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MAP
AIS

Mid-Atlantic Field Guide to Aquatic Invasive Species

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Mid-Atlantic Field Guide to

Aquatic Invasive Species

MID-ATLANTIC AIS FIELD GUIDE

Table of Contents

2 Introduction
4 About MAPAIS
5 Regional Challenges
6 Using this Guide
8 Prevention
12 Identifying, Reporting & Collecting
16 Invasive Aquatic Plants
62 Invasive Wetland Plants
106 Invasive Invertebrates
146 Invasive Mammals and Birds
156 Invasive Fish
198 Invasive Pathogens
204 Invasive Algae
216 Invasive Reptiles and Amphibians
222 Field Guide References
245 Image Credits
261 Glossary
269 Common Name Index
270 Scientific Name Index

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MAP AIS

Introduction

Aquatic invasive species (AIS) pose a significant environmental and economic threat to the ecosystems and communities of the Mid-Atlantic region and beyond. The Mid-Atlantic region encompasses eight states, including Delaware, Maryland, New Jersey, New York, North Carolina, Pennsylvania, Virginia, and West Virginia, as well as Washington D.C. The region is home to the Chesapeake Bay; the largest estuary in the United States, with more than 150 major rivers and streams flowing into its 64,299-square-mile basin. In the Chesapeake Bay watershed alone, nearly 200 known or possible aquatic and terrestrial invasive species have been recorded.

Global trade, human activities, recreation, and a changing climate are helping invasive species spread at accelerated rates. Once established, controlling their spread is both technically difficult and expensive, making eradication nearly impossible. Therefore, identifying and preventing the introduction of these species is the key to averting long-term ecosystem damage, and to ensuring the highest probability of effective control.

This field guide is designed to aid science professionals and other interested individuals in the prevention, early detection, and proper reporting of AIS. This reference can help conservation law enforcement, regional biologists, volunteer monitors, resource managers, educators, students, and other professionals working in the Mid-Atlantic's waters to learn general information about AIS, identify the problem species, collect specimens for verification, and report infestations appropriately.

This field guide is designed to aid science professionals and other interested individuals in AIS early detection and reporting.

The species included in this field guide were selected by the Mid-Atlantic Panel on Aquatic Invasive Species. Additional species may be included as needed in future iterations of the guide.

Information on all reported species in the Mid-Atlantic Region can be found in the USGS Nonindigenous Aquatic Species database (https://nas.er.usgs.gov/viewer/ANSTF_regions/MAPAIS.aspx).

About MAPAIS

Mid-Atlantic Panel on Aquatic Invasive Species

The Mid-Atlantic Panel on Aquatic Invasive Species (MAPAIS) was formed in 2003 through the efforts of the Chesapeake Bay Program's Invasive Species Workgroup, which identified and ranked invasive species threats to the Chesapeake Bay region. The Workgroup and its member agencies recognized the need for greater coordination of AIS programs throughout the Mid-Atlantic region. Thus, MAPAIS was established as one of six regional panels administered by the Aquatic Nuisance Species Task Force, an intergovernmental organization dedicated to preventing and controlling aquatic nuisance species as authorized by the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) of 1990.

MAPAIS has a diverse membership representing state and federal agencies, academic institutions, environmental organizations, commercial interests, and regional entities. Its mission is to assist state and federal agencies and other stakeholders, in developing and implementing strategic, coordinated, action-oriented approaches to prevent and control the introduction and spread of aquatic invasive species in the Mid-Atlantic region. More information on MAPAIS can be found at www.midatlanticpanel.org.

Regional Challenges

The Mid-Atlantic Field Guide to Aquatic Invasive Species is a multi-state resource that provides an overview of species information relevant to AIS in the region. While overarching federal regulations guide management of aquatic invasive species, each state has its own regulatory, policy, and management plans for dealing with AIS challenges. For instance, states have specific lists of prohibited and allowed species, unique reporting mechanisms, and different handling and transportation regulations. A species may be considered locally invasive within one state but is less of a concern in other states, or across the Mid-Atlantic region. Additionally, some non-native species are considered important sportfish in some areas, but invasive in others.

Aquatic invasive species pose varying threats to native plant and animal populations. Therefore, responses to infestations will depend on factors such as individual species, location of colonization, density of the infestation, presence of native species, and other biological and ecological factors.

It is important to consult with the appropriate state agency for the most up-to-date information on local AIS issues. A national database of state contact information is available at https://siren.fort.usgs.gov/findexperts.

Using this Guide

The purpose of this guide is to help slow or stop the spread of aquatic invasive species in the Mid-Atlantic region.

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 pathways 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.

The last section contains species profiles that highlight important species characteristics to help identify AIS.

Species are grouped together into larger taxonomic groups, with a different color representing each group. Within those groups, species are ordered alphabetically by common name. Each profile contains photos, illustrations, maps, and narrative descriptions that highlight important factors or features about the species.

- **Invasive Aquatic Plants (dark green)**
- **Invasive Wetland Plants (light green)**
- **Invasive Invertebrates (teal)**
- **Invasive Mammals and Birds (purple)**
- **Invasive Fish (blue)**
- **Invasive Pathogens (orange)**
- **Invasive Algae (yellow)**
- **Invasive Reptiles and Amphibians (maroon)**

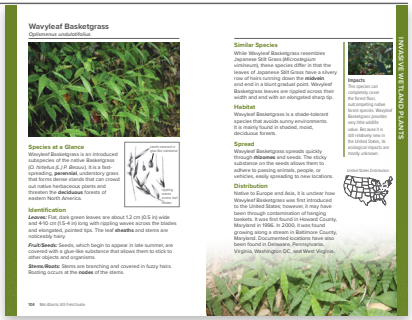
Species profiles follow the general format below:

Species at a Glance: brief overview of species and any interesting facts

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


Wavyleaf Basketgrass
Oplismenus undulatifolius
Species at a Glance
Identification
Leaves: Flat, dark green leaves are about 1.2 cm (0.5 in) wide and 4-10 cm (1.5-4 in) long with rippling waves across the blades and elongated, pointed tips. The leaf sheaths and stems are noticeably hairy.
Fruit/Seeds: Seeds, which begin to appear in late summer, are covered with a glue-like substance that allows them to stick to other objects and organisms.
Stems/Roots: Stems are branching and covered in fuzzy hairs. Rooting occurs at the nodes of the stems.
104 Mid-Atlantic AIS Field Guide
Similar Species
Habitat
Spread
Distribution
Impacts
United States Distribution
INVASIVE WETLAND PLANTS

Spread: highlights pathways and vectors by which the species can be transferred to new locations

Distribution: Native and invasive range information, including distribution in the United States and the Mid-Atlantic region.

Note: Distribution information was taken from the USGS Non-Indigenous Species database, the USDA NRCS plants database, iMAP invasives, and other web-based distribution tracking sites. This information represents 2025 data and may not be completely accurate as distribution information goes quickly out of date. Please use additional resources to verify species locations in your area.

Impacts: Documented or potential influence on biodiversity, the economy, and/or human health.

Additional tips for using the guide:

Each taxonomic group includes a reference section with key information to support accurate species identification. These sections may feature images and diagrams that highlight important anatomical structures and distinguishing features, to aid in the identification process.

Bolded words indicate glossary terms which can be found on page 261.

The back cover page of the field guide can be used as a ruler to help measure specimens in the field.

This guide includes invasive wetland and riparian plant species that, while not considered aquatic, may have the ability to thrive in both wet and dry conditions and have impacts to aquatic systems.

> For the most up to date information on species and distribution information, download the *Mid-Atlantic Field Guide to Aquatic Invasive Species* app available via the Apple app store or Google Play store.

Prevention

Preventing the arrival and spread of aquatic invasive species into Mid-Atlantic water bodies is the best way to control their establishment and spread.

Aquatic invasive species can spread between water bodies through a variety of pathways. These include ballast water discharge from cargo ships, intentional releases of aquarium and water garden species, and common water-related activities like boating, fishing, scuba diving, and swimming. Activities related to professional aquatic biology or ecology may also lead to their spread.

Aquatic invasive species can attach to solid surfaces, like boats, trailers, motors, fishing tackle, waders, boots, bait buckets, live wells, clothing, scuba or other field equipment. Some species can survive for days or even weeks on damp clothing or equipment, and some are so small they are nearly impossible to detect.

Once attached, the species can easily be transported to new locations. By taking precautionary steps, the harmful ecological, economic, and health impacts associated with AIS introductions could be prevented or reduced.

Boating and Fishing

Boaters and anglers are encouraged to be vigilant before and after entering the water. Following the Clean, Drain, Dry method will ensure they are not spreading AIS between water bodies.

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 a boat motor or trailer can be released into new environments, transforming valuable fishing and boating areas into mangled mats of weeds. Some species may even harm boats by jamming steering equipment, and ruining boat engines.

Boater and Angler Checklist to Prevent AIS Spread

- Inspect and clean watercraft, motor, and trailer of any visible plants, animals, or mud.
- Drain water from watercraft, motor, bilge, bladder tanks, live-well and portable bait containers before leaving water access.
- Inspect and clean waders, footwear, ropes, anchors, bait traps, dip nets, downrigger cables, fishing lines, and field gear before leaving water access.
- Rinse watercraft, trailer, and fishing equipment with high-pressure hot water when possible and use a stiff brush to remove visible material on footwear.
- Never dump live fish, bait, or other organisms from one water body into another. Dispose of unwanted bait, fish parts, and packing materials in the trash.
- Dry everything for five days or more, unless otherwise required by local or state laws, when moving between water bodies OR wipe with a towel before reuse.
- 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.

Water Gardening and In-home Aquariums

Water gardening is a popular hobby and a fast-growing area of the aquarium trade. Invasive plant and animal species can move out of a water garden in a variety of ways including direct release by the property owner, flooding caused by extreme weather, and improper disposal of unwanted species. In-home aquariums are a popular pet hobby, but unfortunately aquarium pets are often disposed into water bodies when the pet owner can no longer provide care.

Never release or dispose of unwanted plants or aquarium animals into a lake, pond, river, or other waterbody. Additionally, never dump them into storm drains. Storm drains lead to rivers, lakes, or wetlands – which are all integral components of the larger watershed.

Prevention (continued)

If an aquarium plant or animal is no longer wanted or can no longer be cared for, consider one of the options in the checklist below.

Water Gardener and Aquarium Owner Checklist to Prevent AIS Spread

- Contact a local retailer for proper handling advice or for possible returns.
- Give or 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 of in the trash.
- Contact a local pet store, humane society, veterinarian, or other expert for guidance on appropriate and humane disposal options.
- For more information, visit habitattitude.net.

Scuba Diving and Swimming

Scuba diving and swimming in lakes, rivers, quarries, or off the Atlantic Coast are recreational activities that may lead to the unintentional spread of AIS.

Scuba Diver and Swimmer Checklist to Prevent AIS Spread

- Check all gear that came into contact with water, including regulators, buoyancy compensators [BCs], wetsuits, masks, snorkels, and any other dive gear.
- Thoroughly clean all diving gear, including both the inside and outside of the BC, to ensure that no mud or organic matter is present.
- After cleaning, soak all equipment in hot water or salt water (1/2 cup salt/gallon) for 30 minutes. Be sure to thoroughly rinse with fresh water after cleaning as salt can harm scuba equipment.
- Allow clothing, gear, and other equipment to dry completely before entering different waters.

Aquatic Field Professionals

Aquatic biologists, monitors, volunteers, and anyone working in waterways and wetlands in the Mid-Atlantic region may be entering multiple water bodies within a week, or even a day. These activities may include monitoring, collecting, surveying, fish stocking, and stream restoration, which can all lead to the unintentional spread of AIS.

Aquatic Field Professionals Checklist to Prevent AIS Spread

- Inspect and remove aquatic plants, animals, seeds, and mud from boats, trailers, 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 wells, tubs, tanks, and sampling equipment before leaving water access.
- Dispose of unwanted plants, fish, worms, crayfish, snails, or clams in the trash.
- Wash boat, motor, trailer, and personal gear (waders, boots, scuba gear) and field sampling equipment (nets, bottles, ropes, tubs) with high pressure, hot tap water, OR
- Dry boat, motor, and trailer in the sun for at least five days and equipment for at least 10 days. Another option is to freeze equipment for at least two days before reuse.

Note: The actions described for any of these activities may be legally mandated in some states; therefore, it is recommended to check with the appropriate state regulatory agency for more Information.

Visit *protectyourwaters.net* and *wildlifeforever.org* for more information on AIS prevention.

Identifying, Reporting & Collecting

There are three critical steps in preventing aquatic invasive species from infesting and establishing in a new waterbody:

1) Early detection and accurate identification of a species

2) Reporting the sighting to local or state officials, and if needed, collecting the species for appropriate identification. The process for reporting varies by state. Be sure to check with officials for guidance on reporting methods.

3) Rapid response of local or state natural resources managers and others who will remove or control the infestation.

Identifying and Reporting Tips

Carry tools to accurately identify and document an AIS sighting:

- Digital camera or phone 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 Mid-Atlantic Field Guide to Aquatic Invasive Species and/or the phone app for assistance in species identification

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 the species size and extent of the area it covers.
- Write down a detailed description of unknown specimen(s).
- Take digital photographs of the specimen(s), the immediate environment, and any 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 the Mid-Atlantic Field Guide to Aquatic Invasive Species or App to help identify the species.

Report sighting:
To report a sighting or request assistance with identification in your state visit: https://nas.er.usgs.gov/SightingReport.aspx

Note: This information may not be applicable to all states in the Mid-Atlantic. Therefore, look to your own state for guidance on how to handle reporting and collecting specimens.

Collecting a Specimen*
Only collect a specimen if it is requested by the agency with authority over AIS in your state. 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 of the specimen, the location, and date that it was collected. Be aware that animal specimens may carry disease organisms. Use appropriate prophylactic measures, including wearing gloves and handling the species with forceps.

**Please note: it is illegal to possess or transport certain aquatic invasive species in Mid-Atlantic states. Please review the list of regulated species in your state before handling or transporting.*

Identifying, Reporting & Collecting (cont.)

Collection Tips:

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 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:

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

Vertebrates:

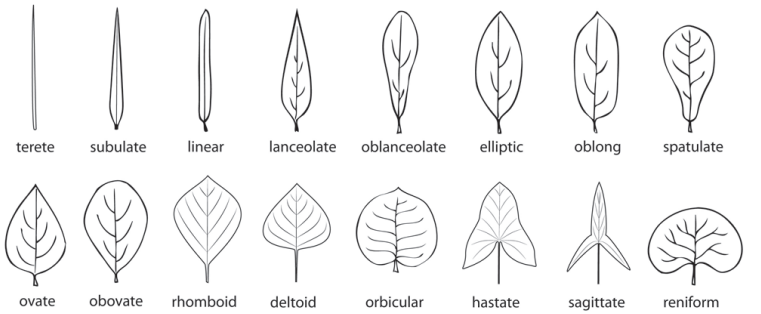
- The United States Postal Service has specific standards and requirements regarding the shipment of hazardous materials such as formalin and dry ice. If shipment to a taxonomic expert is necessary for identification, work with the recipient and the postal service to determine the best and safest method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

BE SURE TO PROVIDE CONTACT INFORMATION

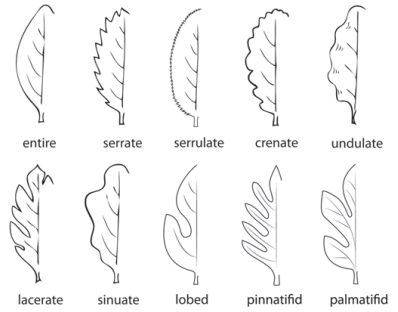
Always include a copy of your name, address, E-mail address, telephone number, and a copy of the notes you made when collecting the specimen in the mailed package.

Plant Structure

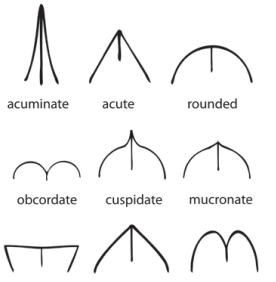
LEAF SHAPES



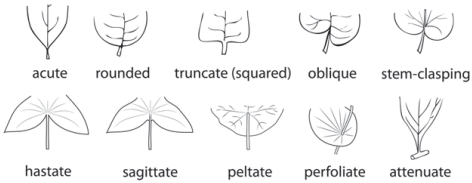
LEAF MARGINS



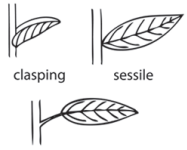
LEAF TIPS



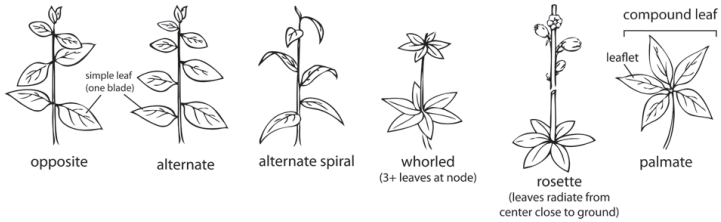
LEAF BASES



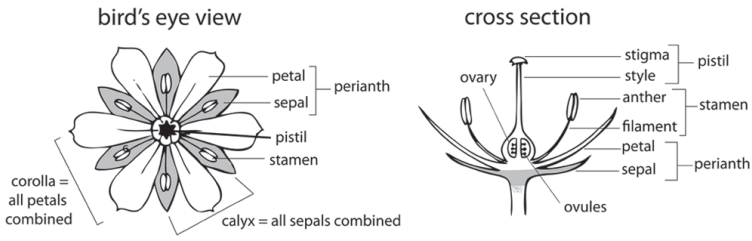
LEAF ATTACHMENTS



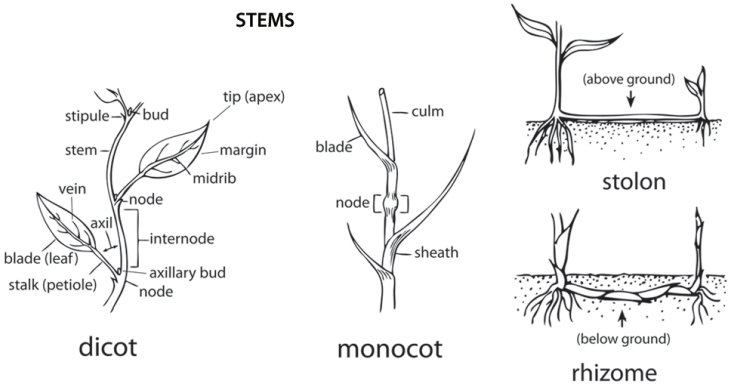
LEAF ARRANGEMENTS



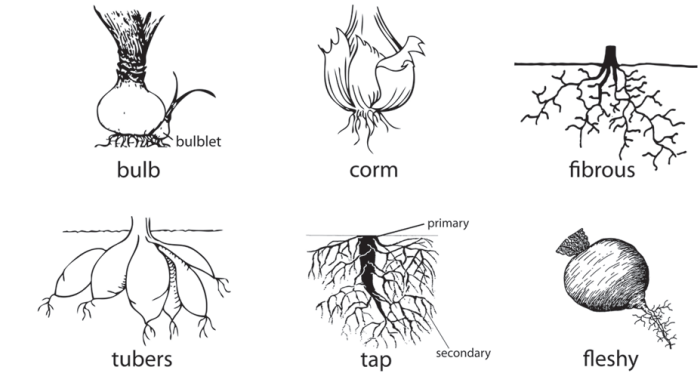
FLOWER PARTS



STEMS



ROOTS

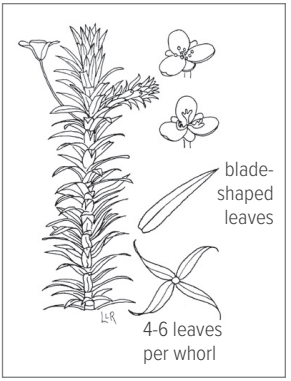


Brazilian Elodea

Egeria densa

Species at a Glance

Brazilian Elodea is a **submerged** aquatic perennial plant 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). Its showy flowers and oxygen generating capabilities make it a useful addition to aquariums. It is often sold under its alias “Anacharis”. 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 Elodea may be confused with another invasive plant, *Hydrilla verticillata* and the native plant American Elodea *(Elodea canadensis*). Hydrilla has small sharp teeth on the edge of the leaves and spines or conical bumps on the underside. Hydrilla also produces **tubers**; Brazilian Elodea does not. American Elodea has only 2-3 leaves per whorl and is smaller, usually less than 2.5 cm (1 in) long. These species also differ significantly in their flowers, with Brazilian Elodea being the only one to produce large, attractive white flowers with three petals.

Habitat

In its native range, Brazilian Elodea 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.

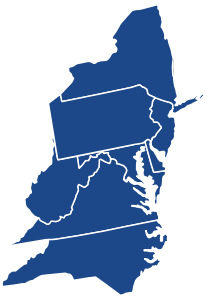
Impacts

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

Spread

The Introduction and spread of Brazilian Elodea has been 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. Therefore, subsequent spread can occur when fragments attach to recreational boats, trailers, and equipment and are spread to new water bodies. Once established, Brazilian Elodea can cover 100 acres of water per year.

Mid-Atlantic Distribution



Distribution

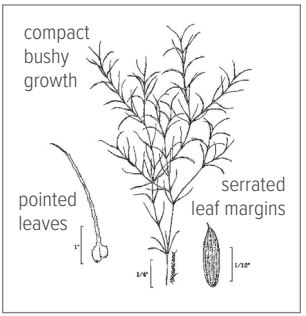
Brazilian Elodea is native to South America, specifically Brazil and coastal regions of Argentina and Uruguay. It is found to be invasive in several states in the U.S., including all states in the Mid-Atlantic region.

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 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** 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 may be confused with Coontail (*Ceratophyllum spp*) and Muskgrass (*Chara sp.*). It can be distinguished from Coontail by its oppositely paired, unbranched, and 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

Brittle Naiad 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). Brittle Naiad tolerates degraded habitats which may give it a competitive advantage over many native species.

Spread

Brittle Naiad spreads by both seed and **fragmentation**. Fragments can cling to boats, trailers, fishing gear, and other recreational equipment. 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 may have been intentionally introduced into Cayuga Lake, New York in 1935; although, the reason for its introduction is unknown. This plant has spread rapidly in the southeast and Mid-Atlantic regions and can be found in all Mid-Atlantic states.

Impacts

Brittle Naiad forms thick **monotypic** mats that can shade out other native plant species. It has even been known to outcompete other harmful invasive plants like Hydrilla. These mats reduce the aesthetic value of lakes, ponds, and rivers, and limit recreational activities such as boating, fishing, and swimming.

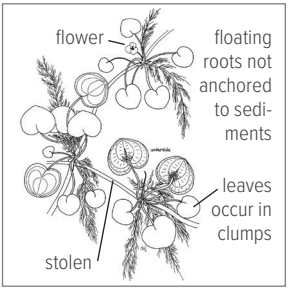
Mid-Atlantic Distribution

Common Frog-bit

Hydrocharis morsus-ranae

Species at a Glance

Common Frog-bit is an **herbaceous** aquatic plant that resembles a miniature Water Lily. It can form dense mats of vegetation that impact the amount of nutrient, light, and oxygen availability in the water.



Identification

Leaves: Small, thick, heart-shaped, and leathery leaves are 1.5-6.5 cm (0.6-2.6 in) long and occur in clumps that are not anchored to the bottom. 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, which enables it to float on the surface of the water.

Flowers: Small, showy flowers, 1 cm (0.4 in) in length, bloom in early summer. Each flower has three white petals and a yellow center.

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

Similar Species

While it is often mistaken for a species of Water Lily, Common Frog-bit leaves are distinctly heart-shaped, leathery, and smaller. Water Lily flowers are much larger with more than three petals. It may also be confused with American Frog-bit, Little Floating Heart, Spatterdock, and Watershield.

Habitat

Common Frog-bit prefers 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

Common 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 also attach to boats, trailers, waterfowl, and flowing currents. Common Frog-bit is used as an aquarium plant, making intentional release by humans another form of spread.

Distribution

Native to Europe and northern Asia, Common Frog-bit was introduced intentionally in the United States as a commercial ornamental species. It 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. In the Mid-Atlantic, populations are also present in New Jersey, New York, and Pennsylvania.

Impacts

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

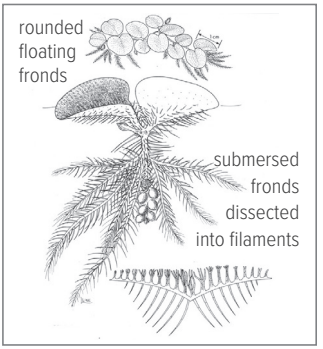
Mid-Atlantic Distribution

Common Salvinia

Salvinia minima

Species at a Glance

Common Salvinia, also called Water Spangles, is a small free-floating aquatic fern native to tropical America. It was cultivated in the United States for use in ornamental fish tanks and ponds but escaped to invade a variety of aquatic habitats. Once introduced, it has the potential to completely cover waterways.



Identification

Leaves: Because it is a fern, leaves are referred to as **fronds**. Fronds are borne in threes with two floating fronds and a third **submersed** frond that is dissected into filaments. The paired floating fronds are rounded with heart-shaped bases and notched tips. Smaller fronds lie flat on the water's surface, while larger fronds fold at a distinct **mid-rib**, giving them a "cup-like" appearance. Length ranges from 0.4-2.0 cm (0.2-0.8 in). Fronds grown in the shade remain broadly round and Emerald green, while those grown in the sun become larger, and turn a rusty brown color. Floating fronds are covered with rows of white bristly hairs on top that branch out to create a water-resistant shield. Long, chestnut-colored hairs coat the underside of the floating fronds, submersed filaments, buds, and **rhizomes**.

Flowers: Salvinias are ferns and have no flowers.

Spores: Spores are produced in **nut**-like sacs called **sporocarps** that are attached in spirals along the submersed filaments.

Stems: Horizontal branching rhizomes float just below the water's surface and produce leaves at each **node**.

Similar Species

Common Salvinia may be confused with Giant Salvinia (*Salvinia molesta*), but it is the smaller of the two species and is readily distinguished by the morphology of the frond hairs. In both plants, the hairs are split four ways; however, in Giant Salvinia the hairs come together at the tip to form a distinct "eggbeater" structure. Typically, mature fronds of Giant Salvinia are the size of a quarter to half-dollar, which is approximately twice the size of Common Salvinia.

Habitat

While commonly found growing on the surface of still or slow-moving ponds, small lakes, canals, and slow streams, this species can also be found in shallow backwaters of bayous, oxbows, ditches, cypress swamps, and marshes in- habiting water bodies with salinity levels as high as 4-7 ppt.

Spread

Common Salvinia reproduces and spreads mostly by fragmentation. Any part of the rhizome that buds or breaks off can form into a new plant. These rhizomes can also lie dormant during periods of reduced moisture and cold and will sprout again when conditions are more favorable. While it does contain spores, they are thought to be sterile.

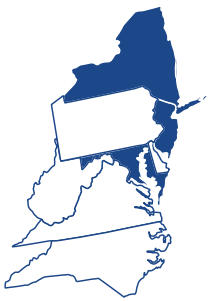
Distribution

Native to Central and South America, Common Salvinia first appeared in the United States in the St. John's River in eastern Florida where it is thought to have been introduced in the ballast water of transoceanic ships. It quickly expanded its range westward and northward and can be found in the Mid-Atlantic region in Maryland, New Jersey, and New York.

Impacts

The exponential growth of Common Salvinia enables it to quickly clog waterways. It has been recorded growing as long as 12 m (39 ft), blanketing waterways with mats up to 25 cm (10 in) thick. These dense mats block sunlight from reaching native species and decrease oxygen concentrations that can ultimately impact fish and other aquatic species. These mats can also restrict recreational activities such as boating, fishing, and swimming.

Mid-Atlantic Distribution



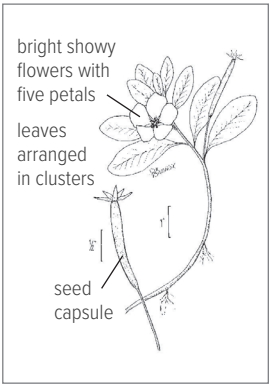
Creeping Water-primrose

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 freshwater shorelines.

Although native to parts of North America, this species has become invasive outside of its native range, where it forms dense floating mats that can displace native aquatic plants and wetland grasses.



Identification

Leaves: Leaves are arranged alternately, and clustered together, varying 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 from 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 shoreline. 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 midrib with less apparent branching veins; and Water Smartweed (*Polygonum amphibium*), which has similar floating leaves to Creeping 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 can absorb atmospheric oxygen, allowing it to survive in low-oxygen waters, grow 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 southern United States, and possibly Australia. In the United States, it is native from South Carolina to Kansas and south to Texas and Louisiana, but it is considered invasive in all Mid-Atlantic states.

Impacts

Creeping Water-primrose alters the chemistry of the aquatic environment by forming dense floating mats that shade out submerged vegetation, reduce dissolved oxygen levels, and impact pH, phosphate, and nitrate levels, making the habitat unsuitable for some native species. These mats also increase flood risk, impede navigation, and impact recreational activities such as boating, fishing, and swimming.

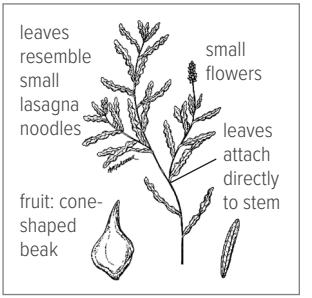
Mid-Atlantic Distribution

Curly-leaf Pondweed

Potamogeton crispus

Species at a Glance

Curly-leaf Pondweed is an invasive aquatic perennial plant that can grow 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: Leaves are **submerged**, oblong, slightly translucent, and olive- green to reddish-brown with rounded tips, that narrow towards the base. They are **alternately** arranged, directly attached to the stem, and grow up to 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 are located at the end of a slender, sometimes curved, **stalk** which appear above the water's surface from June through September.

Fruit/Seeds: Have a prominent cone-shaped beak and a bumpy crown-like ridge.

Stems/Roots: 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 species of Pondweed, many of which have both **emergent** and submerged leaves. Curly-leaf Pondweed has only submerged leaves. Other species of pondweed also lack the tiny but visible serrations and wavy edges of the leaves.

Habitat

Curly-leaf Pondweed prefers soft substrates in shallow, alkaline, and high nutrient waters. It tolerates still or flowing water and can 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** enable Curly-leaf Pondweed to regrow in new locations when they are moved by natural water flow, recreational activities such as boating and fishing, and by intentional plantings for wildlife habitat. It can also reproduce and spread by seeds which are ingested by waterfowl and can pass through the digestive system unharmed.

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 is widespread throughout the Mid-Atlantic region.

Impacts

Because of its tolerance for low light and temperature conditions, Curly-leaf Pondweed grows earlier 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 increased nutrient content that can cause harmful algal blooms.

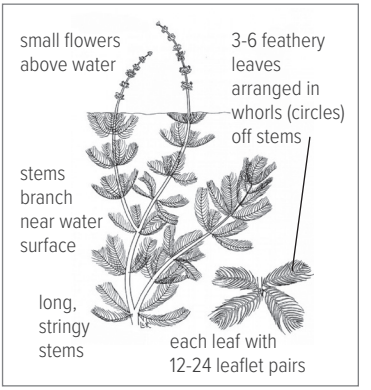
Mid-Atlantic Distribution

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 cause 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 **leaflet** pairs. They are aggregated into a submersed **terminal spike** and the tips 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.

Fruit/Seeds: Hard, segmented capsules contain four seeds.

Stems/Roots: 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 can be difficult to distinguish Eurasian Watermilfoil from the native Northern Milfoil (*Myriophyllum sibiricum*) and Coontail (*Ceratophyllum demersum*). It may also be confused with other leafy milfoil species including bladderworts, hornworts, mermaid weeds, and water crowfoots, 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. While Eurasian Watermilfoil grows best in fertile, fine-textured sediments and nutrient-rich lakes with lots of sunlight, it will readily inhabit disturbed lake beds.

Spread

Eurasian Watermilfoil does not rely on seeds for reproduction but instead reproduces by **fragmentation**. Plant fragments break off and float via water currents, enabling 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. It is common in lakes, ponds, and rivers throughout the Mid-Atlantic region.

Impacts

Eurasian Watermilfoil forms thick mats that outcompete native aquatic plants, reducing food sources, shelter, and spawning areas for fish and wildlife. These mats also interfere with recreational activities such as swimming, fishing, waterfowl hunting, boating, and can entangle boat propellers and other equipment. Heavy infestations can also clog industrial and power plant intakes and even reduce local property values.

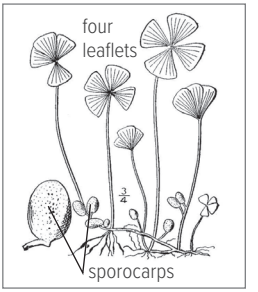
Mid-Atlantic Distribution

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 forms dense stands that crowd out native wetland plants, threatening ecosystems.



Identification

Leaves: Leaves are divided into four triangle-shaped **leaflets** that are hairless and 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. The upper leaflet surface is smooth while the lower surface may have short fine hairs. Emergent leaflets may fold together at night and spread outward during the day.

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

Spores: Near the base of the petioles are small spore-bearing bodies called **sporocarps**, which are .35-.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.

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.

Similar Species

European Water Clover may resemble species of Wood Sorrel (*Oxalis*) or Clover (*Trifolium*), 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 can grow 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.

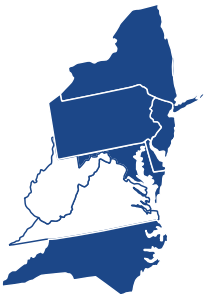
Distribution

Native to parts of southeastern Europe and Asia, this species was introduced into North America during the 19th century as an ornamental plant. Currently, this fern can be found in several Mid-Atlantic states, including Delaware, Maryland, New Jersey, New York, North Carolina, and Pennsylvania.

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 underground rhizomes.

Mid-Atlantic Distribution

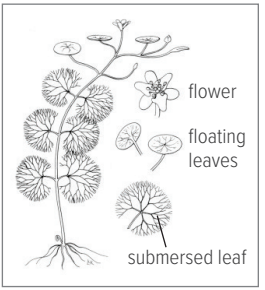


Fanwort

Cabomba caroliniana

Species at a Glance

Fanwort is a **submersed** freshwater perennial plant that can be found rooted in the substrate or floating on top of the water. When rooted, stems may reach lengths of up to 6m (20 ft). It is persistent, aggressive, and competitive, with the potential to take over aquatic ecosystems.



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 small and narrow (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.

Stems/Roots: Range 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 other leafy Milfoils, Beck's Water-marigold (*Megalodonta beckii*), some Bladderworts, Hornworts, Mermaid Weeds, and Water Crowfoots. The leaves of Watermilfoils are **whorled**, and they have small flowers growing from the **axils**. 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, enabling 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.

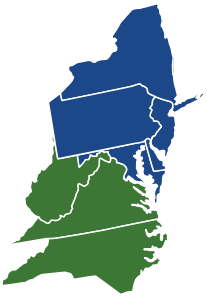
Distribution

Native to the sub-tropic areas of South America and the Gulf Coast region of the United States, Fanwort has been introduced to the Northeast and the Pacific Northwest. It can be found in scattered populations throughout the Mid-Atlantic states.

Impacts

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

Mid-Atlantic Distribution



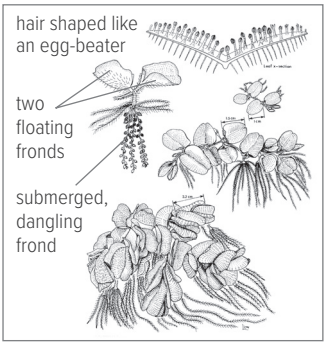
Green - Native Blue - Invasive

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: 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 eggbeater. 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 fold up and compress into chains as the plant ages. The underwater frond is brown, highly divided, and can be mistaken for a root; however, the plant has no true roots. It also acts to conceal the spores.

Flowers: Giant Salvinia does not flower.

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 green 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 "eggbeater" structure.

Habitat

Giant Salvinia prefers slow-moving, nutrient-rich, warm, fresh waters such as ditches, ponds, lakes, slow rivers, and canals. It will only tolerate fresh water 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 attach to recreational boats and equipment and on the feathers or fur of waterfowl and animals. 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.

Impacts

Giant Salvinia forms dense mats of vegetation that reduce water flow, sunlight penetration, and oxygen levels. The resulting stagnant and 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.

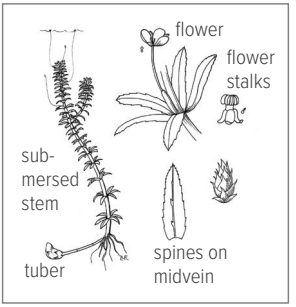
Mid-Atlantic Distribution

Hydrilla

Hydrilla verticillata

Species at a Glance

Hydrilla is a **submerged** aquatic **perennial** plant that many consider 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.



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 **midrib** on the underside of the leaf; however, these are not always present. The underside of the midrib can also be red. Leaves 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 float on the water's surface, are attached at the leaf **axils**, and are clustered towards the tips of the stems.

Stems/Roots: Long 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 food storage, are formed on the plant's roots, allowing it to overwinter.

Similar Species

Hydrilla closely resembles Brazilian Elodea (*Egeria densa*) and North American Elodea (*Elodea canadensis*). Brazilian Elodea typically has whorls of 3-6 leaves, is usually 2-3 cm (0.8-1.2 in) long, and has tiny teeth on the **margins** with no conical bumps on the midrib below. The native North American Elodea has leaves that occur in whorls of three and is usually a much smaller plant. Neither species of Elodea produces the tubers or **turions** found on Hydrilla.

Habitat

Hydrilla grows in a wide variety of still and flowing waters 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

Hydrilla primarily reproduces **vegetatively**, enabling even the smallest fragment to 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, India, 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 and in all the Mid-Atlantic states.

Impacts

Hydrilla's dense thick mats prevent sunlight from reaching native aquatic plant species growing below. As these mats die and decay, bacteria deplete oxygen from the water, impacting fish and other aquatic organisms. Hydrilla also disrupts commercial operations by clogging water intake pipes and filters, hindering irrigation, and limiting recreational activities such as boating, fishing, and swimming.

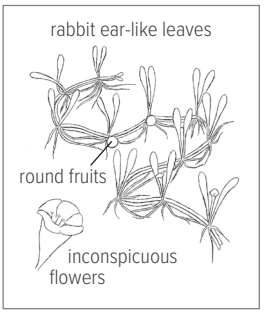
Mid-Atlantic Distribution

Mudmat

Glossostigma cleistanthum

Species at a Glance

Mudmat is a low-growing, mat-forming, aquatic invasive plant that has remained largely undetected 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 surface of the water.



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 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 the leaf **axils** at the base of the plant. They emerge when the water recedes in the summer months. Color ranges from mauve, lilac, pink, 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/Roots: 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 some members 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 attaching to 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. In the Mid-Atlantic, it can be found in areas of New Jersey and Pennsylvania.

Impacts

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

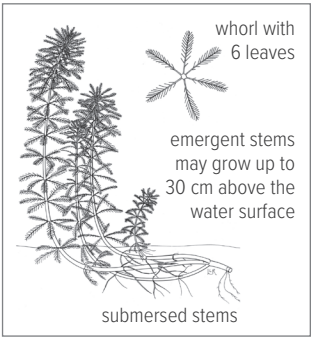
Mid-Atlantic Distribution

Parrot Feather

Myriophyllum aquaticum

Species at a Glance

Parrot Feather, also called Brazilian Watermilfoil, is an **herbaceous** aquatic perennial plant and member of the Watermilfoil family. It gets its name from its bright green feather-like leaves which are **whorled** around the stem and form thick suffocating mats. Only female Parrot Feather plants have been found in North America.



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 divisions per leaf.

Flowers: Small (1.5 mm [0.06 in]) white-pinkish flowers appear between the leaf **axils** of female plants in the spring.

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

Similar Species

A close relative, Eurasian Watermilfoil (*Myriophyllum spicatum*) is easily mistaken for the submerged leaves of Parrot Feather. Other look-a-likes include Bladderworts, Hornworts, Mermaid Weeds, Water Crowfoots, and other leafy Milfoils. The emergent stems and leaves are the most distinct characteristics of Parrot Feather, as they can grow up to 30 cm (12 in) above the water surface and resemble small fir trees.

Habitat

Parrot Feather 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 Parrot Feather 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, Parrot Feather was introduced as a garden plant in the 1800s. It has since spread throughout the United States and can be found in all Mid-Atlantic states.

Impacts

Parrot Feather forms thick mats that can shade out native plant and algae species, impact water flow, and alter the physical and chemical characteristics of lake sand streams. It can also clog recreational waterways and irrigation canals.

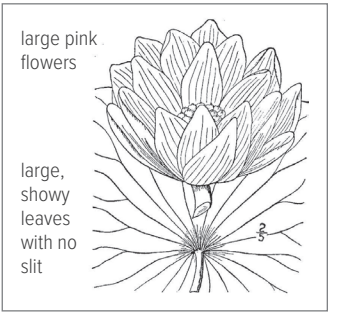
Mid-Atlantic Distribution

Pink Lotus

Nelumbo nucifera

Species at a Glance

Pink Lotus, also called Sacred Lotus and Asian Lotus, is a showy aquatic **perennial** plant 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 to 3 ft) across with many radiating veins.

Flowers: Large, fragrant flowers extend to 2 m (6 ft) above the water. They have 12-15 pink petals with showy yellow **stamens** around a large central **receptacle**. Flowers are 10-25 cm (4-10 in) across. They bloom during the summer for two months. The short-lived flowers open 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; however, cultivars of these two species tend to have whitish-pink flowers. The leaves of the Pink Lotus also 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 prefers 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. It can be found in multiple states in the Mid-Atlantic region, including Maryland, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, and West Virginia.

Impacts

Dense mats of floating Pink Lotus can inhibit the growth of other native aquatic vegetation, decreasing biodiversity, and impacting 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.

Mid-Atlantic Distribution

Pond Water-starwort

Callitriche stagnalis

Species at a Glance

Pond Water-starwort, also known as Common or European 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: The leaves are **opposite** and 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.

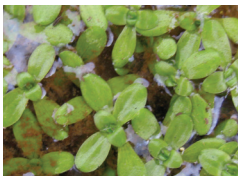
Flowers: Tiny, simple flowers don't have **sepals** or petals and are typically located right next to one another in the leaf **axils**. The flowers can have 0-4 (but usually two) small, white **bracts** at their bases, which may help the flowers float on the water and aid in pollination.

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 other 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. Pond Water-starwort may also be confused with other opposite-leaved delicate plants when not in fruit, such as Mudwort (*Elatine sp.*) or Horned Pondweed (*Zannichellia palustris*).



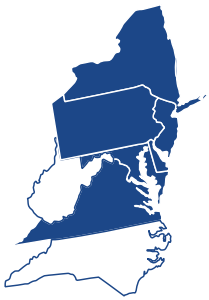
Impacts

Pond Water-starwort can form dense mats of vegetation that may crowd out and displace native aquatic vegetation.

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.

Mid-Atlantic Distribution



Spread

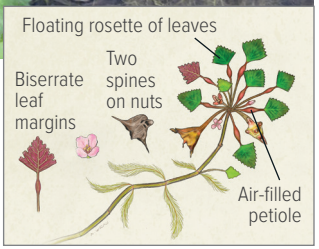
Pond Water-starwort was first recorded in New York in 1861, most likely introduced via ballast water of cargo ships. Once introduced, it became a popular aquarium plant, and subsequent escapes and releases have contributed to its spread throughout North America. It spreads through both seeds and plant 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 populations in Delaware, Maryland, New Jersey, New York, Pennsylvania, and Virginia.

Two-horned Trapa

Trapa bispinosa



Species at a Glance

Two-horned Trapa, a close relative of Water Chestnut (*Trapa natans*), is named for the two horn-like spines found on its seed pod. These barbed pods can spread via water currents or by attaching to waterfowl, nets, or boats, and can remain dormant in sediment for 2-5 years. Once established, Two-horned Trapa forms dense mats that outcompete native plants and severely disrupt aquatic ecosystems.

Identification

Leaves: Leaves are **alternating** and fan-shaped with **biserrate** leaf **margins**. Leaves form **rosettes** that can float through inflated **petioles**, that attach the leaves to a stem. Leaves near the water's surface are green on top and red on the bottom. **Submerged** leaves are **opposite**, linear, and are replaced by roots as they die.

Flowers: Flowers have four petals, four **sepals**, eight **stamens**, and four **carpels**. They are solitary and small, with pink petals and reddish sepals. Starting in early June, flowers sprout from the center of the rosettes.

Fruit/Seeds: **Nuts**, also called drupes, are large, 3-5 cm (1.5-2 in), with two opposing spines or horns that develop from hardened sepals. They also have two pseudo spines where sepals have deteriorated over time.

Stems/Roots: Both stems and roots are submerged and flexible. Roots are anchored into mud or soft sediment and stems extend upward towards the water's surface. Stems can grow to be up to 5 m (16 ft) in length.

Similar Species

Two-horned Trapa has several look-alikes, including Water Chestnut, Mosaic Flower (*Ludwigia sedioides*), and Creeping Water-primrose (*Ludwigia peploides*). Water Chestnut has seed pods with four horns, entirely green leaves, and white flowers. Mosaic Flower is generally smaller and has yellow flowers. Creeping Water-primrose has lance and oval-shaped leaves, and its stem grows along the water's surface.

Habitat

Two-horned Trapa can be found in a variety of habitats that have full access to sunlight with nitrogen-rich soil and water, including lakes, rivers, streams, ponds, wetlands, and reservoirs. It prefers relatively shallow water that is slow moving or still.

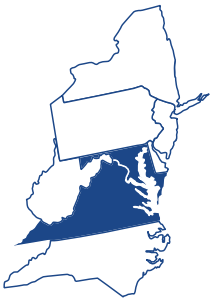
Spread

There are three primary ways that Two-horned Trapa spreads: vegetatively, through nut dispersal, and by attaching to boats, equipment and other organisms. Vegetative reproduction occurs when rosettes break off and float to new areas. The barbed nuts can be carried by water currents or attached to wooden boats, nets, and larger organisms like waterfowl. These nuts can remain dormant in sediment for 2-5 years, enabling the plant to establish in new locations.

Impacts

Because of its rapid and dense growth, Two-horned Trapa forms thick mats that quickly cover water bodies. These mats block sunlight from reaching submerged plants, obstruct water flow, limit recreational use of waterways, and reduce dissolved oxygen. Additionally, Two-horned Trapa outcompetes native species for resources, and absorbs significant quantities of organic nitrogen out of water and sediment.

Mid-Atlantic Distribution



Distribution

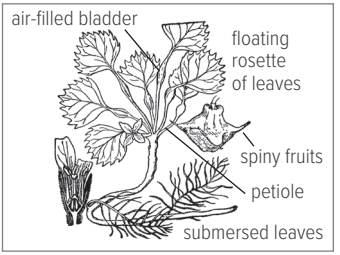
Two-horned Trapa is native to China, Korea, Japan, and Taiwan. It is believed that the plant was first introduced in the U.S. in the late twentieth century, but the first proven reports of the plant occurred in 2014 in the middle and lower Potomac regions of Virginia. It is believed that the plant was introduced intentionally to be used as an edible, for medicinal purposes, in horticulture, and by pond enthusiasts.

Water Chestnut

Trapa natans

Species at a Glance

Water Chestnut is a rooted aquatic plant that can dominate ponds, shallow lakes, and rivers. It grows in thick, dense colonies and can grow as much as 4.8 m (16 ft) in length.



Identification

Leaves: There are two distinct forms of leaves, 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] long), 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 are about 1 cm (0.4 in) long with four white petals located in the center of the leafy rosette and usually appear in mid-to-late July.

Fruit/Seeds: Black **nut**-like structures have four spiny projections, sharp enough to penetrate shoe leather.

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

Similar Species

Water Chestnut may be confused with Two-horned Trapa (*Trapa bispinosa*), Mosaic Flower (*Ludwigia sedioides*), and Creeping Water-primrose (*Ludwigia peploides*). Two-horned Trapa has seed pods with only two horns; leaves are red on the underside, and flowers are pink. Mosaic Flower has similar leaf and growth styles to Water Chestnut but is generally smaller and has yellow flowers. Creeping Water-primrose has lance and oval shaped leaves, and its stem grows along the water's surface.

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 20 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. In the Mid-Atlantic, it has spread to the waters of Delaware, Maryland, New Jersey, New York, Pennsylvania, and Washington DC.

Impacts

Colonies of Water Chestnut can choke a water body, outcompeting native organisms for nutrients and space, while offering little nutritional value for wildlife. The dense floating leaves limit light and oxygen availability and impede boating and other recreational activities.

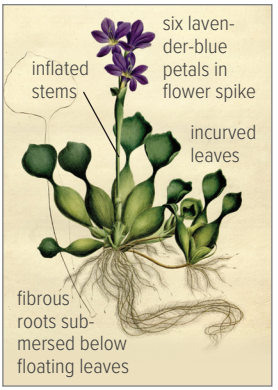
Mid-Atlantic Distribution

Water Hyacinth

Pontederia 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, 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, giving them a spongy appearance and enabling them to stay afloat. Fibrous roots hang beneath the floating leaves. They are dark purple to black and have a feathery appearance.

Similar Species

Water Hyacinth can be confused with American Sponge-plant (*Limnobium spongia*) because of its similar-looking leaves; however, American Spongeplant 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

Water Hyacinth's attractive purple flowers make it 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 enables 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.

Impacts

Water Hyacinth forms thick mats that block sunlight and reduce oxygen levels in the water, disrupting native plant and animal communities and decreasing biodiversity. These mats also limit boat traffic, swimming, fishing, and other recreational activities. In drainage and irrigation canals, Water Hyacinth impedes water flow, resulting in flooding and clogged pumps.

Mid-Atlantic Distribution

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 as a gift to attendees of the Cotton States Exposition held in New Orleans. By 1900 it had escaped cultivation to become a serious pest. It has been collected in multiple Mid-Atlantic States, but is currently established in Maryland and North Carolina.

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 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 of 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 (*Pontederia crassipes*); however, Water Lettuce has large, ribbed leaves and doesn't have the showy flowers characteristic of Water Hyacinth.

Habitat

Water Lettuce inhabits slightly acidic lakes, rivers, ponds, and canals in temperate climates. It can also survive in mud. It is not winter hardy, requiring temperatures above 15°C (59°F) for growth.

Spread

While some believe Water Lettuce to be a native species, others believe it was transported to the United States in the ballast water of cargo ships from the tropical and subtropical regions of Asia, Africa, and South America. It is also commonly sold through the aquarium industry, making intentional and unintentional release from ponds and water gardens potential methods of spread. 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 as early as 1765; however, it has since spread throughout the southeastern United States north to New York and westward to Arizona, California, and Texas. It is also present in Hawaii. In the Mid-Atlantic, Water Lettuce is found in Delaware, Maryland, New Jersey, New York, and North Carolina.

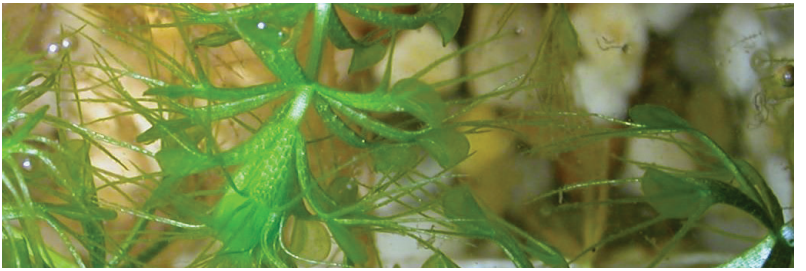
Impacts

The large mats formed by Water Lettuce block sunlight and reduce oxygen levels in the water, disrupting native plant and animal communities and decreasing biodiversity. These mats also interfere with recreational activities such as boating, fishing, and swimming, while making navigation difficult, obstructing flood control efforts, and clogging hydroelectric turbines.

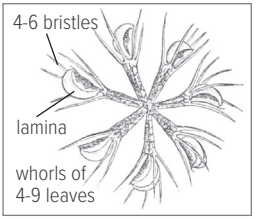
Mid-Atlantic Distribution

Waterwheel

Aldrovanda vesiculosa



Species at a Glance



Waterwheel is a free-floating, rootless, aquatic plant that gets its name from its unique leaves that are **whorled** around the stem, resembling a wheel. It is carnivorous, behaving like a Venus Flytrap and using a trap-like structure called a **lamina**. The lamina can snap shut in 0.01 seconds, which is the fastest recorded plant movement in the world.

Identification

Leaves: Whorls consist of 4-9 leaves arranged around a free-floating stem, giving the plant a cylindrical appearance. The leaves are up to 23 mm (2.3 cm) in diameter. The clam-like traps, called lamina, are 2-3 mm (0.2-0.3 cm) long and are held by **petioles** at the end of the leaves. The lamina appears as two lobes of translucent tissue that is studded inside with 4-6 bristles. The bristles protect the trap from being triggered by non-food items like floating debris. Trap lobes contain 30-40 trigger hairs which, when stimulated, cause the trap to snap shut.

Flowers: Tiny flowers with five green **sepals** and five white petals bloom in the summer. They are only open for 2-3 hours, usually during high sun, after which they are brought beneath the water for seed production.

Fruit/Seeds: Flowering is sporadic and not very successful, yielding only 1-10 seeds per **fruit**. In the fall, the plant forms **turions** that sink to the bottom and over-winter.

Stems/Roots: Simple or sparsely branched stems are filled with air to aid in flotation. Stem length varies between 6 cm (2.5 in) and 20 cm (8 in).

Similar Species

Waterwheel may be confused with other carnivorous plants like species of Bladderworts (*Utricularia spp.*), as well as Hydrilla (*Hydrilla verticillata*), Naiads (*Najas spp.*) and Watermilfoils (*Myriophyllum spp.*). However, Waterwheel is the only plant with the distinguishing clam-like lamina.

Habitat

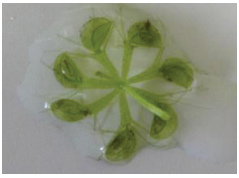
Waterwheel is found in wetlands, streams and lake littoral zones. It prefers clean, shallow, warm standing water with bright light, low nutrient levels, and a slightly acidic pH. Under ideal conditions it is capable of extremely rapid growth; however, it does not tolerate degraded habitats or large fluctuations in water chemistry.

Spread

Waterwheel spreads mainly through the movement of stem fragments and turions which can be transported by recreational equipment like boats, and fishing gear, as well as by waterfowl which can move them between habitats. This plant is also available for sale through the aquarium and water garden industry and can be accidentally or intentionally released.

Distribution

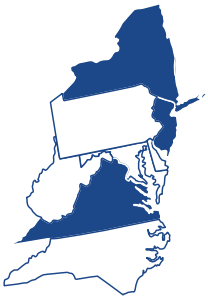
Native to Europe, Africa, Asia, and Australia, Waterwheel has only about 50 confirmed populations worldwide. Therefore, it is considered rare but remains on the watch list because it may become a threat to native communities. In 2012, a new population of Waterwheel was discovered in New Jersey, and other populations have been reported from New York and Virginia.



Impacts

Due to its carnivorous nature, it may compete with other native carnivorous species like Bladderworts. However, studies are needed to determine its impacts on aquatic invertebrate communities and the food web.

Mid-Atlantic Distribution

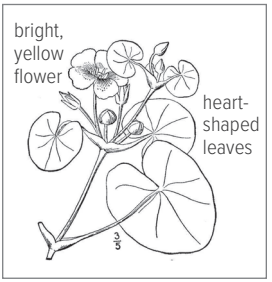


Yellow Floating Heart

Nymphoides peltata

Species at a Glance

This aggressive aquatic perennial plant 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-looking 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 variegate*) 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

Yellow Floating Heart is 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. It can also grow in damp mud.

Spread

Yellow Floating Heart is a popular aquarium plant that 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 stiff seed hairs can be moved to new areas on water currents or as they attach to the feathers or fur of waterfowl and other wildlife.

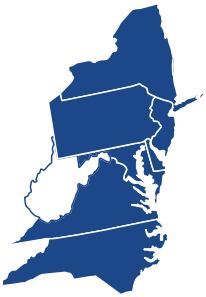
Distribution

Native to Eurasia and the Mediterranean region, Yellow Floating Heart was introduced as an ornamental plant into the United States. It can be found throughout the Mid-Atlantic region.

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.

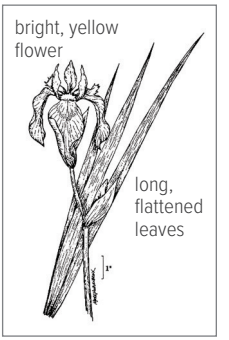
Mid-Atlantic Distribution



Yellow Iris

Iris pseudacorus

Species at a Glance



The Yellow Iris is an exotic member of the iris family, also called the Yellow Flag. It is commonly found in wetland areas of the United States. It is an emergent aquatic perennial plant with showy yellow flowers that have made it attractive as an ornamental plant. It can form dense stands of plants, that can reach up to 2.1 m (7 ft) tall, crowding out native plants and reducing habitat for wildlife.

Identification

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

Flowers: Two to three flowers with bright yellow to cream-colored petals with **sepals** outlined in purple and brown appear on each **stalk**. They are 8 -10 cm (3.1-3.9 in) in diameter and bloom June through August.

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

Stems/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 Cattails (*Typha spp.*), Bur-reeds (*Spanganium spp.*), 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

The Yellow Iris is 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 and throughout the entire Mid-Atlantic region.

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.

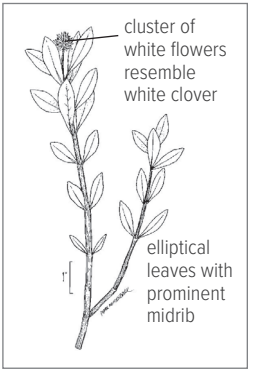
Mid-Atlantic Distribution

Alligatorweed

Alternanthera philoxeroides

Species at a Glance

Alligatorweed is a fast-growing **perennial** plant considered to be one of the world's worst weeds because of its ability to grow both over land and in water. In aquatic environments, it forms dense mats that begin at the shoreline and grow across the surface. In some cases, mats can reach completely across slow-moving rivers and can be robust enough to support the weight of a man.



Identification

Leaves: Simple leaves are **opposite**, elliptical to lance-shaped, shiny, and up to 10 cm (4 in) long with a prominent **midrib** and smooth **margins**. Soft, whitish hairs are found in the leaf **axis**.

Flowers: Distinctive flowers are white, papery, fragrant, and resemble a white clover. While appearing to be a single flower, they are actually a cluster of 6-10 small florets that are about 1.3 cm (0.5 in) in diameter and grow on a **stalk** that can be up to 7.6 cm (3 in) long. Flowers generally appear from April through October.

Fruit/Seeds: Very small **fruits** develop into a single seed.

Stems/Roots: Smooth, hollow stems can be single or branched and sprawl across the ground or water. Each node on the stem can produce a new stem or root, and mats of **creeping** stems can be up to 10 m (33 ft) long. Stems are particularly large and hollow when growing in water.

Similar Species

Alligatorweed is often confused with other members of the Alternanthera family such as Sessile Joyweed (*A. sessilis*) and Lesser Joyweed (*A. denticulata*); however, Alligatorweed is the only aquatic member of this family. Lesser Joyweed is smaller in size and has a small, stalkless cluster of white flowers. Water Primrose (*Ludwigia peploides*) is another look-alike; however, its leaves are **alternatively** arranged, and it has a large yellow flower. One of the main identifying features of Alligatorweed is the hollow stems on mature plants.

Habitat

Alligatorweed is usually found in aquatic habitats such as lakes, ponds, rivers, or along shorelines. It can also grow in a variety of areas, including terrestrial habitats. When growing on land, this plant forms smaller, tougher leaves. When growing in water, it may be rooted in the substrate or exist as a free-floating mat or **tussock**.

Spread

Alligatorweed grows and spreads quickly, reproducing **asexually** by **fragmentation**. Since new stems and roots can develop from a single node, a short fragment can regenerate into a new plant. Fragments are moved by water currents, and through human activities such as boating and fishing.

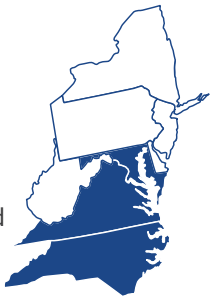
Distribution

Native to South America, Alligatorweed is believed to have been introduced to the United States as a stowaway in the ballast water of transoceanic ships. It was first documented in Alabama in 1897 and is now found in coastal states from Maryland to Texas, the Tennessee Valley, Puerto Rico, and California.

Impacts

The dense, tangled mats formed by Alligatorweed can be up to 1 m (3 ft) thick and have extensive root systems. Excessive growth of this plant clogs waterways, smothers native plants, prevents light and oxygen from entering the water column, and impedes water flow, which canlead to flooding damage. While some invertebrates may use these mats for habitat, this plant has no known direct food value to wildlife.

Mid-Atlantic Distribution

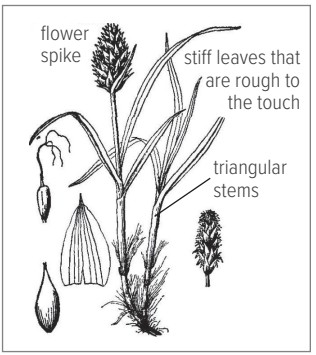


Asiatic Sand Sedge

Carex kobomugi

Species at a Glance

Asiatic Sand Sedge, also called Japanese Sedge, is a course, stout, perennial sedge that grows 10-30 cm (4-12 in) in height and is adapted to coastal beaches and dunes. It forms extensive colonies through cord-like rhizomes that extend many feet under the sand and produce new shoots.



Identification

Leaves: Young leaves are yellow green in color, stiff, and rough to the touch along the edges. Older **basal** leaves are somewhat wider, darker green in color, and leathery to the touch. The edges are **serrated**, which can be seen with the help of a hand lens. Leaves are 3-6 mm wide and are often longer than the triangular stems.

Flowers: Individual plants have either male or female flowers that are arranged in dense clusters or **spikes** at the end of a flowering **stalk**. Male flower spikes are cylindrical in shape and measure 3-4 cm long. Female flower spikes are more slender and typically longer measuring 3-6 cm. Flowering occurs from April to June.

Fruit/Seeds: A papery sac called a **perigynium** encloses the female flowers, each of which develops into a single-seeded **fruit** called an **achene**.

Stems/Roots: The base of the triangular stems is covered in brown scales.

Similar Species

Asiatic Sand Sedge resembles American Beach Grass (*Ammophila breviligulata*), and Beach Panic Grass (*Panicum amarum*). Leaves of Asiatic Sand Sedge are longer and more tapered than the look-a-like grasses, have a yellow green rather than bluish-green cast, and small teeth along the **margin**.

Habitat

Asiatic Sand Sedge grows on sand dunes and on higher ground areas of the beach susceptible to ocean storm disturbance. Like American Beach Grass, it appears to create more habitat for itself by trapping wind-blown sand to form dunes. Sand burial appears to stimulate the growth of **rhizomes**.

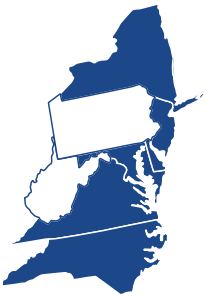
Impacts

Asiatic Sand Sedge can form dense stands on coastal dunes. It has been found in densities of up to 200 plants per square meter. This density effectively excludes native beach grasses and makes dunes more susceptible to erosion.

Spread

Soon after the plant was discovered in the United States, Asiatic Sand Sedge was observed to be potentially useful for stabilizing sand dunes and thus was planted intentionally on dunes in New Jersey and other beaches on the East Coast. This plant likely made its way to the Atlantic Coast through either intentional planting or the water dispersal of plant fragments or seeds. Asiatic Sand Sedge primarily spreads via an extensive rhizome system. It also produces seeds which could extend its spread; however, germination rates are low.

Mid-Atlantic Distribution



Distribution

Native to coastal Japan, China, and Korea, Asiatic Sand Sedge was first reported in the United States in New Jersey in 1929. It was thought to have washed ashore from shipwrecks carrying oriental porcelain, using Asiatic Sand Sedge as packing material. It can now be found along the Atlantic Coast from Massachusetts to North Carolina, and on the Pacific Coast in Oregon.

Beach Vitex

Vitex rotundifolia

Species at a Glance

Beach Vitex is a fast-growing, **perennial**, woody shrub found in coastal sand dunes. It can reach heights of 0.5-1 m (1.6-3.3 ft), shading out native plants and disrupting sea turtle nesting sites, particularly along the North and South Carolina coasts. Active community involvement, strategic mapping, and eradication efforts help to limit the impact this species has on U.S. coastlines.

Identification

Leaves: Oval-shaped leaves are **oppositely** arranged, simple, semi-waxy, smooth, and pale green on the upper side while greyish white on the underside. Both sides of the leaves are covered in dense fine hairs. Size is typically 5 cm (2 in) long and foliage has a spicy fragrance when crushed.

Flowers: Blue to purple flowers are fragrant, 2.5 cm (1 in) across, and are arranged in short **inflorescences** out of the leaf **axils**. Flowering occurs in the summer.

Fruit/Seeds: Round, 0.6 cm (.25 in) wide **fruits** are purplish-black when ripe.

Stems/Roots: Woody stems have square branchlets with fine woolly hairs. The stems grow horizontally along the ground, often rooting at the **nodes** and forming mats that can grow over 18 m (60 ft) long.

Similar Species

Beach Vitex has several native look-a-likes including Silver Leaf Croton (*croton punctatus*), Sea Beach Amaranth (*Amaranthus pumilus*), and Seashore Elder (*Iva imbricata*). Silver Leaf Croton has unpaired leaves with brown dots on the undersides of the leaves that can be seen with magnification. Sea Beach Amaranth has red stems and leaves that are crinkled. Seashore Elder has long linear leaves and doesn't have the round **fruits** found on Beach Vitex.

Habitat

An obligate sand-dune species, Beach Vitex can be found at low elevations on beaches, sand dunes, and rocky shorelines. It grows best in full sun and sandy or well-drained soils. Beach Vitex is highly drought and salt-tolerant and can exist in poor soil conditions and multiple hardiness zones. These characteristics, combined with its rapid growth rate, increase the likelihood that it will expand its range in the United States.

Spread

Beach Vitex is a prolific seed producer but can also reproduce from stem fragments. Seeds and broken off stems can float on water currents and be carried to other beaches. Birds can also facilitate spread as they eat seeds and distribute them in new areas. Seeds and cuttings that are chipped up and spread as mulch may have also helped this species to spread.

Impacts

Beach Vitex grows rapidly and sprawls across the landscape, crowding out native dune plants and shading out sunlight. Beach Vitex's root system destabilizes dunes and increases rates of erosion. It also threatens the endangered Loggerhead Sea Turtle's nesting habitat, as well as habitat for rare and threatened plants.

Mid-Atlantic Distribution

Distribution

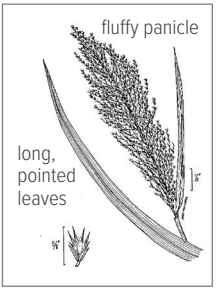
Native to Japan and Korea, Beach Vitex was introduced to the southeastern United States in the mid-1980s as an ornamental landscape plant and for sand dune stabilization. Along the coasts of North and South Carolina, Beach Vitex escaped cultivation and has taken over oceanfront dunes. This species can also be found in Alabama, Florida, Hawaii, and Maryland.

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 leaves are typically 20-60 cm (7.9- 24 in) long and 1-5 cm (0.4-2 in) at their widest point. They 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. They are usually purple or golden in color, but 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 feel rough to the touch and 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

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 nontidal brackish and freshwater marsh communities, 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.

Distribution

Invasive strains of Phragmites, which were introduced in the late 1800s, are now widespread throughout the lower 48 states and southern Canada. It can be found in every Mid-Atlantic state.

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 a toxin that allows it to outcompete native species, quickly turning once biologically diverse wetlands into monocultures.

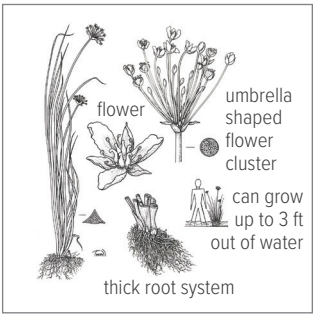
Mid-Atlantic Distribution

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 unnoticed among other wetland plants until it blooms a distinctive spray of attractive flowers in late summer and early fall.



Identification

Leaves: Leaves are **emergent**, 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 underwater and do not flower.

Flowers: Grow in umbrella-shaped clusters 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. Flowering occurs in late summer to early fall and only occurs on emergent plants.

Fruit/Seeds: **Pistils** ripen into dark brown **fruits** 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 another shallow water plant, Bur-reed (*Sparganium spp.*); 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, and streams. It cannot grow in shade and requires wet soil.

Spread

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 may have 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. In the Mid-Atlantic region, Flowering Rush is found in New York and Pennsylvania.

Impacts

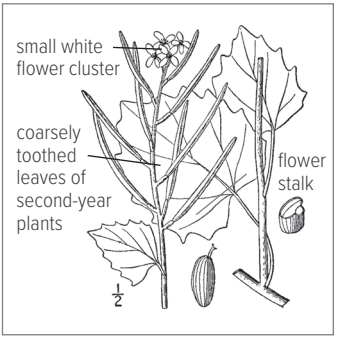
Flowering Rush can crowd out native species and the large number of underground rhizomes can harm fish and other wildlife by destroying food sources and habitats. It can also interfere with recreational activities such as swimming and boating.

Mid-Atlantic Distribution

Garlic Mustard

Alliaria petiolata

Species at a Glance



Garlic Mustard is a cool season biennial herb with leaves that give off a garlicky odor when crushed. First-year plants appear as a **rosette** of 4-8 green leaves that grow close to the ground and remain green all winter. In the spring, the rosettes develop into flowering plants that quickly dominate the forest floor, threatening native plants and forest communities throughout the Eastern and Midwestern United States.

Identification

Leaves: First-year rosettes have dark green, kidney-shaped leaves with scalloped **margins** and deep veins that give them a wrinkled appearance. In the second spring, a flower **stalk** rises from the rosette bearing **alternate**, triangular to heart-shaped, coarsely toothed leaves that smell like garlic when crushed. These flowering plants reach 0.6-1 m (2-4 ft) in height.

Flowers: Clusters of small white flowers appear at the end of an erect stalk on only second-year plants. Each flower has four petals, and blooming occurs from late April through June.

Fruit/Seeds: Seeds are produced in long, slender capsules that become shiny black when mature. By late June, when most Garlic Mustard plants have died, they can be recognized only by the erect stalks of dry, pale brown seed pods that remain throughout summer.

Stems/Roots: Single stems are weak and have a white, slender taproot that is “S”-shaped at the top.

Similar Species

Cut-leaved Toothwort (*Cardamine concatenata*), Sweet Cicely (*Osmorhiza claytonii*), and Early Saxifrage (*Micranthes virginiensis*) are native, white-flowered plants that occur in the same habitat and may be mistaken for Garlic Mustard. Cut–leaved Toothwort is low-growing but has narrow, finger-like leaves. Sweet Cicely has fern-like leaves and flowers with five petals, and Early Saxifrage has five white petals.

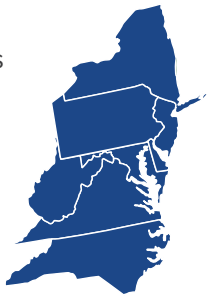
Habitat

Garlic Mustard grows in the moist shaded soils of river floodplains, forests, roadsides, edges of woods and trails, and forest openings. It prefers shady conditions, but can tolerate sunny habitats, usually resulting in smaller flowering plants. Disturbed areas are most susceptible to rapid invasion and dominance.

Impacts

Garlic Mustard aggressively outcompetes native plants by monopolizing resources like sunlight, moisture, nutrients, soil, and space. In the early spring, its rapid growth displaces native vegetation, depriving insects, deer, and other herbivores of essential food sources.

Mid-Atlantic Distribution



Spread

A single Garlic Mustard plant produces thousands of seeds that can scatter as far as several meters from the parent plant. These seeds can stay dormant for 20 years before germinating and remain viable for 5-8 years. Depending on the conditions, Garlic Mustard can either self-fertilize or be cross-pollinated by a variety of insects. While water may transport the seeds, they don't float well and are not carried far by wind; therefore, long-distance dispersal is most likely through animals that can carry the seeds in their fur, or through human-mediated pathways.

Distribution

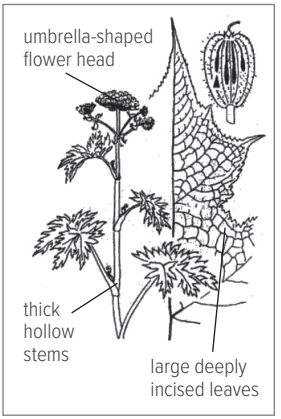
Originally from Europe, Garlic Mustard was first recorded in the United States in 1868 from Long Island, New York. It was most likely introduced by settlers for food and medicinal purposes. By 1991 it had invaded 28 Midwestern and Northeastern states and can be found throughout the Mid-Atlantic region.

Giant Hogweed

Heracleum mantegazzianum

Species at a Glance

Giant Hogweed, also known as Giant Cow Parsnip, is a perennial herb and member of the carrot and parsley family that can grow 4.5-6 m (15 to 20 ft) high. While the plant is beautiful, it is also dangerous and direct contact with its sap can cause blisters and burns on the skin. It is one of the few North American invasive plants that can cause both human health impacts and ecological damage.



Identification

Leaves: Large **compound leaves** are lobed, deeply incised, and 1-1.5 m (3-5 ft) wide. Hairs on the undersides are stiff, dense, stubby, and only 0.25 mm long. **Petioles** have short, coarse, white hairs at the base.

Flowers: Numerous white flowers form a large, flat-topped, umbrella-shaped head that is up to 0.8 m (2.5 ft) across. Flowering occurs from late spring through mid-summer.

Fruit/Seeds: Up to 100,000, 1 cm (0.5 in) long, winged, flattened, oval seeds form in late summer. The seeds, originally green, turn brown as they dry.

Stems/Roots: Thick hollow stems are generally 2.5-8 cm (1-3 in) in diameter but can reach up to 10 cm (4 in). They are marked with dark purplish blotches and raised nodules. Leaf **stalks** are spotted, hollow, and covered with sturdy bristles that are prominent at the base of the stalk. Stems are also covered with less prominent hairs.

Similar Species

While it's much larger than most native plants, Giant Hogweed can be mistaken for Cow Parsnip (*Heracleum lanatum*), Purple-stemmed Angelica (*Angelica atropur- purea*), and Poison Hemlock (*Conium maculatum*). Cow Parsnip only grows 1.5-2.5 m (5-8 ft) tall, and the deeply ridged stems can be green or slightly purple without the dark blotches and raised nodules. Purple-stemmed Angelica has smooth, waxy green to purple stems with no bristles or nodules and a softball-sized cluster of greenish-white or all white flowers. Poison Hemlock is shorter than Giant Hogweed, growing only 1-3 m (4-9 ft). While the stem has some purple blotches, it is waxy, and the entire plant is smooth and hairless, and the leaves are fern-like with bright, glossy, green leaves.

Impacts

Colonies of Giant Hogweed can form dense stands that crowd out slower growing native plants. The sap from broken stems, leaves, roots, flowers, or seeds can cause irritation in the form of severe blisters, burns, painful sores, and purplish blackened scars when it comes in contact with skin.

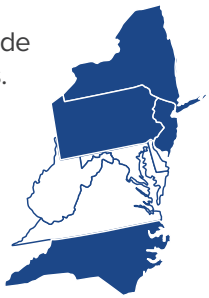
Habitat

Giant Hogweed can colonize a wide range of habitats but prefers rich damp soils such as those found along abandoned railroad rights-of-way, roadside ditches, stream banks, or other moist disturbed areas.

Spread

The numerous seeds produced by this plant can be spread by animals, surface runoff, wind, or by human activities, and may remain viable in the soil for up to 10 years.

Mid-Atlantic Distribution



Distribution

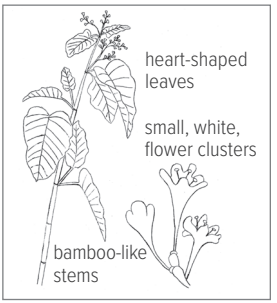
Native to Europe and Asia, Giant Hogweed was likely introduced to the United States and Canada in the early 1900s as an ornamental plant, as its size and impressive flower head made it a unique addition for arboreta and Victorian gardens. It was also a favorite of beekeepers as the flower heads provide food for bees. Giant Hogweed escaped cultivation and has now become naturalized in a number of areas throughout the United States and Canada. In the Mid-Atlantic region, it can be found in New Jersey, New York, North Carolina, and Pennsylvania.

Giant Knotweed

Fallopia sachalinensis

Species at a Glance

Giant Knotweed is an **herbaceous perennial** and member of the buckwheat family. It forms large colonies that can reach heights over 3.7 m (12 ft).



Identification

Leaves: Large, rounded leaves **alternate** on the stem and reach over 0.3 m (1 ft) in length. They have heart-shaped bases and rounded lobes. Thin wavy hairs are present on the underside of the leaves from June through mid-September.

Flowers: Small flowers reach about 10 cm (3.9 in) in length and range in color from a creamy white to greenish white. They grow in short, branched clusters from leaf **axils** at the ends of stems and appear from August to October.

Fruit/Seeds: Three-sided seeds are shiny, brown to black, egg-shaped, and have a paper-like texture.

Stems/Roots: Smooth, hollow, jointed stems are swollen at the **nodes**, light green in color, and are woody in appearance, resembling bamboo shoots.

Similar Species

Giant Knotweed looks similar to Japanese Knotweed (*Fallopia japonica*) and Virginia Knotweed (*Persicaria virginiana*). Giant Knotweed is generally much larger and can be distinguished by its heart-shaped leaf bases and the fine hairs on the underside of the leaves.

Habitat

Giant Knotweed grows in various levels of sunlight in moist soils of streams, riverbanks, wet meadows, roadsides, and areas of human disturbance.

Spread

Giant Knotweed spreads primarily through **rhizomes** and root fragments that disburse to new areas by natural means such as wind and water, and by man-made disturbances such as roadside clearings and equipment.

Distribution

Native to the Sakhalin Islands of Japan, Giant Knotweed was introduced to the United States around 1900 as an ornamental garden plant. It is currently widespread across the United States and is found in all Mid-Atlantic states except South Carolina.

Impacts

Once established, Giant Knotweed is very difficult to eradicate. It quickly forms dense stands that crowd out native vegetation, clog waterways, and displace streamside vegetation, resulting in erosion along stream banks and degraded fish and wildlife habitat.

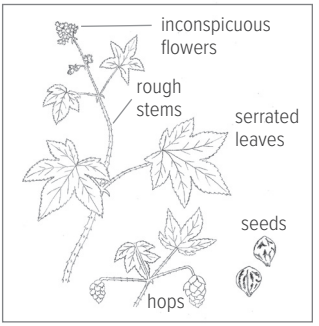
Mid-Atlantic Distribution

Japanese Hop

Humulus japonicus

Species at a Glance

Japanese Hop is a fast-growing, herbaceous, annual climbing vine and member of the hemp family. It can climb to heights of 3 m (10 ft) or more with the help of many small, hooked prickles that cover the stem and can cause irritation to bare skin.



Identification

Leaves: Leaves are **opposite**, **palmate**, and are approximately 5-10 cm (2-3.9 in) in length and have rough, **serrated** edges. They are divided into 5-9 lobes with downward pointing prickles and down-curved **bracts** at their base.

Flowers: Flowers are inconspicuous, lack petals, and are green in color. They bloom in clusters about 5 cm (2 in) in length in early to mid-summer.

Fruit/Seeds: Green hops produced by female plants contain oval, yellowish-brown seeds, which can remain viable for up to three years.

Stems/Roots: Rough stems, which are covered in tiny, hooked hairs, can reach 2.5-11 m (8-35 ft) in length and help the plant climb.

Similar Species

Japanese Hop may be confused with Common Hop (*Humulus lupulus*), which typically has three-lobed leaves; however, the upper leaves sometimes appear unlobed. The leaf stems of Common Hop are also shorter than its leaves. The best way to distinguish Japanese Hop from other species is the down-curved bracts and sharp prickles.

Habitat

Japanese Hop prefers floodplain areas, river and stream banks, roadsides, open fields, and woodlands; or in areas with moist soil. It forms dense, nearly continuous stands, in full sun or shade in sandy, clay, acidic, or neutral soil.

Spread

Numerous small seeds disperse by wind and water movement, allowing Japanese Hop to spread to new locations. Seeds can remain viable for up to three years. It can also reproduce **vegetatively**, starting new populations from small plant fragments.

Distribution

Native to Japan and eastern China, Japanese Hop was introduced to the United States as an ornamental garden plant and is now growing throughout the Eastern and Midwestern United States. It can be found in all Mid-Atlantic states.

Impacts

Japanese Hop can form dense, almost solid stands that outcompete native vegetation. It can be removed by hand-pulling before the seeds mature (August through September), but protection is needed for the skin because irritation and blistering can occur from the hooked hairs covering the vines.

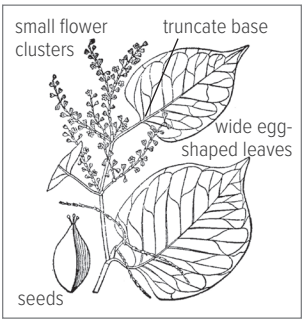
Mid-Atlantic Distribution

Japanese Knotweed

Fallopia japonica

Species at a Glance

Japanese Knotweed is a shrub-like perennial plant that can reach upright heights of over 4 m (13 ft). It is sometimes referred to as “Elephant Ear Bamboo” because it has bamboo-like stems and large heart-shaped leaves that resemble an elephant’s ear.



Identification

Leaves: Wide, triangular to egg-shaped leaves are pointed at the tips and arranged **alternately** along the stem. Size varies, but the average is about 15 cm (5.9 in) long by 8-10 cm (3.1-3.9 in) wide. Leaf stems are often reddish in color and leaf bases are **truncate**.

Flowers: Small, attractive, greenish to white flowers occur in branched clusters about 10-13 cm (3.9-5.1 in) long in the summer.

Fruit/Seeds: Soon after flowering, small, winged **fruits** called **nutlets** are produced. Triangular seeds are shiny and small, about 0.3 cm (0.1 in) long.

Stems/Roots: Smooth, stout, hollow stems are swollen at the leaf joints and resemble bamboo, especially in older plants. Like all members of this family, the base of the stem above each joint is surrounded by a thin membranous **sheath** called an **ocrea**.

Similar Species

Giant Knotweed (*Fallopia sachalinensis*) may be confused with Japanese Knotweed but can be distinguished by its larger leaves with heart-shaped bases instead of Japanese Knotweed's characteristic truncate leaf base. It also resembles bamboo but lacks bamboo's egg-shaped leaves and stems.

Habitat

Japanese Knotweed is tolerant of a variety of growing conditions, including full shade, high temperatures, high salinity, drought, and flooding. It commonly grows in moist, open, partially shaded habitats along rivers, wetlands, roadways, hillsides, and disturbed areas in a variety of soil types and pHs.

Spread

Japanese Knotweed primarily spreads via **rhizomes**, which can rapidly produce new plants, and dense colonies. Plant fragments, seeds, and rhizomes can be spread naturally by water and wind, and by human interactions such as contaminated soil, neglected gardens, or discarded cuttings. While Japanese Knotweed can produce seeds, germination is rare.

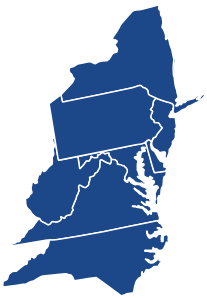
Distribution

Native to Japan, China, and parts of Korea and Taiwan, Japanese Knotweed was likely introduced to the United States in the late 1800s as an ornamental plant and for erosion control and landscape screening. It is now found throughout the United States and is widespread in the Mid-Atlantic region.

Impacts

Japanese Knotweed emerges early in the spring and grows quickly and aggressively. It forms dense mats that crowd and shade out native plants and grasses along creeks, making riverbanks less stable and more likely to erode during flooding.

Mid-Atlantic Distribution

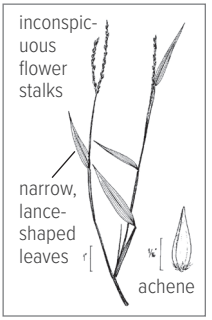


Japanese Stilt Grass

Microstegium vimineum

Species at a Glance

Japanese Stilt Grass is an annual, **herbaceous**, sprawling grass that resembles a miniature bamboo. It germinates in the spring and grows slowly through the summer months, reaching a canopy height of 30-61 cm (12-24 in).



Identification

Leaves: Pale green leaf blades are 3-8 cm (1.2-3.1 in) in length. They are narrow, asymmetrical, taper at both ends, and are lightly hairy, **alternating** along a branched **stalk**. A distinguishing characteristic is a pale silvery stripe of reflective hairs along the **midrib** of the upper surface.

Flowers: Flattened, trapezoid-shaped flowers grow in **spikes** on slender stalks about 3-8 cm (1.2-3.1 in) long in late August to September.

Fruit/Seeds: Dry **fruits** called **achenes** are produced soon after flowering, usually in early October.

Stems/Roots: The weak, somewhat reclining stems are hairless and branched, rooting at the lower **nodes**.

Similar Species

The native perennial Whitegrass (*Leersia virginica*) is similar to Japanese Stilt Grass, but it lacks the silver stripe along the midrib, and it flowers earlier in August. The nodes of Japanese Stilt Grass are also smooth, while Whitegrass has hairy nodes. In the fall, Japanese Stilt Grass turns yellow to pale purple, while Whitegrass stays green.

Habitat

Japanese Stilt Grass prefers a wide variety of habitats, including moist soils of open woods, floodplain forests, wetlands, fields, roadsides, ditches, utility corridors, and gardens. It readily invades areas subject to disturbances such as mowing, tilling, foot traffic, and flooding.

Spread

This species spreads by roots that grow from nodes along the stems that come in contact with the ground. It also spreads by seeds that disperse in water currents during floods, or by contaminated materials, such as hay, soil, and potted plants, or on footwear. Seeds can remain viable for five or more years before they germinate.

Distribution

Native to Japan, Korea, China, Malaysia, and India, Japanese Stilt Grass was introduced into the United States in 1919 as a packing material for porcelain. It is now invasive in several states and has invaded all states in the Mid-Atlantic region.

Impacts

Japanese Stilt Grass rapidly spreads to form extensive mats, outcompeting and displacing native plant species. It can alter natural habitats by changing soil chemistry and creating low-light conditions that shade out other species.

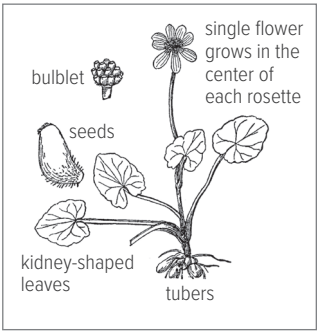
Mid-Atlantic Distribution

Lesser Celandine

Ranunculus ficaria

Species at a Glance

Lesser Celandine, also known as Fig Buttercup and Pilewart, is a low-growing, perennial, flowering herb that completes its life cycle during the winter and spring. When in bloom, large infestations appear as a thick green carpet with yellow dots spread across the forest floor.



Identification

Leaves: Kidney to heart-shaped leaves have both smooth and coarse toothed edges which come together to form a **rosette**. Leaves are tender, **stalked**, and coloration is a shiny, almost lustrous, dark green.

Flowers: A single flower with 8-12 symmetrical petals blooms in the center of each rosette in March and April. They are a buttery yellow color with slightly darker centers and grow to be about 2.5 cm (1 in) wide.

Stems/Roots: Tiny cream-colored **bulblets** are produced in the stem **axils** and become apparent later in the flowering period. Roots produce numerous finger-like **tubers** that are easily visible when the plant is pulled up and are used to store energy for early growth in the spring.

Similar Species

Native Marsh Marigold (*Caltha palustris*) also has kidney-shaped leaves and yellow flowers but does not produce tubers or form a continuous carpet of growth. Other look-a-likes include Celandine (*Chelidonium majus*) and Celandine Poppy (*Stylophorum diphyllum*), both of which belong to the poppy family and have flowers with only four petals.

Habitat

Lesser Celandine prefers moist forested floodplains with sandy soils but can also occur in drier upland areas.

Spread

Lesser Celandine spreads using an abundant network of tubers and bulblets, which easily separate from the parent plant to form a new independent plant. Tubers can be unearthed and scattered to new locations by animal and human activity, attaching to equipment, or by flooding events.

Distribution

Native to Eurasia, including Europe, northern Africa, western Asia, Caucasus, and Siberia, Lesser Celandine was introduced to the United States as an ornamental plant and many colorful varieties are still available commercially. It is reported as an invasive in at least twenty states in the United States, including all Mid-Atlantic states.

Impacts

Lesser Celandine emerges before most native species in the spring, giving it a competitive advantage and enabling it to form a thick blanket of leaves across the forest floor, preventing native species growth.

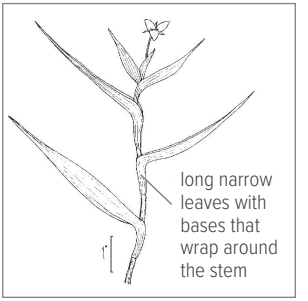
Mid-Atlantic Distribution

Marsh Dewflower

Murdannia keisak

Species at a Glance

Marsh Dewflower is a shallow-water **succulent** plant and member of the dayflower family. It produces long trailing shoots that root at **nodes** and reach heights of approximately 46 cm (18 in). It can be found in water depths of up to 7.5 cm (3 in).



Identification

Leaves: Leaves are **alternate**, 2.5-7.5 cm (1-3 in) long, and have parallel veins, long narrow blades, and oblong bases that wrap around the stem.

Flowers: Growing from the leaf **axils** in groups of 2-4, flowers consist of three pink to violet petals and three small, thin green **sepals**. Each flower lives for only one day, blooming from late August to October.

Fruit/Seeds: Each flower produces a capsule containing thousands of very small seeds.

Stems/Roots: Weak and sprawling stems are 30-76 cm (12-30 in) long and root extensively wherever a **node** touches damp soil.

Similar Species

Marsh Dewflower may be confused with other species in the dayflower family such as the Climbing Dayflower (*Commelina diffusa*), which has three bright blue petals on each flower, and Whitemouth Dayflower (*Commelina erecta*), which has bright blue flowers with only two petals.

Habitat

Most common in coastal marshes, Marsh Dewflower can also be found inland in freshwater marshes, ditches, creeks, rivers, swamps, bogs and along the edges of ponds, lakes, and streams.

Spread

Marsh Dewflower spreads by both seeds and **fragmentation**. Seeds, stems, and roots can be distributed to new locations by wildlife and flooding events, where it quickly establishes.

Distribution

Native to China, Japan, Korea, and Tibet, the earliest record of Marsh Dewflower in the United States dates to the 1920s and early 1930s, in South Carolina. It is believed to have been mixed with rice seeds imported for agriculture. It is now found in all coastal states from New Jersey to Louisiana, inland to Arkansas, Kentucky, and Tennessee, and in the Pacific Northwest in Washington and Oregon.

Impacts

This aggressive plant establishes itself in freshwater wetlands and forms dense mats that crowd out native vegetation and clog waterways.

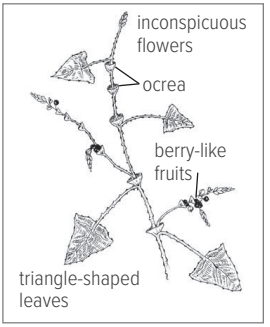
Mid-Atlantic Distribution

Mile-a-minute

Persicaria perfoliata

Species at a Glance

Mile-a-minute, also called Asiatic Tearthumb, is an herbaceous, annual, trailing vine that can grow up to six inches per day and reach lengths of up to 6 m (20 ft). It survives by using sharp, **recurved** barbs to attach and climb over other plants to reach sunlight, smothering and weakening them in the process.



Identification

Leaves: Light green leaves are shaped like distinctive equilateral triangles. They are 3-8 cm (1.2-3.1 in) in length, **alternate** along a thin delicate stem, and have barbs on the undersides. Circular, cup-shaped, leafy structures called **ocrea** surround the stem at each **node** where flower buds, late flowers, and **fruits** emerge.

Flowers: Small, white, and generally inconspicuous.

Fruit/Seeds: Attractive, deep metallic blue, berry-like fruits are arranged in clusters with each fruit containing a single glossy black or reddish-black hard seed.

Stems/Roots: Delicate, thin, reddish stems have curved downward pointing barbs.

Similar Species

Some native vine species, including native Tearthumbs, may be confused with Mile-a-minute; however, they lack the equilateral triangle-shaped leaves and the blue berry-like fruits.

Habitat

Mile-a-minute generally colonizes open and disturbed areas along the edges of woods, wetlands, stream banks, roadsides, and uncultivated open fields. It prefers extremely wet environments with poor soil structure and full sunlight, although it will tolerate shade for part of the day.

Spread

This self-pollinator produces a large number of seeds that can persist in the soil for up to six years. Birds, ants, small mammals, and water are the primary dispersal methods. Fruits can remain buoyant in streams or rivers for 7-9 days, allowing Mile-a-minute to disburse over long distances.

Distribution

Native to India and eastern Asia, the first successful population of this vine in the United States was in York, Pennsylvania in the late 1930s. Today Mile-a-minute has spread to all states in the Mid-Atlantic region.

Impacts

Mile-a-minute grows rapidly, overtaking shrubs and other native vegetation by reducing their access to sunlight and destroying their stems and branches by its added weight and pressure. It also poses problems for nursery and horticulture crops, tree farms, and forestry operations.

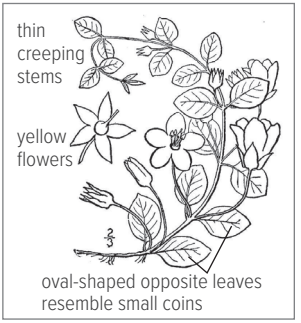
Mid-Atlantic Distribution

Moneywort

Lysimachia nummularia

Species at a Glance

Moneywort, also called Pennywort and Creeping Jenny, is an **herbaceous** low-growing **perennial** plant in 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, and reaching 0.6-4 cm (0.25-1.5 in) in length. The 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

Moneywort is a close relative of Yellow Pimpernel (*Taenidia integerrima*), which has narrower leaves and smaller flowers with much more pointed petals.

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 ground cover. It escaped cultivation by 1900 and is now found throughout the United States.

Impacts

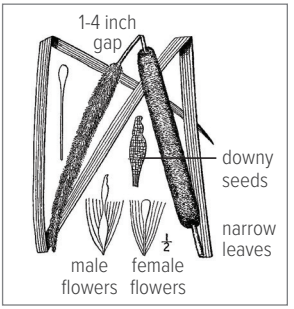
Little is known about the direct ecological impact of Moneywort; however, there is concern that the dense mats formed by this plant could prevent the growth of more desirable native plants. It has also been known to become a nuisance in gardens, pastures, and lawns due to its fast vegetative spread.

Mid-Atlantic Distribution

Narrowleaf & Hybrid Cattail

Typha angustifolia, Typha x glauca

Species at a Glance



The Cattail is an aquatic **perennial** plant that grows in wetland areas and produces distinct velvety brown **spikes** of flowers. There are three species of Cattail commonly found in the United States; the invasive Narrowleaf Cattail (*Typha angustifolia*), the native Common Cattail (*Typha latifolia*), and the Hybrid Cattail (*Typha angustifolia*). The Hybrid Cattail is produced when the two species cross, giving it characteristics of both the non-native and native Cattail 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 is divided into two distinct male and female flowers separated by a 3-10 cm (1.2-3.9 in) gap. Lighter brown **staminate flowers** are located above the **pistillate** flowers, which are often green during bloom, turning dark brown during seed maturation.

Fruit/Seeds: 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/Roots: 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. The Common Cattail has both male and female flower types directly next to each other, whereas the invasive Narrowleaf Cattail has a clear separation of male and female flowers, and the leaves are narrower, deeper green, and typically extend beyond the spike.

Habitat

Stands of invasive Narrowleaf Cattail can be found in a wide variety of wetland habitats, including marshes, 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 flower head 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.

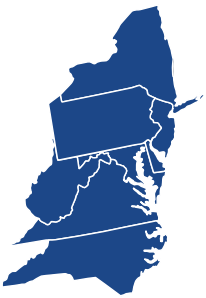
Distribution

The 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 Narrow-leaved species are present. These plants have spread throughout the United States, and all three Cattail species are found in the Mid-Atlantic region.

Impacts

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

Mid-Atlantic Distribution

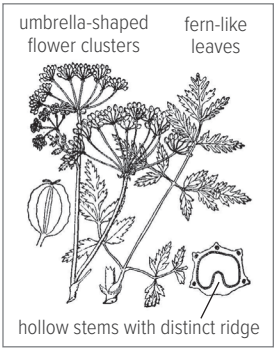


Poison Hemlock

Conium maculatum

Species at a Glance

Poison Hemlock, also called Deadly Hemlock and Poison Parsley, is a weedy plant in the parsley family that is acutely toxic to both people and animals. It has a biennial growth pattern with first-year growth forming low-lying **rosettes** of lacy leaves with reddish or spotted stems, followed by extensive growth of 1-3 m (3-10 ft) during the second year.



Identification

Leaves: Bright green, fern-like, shiny leaves are highly dissected and **alternately** arranged on the stem, dividing three to four times. They can reach up to 30 cm (12 in) long and 10 cm (4 in) wide and have a strong musty smell.

Flowers: Small, white, five-petaled flowers form in umbrella-shaped clusters in June and July.

Fruit/Seeds: Light brown, barrel-shaped seeds are paired, flattened, and 0.3 cm (0.1 in) long with conspicuous longitudinal ribs. They form within green, ridged capsules that eventually turn brown.

Stems/Roots: Stout, extensively branched, and erect stems have distinct ridges. They are hollow, except at the **nodes**. The lower portion of the stem has purple spots. The roots have an odor similar to carrots or parsnips.

Similar Species

Poison Hemlock may be confused with other members of the carrot family that have white umbrella-shaped flower clusters, including Queen Anne's Lace (*Daucus carota*) and Cow Parsnip (*Heracleum L.*). Queen Anne's Lace has hairs on the leaves and stems that are not found on Poison Hemlock. Cow Parsnip differs from Poison Hemlock by its ribbed stem and its **palmately compound leaves**, which radiate at the end of the **stalk** in a semicircle. Neither look-a-likes have purple spotting on the stems.

Habitat

Poison Hemlock grows at low elevations bordering pastures and cropland and gradually invading **perennial** crops. It is often found in stream banks, ditches, riparian woodlands, and floodplains. It tends to be more competitive in wet soil conditions but can survive in dry sites.

Spread

Reproducing only by seed, Poison Hemlock relies on spread primarily through water, birds, animals, and human activity such as agricultural equipment and mowing. Up to 40,000 seeds per plant are produced, which often drop next to the parent plant and regenerate, forming dense stands. Plant stalks can persist through winter, enabling the dispersal of seeds to extend from September through February. Seeds can remain viable for up to six years.

Distribution

A native of Europe, Poison Hemlock was introduced to North America in the 1800s as a garden and ornamental plant. It is found in nearly every state in the United States and is present throughout the Mid-Atlantic states.

Impacts

Poison Hemlock grows aggressively in moist pastures and meadows where it has the potential to outcompete more desirable native species. Early spring growth makes it more likely to be eaten by animals when there is limited forage available. All parts of the plant are highly poisonous and can be fatal to humans and livestock. Symptoms of poisoning can occur in as little as 20 minutes and death can result from respiratory paralysis after ingestion.

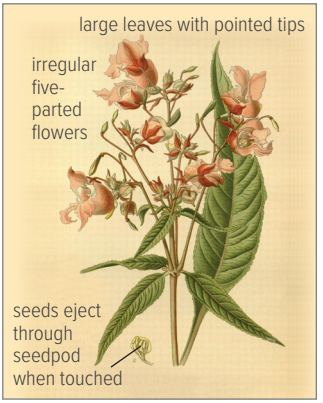
Mid-Atlantic Distribution

Policeman's Helmet

Impatiens glandulifera

Species at a Glance

Policeman's Helmet, also called Ornamental Jewelweed and Poor Man's Orchid, is a large, annual, herbaceous plant in the "touch-me-not" family that grows up to 3 m (10 ft) tall. The large pink-purple flowers are shaped like an English policeman's helmet or an Orchid, giving the plant its common name.



Identification

Leaves: Large oblong or egg-shaped leaves are toothed with a pointed tip. They are either **oppositely** arranged or found **whorled** in groups of three.

Flowers: Irregular five-parted flowers arise from the leaf **axils** and are pink to white to purple in color. Flowering occurs from mid-June through October.

Fruit/Seeds: Seeds can eject up to 20 feet from mature seed pods when touched or disturbed. They remain viable in the soil for 12-18 months.

Stems/Roots: Fleshy, smooth, hollow, reddish stems are multi-branching and resemble bamboo. They have distinct swollen **nodes** that help distinguish it from other plants.

Similar Species

Policeman's Helmet could be mistaken for other members of the same genus such as Orange Jewelweed (*Impatiens capensis*) and the Pale Touch-me-not (*Impatiens pallida*). It can be distinguished from these look-a-likes by its pinkish-purple flowers, swollen nodes, and **serrated** leaves.

Habitat

Policeman's Helmet requires high moisture soils such as wetlands, riparian areas, moist woodlands, gardens, and parks; however, it can tolerate many soil types. It tends to thrive in partial shade but can also be found growing in full sun.

Spread

Policeman's Helmet reproduces solely by seed, producing up to 800 seeds per plant. Seeds have a long viability and germination rate, and can float and germinate in the water, enabling the plant to extend into new areas via waterways.

Distribution

Native to the western Himalayas, Policeman's Helmet was likely introduced into the United States as a garden ornamental plant. In Britain, it is considered extremely invasive and is one of the "top 20" non-native weeds. In the Mid-Atlantic region, this species is found in New York.

Impacts

Policeman's Helmet is a highly aggressive invader that forms dense colonies. These colonies displace native and beneficial plants, reduce forest regeneration, and contribute to flooding and erosion by changing or stopping water movement.

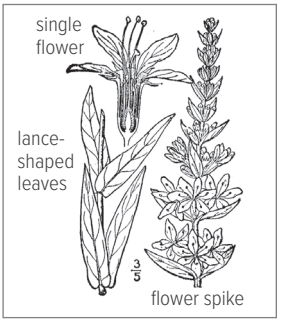
Mid-Atlantic Distribution

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 may enjoy the brilliant purple display, its attractiveness doesn't outweigh the serious threat it poses to ecosystems in the Mid-Atlantic.



Identification

Leaves: The body of the leaf is lance-shaped 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 5-7 petals that can range in color from pink to purple-red and blooms from June to September.

Fruit/Seeds: Two valve-shaped capsules burst at maturity, releasing seeds 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; 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.

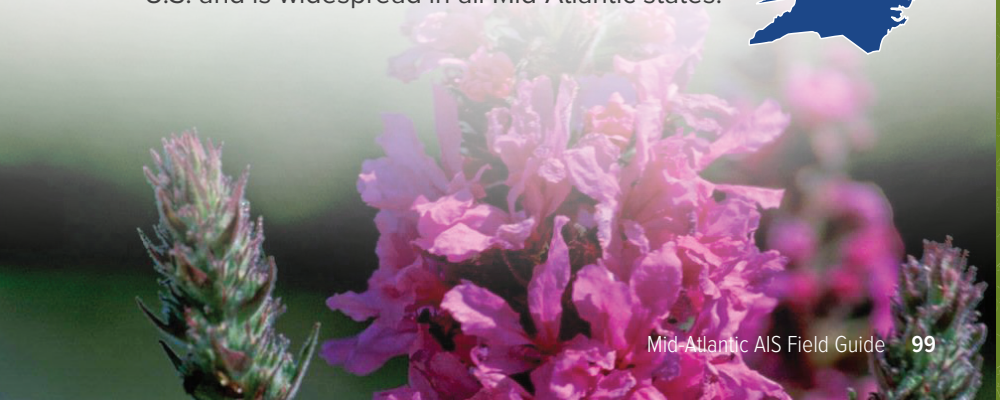
Distribution

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 all Mid-Atlantic states.

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.

Mid-Atlantic Distribution

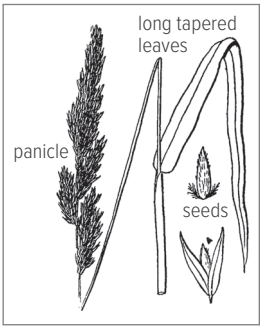


Reed Canary Grass

Phalaris arundinacea

Species at a Glance

Reed Canary Grass is a large cool-season perennial plant 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 have flat blades and a rough texture on both the upper and lower surfaces. Size ranges from 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/Roots: 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 a narrower, more pointed clusters of flowers. Additionally, 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-way, river dikes, 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

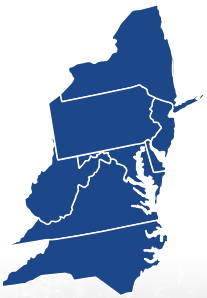
Reed Canary Grass is native to temperate regions of Europe, Asia, and North America. Historically, the Eurasian ecotype was planted throughout the United States for forage and erosion control. It has become naturalized in much of the northern half of the United States and is widespread throughout the Mid-Atlantic region.

Thin, membranous ligule at junction of leaf and leaf stalk

Impacts

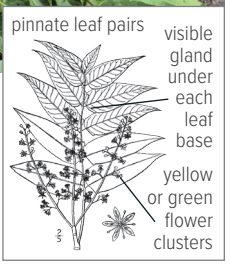
Reed Canary Grass forms large monotypic stands that harbor few other plant species and are of little use to wildlife. Once established, it dominates an area by building up a seed bank that can eventually erupt, germinate, and recolonize treated sites.

Mid-Atlantic Distribution



Tree-of-heaven

Ailanthus altissima



Species at a Glance

Tree-of-heaven is also known as Stinking Sumac or Stink Tree due to the strong odor given off when leaves and twigs are crushed. It is believed to be one of the most rapidly growing and spreading non-native trees in North America. Because it can grow in a wide variety of habitats, Tree-of-heaven has become prevalent even in urban settings. It is also the preferred host of the invasiveSpotted Lanternfly and has helped to facilitate its spread throughout the Mid-Atlantic region.

Identification

Leaves: Leaves are **pinnately** compound with a central stem bearing 10-40 lance-shaped leaflets per leaf. Each leaflet ranges from 0.3-1.2 m (1-4 ft) in length, has smooth **margins** and 1-2 glandular teeth at the base, each with a visible gland on the underside.

Flowers: Flowers are very small and are often yellow or green in color. They typically grow in large clusters and are present from April to July.

Fruit/Seeds: The seeds, known as samaras or samara fruits, are typically 2.5-5 cm (1-2 in) long and enclosed in a paper-like wing. Samaras are found in clusters and are capable of clinging to the trees throughout winter. They are typically red, orange, or yellow in color.

Stems/Roots: Stems change over the lifetime of the plant, with young trees displaying smooth bark that is brownish green and older trees displaying more rough and light brown/gray stems. Twigs are hairless, alternate, and range in color from green to brown to reddish pink. Large, heart- or V-shaped scars are often present along the stem.

Similar Species

There are several tree species that are similar in appearance to the Tree-of-Heaven, including native Sumac, Black Walnut, and Hickory. However, all of these trees have leaflets with serrated edges and do not emit a foul odor when their foliage is crushed. Additionally, the Black Walnut and Sumac do not produce samaras.

Habitat

Tree-of-heaven is highly adaptable and can grow in a wide variety of habitats, including urban and disturbed areas. It is resistant to drought and can tolerate cold temperatures as low as 15° C (-9°F). It can be found along streams, woodland edges, roadsides, railways, fencerows, and forest openings. While Tree-of-heaven can grow in full sun and partial shade, it cannot compete under a closed canopy and therefore does not thrive in full shade.

Spread

Because of its high growth rate, and the lack of insect predators and disease, Tree-of-heaven has quickly established and spread throughout the United States. Reproduction occurs primarily through the distribution of seeds, but it can also spread vegetatively as shoots sprout from existing roots, or as root and stem fragments are relocated.

Distribution

Tree-of-heaven is native to Eastern Asian countries, such as China and Taiwan. It was first brought to North America in the late 1700s and was widely planted in parks and along city streets in the U.S. Tree-of-heaven is now widespread throughout the U.S. and Canada and can be found on every continent except Antarctica.

Impacts

Tree-of-heaven produces an overabundance of seeds, crowds out native species, and produces allelopathic chemicals that directly harm the growth of other nearby plants. Its root system can damage pavement, sewers, and building foundations. It can also play a part in spreading the Spotted Lanternfly, an invasive insect that uses the tree to lay its eggs. Spotted Lanternflies have higher survival rates and produce more eggs when they feed on Tree-of-heaven compared with other tree species.

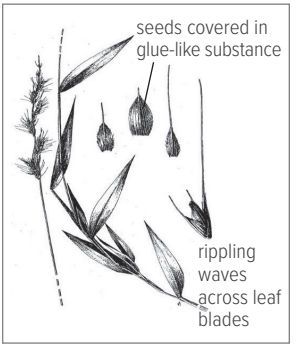
Mid-Atlantic Distribution

Wavyleaf Basketgrass

Oplismenus undulatifolius

Species at a Glance

Wavyleaf Basketgrass is an introduced subspecies of the native Basketgrass (*O. hirtellus (L.) P. Beauv.*). It is a fast-spreading, **perennial**, understory grass that forms dense stands that can crowd out native herbaceous plants and threaten the **deciduous** forests of eastern North America.



Identification

Leaves: Flat, dark green leaves are about 1.2 cm (0.5 in) wide and 4-10 cm (1.5-4 in) long with rippling waves across the blades and elongated, pointed tips. The leaf **sheaths** and stems are noticeably hairy.

Fruit/Seeds: Seeds, which begin to appear in late summer, are covered with a glue-like substance that allows them to stick to other objects and organisms.

Stems/Roots: Stems are branching and covered in fuzzy hairs. Rooting occurs at the **nodes** of the stems.

Similar Species

While Wavyleaf Basketgrass resembles Japanese Stilt Grass (*Microstegium vimineum*), these species differ in that the leaves of Japanese Stilt Grass have a silvery row of hairs running down the **midvein** and end in a blunt gradual point. Wavyleaf Basketgrass leaves are rippled across their width and end with an elongated sharp tip.

Habitat

Wavyleaf Basketgrass is a shade-tolerant species that avoids sunny environments. It is mainly found in shaded, moist, deciduous forests.

Spread

Wavyleaf Basketgrass spreads quickly through **rhizomes** and seeds. The sticky substance on the seeds allows them to adhere to passing animals, people, or vehicles, easily spreading to new locations.

Distribution

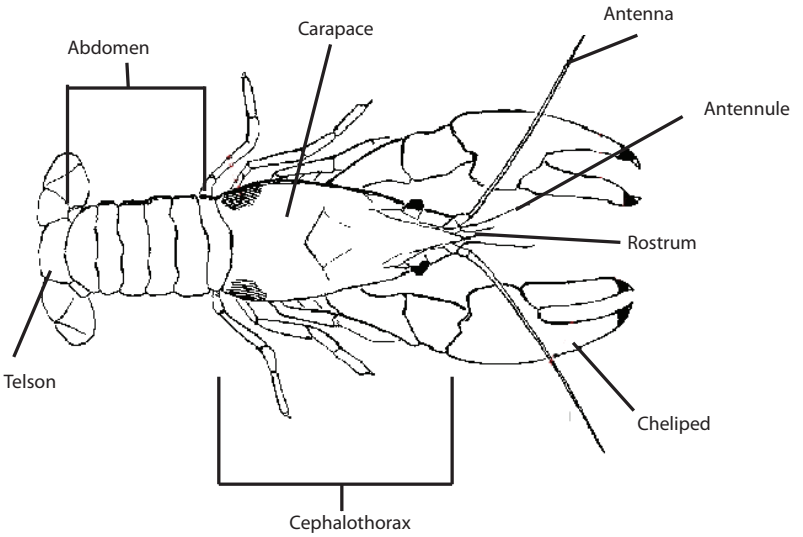
Native to Europe and Asia, it is unclear how Wavyleaf Basketgrass was first introduced to the United States; however, it may have been through contamination of hanging baskets. It was first found in Howard County, Maryland in 1996. In 2000, it was found growing along a stream in Baltimore County, Maryland. Documented locations have also been found in Delaware, Pennsylvania, Virginia, Washington DC, and West Virginia.

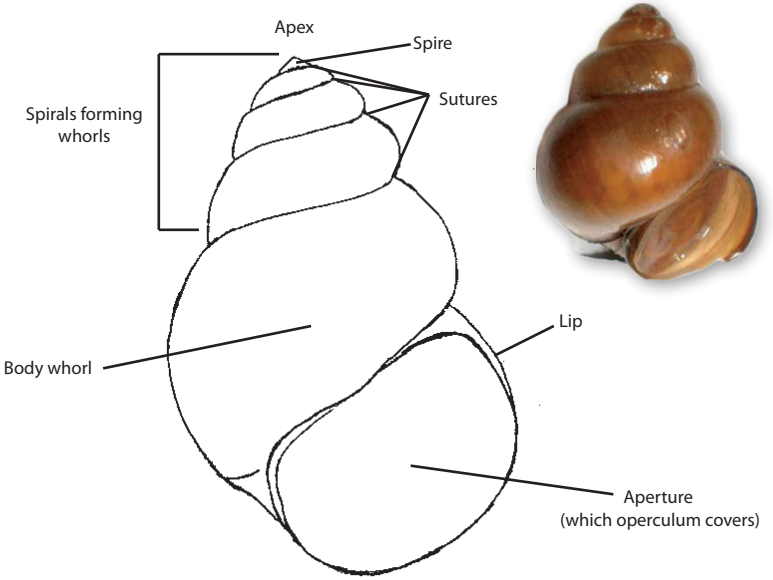
Impacts

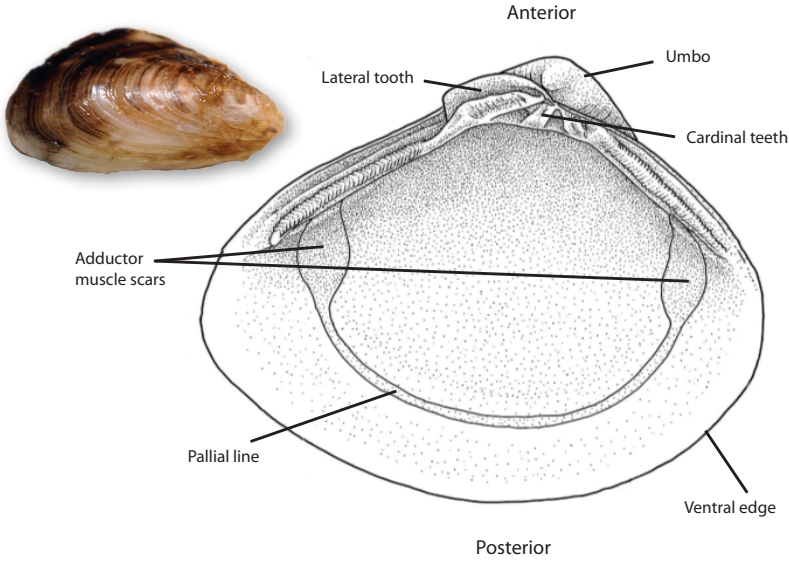
This species can completely cover the forest floor, outcompeting native forest species. Wavyleaf Basketgrass provides very little wildlife value. Because it is still relatively new in the United States, its ecological impacts are mostly unknown.

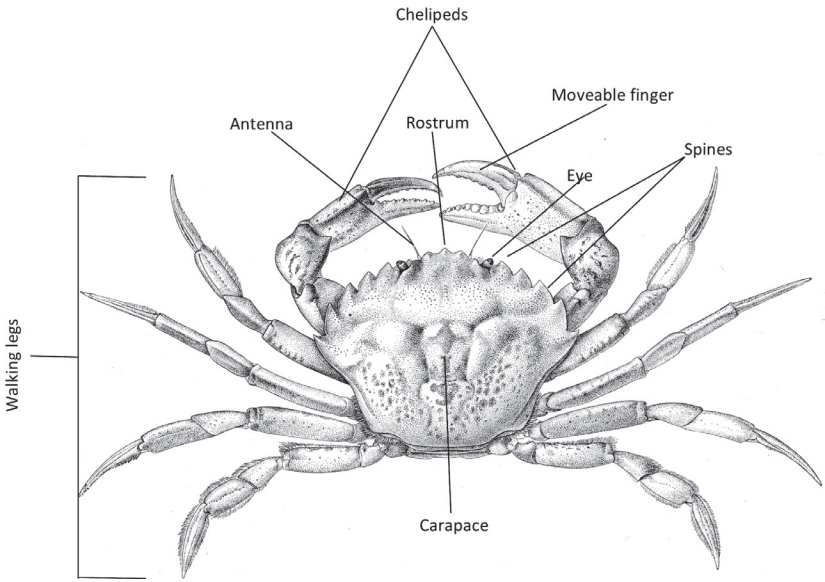
Mid-Atlantic Distribution

Invertebrate Anatomy






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

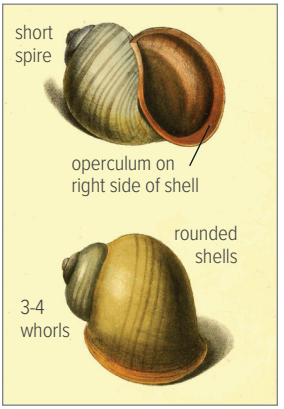

Chelipeds
Moveable finger
Antenna
Rostrum
Spines
Eye
Walking legs
Carapace

Apple Snails

Family Ampullariidae

Species at a Glance

Apple Snails are a family of large freshwater snails widely used in both the food and aquarium trades. There are 120 different species of Apple Snails, with only one native to the United States. They feed on aquatic plants, compete with native freshwater snails, and can carry harmful pathogens, including rat lungworm, a parasite that can cause illness in humans if ingested.



Identification

Members of the Apple Snail family often have black, yellow, or gray bodies, with brown, yellow, blue, or white shells that can display banding. The shells are on average 5-10 cm (2-4 in) tall, with the largest being 15 cm (6 in) tall. Shells are typically round and **globular** in shape, having 3-4 **whorls** and a short **spire**. The **operculum**, which acts as a trap door that can close off the shell and prevent desiccation, is teardrop shaped and on the right side of the shell.

Similar Species

Although no species outside of the *Ampullariidae* family closely resemble Apple Snails, there are 120 species of Apple Snails that share many physical characteristics. Unique features that help aid in their identification include a **siphon**, long **labial** tentacles, and globular-shaped shell. A common way

to differentiate between species of Apple Snail is by examining the egg color, which can be pink, reddish, or green in color, depending on the species and the number of eggs in the clutch.

Habitat

Apple Snails are found in a variety of freshwater systems including lakes, rivers, streams, ponds, swamps, wetlands, ditches, and marshes. They generally prefer slower-moving bodies of water with low salinity and high oxygen concentrations. Apple Snails can adapt to colder temperatures by burrowing into sediment.

Spread

Non-native Apple Snails were likely introduced to the U.S. as an aquarium species; however, their hearty appetite for aquarium plants has led to the intentional release and spread of this group of species. Spread can also occur by the movement of eggs via boats, crops, and flooding. Egg clutches can contain 1,500-2,100 eggs, which allows for rapid spread and growth.

Distribution

Most species of Apple Snails are native to South America, Central America, and the Greater Antilles; however, some species, such as the Florida Apple Snail *(Pomacea paludosa*) are native to the United States in Florida. Apple Snails have long been used in the aquarium trade, which is likely how they were introduced outside of their native range. Currently, only Apple Snail species in the genus "*Pomacea*" are recorded in the U.S., and species such as the Giant Apple snail (*Pomacea maculata*) and Channeled Apple Snail (*Pomacea canaliculata*) have been documented in Mid-Atlantic states.

Impacts

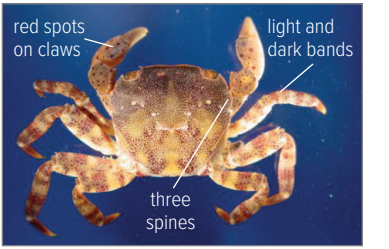
Apple Snails feed heavily on plants and can negatively impact wetland and aquatic ecosystems, as well as agriculture crops, such as rice. They also outcompete and prey on native snails, altering ecosystem functioning. Apple Snails are a threat to human health as they can carry diseases such as rat lungworm, a parasite that can infect humans through improperly cooked snail meat. This can cause fever or death in extreme cases.

Mid-Atlantic Distribution

Asian Shore Crab

Hemigrapsus sanguineus

Species at a Glance



The Asian Shore Crab, also called the Japanese Shore Crab, is a small species of crab from the Asia-Pacific region. It has a very broad diet and has the potential to affect populations of native crabs, fish, and shellfish in its introduced range. It may also compete with larger species, like the Blue Crab, Rock Crab, and even invasive Green Crabs.

Identification

The adult Asian Shore Crab ranges from 35 mm (1.5 in) to 42 mm (1.65 in) in carapace width. It has a square-shaped shell with three spines on each side of the **carapace**. Carapace color can be green, purple, orange, brown, or red. It has light and dark bands along its legs and red spots on its claws. Male crabs have a distinctive, fleshy, bulb-like structure at the base of the moveable finger on the claws.

Similar Species

The Asian Shore Crab may be confused with other species of crab, such as the Green Crab (*Carcinus maenas*); however, the Green Crab is larger and has five spines on the carapace instead

of three. It may also be confused with the Chinese Mitten Crab (*Eriocheir sinensis*), which has four spines on the carapace and dense patches of hairs covering the claws.

Habitat

A very versatile crab, the Asian Shore Crab can tolerate a wide range of temperature and salinity ranges, inhabiting any shallow hard-bottom intertidal or sometimes subtidal habitat. It can live on artificial structures and on mussel beds and oyster reefs. It also tends to aggregate at high densities under rocks where its habitat can overlap with native crab species.

Spread

It is unknown how this species was introduced to the United States, although many speculate that both adults and larvae were introduced through ballast water discharges from transoceanic ships. It is highly prolific, with females producing 50,000 eggs per clutch, and 3-4 clutches per breeding season. The larvae are suspended in the water for approximately one month before developing into juvenile crabs, enabling them to be transported over great distances to new locations.

Distribution

Native to the coasts of China, Hong Kong, Korea, Russia, and Japan, the Asian Shore Crab was first reported in the United States at Townsend Inlet in New Jersey in 1988. It is now well established along the Atlantic intertidal coastline of the United States from Maine to North Carolina. Because it is tolerant of a wide range of environmental conditions, it is likely that its spread will continue along the U.S. coastline.

Impacts

The prolific, versatile characteristics of the Asian Shore Crab make it a threat to declining native crab populations, and to the food web. In addition to competing with native species for food, the Asian Shore Crab is known to feed on commercial species such as larval lobsters, crabs, fish, and shellfish, making it a threat to commercial fisheries and the economy. The Asian Shore Crab may also pose a threat to coastline ecosystems and aquaculture operations.

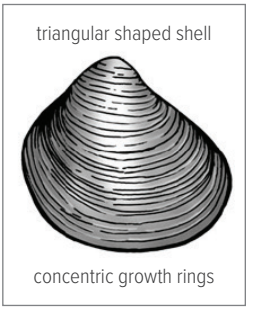
Mid-Atlantic Distribution

Basket Clam

Corbicula fluminea

Species at a Glance

The Basket Clam, also called the Asiatic Clam, Pygmy Clam, or Gold Clam, is a small fresh-water bivalve with two thick-hinged shells that rarely exceeds 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 Basket Clam's shell is typically yellow green to brown, thick and rounded to slightly triangular in shape, and generally 2.5 cm (1 in) in length with elevated concentric growth rings. The Basket Clam may reach up to 6.5 cm (2.6 in), and darker morphs exist in the Southwestern United States. 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

Fingernail and Pea Clams have smooth, instead of serrated, teeth and are generally smaller, with thinner shells and less

prominent growth rings. There is also evidence that there may be other invasive species of Corbicula (*Corbicula largillierti*, and *Corbicula sp. unknown*) in Illinois; however, it is unknown whether these species are present in the Mid-Atlantic, and suspected populations should be reported. *C. largillierti* is dark olive brown, has a pyramidal-shaped shell, lateral purple teeth, and the ridges are tighter and less pronounced than *C. fluminea*. The unknown Basket Clam species has a yellow, triangular shell with fine pinkish rust-colored rays radiating from the **umbo**.

Habitat

The Basket 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 Basket 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. Juveniles are then spread by water currents and human activity. The Basket Clam can 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 Basket Clam is widespread in the United States and spans every state in the Mid-Atlantic region.

Impacts

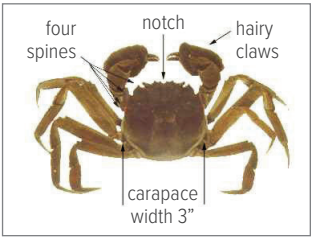
The Basket Clam is a known **biofouler** that blocks water flow to power plants, industrial water systems, and in irrigation canals and pipes. It also filters suspended matter from the water column, increasing water clarity and leading to excessive plant growth and altered nutrient and water quality.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

Mid-Atlantic Distribution

Chinese Mitten Crab

Eriocheir sinensis

Species at a Glance



The Chinese Mitten Crab is a medium sized burrowing crab from East Asia. It has been identified in parts of San Francisco, and in the Great Lakes and Mid-Atlantic regions. This aggressive crab can tolerate both fresh and saltwater, making it a costly and environmentally damaging invader in the Great Lakes and Mid-Atlantic regions.

Identification

The Chinese Mitten Crab ranges from 30-100 mm (1.2-4 in) in length, with legs that nearly double the length of the torso. It gets the name “Mitten Crab” from the dense patches of hairs covering the claws, which resemble 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**. Its color ranges from a light brownish orange to a greenish brown. There is also a small notch present between the eyes.

Similar Species

While the Chinese Mitten Crab may be confused with the Green Crab (*Carcinus maenas*) or Asian Shore Crab (*Hemigrapsus sanguineus*) there are several morphological differences. The Green Crab has five spines on either side of the eyes and three rounded lobes or bumps between the eyes. The Asian Shore Crab is much smaller with only three spines. Both crabs lack the distinctive hairy claws characteristic of the Chinese Mitten Crab.

Habitat

While the Chinese Mitten Crab spends most of its life in freshwater, including rivers, lakes, estuaries, and wetlands, it migrates to saltwater estuaries to reproduce. This crab is very skillful at walking on land, especially during upstream migration, enabling it to bypass dams and other natural obstructions.

Spread

The Chinese Mitten Crab most likely spreads via the ballast water of ships or clinging to the hull of barges during transport. Another vector of spread may have been intentional release, as the Chinese Mitten Crab is a popular seafood item in New York City seafood markets.

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 in the Chesapeake Bay, Gulf Coast, Hudson River, and in other areas in the East Coast, and in the San Francisco Bay.

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. One positive aspect of this crab is that it can be a food source for predatory fish.

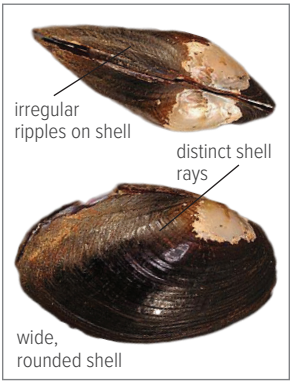
Mid-Atlantic Distribution

Chinese Pond Mussel

Sinanodonta woodiana

Species at a Glance

The Chinese Pond Mussel, also called the Eastern Asiatic Clam, or Swan-Mussel, is a large, invasive, freshwater mussel that has rapidly spread to colonize Europe, Central America, the Indonesian Islands, and most recently, North America. Its life cycle involves a larval parasitic stage on freshwater fish, which helps contribute to its spread.



Identification

The large, wide shell of the Chinese Pond Mussel reaches a maximum size of 30 cm (12 in). It has a deeply rounded **ventral margin**, and the surface is irregularly rippled. A thin coating on the outside of the shell (**periostracum**), is brown with distinct shell rays that run perpendicular to growth lines. The **nacre** has a wide pink band along the outer edge.

Similar Species

The native Alewife Floater (*Anodonta implicata*) is often confused with the Chinese Pond Mussel; however, the Alewife Floater's periostracum color is variable, shell rays often are not visible in older individuals, and the nacre lacks a pink band. In addition, the Alewife Floater only reaches a maximum shell

size of 18 cm (7 in). Identification of these mussels is difficult and often requires expert verification. Note: if found, refer to the *Identifying, Reporting, and Collecting* protocols in the introduction of this guide.

Habitat

A habitat generalist, the Chinese Pond Mussel can tolerate environmental conditions considered unsuitable for native mussels, such as degraded and polluted habitats, heavily modified and artificial habitats, low oxygen conditions, and areas with high siltation rates. It prefers silt and clay substrates and **turbid** conditions with relatively high-water temperatures in either standing or slow-flowing water.

Spread

The life cycle of the Chinese Pond Mussel includes a parasitic larval stage, where it lives for a short time attached to the fins or gills of freshwater fish species. Natural movement of the host fish, or the export of this mussel between regions for aquaculture and the live food trade, has enabled it to spread and establish in new locations. It is prolific and begins reproducing within its first year of life.

Distribution

Native to Eastern Asia, primarily from the Amur and Yangtze Rivers, the Chinese Pond Mussel's first and only documented occurrence in the United States has been in the ponds of a former fish farm in Franklin Township, New Jersey. It is considered locally established in these ponds and was most likely introduced in the larval stage attached to the gills of imported Invasive Carp.

Impacts

While its impact in the United States is currently unknown, the Chinese Pond Mussel could negatively impact native mussel populations as it outcompetes them for host fish during the larval stage. In addition, it may have a negative impact on macroinvertebrates communities and the overall structure of aquatic ecosystems.

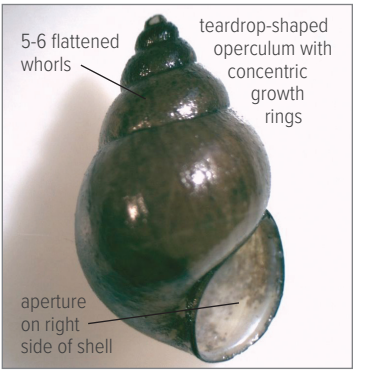
Mid-Atlantic Distribution

Faucet Snail

Bithynia tentaculata

Species at a Glance

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



Identification

The shell of the Faucet Snail is shiny, oval, and ranges from light brown to black in color. The spire is relatively large and rounded, consisting of 5-6 somewhat flattened **whorls**. Adults are small, reaching up to 12-15 mm (0.5 in) in length. A tough, teardrop-shaped plate with concentric rings (adults), called the **operculum** tightly covers the **aperture**. 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

Several species of native snail and young nonnative Mystery Snails can look similar to the Faucet Snail (*Bithynia tentaculata*) and can be difficult for non-experts to identify conclusively. Note: if found, refer to the *Identifying, Reporting, and Collecting* protocols in the introduction of this guide.

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 itself 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.

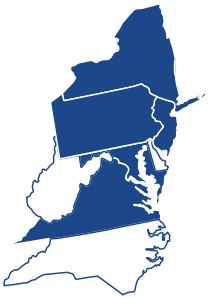
Distribution

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. In the Mid-Atlantic, this snail has established in Maryland, New York, Pennsylvania, Virginia, and Washington DC.

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.

Mid-Atlantic Distribution



Golden Mussel

Limnoperna fortunei

Species at a Glance

While its status in the United States is unknown, the Golden Mussel was discovered in California in 2024, making it the first discovery in North America. It is often referred to as an "ecosystem engineer" due to its ability to rapidly alter aquatic ecosystems.

Identification

The shell of the Golden Mussel is dark brown above the **keel** and yellow to golden brown below. The interior **nacre** of the shell is purple above the keel and white below. Average shell length is 20 mm (0.8 in), although certain South American populations have reached up to 40 mm (1.5 in) and certain Asian populations have reached up to 60 mm (2.4 in). Females typically compose two-thirds of the population.

Similar Species

The Golden Mussel is similar to the Zebra Mussel (*Dreissena polymorpha*) and Quagga Mussel (*Dreissena bugensis*). A distinctive characteristic of the Golden Mussel is the presence

of a **nacreous** layer within the shell. Although these mussels share some of the same physical characteristics, the Golden Mussel exhibits a wider tolerance of ecological conditions than both Dreissenid mussels.

Habitat

While it can acclimate itself to many types of environments, the Golden Mussel prefers brackish to freshwater lakes, rivers, and estuaries between 8-32°C (46-89°F). It uses sticky **byssal threads** to attach itself to hard substrates such as rocks, docks, logs, pilings, and other organisms. This species is tolerant of polluted and contaminated water conditions.

Spread

The Golden Mussel was most likely introduced to South America in the ballast water of ships, or as a contaminant in shipments of live Basket Clams. Once introduced, Golden Mussels reproduce frequently after they reach maturity at one year of age. The larvae can be transported in bait buckets, live wells, bilges, or in ballast water. Adults may attach to boats, trailers, equipment, and aquatic plants and be moved to new locations.

Distribution

Native to China, and Southeastern Asia, the Golden Mussel was introduced into Argentina in 1991. Within a decade, it spread to four other South American countries. In 2024, the Golden Mussel was discovered in California in the Port of Stockton and in the Sacramento-San Joaquin Delta. This is the first known occurrence of this species in North America.

Impacts

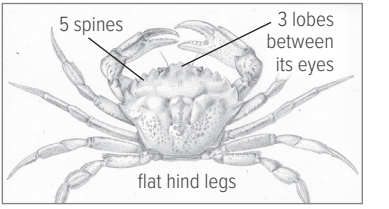
The Golden Mussel is a filter feeder that alters water quality and decreases food sources for native species. It reproduces frequently and settles in thick colonies on hard substrates. The Golden Mussel is known to settle atop native bivalve species, causing them to suffocate or starve. These same characteristics can clog industrial water intake pipes and equipment. Communities in South America estimate a cost of $200,000 per day in industrial and ecological losses.

Mid-Atlantic Distribution

Green Crab

Carcinus maenas

Species at a Glance



One of the world's most successful invaders, the Green Crab is a voracious predator from Europe that feeds on shellfish, causing declines of other crabs and **bivalve** species. It is capable of learning and can improve its prey-handling skills while foraging.

Identification

Despite its name, the Green Crab is not always green. Its **carapace** can be mottled dark brown to dark green with small yellow patches. The underside of the shell may change from green to orange and then red during the molting cycle. It has an array of five spines on either side of the eyes on the front end of the carapace. It also has three rounded lobes or bumps present between its eyes. Adult crabs are typically 6 cm (2.5 in) long but can range up to 10 cm (4 in). The last pair of hind walking legs are relatively flat, similar to those of the commercially produced Dungeness Crab.

Similar Species

While the Green Crab may be confused with the Chinese Mitten Crab (*Eriocheir sinensis*), and the Asian Shore Crab (*Hemigrapsus sanguineus*), there are several morphological differences. The Green Crab can be distinguished by the array of five spines on either side of the eyes, as well as the three lobes between the eyes. The Asian Shore Crab has only three spines, and the Chinese Mitten Crab has four spines and distinctive hairy claws.

Habitat

Found in a variety of habitats, the Green Crab can tolerate a wide range of environmental conditions including salinity and temperature fluctuations. It also inhabits rocky shores, cobble beaches, sand flats, and tidal marshes.

Spread

The Green Crab was most likely introduced through ballast water and shipping; however, it may have also arrived hidden in kelp packing material used in live lobster and bait worm shipments. Once established, the Green Crab has a floating larval stage that enables it to expand its distribution to new locations on water currents.

Distribution

Native to the Atlantic Coast of Europe and northern Africa, the Green Crab first arrived in the Cape Cod region of the United States in the mid-1800s via sailing ships. It began its northward expansion along the Atlantic Coast in the early 1900s and was discovered on the West Coast in 1989. The Green Crab is found throughout the Mid-Atlantic coast.

Impacts

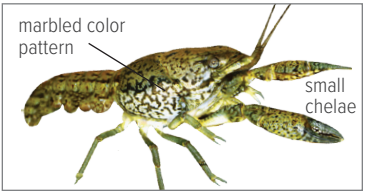
The Green Crab threatens native populations of crabs, clams, mussels and oysters through competition, predation, and its burrowing activities. It has contributed to the decline of many valuable economic commercial species, such as Soft-shell Crabs on the East Coast and Dungeness Crabs on the West Coast. This voracious predator can consume 40 half-inch clams per day, as well as crabs of the same size.

Mid-Atlantic Distribution

Marbled Crayfish

Procambarus virginalis

Species at a Glance



The Marbled Crayfish, also called the Marmorkreb, is a **parthenogenetic** female crayfish. It originated in captivity via the aquarium trade, as a direct descendant of the Slough Crayfish (*Procambarus fallax*), which is native in Georgia and Florida. Genetic analysis is the only way to differentiate between the two species as there are no known morphological differences between them.

Identification

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

Similar Species

The Marbled Crayfish is descended from the Slough Crayfish (*Procambarus fallax*), which is widely distributed across Florida and Georgia 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

Research studies on the Marbled Crayfish have found populations in brick pits, drainage ditches, rice fields, and fish ponds. It appears to be tolerant to drying, with specimens kept alive without water for three days. Optimal growth and reproduction occur in water temperatures above 20 °C (68°F) and breeding completely stops at temperatures below 15 °C (59°F).

Spread

The Marbled Crayfish is a popular aquarium species, increasing 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

There are no native populations of Marbled Crayfish, and all populations in the wild were introduced by humans. However, the Slough Crayfish, is native to the Satilla River drainage in southern Georgia and south through peninsular Florida. The Marbled Crayfish was first discovered in Europe in the 1990s. It has since been introduced to multiple countries, including Canada where multiple individuals were found in the Lake Ontario drainage near Toronto. In the United States, there is a report of the Marbled Crayfish in New York, however, the status of the population is unknown.

Impacts

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

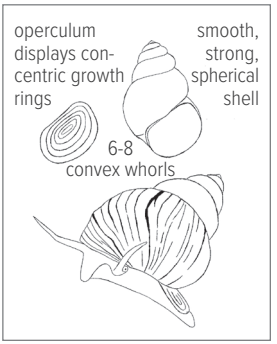
Mid-Atlantic Distribution

Mystery Snails

Cipangopaludina chinensis and Heterogen japonica

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, ornamental, and live food markets has contributed to their spread across the United States, enabling them to form dense populations and outcompete native species for food and habitat.



Identification

Both species have a large shell reaching up to 6.5 cm (2.6 in) in height, which is separated by highly indented **sutures**. Their shells are smooth, strong, and spherical with 6-7 convex **whorls** in the Chinese Mystery Snail and 7-8 whorls in the Japanese Mystery Snail. The shell of the Japanese Mystery Snail grows **allometrically**, with the height increasing faster than the width, making it appear more elongate and narrower than the Chinese Mystery Snail. Coloration is usually dark olive-green 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** displays concentric growth rings that allow the snails 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 because they are so similar in appearance, they may only be distinguishable by genetic means.

Similar Species

The native Brown Mystery Snail (*Campeloma decisum*) is much smaller than the Chinese and Japanese Mystery Snails, typically reaching only 2-4 cm (0.8-1.5 in) in size. It also has less convex whorls. The introduced Banded Mystery Snail (*Viviparus georgianus*) is generally smaller (up to 3.5 cm [1.4 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 likely occurred through the aquarium industry and importation for Asian food markets. Once established in a body of water, they can be spread by recreational water activities, bait buckets, and water holding areas on boats.

Distribution

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 can be found in all Mid-Atlantic states.

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.

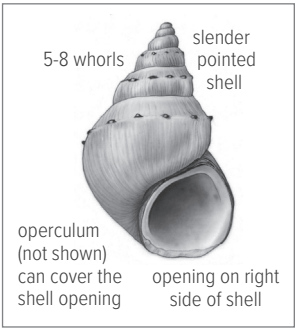
Mid-Atlantic Distribution

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. It reproduces **asexually**, requiring just 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 grooves. 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. Average adult size in an invasive population is 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

The New Zealand Mudsnail closely resembles native Hydrobiid snails in size and shell morphology. Hydrobiid snails are very small with shells reaching a height of less than 8 mm (0.3 in). The shells also tend to lack any distinguishing characteristics; therefore, confirmation of identification typically requires consultation with taxonomic experts. Note: if found, refer to the *Identifying, Reporting, and Collecting* protocols in the introduction of this guide.

Habitat

The New Zealand Mudsnail is known to inhabit freshwater ponds, agricultural, urban, and limestone streams, rivers, lagoons, lakes, ditches, and reservoirs. It has a wide range of tolerances for substrate, temperature, and salinity, and can survive in brackish water.

Spread

The **operculum** 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

While 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 the Mid-Atlantic region are in Delaware, Maryland, New Jersey, New York, and Pennsylvania.

Impacts

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

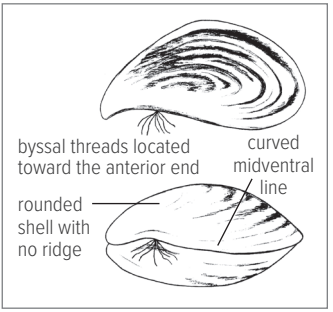
Mid-Atlantic Distribution

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*).



Identification

The shell of the Quagga Mussel 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 **veligers** that free-float in the water column for up to five weeks before settling.

Similar Species

While the Zebra Mussel (*Dreissena polymorpha*) is similar, it is more "D"-shaped, with a 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

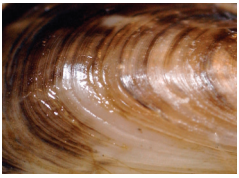
The Quagga Mussel is found in both shallow, warm waters and deep, cool waters of freshwater lakes, reservoirs, ponds, quarries, and slow-moving or sluggish rivers. It requires enough calcium for shell production, and water temperatures above 4°C (39°F) for reproduction. Its byssal threads attach to rocks, docks, cement, wood, and vegetation, but unlike the Zebra Mussel, it can also live and thrive directly on muddy or sandy bottoms.

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

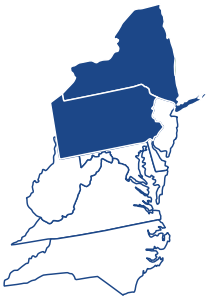
While native to the Black, Azov, and Caspian Sea drainages, the Quagga Mussel first appeared in the Great Lakes in Lake Erie in 1989 in contaminated ballast water. It has since spread throughout all of the Great Lakes, the Mississippi River drainage, and many inland lakes. In the Mid-Atlantic region, it is established in New York and Pennsylvania.



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. The economic impact of the Quagga Mussel is estimated to be in the billions of dollars.

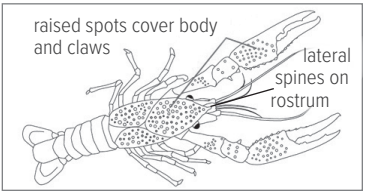
Mid-Atlantic Distribution



Red Swamp Crayfish

Procambarus clarkii

Species at a Glance



The Red Swamp Crayfish, also known as the Mudbug, is a large and aggressive crayfish that can quickly dominate lakes, ponds, rivers, and wetlands. Often used in classrooms and as a popular food item, this highly adaptable crayfish has escaped to invade the Mid-Atlantic region 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 **tubercles** covering the body and claws. Juveniles are typically 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 nearly **obliterated**. 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 acutus*), and the Southern White River Crayfish (*Procambarus zonangulus*). Unlike the Red Swamp Crayfish, the White River Crayfish has a narrow, but visible areola, and juveniles typically have spots on the

carapace instead of wavy lines. They can also be found in faster-flowing streams and ditches. For both species, confirmation of identification typically requires consultation with taxonomic experts. Note: if found, refer to the *Identifying, Reporting, and Collecting* protocols in the introduction of this guide.

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 there is plenty of organic debris like 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

This species is widely available through the aquaculture industry and aquarium trades, making its spread most likely due to intentional or unintentional release. Aquarists who keep them as pets, teachers and students who use them as live study specimens, and consumers who purchase them from live food markets often release this species into the wild. The Red Swamp Crayfish is also able to crawl out of the water and travel long distances at night and during wet weather.

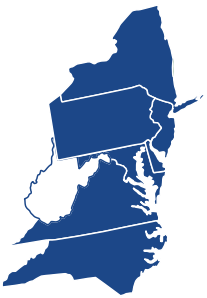
Distribution

This species is native from northern Mexico to the Gulf Coast and the Mississippi River drainage north to Illinois and Ohio. It has spread widely throughout the United States and is found in all coastal Mid-Atlantic states.

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.

Mid-Atlantic Distribution

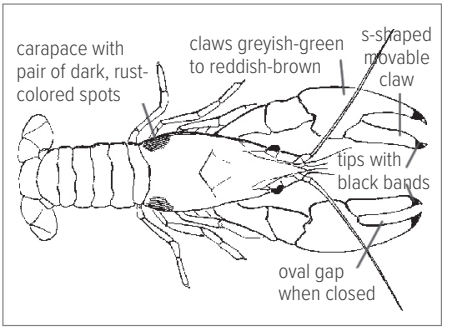


Rusty Crayfish

Faxonius rusticus

Species at a Glance

The Rusty Crayfish is a large, aggressive crustacean that can outcompete native crayfish and alter ecosystems with its appetite for aquatic plants and organisms.



Identification

Adult Rusty Crayfish reach a maximum size of 10 cm (4 in) long with large, robust claws that display red or black banded tips. The coloration of the body is typically light brown to green or bluish with a rusty-colored spot on either side of the **carapace**, which looks as though the crayfish was picked up with a painted forefinger and thumb. Due to the **hybridization** of male Rusty Crayfish with female native crayfish, these spots may not always be present or well-developed, therefore true identification may require assistance from a professional. Note: if found, refer to the *Identifying, Reporting, and Collecting* protocols in the introduction of this guide.

Similar Species

The Rusty Crayfish may be confused with native crayfish, as well as other invasive crayfish, including the Calico Crayfish (*Faxonius immunis*), Virile Crayfish (*F.virilis*), Allegheny Crayfish (*F. obscurus*), and Northern Clearwater Crayfish (*F. propinquus*). However, these crayfish generally have smaller claws and lack the rusty spots present on the carapace.

Habitat

The Rusty Crayfish is often found in silt, clay, or gravel substrates, and prefers areas with adequate rock, log, and debris cover; however, it can survive in a variety of habitats, including lakes, rivers, ponds, and streams. It is most active at temperatures above 8° C (46°F).

Spread

The Rusty Crayfish is often used as bait, making fishing one of the most common vectors of spread. 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 its native range extends throughout the Ohio River basin in Indiana, Kentucky, Ohio, and parts of Tennessee, the Rusty Crayfish has spread beyond this range to become invasive in other areas of the United States. In the Mid-Atlantic region, the Rusty Crayfish has established in all Mid-Atlantic states except for Delaware.

Impacts

The Rusty Crayfish reduces native crayfish populations by competing for food and daytime hiding locations. It is an aggressive eater, damaging aquatic plant beds and reducing food, shelter, and spawning sites for other organisms, including valued sport fish.

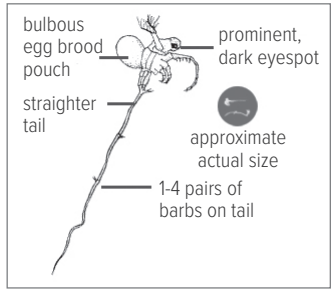
Mid-Atlantic Distribution

Spiny Waterflea

Bythotrephes longimanus

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 cables. It has the potential to outcompete native fish and can threaten a lake's ecosystem.



Identification

This species is not actually a flea, but rather a transparent crustacean or 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 large eyes is clearly separated 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

The Spiny Water Flea prefers large, deep, clear lakes with temperatures of 10-24°C (50-75°F), although it can tolerate temperatures anywhere from 4°C-30°C (40-86°F). It can also be found in wetlands, estuaries, rivers, and congregating in marinas.

Spread

Fishing, boating, and other recreational equipment can transport the Spiny Waterflea and its eggs to new waters.

Distribution

While native to Europe and Asia, the Spiny Waterflea was most likely brought to the Great Lakes region of the United States in the ballast water of ships. It was first found in 1984 in Lake Huron but is now found in all the Great Lakes, including the New York and Pennsylvania portions of Lake Erie, and several inland lakes in New York.

Impacts

While the Spiny Water Flea may be a food source for several freshwater fish, it feeds heavily on zooplankton, including important species like Daphnia, which are crucial food sources for juvenile fish. Anglers consider it a nuisance because the tail spines hook onto and clog fishing lines and downrigger cables.

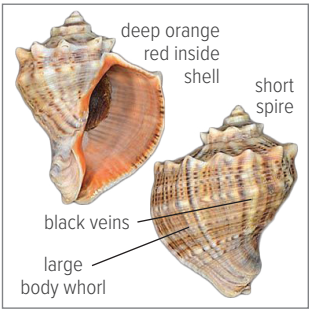
Mid-Atlantic Distribution

Veined Rapa Whelk

Rapana venosa

Species at a Glance

The Veined Rapa Whelk is a large predatory snail found in the Chesapeake Bay. Its main diet consists of natural and cultivated populations of mollusks, such as oysters and mussels. It is considered one of the most unwelcome invaders, worldwide, due to its predatory behavior.



Identification

The heavy, rounded shell of this snail grows 15-18 cm (6-7 in) in length and is almost as wide as it is long, giving it a boxy appearance. It has a short **spire** and a large body **whorl**, and it varies in color from gray to reddish-brown with dark brown dashes on the spiral ribs. Most shells have distinctive black veins throughout. A diagnostic feature for this species is the deep orange color found on the inside of the shell.

Similar Species

The large size, deep orange color inside the shell, and distinctive black veins distinguish the Veined Rapa Whelk from any other type of snail in the United States.

Habitat

This species is extremely versatile, tolerating low salinities, water pollution, and oxygen deficient waters. It favors compact sandy bottoms where it can burrow deep into the substrate.

Spread

The Veined Rapa Whelk lays clusters of eggs which form into free-floating larvae that eventually settle to the bottom of a waterbody, where they will develop into a hard-shelled snail. This species may have been introduced as the larvae were transported in the ballast water of ships, or as egg masses were transported with products for marine farming.

Distribution

Native to marine and estuarine waters of the western Pacific, from the Sea of Japan, Yellow Sea, East China Sea, and the Bohai Sea, the first Veined Rapa Whelk specimen in the United States was collected in 1998 in Hampton Roads, Virginia. Adult specimens, as well as egg cases, continue to be reported from locations in the lower Chesapeake Bay along the western shore of Virginia.

Impacts

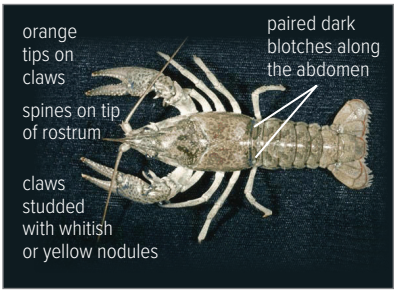
The Veined Rapa Whelk has caused significant changes in the ecology of bottom-dwelling organisms in its native range. While scientists are still studying these impacts, there is great concern over its potential to damage native Chesapeake Bay species.

Mid-Atlantic Distribution

Virile Crayfish

Faxonius virilis

Species at a Glance



The Virile Crayfish, also called the Northern Crayfish, is native to some regions of the United States, but has become introduced to new locations through 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*) and Spinycheek Crayfish (*Faxonius limosus*). The Calico Crayfish differs in having pincers that are gray, purple, or pink, a pale lengthwise stripe along the middle of the abdomen. The Spinycheek Crayfish is smaller with distinctive spiny cheeks and legs with orange tips.

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 riverbanks and under rocks when water levels are low. It doesn't tolerate poor water quality or high salinity water.

Spread

The Virile Crayfish is commonly used as bait, and sold in bait shops and aquarium stores, making intentional or unintentional introduction the likely cause of spread.

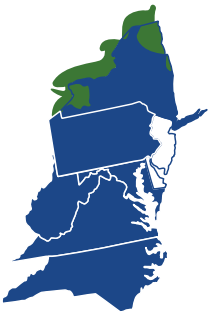
Distribution

Native to the Missouri, Mississippi, Ohio, and Great Lakes drainages of the United States, the Virile Crayfish has been introduced to several states outside of its native range, including Maryland, North Carolina, Pennsylvania, South Carolina, Virginia, and West Virginia in the Mid-Atlantic region.

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.

Mid-Atlantic Distribution

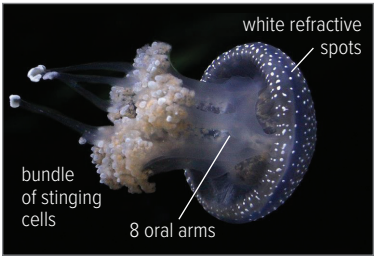


Green - Native Blue - Invasive

White Spotted Jellyfish

Phyllorhiza punctata

Species at a Glance



The White Spotted Jellyfish, also known as the Floating Bell, was introduced to the Gulf Coast region of North America from the Western Pacific Ocean. It is a threat to large commercial fisheries because it feeds on the eggs and larvae of fish, crabs, and shrimp. It also clogs fishing nets. **While mildly venomous, it does not pose a threat to humans who encounter it**.

Identification

This jellyfish has a large, somewhat flattened gelatinous bell that is clear or tinted brown with many small white crystalline refractive spots close to the surface. The bell is usually 45-50 cm (18-20 in) in diameter, but there has been a maximum reported size of 62 cm (24 in) and a weight of 11 kg (25 lbs.). The bell **margin** lacks tentacles, and the central mouth area is ringed by eight, thick, highly branching oral arms that end with large brown bundles of stinging cells. From each oral arm hangs a long ribbon-like transparent appendage. Within its native range, and in certain introduced localities, the White Spotted Jellyfish is a

deep brown color owing to the presence of symbiotic **protozoans** called **zooxanthellae**; however, the populations inhabiting the Gulf Coast region do not host the zooxanthellae and lack the brown coloration.

Similar Species

This species may be confused with the Moon Jellyfish (*Aurelia aurita*) based on size, but the Moon Jellyfish can be easily distinguished by its transparent body and horseshoe-shaped gonads, which can be easily seen through the top of the bell. In other parts of the world, the White Spotted Jellyfish co-occurs with other mastigiid jellyfish, which are similar in appearance, including several species belonging to the genus Mastigias.

Habitat

This coastal and estuarine jellyfish prefers warm temperate seas and is often aggregated in near-shore waters, swimming near the surface in murky waters of harbors and embayments.

Spread

While it's unclear how the White Spotted Jellyfish was introduced from Australia, many believe that ship traffic brought it to the Gulf Coast region. Once introduced, natural ocean circulation processes further distributed it.

Distribution

The White Spotted Jellyfish is widely distributed throughout Australia and much of the Indo-Pacific, including the Philippines archipelago. Swarms of this jellyfish have been reported from east Texas to Florida, north to North Carolina, and South Carolina.

Impacts

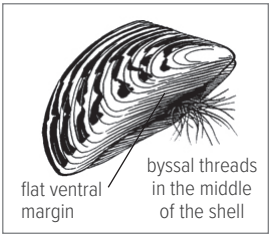
The White Spotted Jellyfish preys on the eggs and larvae of fish, crustaceans, and shrimp, which can impact the food web and threaten fisheries. It also clogs the shrimp nets of commercial fishing operations, damages boat intakes, and fishing gear, and has caused the closure of productive fishing areas, costing millions in economic impacts.

Mid-Atlantic Distribution

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, it can be virtually impossible to eradicate once established.

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 is more rounded or fan-shaped and lacks 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

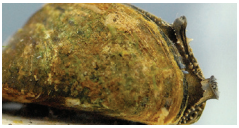
The Zebra Mussel can be found in lakes, rivers, reservoirs, ponds, and quarries. It requires enough calcium for shell production, and water temperatures over 10°C (50°F) for reproduction. It can be found attached to hard surfaces such as rocks, wood, concrete, steel, and even other organisms like native 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, likely imported in contaminated ballast water. It has since spread throughout the Great Lakes, the Mississippi River drainage, and many inland lakes. In the Mid-Atlantic region, Zebra Mussels are established in Maryland, New York, North Carolina, Pennsylvania, and West Virginia.



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.

Mid-Atlantic Distribution

Invasive Mammals and Birds

While some of the species in this section are native to the region (i.e., migrant Canada Goose), or may be considered terrestrial or semi-aquatic, they are considered important species in aquatic invasive species management because they have the potential to severely impact and alter aquatic ecosystems.

Species such as Feral Hog and Nutria threaten the diversity and abundance of native species by degrading habitat, reducing water quality, depleting valuable wetland vegetation, and causing stream bank erosion.

Birds like the Mute Swan and Resident Canada Goose can decrease biodiversity of native birds and wildlife and create health threats as their droppings enter water systems and residential areas.

Early detection and identification of these species is a first line of defense against possible damage to aquatic ecosystems. Once confirmed, species should be reported immediately if found in new locations.

Feral Hog

Sus scrofa

Species at a Glance

The Feral Hog, also known as the Feral Pig, Feral Swine, or Wild Boar, is a feral representative of all domestic pigs. Brought to North America from Europe and Asia as a domestic livestock, or through introductions of Wild Boar, the Feral Hog poses serious ecological, economic, and public health threats.

Identification

The Feral Hog exhibits a wide range of colors, including solid black, gray, brown, blonde, or red to striped, spotted, or grizzled color combinations. The average boar (male) weighs from 59-200 kg (130-440 lbs.). Boars have four tusks that grow continually and can be extremely sharp. Upper tusks can be as long as 8-13 cm (3-5 in) and are usually worn or broken from use. The average sow (female) weighs 35-150 kg (77-330 lbs.) and has no tusks. Both boars and sows have an elongated, tough yet flexible snout that is flattened at the end. The feet are cloven, and the tail is often straight and moderately long, with sparse hair. Signs of the Feral Hog can include tracks, rubbing on nearby trees, rooting, and muddy wallows. In some areas, escaped or free-ranging pigs may be legally considered feral based on their location and lack of documented ownership, rather than on physical appearance.

Similar Species

Not to be confused with recently escaped domestic pigs, the Feral Hog roams free and is not tame. Escaped, or

free-range domestic pigs left unattended or abandoned to roam free may quickly convert to a feral condition.

Habitat

The Feral Hog can adapt to almost any habitat, from tropical coastal marshes to sub-arctic latitudes. In the Mid-Atlantic region, it prefers habitats with an abundant supply of food, water, and dense cover such as swamps, shrubby communities, riparian zones, forests, agricultural fields, and urban or suburban greenways.

Spread

Through natural population growth, illegal movement by sport hunters, and escape from domestic swine operations, the Feral Hog has quickly spread and established wild breeding populations. It is a prolific breeder, capable of tripling its population in 14-16 months. Sows reach sexual maturity at 5-6 months of age, producing 2-3 litters per year of 4-8 piglets.

Distribution

Pigs were first introduced to North America from Europe around 1539, likely as semi-domestic livestock descended from Eurasian swine. Additional introductions of Wild Eurasian Boars from Europe and Asia for sport hunting occurred throughout the 1800s and 1900s. Over many decades, these diverse stocks have converged to form free-ranging Feral Hog populations which have quickly spread across the United States. Experts estimate current numbers at over 5 million animals nationwide. The Feral Hog has been reported from every Mid-Atlantic state, though no established populations occur in Maryland.

Impacts

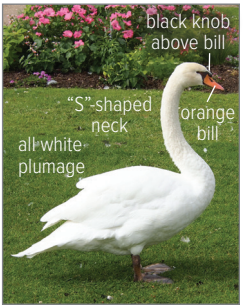
The Feral Hog can be destructive to property, infrastructure, wildlife, and wetlands. Wallowing, or lying in mud or water, can affect ponds and wetlands by muddying the water and destroying aquatic vegetation. Rooting, or turning-over soil, impacts agricultural crops, or facilitates the invasion of noxious weeds, reduces the diversity and distribution of native species and poses a threat to ground nesting birds and wildlife It can also transmit diseases and parasites to wildlife, livestock, pets and humans.

Mid-Atlantic Distribution

Mute Swan

Cygnus olor

Species at a Glance



Although many people enjoy its beauty, the Mute Swan is a large and aggressive bird that originates from Europe and Asia. It adversely impacts ecosystems by uprooting valuable aquatic plants, outcompeting native birds, attacking native wildlife and humans, and carrying disease agents like *E. coli*.

Identification

The Mute Swan is a very large bird, measuring 142-157 cm (56-62 in) in length and weighing 11-14 kg (25-30 lbs.). Adults have all white **plumage**, vibrant orange bills, and a black knob present above the bill. Young birds have grayish bills. When swimming, the Mute Swan often holds its wings slightly upraised over its back, forming a hump. The conspicuously curved neck is held in an S-shape, with the bill held downward while swimming.

Similar Species

The most notable difference between the Mute Swan and native swans, like the Trumpeter Swan (*Cygnus buccinator*) and the Tundra Swan (*C. columbianus*), is that adult Mute

Swans have an orange bill, while the native swans have black bills. The Mute Swan also has a black knob on top of the bill that is absent in the native swans. The "S"-shaped curve in the Mute Swan also distinguishes it from the Trumpeter Swan, which has a "C"-shaped neck.

Habitat

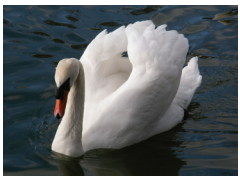
This species can be found in both marine and freshwater environments, including ponds, slow rivers, coastal bays, and inland lakes. It prefers habitats infested with Phragmites and Cattail which it uses for nesting material and as protection from potential predators.

Spread

It is widely thought that all North American Mute Swan populations originated from the release or escape of individuals from early captive flocks that were brought to the United States for ornamental purposes. Because it is relatively long-lived, reaching over 25 years in some wild populations, the Mute Swan has the potential to increase its population size rapidly if left unchecked.

Distribution

Native to Europe and parts of Asia, the Mute Swan was intentionally brought to the United States in the mid-1800s to the early 1900s to beautify city parks, zoos, and private estates. However, a small number of birds escaped into the wild in New Jersey and New York, enabling Atlantic Flyway populations to form. This species can now be found from southern Ontario to North Carolina, with semi-domestic flocks ranging south to Florida.



Impacts

The Mute Swan is capable of uprooting 20 pounds of **submerged** aquatic vegetation per day that would otherwise provide important food and shelter for native fish and wildlife. The Mute Swan also behaves aggressively towards other birds and even humans. It chases native water birds to keep them from nesting, and in extreme cases can attack and kill ducklings, goslings, or other small water birds.

Mid-Atlantic Distribution

Nutria

Myocastor coypus

Species at a Glance

The Nutria, also called the Coypu, is a large, semi-aquatic rodent that was brought to the United States as an important resource for the fur farming industry. When the fur market collapsed, the Nutria was released into the environment, impacting thousands of acres of coastal wetlands as it grazed on native marsh vegetation and burrowed into dikes, levees, and littoral banks.

Identification

The Nutria is a furry, swimming rodent that can weigh 7-9 kg (15-20 lbs.) and reach 0.6 m (2 ft) long. It is light to dark brown with a large head, short legs, and a stout body that appears hump-backed on land. Its large front teeth can range in color from yellow to orange-red. It is highly adapted for aquatic ecosystems with partially webbed hind feet; a long round tail; and eyes, ears, and nostrils that are set high on the head, which allows them to stay above the waterline while swimming.

Similar Species

Often mistaken for beavers and muskrats, the best way to distinguish the Nutria is to look at the size, tail, and head. An adult Nutria is about one-third the size of an adult Beaver and

five to eight times larger than an adult Muskrat. A Beaver has a large, broad, flat tail, and a Muskrat has a long narrow tail that whips back and forth when swimming. The Nutria has a heavy rat-like tail thinly covered in bristly hairs that trails smoothly behind it when swimming.

Habitat

This species has adapted to a wide range of freshwater, estuarine, and saltwater habitats, but is usually found in and along lakes, marshes, and slow-moving streams. It prefers habitats with an abundance of **emergent** vegetation, small trees, shrubs, and other succulent vegetation along the banks. It can also be found under buildings, in overgrown lots, on golf courses, and in storm drains.

Spread

The Nutria was first imported into the United States for Nutria ranching in 1899, which became very popular in the 1930s. After the collapse of the fur market in 1940, thousands of Nutria were released by ranchers who could no longer afford to keep them, or they escaped into the wild. Other than fur harvesters, Alligators are the only significant predator of the Nutria; however, even in areas with an abundance of Alligators, this species can thrive if habitat conditions are suitable.

Distribution

Native to South America, the Nutria was introduced into the United States for the fur farming industry. Accidental and intentional release of this species allowed it to become established in at least 16 states, including Delaware, Maryland, New Jersey, North Carolina, Virginia, and West Virginia in the Mid-Atlantic Region.

Impacts

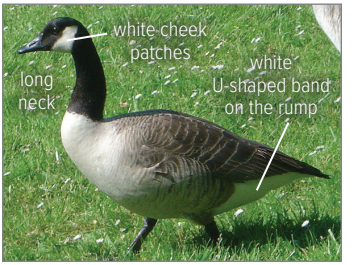
The Nutria feeds heavily on marsh grasses and aquatic vegetation, reducing diversity and abundance of native plants and impacting valuable fish and wildlife habitats. Intense grazing can destroy roots mats and increase erosion, resulting in barren mudflats and open water. The Nutria can also impact important crops like sugarcane, rice, corn, and various fruits and vegetables, resulting in substantial financial losses for farmers. Its burrowing behavior can weaken the foundations of reservoirs, dams, buildings, roadbeds, and flood control levees. It can also serve as a host for several pathogens and parasites which can contaminate drinking water supplies and swimming areas.

Mid-Atlantic Distribution

Resident Canada Goose

Branta canadensis

Species at a Glance



Within the Atlantic flyway, there are two populations of Canada Goose, one is a migratory native species, and the other is an introduced non-migratory resident. The Resident Canada Goose is a product of intentional stocking and is now established throughout the Atlantic flyway states and southern Canada. Since its introduction, populations of the Resident Canada Goose have increased dramatically, with numerous ecological, agricultural, and aesthetic impacts.

Identification

The Resident Canada Goose is a large waterfowl weighing up to 8 kg (18 lbs.). It has a long neck, large body, large, webbed feet, and a wide flat bill. Both sexes have a black head and neck with broad white cheek patches that extend from the throat to the rear of the eye. The breast, abdomen, and **flanks** are light gray to dark chocolate brown. The back and tail are usually dark brown to black with a white U-shaped band on the rump. It is often seen in flight moving in V-shaped flocks.

Similar Species

The Cackling Goose (*Branta hutchinsii*) was once considered the same species as the Canada Goose; however, the Cackling Goose is much smaller and has a tiny, stubby, triangular bill. In addition, the Greater White-fronted Goose (*Anser albifrons*) has a brown, not black, neck and lacks the white cheeks and throat. The Snow Goose (*Chen caerulescens*) has an all-white head and body with black wing tips. The Atlantic Brant (*Branta bernicla*) has a dark chest, with a white neck.

Habitat

A highly adaptable species, the Resident Canada Goose uses a variety of habitats including islands in rivers and lakes, marshes, reservoirs, golf courses, agricultural fields, and grassy fields near water. It prefers typical suburban landscapes that provide food in the form of grassy open areas and ponds for water and roosting.

Spread

The Resident Canada Goose is highly mobile and able to fly long distances to find food and nesting areas. It is also very prolific. The Resident Canada Goose has few natural predators and gosling production is not as impacted by spring weather conditions.

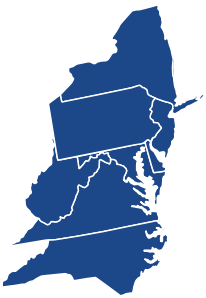
Distribution

Stocking and release of the Resident Canada Goose began in the early 1900s. It now nests throughout the Atlantic flyway states and southern Canada. It typically moves south only when forced by snow and ice. The population of the Resident Canada Goose in the Atlantic flyway has increased dramatically in the last 40 years and now totals over 1 million.

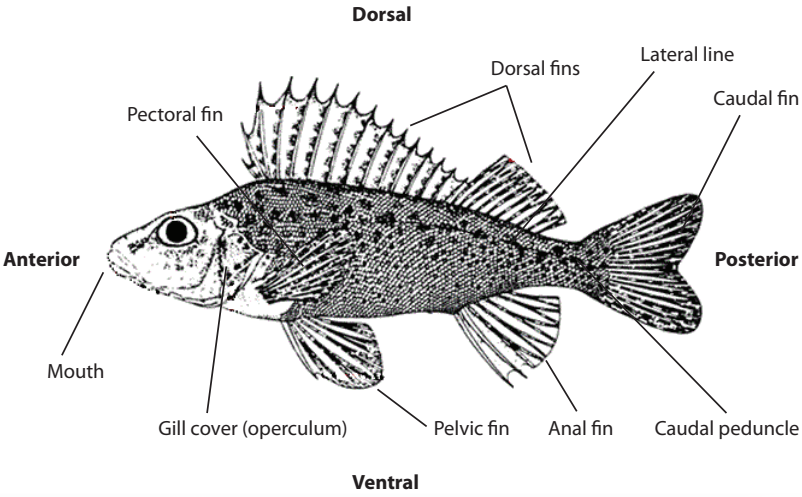
Impacts

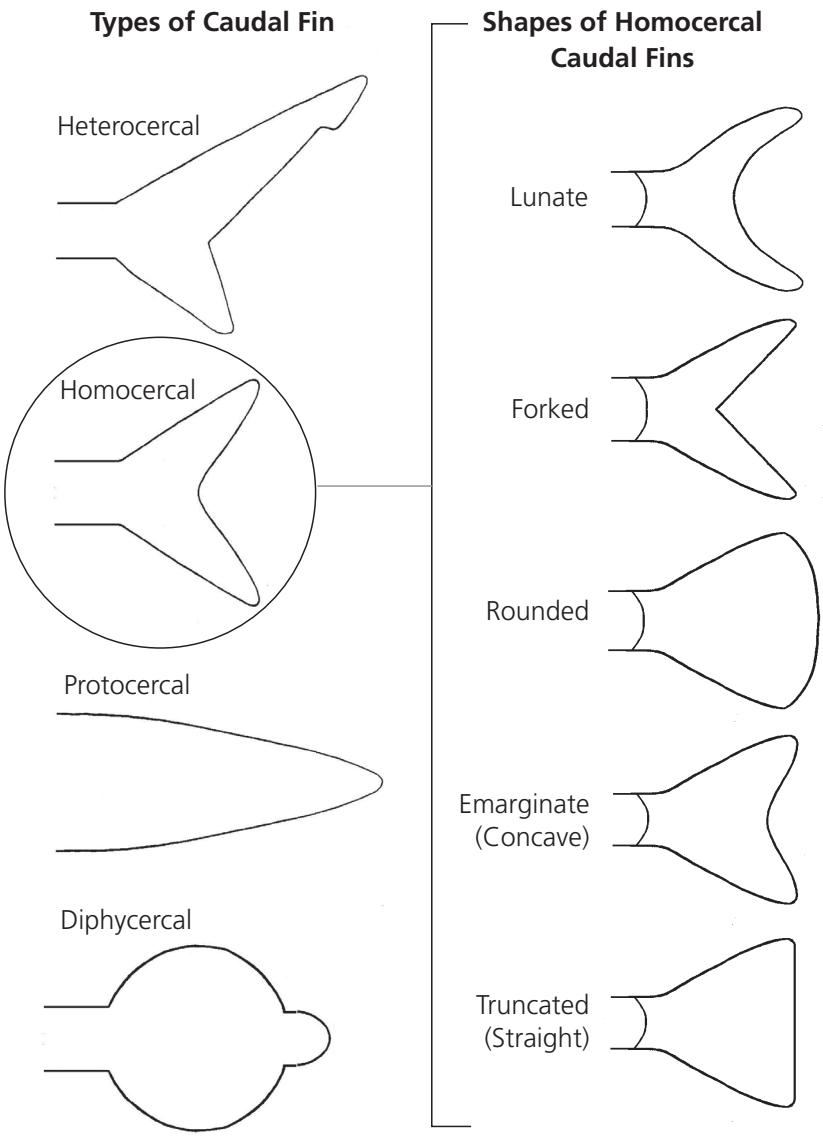
Grazing by the Resident Canada Goose, particularly during the growing season, can damage native vegetation and agricultural crops. In addition, Goose droppings can impact water quality by adding excessive nutrients. The presence of Goose feces in residential areas is not only a nuisance but can also damage property and pose a potential human health threat.

Mid-Atlantic Distribution



Fish Anatomy

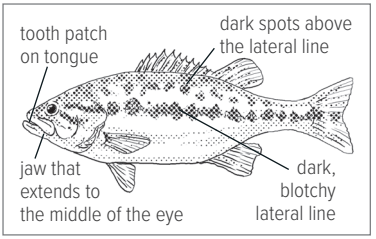



Types of Caudal Fin
Heterocercal
Homocercal
Protocercal
Diphycercal
Shapes of Homocercal Caudal Fins
Lunate
Forked
Rounded
Emarginate (Concave)
Truncated (Straight)

Alabama Bass

Micropterus henshalli

Species at a Glance



The Alabama bass, also known as a Spotted or Black Bass, is one of twelve different species of Black Bass. It is a popular sport fish in the United States that has been spread by anglers in waters nationwide. Once introduced, it can cause significant declines in populations of other bass species, including Largemouth and Smallmouth Bass by **hybridization**, and outcompeting them for food and resources.

Identification

The Alabama Bass can grow up to 24 in (61 cm) in length and can live for 13-14 years. It is generally shorter and lighter than other similar species of bass. Distinguishing features of the Alabama Bass include a tooth patch on its tongue and a jaw that extends to the middle of the eye. The Alabama Bass has a dark and blotchy **lateral line** extending from head to tail which is made up of 68-84 pored lateral line scales. It also has dark spots above the lateral line which do not reach the dorsal fin base.

Similar Species

The Alabama Bass can be mistaken for other bass species, including Spotted, Smallmouth, and Largemouth bass. It closely resembles the Spotted Bass, often requiring genetic testing to tell them apart, although the Alabama Bass typically has more and narrower scales, and a narrower head. The Smallmouth Bass has dark vertical bars, three diagonal stripes behind the eyes, and no visible lateral line. The Largemouth Bass lacks a tooth patch, has uneven spots below the lateral line, and a more continuous lateral line.

Habitat

The Alabama Bass typically prefers clear, relatively deep-water habitats with rocky substrate in large river systems and impoundments.

Spread

Introduced to Georgia in the 1970s for sport fishing, the Alabama Bass spreads rapidly and reproduces early in the spring, giving it a competitive advantage. It can hybridize with several native bass species, threatening to eliminate them through genetic mixing.

Distribution

The Alabama Bass is native to regions of Alabama, Georgia, and Mississippi. In the Mid-Atlantic region, it is established in North Carolina, South Carolina, and Virginia, and is a species of concern for introduction into other Mid-Atlantic states.

Impacts

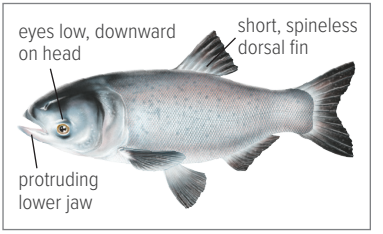
When stocked outside of its native range, Alabama Bass can outcompete other bass species and reproduce more successfully, resulting in a stunted bass fishery. In North Carolina, its introduction caused a rapid decline of native Largemouth Bass. It also threatens Smallmouth Bass through hybridization.

Mid-Atlantic Distribution

Bighead Carp

Hypophthalmichthys nobilis

Species at a Glance



The Bighead Carp is a member of the Invasive Carp complex, which includes Silver, Black, and Grass Carp. There are no established populations in the Mid-Atlantic Region; however, its large size and voracious appetite make it an enormous threat to the area. 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 weighing 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 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*). The **keel** of the Bighead Carp runs from the **pelvic** fins to the **anal** fins, while the Silver Carp has a mid-ventral keel that is more extensive and runs

from the anal fins up to the base of the gills. The Silver Carp also lacks the dark blotches characteristic of the Bighead Carp. The 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 nipple-like bumps.

Habitat

The Bighead Carp lives exclusively in freshwater and prefers large river systems with flowing water that is needed for spawning. It will also inhabit lakes and ponds.

Spread

Once introduced to open waters, the Bighead Carp can readily spawn and disperse itself. Because juveniles of this species can resemble common baitfish species, it may be unintentionally spread through the use of live bait. Spread can also occur as it is sold through the live Asian food market.

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.

Distribution

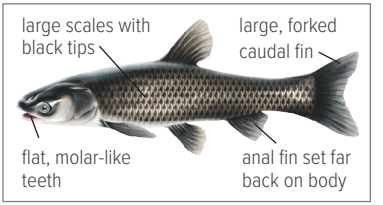
Native to eastern Asia, the Bighead Carp was intentionally introduced into the United States to control algae in aquaculture ponds. During flooding in the early 1980s, it escaped into the Mississippi River and has since moved upstream towards the Great Lakes. There is evidence of reproducing populations in the middle and lower Mississippi and Missouri Rivers and in the Ohio River. The Bighead Carp is also in the Illinois River, which is connected to the Great Lakes via the Chicago Sanitary and Ship Canal. In the Mid-Atlantic region, Bighead Carp have been successfully eradicated from water bodies in New Jersey and Pennsylvania. However, there are currently no established populations in the coastal Mid-Atlantic region.

Mid-Atlantic Distribution

Black Carp

Mylopharyngodon piceus

Species at a Glance



The Black Carp is a member of the Invasive Carp complex, which includes Silver, Bighead, and Grass carp. This species is a molluscivore and has powerful 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. 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 its body 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 15 kg (33 lbs.), but some Black Carp can reach up to 68 kg (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 teeth appear molar-like, whereas the Grass Carp's teeth have deep parallel grooves. The 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

The Black Carp is exclusively freshwater and prefers large river systems and embayments in temperate to subtropical climates.

Spread

The availability of the 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. It was 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 established Black Carp in the Mid-Atlantic region.

Impacts

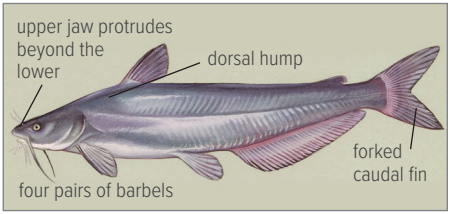
The Black Carp poses a considerable threat to native mussel and snail populations. It can live up to 15 years, consuming several pounds of mollusks each day and competing with native fish, turtles, birds, and some mammals for food. The Black Carp may also be a vector for parasites and diseases affecting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

Mid-Atlantic Distribution

Blue Catfish

Ictalurus furcatus

Species at a Glance



Often confused with the Channel Catfish (*Ictalurus punctatus*), the Blue Catfish is the largest species of North American catfish, reaching up to 150 pounds and living up to 20 years. Populations of non-native Catfish such as the Blue and Channel Catfish have increased dramatically since their introduction and are now present in every major Chesapeake Bay tributary.

Identification

The long, heavy body of the Blue Catfish is smooth and scaleless with a wide head and a high spot near the center of the head called the **dorsal** hump. The upper jaw protrudes well beyond the lower jaw. It has a slate blue body above, fading to silver-white on the sides and belly. The outer **margin** of the **anal fin** is straight, and the **caudal fin** is deeply forked. Four pairs of black, whisker-like barbels appear around the mouth. Adults usually grow to be less than 0.6 m (2 ft) long but can be as long as 1.5 m (5 ft) and weigh more than 45 kg (100 lbs.).

Similar Species

Small Blue Catfish are often confused with Channel Catfish (*Ictalurus punctatus*). The Channel Catfish rarely exceeds 14 kg (30 lbs.), and smaller individuals often have dark spots

that are not found on the Blue Catfish. Large Channel Catfish and medium-sized Blue Catfish can be more difficult to tell apart, often having similar coloration and general body shape. The margin of the anal fin can be used to differentiate these fish. The Blue Catfish has an anal fin with a very straight margin and the Channel Catfish has a rounded margin. They can also be distinguished by counting fin rays in the anal fin; 30-35 rays in the Blue Catfish and 25-29 rays in the Channel Catfish.

Habitat

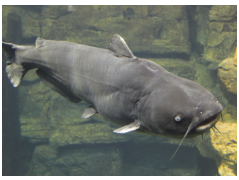
While the Blue Catfish lives primarily in freshwater, it can thrive in brackish waters and has a high tolerance for different habitats and water conditions. It is a bottom dweller, preferring large rivers with deep channels, swift currents, and sandy bottoms.

Spread

The Blue Catfish was intentionally stocked as a food fish, sport fish, and to feed on populations of the invasive Basket Clam. It has established and spread to new locations through connected waterways and by escaping Catfish farms during floods. With a long lifespan and females producing 4,000 to 8,000 eggs per kilogram of body weight, it has continued to expand its range and population.

Distribution

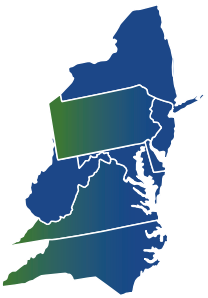
Native to the Mississippi, Missouri, and Ohio River basins, the Blue Catfish has been stocked in at least 20 states. During the 1970s and 1980s, they were introduced into the James, Rappahannock, and York rivers in Virginia, and populations have expanded into nearly every major tributary in the Chesapeake Bay watershed.



Impacts

Because of its adaptability, diverse diet, large size, and growing numbers, there is concern about the potential impacts Blue Catfish may have on native species of fish and shellfish in the Chesapeake Bay. Studies on the James and Rappahannock rivers revealed that Blue and Flathead Catfish make up 75 percent of the total weight of all fish inhabiting some stream reaches.

Mid-Atlantic Distribution



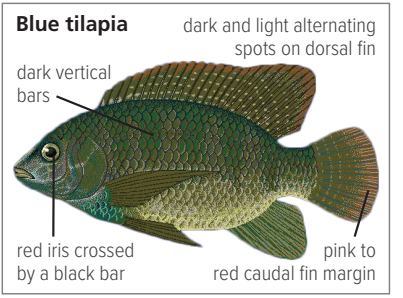
Green - Native Blue - Invasive

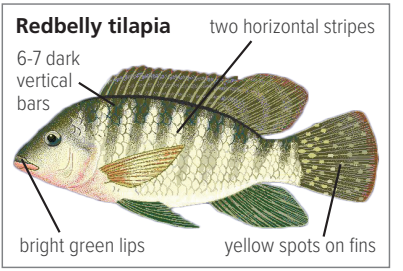
Blue Tilapia and Redbelly Tilapia

Oreochromis aureus and Tilapia zillii

Species at a Glance

The Tilapia is resilient, prolific, easy to grow, and appeals to many consumers with a mild flavor and white flesh. Therefore, species like the Blue and Redbelly Tilapia have become economically important food fish throughout the world. Unfortunately, when released through unintentional escape into the natural environment, they have the potential to outcompete native species and negatively impact aquatic communities.





Identification

The body of the Blue Tilapia is blue and silver with dark vertical bars that may not always be apparent. Dark and light spots alternate on the posterior half of the **dorsal fin**, and the upper **margin** is red or orange in color. The **caudal fin** also has a broad pink-to-red margin. The eye has a red iris that is crossed by a black bar. Males are significantly larger than females, reaching a maximum length of 50 cm (20 in). Breeding males exhibit a bright metallic blue on the head and a more intense pink on the fins, as well as a blue-black chin and chest.

The Redbelly Tilapia is olive-colored on top and light olive to yellow- brown on the sides, often with an iridescent blue sheen. Lips are bright green, and the chest is pinkish. Six to seven dark vertical bars cross two horizontal stripes on the body and **caudal peduncle**. Fins are covered in yellow spots, with the dorsal and **anal fins** displaying the outline of a thin orange band. Spawning coloration is a shiny dark green on the top and sides, red and black on the throat and belly, and obvious vertical bars on the sides. The heads turn dark blue to black with blue- green spots. It reaches a maximum length of 40 cm (15.7 in).

Similar Species

The Blue Tilapia has little or no breeding coloration in males in contrast with the Redbelly Tilapia. The Redbelly Tilapia is also similar to the Spotted Tilapia (*Tilapia mariae*) but differs in that the Spotted Tilapia lacks the blood-red coloration, it has 5-6 black square blotches on its side, and the stripes on its side extend onto the dorsal fin.

Habitat

Both Tilapia species can be found in lakes, wetlands, marine habitats, watercourses, and estuaries. They prefer tropical habitats, but the Blue Tilapia can tolerate cold temperatures as low as 8°C (46°F). The Redbelly Tilapia has the ability to establish in highly salinated waters. Both species are considered hardy and tolerant of a wide range of water quality and habitat conditions.

Spread

Tilapia introductions have occurred through many vectors, including intentional stocking for experimental work by states and private companies, as forage for warm water predatory fish, as a food source, as a control for aquatic plants, and through unintentional escapes.

Distribution

Native to parts of Africa and the Middle East, Blue and Redbelly Tilapia were annually stocked in states like Alabama and Arizona from the late 1950s to the 1970s. In the 1980s there were reports of Blue Tilapia in the lower Susquehanna portion of Pennsylvania; however, this population is thought to be exterminated. In the Mid-Atlantic region, they are established in North Carolina and South Carolina.

Impacts

These Tilapias have the ability to spread rapidly and in large numbers, allowing them to effectively compete with native species for food and nesting space. The Redbelly Tilapia can also alter native benthic communities through the elimination of plants and will often exhibit aggressive behavior towards other fish.

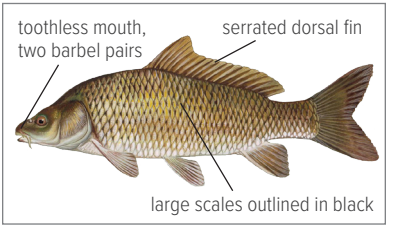
Mid-Atlantic Distribution Blue

Mid-Atlantic Distribution Redbelly

Common Carp

Cyprinus carpio

Species at a Glance



The Common Carp is a voracious, omnivorous fish and one of the largest members of the minnow family Cyprinidae. It is long-lived with a lifespan of up to 50 years. Varieties of Common Carp include Mirror Carp, Leather Carp, and Koi, which are popular in small ponds and water gardens.

Identification

The body is heavy and stout, bronze, brassy, or yellow in color, and has large scales usually outlined in black. Spine-like rays are present at the front of the **dorsal** and **anal fins**. The head is short with a rounded snout, a toothless sucker-like mouth, and two pairs of barbels on each side of the upper jaw. Its average length is 25-55 cm (10-22 in), and it typically weighs 0.5-4.5 kg (1-10 lbs.), although some can reach up to 122 cm (48 in) long and weigh up to 36 kg (80 lbs.).

Similar Species

The Common Carp resembles the Smallmouth Buffalo (*Ictiobus bubalus*), Bigmouth Buffalo (*I. cyprinellus*), Grass Carp (*Ctenopharyngodon idella*), and other species of Carp. The best way to identify the Common Carp is by 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, bays, and shallow water during spring spawning.

Spread

Once introduced, the Common Carp can migrate through natural waterway connections to other bodies of water. It can also be spread by anglers using juvenile Carp as bait.

Distribution

Native to Europe and Asia, the Common Carp was intentionally introduced into the United States in the 1880s as a food and game fish. It is now prevalent throughout the entire United States and is found in every state in the Mid-Atlantic region.

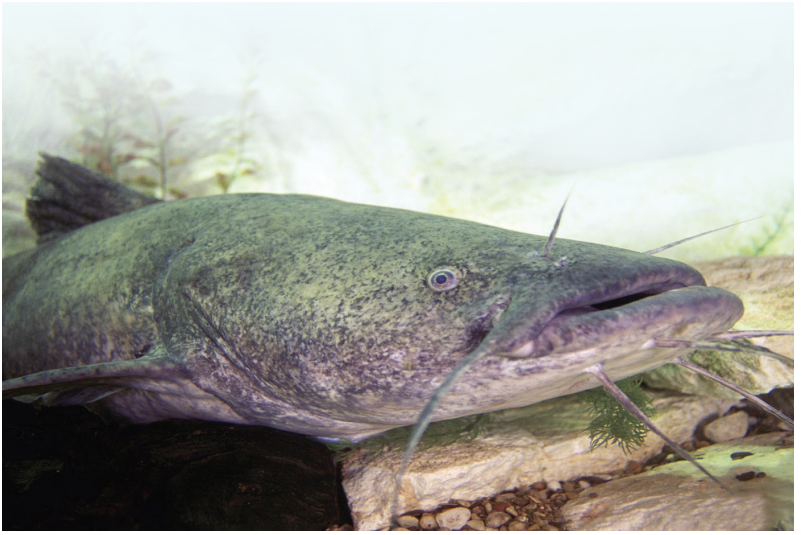
Impacts

The foraging behavior of the Common Carp causes it to dislodge and destroy vegetation, increase water **turbidity**, impact native species' spawning sites, and decrease water quality. It also releases phosphorus that increases algae abundance and production.

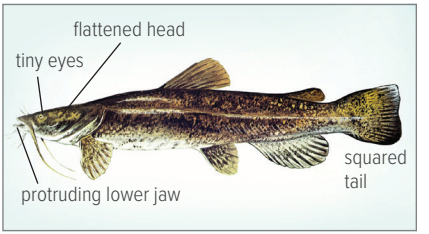
Mid-Atlantic Distribution

Flathead Catfish

Pylodictis olivaris



Species at a Glance



The Flathead Catfish is one of the largest and longest living (up to 20 years) species in the Catfish family. It feeds voraciously on other fish, making it a possible threat to native ecosystems. It has many nicknames, including Pied Cat, Mud Cat, Mississippi Cat, Shovelhead Cat, Yellow Cat, and Opelousa Cat.

Identification

Key characteristics of the Flathead Catfish are its flattened head, tiny eyes, squared tail, and protruding lower jaw. It can grow up to 152 cm (60 in) long and weigh on average 14 kg (30 lbs.), although some have been known to reach over 45 kg (100 lbs.). Coloration is usually brownish-yellow with mottled speckles on the back and a cream-colored white to yellow belly.

Similar Species

Most often confused with the Channel Catfish (*Ictalurus punctatus*), the Flathead Catfish is nearly double its weight.
The lower jawbone of the Flathead Catfish extends outward from the rest of the face (underbite), whereas the Channel Catfish's upper jaw extends over the lower jaw. The Channel Catfish also has a forked tail instead of a squared tail.

Habitat

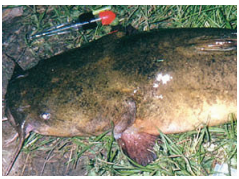
Thriving in reservoirs, lakes, rivers, and large streams, the Flathead Catfish prefers deep, still, muddy waters with logs and other debris to use as shelters.

Spread

The most likely vector of spread is intentional stocking and release by anglers for game and food fishing.

Distribution

Native to North America, including areas of the Mississippi River Basin, the Great Lakes, and the Ohio River drainage, the Flathead Catfish is invasive in western states and throughout the entire Mid-Atlantic region, extending to Florida.



Impacts

The Flathead Catfish is fast-growing, long-lived, and a voracious predator of other fish, making it a threat to the region's ecological and economic resources, such as native fish populations. Species like sunfish and native catfish have declined heavily in some areas where Flathead Catfish are present.

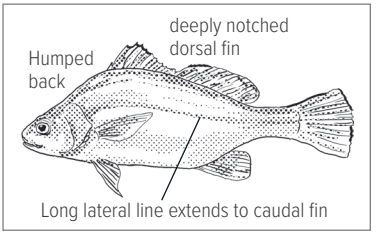
Mid-Atlantic Distribution

Green - Native Blue - Invasive

Freshwater Drum

Aplodinotus grunniens

Species at a Glance



The Freshwater Drum, also known as the Grunt, Sheepshead, or Gray Bass, is known for the grunting or drumming sound produced by males to attract females during breeding season. This is achieved by vibrations of muscles along the **swim bladder**. The Freshwater Drum is the only member of its family in North America to occupy only freshwater habitats.

Identification

The Freshwater Drum has a cylindrical, **laterally** compressed body with **ctenoid** scales, a humped back, sloping forehead, and white lips. The gray to silver body often shows a purple or bronze reflection and dark vertical bars. The **dorsal fin** is long and deeply notched, with 10 spines and 29-32 rays. The **anal fin** is soft, with two spines and seven rays. The long **lateral line** extends to the rounded **caudal fin**. It typically measures 10-24 in in length and weigh 1-8 lbs.

Similar Species

The Freshwater Drum may be confused with other drum species, including its marine relative, the Red Drum, the Atlantic Croaker,

the Silver Perch, and the Black Drum. The Red Drum is more red/coppery in color and has a characteristic dark spot on its caudal fin. The Atlantic Croaker has up to five pairs of small barbels and brown vertical stripes along its sides. The Silver Perch is more greenish gray in color with a white belly and forked tail. The Black Drum has many barbels under the lower jaw and often has dark, thick bands along its sides.

Habitat

The Freshwater Drum prefers the bottoms of medium and large rivers and lakes at depths of 40-60 ft. It typically prefers turbid waters with sandy or muddy bottoms but will tolerate clear and turbid conditions. It can survive in cold and warm waters but will feel stress when water temperature exceeds 25.6°C (78°F).

Spread

The Freshwater Drum has been introduced outside of its native range in the United States through stocking, accidental introduction, and transport. Females can produce 600,000 eggs during one mating season, which encourages the rapid growth of the species. The eggs are buoyant, float near the water's surface, and are easily carried to new locations by currents.

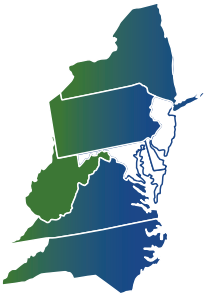
Distribution

Native to North and Central America, including the Mississippi River basin and the Great Lakes, the Freshwater Drum was stocked in Illinois and Colorado lakes in the 1800s as a sport fish. It is now established in the Delaware River, Hudson River, and in the Chesapeake Bay region across several Mid-Atlantic states.

Impacts

Although the impacts of the Freshwater Drum are largely unknown, it is an opportunistic and generalist feeder, which implies that it may compete with native fish for food and influence the population of other species. It feeds on mollusks, which raises specific concern of imperiled freshwater mussel species in the Delaware and Chesapeake bays.

Mid-Atlantic Distribution

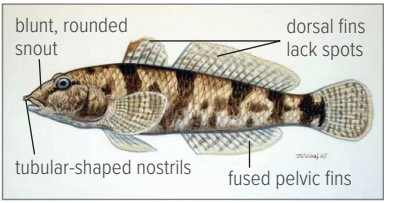


Green - Native Blue - Invasive

Freshwater Tubenose Goby

Proterorhinus semilunaris

Species at a Glance



The Freshwater 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). 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 fin, and the two **dorsal fins** lack spots. 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 Freshwater Tubenose Goby is much smaller than the Round Goby and has tubular-shaped nostril extensions.

The Round Goby has a black spot on the first dorsal fin and has very distinctive frog-like eyes that protrude from the top of the head. In addition, the Freshwater 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 Freshwater Tubenose Goby may also be confused with the native Sculpin; however, the Sculpin does not have scales or pelvic fins that form a suction cup.

Habitat

The Freshwater 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 Freshwater 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 fishermen 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 Freshwater Tubenose Goby was first found in Lake Erie around 1990 and can now be found in lakes St. Clair, Erie, and Superior. There are currently no inland or Mid-Atlantic occurrences of this species other than the Great Lake portion of Pennsylvania.

Impacts

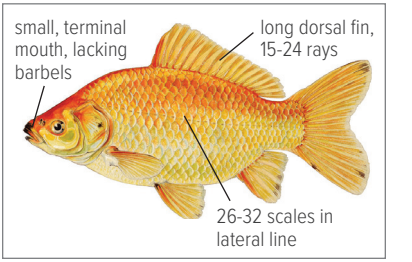
While its impacts are not yet known, the Freshwater Tubenose Goby may be able to compete with and prey upon benthic species in a manner similar to the larger Round Goby. However, because it is small and not as aggressive, the tubenose goby may not be as detrimental as the Round Goby.

Mid-Atlantic Distribution

Goldfish

Carassius auratus

Species at a Glance



The Goldfish, which is a member of the Minnow family, 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

The elongated, stout body is typically 10-20 cm (4-8 in) in length and weighs 0.03 kg (0.06 lbs.), although it can reach a maximum length of 59 cm (23 in) and maximum weight of 3 kg (7 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. While the Goldfish was mostly golden in color one thousand years ago, it now comes in a variety of colors, including orange, yellow, white, black, silver, olive-green, or greenish-brown and combinations of these colors. When found in nature, the Goldfish is most often a shade of green, brown, or gray.

Similar Species

The Goldfish may be confused with the Common Carp (*Cyprinus carpio*), which has two pairs of barbels on the upper jaw, a non-serrate spine, and typically more than 32 scales in the lateral line. However, Goldfish can **hybridize** with the Common Carp, producing individuals with both characteristics.

Habitat

While it prefers a habitat with a muddy bottom and thick vegetation, the Goldfish can tolerate pollution, temperature fluctuations, and high levels of turbidity. It lives in freshwater ponds and slow-moving or still waters in depths of up to 19.8 m (65 ft) and prefers temperatures of 4-41°C (40-106°F); although it cannot live for long at high temperatures.

Spread

Intentionally introduced to ponds, fountains, and small lakes for ornamental purposes, the Goldfish was able to escape and disperse through connecting waters. Many introductions of Goldfish were also due to its use as live bait. In addition, the Goldfish is often released into the wild by pet owners, who do not realize the environmental repercussions.

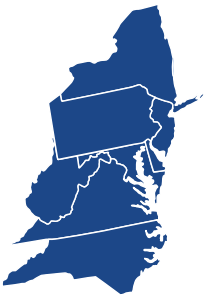
Distribution

Native to eastern Asia, the Goldfish has been reported invasive in the United States by every state except for Alaska and is established in all the Mid-Atlantic states.

Impacts

The Goldfish is believed to be responsible for population declines in many native fish, invertebrate, and plant species. It also uproots plants and creates enormous turbidity due to its aggressive bottom feeding behavior.

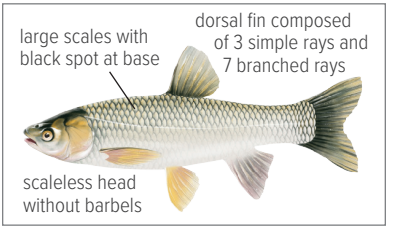
Mid-Atlantic Distribution



Grass Carp

Ctenopharyngodon idella

Species at a Glance



The Grass Carp, also known as the White Amur or the Waanue, is one of the largest minnows in the family Cyprinidae. It is also a member of the Invasive Carp complex, which includes the Black, Bighead, and Silver Carp. It was introduced into the United States to help control the growth of aquatic weeds in aquaculture facilities but escaped into natural ecosystems and is now widespread throughout the United States.

Identification

The Grass Carp's slender, oblong body typically reaches 29-36 kg (65-80 lbs.), although individuals as large as 45 kg (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

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

Habitat

The Grass Carp prefers shallow and quiet waters, typically 0.9-3 m (3-10 ft) deep, such as ponds, lakes, pools and backwaters of large rivers.

Spread

Once introduced, the Grass Carp can spread to distant water bodies by tributaries, waterways, river systems, canals, and dams. This Carp is also still intentionally stocked in aquaculture facilities; however, it must be stocked in the **triploid** form, which means it is sterile and unable to reproduce. Some states require a permit to stock the Grass Carp, and stocking is only permitted in ponds to prevent its spread through waterways and river systems.

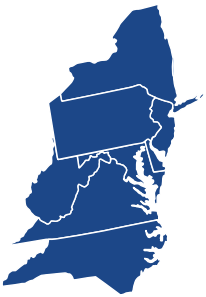
Distribution

Native to eastern Asia, including China and Russia, the Grass Carp was introduced in many countries to help control the growth of aquatic weeds in aquaculture facilities. It is now widespread in the U.S., including all Mid-Atlantic states. Reproductively sterile triploid Grass Carp can be stocked, with a permit, In Delaware, New Jersey, New York, North Carolina, Pennsylvania, Virginia, and West Virginia. In Maryland, use of **diploid** or triploid Grass Carp is prohibited.

Impacts

While the Grass Carp does help to reduce unwanted aquatic vegetation, it also alters the food web by voraciously feeding on plants that are desirable to native invertebrates and fish, thus reducing their food resources. Excreted plant material can also increase nutrient levels in the water, causing harmful algal blooms and affecting water quality.

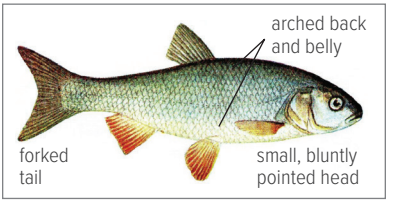
Mid-Atlantic Distribution



Ide

Leuciscus idus

Species at a Glance



The Ide, also called the Orfe, is a large-bodied freshwater fish and member of the Minnow family. It has been introduced in many countries due to its value as a sport fish. Concerns have been raised over its potential to damage native aquatic ecosystems, but more research is needed to determine actual impacts.

Identification

This chunky fish has a distinct arch in the back and belly. The head is small and bluntly pointed, and the tail is forked. Two color forms exist, including the wild form and the ornamental form. The wild form is a grayish-olive color on the back and upper sides, paling to silver on the sides and a silvery-white on the belly. Both **anal** and **pelvic** fins are reddish in color. The ornamental variety has a bright orange back, silver-orange sides and belly, and a bright orange tail and **dorsal fin**. These two color **morphs** are known as Silver and Golden Ides, respectively. Golden populations may revert to wild coloration over time.

Similar Species

This species may be confused with the Rudd (*Scardinius erythrophthalmus*); however, the **pectoral**, pelvic, and anal fins of the Rudd are a distinctive bright reddish-orange color. In addition, the Rudd's iris is yellow to orange, often with a red spot that can cover the pupil, which is absent in the Ide.

Habitat

The Ide prefers to inhabit clear, clean pools of medium-to-large rivers, ponds, and lakes. It retreats into deep holes over winter. The Ide can also tolerate higher levels of salinity, giving it the ability to colonize brackish water and estuarine habitats.

Spread

Valued as an ornamental pond fish, the Ide has been intentionally introduced to new locations for ornamental purposes and angling. Intentional releases and escape by flooding have also allowed this species to move to new locations.

Distribution

Native to Europe, the Ide was first imported in 1877 by the United States Fish Commission. In 1889, an estimated 20 Ide escaped into the Potomac River from fish ponds in Washington, D.C. during a flood event. The Ide is established in the Mid-Atlantic region in the lower Potomac River in Maryland, and it has also been collected in Virginia and West Virginia. Failed populations have also occurred in New Jersey, New York, North Carolina, and Pennsylvania.

Impacts

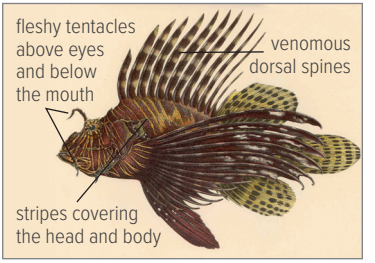
Like other members of the Minnow family, the Ide is a prolific breeder. Large females may contain tens of thousands of eggs. While little is known about the impact of this species, many researchers believe the Ide has the potential to become more of a problem to aquatic ecosystems than either Goldfish or Common Carp.

Mid-Atlantic Distribution

Lionfish

Pterois volitans and P. miles

Species at a Glance



The Red Lionfish (*Pterois volitans*) and the Devil Firefish (*P. miles*) are species of invasive Lionfish that were introduced by humans and are now causing negative impacts on marine ecosystems and reef habitats. Their venomous spines and unique appearance may deter potential predators, making them unrecognizable as prey and allowing their populations to increase.

Identification

Lionfish have distinctive brown or maroon and white stripes covering the head and body that alternate from wide to very thin and sometimes form a V-shape. They have fleshy tentacles above the eyes and below the mouth. Membranes of the fins are often spotted. The **pectoral fins** are fan-like, while the strong, venomous **dorsal** spines are long and separated. The **anal fin** also has sharp venomous spines. Adult Lionfish can grow as large as 46 cm (18 in) while juveniles may be as small as 2.5 cm (1 in) or less.

Similar Species

In their native range, the Red Lionfish and the Devil Firefish can be differentiated by counting the fin rays; however, in

their invasive range, these two species can be virtually identical, and positive identification can only be achieved through genetic analysis. Note: if found, refer to the *Identifying, Reporting, and Collecting* protocols in the introduction of this guide.

Habitat

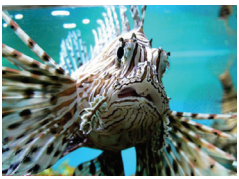
While found in almost all marine habitat types, Lionfish prefer warm marine waters of the tropics. They have been found in water depths from 0.3-305 m (1-1000 ft) on hard bottoms, mangroves, seagrass, coral, and artificial reefs.

Spread

Initial introduction of both species was thought to have occurred during Hurricane Andrew in 1992 when at least six Lionfish escaped from a broken beachside aquarium near Biscayne Bay. The continued release of unwanted Lionfish by aquarium hobbyists is thought to be the cause of additional introductions and the range expansion of the Lionfish.

Distribution

Lionfish are native throughout the South Pacific and Indian oceans, and their native distribution covers a very large area. They were first detected in south Florida waters in 1985 and were documented as established in the early 2000s. They are now well established throughout most of the Caribbean to Cape Hatteras, North Carolina. Juveniles have also been found as far north as New York and Rhode Island, although they are not expected to be able to survive the winter in colder northern waters.



Impacts

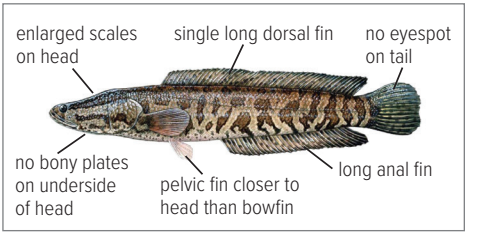
The lack of natural predators is allowing Lionfish to reproduce year-round and quickly increase in abundance. They are voracious predators, consuming over 50 species of fish, including some economically and ecologically important species. They pose a threat to many native reef fish populations through direct predations as well as competition for food and resources. They can also reduce the abundance of herbivorous fishes that keep seaweed and macroalgae from overgrowing corals.

Mid-Atlantic Distribution

Northern Snakehead

Channa argus

Species at a Glance



The Northern Snakehead is a predatory species native to China, Russia, and the Korean peninsula. It possesses an air bladder that works like a primitive lung, allowing it to survive out of water in moist locations for several days. While research is on-going, it is believed to be a potential threat to native aquatic communities through competition and predation.

Identification

The Northern Snakehead has a long, torpedo-shaped body that can grow to a maximum size of 85 cm (33 in). The **dorsal** and **anal fins** are long and continuous, running along the top and bottom of the body and nearly reaching the **caudal fin**. The tail is **truncated**. The scaled head looks like a snake, and the mouth is large with sharp teeth. Coloration is generally tan to black with irregular blotches or spots along the sides.

Similar Species

The Northern Snakehead is often mistaken for the native Burbot (*Lota lota*) and native Bowfin (*Amia calva*). The Burbot is distinguished by a split dorsal fin, a single chin barbel, pelvic fins positioned in front of the pectoral fins, and a long anal fin. The Bowfin is distinguished by a rounded tail, scaleless head, lack of bony plates between the lower jaw bones, pelvic fins at mid-body, and an eyespot near the tail in males. Both species have shorter dorsal and anal fins than the Northern Snakehead. Juvenile Northern Snakeheads may also be mistaken for species of darter.

Habitat

The Northern Snakehead prefers stagnant shallow ponds, swamps, and slow streams with mud or vegetated substrate. It can tolerate low oxygen conditions and survive in waters that are covered in ice.

Spread

Since its discovery in Crofton, MD, in 2002, the Northern Snakehead has spread to all major rivers connected to the Chesapeake Bay and parts of the Delaware River basin. Sale in pet shops, live food-fish markets, uninformed pet release, and religious, cultural, or angler practices may have also contributed to its introduction into the wild. In 2002, the import and interstate transport of the Northern Snakehead was banned without a permit from the U.S. Fish and Wildlife Service.

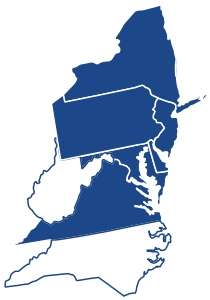
Distribution

Native to China, Korea, and Russia, the Northern Snakehead can now be found in Delaware, Maryland, New Jersey, New York, Pennsylvania, and Virginia.

Impacts

While diet studies show that the Northern Snakehead can compete directly with native species for food and habitat, its impacts remain largely unknown. It is an opportunistic feeder, and may prey directly on native fish, crustaceans, frogs, and small reptiles. There is concern that the Northern Snakehead could be a potential vector for disease transmission, as health screenings of the species in the Potomac River have revealed protozoal, monogenean, and trematode parasites, the presence of Largemouth Bass Virus (LMBV), and mycobacterial infections.

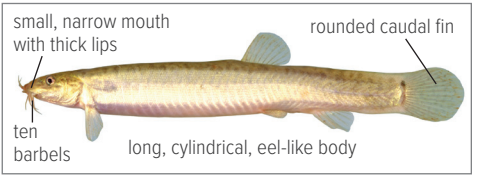
Mid-Atlantic Distribution



Pond Loach

Misgurnus anguillicaudatus

Species at a Glance



The Pond Loach, also called the Dojo and Oriental Weatherfish, 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 Pond Loach 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 fin. The 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 Pond Loach may be confused with species of Lamprey; however, Lamprey are typically thinner 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 Pond Loach can breathe atmospheric oxygen by using its intestine as an accessory respiratory organ, enabling it to live in oxygen-poor waters and bury itself in soft substrates to survive long droughts.

Spread

Commonly used as bait and sold in the aquarium trade, the Pond Loach 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.

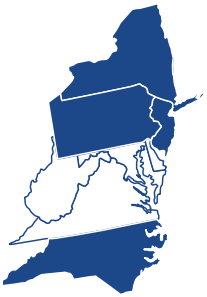
Distribution

Native to Eastern Asia, the Pond Loach 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 drainages in New Jersey, New York, North Carolina, and Pennsylvania in the Mid-Atlantic region.

Impacts

The Pond Loach 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.

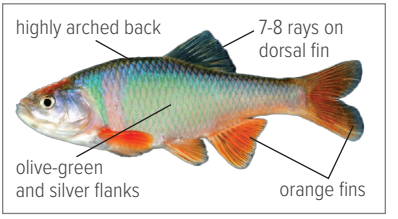
Mid-Atlantic Distribution



Red Shiner

Cyprinella lutrensis

Species at a Glance



The Red Shiner is in the genus *Cyprinella*, which is Greek for "small Carp". While this hardy, widespread Shiner is native to the Midwestern United States, its use as a baitfish has enabled its introduction into habitats outside of its native range.

Identification

The Red Shiner is a deep-bodied species with a highly arched back. Its **flanks** are mixed olive-green and silver, with bright orange fins and a large orange spot that sits between the eyes on its blunt, sloped brow. Spawning males become bluish on the sides and the fins redden. There are 7-8 rays in the **dorsal fin** and 8-10 (usually 9) rays in the **anal fin**. Maximum size is only 9 cm (3.5 in). The Red Shiner can crossbreed with other minnow species, such as the Blacktail Shiner (*Cyprinella venusta*) and the endangered Blue Shiner (*Cyprinella caerulea*), producing hybrids that may also have a faint **caudal** spot.

Similar Species

While easily confused with most other minnows, including the Golden Shiner (*Notemigonus crysoleucas*), the Redfin Shiner (*Lythrurus umbratilis*), the Rudd (*Scardinius erythrophthalmus*), and the Roach (*Rutilus rutilus*), the outstanding characteristics of the Red Shiner are the vibrant orange fins and the orange spot between the eyes.

Habitat

While it's found in a variety of habitats, the Red Shiner prefers silt-disturbed streams and muddy riverbeds where it doesn't have to compete with other minnows for food.

Spread

The Red Shiner was most likely introduced through intentional release from both recreational fishing and more recently, through the aquarium trade. Its extended mating season, coupled with the versatile nature of the eggs, allows this species to spread quickly throughout habitats.

Distribution

The Red Shiner is native to a large portion of the Midwest, reaching from central North Dakota to the southernmost point of Texas along the Mississippi River and its tributaries. Currently, the Red Shiner is established in the Mid-Atlantic region in North Carolina and Virginia.

Impacts

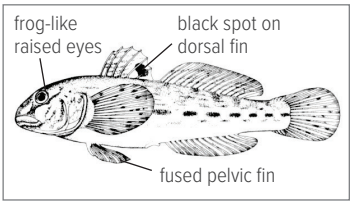
Known to eat small invertebrates, the Red Shiner is in direct competition with native fish and invertebrates for food. The Red Shiner also has adaptive advantages over other cyprinids because it can lay eggs in tight crevices and attach adhesive eggs to rocks and plant life.

Mid-Atlantic Distribution

Round Goby

Neogobius melanostomus

Species at a Glance



The Round Goby is a small, aggressive, bottom-dwelling fish that grows rapidly, reproduces several times in one season, can impact food webs, and competes with native species. Avian botulism outbreaks appear to be 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 fin** that forms one suction cup-shaped fin. Young Round Gobies are a solid slate gray, whereas older gobies are mottled with olive green, black, gray, and brown spots. Spawning males turn almost solid black. It has a soft body and a large round head with very distinctive frog-like raised eyes. On average, it grows 10 -25 cm (3.9-9.8 in) in length.

Similar Species

While the Round Goby looks 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 Freshwater Tubenose Goby (*Proterorhinus marmoratus*), but the Freshwater Tubenose Goby has tubular-shaped nostril extensions and lacks the protruding eyes and the black spot on the first dorsal fin.

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. The Round Goby can occupy a variety of depths and can tolerate a wide range of temperatures, water quality, and oxygen concentrations. It can also survive in brackish water.

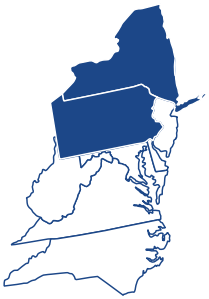
Impacts

The Round Goby is thriving at the expense of native populations, many of which are important sport fish. It outcompetes native species including Sculpin, Logperch, Lake Trout, and Darters for food sources, habitat, and spawning sites. It also spawns more frequently than its native competitors, and feeds directly on their eggs and young.

Spread

The Round Goby was most likely introduced to the Great Lakes through the ballast water of ocean-going cargo ships. Because it resembles small baitfish, boaters and anglers can accidentally carry it from one body of water to another through bait buckets, bilge water, and plant debris. Anglers will also often use the Round Goby as bait.

Mid-Atlantic Distribution



Distribution

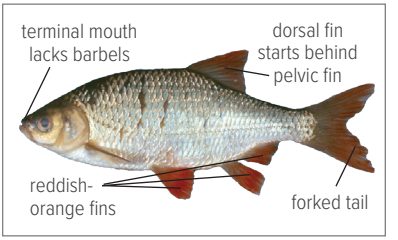
Native to Eurasia, including the Black, Caspian, and Azov seas and tributaries, the Round Goby was first sighted in the St. Clair River in 1990 and has since spread to all of the Great Lakes. It is now working its way inland through rivers and canal systems and can be found in the Mid-Atlantic region in select locations in New York and Pennsylvania.

Rudd

Scardinius erythrophthalmus

Species at a Glance

The Rudd is a medium-sized fish belonging to the Minnow family. It is carnivorous when young, feeding on snails, insects, and small crustaceans, but prefers aquatic vegetation as it ages.



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 that the beginning of its **dorsal fin** is set well behind the front of the pelvic fin. Maximum size is up to 48 cm (19 in) in length.

Similar Species

Young Rudd can be confused with the Golden Shiner (*Notemigonus crysoleucas*); however, adult Rudd can reach much larger sizes. The Rudd has 6-9 scales on the belly, whereas the Golden Shiner has a naked, scale-less 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 Rudd prefers still and sluggish waters in the weedy shoreline areas of lakes and rivers, but it can adapt to a wide range of environmental conditions, including poor water quality.

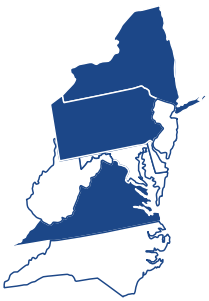
Spread

Due to its similar appearance to the Golden Shiner, Rudd may accidentally be included in shipments to bait dealers. Therefore, bait bucket release by anglers is the primary mechanism by which the Rudd has gained access to open waters.

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 ecosystems.

Mid-Atlantic Distribution



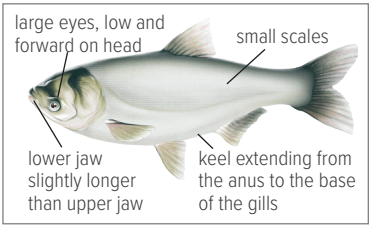
Distribution

Native to Europe and western Asia, the Rudd was most likely 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 21 states. In the Mid-Atlantic region, the Rudd can be found in New York, Pennsylvania, Virginia, and failed populations have occurred in New Jersey and West Virginia.

Silver Carp

Hypophthalmichthys molitrix

Species at a Glance



The Silver Carp is a member of the Invasive Carp complex, which includes Bighead, Black, and Grass Carp. While it is not yet found in the Mid-Atlantic region, its large size, voracious appetite, and ability to leap out of the water make it an enormous threat to the region'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, **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, lacking the irregular dark blotches found on the back and sides of the Bighead Carp. The Bighead Carp 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 nipple-like bumps.

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 Invasive Carp, 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. The Silver Carp also threatens the Mid-Atlantic region by its movement up the Ohio River.

Impacts

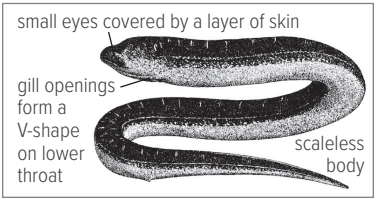
The Silver Carp consumes vast amounts of plankton and detritus each day, competing with native filter feeders and juvenile fish for food. In addition, when startled by boat motors or other equipment, the Silver Carp can leap up to 3 m (10 ft) out of the water, posing a risk of injury to boaters and watersport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

Mid-Atlantic Distribution

Swamp Eel

Monopterus albus

Species at a Glance



The Swamp Eel, also called the Rice Eel, is a member of the Swamp Eel family, Synbranchidae. With the help of specialized gills, it can breathe atmospheric oxygen, allowing it to live in shallow, deoxygenated waters. In addition, the Swamp Eel can reverse its sex, with most maturing as females and some changing to males over time.

Identification

This elongate, snake-like, and cylindrical fish typically has no scales and no **pectoral** or **pelvic fins**. **Dorsal**, **caudal**, and **anal fins** are reduced to folds of skin without fin rays. The head is relatively short, and the teeth are small and not easily seen. Its eyes are small and covered by a layer of skin. The gill openings form a V-shape on the lower throat area. The body and head are dark olive or brown in color above, becoming lighter (often a light orange) below. Some individuals are brightly colored with yellow, black, and gold spots over a light tan, or almost white background. The skin produces a thick mucus layer, making the eel difficult to hold. It may grow as long as 0.9-1 m (3-4 ft) and weigh as much as 1 lb.

Similar Species

The Swamp Eel is most often confused with the American Eel (*Anguilla rostrata*), as well as some species of Lamprey. The American Eel can be distinguished by the presence of pectoral fins, which are absent in the Swamp Eel. Lampreys are best identified by seven small pore-like gill openings. This species may also be confused with other invasive Swamp Eels such as *Ophichthys cuchia* which is similar to *M. albus* in appearance, habitat, and behavior; however, *Ophichthys cuchia* has small scales that are absent in *M. albus*.

Habitat

Ideal habitat for the Swamp Eel is tropical and temperate climates with slowly moving freshwater systems such as agricultural areas, wetlands, muddy ponds, canals, swamps, and rice fields. It is nocturnal and will often burrow into soft, moist sediments where it can survive in low oxygen waters and can even gulp air to survive without water for an extended period.

Spread

While it's unclear exactly how the Swamp Eel was introduced, it was most likely released or escaped from aquariums, fish farms, or through the live fish food market. The Swamp Eel can breathe air, making it possible for it to move across land, although no occurrences of overland travel have been documented.

Distribution

Native to tropical and temperate parts of Southeast Asia, the Swamp Eel was first brought to Hawaii around 1900. Current populations are established in Florida, Georgia, Hawaii, and New Jersey. In 2014, The Swamp Eel was found in Maryland; however, it is not currently established.

Impacts

This species has characteristics that make it very adaptable to new environments. It currently has no known predators in North America; therefore, it has the potential to grow and spread quickly and become widespread in the United States. Because they are a generalized predator, the Swamp Eel is a potential threat to native fish, frogs, and aquatic invertebrates.

Mid-Atlantic Distribution

Invasive Pathogens

Fish are vulnerable to a variety of diseases caused by pathogens such as bacteria, viruses, and fungi, which are a normal part of their environment.

When present at low levels, pathogens do not pose a threat to fish. However, disease outbreaks can occur when fish are stressed by poor diet or sudden environmental changes that weaken the immune system, allowing the pathogens to spread exposed to new pathogens to which the fish has limited immunity.

Hemorrhaging caused by viral hemorrhagic septicemia (VHS) virus

Like human diseases, fish diseases are infectious; once a few fish get sick, the pathogens can spread rapidly in water, from fish to fish, causing large die-offs in the population.

Only a fish disease expert can identify with certainty which pathogen is causing a disease. Diseases may affect fish in different ways, and many of them have similar and overlapping symptoms.

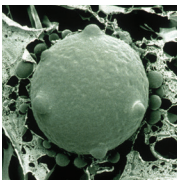
Common warning signs of a fish disease outbreak include:

- Abnormal swimming; swimming in circles or upside down
- Gasping, rapid gill movement; bleeding, eroded, or pale gills
- Skinny body, hollow belly
- Pale body colors
- External cysts, sores, bloodstains; bloody or bulging eyes
- Fungus, often resembling white or yellow fuzz, on body

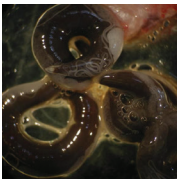
Bulging eyes, a symptom of fish disease

If you see fish exhibiting any of these symptoms, contact state and federal authorities immediately. Refer to the *Identifying, Reporting, and Collecting* protocols in the introduction of this guide for more information on reporting suspected cases.

Common Pathogens

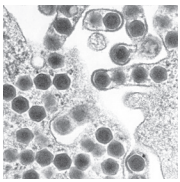


Chytrid Fungus (*Batrachochytrium dendrobatidis [Bd]*): The fungus "Bd" is a member of a phylum of primarily aquatic fungi called Chytridiomycota, some of which are parasitic. Bd infects living amphibians (primarily frogs) and causes the disease known as amphibian chytridiomycosis. This disease is believed to be a major cause of global amphibian declines and extinctions. It is currently found on every continent where amphibians exist and is actively spreading to new populations. This disease interferes with essential processes that allow amphibians to take up water through their skin to breathe. Infected frogs may become lethargic and are often unable to right themselves if turned upside down, and they may jump or swim in circles. In addition, the skin appears bloodshot, and they may sit out in the hot sun when healthy frogs would seek shelter. Some species of frog, such as the African Clawed Frog, appear resistant to the disease, although they can still be carriers and move the fungus to new locations. A second species of Batrachochytrium, *B. salamandrivorans (Bs)*, has emerged as a new amphibian disease agent affecting salamanders in Europe. The U.S. Fish and Wildlife Service has banned the importation of salamanders from Europe to prevent introduction of this disease organism to North American salamander populations.



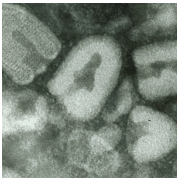
Eel Swimbladder Nematode (*Anguillicola crassus*): Native to Southeast Asia, the Eel Swimbladder Nematode is a small, 3 cm (1.2 in) long parasite that is currently found in the United States in Delaware, Florida, Maryland, New York, North Carolina, and South Carolina. This species uses the Japanese Eel (*Anguilla japonicas*), European Eel (*A. anguilla*) and the American Eel (*A. rostrata*) as hosts. Eggs hatch inside the eels, and as larvae emerge, they are released into the water from the host intestine. Larvae survive in a free-living stage until they are ingested by crustacean intermediate hosts, which are then consumed by the eels. With American Eel populations already declining, the introduction of this nematode may negatively impact its survival. Symptoms include reduced swimming ability, rendering the eel vulnerable to predators, reduced growth rate, and mortality.

Largemouth Bass Virus (LMBV) (*Iridoviridae*): This virus is from the family *Iridoviridae* and is known to cause lethal disease to wild, adult Largemouth Bass (*Micropterus salmonides*) in the eastern United States. Disease usually occurs during warmer months in the summer when bass are physically stressed. When the virus causes disease, symptoms may include increased blood flow and darkened skin, distended abdomen, bloated swim bladder, lesions in the membrane lining the body cavity, pale liver, red spleen, infected gills, lethargic swimming, decreased responsiveness, swimming at the surface and/or in circles, difficulty remaining upright, and death. LMBV is easily transferred from one infected Bass to another and among several other species of fish including Sunfish and Northern Snakehead. The virus has not reportedly caused disease in any other species except Largemouth Bass. Cases of disease and mortality are usually followed by individuals developing antibodies, allowing the population to recover within five to seven years. Many Bass that carry LMBV may never develop disease and appear completely normal. LMBV does not infect warm-blooded species.



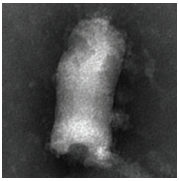
Ranavirus: The genus *Ranavirus* is a genus of highly infectious viruses that are found worldwide and are often lethal to aquatic and terrestrial cold-blooded wildlife. They can cause mass die offs of fish, amphibians (frogs and salamanders), and reptiles (turtles and snakes). While not all species are susceptible, more than 104 species were documented with the virus in 2013. Clinical signs of the disease include swelling of the legs and body, internal **hemorrhaging**, redness of the legs and vent, and discoloration of internal organs. White plaque in the mouth, wheezing, and swollen eyes are additional symptoms that might be present in reptiles. Behavior changes may include lethargy, anorexia, and erratic swimming. Ranaviruses are primarily transmitted by direct contact between a carrier and uninfected individuals. Depending on environmental conditions, the viruses can survive in water for several weeks outside the host, and for shorter periods of time under dry conditions. Drying may also inactivate the viruses, therefore drying recreational boats, trailers, fishing equipment, and other gear after use is important for preventing their spread.

Common Pathogens (continued)

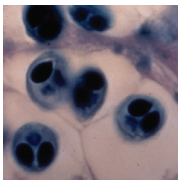


Spring Viremia of Carp (SVC) (*Rhabdovirus carpio*): SVC is a bullet-shaped RNA virus that can cause severe disease outbreaks in members of the Cyprinidae family, such as Common Carp.

SVC usually occurs in the spring when water temperatures are less than 18°C (64°F). Symptoms include bulging eyes; **hemorrhaging** of the skin, gills, and eyes; a bloated appearance; darkening of the skin; and vent protrusion. Diseased fish may appear lethargic, swim and breathe more slowly than normal, and gather at the water inlet or sides of ponds. This highly contagious disease can be spread through contact with feces, urine, gill and skin mucus, and through parasitic invertebrates such as the Carp Louse or Leeches. While fish can carry SVC with or without symptoms, there is no vaccine for the virus and outbreaks can cause high rates of death and substantial economic losses.

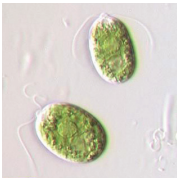


Viral Hemorrhagic Septicemia (VHS) (*Novirhabdovirus sp.*): VHS is a bullet-shaped virus that was discovered in the Great Lakes region as early as 2003, causing significant fish kills in the United States and Canada. Different strains of VHS are present in different regions of the world, with "4b" being the strain impacting the Great Lakes. Symptoms of the disease include bulging eyes, bloated abdomens, darker coloration, unusual behavior, and **hemorrhaging** in the eyes, muscle tissue, skin, gills, and at the base of the fins. Some species of fish are carriers of the virus but show no obvious symptoms. Mortality is highest at water temperatures between 9-12°C (48-54°F) and death rarely occurs at temperatures above 15°C (59°F). VHS is highly contagious and is spread through contact with infected water or from fish to fish. At least 50 species of marine and freshwater fish carry the virus, and survivors can be lifelong carriers.



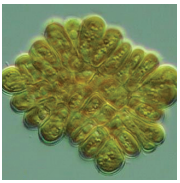
Whirling Disease (*Myxobolus cerebralis*): Whirling Disease is an infection caused by the microscopic parasite *Myxobolus cerebralis*, which impacts members of the Salmonid family. *M. cerebralis* is an invasive species from Europe that can cause fish to swim in a characteristic "whirl" pattern. The parasitic organism has a complex life cycle requiring Tubifex Worms and the Salmonid family of fish to complete. It begins when Tubifex Worms consume spores found in the sediment of river bottoms which develop into a free-swimming form called **Triactinomyxon (TAM)**. TAM spores are released into the water and attach and penetrate through the fish's skin. The TAM spores then multiply rapidly and invade the spinal cord and brain, causing the fish to "whirl". Other symptoms include a blackened tail and deformities of the head and spine. When an infected fish dies, millions of parasite spores can be released into the water to begin the cycle again.

Algae Group Descriptions



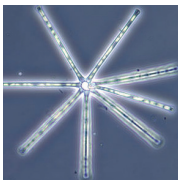
Green Algae (*Chlorophyta*): This large and diverse group of algae can range from small single-celled organisms to large multi-cellular organisms and colonies. They are considered the closest ancestors to the land plants because they share common features, including the **photosynthetic** pigments chlorophyll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

Cyanobacteria (*Cyanophyta*, historically referred to as Blue- Green Algae): 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.

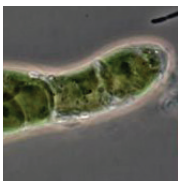


Golden-brown Algae (*Chrysophyta*): Mostly abundant in freshwater, this large group of algae is typically found in waters with a neutral or slightly acidic pH, low conductivity and nutrient levels, and colder temperatures. They are particularly important in lakes, where they may be a primary source of 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.

Black Mat Alga

Lyngbya wollei (Plectonema wollei)

Species at a Glance

Black Mat Alga is a hardy, quickly multiplying, toxic **cyanobacterium** that masquerades as a filamentous blue-green alga. It is considered the prehistoric "beast of water algae" because of its potentially deadly impacts. It forms large benthic and floating mats that have been shown to degrade water quality, aquatic habitats, and produce dangerous toxins.

Identification

Colonies of clustered filaments, usually visible to the naked eye, form dense dark green to black mats along the bottom of the water. These mats remain inconspicuous until they are either dislodged by wave or wind action, or gasses produced during **photosynthesis** become trapped underneath and allow them to float to the surface. The mats start out looking like brown smoke in the water and as they surface, they ball up into the shape of marbles with the texture of coarse hair. The algae filaments are unbranched, untapered, and encased in **sheaths**. Cells have been observed at 2-12 µm in length. While lacking specialized cells, this alga is still able to fix nitrogen from the atmosphere.

Similar Species

Black Mat Alga may be difficult to distinguish from *Phormidium*, which also forms mats that can be dark brown, green, purple, or blue-green. *Phormidium* has short cylindrical cells in a fine sheath. Cells are at least as long as they are wide, and the ends of the cell often taper with a thickened "cap" at the end.

Habitat

While it prefers warm, slightly alkaline waters with abundant nutrients, Black Mat Alga is found in a wide range of habitats, from clear, mineralized, thermally and chemically stable water bodies in Florida, to **turbid** waters with variable nutrients in the St. Lawrence River. It is highly resistant to freezing and cold weather and is also able to survive without light once established.

Spread

Black Mat Alga grows in sediments and rapidly multiplies in warm water. The stringy filaments can cling to fishing gear, boats, trailers, and other recreational equipment and get moved to new locations where mats can persist for several years.

Distribution

Commonly found in ponds and lakes in the southeastern United States, a genetically similar subgroup of algae has been proliferating in the Great Lakes Region and the St. Lawrence River. Many believe Black Mat Algae arrived in these locations because the chemistry and water temperature changed, or it arrived on recreational boats. This alga is also found in locations in New Jersey, North Carolina, Virginia, and the northern Chesapeake Bay area of Maryland.

Impacts

Black Mat Alga is considered a harmful cyanobacterium because of its ability to smother native vegetation, negatively impact fish communities, and produce toxins that are a threat to livestock, dogs, and other animals. In humans, the toxins have caused skin irritations, allergic reactions, gastrointestinal symptoms, and respiratory problems. These toxins are responsible for a musty-earthy taste and odor in water, which can affect aesthetics and recreational water uses. It's also nearly impossible to control with current physical, chemical, and biological tools.

Mid-Atlantic Distribution

Codium

Codium fragile ssp. Tomentosoides

Species at a Glance

Codium, also referred to as the “Oyster Thief”, has been introduced around the world through shellfish aquaculture, recreational boating, and ballast water transport. It will often make its home on the shells of oysters, scallops, and clams, smothering them and causing damage to aquaculture industries. Codium is also a nuisance when it accumulates and rots on beaches, producing a foul odor.

Identification

A large, dark green, branching alga that can reach up to 1 m (3 ft) in length and weigh up to 4 kg (8 lbs.). In wave exposed areas, it tends to be shorter as it undergoes more frequent **fragmentation**. Codium is composed of cylindrical, **dichotomous**, spongy branches that are 3-10 mm in diameter. A spongy **basal** holdfast anchors the plant to hard objects. The cortex of the alga is formed of club-shaped, bladder-like swellings called **utricles** that are tightly compressed together. The alga is upright when small, but droops as it gets larger. Juvenile stages appear as fuzzy, moss-like mats. Codium bleaches white when washed onto shore.

Similar Species

While Codium is often mistaken for a sponge, there are no native sponges in the northwest Atlantic Ocean with a similar appearance to this alga. While it's difficult to distinguish the different subspecies of Codium, it can be done by looking at variations in the size and shape of the utricles.

Habitat

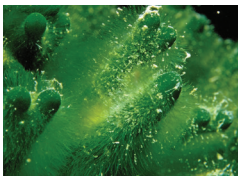
Able to colonize a wide range of environments, Codium tolerates wide variations in salinity and temperature. It prefers sheltered habitats such as harbors, estuaries, and bays and generally prefers to attach itself to hard surfaces such as rocks, ropes, jetties, wharf pilings, and shellfish.

Spread

Codium was most likely introduced through ballast water, hull fouling, aquaculture, and through its use as a packing material for shipping live marine organisms. Once introduced, it has multiple methods of reproduction that can help it establish and spread, including sexual reproduction, **parthenogenesis**, and fragmentation. Water currents can also carry this species over long distances, introducing it to new locations.

Distribution

Native to coastal Japan, Codium has established itself worldwide. On the East Coast of North America, it is found from the Gulf of Saint Lawrence in Canada, down to South Carolina and in all coastal Mid-Atlantic states.



Impacts

Considered a fouling organism, Codium causes problems when it attaches itself to shellfish beds, fishing nets, and other man-made structures. This alga can smother the shellfish it rests upon and can float away with oysters attached to it. It can also impact the benthic environment by making it difficult for invertebrates and fish to move among it and forage on the ocean floor. It has been known to displace native kelp forests and can therefore disrupt the food web in these habitats.

Mid-Atlantic Distribution

Didymo

Didymosphenia geminata

Species at a Glance

Didymo, also called “rock snot,” is a single-celled diatom alga found in the cool waters of northern Europe and North America. Since the mid-1980s, it has begun to take on nuisance characteristics, releasing stalk material when conditions are right that form massive blooms that may negatively impact fish and macroinvertebrate communities.

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-stalked 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 external cell wall is made of silica and is capable of producing the extracellular stalk material that forms thick nuisance mats that can be over 20 cm (8 in) thick. While it appears slimy, it is actually rough to the touch, feeling like wet wool or cotton. Didymo is very difficult to pull apart and detach from rocks.

Similar Species

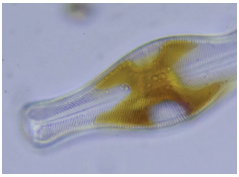
Unlike other species of algae, Didymo does not break apart when rubbed between two fingers, nor does it feel slimy to the touch. Only microscopic examination can confirm the identity of Didymo over other stalk-forming Diatoms such as *Gomphoneis* and *Cymbella*.

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 flowing water or where there is plenty of wave action.

Spread

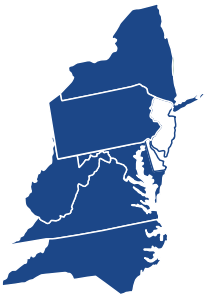
Anglers, kayakers, canoeists, and boaters can spread Didymo on boats, fishing gear, waders, and boots. Felt-soled waders are especially good at transporting Didymo because they can stay wet for longer periods of time, and Didymo can survive outside of a stream in a cool, damp environment for at least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



Impacts

Didymo cells can create large amounts of stalk material that form thick mats on the bottom of rivers and streams. These mats may negatively impact fish and macroinvertebrate communities. While aesthetically unappealing, Didymo does not appear to be a threat to human health.

Mid-Atlantic Distribution



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 varying water quality conditions and has expanded to diverse areas including parts of Canada, New Zealand, and scattered areas in the United States, including New England, Lake Superior, the western United States, and the Mid-Atlantic region in Maryland, New York, North Carolina, Pennsylvania, Virginia, and West Virginia.

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. Toxins produced by this 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 slowly 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 (P) and nitrogen (N) 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 P and N 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 or fur of waterfowl and other animals. Under stressful conditions, Golden Alga can 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. In the Mid-Atlantic, it can be found in North Carolina, West Virginia, and Pennsylvania, where in 2009, Golden Alga caused a massive kill spanning nearly 30 miles of Dunkard Creek along the Pennsylvania-West Virginia border.

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.

Mid-Atlantic Distribution

Red Alga

Gracilaria vermiculophylla

Species at a Glance

Thought to be native and widespread throughout the Northwest Pacific Ocean, Red Alga is primarily used as a precursor for agar, which is widely used in the pharmaceutical and food industries. It is highly tolerant of stress and can grow in a wide variety of conditions, allowing it to outcompete native algae and modify its environment.

Identification

This red macroalga is cartilaginous, cylindrical, and can grow to lengths of 15-100 cm (6-40 in). It is coarsely branched, resembling a wig, with branches around 2-5 mm (0.08-0.2 in) in diameter. It can be found free-floating in the water or attached to small stones or shells. Color varies from brown to gray to red, depending on the availability of sunlight. The male reproductive organs are borne in pits (**conceptacles**) that are usually more than 75 m deep and can be a distinguishing characteristic for identification.

Similar Species

This species may be confused with Brown Algae (Phaeophyceae) and other *Gracilaria* species. *G. gracilis* is a more distinct red, smaller, more delicate, more sparingly branched, and the male conceptacles are usually less than 50 µm deep. Therefore, characterization of reproductive structures is often necessary for correct identification.

Habitat

Red Alga grows in a wide range of temperatures, light intensities, and salinities in both temperate and tropical regions. It is well-adapted to low energy, shallow- bottom bays, lagoons, estuaries, harbors, and inlets where it forms extensive beds and attaches to rocks or pebbles and is often covered with sand and mud. It is also tolerant to stressors such as sedimentation, low nutrients, and desiccation.

Spread

Growing extensively from fragments, Red Alga spreads as fragments hitchhike on recreational equipment such as fishing and boating gear, or as they naturally disperse by water currents. Red Alga is also a highly efficient recruiter around oyster reefs, as it attaches to the shells and can be moved with oyster shipments to new locations.

Distribution

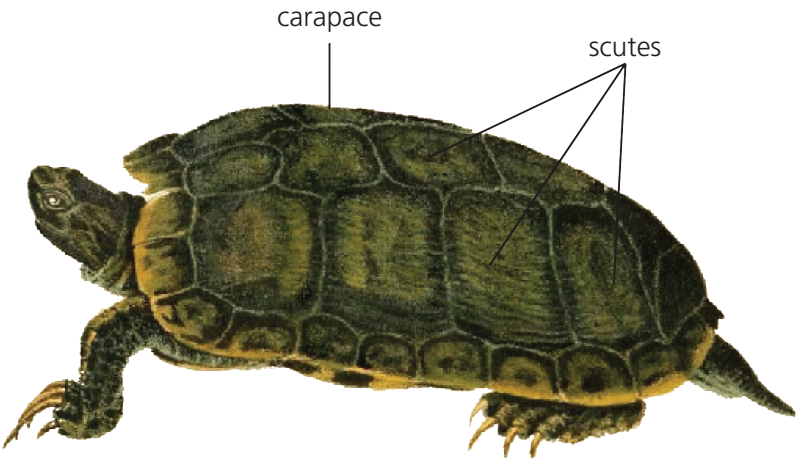
Native to the Northwest Pacific Ocean including areas of Japan and East Asia, Red Alga was first discovered in the Mid-Atlantic region in 2000 in North Carolina. By 2002 it was also found in Virginia growing extensively on gill nets and trawls.

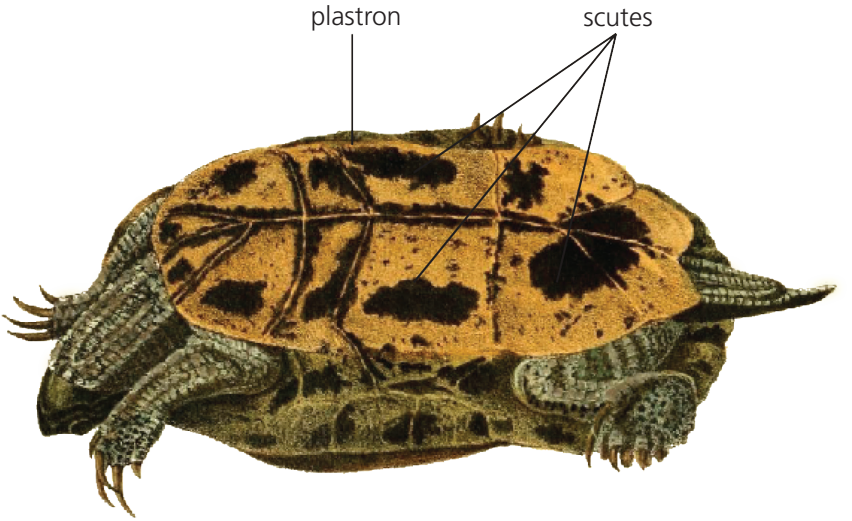
Impacts

Red Alga outcompetes native species of algae, inhibiting their growth and survival. Loose-lying populations can develop into dense mats that modify the habitat available for benthic communities and bottom-dwelling fish. These mats can also decrease light intensity, decrease oxygen, and change the pattern of water movements, which in turn affects sedimentation rate and food availability.

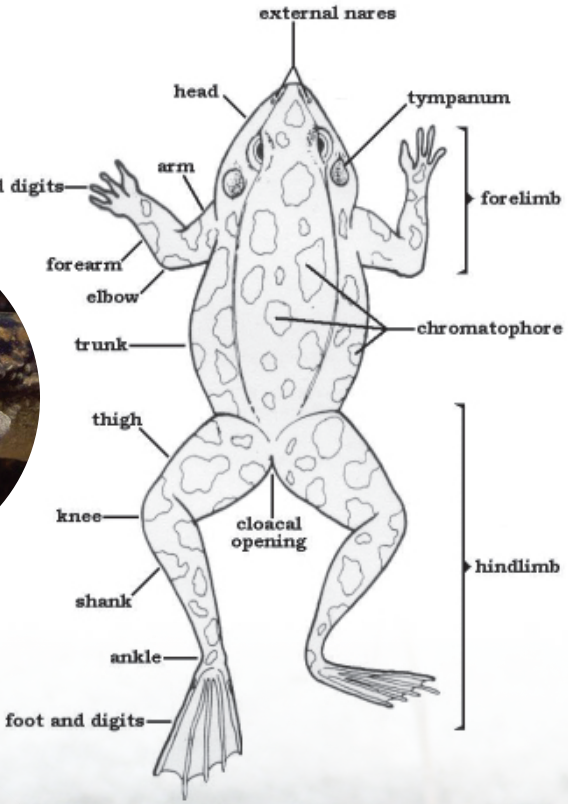
Mid-Atlantic Distribution

Turtle Shell Anatomy





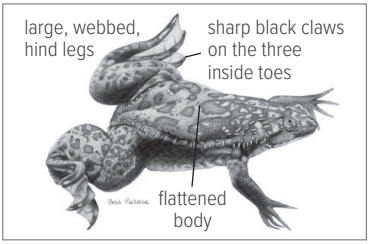
Frog Anatomy



African Clawed Frog

Xenopus laevis

Species at a Glance



The African Clawed Frog is from a unique family of frogs called Pipidae, which lack a tongue and visible ears. It was widely used as an experimental amphibian in laboratories and also became a popular pet species, leading to releases and escapes from captivity that have allowed this highly adaptable species to form invasive populations around the world.

Identification

This plump, medium-sized aquatic frog has a flattened body and a wedge-shaped head that is smaller than the body. Males are 5-6 cm (2.5 in) long and females are larger, reaching 10-12 cm (4 in). Instead of moveable eyelids, this species has a horny transparent covering that protects the small, upward-turned eyes. The front limbs are small with unwebbed fingers, and the hind legs are large with webbed fingers. The three inside toes on the back feet have sharp black claws. The skin is smooth and slippery, except where the **lateral line** gives the appearance of "stitching". It is multicolored on the back with blotches of olive-gray or brown, and the underside is creamy white or yellowish. This frog can change its appearance to match its background; therefore, it can become dark, light, or mottled. A distinguishing characteristic is that males lack a vocal sac. Females also have a **cloacal** extension at the end of the abdomen.

Similar Species

No frog in North America resembles this species.

Habitat

A water-dependent species, the African Clawed Frog occurs in a wide range of habitats, including heavily modified and degraded ecosystems. It prefers stagnant pools and quiet streams and tends to avoid large rivers and water bodies with predatory fish. It can tolerate wide fluctuations in pH; however, metal ions are toxic to it. It leaves the water only when forced to migrate, crawling over long distances to reach other ponds. During dry conditions, this frog can burrow into the mud and lie dormant for up to a year.

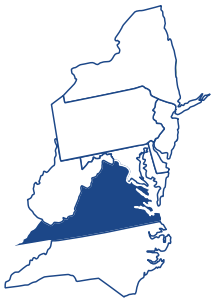
Spread

The African Clawed Frog was introduced as a laboratory test species to be used in pregnancy tests after it was discovered that females would begin laying eggs when injected with a pregnant woman's urine. It was in such high demand that large numbers were bred in captivity, and a significant pet trade developed in the 1960s. It was intentionally released from laboratories around the world when new technologies for pregnancy diagnosis were developed in the late 1950s. Other modes of introduction include intentional releases of unwanted pets and escapes from aquariums, especially because of long lifespan of up to 15 years.

Impacts

The African Clawed Frog has a voracious appetite and will eat anything it catches, including native invertebrates, frogs, fish, and birds, as well as its own tadpoles. It can out-compete native frogs and other aquatic species and can act as a vector for parasites and diseases such as Chytrid Fungus that can be transmitted to native frogs. It can also secrete a skin toxin that may be harmful to predators, including native fish.

Mid-Atlantic Distribution



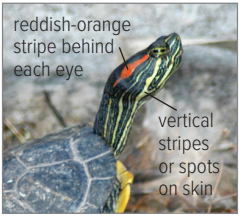
Distribution

Native to southern and western regions of Africa, the African Clawed Frog was shipped around the world in the 1940s and 1950s. In the Mid-Atlantic region, the frog is established in Virginia ponds and has also been collected in North Carolina.

Red-eared Slider

Trachemys scripta elegans

Species at a Glance



The Red-eared Slider gets its name from the red oblong stripes behind each eye. This medium-sized aquatic turtle has been listed as one of the "100 World's Worst Invaders" because of its ability to outcompete native turtles for food, resources, and habitat. Its popularity in the pet trade has helped account for its numerous introductions worldwide.

Identification

A distinctive, broad, reddish-orange stripe runs from behind each eye to the left and right **flanks** of the head. The shell is dark green with yellowish vertical stripes on each **scute**. The skin is olive to brown with vertical yellow stripes or spots. Females typically reach 25-33 cm (10-13 in) in length, whereas males are considerably smaller, reaching 18-23 cm (7-9 in) with a long, thick tail and elongated claws on the front feet. The **plastron** has dark smudges on each of its pale-yellow scutes. Older males often **melanize**, which results in a loss of pattern and color.

Similar Species

The Red-eared Slider is most often confused with the Yellow-bellied Slider (*Trachemys scripta scripta*), which has a yellow vertical stripe behind each eye instead of red. It is also confused with the

native Painted Turtle (*Chrysemys picta*), which can be distinguished by a dark upper shell and vibrantly colored underside that is usually red or orange with black markings.

Habitat

The Red-eared Slider is a hardy freshwater turtle that flourishes in many types of habitats and is frequently seen basking on rocks, logs, masses of vegetation, and banks. It prefers quiet waters such as ponds and wetlands, but will also inhabit slow-moving waterways, brackish waters, or even fairly polluted waters. It can survive the cold of winter by hibernating in the silty, muddy bottoms of lakes and rivers.

Spread

Intentional release by pet owners is the most common vector of spread. Despite a 1975 ban by the U.S. Food and Drug Administration on the sale of Red-eared Sliders less than four inches in **carapace** length, small hatchlings are still available via the Internet or mail order. Adult sliders can reach lengths of up to 30 cm (12 in), and unsuspecting owners are rarely prepared to continue maintaining them in captivity at this size, which often leads to intentional release into the environment.

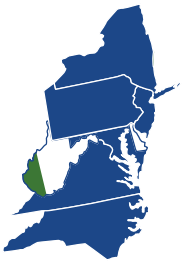
Distribution

The native range of the Red-eared Slider includes the Mississippi River Valley from Illinois south to Louisiana, west to eastern Texas, and east into western Alabama where they begin to integrate with Yellow-bellied Sliders. With the help of humans, this turtle has been introduced into numerous countries around the world and can be found in most Mid-Atlantic states.

Impacts

This aggressive omnivore feeds on fish, plants, insects, amphibians, and other aquatic organisms and their eggs, directly competing with many native aquatic and terrestrial turtles for food, basking areas, and nesting sites. Its ability to survive and reproduce in polluted waters makes it prone to contracting and spreading diseases. In the southeastern Coastal Plain of the United States, **hybridization** with the native Yellow-bellied Slider and the **genetic swamping** of the native gene pool is considered a serious conservation concern.

Mid-Atlantic Distribution



Green - Native Blue - Invasive

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1. Frammanderter. 2006. *Gracilaria vermiculophylla* Fact sheet. <http://www.frammandearter.se/0/2english/pdf/Gracilaria_vermiculophylla.pdf>.
2. Nettleton, J.C., Mathieson, A.C., Thornber, C., Neefus, C.D., and Yarish, C. 2013. Introduction of *Gracilaria vermiculophylla* to New England, USA: Estimated Arrival Times and Current Distribution. Rhodora, 115(961): 28-41.

INVASIVE REPTILES AND AMPHIBIANS:

African Clawed Frog

1. Garvey, N. African Clawed Frog Fact Sheet. University of Michigan Museum of Zoology, Aimal Diversity Web, presented by the Smithsonian National Zoological Park. <https://nationalzoo.si.edu/Animals/ReptilesAmphibians/Facts/FactSheets/Africanclawedfrog.cfm>.
2. Willigan, E. 2011. Introduced Species Summary Project: African Clawed Frog (*Xenopus laevis*). Columbia University in the City of New York. <http://www.columbia.edu/itc/cerc/danoff-burg/invasion_bio/inv_spp_summ/xenopus_laevis.htm>.

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Page 2: Introduction-Sean Kelly, Flickr.

Page 3: Introduction-**close-up**: iNaturalist; **bottom:** Asian Carp Regional Coordinating Committee, Flickr.

Page 5: Regional Challenges-**bottom:** Steve Dewey, Utah State University, Bugwood.org.

Page 8: Prevention-**top:** Cleveland Metroparks

Page 9: Prevention-**logo:** Stop Aquatic Hitchhikers

Page 13: Reporting and Collecting-**Lesser Celandine:** Leslie J. Mehrhoff, University of Connecticut, Bugwood.org; **Asian Shore Crab:** Ken-ichi Ueda, iNaturalist.org, Eol.

Page 15: Reporting and Collecting-Daniel Balakov, iStock.

INVASIVE AQUATIC PLANTS:

Page 16: Plant structure diagram-UFL CAIP.

Page 17: Plant structure diagram-UFL CAIP.

Page 18: Brazilian Elodea-**background:** Leslie J. Mehrhoff, University of Connecticut (BW); **line art:** University - Florida/IFAS Center for Aquatic Plants

Page 19: Brazilian Elodea-**U.S. map:** USDA PD; **top:** Richard Old, XID Services Inc. (BW)

Page 20: Brittle Naiad-**background and line art:** Robert H. Mohlenbrock. USDA NRCS, 1995, Northeast wetland flora: Field guide to plant species. Provided by USDA NRCS Wetland Science Institute (WSI), Chester.

Page 21: Brittle Naiad-**top:** Leslie J. Mehrh-f, IPANE, USGS NAS; **U.S. map:** USDA PD.

Page 22: Common Frog-bit-**background:** Leslie J. Mehrhoff, University of Connecticut (BW); **line art:** UFL CAIP.

Page 23: Common Frog-bit-**top:** Leslie J. Mehrhoff, University of Connecticut (BW); **U.S. map:** USDA PD; **bottom:** Louis M. Landry 2006.

Page 24: Common Salvinia-**background:** Barry Rice, Calphotos (EOL); **line art:** UFL CAIP

Page 25: Common Salvinia-**U.S. map:** USDA PD; top: Barry Rice, Calphotos (EOL).

Page 26: Creeping Water-primrose-**background:** Barry Breckling, Calphotos (EOL); **line art:** USDA NRCS, Wetland flora: Field -fice illustrated guide to plant species.. Provided by NRCS National Wetland Team._Accessed by USDA plants database.

Page 27: Creeping Water-primrose-**top:** Smithsonian Institution (EOL); **U.S. map:** USDA PD.

Page 28: Curly Leaf Pondweed-**background:** Chris Evans, River to River CWMA (BW); **line art:** Accesed from USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora - the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 29: Curly Leaf Pondweed-**top:** Richard Old, XID Services, Inc. (BW); **U.S. map:** USDA PD.

Page 30: Eurasian Watermilfoil-**background:** Richard Old, XID Services, Inc. (BW); **line art:** University - Florida/IFAS Center for Aquatic Plants.

Page 31: Eurasian Watermilfoil-**top:** Richard Old, XID Services, Inc. (BW); **U.S. map:** USDA PD.

Page 32: European Water Clover-**background:** John Hilty, Illinois Wildflowers (EOL); **line art:** Accessed from USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 33: European Water Clover-**top:** Leslie J. Mehrhoff, University of Connecticut (BW); **U.S. map:** USDA PD.

Page 34: Fanwort-**background:** Troy Evans, Eastern Kentucky University (BW); **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora - the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 35: Fanwort-**top:** Leslie J. Mehrhoff, University of Connecticut (BW); **U.S. map:** USDA PD.

Page 36: Giant Salvinia-**background:** Devin Oehler, iNaturalist, EOL; **line art:** UF CAIP.

Page 37: Giant Salvinia-**top:** Barry Rice, Calfphotos (EOL); **U.S. map:** USDA PD.

Page 38: Hydrilla-**background:** Chris Evans, River to River CWMA (BW); **line art:** UF CAIP.

Page 39: Hydrilla-**top:** Tim Krynak, Cleveland Metroparks, Bugwood.org; **U.S. map:** USDA PD.

Page 40: Mudmat-**background and close-up:** Colette Jacono, USGS, accessed by USGS NAS; **line art:** Patty Wellington, Erie, PA.

Page 41: Mudmat-**top:** Colette Jacono, USGS, accessed by USGS NAS; **U.S. map:** USGS NAS; **bottom:** Connecticut Agricultural Experiment Station.

Page 42: Parrot Feather-**background:** Alison Fox, University of Florida (BW); **line art:** UF CAIP.

Page 43: Parrot Feather-**top:** Kerry Dressler, UF CAIP; **U.S. map:** USDA PD; **bottom:** Nancy Loewenstein, Auburn University (BW).

Page 44: Pink Lotus-**background:** Nick Kurzenko, Calphotos; **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 45: Pink Lotus-**top:** iNaturalist; **U.S. map:** USDA PD.

Page 46: Pond Water-starwort-**background:** Harry Rose, Flickr; **line art:** Biodiversity heritage library (EOL).

Page 47: Pond Water-starwort-**top:** Harry Rose, Flickr; **U.S. map:** USDA PD; **bottom:** WMC.

Page 48: Two-horned Trapa-**background:** Nick Newberry, iNaturalist; **line art:** Amanda Wray.

Page 49: Two-horned Trapa-**top:** Nancy Rybicki, USGS, USGS NAS; **U.S. map:** USDA PD.

Page 50: Water Chestnut-**background:** Leslie J. Mehrhoff, University of Connecticut (BW); **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora - the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 51: Water Chestnut-**top:** Accessed by USDA PD: Steve Hurst. Provided by ARS Systematic Botany and Mycology Laboratory; **U.S. map:** USDA PD.

Page 52: Water Hyacinth-**background:** Sandino Guerrero, iNaturalist.org (EOL); **line art:** WMC.

Page 53: Water Hyacinth-**top:** Ivo Antusek, Biolib.cz (EOL); **U.S**. **map:** USDA PD.

Page 54: Water Lettuce-**background:** Reinaldo Aguilar, Flickr (EOL); **line art:** WMC.

Page 55: Water Lettuce-**top:** Forest and Kim Starr, Biolib.cz (EOL); **U.S. map:** USDA PD.

Page 56: Waterwheel-**background** and **line art:** WMC.

Page 57: Waterwheel-**top:** WMC; **U.S. map:** USDA PD.

Page 58: Yellow Floating Heart-**background:** JC Shou, Biopix Nature Photos (EOL); **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society.

Page 59: Yellow Floating Heart-**top:** Rob Andress, Alabama DCNR (BW); **U.S. map:** USDA PD.

Page 60: Yellow Iris-**background:** Leslie J. Mehrhoff, University of Connecticut (BW); **line art:** Accessed by USDA PD: USDA NRCS, Wetland flora: Field office illustrated guide to plant species.. Provided by NRCS National Wetland Team.

Page 61: Yellow Iris-**top:** H.Zell University - North Carolina Extension; **U.S. map:** USDA PD; **bottom:** Nancy Loewenstein, Auburn University (BW).

INVASIVE WETLAND PLANTS:

Page 62: Alligatorweed-**background:** WMC; **line art:** USDA PD.

Page 63: Alligatorweed-**top** and **U.S. map:** USDA PD.

Page 64: Asiatic Sand Sedge-**background:** Leslie J. Mehrh-f, University - Connecticut, Bugwood.org; **line art:** plant.ac.cn.

Page 65: Asiatic Sand Sedge-**top:** Leslie J. Mehrh-f, University - Connecticut, Bugwood.org; **U.S. map:** USDA PD.

Page 66: Beach Vitex-**background:** Ahmad Fuad Morad, Flickr (EOL); **labeled image:** David Eickhoff, Flickr (EOL).

Page 67: Beach Vitex-**top:** Forest and Kim Starr, Biolib.cz (EOL); **U.S. map:** USDA PD.

Page 68: Common Reed (Phragmites)-**background:** Richard Old, XID Services, Inc. (BW); **line art:** Acessed by USDA PD: USDA NRCS, Wetland flora: Field -fice illustrated guide to plant species.. Provided by NRCS National Wetland Team.

Page 69: Common Reed (Phragmites)-**top:** Ken Chamberlain, The Ohio State University (BW); **U.S. map:** USDA PD; **bottom:** John M. Randall, The Nature Conservancy (BW).

Page 70: Flowering Rush-**background:** Leslie J. Mehrhoff, University of Connecticut (BW); **line art:** UF CAIP.

Page 71: Flowering Rush-**top** and **bottom:** Leslie J. Mehrhoff, University of Connecticut (BW); **U.S. map:** USDA PD.

Page 72: Garlic Mustard-**background:** Rob Routledge, Sault College (BW); **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora - the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 73: Garlic Mustard-**top:** Steven Katovich, USDA Forest Service (BW); **U.S. map:** USDA PD.

Page 74: Giant Hogweed-**background:** Donna R. Ellis, University - Connecticut, Bugwood.org; **line art:** Lamarck, J., & Bonnier, G. (1993). Apiacées (Ombellifères). La Grande Flore en Couleurs du Nord de la France et de la Belgique: Clé des genres et espèces (pp. 1–64).

Page 75: Giant Hogweed-**top:** Terry English, USDA APHIS PPQ, Bugwood.org; **U.S. map:** USDA PD.

Page 76: Giant Knotweed-**background:** Tom Heutte, USDA Forest Service (BW); **line art:** Patty Wellington, Erie PA.

Page 77: Giant Knotweed-**top:** Thurston County Washington Noxious Weed Control Agency; **U.S. map:** USDA PD; **bottom:** Tom Heutte, USDA Forest Service (BW).

Page 78: Japanese Hop-**background:** Leslie J. Mehrhoff, University of Connecticut (BW); **line art:** Patty Wellington, Erie, PA.

Page 79: Japanese Hop-**top:** Leslie J. Mehrhoff, University of Connecticut (BW); **U.S. map:** USDA PD; **bottom:** Chris Evans, River to River CWMA (BW).

Page 80: Japanese Knotweed-**background:** David J. Moorhead, University of Georgia (BW); **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora - the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 81: Japanese Knotweed-**top:** Leslie J. Mehrhoff, University of Connecticut (BW); **U.S. map:** USDA PD.

Page 82: Japanese Stilt Grass-**background:** David J. Moorhead, University of Georgia (BW); **line art:** Accessed by USDA PD: USDA NRCS, Wetland flora: Field office illustrated guide to plant species. Provided by NRCS National Wetland Team.

Page 83: Japanese Stilt Grass-**top:** Steve Hurst, USDA NRCS PD (BW); **U.S. map:** USDA PD; **bottom:** Chuck Bargeron, University of Georgia (BW).

Page 84: Lesser Celandine-**background:** Leslie J. Mehrhoff, University of Connecticut (BW); **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 85: Lesser Celandine-**top:** Leslie J. Mehrhoff, University of Connecticut (BW); **U.S. map:** USDA PD; **bottom:** Amadej Trnkoczy, Calphotos (BW).

Page 86: Marsh Dewflower-**background:** Suzanne Cadwell, iNaturalist.org (EOL); **line art:** USDA PD.

Page 87: Marsh Dewflower-**top** and **U.S. map:** USDA PD; **bottom:** Suzanne Cadwell, iNaturalist.org (EOL).

Page 88: Mile-a-minute-**background:** Jil M. Swearingen, National Park Service (BW); **line art:** Mary A. Hoffelt, Ohio State University.

Page 89: Mile-a-minute-**top:** Leslie J. Mehrhoff, University of Connecticut (BW); **U.S. map:** USDA PD; **bottom:** USDA APHIS PPQ - Oxford, North Carolina, USDA APHIS PPQ, Bugwood.org.

Page 90: Moneywort-**background:** Malcom Storey, BioImages, The Virtual Field Guide UK (EOL); **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 91: Moneywort-**top** and **bottom:** WMC; **U.S. map:** USDA PD.

Page 92: Narrowleaf & Hybrid Cattails-**background:** Anthony D. White, The Ohio State University, Bugwood.org; **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 93: Narrowleaf & Hybrid Cattails-**top:** Barnes, T.G. and Francis, S.W. 2004. Wildflowers and Ferns of Kentucky, University Press of Kentucky; **U.S. map:** USDA PD.

Page 94: Poison Hemlock-**background:** WMC; **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols. Provided by Kentucky Native Plant Society, New York.

Page 95: Poison Hemlock-**top:** Malcom Storey, BioImages, The Virtual Field Guide UK (EOL); **U.S. map:** USDA PD.

Page 96: Policeman's Helmet-**background:** Udo Schmidt, Flickr (EOL); **line art:** Biodiversity Heritage Library (EOL).

Page 97: Policeman's Helmet-**top** and **U.S. map:** Acessed by USDA PD: Howard, R.A. Provided by Smithsonian Institution, Richard A. Howard Photograph Collection. United Kingdom, England, Kew, Royal Botanic Gardens.; **bottom:** Joe Potter Buttler, iNaturalist (EOL)

Page 98: Purple Loosestrife-**background:** Steve Dewey, Utah State University (BW); **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 99: Purple Loosestrife-**top:** Norman E. Rees, USDA Agricultural Research Service (BW); **U.S. map:** USDA PD; **bottom:** Barry Rice, Sarracenia.com (BW).

Page 100: Reed Canary Grass-**background:** Chris Evans, River to River CWMA (BW); **line art:** Accessed by USDA PD: Britton, N.L., and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.. Provided by Kentucky Native Plant Society, New York.

Page 101: Reed Canary Grass-**top:** Richard Old, XID Services, Inc. (BW); **U.S. map:** USDA PD; **bottom:** Jamie Nielson, University of Alaska Fairbanks, Cooperative Extension Service (BW).

Page 102: Tree-of-heaven-**background:** Regina Karolyi, iNaturalist; **line art:** USDA Plants Database, Wikimedia Commons.

Page 103: Tree-of-heaven-**top:** James 1995, iNaturalist; **U.S. map:** USDA PD.

Page 104: Wavyleaf Basketgrass-**background:** WMC; **line art:** Ursula Scholz, Utah State University.

Page 105: Wavyleaf Basketgrass-**top** and **bottom:** WMC; **U.S. map:** USDA PD.

INVASIVE INVERTEBRATES:

Page 106: Invertebrate anatomy-**crayfish:** Doug Jensen, Minnesota Sea Grant; **snail:** Patty Wellington, Erie, PA.

Page 107: Invertebrate anatomy-**mussel:** Lisa Kanellos, Bivatol.org (EOL); **crab:** Freshwater and marine image bank (EOL).

Page 108: Apple Snails-**background:** Chris Burwell, iNaturalist; **line art:** Zoological Illustrations, Volume III. Author: William Swainson, F.R.S., F.L.S.

Page 109: Apple Snails-**top** and **U.S. map:** USGS NAS.

Page 110: Asian Shore Crab-**background:** Jeff Holmes, iNaturalist.org (EOL); **labeled image:** USGS NAS.

Page 111: Asian Shore Crab-**top:** Chris Alice, iNaturalist; **U.S. map:** USGS NAS.

Page 112: Basket Clam-**background:** Lake George Association; **line art:** Virginia Cooperative Extension, Virginia Tech and Virginia State University.

Page 113: Basket Clam-**top:** Illinois-State University; **U.S. map:** USGS NAS.

Page 114: Chinese Mitten Crab-**background:** WMC; **labeled image:** Illinois-Indiana Sea Grant.

Page 115: Chinese Mitten Crab-**top:** Christophe Defevre, World Register of Marine Species (EOL); **U.S. map:** USGS NAS.

Page 116: Chinese Pond Mussel-**background:** Alexander Mrkvicka (BW); **labeled image:** Femorale (EOL).

Page 117: Chinese Pond Mussel-**top:** Alexander Mrkvicka (BW); **U.S. map:** USGS NAS.

Page 118: Faucet Snail-**background** and **labeled image:** Jan Delsing, Biolib.cz (EOL).

Page 119: Faucet Snail-**top:** Biopix (EOL); **U.S. map:** USGS NAS.

Page 120: Golden Mussel-**background:** Wikipedia Commons; **labeled image:** WMC.

Page 121: Golden Mussel-**top:** Andrea Gantzer, iNaturalist; **U.S map:** cited literature.

Page 122: Green Crab-**background:** iNaturalist.org (EOL); **line art:** Freshwater and marine image bank (EOL).

Page 123: Green Crab-**top:** N. Sloth, Biopix (EOL); **U.S. map:** USGS NAS.

Page 124: Marbled Crayfish-**background:** Wikimedia Commons; **labeled image:** Wikipedia.

Page 125: Marbled Crayfish-**top:** Wikipedia; **U.S. map:** cited literature.

Page 126: Mystery Snails-**background:** Illinois-Indiana Sea Grant; **line art:** Patty Wellington, Erie, PA.

Page 127: Mystery Snails-**top** and **U.S. map:** USGS NAS; **bottom:** Wikimedia Commons.

Page 128: New Zealand Mudsnail-**background** and **line art:** USGS NAS.

Page 129: New Zealand Mudsnail-**top:** Tim Worsfold, World Register of Marine Species (EOL); **U.S. map:** USGS NAS.

Page 130: Quagga Mussel-**background:** Amy Benson, USGS (BW); **line art:** Patty Wellington, Erie, PA.

Page 131: Quagga Mussel-**top:** Michigan Sea Grant; **U.S. map:** USGS NAS.

Page 132: Red Swamp Crayfish-**background:** WCM; **line art:** Chris Benson, Minnesota Sea Grant.

Page 133: Red Swamp Crayfish-**top:** Valter Jacinto, Flickr (EOL); **U.S. map:** USGS NAS.

Page 134: Rusty Crayfish-**background** and **line art:** Jeff Gunderson, Minnesota Sea Grant.

Page 135: Rusty Crayfish-**top:** Cal Vornberger, Animal Diversity, University of Michigan (EOL); **U.S. map:** USGS NAS.

Page 136: Spiny Waterflea-**background:** Brendan Boyd, iNaturalist (EOL); **line art:** Minnesota Sea Grant.

Page 137: Spiny Waterflea-**top:** Michigan Sea Grant; **U.S. map:** USGS NAS; **bottom:** Accessed by EPA Great Lakes Image Archive, Steve Geving, Minnesota Department of Natural Resources.

Page 138: Veined Rapa Whelk-**background:** WMC; **line art:** Femorale (EOL).

Page 139: Veined Rapa Whelk-**top and bottom:** WMC; **U.S. map:** USGS NAS.

Page 140: Virile Crayfish-**background:** G. Berry, iNaturalist.org (EOL); **labeled image:** Dr. Keith Crandall, Accessed by Oregon Sea Grant.

Page 141: Virile Crayfish-**top:** Etienne Falquet, iNaturalist; **U.S. map:** USGS NAS.

Page 142: White Spotted Jellyfish-**background:** WCM; **labeled image:** miloslav petrtyl, Biolib.cz (EOL).

Page 143: White Spotted Jellyfish-**top:** WMC; **U.S. map:** USGS NAS.

Page 144: Zebra Mussel-**background:** Randy Westbrooks, USGS (BW); **line art:** Minnesota Sea Grant.

Page 145: Zebra Mussel-**top:** Thomas F. Nalepa, NOAA; **U.S. map:** USGS NAS.

INVASIVE MAMMALS AND BIRDS:

Page 146: **Feral Hog:** Craig O'Neal, Flickr (EOL).

Page 147: Mute Swan-**background:** Nick Goodrum, Flickr (EOL); **Nutria-inset:** Steve Kendrot, USDA APHIS3.

Page 148: Feral Hog-**background:** WMC; **labeled image:** Brian Gratwicke, Flickr (EOL).

Page 149: Feral Hog-**top:** Smithsonian Wild, Flickr (EOL); **U.S. map:** backcountyattitude.com

Page 150: Mute Swan-**background:** Jiri Duchon, Biolib.cz (EOL); **labeled image:** James Maughn, iNaturalist.org, Flickr (EOL).

Page 151: Mute Swan-**top:** WMC; **U.S. map:** Cornell Lab of Ornithology.

Page 152: Nutria-**background:** Calau00, iNaturalist; **labeled image:** Alex R, iNaturalist.

Page 153: Nutria-**U.S. map:** USGS NAS.

Page 154: Resident Canada Goose-**background:** Eckhard Pecher, ISSG Database (WMC); **labeled image:** ISSG Database (WMC).

Page 155: Resident Canada Goose-**top:** Andreas Trepte, ISSG Database (WMC); **U.S. map:** Terry Sohl, Nature Serve.

INVASIVE FISH:

Page 156: Fish Anatomy-**line art:** Minnesota Sea Grant; **bottom:** Dave Jude, Michigan Sea Grant.

Page 157: Fish Anatomy-**tail shapes:** Patty Wellington, Erie, PA.

Page 158: Alabama Bass-**background:** Fletcher Stone, iNaturalist; **line art:** Creative Market.com.

Page 159: Alabama Bass-**top:** Jeff Garner, iNaturalist; **U.S. map:** USGS NAS.

Page 160: Bighead Carp-**background:** David Riecks, Illinois-Indiana Sea Grant; **line art:** Invasive Species Centre.

Page 161: Bighead Carp-**top:** Ontario Ministry of Natural Resources; **U.S. map:** USGS NAS.

Page 162: Black Carp-**background:** Rob Cosgriff, Illinois Natural History Survey; **line art:** Invasive Species Centre.

Page 163: Black Carp-**top:** Portynki, iNaturalist; **U.S. map:** USGS NAS.

Page 164: Blue Catfish-**background** and **line art:** WMC.

Page 165: Blue Catfish-**top:** WMC; **U.S. map:** USGS NAS.

Page 166: Blue Tilapia and Redbelly Tilapia-Blue Tilapia **line art:** Fishbase; Redbelly Tilapia **line art:** WMC.

Page 167: Blue Tilapia and Redbelly Tilapia-**top:** WMC; Blue and Redbelly Tilapia **U.S. maps:** USGS NAS.

Page 168: Common Carp-**background:** Biopix (EOL); **line art:** Eric Engbretson, U.S. Fish and Wildlife Service (BW).

Page 169: Common Carp-**top:** Biopix (EOL); **U.S. map:** USGS NAS; **bottom:** Miroslav Fiala, Biolib.cz (EOL).

Page 170: Flathead Catfish-**background:** Eric Engbretson, U.S. Fish and Wildlife Service (BW); **line art:** Duane Raver, U.S. Fish and Wildlife Service (BW).

Page 171: Flathead Catfish-**top:** Fishbase; **U.S. map:** USGS NAS.

Page 172: Freshwater Drum-**background:** Nicholas Cowey, iNaturalist; **line art:** Creative Market.com.

Page 173: Freshwater Drum-**top:** Tyler Matrangos, iNaturalist; **U.S. map:** USGS NAS.

Page 174: Freshwater Tubenose Goby-**background:** Miloslav Petrtyl, Biolib.cz (EOL); **line art:** Márton Zsoldos, iNaturalist.

Page 175: Freshwater Tubenose Goby-**top:** WMC; **U.S. map:** USGS NAS; **bottom:** David Jude, Center for Great Lake and Aquatic Sciences.

Page 176: Goldfish-**background:** Jon Sullivan, Biolib.cz (EOL); **line art:** New York State Department of Environmental Conservation.

Page 177: Goldfish-**top:** Biopix (EOL); **U.S. map:** USGS NAS.

Page 178: Grass Carp-**background:** Eric Engbretson, U.S. Fish and Wildlife Service (BW); **line art:** Invasive Species Centre.

Page 179: Grass Carp-**top:** JC Schou, Biopix (EOL); **U.S. map:** USGS NAS.

Page 180: Ide-**background** and **line art:** WMC.

Page 181: Ide-**top:** WMC; **U.S. map:** USGS NAS.

Page 182: Lionfish-**background:** Mark Rosenstein, iNaturalist.org (EOL); **line art:** Freshwater and marine image bank (EOL).

Page 183: Lionfish-**top:** Jiri Duchon, Biolib.cz (EOL); **U.S. map:** USGS NAS.

Page 184: Northern Snakehead-**background:** Brian Gratwicke_FLICKR_EOL images; **line art:** Northern-Snakehead-ID_SusanTrammell_Bugwoodorg@4x_Optimi2.

Page 185: Northern Snakehead-**top:** USGS Archive (BW); **U.S map:** USGS NAS.

Page 186: Pond Loach-**background:** Gourami Watcher (WMC); **line art:** Noel Burkhead, Flickr (EOL).

Page 187: Pond Loach-**top:** New York Department of Environment Conservation Archive (BW); **U.S. map:** USGS NAS.

Page 188: Red Shiner-**background:** Wilddallas, iNaturalist; **line art:** Tom Kennedy, iNaturalist.

Page 189: Red Shiner-**top:** USGS; **U.S. map:** USGS NAS; **bottom:** Marine Discovery (WMC).

Page 190: Round Goby-**background:** Eric Engbretson, U.S. Fish and Wildlife Service (BW); **line art:** Fishbase.

Page 191: Round Goby-**top:** U.S. Fish and Wildlife Service Archive (BW); **U.S. map:** USGS NAS.

Page 192: Rudd-**background:** Michael Kesl, Biolib.cz (EOL); **line art:** Museum of Comparative Zoology, Harvard University.

Page 193: Rudd-**top:** Portynki, iNaturalist; **U.S. map:** USGS NAS; **bottom:** Sean Rafferty, Pennsylvania Sea Grant.

Page 194: Silver Carp-**background:** T. Lawrence, Great Lakes Fishery Commission; **line art:** Invasive Species Centre.

Page 195: Silver Carp-**top:** Dan O'Keefe, Michigan Sea Grant; **U.S. map:** USGS NAS.

Page 196: Swamp Eel-**background:** Drriss, Flickr (EOL); **line art:** Fish Base (EOL).

Page 197: Swamp Eel-**top:** WMC; **U.S. map:** USGS NAS.

INVASIVE PATHOGENS:

Page 198: Fish Pathogens-**top:** U.S. Fish and Wildlife Service; **bottom:** Mohammed Faisal, USGS.

Page 199: Fish Pathogens-**top:** Wisconsin DNR; **bottom:** Dr. Paul Bowser, Cornell University.

Page 200: Common Pathogens-**Chytrid Fungus and Eel-swimbladder Nematode:** WMC.

Page 201: Common Pathogens-**Largemouth Bass Virus:** U.S. Fish and Wildlife Service; **Ranavirus:** WMC.

Page 202: Common Pathogens-**Spring Viremia of Carp and Viral Hemorrhagic Septicemia:** WMC.

Page 203: Common Pathogens-**Whirling Disease:** WMC.

INVASIVE ALGAE:

Page 204: Algae Groups-**Green:** William Bourland (EOL); **Cyanobacteria:** David Patterson (EOL); **Golden-brown:** David Patterson and Bob Anderson (EOL); **Dinoflagellates:** Maria Faust, Smithsonian Institute (EOL).

Page 205: Algae Groups-**Diatoms:** William Bourland (EOL); **Euglenoids:** David Patterson (EOL); **bottom:** New Hampshire Department of Environmental Services.

Page 206: Black Mat Alga-**background:** Rohn, iNaturalist.

Page 207: Black Mat Alga-**U.S. map:** literature cited.

Page 208: Codiuim-**background:** Sarah Carline, iNaturalist.org (EOL).

Page 209: Codium-**top:** Wikipedia; **U.S. map:** literature cited.

Page 210: Didymo-**background:** Matt Shank, Susquehanna River Basin Commission.

Page 211: Didymo-**top:** Jason Cooper, iNaturalist; **U.S. map:** USGS National Water Quality Assessment and EPA Environmental Monitoring Assessment.

Page 212: Golden Alga-**background:** Texas Parks and Wildlife

Page 213: Golden Alga-**top:** Dr. John LaClaire, University of Texas at Austin; **U.S map:** Texas Parks and Wildlife and PFBC golden alga action plan.

Page 214: Red Alga-**background:** N. Sloth, Biopix (EOL).

Page 215: Red Alga-**top:** N. Sloth, Biopix (EOL); **U.S. map:** literature cited.

INVASIVE REPTILES & AMPHIBIANS:

Page 216: **Turtle Shell Anatomy**-Biodiversity Heritage Library.

Page 217: Frog Anatomy-**frog:** Doral Academy Prep Frog dissection guide; **bottom:** John White, 2006, Calphotos, EOL CC.

Page 218: African Clawed Frog-**background:** Todd Pierson, Calphotos (EOL); **line art:** Pieterse, B. Atlas and Red Data of the Frogs of South Africa, Lesotho, and Swaziland.

Page 219: African Clawed Frog-**top:** Brian Gratwicke, Flickr (EOL); **U.S. map:** USGS NAS.

Page 220: Red-eared Slider-**background:** Todd Pierson, 2011, Calphotos, EOL CC; **labeled image:** © John White - Virginia Herpetological Society.

Page 221: Red-eared Slider-**top:** © John White - Virginia Herpetological Society; **U.S. map:** USGS NAS.

Back cover: **Water Hyacinth:** Mauricio Mercante, Flickr (EOL); **Mute Swan:** WMC; **African Clawed Frog:** Animals Wallpapers High Definition website; **Red Swamp Crayfish:** WMC.

Glossary

Achene: Dry, one-seeded fruit that splits to release the seed

Adipose fin: A small, rayless, fleshy dorsal fin present in certain fishes

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

Allometry (Allometric): Growth of part of an organism in relation to the growth of the whole organism or some part of it

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

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

Apex: The tip, point, or peak

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

Asexual reproduction: Mode of reproduction that does not involve meiosis; 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

Basal: of, at, or forming at the base

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

Biserrate: Double serrated

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

Bulblet: A small bulb, or bulb-shaped growth arising from the leaf axil 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

Carpel: a female reproductive structure found in flowering plants

Cationic: a positively charged ion

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: Narrow part of a fish's body to which the caudal or tail fin is attached

Chelae: A pincer-like organ or claw found on some arthropods

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

Cladoceran: Small crustaceans in the order Cladocera which are commonly found in most freshwater habitats

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

Compound leaf: A leaf composed of several leaflets on a common stalk, arranged either palmately or pinnately

Conceptacles: Specialized cavities of marine and freshwater algae that contain the reproductive organs

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

Ctenoid scales: A type of fish scale with a spiny, comb-like edge found in many bony fishes like perch and sunfish

Cyanobacteria: Phylum of bacteria that obtain their energy through photosynthesis

Deciduous: Falling off or shedding at a particular season or stage of growth, such as trees shedding their leaves annually

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

Dichotomous: Divided, or branching into two parts

Dimorphism: The difference in appearance between males and females of the same species

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

Diphycercal: Caudal tail shape; vertebrae extend to the tip of the tail and the tail is symmetrical and expanded

Diploid: Having two complete sets of chromosomes

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

Epilithic: Growing on the surface of a rock

Epiphytic: Growing on another plant

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

Flanks: The side of the body between the ribs and the hips

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

Fronds: Large or leaf-like part of a palm, fern, or similar plant

Fruit: The seed bearing portion of a plant

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

Genetic Swamping: A situation where the genetic makeup of a local population is overwhelmed by gene flow from another population, often leading to the replacement of local genotypes with those of the donor population

Globular: Shaped like a globe or sphere

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

Hemorrhage: A profuse discharge of blood, as from a ruptured blood vessel

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)

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 mixing of different species or varieties of animals or plants to produce hybrids of those species

Inflorescence: A cluster or arrangement of flowers on an axis

Keel: A lateral ridge found on the caudal peduncle of many fast-swimming fishes that provides stability and support to the caudal fin

Labial: Relating to the lips

Lamina: A trap-like organ of a plant

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

Mandible: The bone of the lower jaw

Margin: The edge or border of something

Melanize: To convert into a group of naturally occurring dark pigments called melanin

Mid-vein (Midrib): 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

Morphs: 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

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

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

Obliterate: Invisible or indistinct

Ocrea: A sheath around a stem or node formed by two or more stipules

Operculum: A structure that acts as a lid or covering to close the aperture of a mollusk's shell when the animal is retracted

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

Palmate: Having several lobes (typically 5-7) whose mid-ribs all radiate from one common point

Panicles: A many branched inflorescence

Parthenogenesis (Parthenogenetic): Natural form of asexual reproduction in which growth and development of embryos occur without fertilization

Pelvic fin: Each pair of fins on the underside of a fish's body, attached to pelvic girdle and helping to control direction

Perigynium: A fleshy cup or tube that encloses the female flowers of sedges of the genus Carex

Periostracum: a thin organic coating which is the outermost layer of the shell of many shelled animals

Petiole: A leaf stalk

Pharyngeal: Relating to the pharynx, which is the membrane-lined cavity behind the nose and mouth that connects them to the esophagus

Photosynthesis (Photosynthetic): The process where green plants and some other organisms use sunlight to synthesize foods from carbon dioxide and water

Pinnate: Having leaflets arranged on either side of the stem, typically in pairs opposite each other

Pistils: The female fertilizing organs of a flower

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

Plastron: The ventral surface of a turtle shell

Plumage: a bird's feathers

Prokaryote: A microscopic single-celled organism that has neither a distinct nucleus with a membrane nor other specialized organelles

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

Protozoan: A single-celled microscopic animal of a group of phyla of the kingdom Protista

Quadrifoliate: Having four leaves or leaflets

Receptacle: Thickened part of a stem from which the flower organs grow

Rhizomes: A creeping underground stem

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

Rostrum: A beak-like projection, especially a stiff snout or anterior prolongation of the head in an insect, crustacean, or cetacean

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: A sharply toothed leaf 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

Siphon: Tubular structure found in aquatic organisms, especially mollusks, to move fluids in or out of the body

Spike/Spikelet: A flower or fruit bearing stalk

Spire: A long tapering conical or pyramidal object

Sporocarp: specialized type of structure found in some ferns whose primary function is the production and release of spores

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

Submersed (submerged): 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

Swim bladder: a gas-filled sac present in the body of many bony fishes, used to maintain and control buoyancy.

Telson: The last segment in the abdomen, or terminal appendage in crustaceans, chelicerates, and embryonic insects

Terminal: Situated at the end or extremity

Triactinomyxon: Spores that live in tubifex worms and can infect other fish with whirling disease

Triploid: Containing three homologous sets of chromosomes

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 (turbid): Muddiness 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

Tussock: A small hillock of grassy, or grass-like plant growth

Utricles: A small cell, sac, or bladder-like protuberance in an animal or plant

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.

Zooxanthellae: a yellowish-brown symbiotic dinoflagellate present in large numbers in the cytoplasm of many marine invertebrates

Common Name Index

African Clawed Frog....218
Alabama Bass....158
Alligatorweed....62
Apple Snails....108
Asian Shore Crab....110
Asiatic Sand Sedge....64
Basket Clam....112
Beach Vitex....66
Bighead Carp....160
Black Carp....162
Black Mat Alga....206
Blue Catfish....162
Brazilian Elodea....18
Brittle Naiad....20
Cattails (Narrowleaf & Hybrid)....92
Chinese Mitten Crab....114
Chinese Pond Mussel....116
Chytrid Fungus....200
Codium....208
Common Carp....168
Common Frog-Bit....22
Common Reed (Phragmites)....68
Common Salvinia....24
Creeping Water-primrose....26
Curly-leaf Pondweed....28
Didymo....210
Eel Swimbladder Nematode....200
Eurasian Watermilfoil....30
European Water Clover....32
Fanwort....34
Faucet Snail....118
Feral Hog....148
Flathead Catfish....170
Flowering Rush....70
Freshwater Drum....172
Freshwater Tubenose Goby....174
Garlic Mustard....72
Giant Hogweed....74
Giant Knotweed....76
Giant Salvinia....36
Golden Alga....212
Golden Mussel....120
Goldfish....176
Grass Carp....178
Green Crab....122
Hydrilla....38
Ide....180
Japanese Hop....78
Japanese Knotweed....80
Japanese Stilt Grass....82
Largemouth Bass Virus....201
Lesser Celandine....84
Lionfish....182
Marbled Crayfish....124
Marsh Dewflower....86
Mile-a-minute....88
Moneywort....90
Mudmat....40
Mute Swan....150
Mystery Snails....126
New Zealand Mudsnail....128
Northern Snakehead....184
Nutria....152
Parrot Feather....42
Pink Lotus....44
Poison Hemlock....94
Policeman's Helmet....96
Pond Loach....186
Pond Water-starwort....46
Purple Loosestrife....98
Quagga Mussel....130
Ranavirus....201
Red Alga....214
Red-eared Slider....220
Red Shiner....188
Red Swamp Crayfish....132
Reed Canary Grass....100
Resident Canada Goose....154
Round Goby....190
Rudd....192
Rusty Crayfish....134
Silver Carp....194
Spiny Waterflea....136
Spring Viremia of Carp....202
Swamp Eel....196
Tree-of-heaven....102
Tilapia (Blue and Redbelly)....166
Two-Horned Trapa....48
Veined Rapa Whelk....138
Viral Hemorrhagic Septicemia....202
Virile Crayfish....140
Water Chestnut....50
Water Hyacinth....52
Water Lettuce....54
Waterwheel....56
Wavyleaf Basketgrass....104
Whirling Disease....203
White Spotted Jellyfish....142
Yellow Floating Heart....58
Yellow Iris....60
Zebra Mussel....144

Scientific Name Index

Ailanthus altissima....102
Aldrovanda vesiculosa....56
Alliaria petiolata....72
Alternanthera philoxeroides....62
Anguillicola crassus....200
Aplodinotus grunniens....172
Batrachochytrium dendrobatidis....200
Bithynia tentaculata....118
Branta canadensis....154
Butomus umbellatus....70
Bythotrephes longimanus....136
Cabomba caroliniana....34
Callitriche stagnalis....46
Carassius auratus....176
Carcinus maenas....122
Carex kobomugi....64
Channa argus....182
Cipangopaludina spp.....126
Codium fragile ssp. tomentosoides....208
Conium maculatum....94
Corbicula fluminea....112
Ctenopharyngodon idella....178
Cygnus olor....150
Cyprinella lutrensis....188
Cyprinus carpio....168
Didymopshenia geminata....210
Dreissena bugensis....130
Dreissena polymorpha....144
Egeria densa....18
Eriocheir sinensis....114
Fallopia japonica....80
Fallopia sachalinensis....76
Family ampullariidae....108
Faxonius rusticus....134
Faxonius virilis....140
Glossosigma cleistanthum....40
Gracilaria vermiculophylla....214
Hemigrapsus sanguineus....110
Heracleum mantegazzianum....74
Humulus japonicus....78
Hydrilla verticillata....38
Hydrocharis morsus-ranae....22
Hypophthalmichthys molitrix....194
Hypophthalmichthys nobilis....160
Ictalurus furcatus....164
Impatiens glandulifera....96
Iridoviridae....201
Iris pseudacorus....60
Leuciscus idus....180
Limnoperna fortunei....120
Ludwigia peploides....26
Lyngbya wollei....206
Lysimachia nummularia....90
Lythrum salicaria....98
Marsilea quadrifolia....32
Micropterus henshalli....158
Microstegium vimineum....82
Misgurnus anguillicaudatus....186
Monopterus albus....196
Murdannia keisak....86
Mylopharyngodon piceus....162
Myocastor coypus....152
Myriophyllum aquaticum....42
Myriophyllum spicatum....30
Myxobolus cerebralis....203
Najas minor....20
Nelumbo nucifera....44
Neogobius melanostomus....190
Novirhabdovirus sp.....202
Nymphoides peltata....58
Oplismenus undulatifolius....104
Oreochromis aureus....166
Persicaria perfoliata....88
Phalaris arundinacea....100
Phragmites australis....68
Phyllorhiza punctata....142
Pistia stratiotes....54
Pontederia crassipes....52
Potamogeton crispus....28
Potamopyrgus antipodarum....128
Procambarus clarkii....132
Procambarus virginialis....124
Proterorhinus semilunaris....174
Prymnesium parvum....212
Pterois volitans and P. miles....182
Pylodictis olivaris....168
Ranavirus....201
Ranunculus ficaria....84
Rapana venosa....138
Rhabdovirus carpio....202
Salvinia minima....24
Salvinia molesta....36
Scardinius erythrophthalmus....192
Sinanodonta woodiana....116
Sus scrofa....148
Tilapia zillii....166
Trapa bispinosa....48
Trapa natans....50
Trachemys scripta elegans....220
Typha angustifolia and Typha x glauca....92
Vitex rotundifolia....66
Xenopus laevis....218

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

Sea Grant
PENNSYLVANIA

Mid-Atlantic Panel on
Aquatic Invasive Species