

# Fanwort: An Invasive Aquatic Plant

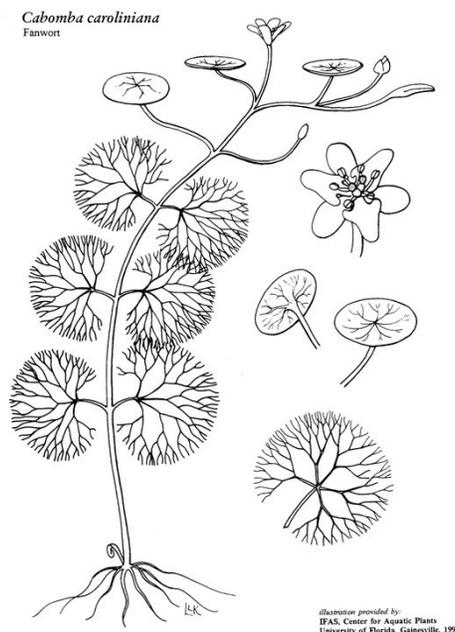
## *Cabomba caroliniana*



### Description

- Fanwort is a submerged invasive aquatic plant that can form dense mats at the water surface.
- The delicate green underwater leaves are fan-like and average 2 inches across. Leaves are arranged in opposite pairs on the stem. Small oval floating leaves are occasionally present.
- Small diamond-shaped floating leaves with the stem attached in the center may develop.
- Tubular stems can attain lengths of 6 feet.
- The white or cream flowers are ½” wide and form during May through September; however, some variations of Fanwort have pinkish or purplish flowers.

### Fanwort



### Habitat

Fanwort is a very hardy and persistent species that has established itself in a wide range of aquatic habitats. Fanwort is native to southern United States, but is non-native in northern regions.

- Over-winters in the frozen lakes of northern climates and can thrive in warm southern water bodies.
- Grows under a wide range of water chemistry conditions and can be found in both oligotrophic (low nutrient) and eutrophic (nutrient rich) lakes. Fanwort can tolerate a wide range of temperature and pH.
- Prefers slow moving waters, including lakes and ponds, but occasionally can be found in rivers.

## Distribution Map



## Reproduction

Fanwort reproduces by both vegetative methods and seed formation.

- Vegetatively, *C. caroliniana* reproduces by stem (rhizome) fragmentation. Stems are very fragile, fragment easily and most pieces can re-sprout and grow into new plants
- Seeds are also formed, and Fanwort can re-grow from seeds remaining in lake or pond sediment.

## Impacts and Threats Posed by Fanwort

Fanwort is a highly competitive plant that is capable of rapid growth and spread. Fanwort can displace native species, reduce biodiversity, hamper recreational uses, reduce real estate value, diminish aesthetic values, and decrease water quality.

- Once established, Fanwort can negatively impact and out-compete native vegetation. Fish and animals that were dependent on the native vegetation must relocate or perish, leading to a decline in biodiversity.
- Fanwort can greatly impede boaters, fisherman, water skiers and swimmers, and these limitations on water use can negatively impact real estate values.
- *C. caroliniana* produces dense large mats of vegetation on the water surface, thus intercepting sunlight to the exclusion of other submerged plants.
- Sediment levels increase with increasing Fanwort abundance.
- When dense mats of Fanwort decay, the available oxygen in the water may be depleted. The resulting low oxygen conditions (anoxic) can lead to fish kills and harm other aquatic organisms.

## Management Methods

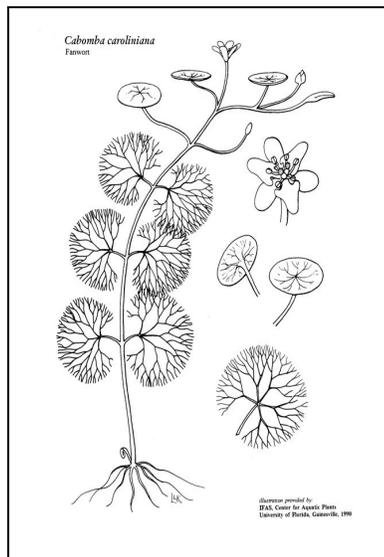
Management methods currently include mechanical removal, drawdowns and herbicides. No known biological controls exist.

- Although harvesting can greatly reduce the Fanwort biomass in a water body, harvesting causes fragmentation and fragments are capable of producing new plants. Some fragments may drift down stream or attach to boats and wildlife and create new infestations elsewhere.
- Drawdowns can be an effective mode of Fanwort control if the drawdown is of an adequate time and depth to prevent re-growth from seeds, however, drawdowns may affect fish, aquatic organisms, reptiles, amphibians and downstream conditions.
- Several herbicides have been used to control Fanwort, but the most effective is Fluridone (a systemic herbicide).
- Benthic barriers may be used in small areas including swimming beaches, boating lanes and around docks. The barriers restrict light and upward growth but can have a negative impact on benthic organisms, and need to be properly anchored and maintained.

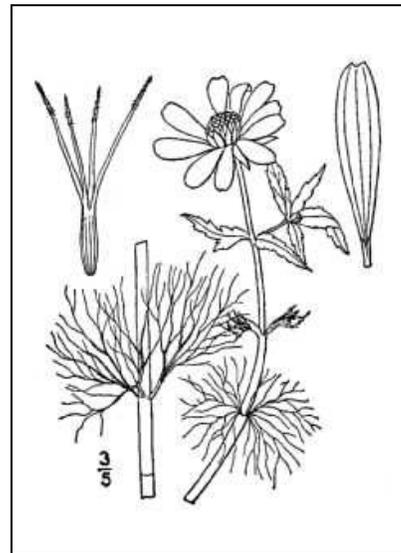
## Other Information

- Fanwort is on the Massachusetts Prohibited Plant List (as of January 1, 2006).
- Fanwort was first discovered in 1930 in Hatfield, MA. Since then, despite management efforts, Fanwort has spread throughout most of New England. Due to its delicate appearance Fanwort is still in high demand at pet stores, aquarium dealers and over the Internet.
- Informational websites:  
<http://aquat1.ifas.ufl.edu/welcome.html> (Center for Aquatic Invasive Species, Florida)  
[www.ccy.wa.gov/programs/wq/plants/weeds/cabomba.html](http://www.ccy.wa.gov/programs/wq/plants/weeds/cabomba.html) (Washington State Ecology Dept.)  
[www.ProtectYourWaters.net](http://www.ProtectYourWaters.net) (Aquatic Nuisance Species national web site)
- Fanwort is often confused with the native Water Buttercup (*Ranunculus*) and Water Marigold (*Megalodonta beckii*). (see drawing below)
  - Water Buttercup has leaves that are arranged singly on the stem, not in opposite pairs.
  - Water Marigold has opposite leaves that attach directly to the stem with no petiole between the leaf and stem.

### Fanwort compared to native Water Marigold



Fanwort



Water Marigold

## References:

- 1) [www.mass.gov/dcr/waterSupply/lakepond/geir.htm](http://www.mass.gov/dcr/waterSupply/lakepond/geir.htm) (Generic Environmental Impact Report)  
<http://plants.ifas.ufl.edu/cacapic.html> (Center for Aquatic and Invasive Species)  
<http://www.bio.umass.edu/biology/conn.river/cabomba.html> (UMass- Conn. River Page)  
<http://www.ecy.wa.gov/programs/wq/plants/weeds/cabomba.html> (WA State Dept. of Ecology)
- 2) Photographs were obtained from:  
Kerry Dressler 1996 (cover photograph)  
<http://aquat1.ifas.ufl.edu/> (line drawing of Fanwort)  
[http://plants.usda.gov/cgi\\_bin/plant\\_profile.cgi?symbol=MEBE2](http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=MEBE2)  
(Line drawing of Water Buttercup from USDA Plant Profile website)
- 3) The distribution map was taken from:  
<http://plants.ifas.ufl.edu/cacapic.html> (Center for Aquatic and Invasive Species)

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or visit the Lakes and Ponds website at: [www.mass.gov/lakesandponds](http://www.mass.gov/lakesandponds)

Prepared by Michelle Robinson: November 2002

## Variable Milfoil: An Invasive Aquatic Plant

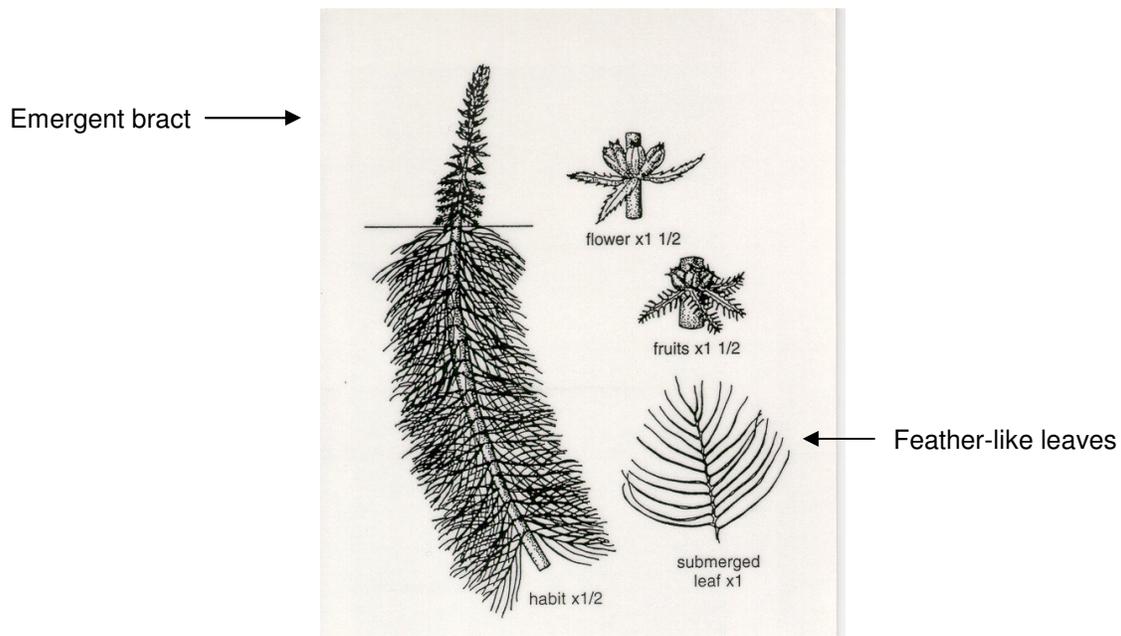
*Myriophyllum heterophyllum*



### Description

- Variable Milfoil is an aquatic rooted, submerged non-native plant with a “raccoon-tail” or pipe cleaner appearance.
- Variable Milfoil can form dense mats at the water surface and can grow in the photic zone, in up to 10 feet of water.
- The delicate green underwater leaves are feather-like and average ½ to 2 inches across. Leaves are arranged around the stem in whorls of 4-6. The leaves have 6-12 segments.
- During late summer a 4-6 inch emergent bract develops, protruding above the water surface. The small bright green leaves on the bract are oval and are both serrated and non-serrated. (The lower female section of the bract has serrated leaves, and the upper male portion has smooth margins).
- The stems are thick, robust and usually red.

### Variable Milfoil



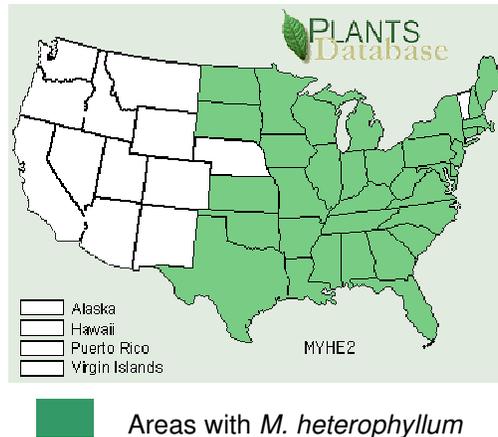
### Habitat

Variable Milfoil is a hardy species that has established itself in a wide range of aquatic habitats.

- Over-winters in the frozen lakes of northern climates and can thrive in warm southern water bodies.
- Grows under a wide range of water chemistry conditions, can be found in acidic and calcium-rich lakes and can tolerate a wide range of temperatures.
- Prefers slow moving waters, including lakes and ponds, but occasionally can be found in rivers.
- Found state wide, but tends to prefer the acidic waters of eastern Massachusetts

## Distribution Map

### *Myriophyllum heterophyllum*



## Reproduction

Variable Milfoil reproduces by both vegetative and sexual methods.

- Vegetatively, *M. heterophyllum* reproduces by fragmentation, rhizome division and asexually by budding.
- Although it is not as common, *M. heterophyllum* can re-grow from seeds remaining in lake or pond sediment.

## Impacts and Threats Posed by Variable Milfoil

Variable Milfoil is a highly competitive plant that is capable of rapid growth and spread. Variable Milfoil can displace native species, reduce biodiversity, hamper recreational uses, reduce real estate, diminish aesthetic values and decrease water quality.

- Once established, Variable Milfoil can out-compete native vegetation. Species that depend on that native vegetation to survive are forced to relocate or perish, resulting in a loss of biodiversity.
- Variable Milfoil produces dense large mats of vegetation on the water surface, thus intercepting sunlight leading to the exclusion of other submerged plants.
- As Variable Milfoil plants die and sink to the lake bottom, sediment levels increase.
- Variable Milfoil greatly impedes boaters, fisherman, water skiers and swimmers, and these limitations on water use can negatively impact real estate values.
- When dense mats of Variable Milfoil decay, the available oxygen in the water is depleted. The resulting low oxygen conditions (anoxia) can lead to fish kills and harm other aquatic organisms.



## Management Methods

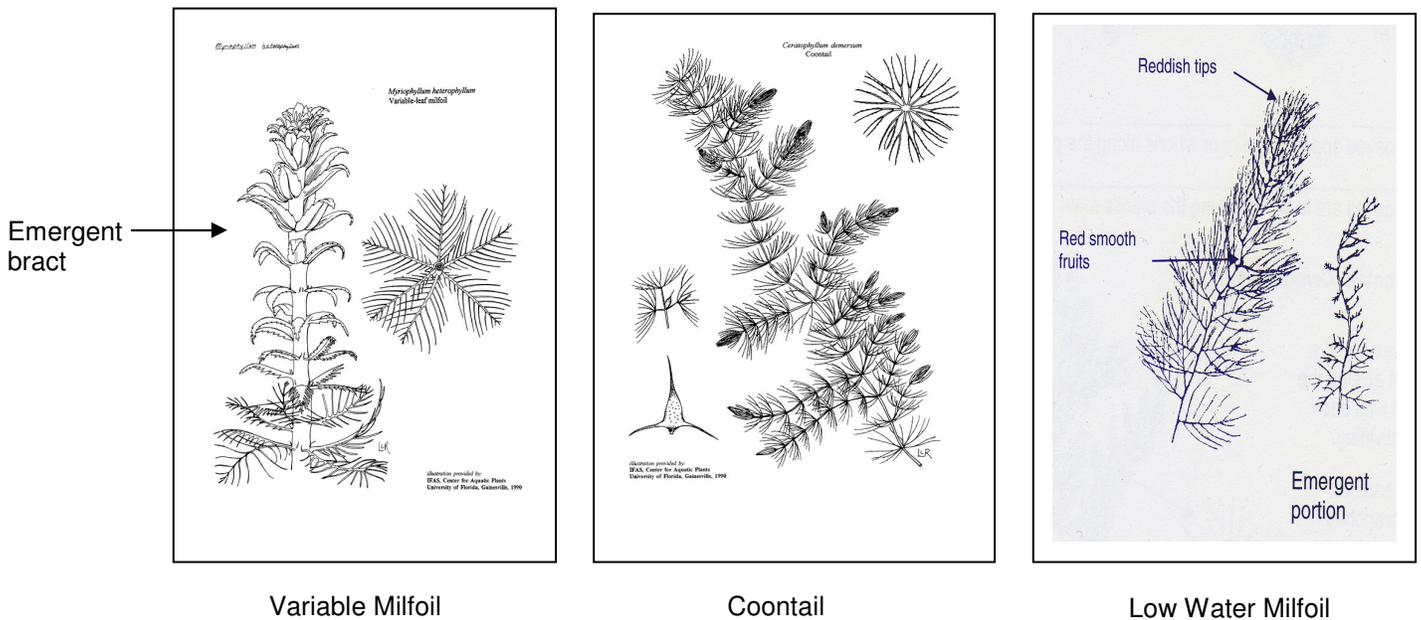
Management methods currently include mechanical removal, drawdowns, and herbicides. No known biological controls exist.

- Although harvesting can greatly reduce the Variable Milfoil biomass in a water body, harvesting also causes fragmentation, and fragments are capable of producing new plants. Some fragments may drift down stream or attach to boats and wildlife and create new infestations elsewhere.
- Drawdowns can be an effective mode of Variable Milfoil control if the drawdown is extensive enough to prevent re-growth from seeds. Drawdowns may impact fish, aquatic organisms, reptiles, amphibians and downstream conditions.
- Several herbicides have been used to control Variable Milfoil, including Diquat and 2,4-D.
- Benthic barriers may be used in small areas including swimming beaches, boating lanes and around docks. The barriers restrict light and upward growth but can have a negative impact on benthic organisms, and need to be properly anchored and maintained.

**Other Information**

- Variable Milfoil is on the Massachusetts Prohibited Plant List (as of January 1, 2006)
- Variable Milfoil is occasionally sold in pet stores as Red Foxtail.
- Informational web sites:
  - <http://aquat1.ifas.ufl.edu/welcome.html> (Center for Aquatic Invasive Species, Florida)
  - [www.ProtectYourWaters.net](http://www.ProtectYourWaters.net) (Aquatic Nuisance Species national web site)
  - <http://www.state.me.us/dep/blwq/topic/invasive.htm> (Maine DEP web site)
- Variable Milfoil is often confused with the native Coontail (*Ceratophyllum*), Low Water Milfoil (*Myriophyllum humile*), and endangered Farwell's Milfoil (*Myriophyllum farwellii*).
  - The leaves of Coontail are branched (the stem continues to fork and split) where as Variable Milfoil has leaves that are feathered (like a bird feather).
  - Although both the native Low Water Milfoil and exotic Variable Milfoil have feathered leaves, the native Low Water Milfoil has very limp leaves that are alternate, not whorled. Low Water Milfoil does *not* form a stiff emergent bract with variable-type leaves, instead it develops a delicate emergent portion and smooth fruits at the leaf axils.
  - Farwell's Milfoil looks similar to Low Water Milfoil, but under close inspection, the fruits have ridges and bumps (not smooth).

**Variable Milfoil compared to native Coontail and Low Water Milfoil**



**References:**

- 1) Literature sources:
  - <http://www.mass.gov/dcr/waterSupply/lakepond/geir.htm> (Generic Environmental Impact Report)
  - [www.rook.org/earl/bwca/nature/aquatics/myriophyllumhet.html](http://www.rook.org/earl/bwca/nature/aquatics/myriophyllumhet.html)
  - <http://www.wapms.org/plants/milfoil.html> (Western Aquatic Plant Managers Society)
- 2) Photographs were obtained from:
  - Unknown (cover photo)
  - <http://www.state.me.us/dep/blwq/topic/invasive.htm> (guy in canoe, Maine DEP)
  - <http://www.state.me.us/dep/blwq/doclake/varldr2.jpg> (first line drawing of Variable Milfoil)
  - A Guide to Aquatic Plants in Massachusetts (line drawings of Coontail and Low Water Milfoil)
- 3) The distribution map was taken from:
  - [http://plants.usda.gov/cgi\\_bin/topics.cgi](http://plants.usda.gov/cgi_bin/topics.cgi) (USDA Plant Data Base)

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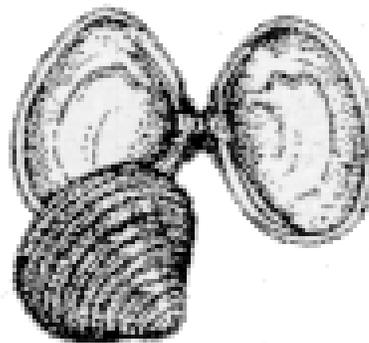
**Established**  
**Asian Clam: An Exotic Aquatic Species**  
*Corbicula fluminea*



**Description**

- Asian clams are native to South East Asia and were first reported on the west coast of the United States around 1930. They have since spread to over 39 states, including three waterbodies in Massachusetts.
- Asian Clams are small, averaging less than 25mm (1.5 inches) and rarely exceed 50 mm.
- Shells are light green/light brown with distinctive elevated concentric ridges on their shell.
- Asian Clams have two lateral teeth and 3 cardinal teeth visible inside their shell.

**Asian Clam**

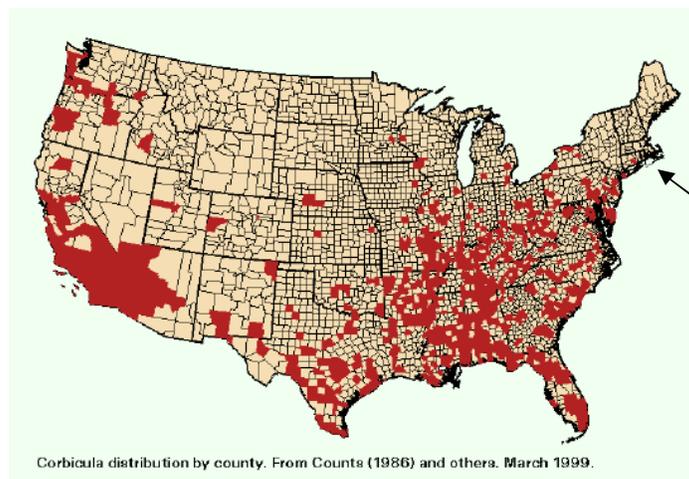


**Habitat**

The Asian Clam is a very hardy and persistent species that has become established across the United States above 40<sup>o</sup> latitude.

- Asian Clams prefer quiet waters with low salinity and sandy substrates, however, populations have been found thriving in brackish estuaries and in water bodies with silty sediments.
- Asian Clams prefer to colonize sunlight warmer areas near the shore, and typically avoid the low oxygen levels and cooler conditions associated with the deeper layer (hypolimnion) of the water body. Usually, due to their short siphons, one third of the shell protrudes above the substrate.
- Although they are able to withstand freezing conditions, their ability to reproduce decreases with exposure to lower temperatures.
- This species has been documented in a few locations in MA, and is established in bordering states (VT NY).

## Distribution Map



Asian Clams are established in Webster Lake and Tispaquin Pond. A pioneer infestation was documented in Fort Meadow Reservoir in 2005. There were also sightings of Asian Clams in the Charles River in the 1970's.

## Reproduction

Mature Asian Clams are hermaphroditic and it is believed that they occasionally self fertilize. The young are incubated within the safety of the parent's shell, and are released 4-5 days later. The young microscopic pediveligers travel along the substrate to new locations and attach to any available suitable substrate with byssus fibers. Young that are hatched in the spring usually attain sexual maturity by the fall, and may live for up to seven years. Asian Clams typically spawn between July and September.

- Asian Clams can release over 320-387 offspring *daily*, depending on the conditions.
- Water temperature extremes (above 37<sup>o</sup> C and below 1<sup>o</sup>C) can inhibit spawning.

## Impacts and Threats Posed by Asian Clam

Asian Clam is a prolific and highly competitive species that is capable of rapid growth and spread. Asian Clam can displace native species, reduce biodiversity, alter the food chain, and damage equipment (including boat motors, intake pipes, diving gear, commercial water systems).

- Asian Clams can clog intake pipes causing boat engines to overheat, power plant cooling systems to fail and result in millions of dollars of damage each year.
- Asian Clams are efficient filter feeders that consume microscopic plants and animals from the base of the food chain, and their intensive filtering activity can drastically decrease the quantity of food available in the waterbody. Many juvenile fish species require a source of microscopic plants and animals to eat in order to survive and must compete with the Asian Clams for food. A decrease in the survival rate of juvenile fish can impact the entire the fish population in future years.
- Asian Clams form dense clusters, often over 6000 animals per square meter. The heavy clusters occasionally cover the benthic area of a waterbody, destroy historic underwater sites and alter the benthic community.
- Many native mussels are now threatened and in danger of becoming extinct due to infestations of Asian Clams.

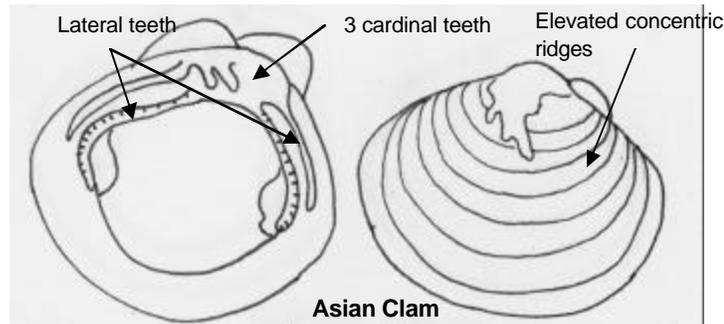
## Management Methods

Management methods currently include mechanical methods, chemical control and temperature alteration, although many of these are not suitable options for lakes and ponds

- Clusters of shells can be removed manually by labor intensive scraping. Although this removes the mussels, microscopic veligers remain in the water and will re-colonize the area.
- Birds, raccoons, bass, carp and numerous other species consume Asian Clams, however, there are too few of these predators to have a significant impact on the overall Asian Clam population.
- Heating the water in pipes above 27<sup>o</sup> C can kill adults and larva.
- Exposure to extended periods drying, high salinity, and low concentrations of chlorine or bromine can kill adult and juvenile stages of *Corbicula*, however this is more suitable for factories than lake managers.
- Prevention is the best line of defense when dealing with Asian Clams. In 1987 Massachusetts passed a regulation that prevents the importation, sale or transport of this species.

### Other Facts:

- It is believed that Asian Clams were introduced by Chinese immigrants who intended to harvest the clams as a food source.
- There are two morphs of Asian Clam in the United States. The dark morph is found in the southwest, and the light morph is common in the northeast.
- Researchers are investigating the possibility that there are two separate species of Asian Clam, *Corbicula fluminalis* and *Corbicula manilensis*.
- Asian Clams are still sold commercially as bait throughout the United States, and in the aquarium trade as pygmy or gold clams.
- Asian Clams can be confused with native Fingernail Clams, however, Fingernail Clams lack the three cardinal teeth and two lateral teeth.



### Prevent The Spread!

- Never release any plant or animal into a waterbody unless it came from that waterbody.
- Flush engines, dispose of bait, bilge water, bait bucket water on dry land away from shore.
- Report any suspected sightings of this species ASAP to [michelle.robinson@state.ma.us](mailto:michelle.robinson@state.ma.us)
- Spread the word to other boaters and fisherman.

### Other Exotic Species Informational websites:

<http://nas.er.usgs.gov/queries/plants/PlantState.html> (USGS- search for exotic species by state)  
[www.ProtectYourWaters.net](http://www.ProtectYourWaters.net) (Aquatic Nuisance Species national web site)

### References:

#### 1) Literature References:

- USGS Exotic Species Website: [http://nas.er.usgs.gov/mollusks/docs/co\\_flumi.html](http://nas.er.usgs.gov/mollusks/docs/co_flumi.html)
- Gulf States Marine Fisheries Commission [http://nis.gsmfc.org/nis\\_alphabetic\\_list.php#mollusks](http://nis.gsmfc.org/nis_alphabetic_list.php#mollusks)
- Illinois Natural History Survey [www.inhs.uiuc.edu/cbd/musselmanual/page174\\_5.html](http://www.inhs.uiuc.edu/cbd/musselmanual/page174_5.html)
- SGNIS "Aquatic Immigrants of the Northeast. No. 4: Asian Clam, *Corbicula fluminea*" Balcom, N.C., 1994 Connecticut Sea Grant College Program

#### 2) Photographs were obtained from:

Asian Clam: Noel M. Burkhead- USGS

1<sup>st</sup> Asian Clam line drawing: EPA website at: [www.epa.gov/maia/images/clam.gif](http://www.epa.gov/maia/images/clam.gif)

2<sup>d</sup> Asian Clam line drawing: re-drawn by Michelle Robinson

#### 3) The distribution map was taken from:

USGS Exotic Species Website: [http://nas.er.usgs.gov/mollusks/docs/co\\_flumi.html](http://nas.er.usgs.gov/mollusks/docs/co_flumi.html)

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Or visit the Lakes and Ponds web site at: <http://www.mass.gov/lakesandponds>

Prepared by Michelle Robinson: January 2004



## STOP AQUATIC HITCHHIKERS!

Prevent the transport of nuisance species.  
Clean all recreational equipment.  
[www.ProtectYourWaters.net](http://www.ProtectYourWaters.net)