



FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island

November 2017

Variable Milfoil



Size of variable milfoil relative to a penny



Emergent spike with bracts and tiny flowers



The bulk of the plant grows under water



Bracts above the water surface make paddling difficult

Species Description and General Information

Variable milfoil (*Myriophyllum heterophyllum*) is an under water, invasive plant with fine, densely packed, feather looking leaves whorled around a main stem. There are generally 4 to 6 leaves per whorl (5 is common) and each leaf has 5 to 14 pairs of leaflets. Stems range from green to bright red in color, and may be thin and flimsy or thicker like a twig. In summer, plants may exhibit a three- to six-inch emergent spike above the waterline. Specialized leaves (bracts) and flowers grow along this spike. Bracts are tiny, blade-shaped leaves, serrated and longer than the flower. Flowers are small, white and occur in the axils of the bracts. Variable milfoil grows in both still and flowing waters in a variety of substrates at depths from 1 to 5 meters. Plants reproduce by spreading rhizomes (lateral roots), turions, seeds and fragmentation.

Why is Variable Milfoil Considered an Invasive Species?

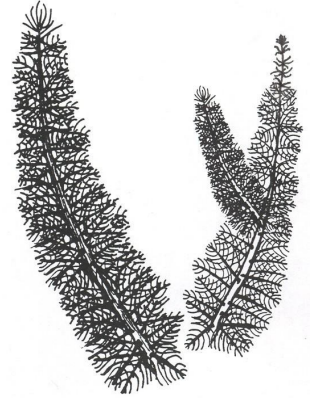
Originally, in its native environment, insects and fish fed on milfoil to control its growth. However, in Rhode Island, milfoil has no natural predators to keep its population in check. Milfoil grows rapidly, and under optimum temperature, light and nutrient conditions, it may grow up to an inch per day. Thick growth of milfoil may degrade water quality and displace beneficial native plants. Dense stands can impede recreation such as swimming, fishing and boating, it can devalue waterfront property, and slow water flow to provide breeding areas for mosquitoes. Milfoil spreads easily by fragmentation and is the most common, wide-spread, aquatic invasive in Rhode Island. Is very difficult to control once it becomes fully established, so it is imperative that it be contained in those lakes where it is a problem, and kept from spreading to other lakes and rivers.

How Did Variable Milfoil Become Established in Rhode Island?

Variable milfoil is native to the Southeastern and Midwestern United States. It was first observed in New England in Bridgeport, CT in 1932 and now is established in every New England state. Initial introductions were most likely from aquarium releases or from "stowaway" fragments attached to a boat or trailer. Milfoil can live out of water for many hours if it remains wet, like when it's wound around a wet carpeted bunk on a boat trailer. Once introduced, milfoil can spread through fragmentation, whereby plant pieces break off from the parent plant through wind or boat action, grow roots and settle in a new location.

What Methods Are Currently Being Used to Control Milfoil?

Hand pulling may be effective to completely remove small patches, however because milfoil reproduces by fragmentation, pulling activities may unintentionally promote the spread of the plant if care is not taken to be sure that all plant fragments are caught and removed. The manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from existing or permitted docks, beaches or swimming areas under the RI Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area or control of larger patches via mechanical cutting or harvesting requires a DEM wetlands permit. However these physical removal methods, such as mechanical harvesting, are generally not recommended for milfoil species because the plant can reproduce by fragmentation. Experience from other states has indicated that infestations of fragmenting species can actually be made worse by mechanical harvesting activities that unintentionally promote the spread of the plant.



Chemical control may be effective for large populations. The DEM Division of Agriculture licenses the applicators that apply federally regulated herbicides to treat invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture. The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator, who can provide treatment options and estimate associated costs. A more detailed survey of the entire water body will likely be needed to assess the severity of the infestation and develop the most effective and cost efficient long-term management plan.

Please Help Prevent the Spread of Variable Milfoil in Rhode Island!

Learn to identify invasive plant species and be on the lookout for new plants in your lake.

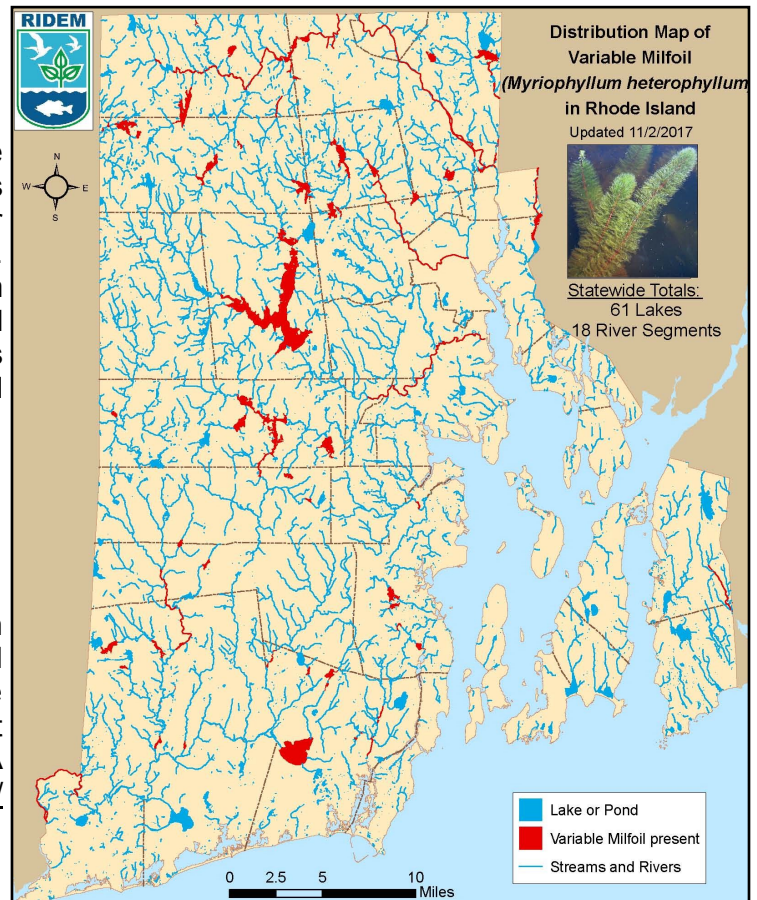
It is much easier and cost effective to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwg/pdfs/identify.pdf>.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Variable Milfoil found in Rhode Island?

As of November 2017, variable milfoil has been documented in 61 lakes or ponds, and 20 rivers and streams. It is the most widespread aquatic invasive plant in the state. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwg/aismaps/myrhet.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island November 2017

Fanwort



Size of fanwort relative to a penny. Two fan shaped leaves are directly opposite from each other on the stem.



Small, white flowers on the tip of the stem emerge from the water in summer, while the remainder of the plant stays below the surface.



Fanwort can grow very tall and dense, taking up most of the water column, from the sediment to the surface.

Species Description and General Information

Fanwort (*Cabomba caroliniana*) is an underwater, invasive plant that can be identified by its bright green leaves, which are divided into fine branches giving them a feathery, fan-like appearance. Two leaves are attached to the stem at the same spot directly opposite from one another. Small, white flowers stick out of the water, between May and September, on short stalks that extend from the tip of the stem. Flower buds on the stalks are surrounded by very small, floating leaves that are linear and entire, differing from the underwater leaves. Fanwort prefers shallow waters (less than 3 meters), but can survive in depths up to 10 meters. Plants thrive in nutrient-rich environments with a low pH and silty substrate and can withstand relatively high levels of turbidity. They do not grow well in alkaline waters with high calcium levels (not common to RI), and hard substrates impede plant growth. Fanwort is rooted (rhizomes), and does produce seeds, but is spread primarily through fragmentation, whereby just a piece of the plant breaks off and can settle in new locations to regenerate without an intact root system.

Why is Fanwort Considered an Invasive Species?

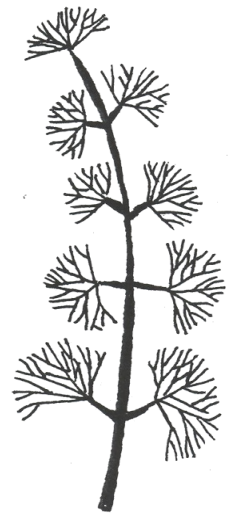
Fanwort is a competitive, quickly growing plant that can easily spread and displace native species. Dense stands of fanwort can interfere with recreational activities such as swimming, boating, paddling and fishing. Heavy infestations can lower the aesthetic quality of the water body and devalue waterfront properties. When dense stands of fanwort die off and decompose, this can lower oxygen levels, creating the potential for fish kills.

How Did Fanwort Become Established in Rhode Island?

Fanwort is native to the southeastern United States and parts of South America. It was likely introduced into natural water bodies in New England as an aquarium plant and was first observed in Rhode Island in 1936. Because plants can reproduce through fragmentation, boats, motors, fishing gear and other equipment used in infested waters that are not properly cleaned can harbor viable plants and spread fanwort to new water bodies. According to USGS, plant fragments that are kept moist can survive 6 to 8 weeks. Therefore, it is extremely important to clean and remove all plant materials from motors, boats, trailers and other gear each time they are taken out of a water body!

What Methods Can Be Used to Control Fanwort?

Because it can reproduce by fragmentation, physical control activities such as cutting or raking may unintentionally promote the spread of fanwort, if care is not taken to remove all of the plant pieces. It is recommended that hand-pulling be limited to small patches when the plant is first discovered and requires immediate removal and eradication. By law, the manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from, existing or permitted docks, beaches or swimming areas under the Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area requires a DEM wetlands permit. The placement of benthic barriers to compress and shade out small patches of fanwort may also provide effective control but is less feasible for larger infestations, and also requires a wetlands permit or permission of the RIDEM Water Quality and Wetlands Restoration Team.



Chemical control may be effective for large populations. The DEM Division of Agriculture licenses the applicators that can apply federally regulated herbicides to treat invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture (see below). The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator who can provide treatment options and estimate the associated costs. A more detailed survey of the entire water body will likely be needed to develop the most effective and cost efficient long-term lake management plan.

Please Help Prevent the Spread of Fanwort in Rhode Island!

Learn to identify invasive plant species and be on the lookout for new plants in your lake.

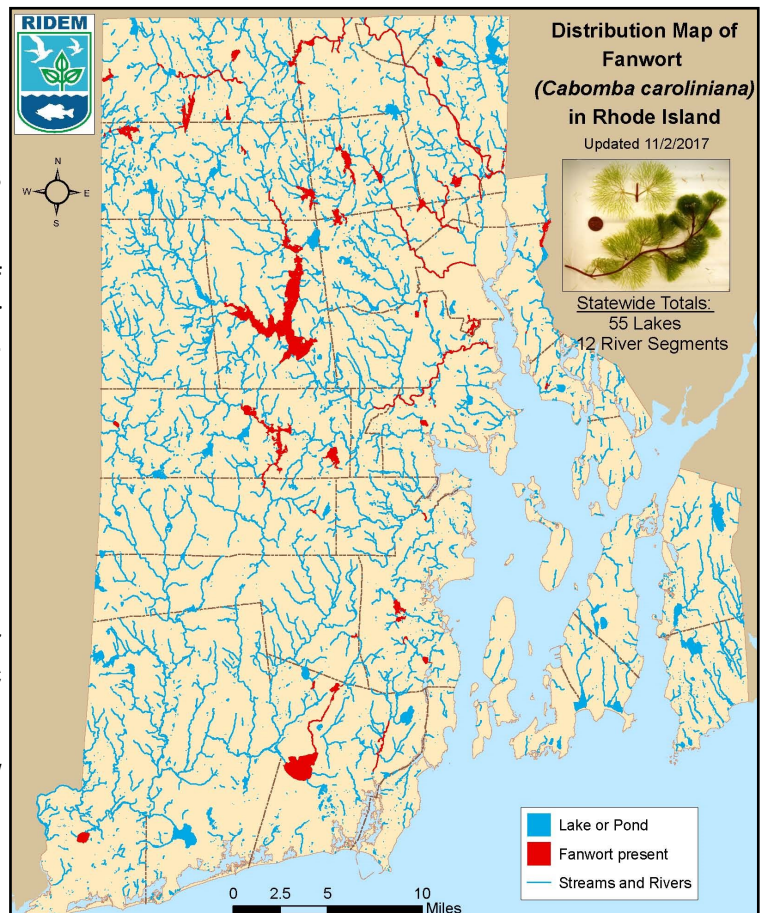
It is much easier and cost-effective to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/identify.pdf>.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is fanwort found in Rhode Island?

As of November 2017, fanwort has been documented in 55 lakes or ponds, and 12 river segments. It is the second most widespread aquatic invasive plant in the state. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aismaps/cabcar.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island

November 2017

Curly-leaf Pondweed



Curly-leaf pondweed leaves have wavy margins like bacon



A picture of curly-leaf pondweed under water, the stand can become very thick



Close-up of the leaf veins, they have a stained-glass appearance

Species Description and General Information

Curly-leaf pondweed (*Potamogeton crispus*) is an underwater plant that can be identified by the wavy margins of its leaves (which are serrated, not smooth). Leaves are arranged alternately along the stem, and stems are branched and flattened. Plants prefer nutrient-rich waters and tolerate varying levels of salinity ranging from fresh to brackish waters. Curly-leaf pondweed is typically found in waters with a depth less than 3 meters but can be found in depths up to 12 meters. Plants fruit and flower in late spring to early summer, then die and begin to decay. Plants typically reproduce through turions (specialized buds) that are produced at the time of flowering and germinate in late summer or fall. Curly-leaf pondweed can also spread through plant fragments that re-root with just a small amount of the plant (no seeds or roots needed to reproduce and spread).

Why is Curly-leaf Pondweed Considered an Invasive Species?

During spring and early summer, curly-leaf pondweed can form dense stands that can restrict access to docks and impede fishing and swimming activities. Invasive pondweeds also compete with native plants and may displace beneficial native vegetation. Since small plants overwinter, it is often one of the first plants to begin growing in the spring, providing it with a competitive advantage. The mid-summer die off and subsequent decomposition of curly-leaf pondweed may recycle phosphorous levels in water bodies, decrease oxygen levels, and produce algae blooms or fish kills. Unsightly decaying plants may also wash up on beaches. Invasives can devalue waterfront property and are costly to control and manage.

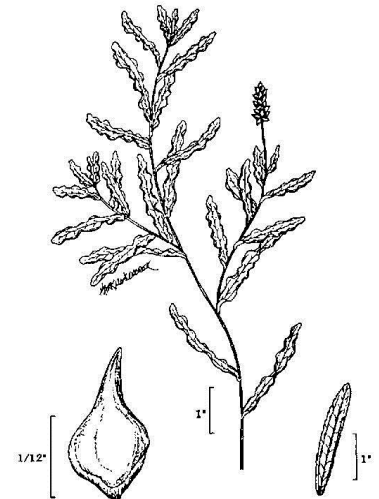
How Did Curly-leaf Pondweed Become Established in Rhode Island?

Curly-leaf pondweed is native to Eurasia, Africa and Australia but is now well established in the continental United States. Initial plants were likely introduced by aquarium hobbyists or in fish hatchery stock. Because plants can reproduce through fragmentation, boats, motors, fishing gear and other equipment that is not properly cleaned can harbor viable plants and spread curly-leaf pondweed into new water bodies. Once introduced into a water body, plants can spread through plant fragments and turions distributed by currents, waterfowl and boats. Because of its tolerance to low light, ability to overwinter under ice and its rapid growth, curly-leaf pondweed can quickly become established in water bodies.

What Methods Can Be Used to Control Curly-leaf Pondweed?

Because it can reproduce by fragmentation, physical control activities such as cutting or raking may unintentionally promote the spread of curly-leaf pondweed. It is recommended that physical control be limited to those areas where the plant is a nuisance and requires immediate relief or to manual hand-pulling of small patches. By law, the manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from, existing or permitted docks, beaches or swimming areas under the Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside of this area or control of larger patches via mechanical cutting or harvesting requires a DEM wetlands permit (or special permission from the Water Quality and Wetlands Restoration Team).

Chemical control may be effective for large populations. The DEM Division of Agriculture licenses the applicators that can apply federally regulated herbicides to treat invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture (see below). The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator who can provide treatment options and estimate the associated costs. A more detailed survey of the entire water body will likely be needed to develop the most effective and cost efficient, long-term management plan.



USDA-NRCS PLANTS
Database / USDA NRCS

Please Help Prevent the Spread of Curly-leaf Pondweed in Rhode Island!

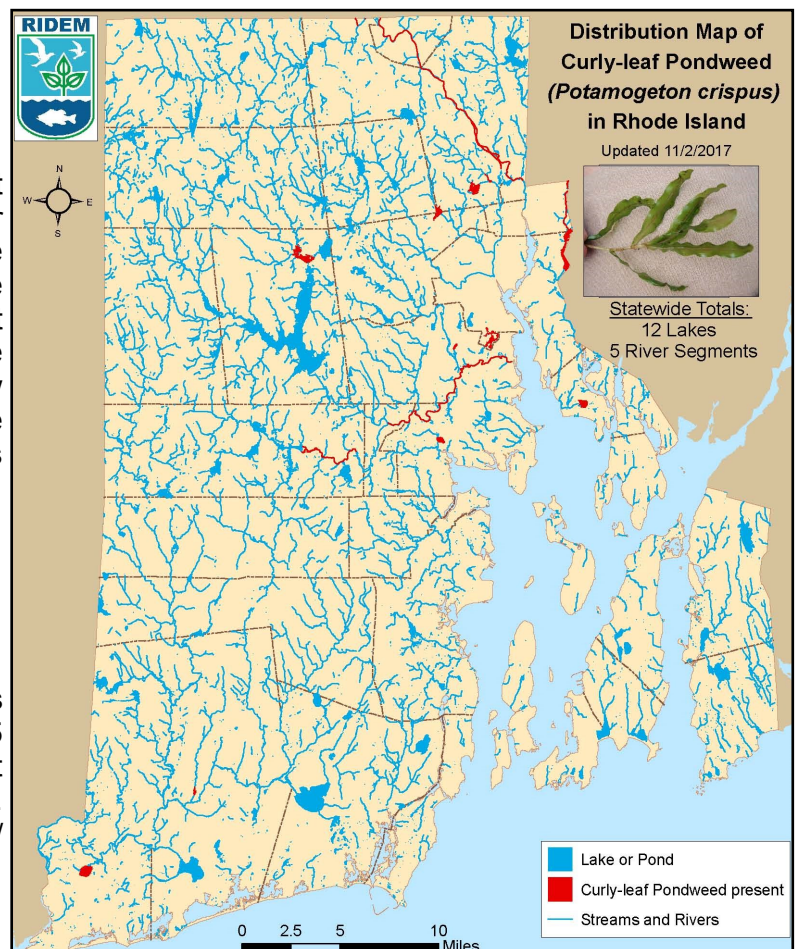
Learn to identify invasive plant species and be on the lookout for new plants in your lake. It is much easier and cost-effective to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/identify.pdf>.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Curly-leaf Pondweed found in Rhode Island?

As of November 2017, curly-leaf pondweed has been documented in 12 lakes or ponds, and 5 river segments. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aismaps/potcri.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island

November 2017

Eurasian Milfoil



In the water, long stems of Eurasian milfoil are very noticeable, stems may be tan or reddish in appearance



Four leaves radiate from the same part of stem in a whorl, and whorls are often spaced out along the stem (left), but can become dense toward the tip of the stem (right)



At the tip, a spike emerges from the water with several very small buds (pinkish here) that become small yellow flowers in summer



Here, many flowering spikes from a large stand of Eurasian milfoil protrude from the water, and trap other small floating plants, algae, and pollen at the surface

Species Description and General Information

Eurasian milfoil (*Myriophyllum spicatum*) is an underwater, rooted invasive plant. Leaves are whorled around the stem in groups of 3 to 6, but 4 leaves per whorl is most common. Leaves are feather divided with 12 to 24 leaflets per leaf. The leaf tips are blunt, giving the appearance that they have been snipped off. Whorls are openly spaced along the stem with 1 to 3 cm in between. Small, yellow flowers appear on an emergent spike in late summer. Plants prefer lakes, ponds and low energy areas of rivers and can tolerate a range of salinities. Plants disperse primarily through fragmentation and through spreading rhizomes (roots).

Why is Eurasian Milfoil Considered a Nuisance Species?

Because plants are tolerant of low water temperatures and grow from roots initiated in the fall, Eurasian milfoil begins its spring growth earlier than other aquatic species. Its ability to create dense, monotypic stands that form canopies over the surface of the water allow it to outcompete and displace native species. Several case studies of Eurasian milfoil introductions reveal a subsequent substantial reduction in native species abundance and diversity. Further, Eurasian milfoil is a poor food source for waterfowl and supports a lower abundance of invertebrates (they serve as a food source for fish). Dense stands impede recreation opportunities such as fishing, boating and swimming and can devalue waterfront property. When plants begin to decompose they can lower the oxygen levels of the water body, creating the potential for fish kills.

How Did Eurasian Milfoil Become Established in Rhode Island?

Eurasian milfoil is native to Europe and parts of Asia and North Africa. It was likely introduced as an ornamental that escaped cultivation, or as an aquarium plant that was dumped into natural water bodies. Because the plant can reproduce through fragmentation, trailers and boating equipment that are not cleaned of plant fragments are a likely means of introduction. Eurasian milfoil maintains a high tolerance for pollutants and easily invades polluted and disturbed areas.

What Methods Can Be Used to Control Eurasian Milfoil?

Physical control through hand pulling or large scale mechanical harvesting are options for milfoil control. However, because Eurasian milfoil can reproduce through fragmentation, physical pulling and cutting may unintentionally disperse plant fragments, exacerbating the infestation. Therefore, physical control is not recommended, except where hand pulling can be monitored for escaped fragments when completely eradicating small, pioneer populations. By law, the manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from existing or permitted docks, beaches or swimming areas under the RI Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area or physical control of larger patches via mechanical cutting or harvesting requires a DEM wetlands permit (contact the RIDEM OWR Water Quality and Wetlands Restoration Team).



Chemical control may be effective for large populations. The DEM Division of Agriculture licenses the applicators that can apply federally regulated herbicides to treat invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture to ensure proper use. The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator, who can provide targeted treatment options and estimate associated costs. A more detailed survey of the entire water body will likely be needed to assess the severity of the infestation and develop the most effective and cost efficient long-term lake management plan.

Please Help Prevent the Spread of Eurasian Milfoil in Rhode Island!

Learn to identify invasive plant species and be on the lookout for new plants in your lake.

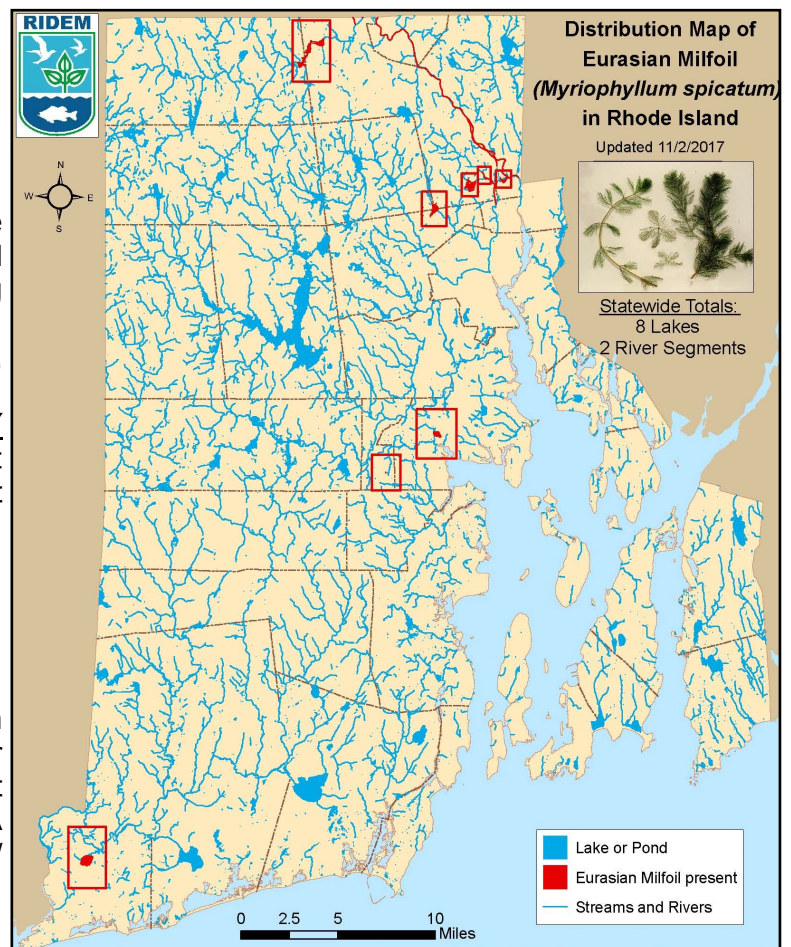
It is much easier and cost-effective to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfqw/pdfs/identify.pdf>.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Eurasian milfoil found in Rhode Island?

As of November 2017, Eurasian milfoil has been documented in 8 lakes or ponds, and 2 river segments. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfqw/aismaps/myrspi.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island

November 2017

Mudmat



Mudmat size relative to a finger tip**



Leaves of mudmat



Dense growth of mudmat †

Species Description and

General Information

Mudmat (*Glossostigma cleistanthum*) is an aquatic plant characterized by tiny leaves rising from stems that grow horizontally below the soil surface. It appears as bright green, turf like patches developing on the muddy substrates of littoral zones. Plants can be both under water and above the surface. Where growth is submerged, the leaves of mudmat range between 0.5-2.5 in long and bear closed, self-fertilizing flowers that are nearly sessile. Leaves grow along the stem in opposite pairs that resemble rabbit ears. If water recedes and plants are emergent, leaves may be much smaller (0.2 to 0.5 in long). Emergent mudmat plants produce insect-pollinated flowers located on short stalks. Seeds, produced in capsules, are present in U.S. populations and are one of the contributing factors in its rapid expansion rate once mudmat is introduced into a water body.

Why is Mudmat Considered an Invasive Species?

Once introduced, mudmat spreads rapidly to cover prime littoral habitat, displace native species and reduce biodiversity. Due to its small size, it is not likely to interfere with recreational lake uses such as boating, swimming, and fishing. However, in areas where plants reach extremely high densities (as many as 25,000 plants per square meter) mudmat is a threat to natural aquatic communities. Due to its affinity for oligotrophic (low nutrient, high water clarity) conditions, this species may be a particular threat to pristine water bodies. These pristine water bodies often contain rare native plants, several of which have been associated with the same habitat where mudmat is commonly found.

How Did Mudmat Become Established in Rhode Island?

Mudmat is a native species of Australia, New Zealand, India and East Africa. The initial introduction of this invasive is thought to be due to an aquarium release. Subsequent movement to new water bodies has been attributed to natural movement throughout watersheds, migrating waterfowl, boating and fishing activities. mudmat was first detected in ponds and reservoirs in Connecticut in 1992 and has since spread to north central New Jersey, Rhode Island and southeastern Pennsylvania. Due to its inconspicuous size, mudmat may have a much more expansive distribution than is currently known and should be closely monitored.

** http://fl.biology.usgs.gov/Nonindigenous_Species/Glossostigma/glossostigma.html

† <http://pest.ceris.purdue.edu/searchpest.php?selectName=PBFQABA>

What Methods Can Be Used to Control Mudmat?

Due to its diminutive size and close association with the sediment, physical removal of plants may prove difficult. By law, the manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from, existing or permitted docks, beaches or swimming areas under the RI Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area or physical control of larger patches via mechanical cutting or harvesting requires a DEM wetlands permit or special permission from the RIDEM Water Quality and Wetland Restoration Team.

Chemical control may be effective for large populations. The DEM Division of Agriculture licenses the applicators that can apply federally regulated herbicides to treat invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture to ensure proper use. The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator, who can provide targeted treatment options and estimate associated costs. A more detailed survey of the entire water body will likely be needed to assess the severity of the infestation and develop the most effective and cost efficient long-term lake management plan.

Please Help Prevent the Spread of Mudmat in Rhode Island!

Learn to identify invasive plant species and be on the lookout for new plants in your lake.

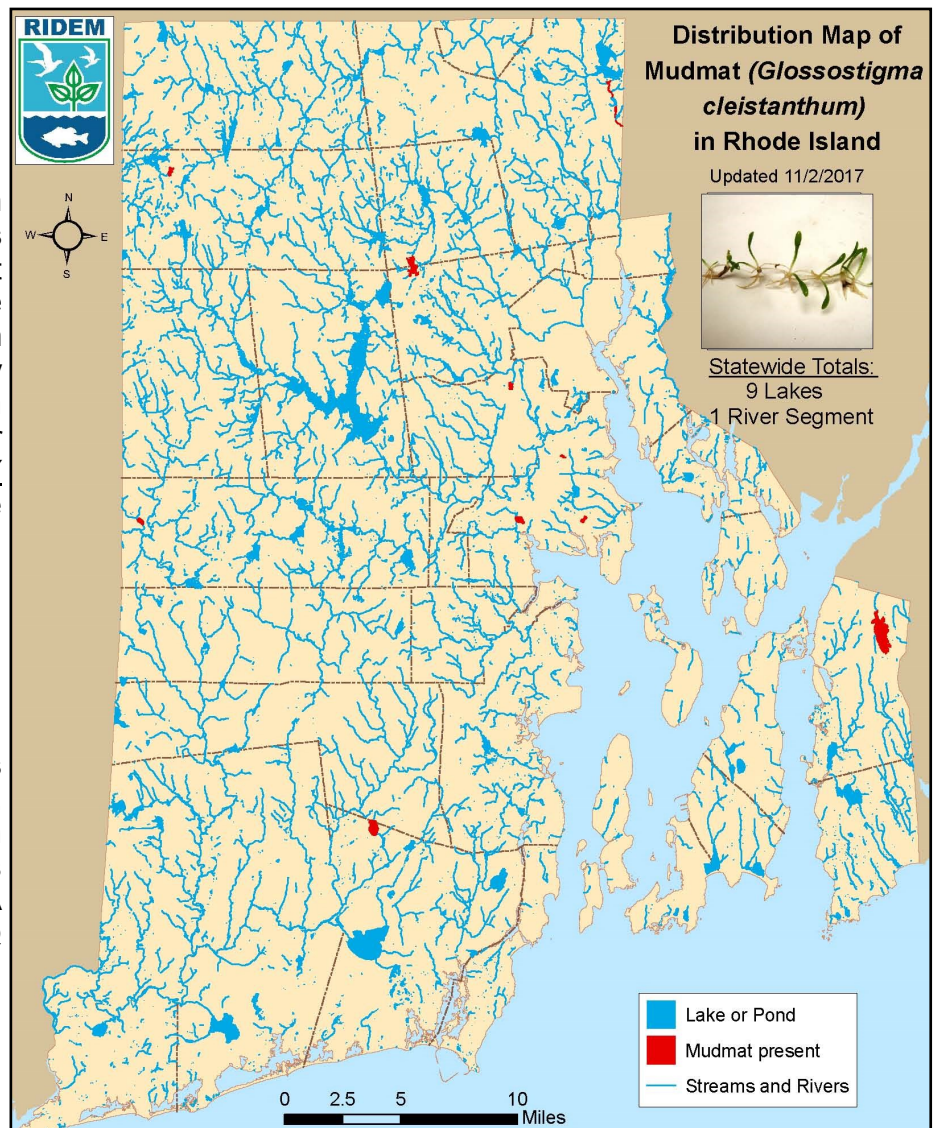
It is much easier and cost-effective to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aisindex.htm>.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Mudmat found in Rhode Island?

As of November 2017, mudmat has been documented in 9 lakes or ponds, and 1 river segment. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aismaps/glocle.pdf>



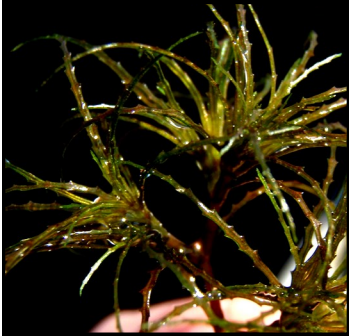


FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island

November 2017

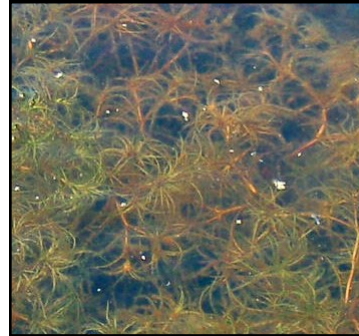
Spiny Naiad



Spiny naiad leaves form “tufts” at the growing tip



Leaves are serrated (dashes indicate $\frac{1}{16}$ inch lines on a ruler)



Plants may grow up to the surface of the water



Spiny naiad plants carpet the bottom of a lake

Species Description and General Information

Spiny naiad (*Najas minor*) is an invasive aquatic plant that is found under water in slow-moving streams, ponds and lakes. Spiny naiad also may be referred to as slender, brittle, European or bushy naiad. Individual spiny naiad leaves are thin and spikey, 1-1.5 in long, and obviously serrated (not smooth) along the side. Leaves are attached to the stem (oppositely, but can appear whorled) and often bunch, forming “tufts” at the growing tip, giving the plant a bushy appearance (like pom-poms). Leaves are stiff and maintain their shape out of the water, arching backwards. Spiny naiad may be confused with native slender naiad, however, the serrations (spines) on spiny naiad are visible to the naked eye, whereas spines on slender naiad are only visible under significant magnification. The heavily-branched stems of the plant may reach up to 4 feet in length. Flowers are very inconspicuous, and emerge from leaf axils during spring and summer, then one-seeded fruits appear in the fall. Spiny naiad is an annual but can spread by fragmentation during the growing season. It is tolerant of turbidity and nutrient-rich conditions.

Why is Spiny Naiad Considered a Nuisance Species?

Once introduced, spiny naiad spreads rapidly and may completely cover the lake bottom, out-competing native plant species for space. It may grow along with other invasive plants, or form dense monotypic (single species) stands. If this plant becomes dominant, it may create conditions that are detrimental to native fish and waterfowl. Spiny naiad may also interfere with recreational activities such as boating, swimming and fishing.

How Did Spiny Naiad Become Established in Rhode Island?

Spiny naiad is native to Europe, and was first introduced to the United States in the 1930s. It has since spread rapidly throughout the Midwest and east coast. Movement to new water bodies has been attributed to natural flow throughout watersheds, migrating waterfowl, boating and fishing activities. The brittleness of this plant allows it to break easily into fragments that may become attached to boats, trailers or equipment. The small seeds can easily become attached to waterfowl or taken up in the bilge water of boats. As a result, spiny naiad infestations can spread very quickly.

What Methods Can Be Used to Control Spiny Naiad?

Because of its ability to spread through fragmentation, physical control is generally not recommended. Hand-pulling may be effective for short-term relief for small patches if all fragments are collected. By law, the manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from, existing or permitted docks, beaches or swimming areas under the RI Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area or physical control of larger patches via mechanical cutting or harvesting may require a DEM wetlands permit (for more information, contact the Water Quality and Wetlands Restoration Team noted below).

Chemical control may be effective for large populations. The DEM Division of Agriculture licenses the applicators that can apply the regulated herbicides to treat invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture to ensure proper use. The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator, who can provide targeted treatment options and estimate associated costs. A more detailed survey of the entire water body will likely be needed to assess the severity of the infestation and develop the most effective and cost efficient long-term management plan.

Please Help Prevent the Spread of Spiny Naiad in Rhode Island!

Learn to identify invasive plant species and be on the lookout for new plants in your lake.

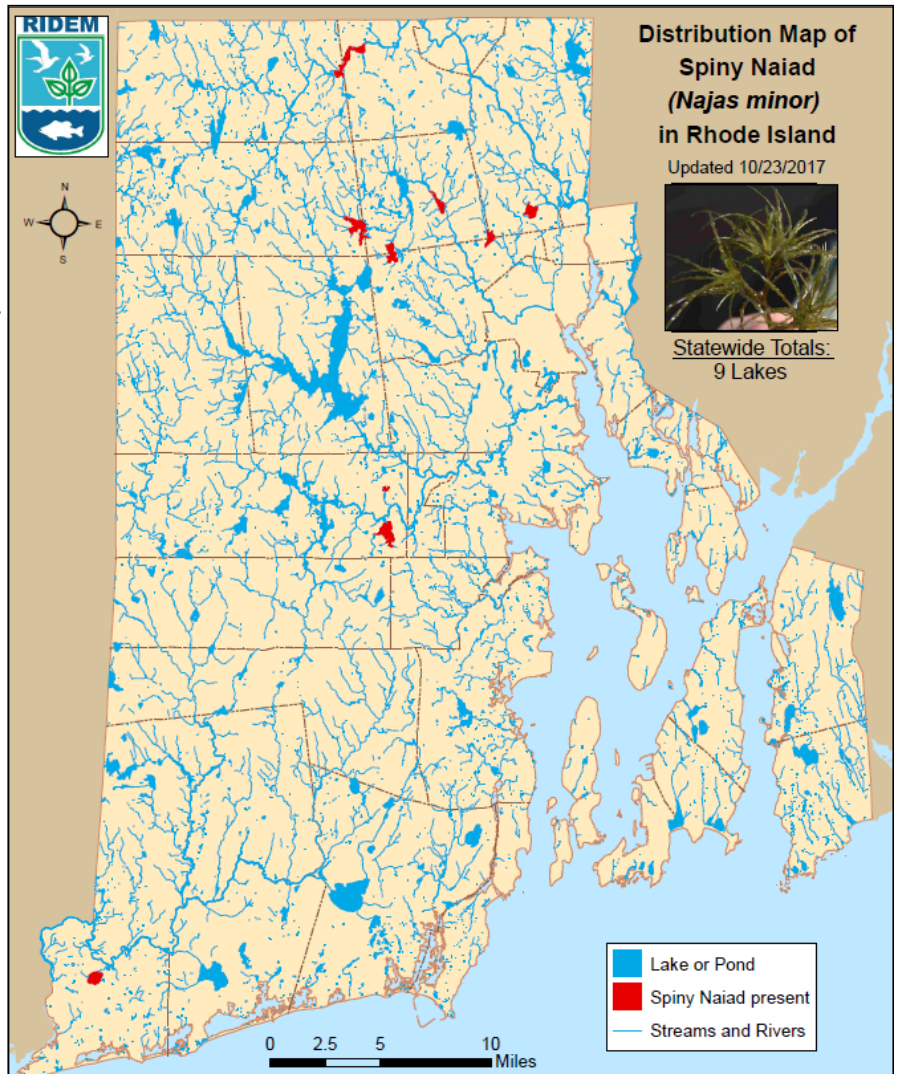
It is much easier to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/identify.pdf>.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Spiny Naiad found in Rhode Island?

As of November 2017, spiny naiad has been documented by the Rhode Island Department of Environmental Management in 9 ponds. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aismaps/najmin.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island November 2017

Water Chestnut



Floating rosette of diamond-shaped leaves (toothed edges)



Spiked fruits of water chestnut with four sharp barbs



Dense floating mat of water chestnut covers water surface

Species Description and General Information

Water chestnut (*Trapa natans*) is a rooted floating aquatic plant with both floating and submerged leaves. Floating leaves are arranged in a rosette pattern attached to the main stem by leaf-stems with air-filled bladders to provide buoyancy. Floating leaves are green, glossy, triangular and toothed. Submerged leaves are alternate and feathery. Flowers are small, white and located in the center of the rosette, blooming only in the morning. The fruit is large and woody and contains four sharp barbs. Fruits appear by late summer and are released as the plants die off with the onset of frost. Seeds remain viable for up to twelve years, though most germinate within two years. Water chestnut prefers soft sediments and quiet, nutrient rich waters.

Why is Water Chestnut Considered a Nuisance Species?

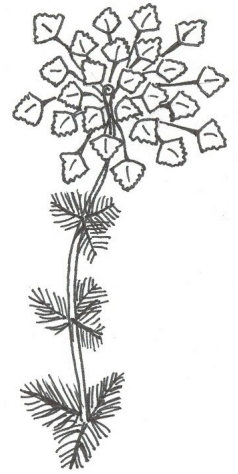
Water chestnut can form dense, floating mats that cover the surface of the water. These mats limit the amount of light available to other aquatic plants, allowing it to quickly displace native species and decrease biodiversity. The decomposition of these mats may lower the dissolved oxygen in the water, creating the potential for fish kills. Dense mats also impede recreation such as boating, fishing and swimming. The USGS reports that many previously fished bays in Lake Champlain are now completely inaccessible as a result of a severe water chestnut infestation. The barbed fruits wash up along the shoreline posing a hazard for humans and pets.

How Did Water Chestnut Become Established in Rhode Island?

Water chestnut was introduced to New England from Asia as an ornamental plant that spread into natural water bodies. Water chestnut was first observed in Rhode Island in 2007 in Belleville Pond, North Kingstown and several subsequent infestations are currently known. Once introduced into a water body, water chestnut can establish and spread rapidly. Each seed may produce 10 to 15 rosettes and each rosette may produce 15-20 seeds. Plants disperse primarily through seeds but also by rosettes that detach from their stems, float to another area and drop their seeds.

What Methods Can Be Used to Control Water Chestnut?

Because it is an annual, water chestnut management is most effective through physical control. Hand pulling is effective for small populations. Because seeds can remain viable for up to 12 years, yearly monitoring of pulled water bodies is necessary. Water chestnut can spread rapidly. Thus, early detection and rapid response to infestations is important. Severe infestations may require large scale mechanical harvesting. By law, the manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from, existing or permitted docks, beaches or swimming areas under the Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area or physical control of larger patches via mechanical cutting or harvesting requires a DEM wetlands permit.



Chemical control may be effective for large populations. The DEM Division of Agriculture licenses the applicators that can apply federally regulated herbicides to treat invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture. The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator who can provide treatment options and estimate the associated costs. A more detailed survey of the entire water body will likely be needed to develop the most effective and cost efficient long-term management plan.

Please Help Prevent the Spread of Water Chestnut in Rhode Island!

Learn to identify invasive plant species and be on the lookout for new plants in your lake.

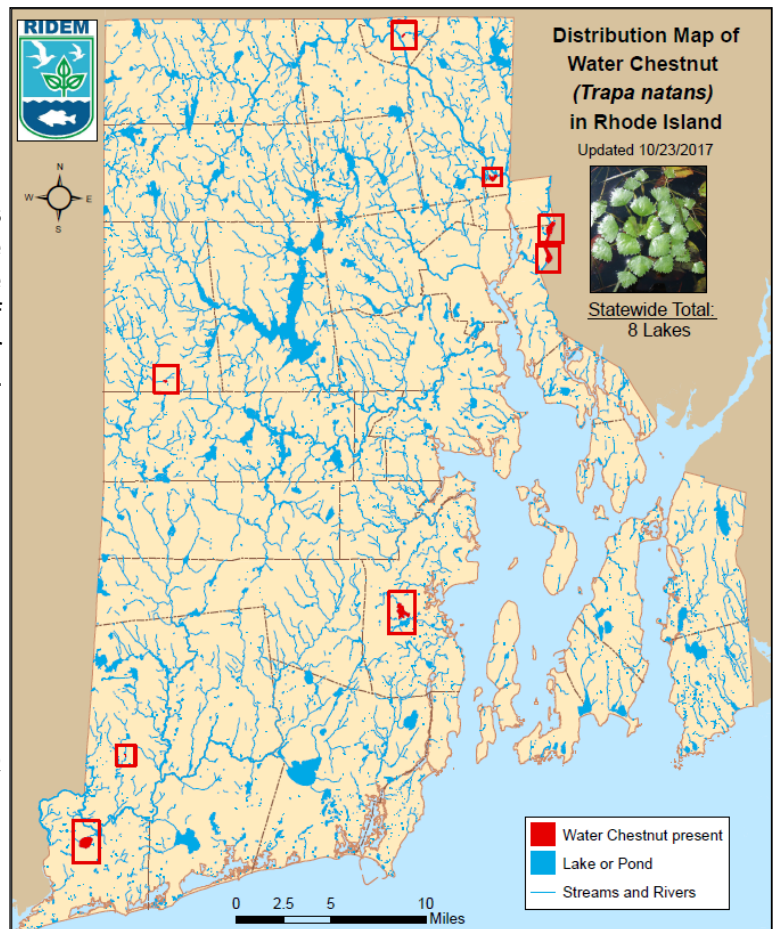
It is much easier and cost effective to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/identify.pdf>.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Water Chestnut found in Rhode Island?

As of November 2017, water chestnut has been documented in 8 lakes or ponds. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aismaps/tranat.pdf>



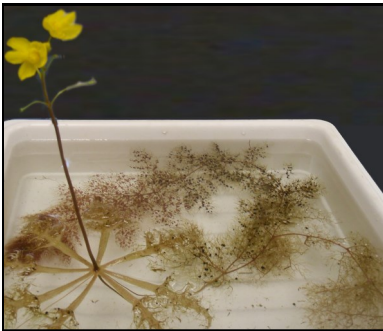


FACT SHEET

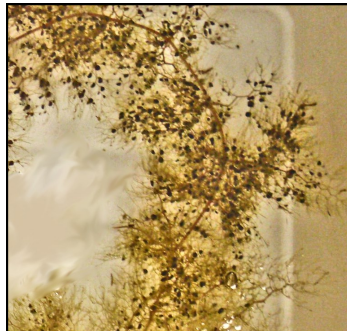
Freshwater Aquatic Invasive Species in Rhode Island

November 2017

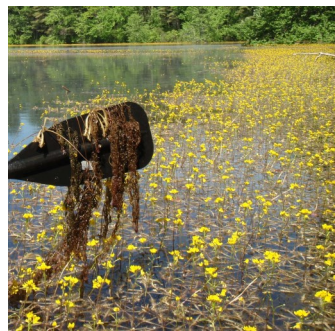
Inflated Bladderwort



Yellow flowers sit above the water on a buoyed float, and winding, branched stems are under water



Close-up of under-water plant with branching stems and blackened digestive bladders



Large flowering populations can appear to look like a field rather than a lake



The plant produces a float shaped like a wagon wheel or snowflake to support the stem and flowers

Species Description and General Information

Inflated bladderwort (*Utricularia inflata*) is mostly an underwater, free-floating plant (not rooted), also known as swollen bladderwort. When scooped up from under the water's surface, the bulk of the plant looks like a mesh of thin, fragile, branched strings littered with small dots (bladders). The stolons, or main "vines" of the plant can be many feet long and float freely with no true roots in the soil. Numerous stems attached along the stolons split into many thin branches that are suspended under the water. Because the plant does not have roots to take nutrients from the sediment, bladderworts obtain nutrition by digesting microscopic animals in the water—they are carnivorous! Hundreds of small digestion sacs or bladders appear to dot the thin branches in brown, black, or green. Each sac serves to trap prey (such as zooplankton) which the plant later breaks down for nutrients. When flowering in June, the plants produce a characteristic snowflake-like whorl of spongy structures at the water's surface to support the flower stem, often called a "float". The float resembles a wagon wheel or snowflake and can reach up to six inches or more in diameter. A stalk emerges from the center of the float to support several vibrant yellow, snapdragon-like flowers. Inflated bladderwort can be easily confused with native floating bladderwort (*Utricularia radiata*) however the invasive float is much larger. Inflated bladderwort is spread primarily through fragmentation, so just a small snippet of the stem and branches can easily create an entirely new plant! Plants are typically found in the quiet waters of freshwater lakes and ponds.

Why is Inflated Bladderwort Considered an Invasive Species?

Because it reproduces easily by fragmentation, inflated bladderwort can easily spread to new locations. It may establish itself in a new waterbody with only a small piece transported by birds or wildlife, stuck to fishing gear, or boats, or trailers. Invasives grow in large abundances to quickly displace native plants, by competing for space, sunlight and nutrients. They can form dense mats over large areas of water that limit the amount of light available to other aquatic plants, shading them out to displace the native species. These mats can become a nuisance for recreational activities such as boating, fishing and swimming, and can become a breeding ground for mosquitoes. Plants can also form large stands that can clog boat motors and propellers, block waterways and create nuisance problems. Invasive plants like inflated bladderwort are economic problems, becoming costly to manage, impacting tourism and recreation, and decreasing waterfront property values on lakes.

How Did Inflated Bladderwort Become Established in Rhode Island?

Inflated bladderwort is native to the southeastern coastal plains of the United States. It is now reported in Washington, Pennsylvania, New Jersey, New York, Massachusetts and Rhode Island. It is possible that inflated bladderwort was introduced by humans — on watercraft or discarded from water gardens. Plant fragments also may be transported on migratory waterfowl from areas where inflated bladderwort is native.

What Methods Can Be Used to Control Inflated Bladderwort?

Depending on the level of infestation, there are several physical approaches available for inflated bladderwort control. Hand pulling may be effective to completely remove small patches. However, because the plant can reproduce by fragmentation, physical control activities may unintentionally promote the spread of the plant if plants or plant fragments are not completely removed. By law, the manual removal of aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from existing or permitted docks, beaches or swimming areas under RI Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside of this area or control of larger patches via mechanical cutting or harvesting requires a DEM wetlands permit (or special permission from the RIDEM Water Quality and Wetlands Restoration Team).

Chemical control may be effective for large populations. The DEM Division of Agriculture licenses the applicators that can apply federally regulated herbicides to treat target invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture. The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator, who can recommend treatment options and estimate the associated costs. A more detailed survey of the entire water body will likely be needed to assess the severity of the infestation and develop the most effective and cost efficient long-term management plan.

Please Help Prevent the Spread of Inflated Bladderwort in Rhode Island!

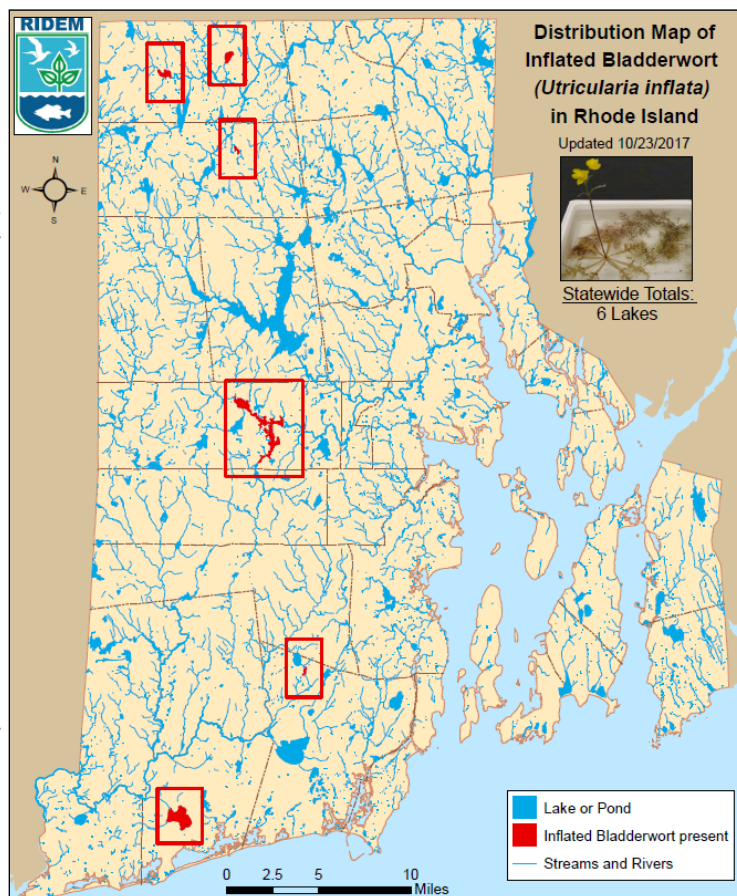
Learn to identify invasive plant species and be on the lookout for new plants in your lake. It is much easier and cost-effective to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfqw/pdfs/identify.pdf>.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Inflated Bladderwort found in Rhode Island?

As of November 2017, inflated bladderwort has been documented in 6 lakes or ponds. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfqw/aismaps/utrinf.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island November 2017

Water Hyacinth



Purple flowers arise from the center stalk¹



Thick, glossy leaves radiate from center of plant²



Inflated stems act as buoys enabling plants to float³



Inside of its thick stem looks like styrofoam¹



Plant growth can quickly cover entire lakes⁴

Species Description and General Information

Water hyacinth (*Eichhornia crassipes*) is an aquatic plant with thick, glossy, curved leaves. The plants freely float on the surface of the water and leaves can stand 1 to 3.5 feet up above the water. The curled leaves are 4-8 inches across and branch out from the center of the plant on modified stems. The enlarged stems are spongy, bulbous stalks called petioles that contain light, air-filled tissues that keep the plant afloat. When flowering, water hyacinth has a tall stalk in the center that supports several purple flowers with six petals each. Its long, feathery roots dangle in the water, hanging from the underside of the center and are dark purple or black with small, white root-hairs like a pipe cleaner. Water hyacinth reproduces by way of runners or stolons to form new daughter plants and also through seeds. When large quantities of its seeds are produced, they may be viable for up to 30 years.

Why is Water Hyacinth Considered an Invasive Species?

Water hyacinth is considered invasive throughout the world because it grows rapidly and can spread easily over vast expanses of water. It has been known to double its population within two weeks and infest large areas. After establishing in Africa's Lake Victoria in 1989, water hyacinth eventually grew to cover approximately 77 square miles of the water body!

Water hyacinth grows in mats and populations covering large areas can cause a variety of environmental and economic problems. Thick layers of water hyacinth on the surface shade out native aquatic plants below, and reduce nutrient availability to native species. The plant mats reduce light and oxygen in the water column, changing water chemistry, degrading plant and animal habitat and harming fish populations. Large infestations also cause practical problems for boating, fishing, or swimming through dense plant masses. Globally, water hyacinth is considered a serious threat to biodiversity and human health, creating prime habitat for mosquitoes which carry a variety of infectious diseases including Eastern Equine Encephalitis Virus ("triple E") and West Nile Virus.

How Did Water Hyacinth Become Established in Rhode Island?

Water hyacinth originated in South America and has been introduced as an ornamental water garden plant to all parts of the world except Europe. It was first introduced to North America in 1884 and has since spread to most areas of the United States including Rhode Island, likely planted here as an ornamental. Although accustomed to more tropical climates and often considered intolerant of freezing weather conditions, water hyacinth appears to be adapting to the climate in southern New England and surviving mild winters. Over-wintering populations may have been found living in Connecticut, and as winter temperatures rise due to climate change it is more likely than previously expected to become established in Rhode Island.

What Methods Are Currently Being Used to Control Water Hyacinth?

Management techniques to control populations in other areas have included coordinating manual beach cleanup efforts in the local community to remove plants before they produce seeds. However, in order to ensure protection of native or rare wetland plants and animals, this type of project requires approval from the RIDEM Office of Water Resources Wetlands Permitting Program. By law in Rhode Island, the manual removal of aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from existing or permitted docks, beaches or swimming areas under the RI Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area or physical control of larger patches via mechanical cutting or harvesting requires a DEM wetlands permit (or special permission from the Water Quality and Wetlands Restoration Team).

Chemical control of plants using herbicides may be effective for large populations. Each herbicide treatment requires a specific permit from the DEM Division of Agriculture to ensure the federally regulated chemicals are used properly to treat invasive plants. Additionally, due to the volatile nature of herbicides, they can only be applied by a person properly licensed by the DEM Division of Agriculture. These professionals can outline the possible control options, and estimate associated treatment costs to develop a treatment plan designed specifically to target the invasive plant. A certified lake manager or licensed herbicide applicator who is knowledgeable about the invasive must comply with regulations, ensure environmental impacts are avoided, and complete the project safely. To develop this type of comprehensive strategy to treat invasive species in a lake, a more detailed survey of the entire water body will likely be needed to assess the severity of the infestation and develop the most effective and cost efficient long-term management plan.

Please Help Prevent the Spread of Water Hyacinth in Rhode Island!

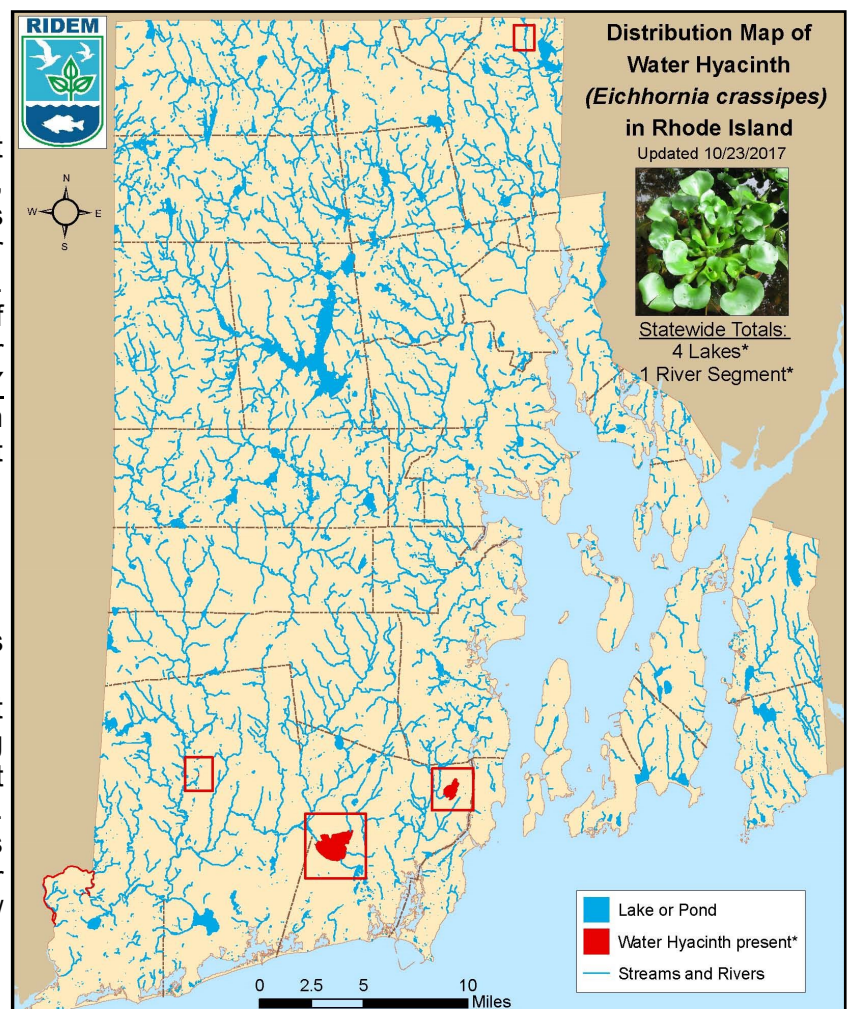
Prevention is key to stopping the spread of water hyacinth to other water bodies. It is important to avoid planting or disposing it from water gardens. Learn to identify invasive plant species and be on the lookout for new plants in your lake. It is much easier and cost-effective to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Thus constant monitoring is essential to avoiding a long term battle with this invasive plant.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear, and motors, too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Water Hyacinth found in Rhode Island?

As of October 2017, water hyacinth has been documented in 4 lakes/ponds and in 1 river segment. Note that at each location it was found, it did not appear the following summer, so it is believed that it cannot survive yet though the Rhode Island winter. The distribution map on the right shows locations where it was found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aismaps/eicra.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island November 2017

Brazilian Elodea



Brazilian elodea



Flower of Brazilian elodea



Brazilian elodea relative to the size of a hand

Species Description and General Information

Brazilian elodea (*Egeria densa*) is an under water, aquatic plant found in freshwater environments. Leaves are green, linear and serrated (magnification may be necessary to view serrations). Leaves are arranged around the stem in whorls of 4 to 8, helping to distinguish the plant from native Rhode Island elodea species which have whorls of 3. Further, Brazilian elodea leaves are typically longer than those of native elodea, measuring 1-3 cm. White flowers composed of three petals emerge from the water's surface in late summer to fall. Although flowers are produced, only males are found in the U.S., preventing seed production. Reproduction and dispersal occur exclusively through fragmentation. Double nodes along the stem cause branching and the formation of adventitious roots. Only plant fragments containing a double node can successfully regenerate.

Why is Brazilian Elodea Considered an Invasive Species?

Brazilian elodea can form dense, monotypic stands that crowd out beneficial native plants. Dense stands can restrict water movement and trap sediment, resulting in water chemistry fluctuations that stress aquatic organisms. As plants grow to the surface they form thick mats of vegetation that can impede recreation such as swimming, boating and fishing, and devalue waterfront property.

How Did Brazilian Elodea Become Established in Rhode Island?

Due to its attractiveness and reputation as a good "oxygenator", *Egeria densa* is commonly used as an aquarium plant and sold under the name *anacharis*. Initial introductions were likely the result of people pouring their fish tanks into local water bodies. Because the plant can spread by fragmentation, boats, trailers, and fishing equipment harboring plant fragments may unintentionally spread Brazilian elodea within and between water bodies.

What Methods Can Be Used to Control Brazilian Elodea?

Because Brazilian elodea can reproduce through fragmentation, physical control is generally not recommended. Mechanical raking and cutting has the potential to unintentionally spread plant fragments and exacerbate the infestation. Physical control should be limited to hand pulling small patches and the entire plant must be removed. By law, the manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from existing or permitted docks, beaches or swimming areas under the RI Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area requires a DEM wetlands permit (for more information, contact the RIDEM Water Quality and Wetlands Restoration Team).

Chemical control may be effective for large populations. The DEM Division of Agriculture licenses the applicators that can apply federally regulated herbicides to treat invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture to ensure proper use. The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator, who can provide targeted treatment options and estimate associated costs. A more detailed survey of the entire water body will likely be needed to assess the severity of the infestation and develop the most effective and cost efficient long-term management plan.

Please Help Prevent the Spread of Brazilian Elodea Species in Rhode Island!

Learn to identify invasive plant species and be on the lookout for new plants in your lake.

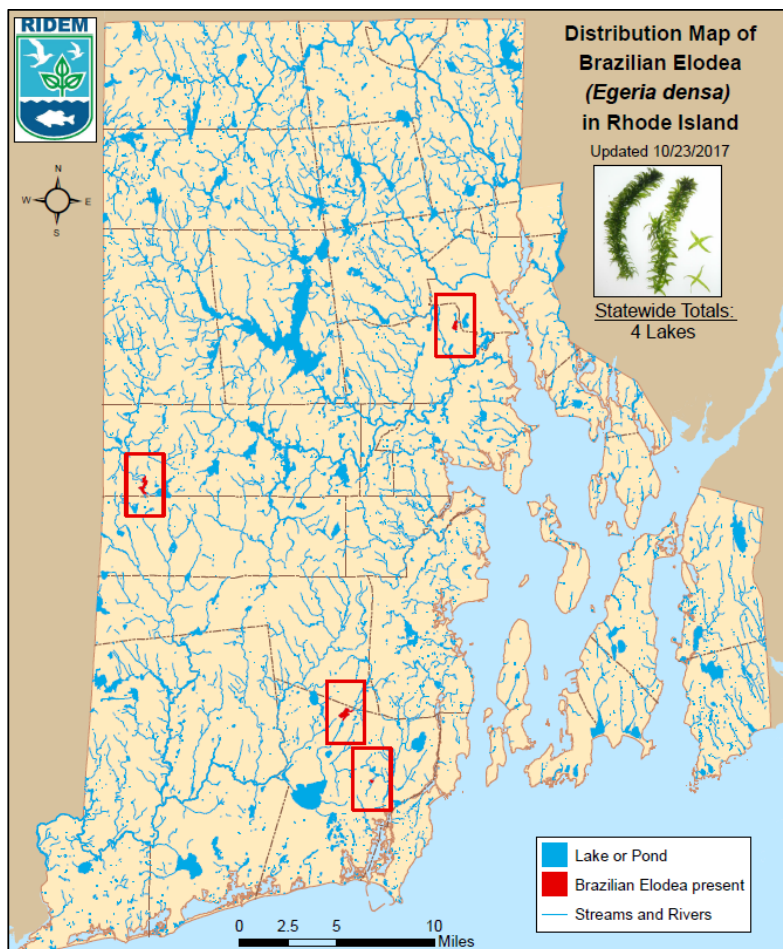
It is much easier and cost-efficient to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfqw/pdfs/identify.pdf>.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Brazilian Elodea found in Rhode Island?

As of November 2017, Brazilian Elodea has been documented in four lakes or ponds. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfqw/aismaps/egeden.pdf>





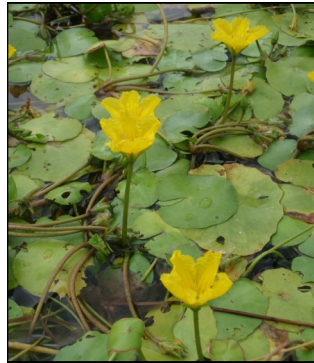
FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island November 2017

Yellow Floating Heart



Plants cover the surface of the pond like a carpet



Showy flowers of yellow floating heart



Leaves and tangled stems form a mat



Floating leaves shade out native species

Species Description and General Information

Yellow floating heart (*Nymphoides peltata*) is a perennial, floating plant that can carpet the water surface with winding stems and heart-shaped leaves. The floating, heart-shaped leaves are usually opposite from each other along the stem and measure 2-6 inches wide. The showy yellow flowers occur on stalks and rise a few inches above the water, flowering June to September. There may be one to several flowers on each stalk. The flowers have five fringed petals, and measure 1-1.5 inches in diameter when fully open. The seeds are contained in capsules and are flat and oval in shape, and are easily transported over distances by waterfowl. Yellow floating heart is also a fragmenting reproducer, that is, a small part of the plant cut from the main plant can grow roots, reproducing and spreading easily. Yellow floating heart prefers the still waters found in lakes and ponds, and is often found rooted in the mud.

Why is Yellow Floating Heart Considered a Nuisance Species?

Yellow floating heart can form dense, floating mats over large areas of water. These mats limit the amount of light available to other aquatic plants, allowing it to quickly displace and out-compete native species. Dense mats also impede recreation such as boating, fishing and swimming. Plants can also form large stands that block waterways and canals, creating problems for infrastructure and industry. Invasive plants are costly to control, and can devalue water front property values. When plants die-off, the subsequent decomposition of a large biomass of plants can recycle phosphorus levels in lakes, decrease oxygen levels, and produce algae blooms or fish kills. It reproduces easily via fragmentation and can spread quickly to other waterbodies.

How Did Yellow Floating Heart Become Established in Rhode Island?

Yellow Floating Heart is native to Europe and parts of Asia and was first reported in the United States in 1882 in Winchester, MA. DEM first confirmed the presence of yellow floating heart in Rhode Island in 2010. Yellow floating heart was likely introduced as an ornamental plant in water gardens that escaped or was discarded into local water bodies. Once introduced, yellow floating heart disperses by seeds, rhizomes and through fragmentation, whereby plant fragments break off and settle in new locations. Seeds and fragments attach to waterfowl, boats, motors, and trailers and can may spread the plant to other water bodies.

What Methods Can Be Used to Control Yellow Floating Heart?

Yellow Floating Heart can spread rapidly. Thus, early detection and rapid response to infestations is important. Prevention is key: education, monitoring of the current population, and boat hygiene are necessary to stop the spread of Yellow Floating Heart to other Rhode Island waterbodies. Hand pulling may be effective to completely remove small patches, however because this plant reproduces by fragmentation, physical control activities may unintentionally promote the spread of the plant if care is not taken to be sure that all plant fragments are caught and removed. The manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from existing or permitted docks, beaches or swimming areas under the RI Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area to control larger patches via mechanical cutting or harvesting requires a DEM wetlands permit. However, harvesting by large machines is generally not recommended for this species because the plant can reproduce by fragmentation. Experience from other states has indicated that infestations of fragmenting species can actually be made worse by mechanical harvesting activities that unintentionally promote the spread of the plant.

Chemical control may be effective for large populations but has not been used for yellow floating heart in Rhode Island. The DEM Division of Agriculture licenses the applicators that apply federally regulated herbicides to treat invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture to ensure proper use. The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator, who can provide targeted treatment options and estimate associated costs. A more detailed survey of the entire water body will likely be needed to assess the severity of the infestation and develop the most effective and cost efficient long-term management plan.

Please Help Prevent the Spread of Yellow Floating Heart in Rhode Island!

Learn to identify invasive plant species and be on the lookout for new plants in your lake.

It is much easier and cost-effective to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/identify.pdf>.

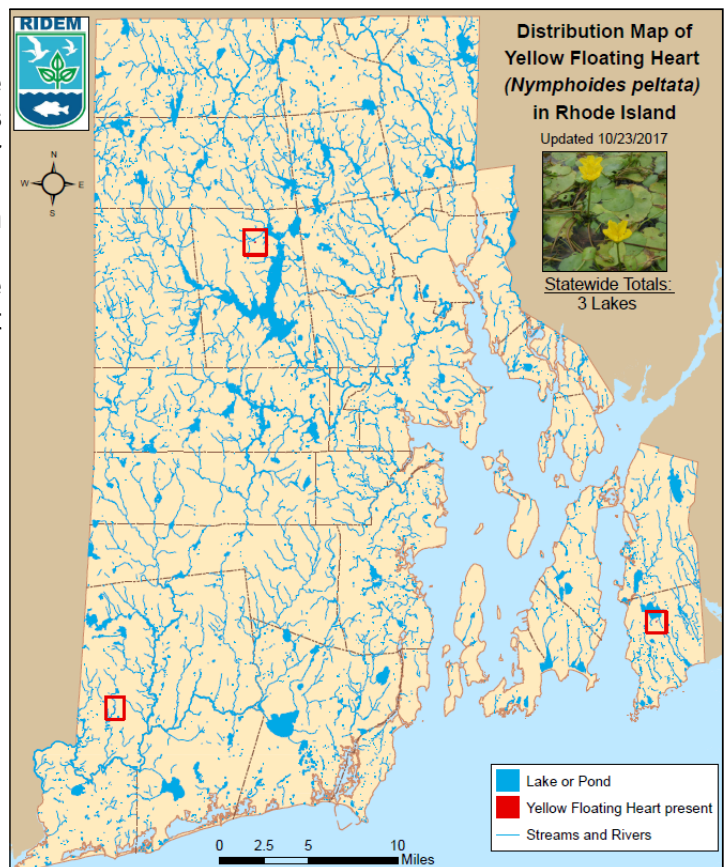
Be a GREAT Boater!

Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Yellow Floating Heart found in Rhode Island?

As of November 2017, Yellow Floating Heart has been documented in 3 lakes or ponds. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aismaps/nympel.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island

November 2017

American Lotus



Leaves generally float on the surface, but can also stand up emerging in low water conditions



Delicate flower petals are white or yellow. The center is a small, yellow, growing seed pod



Flower petals drop and the seed pod continues to grow 4 to 6 inches across; it has many seeds



Dense stands of the plants have hardy root systems that make it difficult to get rid of in an area completely

Species Description and General Information

American lotus (*Nelumbo lutea*) is a floating-leaf aquatic plant that often rises above the surface of the water to become emergent. American lotus has round, bluish-green leaves that can be up to 2 feet in diameter and are flat in appearance if the plant is floating and conical when emergent. Although often confused with water lilies when floating, lotus leaves lack the characteristic slit of lily pads and have a thick central stem. The flowers of American lotus are very large (up to 10 inches across) and appear from July to September. The flowers may have more than twenty delicate petals which range in color from yellowish-white to darker yellow. In the center of the flower is an inverted, yellow, cone-shaped seed pod. The seed pod remains and enlarges after the flower dies. American lotus is found in marshes, quiet backwaters and near-shore areas in large rivers and occurs in muddy, shallow ponds to water over 6 feet deep. American lotus propagates through the spreading of seeds or rhizomes.

Why is American Lotus Considered a Nuisance Species?

American lotus has the ability to expand rapidly and cover wetland habitats; plants can completely cover a one acre pond in three to four years. Dense populations of American lotus suppress the growth of beneficial native plants by shading out the lower-growing plants, creating a single-species (monotypic) stand which decreases biodiversity. In Rhode Island, American lotus has no natural predators to control its growth. Dense emergent stands inhibit swimming, paddling and boating. The bloom and decomposition of these mats may lower the dissolved oxygen in the water, creating the potential for fish kills.

How Did American Lotus Become Established in Rhode Island?

Nelumbo lutea is native to the southern United States, Central America and the Caribbean. Its range was extended northward by Native Americans who used the seeds and tubers for food. American Lotus is among today's most popular aquatic ornamental plants, and is often used in water gardens. Plants may also be intentionally planted in a water body for its aesthetic value. Planting in RI water bodies is prohibited under the Fresh Water Wetlands Regulations, Rule 5.01. Seeds may be carried by wind, wave or migratory waterfowl.

What Methods Can Be Used to Control American Lotus?

Early detection and rapid response to infestations is important. Hand pulling may be effective for small populations. However, if the seeds have already been dispersed, this will not eradicate the population, and annual monitoring and continued hand pulling will be necessary to reduce the seed bank. By law, the manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from existing or permitted docks, beaches, or swimming areas under the RI Fresh Water Wetlands Regulations (Rule 6.02). Manual plant removal outside this area or control of larger patches via mechanical cutting or harvesting requires a DEM wetlands permit (or special permission from the RIDEM Water Quality and Wetlands Restoration Team).

Chemical control may be effective for large populations. The DEM Division of Agriculture licenses applicators that can apply federally regulated herbicides to treat invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture to ensure proper use. The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator, who can provide targeted treatment options and estimate associated costs. A more detailed survey of the entire water body will likely be needed to assess the severity of the infestation and develop the most effective and cost efficient long-term management plan.

Please Help Prevent the Spread of American Lotus in Rhode Island!

Learn to identify invasive plant species and be on the lookout for new plants in your lake. It is much easier, and cost-effective, to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/identify.pdf>.

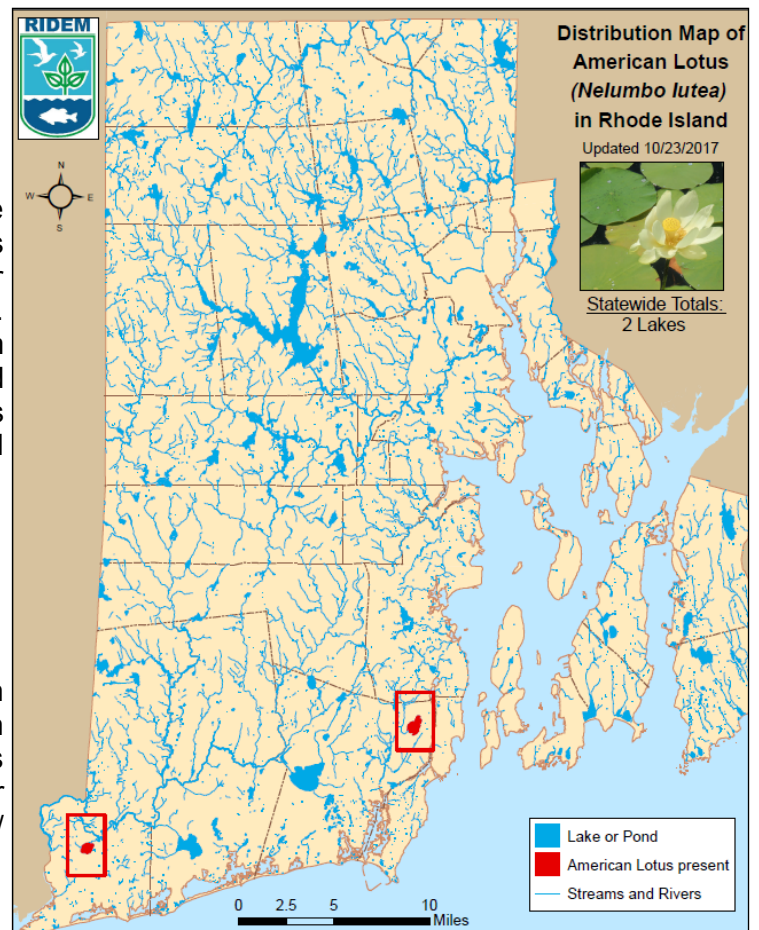
Never dump aquarium or water garden plants into a water body, and avoid using American lotus in water gardens. RIDEM also encourages the use of clean boat hygiene practices. Boats (trailers and motors too) should be inspected for plant fragments before launching in the water and after boats have been hauled out of the water. See posted reminders at state boat ramps.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is American lotus found in Rhode Island?

As of November 2017, American Lotus has been documented by RIDEM Office of Water Resources in two lakes. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aismaps/nellut.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island

November 2017

Parrot Feather



Parrot feather has rubbery leaves that stay in their form out of the water. Parrot feather can take over a shallow pond.

Species Description and General Information

Parrot feather (*Myriophyllum aquaticum*) is a rooted aquatic plant that colonizes slow moving, nutrient rich waters. Stems rooted in the substrate grow through the water and emerge at the surface, sticking up above the surface at heights 1 inch to 1 foot in the air. Emergent leaves are bright green to bluish green and have a waxy surface. Leaves measure 1/2 inch to 2 inches long, and look like a feather divided with 6-18 leaflet pairs along the main vein of the leaf. Leaves are arranged around the stem in whorls of 4-6 leaves. Leaves are stiff and maintain shape out of water like plastic fish tank plants. Submerged leaves are slightly smaller than leaves above the water and have 10-15 leaflet pairs if present. Inconspicuous flowers form in the axils of emergent leaves. Only female flowers are present in the United States, restricting reproduction exclusively to fragmentation.

Why is Parrot Feather Considered an Invasive Species?

Because it reproduces easily by fragmentation, parrot feather can easily spread to new locations. It may establish itself in a new waterbody with only a small piece transported by birds or wildlife, or stuck to fishing gear, or boats, or trailers. Invasives grow in large abundances to quickly displace native plants, by competing for space, sunlight and nutrients. Plants can become a nuisance for recreational activities such as boating, fishing and swimming, and can slow water flow, making a breeding ground for mosquitoes.

How Did Parrot Feather Become Established in Rhode Island?

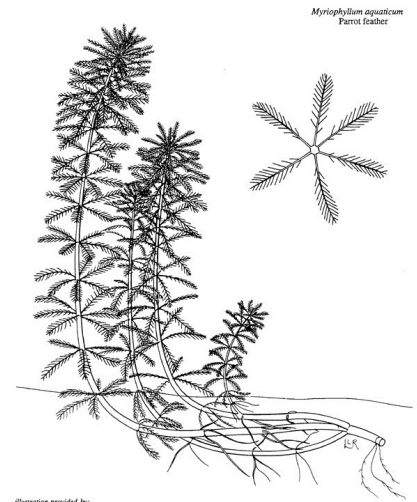
Parrot feather is native to South America. Due to its attractiveness, it was likely first introduced to the United States as an aquarium or water garden plant that escaped cultivation or was dumped into a natural water body. Parrot feather was first observed by DEM in Rhode Island at Pocasset Pond in Johnston Memorial Park, Johnston, RI in 2009. Once introduced to a water body, plant fragments carried by currents, waterfowl or boats can spread the infestation throughout a water body. Because of its robust stems and waxy leaves, plants can survive for long periods of time out of water. Thus, fragments attached to boats, trailers or fishing gear can be transported over long distances and introduced into new water bodies.

What Methods Can Be Used to Control Parrot Feather?

Due to its ability to reproduce through fragmentation, physical control of parrot feather is limited. Mechanical cutting or harvesting can spread plant fragments in a water body, unintentionally exacerbating the infestation. Hand pulling small patches may be effective if entire plants are removed. By law, the manual removal of submerged aquatic vegetation is restricted to that area adjacent to, but no more than fifteen feet from, existing or permitted docks, beaches or swimming areas under the Fresh Water Regulations (Rule 6.02). Manual plant removal outside this area requires a DEM wetlands permit (contact RIDEM Water Quality and Wetlands Restoration Team).

Parrot feather is adapted to water level fluctuations and is known to survive on wet river banks and lake shores. Water level draw downs are not an effective control option.

Chemical control of parrot feather is difficult as the waxy coating of the emergent leaves is difficult for herbicides to penetrate. Thus, eradication of parrot feather in a water body is unlikely once established. Several herbicides demonstrate potential for partial control. The DEM Division of Agriculture licenses the applicators that can apply federally regulated herbicides to treat target invasive plants. Each herbicide treatment requires a specific permit from the Division of Agriculture. The most appropriate means of selecting a specific treatment plan is to consult a lake manager or licensed herbicide applicator, who can provide treatment options and estimate the associated costs. A more detailed survey of the entire water body will likely be needed to develop the most effective and cost efficient long-term management plan.



Please Help Prevent the Spread of Parrot Feather in Rhode Island!

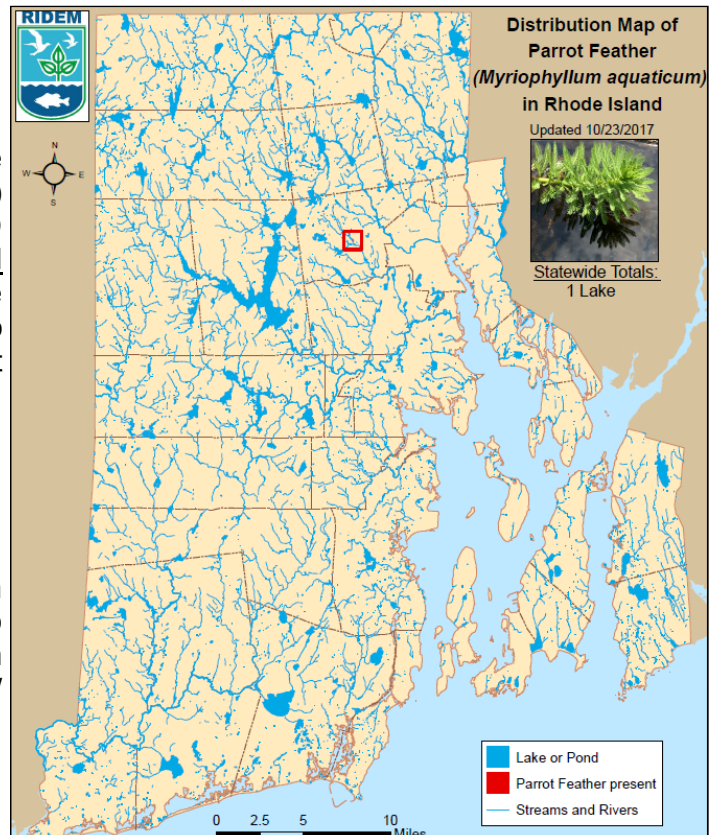
Learn to identify invasive plant species and be on the lookout for new plants in your lake. It is much easier and cost effective to manage a small patch of invasive plants than an entire lake covered with plants, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/identify.pdf>.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Parrot Feather found in Rhode Island?

As of November 2017, parrot feather has only been documented in 1 pond in the state. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aismaps/myraqu.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island November 2017

Asian Clam



Empty Asian clam shells laying on a rock at low water levels



Asian clam size relative to a penny



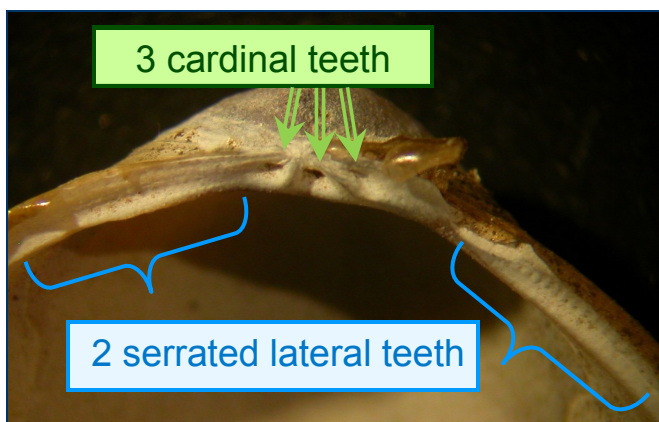
Interior of Asian clam

Species Description and General Information

Asian clam (*Corbicula fluminea*) is an invasive freshwater clam that prefers sandy lake bottoms and can be found at the sediment surface or slightly buried; Asian clams do not attach themselves to rocks or other surfaces. The exterior of the shell ranges from yellow-green to light brown to nearly black with thick concentric rings, while the interior is white to light blue or light purple. Each valve (shell) possesses three cardinal teeth and anterior and posterior lateral teeth with fine serrations (see below). Clams reach maturity at 1/4 - 3/8 of an inch and can grow up to 2 inches in diameter. You are most likely to find the small shells of dead clams resting on the bottom in shallow, sandy areas.

Why is Asian Clam Considered an Invasive Species?

Asian clams multiply rapidly and populations can easily reach high densities in freshwater - thousands per square meter have been recorded! The Asian Clam is hermaphroditic, which means both sexes are found in the same organism, allowing the clam to self-fertilize and reproduce quickly. Larvae grow in the gills of the parent clam and are released about 4-5 days later into the water as free-swimming, microscopic organisms called veligers (or pediveligers). A sexually mature Asian clam may release hundreds to thousands of veligers each day. These juveniles will become mature and may be capable of spawning in less than a year.



Asian clams are filter feeders, which means that they take in lake water and strain out algae. At high densities, Asian clams can out-compete other native filter feeders (such as fish, mussels and aquatic insects) for available food. Asian clams have played a role in the decline of many freshwater clams and mussels, reducing native biodiversity.

Shells of large populations may also clog the intake pipes of power and water facilities, costing an estimated \$1 billion annually in the United States to manage.



How Did Asian Clam Become Established in Rhode Island?

Asian clam was likely first introduced by immigrants to the United States as a food source and has since spread across the country. Clams are sometimes used as live bait and may be introduced to new water bodies when bait buckets are dumped into the water. Asian clam is also sold as an aquarium species, usually marketed as “gold clam” or “pygmy clam”, and can be introduced when unwanted fish tanks are poured into a water body. Microscopic clam larvae may also be transported to new locations in bilge or ballast water or in bait buckets filled with lake water. Once introduced, rivers and streams may transport larvae throughout the watershed.

What Methods Can Be Used to Control Asian Clam?

Once introduced into a water body it is unlikely that Asian clam can be eradicated. No effective large-scale control options currently exist. Preventative actions are the best defense in the fight against Asian clam.

Please Help Prevent the Spread of Asian Clam in Rhode Island!

Learn to identify invasive species and be on the lookout Asian clam in your lake. Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/identify.pdf>.

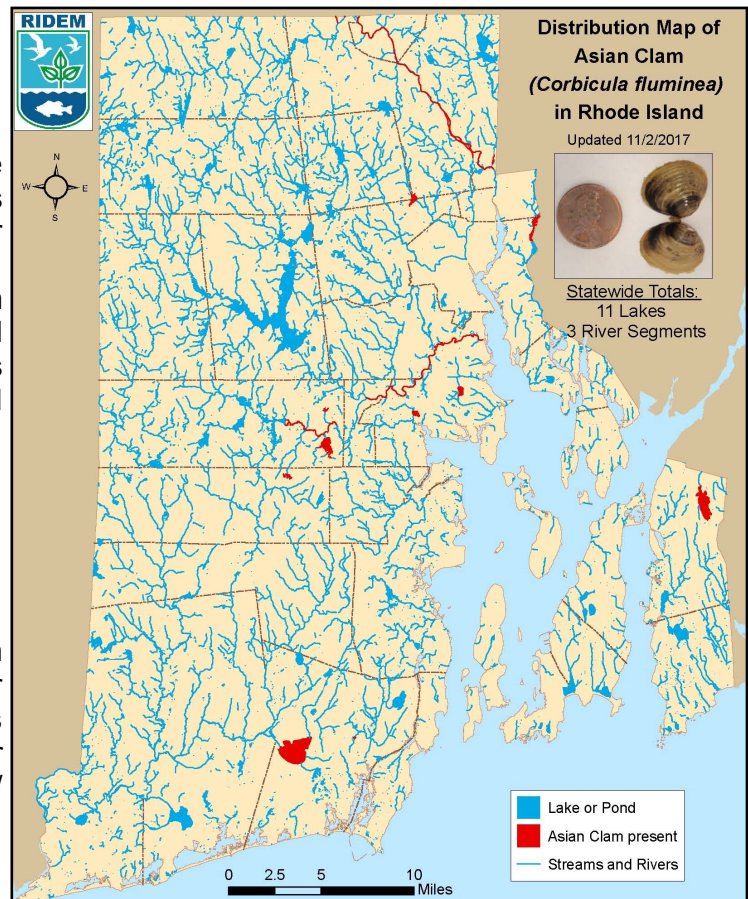
Never release a plant or animal into a water body unless it came from that water body. Discard unused bait in the trash and do not dump aquarium contents into any water body. Because juveniles are free-swimming in the water and microscopic, all water should be drained from boats upon exiting the water. The flushing of engines and bilge water should be done out of and away from the water, and then given a chance to dry before putting into a new water body to prevent the release of Asian clam larvae. Report any suspected sighting of this species to RI DEM, and spread the word to fellow boaters and fishermen! See posted reminders at state boat ramps.

Be a GREAT Boater! Check, Clean, Drain & Dry!

RIDEM encourages the use of clean boat hygiene practices. **CHECK** boats (trailers, gear and motors too) for plant fragments before launching in the water AND after boats have been hauled out of the water. **CLEAN** any plant fragments, and dispose of them away from the water, and **DRAIN** your motor and bilge. Allow boats to **DRY** overnight at least 24 hours before putting in at another lake. See posted reminders at state boat ramps.

Where is Asian clam found in Rhode Island?

As of November 2017, Asian clam has been documented in 11 lakes or ponds, and 3 river segments. The distribution map on the right shows locations where it has been found in red. A larger map can be found online @ <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/aismaps/corflu.pdf>





FACT SHEET

Freshwater Aquatic Invasive Species in Rhode Island November 2017

Mystery Snails



Species Description and General Information

There are three mystery snails considered to be invasive in Rhode Island. Chinese or Japanese mystery snails are referred to by a variety of scientific names, but North American literature most commonly uses *Cipangopaludina chinensis*, or *C. japonica*, respectively*. These are large freshwater snails that are uniformly brown or olive green on the outside and white to pale blue on the inside. The Japanese variety of this species is black and usually a dark green, moss-like algae covers the shell. The third invasive snail species is the banded mystery snail (*Viviparus georgianus*), which has a more spherical shell which is yellowish to greenish in hue and has a distinct reddish-brown banding pattern. Generally, adults of this species reach lengths greater than 1.5 inches, and can grow up to 2.5 inches from the tip of the whirl to the bottom of the shell opening. The banded mystery snail differs from Chinese/Japanese mystery snails in that it is native to North America, but is considered an invasive north of the Carolinas. Shells of mystery snails form in 6-7 convex whorls that wrap to the right (dextral), away from the shell opening, with deep indentations where whorls meet. Mystery snails are commonly known as trapdoor snails (or black snails) because of the dark, solid, door-like operculum that covers the opening of the shell when the snail is fully retracted. Most native snails do not possess this “trap door” operculum. Mystery snails prefer lakes and slow-moving streams between 0.2-7 meters in depth with soft mud, silt, or sandy substrate. In infested waterbodies during summer months, live mystery snails can be seen along the shoreline in shallow water and empty shells of deceased snails can be found washed up on beaches, particularly on the downwind side of a lake. They are thought to be called “mystery” snails based on their unique lifecycle; in the spring they give birth to young, and then suddenly, fully developed snails mysteriously appear from deeper parts of the lake.

Related Non-Invasive Species

Don't be tricked, there is a brown mystery snail (*Campeloma decisum*) native to the northeastern United States that is typically olive green in color and can easily be confused with its invasive counterparts. It is smaller and narrower than the invasive snails, rarely reaching 1.5 inches and is more elongated than the other two snails. The most obvious difference is the shape of its shell opening and operculum—instead of a completely rounded shell opening (as the invasives have), the shell opening of the native brown mystery snail has an apex opposite from the tip of the shell.

*Taxonomic confusion exists as to whether Chinese and Japanese mystery snails are entirely different species, or if morphological differences are due to variances in individuals. Again, Japanese mystery snails appear to have more elongated whorls than Chinese mystery snails.

What Makes These Snails Invasive Species?

Once an adult, one female mystery snail can produce over 100 live, crawling young each brood. This is an important factor in their dispersal, as it only takes one impregnated female to start a new population, since one female usually produces more than 170 young in one lifetime. Their ability to close up also protects them against drying out if taken out of water. When snails attach to plants and are inadvertently tangled on boat trailers, the snails can stay moist and alive for at least 4 weeks, allowing for long-range transport to other, potentially uninfected waterbodies. Mystery snails are a problem because they feed on any organic and inorganic bottom material, diatoms, and algae, thus competing with native snails and fish for food and habitat. Mystery snails can also clog the screens on water intake pumps for irrigation. Banded mystery snails are especially problematic because they can prey on the eggs of largemouth bass. Mystery snails may also be a human health concern, as swimmers are at a risk of injury from mystery snails by cutting a foot or hand on sharp, broken shells along the shore. Further, in some countries, mystery snails have been known to host human intestinal flukes (*Echinostoma cinetorchis*) and transmit other diseases and parasites. In China they are eaten as part of the human diet because the meat is high in protein, low in fat, and considered delicious.

How Did Mystery Snails Become Established in the United States?

The earliest record of invasive mystery snails in the United States dates back to the late 1800s when they were imported from Southeast Asia to San Francisco for the live food market. They were discovered in Boston as early as 1914 and may have been accidentally introduced in Massachusetts in the early 1900s either with goldfish released to control mosquito populations or when byproduct was released into waters by Asian food markets. By 1965, they had also been discovered in Connecticut, Maryland, New Hampshire, New Jersey, New York, Pennsylvania, Maine, Virginia, Idaho, Indiana, Michigan, Ohio, Wisconsin, Lake Michigan, Lake Erie, Lake Ontario, and the Niagara River. Since then, dispersal has become widespread in ponds, lakes, rivers, and drainage ditches across the country, likely due to the dumping of contaminated live bait or aquariums, or from transport on recreational watercraft, boat trailers and gear.

Please Help Stop the Spread of the Invasive Mystery Snail!

The most manageable threat to spreading mystery snails is recreational boaters and anglers transporting them from lake to lake. Care should be given to thoroughly check, drain and dry a boat being transported from waters known to have invasive mystery snails. Cleaning boots, waders and other fishing gear, and allowing them time to thoroughly dry is especially important. Never release a plant or animal into a water body unless it came from that water body. Discard unused bait in the trash and do not dump aquarium contents into any waterbody. The flushing of engines and bilge water should be done out of and away from the water. Once introduced into a waterbody, it is unlikely that invasive mystery snails will be eradicated. No effective large-scale control options currently exist. Aquatic pesticides are ineffective at controlling mystery snails, and instead may often kill native snails. The trap-door-like structures near the opening of the shell give mystery snails the ability to close-up when water conditions become inhospitable, and when water quality is restored, they can re-open and continue to thrive. Since mystery snails do not feed on plant material, removing plants from the water body will not control the introduced population. Winter lake draw-downs are also ineffective because the snails migrate to the depths of the waterbody and hibernate in temperatures lower than 15°C. Preventative actions are the best defense in the fight against mystery snails. Learn to identify invasive species and be on the lookout for mystery snails in your lake. Examine sand and muck along the shore, where they are most likely to be seen. Report any suspected sightings of this species to RI DEM, and spread the word to fellow boaters and fishermen!

For more information also see:

- Protect Your Waters
<http://www.protectyourwaters.net/>
- 100th Meridian Initiative
<http://www.100thmeridian.org/>
- Aquatic Invasive Species in Rhode Island
<http://www.dem.ri.gov/programs/water/quality/surface-water/aquatic-invasive-species.php>





FACT SHEET

Office of Water Resources

September 2017

Freshwater Aquatic Invasive Species in Rhode Island Asian Carp



Bighead Carp **



Common Carp †



Grass Carp - the lipped mouth is typical of many Asian Carp ††

Species Description and General Information

Asian carp can describe any fish in the family *Cyprinidae*: Grass Carp, Common Carp, Silver Carp, Large scale Silver Carp, Bighead Carp, Black Carp, Crucian Carp and the Common Goldfish. They are commonly around 18-30 inches and 10-15 lbs but, depending on the species, can grow up to 4 feet long and weigh up to 90 lbs. Barbels (whiskers) are present on either side of a lipped mouth. They consume a variety of different foods, feeding on plant material, algae, fish eggs, insects, insect larvae, and mollusks. Although they are very hardy and tolerant of most conditions, carp prefer large bodies of slow or standing water and soft bottom sediments. They have a sharp sense of smell, hearing and taste, and tend to gather in small schools. Spawning occurs in spring when water temperatures warm. Fish move upstream in rivers or congregate in shallow, weedy areas where females may deposit up to two million eggs at a time. Males fertilize the eggs which hatch a few days later. Juveniles may grow up to fifteen inches in their first year of life and usually reach sexual maturity in three to four years.

Why are Asian Carp Considered an Invasive Species?

Carp are considered a nuisance species due to their large size, ravenous appetites, and rapid rate of reproduction. They pose a significant threat to native biodiversity, including native fish species as well as waterfowl. Carp are hardy fish that can tolerate extremely low levels of dissolved oxygen (by gulping air at the surface) and large temperature changes that would be lethal to other fish species. To find food, carp suck up muck from the bottom into their mouths, expelling the inedible mud and swallowing the remaining organisms. This feeding behavior uproots plants and disturbs bottom sediments, causing severe habitat damage and lowering the water quality. Stirred-up sediment may clog the gills and filter-feeding apparatus of aquatic organisms such as fish, mussels and snails. All of these impacts render the habitat unsuitable and are detrimental to the survival of native aquatic species. Additionally, since carp may eat the eggs of other fish they minimize the population of native species, which then allows the carp to monopolize waterbodies.

† http://nematode.unl.edu/common_carp.jpg

** <http://conservationreport.files.wordpress.com/2009/12/asian-carp.jpg>

†† http://www.tnfish.org/PhotoGalleryFish_TWRA/FishPhotoGallery_TWRA/images/GrassCarpHeadMeltonHillNegus_jpg

How Did Asian Carp Become Established in Rhode Island?

Carp are native to Eurasia and were purposely introduced in the late 1880's by the U.S. Fish Commission as a food fish. The Carp proved to be detrimental to native fish populations and unfortunately never became popular as a food or sport fish in North America, as they have in Europe. Common goldfish and ornamental variants of the common carp (known by their Japanese name "koi") can escape from private ponds and water gardens, and be introduced if an aquarium is dumped into a natural water body. Populations of Asian carp have now been established in nearly every state in the United States either through intentional introduction or natural movement of the fish through watersheds. Once established, their population is hard to control as they are prolific breeders with few natural predators aside from humans. Juvenile carp are eaten by larger carnivorous species such as pickerel or pike. However, after a few years of age they will outgrow predators.

What Methods Can Be Used to Control Asian Carp?

Prevention is the best way to reduce the risk of carp establishing populations in your pond or lake. Do not release non-native fish into waterbodies. The most basic method of physical control once a population is established is to harvest the fish, either by angling or seine netting; carp will take a variety of bait including corn and worms, and put up a good fight for sport fishermen. Control through water level manipulation, traps and electrofishing have also been attempted, but generally proved to be ineffective or labor-intensive. The most common method of preventing carp infestation is the use of barriers, such as metal grates, electrical barriers or culverts. However, the initial cost of installing these barriers is high and the structures may obstruct boat traffic and the spawning runs of other fish. The effectiveness of metal grates can be limited, as they may not exclude juvenile fish.

Please Help Prevent the Spread of Carp in Rhode Island!

Learn to identify invasive species and be on the lookout for new fish in your lake.

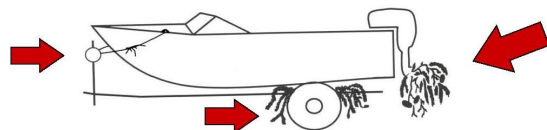
It is much easier and cost-efficient to manage a small population than an entire lake, so early detection is key! Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfwaq/pdfs/aqinvspe.pdf>.

Do not dump aquarium contents or aquatic pets (such as koi and goldfish) into any local water bodies. Discard unused bait and other packing materials in the trash, not in the water. Do not release carp into local waters. Because water contains microscopic organisms, all water should be drained from boats upon exiting the water. The flushing of engines and bilge water should be done out of, and away from, the water, and then given a chance to dry for at least 24 hours before putting into a new water body to prevent the transport, release, and spread of invasives.

For more information also see:

- Protect Your Waters
<http://www.protectyourwaters.net/>
- 100th Meridian Initiative
<http://www.100thmeridian.org/>
- The URI Watershed Watch Program
www.uri.edu/ce/wq/ww
- The Rhode Island Natural History Survey
<http://www.rinhs.org/>
- Aquatic Invasive Species in Rhode Island
<http://www.dem.ri.gov/programs/water/quality/surface-water/aquatic-invasive-species.php>

BOATERS: INSPECT VESSEL CAREFULLY BEFORE and AFTER USE!



- **CHECK** watercraft, trailer and gear before and after each use
- **CLEAN** all weeds and plant fragments from boats, boots & gear
- **DRAIN** boat, bait buckets, live wells and motors far from water
- **DRY** boats out of the water at least 24 hours before next put-in
- Never release bait, shellfish, pet fish, or plants into a waterbody



FACT SHEET

Office of Water Resources

September 2017

Freshwater Aquatic Invasive Species Threatening Rhode Island Didymo — “Rock Snot”



Thick, brown, Didymo bloom covers the bottom of a stream, smothering aquatic organisms underneath**



Clumps of didymo feel like wet cotton or wool and resist pulling apart ‡



As the stalks die, they become frayed and white, resembling toilet tissue‡

Species Description and General Information

Didymo (*Didymosphenia geminata*), also referred to as “rock snot”, is an invasive freshwater diatom (a type of algae) that can generally be found in relatively cold, shallow, clear, rocky streams. Unlike other common algae species that can be found attached to the stream bottom, didymo cells will not appear green in color. Mats of didymo may be brown, yellow-brown or white in color. Didymo is also distinctive from other native algae species because it does not feel slimy, but instead like wet cotton or wool. The diatom produces stalks that attach to rocks and vegetation along stream bottoms. These stalks form the bulk of a nuisance bloom, not the diatom cells themselves. A didymo infestation may start as small bubbly colonies on submerged rocks, then form long filamentous streamers as the stalks grow. The ends of the streamers will eventually turn white and break up, giving the mat the appearance of strands of toilet paper.

Why is Didymo Considered an Invasive Species?

Nuisance didymo blooms can completely cover the stream bottom, smothering aquatic plants, native mussel beds and ruining habitat for beneficial insects (such as stoneflies, mayflies and caddisflies). Because aquatic insects are an important food source for brook trout (and other aquatic animals), didymo blooms can negatively impact their populations by decreasing food availability. Further, thick mats of didymo can restrict water flow, and algae decomposition can decrease water oxygen levels necessary for trout. As a result, didymo is seen as a threat to trout streams, trout fishing and related tourism. Although not harmful to human health or drinking water, mats of didymo are unsightly and degrade the aesthetic quality of streams.

**New Hampshire DES ‡Tim Daley, Pennsylvania DEP

Where is Didymo From and How is it Spreading?

Didymo is native to the cool, oligotrophic (low nutrient) waters of the far northern regions of Europe and North America where it has largely remained a benign species. Recently, however, it has begun to take on invasive characteristics in its native range and has been expanding its range south to warmer and more nutrient-rich waters. Currently, it is found in New York, Pennsylvania, Vermont and New Hampshire. The reason for this sudden expansion is not well understood. Humans are playing a significant role in introducing didymo to new water bodies. It only takes a single diatom cell to start a new infestation. These microscopic cells cling to fishing gear, boots, boats and can be absorbed by felt-soled waders. Therefore, felt-soled waders have been banned in RI (Freshwater Fishing Regulations 1.17: <http://www.dem.ri.gov/pubs/regs/regs/fishwild/fish1314.pdf>). Didymo cells can remain viable for several weeks under moist conditions, so any gear that is not dried completely or properly decontaminated can introduce didymo to new water bodies.

What Methods Can Be Used to Control Didymo?

There are currently no known methods to effectively control or eradicate didymo in natural water bodies. The only defense against the negative impacts of a didymo infestation is to prevent its introduction.

Please Help Prevent the Introduction of Didymo to Rhode Island!

Because one single microscopic didymo cell can start an entirely new infestation, recreational users of water bodies are encouraged to check, clean, drain and dry equipment before using it in another water body.

Check: Look for, and remove, visible algae and plant material from anything that has come in contact with the water or sediment, including boots, gear, nets, rods and reels etc.

Clean: Soak, scrub or expose all equipment in one of the solutions below for at least 10 minutes:
Hot water: 140°F (hotter than most tap water)
Dishwashing detergent: 5% solution (~1 cup of detergent to 1 gallon of water)

Dry: Dry all gear completely before re-use. If cleaning in one of the above solutions is not feasible, drying alone will suffice. Completely dry all materials and keep dry for at least 48 hrs.

Freeze: Freezing gear until solid will kill didymo, although it can also damage gear, so be aware..

DO NOT USE FELT SOLED BOOTS

The use of felt soled waders has been banned in Rhode Island. Avoid use of porous material that can soak up water and harbor bacteria and microscopic organisms such as Didymo. These products increase risk of contamination and spreading Didymo to other ponds. For more information see the [RI Freshwater Fishing Regulations](#).



For more information also see:

- Northeast Aquatic Nuisance Species Panel
www.northeastans.org/
 - 2013 International Didymo Conference
<http://stopais.org/didymoconferenceresults.html>
 - Trout Unlimited
<http://www.tu.org/science/aquatic-invasive-species-ais>
 - Aquatic Invasive Species in Rhode Island
<http://www.dem.ri.gov/programs/water/quality/surface-water/aquatic-invasive-species.php>
-



FACT SHEET

Office of Water Resources

September 2017

Freshwater Aquatic Invasive Species Threatening Rhode Island: Zebra Mussel



Relative zebra mussel size*



Byssal threads of a zebra mussel †



Zebra mussels attach to and cover a shopping cart ††

Species Description and General Information

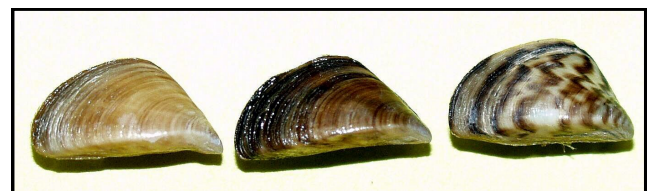
Zebra Mussel (*Dreissena polymorpha*) is a small, invasive, freshwater mollusk. The distinctive light and dark tan lines on the exterior of the zebra mussel shell gave rise to its common name; however not every individual mussel will follow the striped pattern (see photo below). It attaches to hard underwater surfaces via minute, thread like fingers known as 'byssal threads'. It is the only freshwater mussel able to attach itself to hard objects. Water bodies with an established zebra mussel population have mollusks carpeting any hard surface such as docks, rocks, boats, pipes and debris (see photo above). Adult mollusks reach sizes of 1/4 inch to 1-1/2 inches and can grow up to a maximum size of 2 inches.

Why is the Zebra Mussel Considered an Invasive Species?

This mussel has the capacity to reproduce in extremely high amounts, making population growth exponential. Once an adult, one female zebra mussel can release 100,000 to 500,000 eggs onto the water a year. Her free floating eggs become known as 'veligers' or microscopic larvae which begin to form shells. The extremely small size of the veliger makes it hard to detect within a water body until it matures in size. After two weeks, the veligers begin to settle out of the water column, attaching to hard surfaces with their byssal threads.

Zebra mussels easily attach to any solid object, quickly becoming a hassle for private residences or businesses with infrastructure in the water. They can attach to and clog intake pipes on boats, or irrigation pumps drawing from the water. Swimmers are also at a risk of injury from zebra mussels by cutting a foot or hand on sharp zebra mussel shells coating rocks or swim ladders. The ability to attach to any hard surface allows the zebra mussel to collect on top each other, forming layers on objects, and can even smother other native mussels.

Zebra mussels are filter feeders, which means they take in lake water and filter out algae and debris; one zebra mussel can filter one gallon of water per day. Increased populations of zebra mussels can increase water clarity in a lake, allowing greater amounts of sunlight deeper into the water, potentially increasing aquatic plant growth.



Varying color of zebra mussels (credit: USGS Nonindigenous Aquatic Species)

How Did Zebra Mussels Become Established in the United States?

Zebra mussels are native to freshwaters in eastern Europe and Asia. Their first discovery in the United States was in 1988 in Lake St. Clair, between Lake Huron and Lake Erie. It is believed they were transported to the great lakes region via the ballast water tanks in large ocean carrier ships. Ocean ships use ballast water to control how deep a ship sits in the water, as well as to stabilize a ship while crossing oceans. Invasive species can easily be drawn into ballast tanks at an origin port, and released into the water at the destination port.

Since 1988, the zebra mussel has easily spread throughout the Great Lakes and into connecting water ways. Presently, they are found throughout the entire Mississippi River Valley, east to the Hudson River, western Massachusetts and Connecticut water bodies. They have also been documented as far west as California, Utah, Colorado and south to Texas.



Please Help Prevent the Introduction of Zebra Mussel to Rhode Island!

The primary threat to spreading zebra mussels is now the recreational boater. Care should be given to thoroughly wash a boat being transported from waters known to have zebra mussels. Some steps to be taken consist of draining boats and motors far from the water, allowing it to dry before next use; as well as cleaning boots, waders and all fishing gear or other recreational equipment (water skis or tubes) before and after use.

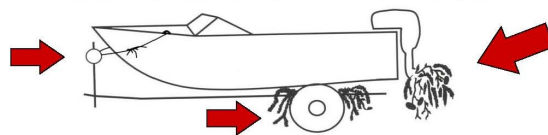
Once introduced into a water body it is unlikely that zebra mussels will be eradicated. No effective large-scale control options currently exist. Preventative actions are the best defense in the fight against zebra mussels. Learn to identify invasive species and be on the lookout for zebra mussels in your lake. Identification resources are available on the RIDEM website at <http://www.dem.ri.gov/programs/benviron/water/quality/surfqw/pdfs/identify.pdf>. Examine hard surfaces in the water such as docks and boats, where they are most likely to attach. Report any suspected sighting of this species to RI DEM, and spread the word to fellow boaters and fishermen!

Never release a plant or animal into a water body unless it came from that water body. Discard unused bait in the trash and do not dump aquarium contents into any water body. Because juveniles are free-swimming in the water and microscopic, all water should be drained from boats upon exiting the water. The flushing of engines and bilge water should be done out of, and away from, the water, and then given a chance to dry for at least 24 hours before putting into a new water body to prevent the release of zebra mussel larvae.

For more information also see:

- Protect Your Waters
<http://www.protectyourwaters.net/>
- 100th Meridian Initiative
<http://www.100thmeridian.org/>
- The URI Watershed Watch Program
www.uri.edu/ce/wq/ww
- The Rhode Island Natural History Survey
<http://www.rinhs.org/>
- Aquatic Invasive Species in Rhode Island
<http://www.dem.ri.gov/programs/water/quality/surface-water/aquatic-invasive-species.php>

BOATERS: INSPECT VESSEL CAREFULLY BEFORE and AFTER USE!



- **CHECK** watercraft, trailer and gear before and after each use
- **CLEAN** all weeds and plant fragments from boats, boots & gear
- **DRAIN** boat, bait buckets, live wells and motors far from water
- **DRY** boats out of the water at least 24 hours before next put-in
- Never release bait, shellfish, pet fish, or plants into a waterbody