

New Hampshire Lakes Association Aquatic Invasive Species Identification Guide



Aquatic Invasive Species Education and Prevention Program

Brought to New Hampshire lakes and ponds by local groups and:

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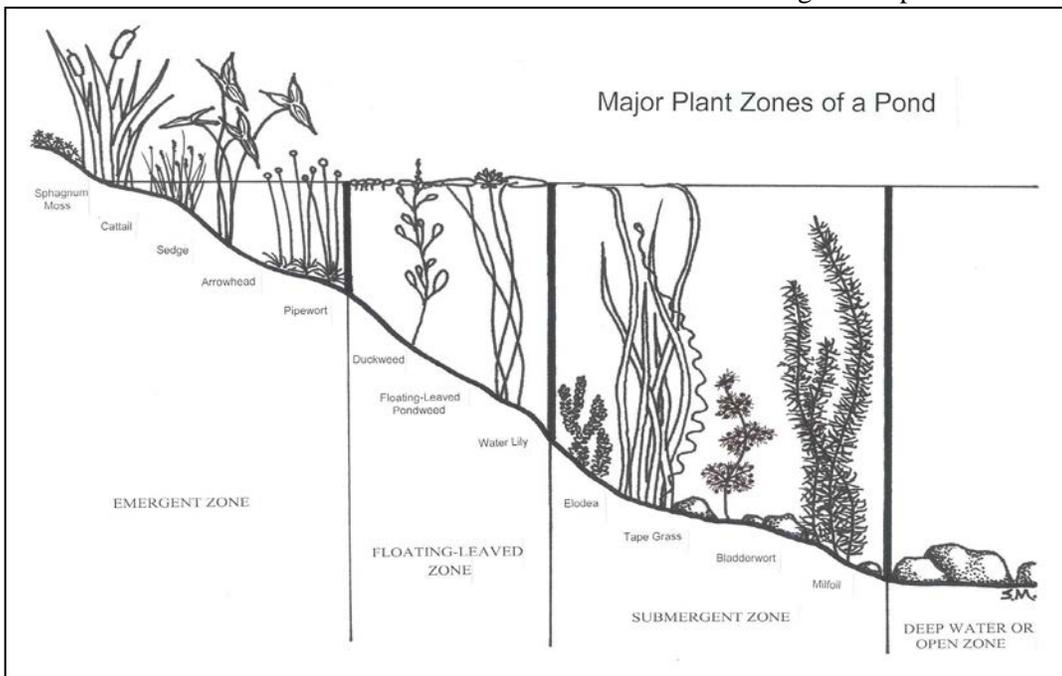


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Members dedicated to protecting lakes and their watersheds

Aquatic Plants and Their Role in Lake Ecology

Aquatic plants are a common sight in New Hampshire's waterbodies, and many lake residents, as well as visitors to New Hampshire's numerous waterbodies, may question the importance and role of aquatic vegetation. One may ask whether these plants are beneficial or detrimental to the health of a lake ecosystem. This fact sheet will seek to address the most commonly asked questions and concerns regarding aquatic vegetation and their role in lake ecology.



What types of aquatic plants live in my lake? There are three common categories of aquatic vegetation; emergent, submergent, and floating. The first category is often the first one encountered as you approach a lake or pond, and is called the "emergent" vegetation. Emergent vegetation is one of the most common types of aquatic vegetation and it grows with its roots down in the sediment and the majority of the shoots stick up out of the water. Submergent plants are those that are wholly underwater and may be rooted or unrooted. Floating leaved plants are those that have leaves that float on the surface of the water and can be rooted or unrooted. Smaller plants called phytoplankton, commonly known as algae, are also present in our waterbodies and though present in the shallows near shore, are the primary plants found in deeper water of lakes where it is too deep for other vegetation to grow or root.

In most cases all of these vegetative forms are present in a waterbody, creating a diverse aquatic habitat for a wide range of organisms. All types of aquatic vegetation are beneficial to a lake ecosystem provided that they are native to New Hampshire waters.

What are the benefits of aquatic plants? Aquatic plants provide many of the same functions as terrestrial plants. Aquatic plants provide a food source, habitat, removal of carbon dioxide, and production of oxygen through photosynthesis. Plants act as the producers in an ecosystem since they produce their own food as well as food for the consumers or animals of that ecosystem. Aquatic vegetation provides food for tiny microscopic animals called zooplankton, fish, waterfowl, moose and other mammals, and in some cases humans.

Aquatic vegetation also acts as a habitat. Submerged vegetation provides a habitat for small fish which may seek refuge from predators. They may also use this vegetation as spawning beds to lay their eggs. Emergent vegetation provides a habitat for certain songbirds, or wading birds that may nest at these sites or use them as feeding areas.

Not all aquatic plants are nuisances which require removal. Native plants provide many benefits to the lake including spawning and habitat areas for organisms in the lake, as well as fishing and wildlife viewing areas for the residents around the lake.

The wildlife that resides on a lake, as a result of healthy habitats, adds to its serenity. Melodies sung by songbirds, the cry of the common loon, the chirping of frogs, dazzling dragonflies, the painted turtle sunning itself on a rock, and even the majestic herons would be threatened if it weren't for the food and habitat which aquatic vegetation provide.

Aquatic plants also provide several items which humans use. Some of these include rice, cranberries, blueberries, fiber for rope, reeds for caning, herbs, medicinal compounds, and aesthetic items such as flowers and colorful fruits and berries for decoration.

What can be done to limit nuisance amounts of plant growth? As a lake resident or concerned citizen, be aware of the activities that take place within the watershed. Nonpoint source pollution is the most

common means of nutrient transport into a waterbody. Runoff from roads, septic systems, lawns, and agriculture may bring with it much nitrogen and phosphorus and even silt and sediment. In freshwater, phosphorus is a nutrient that limits plant growth. The lower the phosphorus levels, the fewer the plants. The best way to protect a waterbody is by protecting its shoreland by maintaining a healthy, well-distributed stand of trees, saplings, shrubs, and groundcover, which act as a filter for nutrients and sediments.

Aquatic plants are a natural and beneficial part of your lake. Aquatic plants are found in most lakes and ponds in New Hampshire. They are a natural component and vital link to a healthy and diverse aquatic ecosystem. When aquatic plants interfere with human activities, the plants may be quickly viewed as “weeds,” or nuisances that must be removed. However, complete removal of native plants is not recommended. Not only is it costly and impractical, and may need a permit, it is detrimental to a healthy lake ecosystem. In addition, if the lake is cleared of its native aquatic vegetation, invasive exotic aquatic vegetation may start to colonize the lake, or the lake may shift to an algal dominated system in which clarity is low and the water is murky. This occurrence has been proven in a number of New Hampshire waterbodies where disturbances to native plant communities have taken place. Maintaining a healthy and diverse population of native plant life in a waterbody is the ultimate goal.

If you suspect you find a plant that may be an aquatic invasive species, please contact the DES Exotic Species Program immediately at (603) 271-2248.

Aquatic Invasive Plant Main Points

What are aquatic invasive plants? Aquatic invasive plants are exotic aquatic plants that are not native to New Hampshire and that have certain invasive characteristics that allow them to grow more rapidly than native vegetation, thereby taking over a waterbody. Native aquatic plants, on the other hand, are vital to a healthy lake or pond; they are kept in check through natural controls (predators and other environmental factors).

Why are invasive aquatic plants a problem?

Invasive aquatic plants are problematic as they can clog waterbodies, impede recreational activities like swimming, fishing and boating, and they can be economically and ecologically harmful as well. In some states, milfoil and other invasive aquatic plants have been implicated in people drowning.

What is the extent of the problem? Invasive aquatic plants are now found in approximately 90 waterbodies in New Hampshire. Some waterbodies have multiple infestations of plants (as many as six).

What is the law that pertains to exotic aquatic plants in New Hampshire? RSA 487:16-a prohibits the sale, introduction, propagation, purchase, importation and transportation of 27 listed prohibited species in New Hampshire. Chapter Env-Wq 1300 is where Administrative Rules on the program are found.

How are aquatic invasive species spread? New exotic species are brought into the country and state via the pet and nursery industry. Occasionally these species escape into the wild and become invasive. Once in our lakes and ponds, the transient boater is the prime mechanism of spread from waterbody to waterbody. While birds are often thought to be a vector, it is unlikely that they are the cause of very many infestations.

What control measures are being used in NH?

Various management practices are being used (in an approach termed Integrated Plant Management), including hand-pulling, benthic barriers, and herbicide applications. Once entrenched, invasive plants are very difficult to manage, and likely cannot be eradicated. Management practices cost hundreds of thousands of dollars annually.

What education activities are being used? Numerous education strategies are used to spread the word about invasive species. The use of volunteer Weed Watchers, Lake Hosts, and other interested parties helps to spread the word. The Department of Environmental Services’ (DES) staff, along with the New Hampshire Lakes Association (NH LAKES) and other organizations, include the topic of aquatic invasive species in various public presentations throughout the state. Additionally, fact sheets, pamphlets, and other educational materials are distributed on a wide basis throughout the state. Signs are also posted at access sites to inform the lake user whether or not a particular waterbody is infested with an aquatic invasive plant, and what they should do to protect the lake.

What about research to solve the problem controlling and/or eventually eradicating aquatic invasive species?

DES continues to coordinate and fund projects associated with aquatic invasive plant research. Recent projects include an evaluation of seed viability of variable milfoil to determine if regrowth is common from milfoil seeds in bottom sediments. DES is also conducting research to try to limit the dosing and number of treatments when herbicide treatments are required to reduce an infestation.

ENVIRONMENTAL Fact Sheet



29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • www.des.nh.gov

What are New Hampshire's Exotic Aquatic Plant Laws?

As of January 1, 1998, the **sale, distribution, importation, purchase, propagation, transportation, or introduction** of exotic aquatic weeds in the state **is prohibited** (RSA 487:16-a). This law was designed to act as a tool for lake managers to help prevent the spread of nuisance aquatic weeds. It is hoped that by preventing their transport over land, their spread between lakes will be stopped.

What are exotic aquatic weeds? Exotic aquatic weeds include only those species of vascular aquatic plants which were not part of New Hampshire's native aquatic flora before 1950. This list contains 28 exotic plants:

Latin Name	Common Name(s)
All <i>Myriophyllum</i> species	Milfoils or feather-foils
All <i>Cabomba</i> species	Fanworts
<i>Hydrilla verticillata</i>	Hydrilla or Anacharis
All <i>Trapa</i> species	Water chestnut
<i>Potamogeton crispus</i>	Curly-leaf pondweed
<i>Lythrum salicaria</i>	Purple loosestrife
<i>Phragmites australis</i> or <i>P. communis</i>	Common reed
<i>Egeria densa</i>	Brazilian elodea
<i>Hydrocharis morsus-ranae</i>	European frogbit
<i>Butomus umbellatus</i>	Flowering rush
<i>Najas minor</i>	European naiad
<i>Nymphoides peltata</i>	Yellow floating heart
<i>Crassula helmsii</i>	Swamp stonecrop
<i>Epilobium hirsutum</i>	Great willow herb or hairy willow herb
<i>Glyceria maxima</i>	Reed sweet grass or manna grass
<i>Hygrophila polysperma</i>	East Indian Hygrophila
<i>Ipomoea aquatica</i>	Water spinach
<i>Iris pseudocarus</i>	Yellow iris or yellow flag iris
<i>Lagarosiphon major</i>	African oxygen weed
<i>Limnophila sessiliflora</i>	Ambulia
<i>Marsilea quadrifolia</i>	Water fern
<i>Myosotis scorpiodes</i>	Water forget-me-not
<i>Sagittaria japonica</i>	Double flowering arrowhead, Japanese arrowhead, or old world arrowhead
<i>Sagittaria sagittifolia</i>	Giant sagittaria
<i>Typha gracilis</i>	Slender cattail
<i>Typha laxmanii</i>	Dwarf cattail or Laxman's cattail
<i>Typha minima</i>	Miniature cattail or micro-mini cattail
<i>Salvinia molesta</i>	Giant salvinia

What are the penalties for spreading exotic aquatic plants? It shall be unlawful to knowingly, recklessly, or purposely offer for sale, distribute, sell, import, purchase, propagate, or introduce exotic aquatic weeds into New Hampshire waterbodies (487:16-b). Any person engaging in such an activity shall be guilty of a violation and may be subject to an **administrative fine of up to \$2000**.



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Aquatic Invasive Animal Species in New Hampshire

The Fish and Game Department regulates fishing and importation and release of animals (vertebrates and invertebrates) in the state, including possession, transport, and use of aquatic invasive species by anglers, bait dealers, and aquaculture producers.

Stop Aquatic Hitchhikers!

Aquatic Invasive Species are hitching rides to new waters. These invaders spread quickly, wreak havoc on native plants and animals, degrade the quality of aquatic resources and make waters unusable for boating, fishing, and swimming.

Aquatic invasive species includes both plants and animals such as zebra mussels, exotic milfoil and fish, which can easily be transported to new waters by boats, motors, trailers, fishing equipment, livewells, bait buckets, diving gear, and other aquatic recreational equipment.

The quality of New Hampshire's waters are extremely valuable both as a natural and economic resource. In addition to providing essential aquatic habitat, New Hampshire's waters annually provide ~14.7 million visitor days for boating, fishing, and swimming, which are popular family-oriented recreational activities that generate more than \$1 billion to the state's economy.

Preventing the spread of aquatic invasive species is the most environmentally sound and cost-effective method for battling aquatic hitchhikers since once they become established, aquatic invasive species can be impossible to contain and control.

New Hampshire has laws and regulations that prohibit the import and possession of these alien invaders. Additionally, the release of any amphibian, reptile, or fish is illegal without first obtaining special permits issued by the New Hampshire Fish and Game Department.

Compliance with the importation, possession, and release laws is critically important because it represents the most effective strategy for preventing the destruction caused by aquatic invasive species. Please remember, unwanted plants and animals should never be disposed of in New Hampshire's waters because the potential harm caused by this action can devastate aquatic habitat essential to native plants and animals.

N.H. laws and Fish and Game rules related to aquatic invasive species

Prohibited Species - Importation and Possession

No person shall be issued a permit to import (*Fis 803.03 & Fis 803.04(b)*) or possess (*Fis 804.03*) the following designated prohibited wildlife:

Invertebrates:

Zebra mussels (*Dreissena polymorpha, D. bugensis*)
Spiny waterflea (*Bythotrephes cederstroemi*)
Fishhook waterflea (*Cercopagis pengoi*)
All non-indigenous crayfish
Asiatic clam (*Corbicula fluminea*)

Fish:

Walking catfish (*Clarias batrachus*)
White amur/grass carp (*Ctenopharyngodon idella*)
Black carp (*Mylopharyngodon piceus*)
European rudd (*Scardinius erythrophthalmus*)
Round goby (*Neogobius melanostomus*)
Tubenose goby (*Proterhinus marmoratus*)
Ruffe (*Gymnocephalus cernuus*)
Snakeheads (Family: Channidae)

[NOTE: *Fis 803.03, 803.04(b), and 804.03* effective as of June 5, 2007]

Prohibited Species - Release (*Fis 805.01*)

No person shall be issued a permit to release the following designated prohibited wildlife:

Amphibians	All indigenous imported into the state
	All exotics
Reptiles	All indigenous imported into the state
	All exotics
Fish	All species listed as prohibited for importation and release
	All non-indigenous species
	Any species not naturalized in New Hampshire
Invertebrates	All indigenous imported into the state
	All exotics

Definitions

"Aquatic species" includes, but are not limited to, all fish, crustaceans, mollusks, invertebrates and aquatic plants that usually inhabit fresh water. (RSA 211:62-e)

"Exotic species" means wildlife that are non-indigenous species (not naturally occurring or naturalized in New Hampshire). (Fis 801.08)

"Import" means bringing or causing wildlife to be transported into the state by any means. (Fis 801.11)

"Prohibited" means that the wildlife species or activity such as collection, importation, transportation, possession, sale, transfer or release of that wildlife is not allowed. (Fis 801.19)

"Wildlife" refers to all species of mammals, birds, fish, mollusks, crustaceans, amphibians, invertebrates, reptiles or their progeny or eggs which, whether raised in captivity or not, are normally found in a wild state. (RSA 207:1, XXXV)

For More information:

Visit the NH Fish and Game website at <http://www.wildlife.state.nh.us/fishing/nuisance-species.html>

Variable milfoil

Myriophyllum heterophyllum (Michx)

Species Description: Milfoil is a submerged aquatic plant with fine densely packed, featherlike leaves whorled around a main stem. It can grow up to 15 feet and may exhibit a three-to-six inch green spike like flower above the waterline in late June or in July. A cross-section of the stem will reveal “pie-shaped” air chambers.

This invasive exotic species of milfoil has been in the state since the late 1960s, and can currently be found in 77 waterbodies in New Hampshire. There are six native milfoil species present in the state that do not cause problems, as they are low growing and do not form monocultures, unlike variable milfoil. Eurasian milfoil is another non-native milfoil found in New Hampshire, but it is less of a threat than variable milfoil due to our water chemistry (Eurasian milfoil tends to be found in waters with higher pH ranges than those found in New Hampshire).

Why is variable milfoil considered an invasive species? This species is not native to our state and is very difficult to control once it becomes fully established. Variable milfoil reproduces through fragmentation whereby plant fragments break off from the parent plant through wind or boat action, grow roots, and settle in a new location. Seeds are also a means of spread within an infested waterbody. Variable milfoil spreads rapidly and displaces beneficial native plant life, often forming monoculture of growth around the shallows of a waterbody. It makes swimming difficult and can devalue waterfront property. Where this species grows in its native environment, insects and fish may feed on this plant at such a rate as to control its growth. In New Hampshire, variable milfoil has no abundance of natural predators to keep its population in check. Under optimum temperature, light and nutrient conditions, milfoil may grow up to an inch per day.

How did exotic milfoil become established in this state? It was most likely a “stowaway” fragment attached to a boat or trailer that came to this region. Milfoil can live out of water for many hours if it remains moist, like when it’s wound around a wet carpeted bunk



on a boat trailer or in a live well. Milfoil is usually first found near boat launch sites when it infests a new waterbody, a sure sign that transient boaters are the leading means of spread. Another theory is that milfoil was introduced to a New Hampshire waterbody through the dumping of a home aquarium. This plant is sometimes used as an ornamental plant in fish aquariums.

Once established, how does milfoil infest other areas of a waterbody? Boat propellers chop milfoil plants into small fragments. These fragments float on the surface and are at the mercy of the wind and lake currents. In a short time, roots form on these fragments. If washed into shallow areas, these plants eventually take hold creating a new colony of milfoil. The cycle goes on until every suitable area is filled in with these weeds. An alternative form of the plants develops during low water. This vegetation type is more succulent than the submersed form and can persist for moderate periods of low water.

DES has recently collaborated in a study to evaluate the viability of milfoil seeds and the research showed that milfoil seeds are very viable and have a high regeneration rate, though survival of the seedlings is thought to be relatively low. Regardless, seed production in a dense milfoil bed is high, and seeds are thought to be a probable source of new plants, even following extensive control measures (seeds are resistant to herbicides). Data suggest that long term monitoring and appropriate follow up activities are needed to truly reduce or potentially eradicate infestations. Regular surveys by DES biologists or volunteer Weed Watchers are needed to find new growth early, so that small scale control measures can address the problem before it spreads. It is unlikely that seeds are responsible for lake to lake spread, though, and fragments are still the big cause of that problem.

What methods are currently being used to control milfoil? DES implements an integrated plant management (IPM) approach for control. Each infestation is assessed and a long term management plan is prepared to guide control activities for a number of years. Waterbody specific goals range from reduction of the infestation, to control, to possible eradication depending on the status of the infestation and characteristics of the waterbody. All available control options are considered, and actions are chosen that best suit the size, density, and character of the infestation. Hand pulling, diver-assisted suction harvesting, benthic barrier placement, herbicide treatment, and other strategies are evaluated for each infestation, including a review of a ‘no control’ option, and often a combination of approaches are recommended.

Have chemicals been used to effectively control invasive exotic milfoil? Yes. DES has collaborated on a number of research projects focusing on chemical

control of milfoil. Through that research we evaluated 11 aquatic herbicides on the market and have learned that 2,4D is the best herbicide available for control of this plant. Used at lower concentrations to target milfoil, native aquatic plants and other aquatic life are not impacted by the herbicide.

Herbicide treatment is a science, and therefore should be conducted by trained professionals. It is illegal to apply chemical herbicides to any New Hampshire waters unless you contract with a licensed applicator. The use of chemicals by an untrained person could jeopardize the health and welfare of the lake and its ecology. Inappropriate or inaccurate use of chemicals is life threatening to people, mainly due to overdosing as a result of the unwise "more is better" approach. It should be noted that the state has been conducting herbicide applications under permit and through licensed applicators for several years, and no negative impacts to non-target plants, animals, or humans have been observed.

EURASIAN MILFOIL (*Myriophyllum spicatum*)

Species Description: Eurasian milfoil is a submerged aquatic plant with whorled feather like leaves that appear to have been clipped on the end. Eurasian milfoil can grow 12 to 15 feet tall, and exhibits a reddish shoot near the surface. It forms dense mats of tangled plants in lakes and ponds. Leaves have 12 or more pairs of leaflets which is an identifying factor to aid in species level identification.

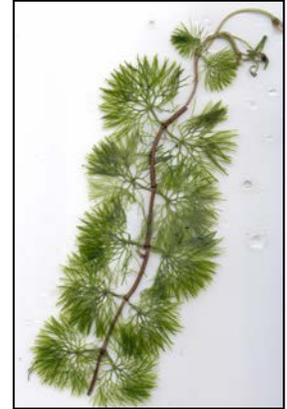


General Information: Eurasian milfoil, which originally came to this country from Europe and Asia, is a serious nuisance to many lake residents. Once introduced to a lake (usually by transient boats) it grows and spreads very quickly, ultimately impairing the ecology of the system, and value of shorefront property.

There are five waterbodies with Eurasian milfoil in New Hampshire today: Mountain Pond in Brookfield; the Connecticut River south of Hanover; Mascoma Lake in Enfield; Post Pond in Lyme; and the Nashua River. This species can also be found in nearby Vermont and Massachusetts, and is considered a national problem in lakes and other freshwater systems.

FANWORT (*Cabomba caroliniana*)

Species Description: Fanwort is a submerged bright green aquatic plant with narrow leaves arranged in a fan shape manner oppositely located on a long a narrow stem. Floating, lily-like leaves are found on the water's surface during flower production in August or September. Flowers are small, white, and emergent. This plant stands approximately two to 12 feet tall. Leaf segments are approximately 1 mm wide.



General Information: Fanwort is a native plant of the southern United States, and Latin and South America. It is currently found in Arlington Mill Reservoir in North Salem, Big Island Pond in Derry, Lake Massabesic in Auburn, Mine Falls Pond in Nashua, Nashua River in Nashua, Otternic Pond and Robinson Pond in Hudson, Phillips Pond in Sandown, and Wilson Lake in Salem. This exotic plant was discovered in New Hampshire in the late 1960s and entered the state via the back of a transient boat trailer or was dumped from a tropical fish aquarium. This plant has been prohibited in New Hampshire since 1999.

Characteristic of many invasive exotic plants introduced to a new environment, fanwort quickly invades shoreline areas of waterbodies, ultimately impairing recreational activities and other designated uses of the waterbodies

WATER CHESTNUT (*Trapa natans*)

In July 1998, the NH Department of Environmental Services confirmed reports that the invasive exotic aquatic plant water chestnut has infested the Nashua River in Nashua. Since then, it has also been found in the Connecticut River. The



seeds are being found more and more on transient recreational gear where they get stuck in the carpeting on trailer bunks, so it is expected that more water chestnut infestations will be found in the near future.



Water chestnut can completely cover the surface of a waterbody and cause ecological hardship to native plants and animals. Fishing and boating can become extremely difficult as well.

This plant is not the same species as the edible water chestnut used in Asian cooking. Water chestnut is a member of the Trapaceae family and derives its name from the single seeded horned fruits, the chestnut. Each of the four horns on the nut is sharp and has a spine with several barbs. Each plant has two types of leaves: submerged leaves that are featherlike and oppositely paired along the stem, and waxy floating leaves that are triangular and form a rosette on the water's surface. The petiole (leaf stalk) of the floating leaves has a bladder-like swelling filled with air and spongy tissue which provides buoyancy. Cordlike plant stems can attain lengths of up to 16 feet.

The water chestnut is an annual plant which exhibits great reproductive capacity. The seeds germinate in early spring. An individual seed can give rise to 10 to 15 rosettes, each of which can produce 15 to 20 seeds. Thus, one seed can produce 300 new seeds in a single year.

Water chestnuts begin to flower in mid to late July, with their nuts ripening approximately one month later. Flowering and seed production continue into the fall when frost kills the floating rosettes. The mature nuts sink to the bottom when dropped and may be able to produce new plants for up to 12 years. The plant spreads either by the rosettes detaching from their stems and floating to another area, or more often by the nuts being swept by currents or waves to other parts of the lake or river. The plant overwinters entirely by seed.

Water chestnut is an aquatic invasive plant that limits boating and fishing in infested areas. It has the potential to infest wetlands and critical environmental habitats in other areas of the state.

CURLY LEAF PONDWEED (*Potamogeton crispus*)



Species Description: Curly-leaf pondweed is a submerged plant with strap-shaped leaves, similar to many of New Hampshire native pondweeds. However, unlike our native pondweeds, Curly-leaf pondweed leaves are distinctly ruffled with finely serrated edges. It grows in large dense beds.

General Information: Curly-leaf pondweed, a native plant of Europe and Asia, is a threat to lakes and ponds throughout the United States. This species was confirmed in a small pond in southwestern Maine in 2004. It is also present in nearby Massachusetts, Southwestern Maine, Vermont, Connecticut, New York, and Rhode Island.

Curly-leaf pondweed is adapted to growing in cool conditions. Plants sprout from rhizomes and turions (a hard vegetative bud) in the fall and grow through the winter, reaching maturity early in the season (late spring through early summer). Plants generally die back by mid-July after releasing seeds and more importantly the turions. Once released, the turions scatter, floating through the water and sinking to the bottom where they lie dormant until the water begins to cool again in the fall.

Why is it a problem? In spring, curly-leaf pondweed can interfere with recreational and other uses of lakes and rivers by producing dense mats at the water's surface. Matted curly-leaf pondweed can displace native aquatic plants. In mid-summer, curly-leaf plants usually die, and dying plants accumulate on shorelines.

Spiny Naiad (*Najas minor*)



General Information:

During summer 2015, Spiny naiad (*Najas minor*) was found in Glen Lake in Goffstown, Island Pond in Pelham, Millville Lake in Salem, Northeast Pond in Milton and the Salmon River.

Spiny naiad is a submersed aquatic plant that is found in slow-moving streams, ponds and lakes. It is tolerant of turbidity and eutrophic conditions. Spiny naiad also may be referred to as slender, brittle, European or bushy naiad. The heavily-branched stems of the plant may reach up to 4 feet in length. Leaves are opposite, alternate or whorled around the stem and form “tufts” at the growing tip, giving the plant a bushy appearance. Spiny naiad leaves are thin, strap-shaped, 1-1.5in long, serrated and arch backwards. Leaves are stiff and maintain their shape out of the water. 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. Flowers, which emerge from leaf axils leaves during spring and summer, along with one-seeded fruits that appear in the fall, are very inconspicuous. Spiny naiad is an annual but can spread by fragmentation during the growing season.

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 New Hampshire? 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.

Zebra Mussels (*Dreissena polymorpha*)

What are Zebra Mussels and where do they come from? Zebra mussels are small shellfish marked by alternating light and dark bands. They are typically two inches or less

(roughly the size of a pistachio nut) in size and have a life span of four to eight years. Zebra mussels have an extremely high reproductive rate of 30,000-1,000,000 new mussels per year and are able to reproduce at one year of age.



Zebra mussels are native to the drainage basins of the Black, Caspian and Aral Seas of Eastern Europe. It is believed that ships originating from European ports carried the mussel in freshwater ballast that was discharged into Great Lake ports.

The first North American zebra mussel discovery was in Lake St. Clair, Mich., in June 1988. By September 1991, the mussel was found in all five of the Great Lakes, the St. Lawrence River, the Finger Lakes region of New York, and throughout the Mississippi River basin. The mussel is expected to infest most areas of North America within the next few years. During the summer of 1993 the zebra mussel was discovered in Lake Champlain, Vermont. In 1998, the mussel was found in East Twin Lake, Connecticut. During the summer of 2009 the zebra mussel was identified in a pond in the Berkshire region of Massachusetts. With infestations to the south and west, it is anticipated that their arrival in New Hampshire is just a matter of time.

Adult and juvenile mussels (referred to as veligers) are transported by waterfowl and by attachment to boat hulls, crayfish and turtles. Larval stage mussels (veligers) can be transported in anglers bait bucket water and boat engine cooling water. Similar to other introduced non-native species such as milfoil, these exotic mussels can reproduce rapidly because natural predators are not present to keep the population in check.

Why are Zebra Mussels a concern in North America?

Zebra mussels are not native to the U.S. They disrupt aquatic ecology via the food web and cause problems to humans wherever they have appeared. Zebra mussels are the only freshwater mussel that can secrete durable elastic strands, called byssal fibers, by which they can

use to securely attach to nearly any surface, forming barnacle-like crusts several feet thick. Through this mechanism zebra mussels can attach to stone, wood, concrete, iron, steel, aluminum, plastic, fiberglass, PVC, crayfish and other mussels. They have also recently been found growing on softer substrates like plants and mud.

What problems do Zebra Mussels cause? The zebra mussel's ability to rapidly propagate and physically attach to objects creates several problems:

- Zebra mussels filter small particles such as phytoplankton (microscopic plants), small zooplankton (microscopic animals), and detritus (pieces of organic debris) from water. Mussels are capable of filtering up to 1 liter of water within a 24 hour period. Large populations can severely alter the lake or riverine food web by competing with existing species such as salmon and walleye.
- Raw water intakes such as those at drinking water, electric generation, and industrial facilities can become infested with zebra mussels. A water supply system serving 50,000 people in a Michigan city had to shut down due to pump failure by zebra mussels in its intake system.
- Beaches in infested areas may be impacted by the washing up of sharp shells in shallow areas, which can cut bathers and litter beaches. Decomposition of mussels can also create obnoxious odors.
- Impacts on boating and navigation include:
- Organisms attached to hulls increase drag, reduce speed, thus increasing fuel consumption.
- Growth of larval mussels drawn into a boat engine cooling water intakes may occlude the cooling system, leading to overheating and possible damage to the engine.
- If shells are drawn into the engine, abrasion of cooling system parts could result.
- Marker buoys can sink under the weight of mussel encrustation.
- Docks can be destabilized or sunk by mussel colonization.

What kind of habitat do Zebra Mussels prefer?

Zebra mussels can tolerate fairly wide ranges of environmental conditions. They prefer water temperatures between 68°F and 77°F and water currents 0.15 to 0.5 meters per second for proper growth. The mussels prefer spawning in water temperatures in the mid 50°F range. While normally a freshwater species, the zebra mussel can adapt to and inhabit brackish waters ranging from 0.2 to 2.5 parts per-thousand total salinity in estuarine locations. Zebra mussels are found in lakes that are not overly enriched but which have a higher calcium content. Only a few of New Hampshire's waterbodies are at a risk for infestation, especially waterbodies with calcium levels greater than 12

ppm, like the Connecticut and Merrimack rivers, and lakes and ponds along the western border of NH.

How can Zebra Mussels be controlled? An effective way to permanently eliminate infestations has not been found, therefore, emphasis must be placed on controlling impacts on ecosystems and water users. For drinking water, electrical generation and industrial facilities, screen mesh can exclude adult and juvenile mussels from water intake systems. This method is only effective in excluding those mussels which originate upstream of the screens or filters. Veligers can pass through the screens and infest downstream areas. Other controls for water intakes include increasing intake and distribution flows to rates exceeding those at which zebra mussels can attach, and physically scraping the mussels where access for personnel and equipment is available. Oxygen deprivation, thermal controls (exposing mussels to water temperatures greater than 140°F), and chemical controls can be used to kill the mussels. However, these methods will likely affect other aquatic organisms.

What can individuals do to help? Tell your lake, river or watershed association, your local marina, your municipal officials, or anyone with an interest in aquatic resource protection about the zebra mussel. If you are in the power generation industry, plan now for the mussel's invasion to your facility. Call the UNH Cooperative Extension Services or NH Sea Grant, both in Durham, to learn about their zebra mussel public education program, or the NH Fish and Game Department to learn about their initiatives with the zebra mussel. You can also contact the DES, as the state agency with the primary responsibility of protecting and managing the state's lakes and rivers. DES intends to take an active role in zebra mussel prevention and control.

When boating in infested waters, be sure to clean and de-mussel your boat before you leave the area. De-

musseling includes performing the following activities **AWAY FROM ANY SURFACE WATER:**

- Draining the bilge, live wells and engine cooling system.
- Dumping any bait buckets.
- Inspecting the boat by checking the hull, trim plates, anchors, and the trailer.
- Washing down the boat with hot water (140°F), if mussels are found, and allowing the boat and trailer to sit for 2-5 days dry and/or spraying down gear with a 10% bleach solution and letting the solution stand for a few minutes before rinsing clean.

The best defense is to prevent the zebra mussel from entering the waters of New Hampshire. However, when they arrive, we all need to implement the proper controls to prevent these undesirable invaders from spreading.

ASIAN CLAM (*Corbicula fluminea*)

What are Asian clams and where do they come from? Asian clams, also called “golden clams,” are round, yellow-green to dark brown colored shellfish with thick, concentric rings on their shells. The clams are typically small, averaging less than 1.5 inches in size, and have a life span of one to seven years. A single clam can release 2,000-8,000 offspring in a year, depending on conditions, and some can self-fertilize.



Photos courtesy of Lake George Association, N.Y.

Asian clams are native to the freshwater of southern and eastern Asia. It is believed that immigrants to North America brought the clams as a food source and subsequently released them into the wild. The first documented discovery of Asian clams in the United States was sometime between 1924 (Indiana report) and 1938 (Washington State report). Today, the Asian clam is found in over 40 states and is expected to continue spreading. An infestation was recorded in the Northeast in Marlborough, Mass. at Fort Meadow Reservoir in 2005, and in Lake George, N.Y. in 2010. Populations of the Asian clam have been documented in four New Hampshire waterbodies: Merrimack River, from Bow, south; Cobbetts Pond in Windham; Long Pond in Pelham; and Wash Pond (Sunset Lake) in Hampstead. There are likely more populations that have yet to be documented.

Why are Asian clams a concern in North America?

Asian clams are not native to the United States. Larval and juvenile clams are easily transported by water currents, or when humans move water from one waterbody to another. They can form dense clusters of over 5,000 clams per square meter, dominating the benthic community and altering the benthic substrate. Native birds, mammals, fish and other animals feed on Asian clams. However, these invasive clams reproduce

rapidly, making it difficult for native predators to keep Asian clam populations in check.

What problems do Asian clams cause? The Asian clam’s ability to rapidly propagate and physically attach to objects as juveniles creates several problems, including:

- Large populations of Asian clams may severely alter lake or riverine food webs by directly competing with existing native fish and shellfish species for food and space.
- Raw water intakes such as those at drinking water, electric generation, and industrial facilities become impaired or clogged by clam shells or by juveniles that are sucked into the intake and that grow in the system.

The clams release phosphorus into the water through burrowing, feeding from the sediment and their excreta. Phosphorus feeds plant and algal growth, and makes potentially hazardous cyanobacteria blooms more likely to occur. Impacts on boating and navigation include:

- Larval clams drawn into boat engine cooling water intakes may occlude the cooling system, leading to overheating and damaging the engine.
- If shells are drawn into the engine, abrasion of cooling system parts, especially impellers, could result.

What kind of habitat do Asian clams prefer? Asian clams can tolerate a fairly wide range of environmental conditions. Asian clams live in lakes, ponds, rivers and streams with sand or gravel bottoms, in sun-lit, warm, shallow water. They live just below the surface of the sediment or with a third of their shell just above the sediment’s surface. Generally, it was thought that these clams only tolerated water temperatures of 2°C to 36°C; however, in Lake George these clams successfully overwinter, surviving temperatures below 1°C for months. These clams are found in clear water with good water quality and are intolerant of high nutrient levels.

How can Asian clams be controlled? An effective way to permanently eliminate infestations has not been found, therefore, emphasis must be placed on controlling impacts on ecosystems and water users. Methods that have been tested for removing adult Asian clams include: removal of infested sediment, water level drawdown, and asphyxiating with plastic mats. Controls for water intakes include: increasing flows, removing clams by hand and using chemicals or high temperatures to kill the clams. However, many of these methods will likely affect other aquatic organisms and may require state and/or federal permits/approvals.

Asian clams are regulated in New Hampshire, and it is illegal to import, possess or release Asian clams in

this state. (Administrative Rules NHFG FIS 803.04, NHFG FIS 804.03 and NHFG FIS 805.01 respectively.)

What can citizens do to help? Tell your local watershed association, marina, municipal officials, or anyone interested in protecting New Hampshire's waters about the Asian clam. If you are in the power generation industry, plan now for the clam's invasion of your facility. Do not purchase Asian clams for use in aquariums, in ponds or as bait. When boating in infested waters, perform the following activities **AWAY FROM ANY SURFACE WATER**:

- Inspect for and remove mud, plants and organisms from your boat hull, trim plates, anchors and trailer.
- Remove all water from your boat and equipment: drain your boat's bilge, live wells and engine cooling system; dump bait buckets.
- Dry anything that comes into contact with the water for five to seven days in the sun before traveling to another waterbody
- If you find clams, wash down the boat with hot water (140° F) and allow the boat and trailer to sit for two to seven days to dry and/or spray down gear with a 10 percent bleach solution and let the solution stand for a few minutes before rinsing clean
- The best defense against Asian clams is to prevent them from entering New Hampshire's waters. However, when they arrive, we all need to take part in ensuring that this invasive species does not continue to spread. DES and the Fish and Game Department are collaborating to identify occurrences of this species in New Hampshire.

ENVIRONMENTAL Fact Sheet



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Didymo

(*Didymosphenia geminata*)

During the summer of 2007, the first population of Didymo (also called, "rock snot") was found in the Connecticut River in Pittsburg, N.H.

This non-native and invasive alga forms thick mats of felt-like growth on rocks, and can impair the recreational and ecological values of waterways in the state. Below are some frequently asked questions about rock snot, and the answers to each question.



What is Didymo? Didymo is the common name for *Didymosphenia geminata*, an invasive freshwater diatom (microscopic alga). Didymo can form extensive "blooms" on the bottoms of rocky river beds, essentially smothering aquatic life forms such as macro invertebrates (aquatic insects), native algae, and other organisms. Didymo uses stalks to attach to rocks and plants in a river system. The diatom actually creates these stalks, which can form masses 3 inches to 5 inches thick on the river bottom, and trail for lengths of 2 feet to 3 feet in the current. It is actually the stalks that are more problematic than the alga. The alga will eventually die off and decompose, while these stalks tend to persist for several months on the river bottom.

Where did it come from? Didymo is generally a northern circumpolar species, found in colder, low nutrient, high clarity streams. We are noticing, however, a shift in the habitats where Didymo can survive now, which includes streams in warmer climates, streams with more nutrients, and streams with moderate clarities and even some tannic (tea colored) waters. Didymo is currently found in Europe (Scotland, Poland) and it is spreading throughout the Northwest U.S. It is also in Quebec and British Columbia. New Zealand has been particularly hard hit by the Didymo problem. We believe Didymo was introduced to this region by contaminated fishing/wading gear.

Why is Didymo a problem? Didymo will change the bottom appearance, structure, and food web of a stream. Ecologically, common macro invertebrates found on the bottoms of well-oxygenated streams will change to more worm-like and snail populated communities. Aesthetically, the brownish-white flowing masses of stalk structures are unpleasant to see and recreate in.

What is the current distribution in the Northeast? As of fall 2007, Didymo extends from just north of Lake Francis in Pittsburg, down through Northumberland, N.H. In other states, portions of the White River in Vermont downstream of the Stony Brook confluence are infested, and the Batten Kill River between Vermont and New York has some populations of Didymo. Most recently, the East and West Branches of the Delaware River in New York and Pennsylvania support populations of this alga.

What does it look like? Didymo is often described as looking similar to a sewage spill with wet toilet paper streaming in the waterbody. This is the result of the stalk material becoming long and shredding at the ends, and bleaching white. These mats have a slimy appearance, but are not slimy at all to the touch.

Over time, the bloom may take on a brownish/floppy appearance as sediment particles become embedded within the stalks.

What does it feel like? Didymo feels like wet felt, wool, or cotton balls. It is hard to pull apart, and hard to remove from the substrate it has attached to. In contrast, most other algae species feel slimy and will slip through your fingers.



Does it smell or have an odor? Generally, no. There is no distinctive odor or smell associated with the alga or the stalk material.

In what types of habitats/conditions is Didymo generally found? Didymo is found in river systems with stable substrates such as cobble or rock bottoms. Water conditions are usually clear, cool (optimal temperature is about 60°F), have high light penetration, and lower nutrient concentrations. Flow conditions are generally moderate to moderately fast.

How does Didymo spread? This alga is so small it can go unobserved when it is a single algal cell on the bottom or in the water column. Additionally, the alga can remain viable for several weeks if kept moist. Because of this, spread of the alga is unfortunately easy. Felt soled waders are often particularly to blame, since fishermen use them to gain a grip on slippery, rocky bottomed areas. The alga easily becomes attached to the felt, and if not properly cleaned or thoroughly dried before use, the diatom can spread to another waterbody. Any other recreational equipment, including bait buckets, neoprene diving gear, water shoes/sandals, canoes, kayaks, and life jackets, to name a few.

Will we ever get rid of it? There is no means of “eradication” for this alga. Copper sulfate complexes can be used, but they are not 100 percent effective. Some algae will survive and float downstream and form new colonies. Many researchers across the globe are currently working on control and eradication methods.

Can Didymo grow in lakes? Yes, since Didymo is an alga, it can certainly grow in lakes, ponds, or other freshwater systems. Didymo generally will not reach bloom conditions in these types of systems, however. Didymo will mostly be a problem in river systems. In fall 2007, biologists from the N.H. Fish and Game Department noted the presence of Didymo attached to

some of the nets deployed for a period of time for fisheries sampling in Lake Francis.

What do I do if I think I saw Didymo? First, consult the link on the Didymo page www.des.nh.gov/wmb/exoticspecies called “How to Tell if You May Be Seeing Didymo” to determine if the specimen is worth collecting. If yes, then collect a representative sample of what you are seeing, and send it to the N.H. Department of Environmental Services or the Vermont Department of Environmental Conservation. Addresses are listed on the identification page. Please send samples to the agency in the state where the sample was collected. Include a location description, estimate of the area that is impacted, and date/time the sample was collected. GPS coordinate are also very helpful, if you have a GPS unit handy. Samples can be folded into a business card, or placed into a jar or plastic baggie.

What is the response strategy that is being taken to combat this problem species? The biologists from both the Vermont and the New Hampshire environmental agencies have met and will be coordinating on strategies to track and monitor Didymo spread. Signage is available from either state agency, or by download from www.des.nh.gov/wmb/exoticspecies on the Didymo page. Laboratory personnel in each state are prepared to examine specimens that are sent in for identification. We are all now just learning how to respond and contain (if possible) this new threat to our waterbodies. More information will be posted on the New Hampshire/Vermont Didymo websites as it becomes available.

What should I do? We prescribe a “CHECK and CLEAN” protocol.

CHECK – Remove all visible clumps of algae and plant material from fishing gear, waders, clothing, water shoes and sandals, canoes and kayaks, *and anything else* that has been in the water.

CLEAN – Soak and scrub all items for at least 10 minutes in *very hot water* with lots of soap. Felt-soled waders need 30 minutes!

For more information on aquatic invasive species visit:

<http://des.nh.gov/organization/divisions/water/wmb/exoticspecies/index.htm>

Spiny Water Flea (*Bythotrephes longimanus*)



(Photo source: Minnesota Sea Grant)

What is Spiny Water Flea? Spiny water flea (*Bythotrephes longimanus*) is a tiny crustacean related to native forms of zooplankton, such as *Daphnia*, but ranges up to about one half-inch in size, over ten times larger than native water fleas! The elongated, barbed tail of this non-native organism protects against predation by small juvenile fish that have difficulty ingesting the tail spine.

Where did it come from? Spiny water flea is native to Eurasia and was introduced into the Great Lakes via freighter ballast in the mid-1980s. It was discovered in Great Sacandaga Lake, N.Y. in September 2008, in Lake George, N.Y. in 2012, and in Lake Champlain N.Y./V.T. in 2014.

Why is Spiny Water Flea a threat? This non-native organism threatens fishing in two ways:

1. Spiny water fleas compete with juvenile sport fish for food. Both the spiny water flea and young fish prey almost entirely on native water fleas and other zooplankton. Research has shown that spiny water flea predation is capable of reducing the diversity and density of native zooplankton, thus impoverishing the food chain that sustains adult fish.

2. The barbed tail of this organism catches on fishing gear, especially fishing lines and downrigger cables. Masses of the organism can accumulate as gelatinous, cotton-like clumps, fouling gear, and interfering with fishing.

How does Spiny Water Flea spread from one water body to another? Research has shown that human recreation involving boats is the principle mechanism of transfer of non-native species between water bodies. Boating is an activity that is extremely vulnerable to

“hitch-hiking” by non-native organisms because so many surfaces, nooks, and crannies of nautical gear are immersed in water. This is especially true of the spiny water flea because it produces thick-walled “resting” eggs that can remain dormant for long periods of time and are resistant to environmental extremes. These eggs even survive passage through the digestive tracts of fish. Adult spiny water fleas snagged during boating or fishing may contain resting eggs. These eggs can survive for extended periods after being tangled with downriggers, anchor line, trailer parts, and fishing gear. Consequently, resting eggs are insidious “stowaways” and contribute greatly to the rapid dispersal of this non-native organism from infested lakes to clean ones. There is no way to eradicate spiny water flea once it is introduced into a waterbody.

What can you do to keep Spiny Water Flea out of our waters? The only hope for excluding spiny water flea from our waters is personal vigilance on the part of each and every visiting boater and angler.

If you move your boat among various water bodies, you are the highest probability carrier of non-native organisms from waterbody to waterbody.

Clean, Drain and Dry! If you visit more than one waterbody per season, please scour your boat, trailer, bait buckets, fishing gear, and anything else exposed to outside waters and remove all plant fragments, mud, and debris. Drain water from bilge, engine, and live wells, and allow all of the above to dry completely for at least five days before visiting another waterbody.



(Photo source: Minnesota Department of Natural Resources)

This information on the spiny water flea was adapted from the Massachusetts Department of Environmental Conservation Spiny Water Flea Alert. (www.mass.gov)

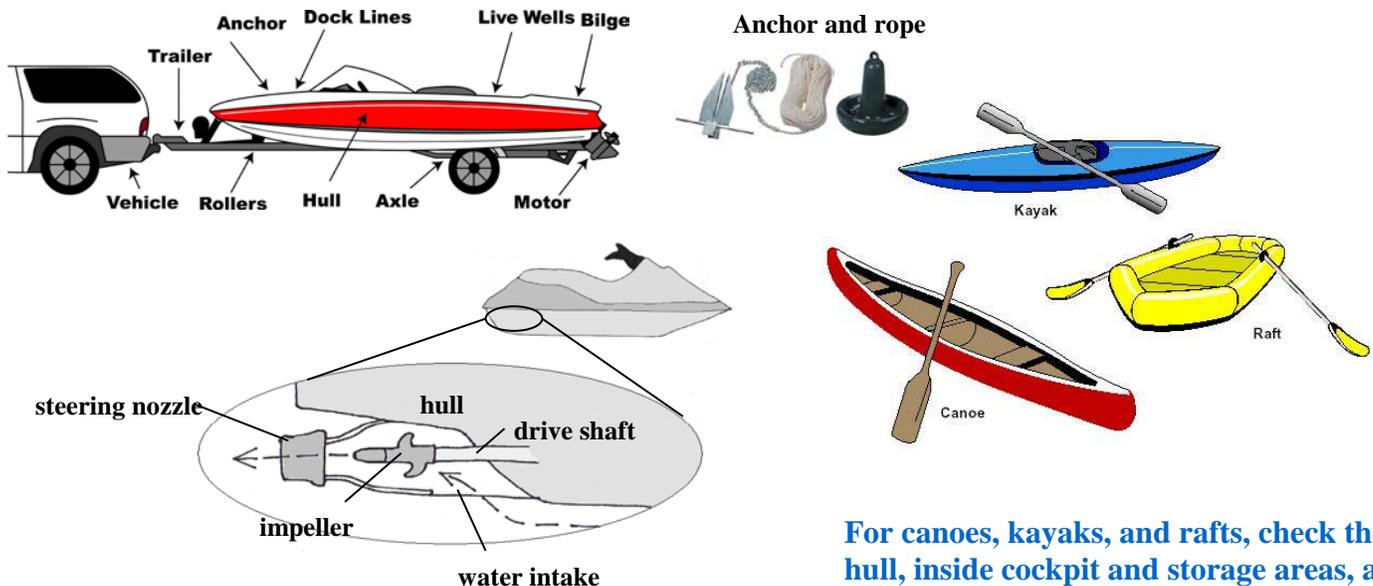
“Clean, Drain & Dry!” - A guide for boaters

CLEAN:

- **Inspect** boat and trailers before entering *and* after leaving the water.
- **Remove** all visible plants, animals, mud, and other debris.
- **Dispose** of all removed debris and **encourage** boaters to dispose of all unused bait and unwanted fish parts in a proper container away from the water.
- **Encourage** boaters to inspect all live wells, recreational gear, including fishing gear, and anchor and to remove all debris. (*It is possible that Asian clams are transported on anchor sediment.*)
- **Inspecting Jet Powered Craft:** Personal watercraft have a jet drive system which requires some extra precautions to avoid spreading aquatic invasive species. A pump pulls water in through an opening under the craft, and the impeller (an internal propeller) forces water out, moving the craft forward. Invasive species can become stuck in the jet drive system and get transported from one waterbody to another.
 - Before entering and after leaving the water, ask the boat owner to start and run the engine for a second or two to blow out any excess water and debris. (Make sure no one is standing directly behind the watercraft!)
 - After the engine has stopped, pull out any plants or other debris that is still in the steering nozzle.
 - Check under the craft for the water intake for plant fragments.

Watercraft Inspection Check Points:

Check these areas and remove all hitchhiking debris!



For canoes, kayaks, and rafts, check the hull, inside cockpit and storage areas, and all paddles and the trailer it came in on.

DRAIN:

- **After boating and before leaving the launch:** Open all drain plugs and drain water from the motor, bilge, live wells, bait buckets, and other locations where water collects. Keep drain plugs open between waterbodies.
- **After leaving the launch:** Flush/rinse boats, trailers, bait buckets and other recreational gear with clean water (the higher the temperature and higher the pressure of the rinse water the better) in a location where the rinse water will not flow into a waterbody, catch basin, or other storm drain structure.

DRY:

- Allow your boat, trailer, and recreational gear to dry for at least 5 days before being used in another waterbody.
- **If boaters do not have 5 days drying time:** Rinse off boat, trailer, and all gear with clean water where the runoff water will not flow into a waterbody or storm drain system) and then towel dry.