopsis omiscomaycus*), and the invasive white perch (*Morone americana*), the Eurasian ruffe can be distinguished by the lack of scales on its head, and its downturned mouth. The yellow perch also has two separate **dorsal fins** and a body pattern with dark vertical bars, and the trout perch has a short, single-lobed **dorsal fin** and an adipose fin; these are lacking in the ruffe.

Habitat

The Eurasian ruffe is highly adaptable and will exploit a wide range of depths and conditions in lakes and rivers. However, it prefers turbid lakes with soft bottoms and little or no vegetation, and rivers with slow moving waters.

Spread

Once introduced into Lake Superior, ballast water exchange within the Great Lakes may have facilitated further spread. It may also spread unintentionally through the use of live bait.

Distribution

Native to fresh and brackish water areas of Eurasia, the ruffe was introduced into Lake Superior in the mid-1980s. Since its introduction, it has spread throughout the upper Great Lakes. It is not currently present in Lake Erie or Ohio waters.

Environmental Impacts

Explosive growth of the Eurasian ruffe population means less food and space in the ecosystem for other fish with similar diets and feeding habits. Because of this, walleye, perch, and a number of small forage fish species are seriously threatened by continued expansion of this pest species.

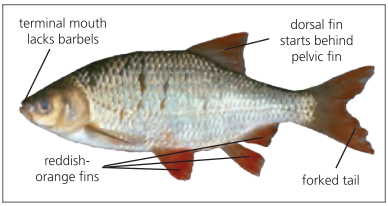
United States Distribution

European Rudd

Scardinius erythrophthalmus

Species at a Glance

The European rudd is a medium-sized fish belonging to the carp and minnow family. It is largely carnivorous when young, feeding on snails, insects, and small crustaceans, but prefers aquatic vegetation as it gets older.



Identification

The body of the rudd is somewhat stocky, robust, and elliptical in shape, with large scales and a forked tail. It has a scaled, **keel**-like belly that runs from the **pelvic** to the **anal fins**. Coloration is brownish-green above and brassy yellow to rosy on the sides, fading to silvery underneath. The **pectoral**, **pelvic**, and **anal fins** are a distinctive bright reddish-orange color. The mouth is **terminal** and lacks barbels, and the lower lip is sharply angled, with a protruding lower jaw. The iris of the eye is yellow to orange, often with a red spot that can cover the pupil. Another identifying feature of the rudd is the beginning of its **dorsal fin** set well behind the front of the **pelvic fin**. Maximum size is up to 48 cm (19 in) in length.

Similar Species

While young rudd often resemble golden shiners (*Notemigonus crysoleucas*), adults reach larger sizes. Rudd have 6–9 scales on the belly, whereas the golden shiner has a naked, scale-less keel along the belly. In addition, the fins of the golden shiner are clear to pale orange, not bright orange or red, and it lacks the red spot on the iris above the pupil.

Habitat

The European rudd prefers still and sluggish waters and weedy shoreline areas of lakes and rivers, but it can adapt to a wide range of environmental conditions, including poor water quality.

Spread

Bait bucket release is the primary mechanism by which the rudd has gained access into open waters. Because of the rudd's similarity to golden shiners, they can become mixed in with shiner shipments to bait dealers and become introduced into new environments by anglers. They may also be spread via the ornamental pond trade.

Distribution

Native to Europe and western Asia, the European rudd was probably introduced to the United States as a game and food fish. Since its introduction, it has spread throughout much of the country and has been collected in 23 states. In Ohio, the rudd has been collected in Lake Erie from two counties.

Environmental Impacts

Although the rudd's impacts are mostly unknown, it may compete with native fish for invertebrate food sources and influence the population dynamics of various ecosystems.

Ohio Distribution

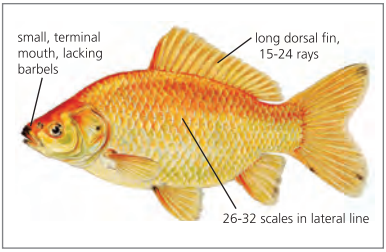
United States Distribution

Goldfish

Carassius auratus

Species at a Glance

The goldfish is a freshwater member of the carp and minnow family. It was one of the first aquatic invasive species to reach North America, arriving in the 1600s as ornamental fish for aquariums and water gardens. It is now one of the world's most widespread invasive species.



Identification

It has a stout body, which is typically 10–20 cm (4–8 in) in length and weighs 100–300 g (3.5–10.5 oz), although it can reach a maximum length of 59 cm (23 in) and maximum weight of 6.6 lbs. It has a long **dorsal fin** with 15–24 rays, and a hard **serrate** spine at the origin of both the **dorsal** and **anal fins**. There are normally 26–32 scales in the **lateral line**. The mouth is small, **terminal**, and lacks barbels. Domestic goldfish come in a variety of colors, including orange, yellow, white, black, silver, olive-green, greenish-brown, and combinations of these colors. When found in nature, goldfish are most often a shade of green, brown, or gray.

Similar Species

Goldfish can be distinguished from common carp (*Cyprinus carpio*) by the carp's two pairs of barbels on the upper jaw, a non-**serrate** spine, and typically more than 32 scales in the **lateral line**. However, they can also **hybridize** with the common carp, producing individuals with both characteristics.

Habitat

While goldfish prefer a habitat with a muddy bottom and thick vegetation, they can tolerate pollution, temperature fluctuations, and high levels of **turbidity**. They naturally live in freshwater ponds and slow-moving or still waters in depths of up to 19.8 m (65 ft) and prefer temperatures of 4–41°C (40–106°F), although they cannot live for long at high temperatures.

Spread

Goldfish have been intentionally introduced for ornamental purposes to ponds, fountains, and small lakes to which they may disperse through connecting waters. Many introductions of goldfish were also due to their use as live bait. In addition, goldfish are often released into the wild by pet owners not realizing the environmental repercussions of setting the fish free.

Distribution

Native to eastern Asia, goldfish have been reported invasive in the United States by every state except for Alaska. They are established in all of the Great Lakes and throughout the state of Ohio.

Environmental Impacts

Goldfish are believed to be responsible for population declines in many native fish, invertebrate, and plant species. They also uproot plants and create enormous **turbidity** due to their aggressive bottom feeding behavior.

Ohio Distribution

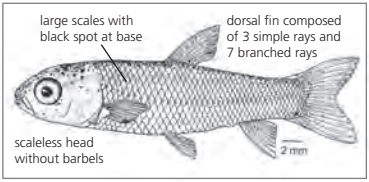
United States Distribution

Grass Carp

Ctenopharyngodon idella

IN LAKE ERIE BASIN

Species at a Glance



The grass carp, also known as the white amur, is one of the largest minnows in the family Cyprinidae. It is also a member of the Asian carp complex, which also includes the black, bighead, and silver carps. They were introduced into the United States to help control the growth of aquatic weeds in ponds; however, they also feed voraciously on other food types, including invertebrates, vertebrates, and algae.

Identification

The body of the grass carp is oblong in shape, but considered slender for most carp. They typically reach between 65 and 80 lbs, although individuals as large as 100 lbs have been reported. Scales are large, with dark edges and a black spot at the base. The scaleless head lacks barbels. Overall color is olive to silvery-white, while the fins are clear to gray-brown. The **dorsal fin** is composed of three simple rays and seven branched rays.

Similar Species

Grass carp may be confused with the common carp (*Cyprinus carpio*), which can be distinguished by the presence of barbels around the mouth. Common carp are also more golden in color and have spiny modified rays on the **dorsal** and **anal fins**.

Habitat

Grass carp prefer shallow and quiet waters, typically 0.91–3 m (3–10 ft) deep, such as ponds, lakes, and pools and backwaters of large rivers.

Spread

This species is often purposefully stocked in private ponds for aquatic vegetation control; however, only sterilized triploid grass carp can be stocked or possessed within the state. Once introduced, grass carp can spread to distant water bodies by tributaries, waterways, river systems, canals, and dams.

Distribution

Native to eastern Asia, including China and Russia, grass carp were introduced in many countries for aquatic plant control, including throughout much of the United States. In Ohio, spawning has only been documented on the Sandusky and Maumee rivers. They are now widespread in 45 states in the U.S., including Ohio.

Environmental Impacts

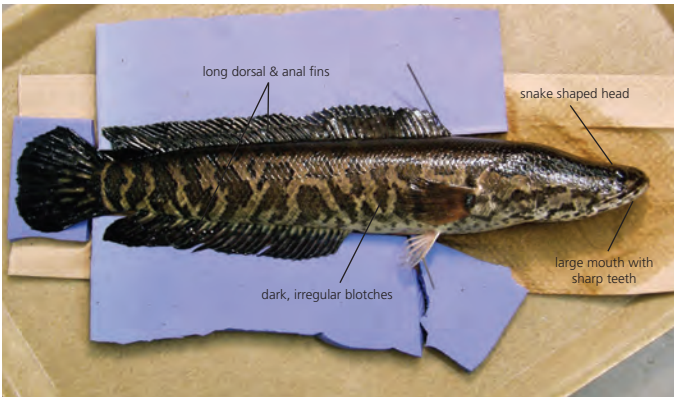
While grass carp do help to reduce unwanted aquatic vegetation, they alter the food web because they also voraciously feed on desirable plant species, reducing the amount of food available to native invertebrates and fish. Excreted plant material can also increase nutrient levels in the water that cause harmful algal blooms and affect water quality.

Ohio Distribution

United States Distribution

Northern Snakehead

Channa argus



Species at a Glance

The northern snakehead is a freshwater fish nicknamed “Frankenfish” because of its intimidating appearance and voracious appetite. An air bladder that works like a primitive lung lets this species survive out of the water in moist locations and wriggle over land to new bodies of water. These adaptations give the snakehead a competitive edge in securing habitat and expanding its range.

Identification

These cylindrical fish can grow over 84 cm (33 in) long. As the name implies, the scaled head of the fish looks like a snake’s. They have a large mouth with sharp teeth, a **truncate**, not rounded tail, and are easily identified by dark irregular blotches along their sides. Snakeheads also possess relatively long **dorsal** and **anal fins**.

Similar Species

The native bowfin (*Amia calva*) is often mistaken for the northern snakehead. Bowfin are distinguished by their relatively short anal fin, rounded tail, scaleless head, and an eyespot near the tail in males. The burbot (*Lota lota*) looks somewhat similar but can be distinguished by its split **dorsal fin** and a single barbel on the lower jaw.

Habitat

These fish prefer stagnant shallow ponds, swamps, and slow streams with mud or vegetated substrate. Temperature range is from 0–30°C (32–86°F), and they can survive in waters that are covered in ice. As juveniles, northern snakeheads eat zooplankton, insect larvae, small crustaceans, and young fish. As adults, they become voracious predators, feeding on other fish, crustaceans, frogs, small reptiles, and even birds and mammals.

Spread

Before their threat was fully appreciated, live snakeheads were sold in the United States in pet shops and live fish markets. Uninformed pet owners may have released them into the wild when they grew too big for aquarium tanks or as part of religious or cultural practices.

Distribution

Native to China, Russia, and Korea, the first reported breeding population in the United States was discovered in a pond in Crofton, Maryland in May 2002. While there is evidence of populations as close as eastern Pennsylvania, and a single individual was captured in Illinois' Lake Michigan waters, northern snakehead have never been observed within Ohio waters.

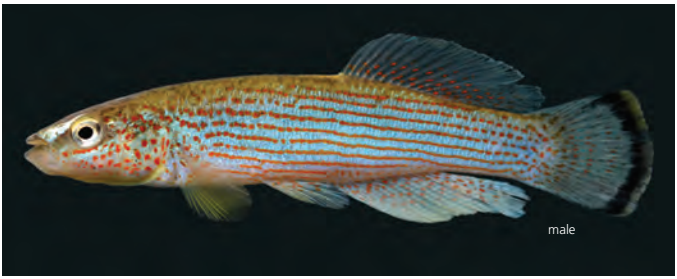
Environmental Impacts

With no natural enemies, northern snakeheads can devastate populations of native fish and wildlife. They compete directly with native fish, altering feeding habits, food availability, and behaviors of other members of the ecosystem.

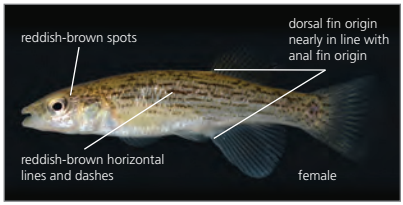
United States Distribution

Northern Studfish

Fundulus catenatus



Species at a Glance



The northern studfish is an attractive, relatively large topminnow with patchy native distribution in the U.S., including populations in the Green, Cumberland, and Tennessee River basins as well as areas of the Ozarks. It feeds on aquatic invertebrates near the surface but will also forage for snails and other bottom-dwelling organisms.

Identification

Like other topminnows, northern studfish have a flattened head and an upward pointed mouth adapted for surface feeding, a rounded **caudal fin**, and a **dorsal fin** that is set relatively far back towards the tail. The **dorsal fin** origin is nearly in line with the **anal fin** origin. They have a light brown back with a gold streak down the center in front of the **dorsal fin**. Reddish brown spots appear on the sides of the head. The sides of the body can be silvery-blue to brownish with many reddish brown horizontal lines and dashes. These are bright red on breeding males, which also display yellow paired fins and an orange **caudal fin** margin with a dark band. Typically seen from 5–10 cm (2–4 in), but can grow to 15 cm (6 in) or larger.

Similar Species

Northern studfish are superficially like other topminnows present in Ohio, but they are unique in their many reddish brown horizontal lines and relatively large size. The eastern and western banded killifish (*Fundulus diaphanus diaphanus* and *F. diaphanus menona*) have many vertical bands on their sides (greater than 15, and 12–15, respectively). The blackstripe topminnow (*F. notatus*) has a horizontal black stripe that runs from the lips to the tail.

The eastern and western mosquitofish (*Gambusia holbrooki* and *G. affinis*) do not have bands or stripes on their sides.

Habitat

Preferred habitat for northern studfish includes shallow water along margins of pools, riffles, or backwaters with little current, but with a permanent flow of clear water over clean sand, gravel, or rock bottoms. They spawn over clean gravel substrate whereas most other topminnows spawn on aquatic vegetation. They can be found in a wide range of stream sizes and gradients.

Spread

Northern studfish are one of the more attractive topminnows, and thus may be spread by collectors via aquarium release. Due to their habitat, size, and hardiness, they can also be collected by anglers as baitfish and subsequently released into new bodies of water. Never release aquarium organisms or live bait. Rehome or humanely dispose of aquarium pets and plants, and dispose of bait in the trash or freeze for later use.

Distribution

Native populations occur in several patchy distributions in the south central U.S., including in the Green, Cumberland, and Tennessee River basins as well as areas of the Ozarks. Their range has expanded to include invasive populations in Iowa, Kentucky, Louisiana, Mississippi, Missouri, Ohio, Oklahoma, and West Virginia, likely due to intentional or accidental human release. In Ohio, they can be found in the basins of the Little Miami River, the Little Hocking River, Sunfish Creek in Pike County, and Pipe and Captina Creeks in Belmont County.

Environmental Impacts

With their relatively large size and aggressive nature, northern studfish have the potential to outcompete native topminnows and other aquatic organisms that rely on aquatic invertebrates for food and push out organisms that occupy the same habitat niche. Their large size and ability to also feed on the bottom puts them in competition with more organisms compared with other invasive topminnows, as they can feed on a wider variety of prey.

Ohio Distribution

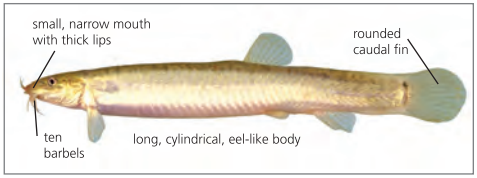
United States Distribution

Orange - Invasive Green - Native
Blue - Both Native & Invasive

Oriental Weatherfish

Misgurnus anguillicaudatus

Species at a Glance



The oriental weatherfish, also called the dojo and Chinese loach, is a small eel-like fish that gets its name from its ability to "forecast the weather." It is sensitive to changes in barometric pressure, so increases in activity and swimming in fast circles can indicate that major weather changes are imminent. This species is also popular in the aquarium trade because it is hardy and has a voracious appetite that can help keep tanks clean. Unfortunately, the release of this species into natural waterways has caused negative impacts to water quality, native species, and the food web.

Identification

The oriental weatherfish has a long, cylindrical, eel-like body with greenish-gray-brown marble markings on the dorsal side, and pale silver sides and underbelly. Many specimens have a large pigmented spot located above the base of the **caudal fin**. The mouth is small and narrow with thick, fleshy lips surrounded by ten barbels. The **lateral line** is short and doesn't extend past the **pectoral fins**. Each **pectoral fin** has a stout spine, and the **caudal fin** is rounded. Average size is up to 28 cm (11 in). This species exhibits sexual size **dimorphism**, with the average length of the female being considerably larger than that of the males.

Similar Species

Because of its eel-like body, the oriental weatherfish may be confused with species of lamprey; however, lampres are typically thinner, have no **pectoral** or **pelvic fins**, and don't have the characteristic barbels on the mouth.

Habitat

This species is very hardy and can survive a wide range of temperatures and environmental conditions. It is typically found in slow or still waters with muddy or silty bottoms abundant with aquatic plants. It feeds on bottom-dwelling animals, insect larvae, snails, and worms. The oriental weatherfish can breathe atmospheric oxygen by using its intestine as an accessory respiratory organ, allowing it to live in oxygen-poor waters and to bury itself in soft substrates to survive long droughts.

Spread

Commonly used as bait and sold in the aquarium trade, the oriental weatherfish is released when aquariums are dumped or when bait buckets are emptied. Its popularity as a food-fish is also linked with its purposeful introduction into the wild to create harvestable populations.

Distribution

Native to eastern Asia, the oriental weatherfish was most likely introduced to natural waters in the United States by fish farm and aquarium escapes. It is found in both eastern and western parts of the United States, and has established in eastern Illinois, western Indiana, and central Michigan within the Midwest.

Environmental Impacts

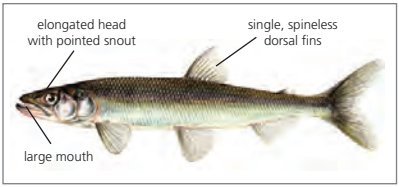
The oriental weatherfish can negatively impact native species by predation and competition for food, habitat, and spawning sites. It can also increase **turbidity** and nitrogen levels in standing water, which can negatively impact water quality.

United States Distribution

Rainbow Smelt

Osmerus mordax

Species at a Glance



The rainbow smelt is a small fish that is eagerly pursued by anglers because of its fine flavor. Its Latin name *Osmerus*, which comes from the Greek word meaning “odor”, is fitting because when removed from the water, they give off an odor which smells like freshly cut cucumbers.

Identification

The rainbow smelt has a small, slender body that typically ranges from 18–23 cm (7–9 in) long and weighs around 85 g (3 oz). Smelt are mostly silver, with pale olive-green backs and iridescent purple, blue, and pink sides. A conspicuous silvery streak runs lengthwise along each side. In the water, rainbow smelt shimmer colorfully, but when removed, they quickly fade to a silver white. In freshwater they are darker, becoming almost black on the back. The head is elongated, with a relatively large mouth and pointed snout. The lower jaw protrudes, and prominent teeth can be seen on the tongue and both jaws. Scales are thin and easily detached. A single **dorsal fin** and a single **adipose fin** lack spines. Spawning males are covered on the head, body, and fins with tiny bumps called **nuptial tubercles**.

Similar Species

While they may be confused with many minnow species, rainbow smelt have an **adipose fin** and prominent teeth that minnows lack.

Habitat

Historically, rainbow smelt have been strictly **anadromous** (residing in saltwater, but entering freshwater to reproduce). However, since the early 1900s the smelt has been successfully introduced into freshwater systems. It prefers deeper, cooler waters during the warmer seasons but will favor shallower coastal areas for feeding as winter approaches.

Spread

Rainbow smelt spread naturally through waterway connections. Other potential vectors include ballast water, bait bucket transfers, improper disposal of fish remains containing gametes, and intentional introduction as forage and bait fish.

Distribution

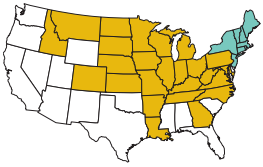
The rainbow smelt is native to the Atlantic Coastal drainages of North America and the Pacific drainages of North America and Asia. It was introduced into Michigan's Crystal Lake as a food for stocked salmon and soon escaped into Lake Michigan. It can now be found in all of the Great Lakes, the Mississippi River, and other inland waters. In Ohio, rainbow smelt populations are established in Ohio's Lake Erie waters.

Environmental Impacts

Rainbow smelt could impact sport fishing and native fish populations because they compete directly with sport fish such as perch, walleye, and lake trout for food. Smelt also feed on early or larval stages of other fish.

Ohio Distribution

United States Distribution



Orange - Invasive

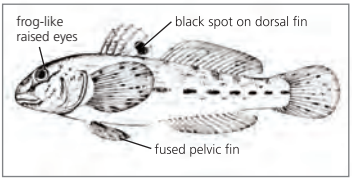
Blue - Both Native & Invasive

Round Goby

Neogobius melanostomus

IN OHIO RIVER BASIN

Species at a Glance



The round goby is a small, aggressive, bottom-dwelling fish that has dramatically altered the Great Lakes food web since it was first discovered in Lake St. Clair in 1990. It grows rapidly and reproduces several times in one season. Avian botulism outbreaks appear directly related to the round goby due to its heavy feeding on invasive zebra and quagga mussels.

Identification

The two most distinguishing features of the round goby are the black spot on the **dorsal fin**, and the fused **pelvic fins** that form one suction-cup-shaped structure. Young round goby are a solid slate gray, whereas older goby are mottled, with olive green, black, gray, and brown spots. Spawning males turn almost solid black. Their soft body and large round head have very distinctive frog-like raised eyes. On average, they grow 10–25 cm (3.9–9.8 in) in length.

Similar Species

While round gobies look very similar to the native mottled sculpin (*Cottus bairdi*), the sculpin has two separated **pelvic fins** and lacks the black spot on the **dorsal fin**. The round goby may also resemble the much smaller, invasive tubenose goby (*Proterorhinus marmoratus*), but the tubenose has tubular shaped nostril extensions and lacks protruding eyes.

Habitat

This freshwater fish prefers shallow water with rocky and sandy bottoms where it likes to perch on top of rocks and hide in crevices. Round goby can occupy a variety of depths; can tolerate a wide range of temperatures, water quality, and oxygen concentrations; and can survive in brackish water.

Spread

The round goby was introduced to the Great Lakes through the ballast water of ocean-going cargo ships. Because they resemble small baitfish, boaters and fishermen can accidentally carry them from one body of water to another through bait buckets, bilge water, and plant debris.

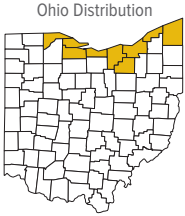
Distribution

Native to Eurasia, including the Black, Caspian, and Azov seas and tributaries, round goby were first sighted in the St. Clair River in 1990 and since have spread to all of the Great Lakes. In Ohio, the round goby is abundant in Lake Erie and its lower tributaries, throughout the Rocky River's east branch, and in Hinkley Lake. The species was first collected from Ohio waters in 1993 and was widespread throughout Lake Erie by 1998.

Environmental Impacts

The round goby is thriving at the expense of native populations, many of which are important sport fish. It is a voracious fish-egg predator and outcompetes native species including sculpin, logperch, lake trout, and darters for food sources, habitat, and spawning sites. It also spawns more frequently and feeds on their eggs and young.

Ohio Distribution

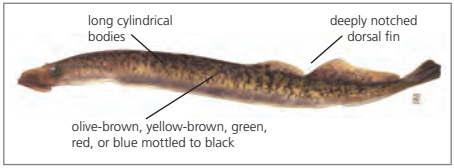


United States Distribution

Sea Lamprey

Petromyzon marinus

Species at a Glance



Sea lampreys are primitive, jawless fish that resemble eels. These aggressive parasites affect Great Lakes native fish populations such as lake trout, whitefish, and walleye because they can latch onto their victims for up to several weeks and feed on their blood and body fluids.

Identification

Sea lampreys have long, flexible, cylindrical, scaleless bodies with a deeply notched **dorsal fin**, separating it into two distinct parts. The body is 30–51 cm (12–20 in) long and weight can range from 227–369 g (8–13 oz). Adults have a disc-like mouth that contains circular rows of over 100 sharp, hooked teeth. Larval lampreys, called **ammocoetes**, have a very small, undeveloped mouth hidden between folds of skin. Juveniles have white undersides and uniformly colored blackish blue or silver backs. Adults can be olive-brown, yellow-brown, green, red, or blue mottled with a darker shade of the same color; or sometimes nearly black. The underside is typically white or gray.

Similar Species

Sea lampreys are most similar to our native lampreys; however, our native lampreys pose no threat to our native fishes or ecosystems. Some native lamprey species are protected as endangered within the state, several are

non-parasitic, and none should be harassed in their native waters. Sea lamprey's invasive range only overlaps with silver (*Ichthyomyzon unicuspis*), northern brook (*I. fossor*), and American brook (*Lethenteron appendix*) lampreys in Ohio. American brook lamprey is most similar, but all are smaller than the sea lamprey and lack the prominent blotches of dark pigment. Silver and northern brook lampreys also have a more contiguous **dorsal fin**.

Habitat

Sea lampreys require three distinctly different habitats connected by free-flowing stretches of stream. Spawning adults are found in late May or early June in shallow pits near the upper end of gravel riffles. After hatching, the **ammocoetes** drift down to larger, slower moving streams and burrow into the sediment. After several years, they transform into parasitic adults in spring, and migrate into large bodies of water. They migrate back to tributary streams the following spring to spawn and then die shortly after.

Spread

In 1921, the sea lamprey appeared in Lake Erie, arriving via the Welland Canal. It took just 25 years for it to spread to the remaining Great Lakes.

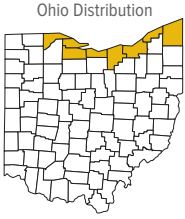
Distribution

Sea lampreys are native to the Atlantic Ocean, where natural populations moved into the freshwater areas of Lake Ontario and the St. Lawrence River to spawn. Now landlocked in the Great Lakes, the sea lamprey has distributed itself into the tributaries of those lakes. Invasive sea lamprey are only present in Ohio's Lake Erie waters and its tributaries below the first substantial obstruction.

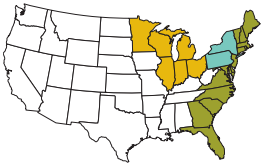
Environmental Impacts

A single sea lamprey can destroy up to 40 pounds of fish during its adult lifetime. Under some conditions, only one out of seven fish attacked will survive. The sea lamprey population explosion in the 1940s and 1950s contributed significantly to the collapse of economically important Great Lakes fish species such as lake trout.

Ohio Distribution



United States Distribution



Orange - Invasive Green - Native
Blue - Both Native & Invasive

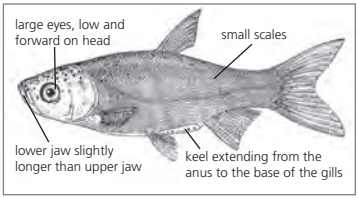
Silver Carp

Hypophthalmichthys molitrix

IN LAKE ERIE BASIN

Species at a Glance

The silver carp is a member of the Asian carp complex, which also includes bighead, black, and grass carps. Its large size, voracious appetite, and ability to leap out of the water make it an enormous threat to the state's fisheries and recreational economies.



Identification

This very large filter feeder averages 40–70 cm (16-28 in) in length, but can reach up to 130 cm (51 in) and weigh up to 36 kg (80 lbs). Its deep body is **laterally compressed**, with a **ventral keel** that extends forward from the anus almost reaching the base of the gills. Large eyes are located low and forward on the head. The mouth is large and **terminal**, and the lower jaw is slightly longer than the upper jaw. No barbels are present on the mouth. The short **dorsal fin**, which lacks spines, contains 7–10 rays. Scales are very small. Coloration is olive to grayish-black on the back, with silvery sides blending to white below, and darker pigmentation on the fins.

Similar Species

While it most closely resembles the invasive bighead carp (*Hypophthalmichthys nobilis*), the silver carp is fairly uniform in color, whereas the bighead has irregular dark blotches on its back and sides. The bighead also has a less extensive **keel**, spanning from the **pelvic fin** to the **anal fin**. Silver carp may also resemble the common carp (*Cyprinus carpio*), which has barbels on either side of the mouth, and species of suckers (Catostomidae), which have thick lips containing small folds or nipple-like bumps. Small, juvenile silver carp also look superficially similar to native gizzard shad.

Habitat

The silver carp is an exclusively freshwater fish, preferring large river systems, lakes, or impoundments with flowing water needed for spawning. It can feed in temperatures as low as 2.5°C (36.5°F) and can withstand low levels of oxygen.

Spread

Once introduced to open waters, the silver carp readily spawns and disperses. Because juveniles resemble some common baitfish species, it may be unintentionally spread through the use of live bait. It can also spread in illegal shipments of live Asian carps, which is popular in the Asian food market.

Distribution

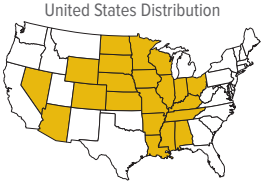
Native to eastern Asia, the silver carp was intentionally introduced into the United States to control algae in aquaculture ponds. During flooding in the early 1980s, it escaped into the Mississippi River and has since moved upstream towards the Great Lakes. In Ohio it can be found in the Ohio River drainage, and there are records from Adams, Brown, Clermont, Gallia, and Hamilton counties.

Environmental Impacts

The silver carp consumes vast amounts of plankton and **detritus** each day, competing with native filter feeders and juvenile fish for food. In addition, when startled by boat motors or other equipment, the silver carp can leap up to 3 m (10 ft) out of the water, posing a risk of injury to boaters and water-sport enthusiasts.

Ohio Distribution

United States Distribution

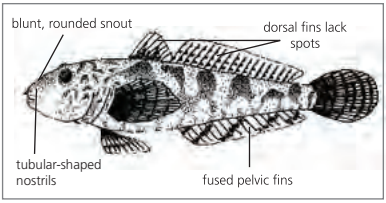


Tubenose Goby

Proterorhinus semilunaris

Species at a Glance

The tubenose goby is a small, bottom-dwelling fish that gets its name from its tubular-shaped nostrils. It feeds mainly on aquatic insects, and although females can live for up to five years, males die immediately after spawning.



Identification

Its cylindrical body has small scales and a somewhat flattened underside, measuring 6–11 cm (2.4–4.3 in) in length. It has a blunt and rounded snout with a wide mouth and large lips. Tubular shaped nostrils extend just beyond the tip of the snout. Two **pelvic fins** are fused into a single suction-cup-shaped disc, and a dark bar may be present on the front edge of the first **dorsal fin**. The body is light brown with darker brown blotches that can form vertical bars on the rear half of the sides. A triangular black spot is present at the base of the **caudal fin** followed by two white spots.

Similar Species

While it may be confused with the round goby (*Neogobius melanostomus*), the tubenose goby is much smaller than the round goby and has tubular-shaped nostril extensions. The round goby has a black spot on the rear edge of the first **dorsal fin** and has very distinctive frog-like eyes that protrude from the top of the head. In addition, the tubenose goby does not feed on zebra mussels, and its mouth is too small to be caught on fishing lines like the round goby. The tubenose goby may also be confused with native sculpins; however, sculpins do not have scales or **pelvic fins** that form a suction cup.

Habitat

The tubenose goby lives in slightly brackish to freshwater. It actively defends nest sites created under rocks, logs, and shells in shallow areas of lakes and rivers with plenty of plant cover.

Spread

The tubenose goby was most likely introduced to the Great Lakes in the ballast water of ocean-going ships. Since it often resembles small bait fish, it can also be spread by boaters and fishers who accidentally carry it from one body of water to another through bait buckets, bilge water, and plant debris.

Distribution

Native to the Black and Caspian seas in Europe, the tubenose goby was first found in Lake Erie around 1990 and can now be found in lakes St. Clair, Erie, and Superior. Current occurrences in Ohio are limited to Lake Erie in the waters around the Bass Islands.

Environmental Impacts

While their impacts are not yet known, tubenose gobies may compete with and prey upon benthic species in a manner similar to the larger round goby. However, because it is smaller and not as aggressive, the tubenose goby may not be as detrimental as the round goby.

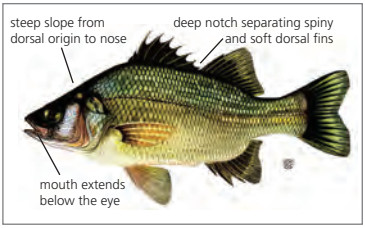
United States Distribution

White Perch

Morone americana

Species at a Glance

The white perch, also called the silver perch and the stiffback, is not actually a perch but rather a member of the temperate bass family. It is a prolific competitor of native fish species and is believed to have the potential to cause declines of Great Lakes walleye populations.



Identification

Its deep, **laterally compressed** body, which averages in length from 13–18 cm (5.1–7 in), is steeply sloped from the dorsal origin to the nose. The mouth is large and extends just below the eye, and the tongue lacks teeth. The **dorsal fin** is made up of a spiny and soft portion separated by a deep notch and a small membrane. Color is silvery-gray to greenish-brown above, fading to silvery-white below and paler on the sides with no dark horizontal stripes.

Similar Species

The white perch is most similar to the white bass (*Morone chrysops*), which grows larger, is more uniformly silver with prominent dark horizontal stripes, and lacks the connected membrane between the first and second **dorsal fins**. **Hybridization** between the two species has been documented in Lake Erie, which has resulted in mixed characteristics.

Habitat

This predacious and opportunistic feeder thrives in brackish and freshwater rivers, streams, and lakes. It exploits shallow to deep water and can overpopulate quickly.

Spread

Spread has occurred through natural dispersal, unauthorized stockings, and recreational activities. Additional spread may occur as the white perch is stocked as a sport fish in many areas of the Mississippi River Watershed.

Distribution

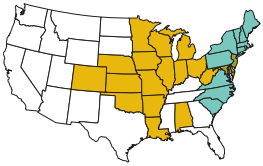
The white perch is native to the Atlantic coastal regions of the United States, including the Lower St. Lawrence River south to South Carolina. It invaded the Great Lakes through the Erie and Welland canals in 1950 and is now found in all of the Great Lakes. In Ohio it is established in Lake Erie and its tributaries, where it is among the most numerous species in the system. It is also established in several inland reservoirs such as East Fork and LaDue, and records occur for the Ohio, Mahoning, and Muskingum rivers.

Environmental Impacts

The diet of the white perch, which includes zooplankton, insect larvae, and other fishes, puts it in direct competition with native game and forage species for food. In the spring, white perch feed heavily on the eggs of other fish species such as walleye and white bass, limiting recruitment and causing declines in species numbers.

Ohio Distribution

United States Distribution



Orange - Invasive Green - Native
Blue - Both Native & Invasive

Other Species of Concern for Ohio

While this guide covers many aquatic invasive species established or with the potential to establish in Ohio, it is not a complete list. Unfortunately there are many other invasive species that are currently, or may in the future, threaten Ohio's native ecosystems. For your reference we have included a list of additional species that are of concern, but please recognize that this list is also not exhaustive. Note that not all of the species listed below are strictly aquatic, as some may be found in fields near wetlands, wooded riparian zones, and similar.

PLANTS

Amur honeysuckle	*Lonicera maackii*
Autumn-olive	*Elaeagnus umbellata*
Black dog-strangling vine/black swallowwort	*Vincetoxicum nigrum*
Callery pear	*Pyrus calleryana*
Common barberry	*Berberis vulgaris*
Common privet	*Ligustrum vulgare*
Common teasel	*Dipsacus fullonum*
Cutleaf teasel	*Dipsacus laciniatus*
Dame's rocket	*Hesperis matronlis*
European buckthorn	*Rhamnus cathartica*
European wand loosestrife	*Lythrum virgatum*
Fig buttercup/lesser celandine	*Ranunculus ficaria*
Garlic mustard	*Alliaria petiolata*
Giant hogweed	*Heracleum mantegazzianum*
Giant knotweed	*Fallopia sachalinensis*
Glossy buckthorn	*Frangula alnus*
Hairy willow herb	*Epilobium hirsutum*
Japanese barberry	*Berberis thunbergii*
Japanese honeysuckle	*Lonicera japonica*
Japanese hop	*Humulus japonicus*
Japanese knotweed	*Fallopia japonica*
Japanese stiltgrass	*Microstegium vimineum*
Kudzu	*Pueraria montana var. lobate*
Mile-a-minute	*Persicaria perfoliata*
Morrow's honeysuckle	*Lonicera morrowii*
Multiflora rose	*Rosa multiflora*
Oriental bittersweet	*Celastrus orbiculatus*
Russian-olive	*Elaeagnus angustifolia*
Spotted knapweed	*Centaurea stoebe L. ssp. micranthos*
Tatarian honeysuckle	*Lonicera tatarica*
Tree-of-heaven	*Ailanthus altissima*

Japanese knotweed

INVERTEBRATES	
Golden mussel	*Limnoperna fortune*
Killer shrimp	*Dikerogammarus villosus*
Marron	*Cherax tenuimanus*
Yabby	*Cherax destructor*
FISHES	
Amur sleeper	*Perccottus glenii*
Bitterling	*Rhodeus sericeus*
Crucian carp	*Carassius carassius*
Eurasian minnow	*Phoxinus phoxinus*
European perch	*Perca fluviatilis*
Ide	*Leuciscus idus*
Large-scale silver carp	*Hypophthalmichthys harmandi*
Nile perch	*Lates niloticus*
Prussian carp	*Carassius gibelio*
Red shiner	*Cyprinella lutrensis*
Roach	*Rutilus rutilus*
Snakeheads	*Channa spp. and Parachanna spp.*
Stone moroko	*Pseudorasbora parva*
Tench	*Tinca tinca*
Threespine stickleback	*Gasterosteus aculeatus*
Walking catfish	*Claris batrachus*
Wels catfish	*Silurus glanis*
Zander	*Sander lucioperca*

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Glossary

Allelopathic (Allelopathy): The process by which a plant releases chemicals that can inhibit or benefit other plant species

Alternate: Leaves spaced singly along a stem, one at each node

Ammocoete: The larval stage of primitive jawless vertebrates, such as the sea lamprey

Anadromous: Migrating between freshwater and saltwater to breed

Anal fin: An unpaired fin located on the underside of a fish, posterior to the anus.

Anther: Plant structure located in the stamen (male organ) of the flower that contains the pollen

Antheridium (plural **antheridia):** The male sex organ of algae, mosses, ferns, fungi, and other nonflowering plants

Areola: A small circular area; small space that separates the carapace in crayfish

Asexual reproduction: Mode of reproduction that does not involve meiosis or separate sexes; offspring arise from a single parent and inherit genes only from that parent

Axil: The angle formed between two structures on a plant, such as a leaf and a stem

Biofouler: A living organism whose growth or activity results in the impairment or degradation of something, such as a ship's hull or mechanical equipment

Bract cell: a one-celled appendage at a branchlet node

Bracts: Small, specialized, leaf-like structures at the base of a flower or leaf

Bulbil/Bulblet: A small bulb, or bulb-shaped growth typically arising from the leaf axil, base of stem, or replacing the flowers; capable of producing a new plant when separated from the parent plant

Byssal threads: Strong, silky fibers made from proteins that are used by mussels or other bivalves to attach to rocks, pilings, or other substrates

Carapace: A hard, bony or chitinous case or shield covering the dorsal (upper) part of an animal, such as a turtle or crab

Caudal: Directed towards the hind part of the body

Caudal fin: The tail fin located at the end of the caudal peduncle and used for propulsion

Caudal peduncle: The posterior portion of a fish's body from where it narrows to the attachment of the tail fin

Chloroplast: Specialized organelles found in plant cells and other eukaryotic organisms where photosynthesis occurs

Cladoceran: Small crustaceans in the order Cladocera which are commonly called "waterfleas" and found in most freshwater habitats

Cleistogam (cleistogamy): Small, inconspicuous, self-pollinating flowers, often more fruitful than showier ones on the same plant

Composite flowers: Large family of flowering plants with individual flowers forming clusters or groups of flowers arranged on a stem, giving it the appearance of a single flower

Compound eye: The eye of most insects and some crustaceans, consisting of multiple light-sensitive parts, each serving to focus light on the retina to form a portion of an image

Creeping: Growing by spreading out and staying close to the ground

Detritus: Non-living, particulate organic material; any disintegrated material or debris

Dioecious: Having male and female reproductive organs on separate individuals of the same species

Dorsal fins: Are located on the back of a fish and serve to protect against rolling and assist in sudden turns and stops; can have up to three

Emarginate: Caudal fin with a slight inward curve

Emergent: Plants with leaves that extend above the water surface, usually found in shallow water

Flagellum (plural **flagella):** Long, slender, whip-like extensions of certain cells or unicellular organisms, used mainly for movements

Fragmentation: A form of asexual reproduction where an organism is split into fragments that develop into mature, fully grown individuals that are clones of the original organism

Fruit: The seed bearing portion of a plant

Fusiform: Elongated and spindle-shaped, tapering at both ends; fish with this body shape are capable of swimming very fast

Gonopodium: anal fin of a male fish modified to function as a copulatory organ

Gonopods: Specialized appendages of various arthropods used in reproduction or egg-laying

Haptonema: A stiff, hair-like organelle attached near the flagella in a group of algae called haptophytes; may function in attachment, feeding, or avoidance

Hermaphroditic: Organism that has reproductive organs associated with both male and female sexes

Heterocercal: Caudal tail shape; vertebrae extend into the upper lobe of the tail, making it longer (as in sharks, sturgeons, and gars)

Homocercal: Caudal tail shape; fin appears superficially symmetric but in fact the vertebrae extend for a very short distance into the upper lobe of the fin

Hybridization: The crossbreeding of different species to produce hybrids of those species, often with intermediary characteristics

Inflorescence: A cluster or arrangement of flowers on an axis

Keel: A lateral ridge found on the ventral surface of many fast-swimming fishes

Lateral line: A series of sensory pores along the head and sides of a fish and some amphibians by which water currents, vibrations, and pressure changes are detected

Laterally compressed: Flattened from side to side; fish with this body shape usually do not swim rapidly but have exceptional maneuverability

Leaflet: Individual blades found in a compound leaf

Lemma: A larger, outer bract which, along with the palea, serves to contain the floret(s) held within and provides a protective covering for the developing floret as well as for the seed after ripening

Ligule: Thin, membranous extension of the leaf sheath on the upper surface of the leaf; may be hairy or bristly, hard or soft

Lunate: Caudal fin shaped like a crescent moon

Macrolaga (plural **Macroalgae):** algae visible to the naked eye

Margin: The edge of a structure

Mid-vein (Mid-rib): The central vein of a leaf that runs from the tip to the base of the leaf

Monoecious: Having male and female reproductive structures on the same plant

Monotypic: Having only one type or representative; such as a genus containing only one species

Morph: One of several variant forms of an animal or plant

Nacre (Mother of pearl): The hard, pearly, iridescent substance forming the inner layer of a mollusk shell

Node: A knob or joint of a stem from which leaves, roots, shoots, or flowers may arise

Nut: Dry fruit having a hard shell which usually contains only one seed; nutlets are very small nuts

Nuptial tubercles: Usually small, raised structures on regions of the head, body or fin rays where two individuals come in contact to breed; may function to maintain body contact between the sexes during spawning

Oogonium (plural **oogonia):** The female sex organ of certain algae and fungi; typically a rounded cell or sac containing oospheres

Operculum: A structure that acts as a lid or covering to close the aperture of a mollusk's shell or fish's gill

Opposite: Two leaves emerging from one node directly across from one another; leaves occurring in pairs

Panicles: A many branched inflorescence

Parthenogenesis: Asexual reproduction in which a female animal produces eggs that develop as clones.

Pectoral fins: Paired fins along the side of the body and behind the gills, analogous to our arms

Pelagic: Relating to open water, not orienting to shorelines or submerged structures

Pelvic fins: Paired fins along the ventral surface, analogous to our legs

Peritonium: The membrane that lines the abdominal cavity and covers most of the abdominal organs

Petiole: A leaf stalk

Pharyngeal: Relating to the pharynx, which is the cavity behind the mouth that connects it to the esophagus

Pharyngeal teeth: "throat" teeth carried on the innermost gill arches of many fishes

Pistils: The female fertilizing organs of a flower

Pistillate: Having pistils (female flowers) but no stamens (male flowers)

Protocercal: Caudal tail shape; vertebrae extend to the tip of the tail and the tail is symmetrical but not expanded

Rhizomes: A creeping underground stem

Rosette: Leaves arranged in a radiating pattern at the base or top of the plant

Rostrum: In crayfishes and other decapods, a pointy projection at the anterior end of the carapace

Runner: A slender, creeping stem that puts forth roots from nodes spaced at intervals along its length; new plants eventually grow from the nodes and can become detached from the parent plant

Scute: A thickened horny or bony plate or large scale; such as on the shell of a turtle, underside of a snake, back of a crocodile, etc.

Sepals: Part of the outer floral leaves; usually green

Serrate/Serrated: With fine, tooth-like or saw-like notches along the margin

Sessile: Sitting directly on a main stem or branch without the support of a leaf stalk

Sheath: The extension of the leaf that surrounds the stem

Spike/Spikelet: A flower- or fruit-bearing stalk

Stalk: A stem or similar structure that supports a plant part such as a flower, flower cluster, or leaf

Stamen: The male fertilizing organ of a flower

Staminate: Having stamens (male flowers) but no pistils (female flowers)

Stolon: A horizontally creeping stem on the surface of the soil

Submerged/Submersed: Plants growing with their root, steams, and leaves completely under the surface of the water

Sutures: A line or junction of adjacent animal or plant parts such as the juncture between whorls of a mollusk shell or the junction between the valves of a bivalve shell

Telson: The terminal appendage in crustaceans, chelicerates, and insects; the telson is the small, central segment of an aquatic invertebrate's tail and is flanked by uropods to form the tail fan

Terminal: Situated at the end or extremity

Truncate: Appearing to end abruptly, shortened, cut off at the end

Tuber: The short, thickened, fleshy, food-storing portion of an underground stem with many surface buds; shaped like a tiny potato

Tubercle: A small rounded projection, especially on the bone or on the surface of a plant or animal

Turbidity: Cloudiness in water created by stirring up sediment or having foreign particles suspended

Turion: A young scaly shoot budded off from underground stems; detachable winter bud used for survival when conditions are unfavorable

Vegetatively: A form of asexual reproduction of a plant where new plants grow from parts of the parent plant

Veliger: The free-swimming, planktonic larva of certain aquatic mollusks such as zebra mussels

Ventral: Relating to the underside of an animal or plant

Whorl/Whorled: A pattern of spirals or concentric circles; In plants: an arrangement of three or more leaves, flowers, or bracts radiating from a common node, spread at intervals along the stem.

Common Name Index

Scientific Name Index

Measurement Conversion

1 centimeter = 0.39 inches

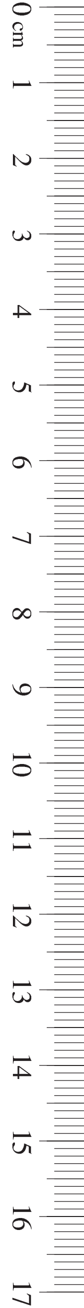
2.5 centimeters = 1 inch

25.4 millimeters = 1 inch

30.5 centimeters = 1 foot

1 meter = 3.28 feet

0.914 meters = 1 yard



Centimeter Specimen Ruler