

Aquatic Invasive Species Identification and Surveying Protocol

NOT FOR DISTRIBUTION



Samantha Epstein

Invasive Species Program Coordinator

Hudson River Sloop Clearwater

General Overview

An invasive species is defined as one that is non-native to the ecosystem, causes harm or has the potential to cause harm to the economy, ecology, or to human health, and the species' harmful impacts significantly outweighs its benefits. Some of the invasive species found in the Lower Hudson Region are already widespread, while others can be established, emerging, or still a threat. There are also species that are approaching the region, and can be found in neighboring regions.

This Field Guide is a tool to help volunteers identify common aquatic invasive species found in the Lower Hudson region, as well as species that are approaching from neighboring regions. It will also cover surveying and data collection protocol.

New Regulations

A new amendment to Subdivision (i) of § 377.1 of Title 9 NYCRR has been approved by the New York Office of Parks, Recreation, and Historic Preservation that is designed to control the introduction and spread of aquatic invasive species at facilities under OPRHP jurisdiction. Under the newly amended legislation, one must take *reasonable precautions* to stop the spread of AIS:

- Summarized: Prior to launching and when leaving the site, the operator shall inspect for and remove any plant, aquatic life or animal, or parts thereof, and dispose in designated receptacles or in such a manner to avoid contact of the material with the waterbody. Measures must also be taken before arriving at a new site or leaving the current site to drain the watercraft (bilge area, livewells, bait wells, and ballast tanks) – Effective Nov. 12, 2014

NY Senate also amended the navigation law to include a section about universal AIS signage at launches.

- Summarized: The Department of Environmental Conservation will design and establish universal signage which will be posted at any access point to the navigable waters of the state relating to the threat and mitigation of AIS. Owners of each public boat launch shall conspicuously post the universal sign at each public boat launch in the state

Prohibited Species

New York State has listed numerous terrestrial and aquatic species as prohibited and regulated. These new regulations were published in September 2014, and became effective in March 2015. The new regulation (6 NYCRR Part 575 Prohibited and Regulated Invasive Species) prohibits 69 plants, 15 fish species, 17 aquatic invertebrates, 5 terrestrial and aquatic vertebrates 3 species of algae and cyanobacteria, and more. These prohibited species range from the mute swan to hydrilla to the spiny water flea.

Aquatic Invasive Species now prohibited in NY include:

- Killer Green Algae
- Didymo
- Golden Algae
- Fanwort
- Brazilian Waterweed
- Hydrilla, Water Thyme
- European Frogbit
- Yellow Iris
- Purple loosestrife
- Parrot-feather
- Broadleaf Water-milfoil
- Broadleaf water-milfoil hybrid
- Eurasian watermilfoil
- Yellow floating heart
- Curly leaf pondweed
- Water chestnut
- Northern Snakehead
- Bullseye Snakehead
- Giant Snakehead
- Walking Catfish
- Western Mosquitofish
- Eastern Mosquitofish
- Largescale Silver Carp
- Silver Carp
- Bighead Carp
- Oriental Weatherfish
- Black Carp
- Round Goby
- Sea Lamprey
- Tubenose Goby
- Tench
- Chinese Mystery Snail
- Japanese Mystery Snail
- Faucet Snail
- Spiny Water Flea
- Fishhook Water Flea
- Asian Clam
- Suminoe Oyster
- Carpet Tunicate
- Zebra Mussel
- Quagga Mussel
- Chinese Mitten Crab
- Asian Shore Crab
- Bloody Red Shrimp
- Rusty Crayfish
- New Zealand Mud Snail
- Vined Rapa Whelk
- Asian Sea Squirt
- Mute Swan

Chinese Mystery Snail

Cipangopaludina chinensis/Bellamya chinensis

Identification:

- Shell is large, spherical, smooth
- Coloring:
 - Outer shell is light as a juvenile and olive green, greenish brown, or reddish brown as an adult
 - Inner shell is white to pale blue
- Operculum (“trapdoor”) is concentrically marked with no banding
- Shells have 6-8 whorls that are strongly rounded and each suture where the whorls join is very indented
- Shell length can reach 2.5 inches
- Outer lip of shell is blackish and either round or oval

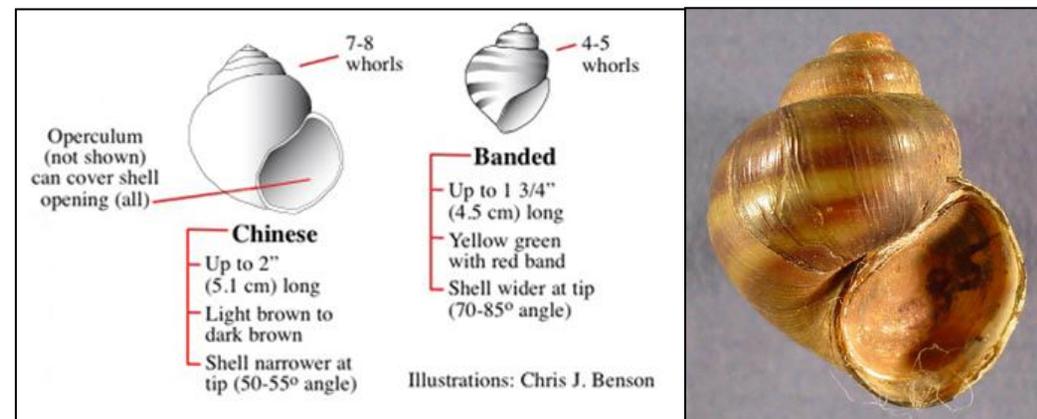


Habitat:

The Chinese mystery snail can be found in lakes, ponds, and slow moving rivers or streams.

Lookalike:

Banded Mystery Snail – has red bands that run parallel to the whorls of the shell. Shells can reach 1 ¾ inches long.



Banded mystery snail

Zebra Mussel

Dreissena polymorpha

Identification:

- Shell triangular with a sharply pointed shell hinge end
- Grows up to 5 cm but rarely exceeds 4 cm
- Prominent dark and light banding pattern on the shell
 - Tan with broad, transverse color bands that are either smooth or zigzag in shape
- Attached to hard surfaces using byssal threads – sometimes found on loose, individual mussels
 - Hair-like strands coming out of the hinge
- Shell has a D-shape, giving it a straight midventral line and a prominent ridge
- Sits flat on its ventral side, unlike other mussel species

Habitat:

Zebra mussels can tolerate a wide range of environmental conditions. They prefer temperatures between 68F and 77F, and water currents 0.15 – 0.5 m/s. The zebra mussel is a freshwater species but can adapt to brackish waters up to 2.5 ppt. They can be found in overly enriched lakes or those with high calcium content.



Lookalikes:

Quagga mussel – has rounded carina and a convex central side (determined by placing shells on ventral side – quagga mussels will topple over). Quaggas a rounder in shape. It has dark, concentric rings on its shell and is paler in overall color, especially near the hinge



Zebra mussel

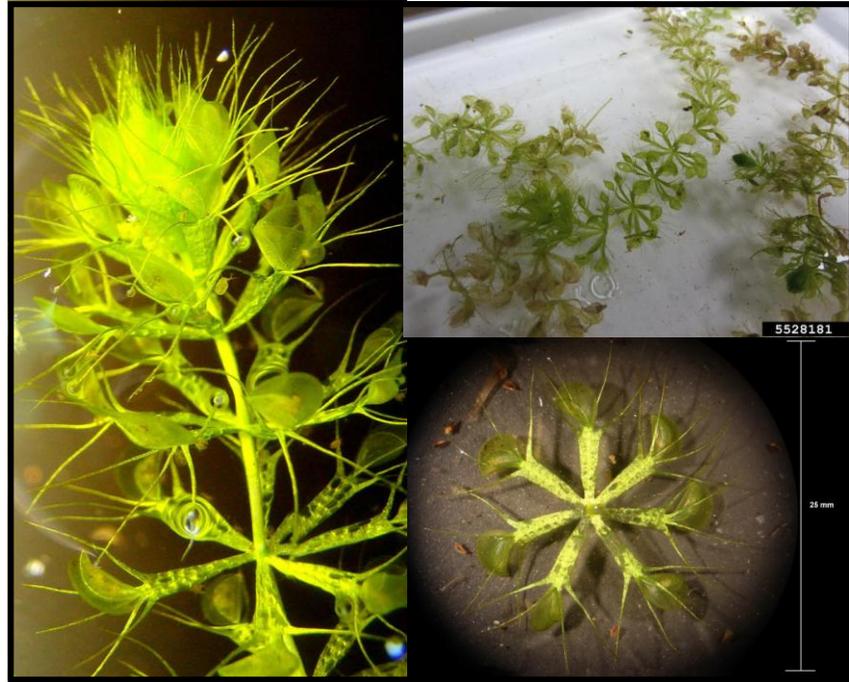
Quagga mussel

Aldrovanda/Waterwheel

Aldrovanda vesiculosa

Identification:

- Free-floating, rootless plant
- Carnivorous, capturing small aquatic invertebrates using small traps
- Leaves arranged in whorls of 4-9 around free-floating stem
- Clam-like traps, surrounded by 4-6 bristles
- Stem is air-filled to aid in floatation. Length depends on water quality, prey abundance, and irradiance
- Flowers are small, solitary 5-part white flowers that only opens for a few hours

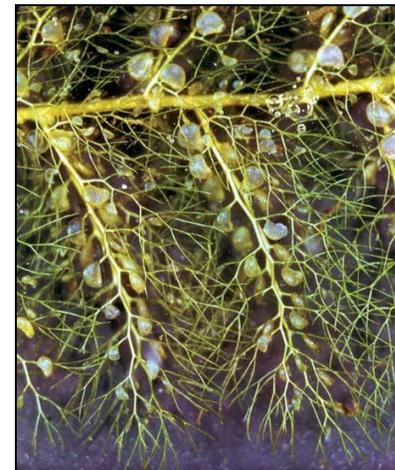


Habitat:

Waterwheel grows in wetlands, streams, and lake littoral zones. It prefers clean, shallow, warm standing water with bright light and low nutrient levels.

Lookalikes:

Bladderwort – native, free-floating plants with tiny bladder-like structures on their branched underwater leaves. Their bladders are small vacuum traps that can catch tiny animals.



Bladderwort

Fanwort

Cabomba caroliniana

Identification:

- Multi-branched, submerged perennial plant with a few small, alternately arranged floating leaves
- Submerged leaves are oppositely arranged and attached by a single petiole
- Finely divided fan-shaped submerged leaves reach 5 cm across
- Small (up to 2 cm diameter) white/pink flowers rising from the tip of the stem and stand slightly above the water surface
- Stems can reach 10 meters and are covered with white or reddish-brown hairs

Habitat:

Fanwort is typically prefers shallow waters and can be found in ponds, lakes, and slow moving streams.

Lookalikes:

Watermilfoil (pictured below), coontail/hornwort, bladderwort

Bladderwort – native, free-floating plants with tiny bladder-like structures on their branched underwater leaves. Their bladders are small vacuum traps that can catch tiny animals.

Coontail/hornwort – native species with slender, densely branched stems. Compound leaves, forked into linear-flattened segments with fine teeth on one side of the leaf margin. Leaves are stiff/brittle and grow in whorls of 9-10 at each stem node.



Coontail/Hornwort

Bladderwort

Didymo (rock snot)

Didymosphenia geminata

Identification:

- Microscopic algae that is tan, brown, or white
- Large stalk material forms thick mats on stream bottoms
- Forms long white “tails” coming off rocks
- Texture – feels like wet wool (not slimy)
- Strength – firmly attached, does not fall apart when rubbed between fingers

Habitat:

Didymo likes cool, clear, nutrient poor waters but can be found in nutrient rich waters. It likes rivers with regulated, stable flows.

Lookalikes:

Filamentous algae – nicknamed “pond scum,” filamentous algae includes many types of algae that have a thread-like, stringy appearance. Filamentous algae is usually green and feels slimy, cottony, or coarse, compared to the “wet wool” texture of didymo.



Filamentous algae

Hydrilla

Hydrilla verticillata

Identification:

- Leaves pointed, bright green, about 5/8 inches long
- Ribbon/lance-shaped leaves
- Leaves grow in whorls of 3-8, but usually 5
- Margins of the leaves are serrated/toothed
- One or more sharp teeth along the length of the leaf mid-rib
- Turions (overwintering seeds) are ¼ inch long and grow at the leaf axils
- Tubers (potato-like energy storage) are white/yellowish, and grow 2-12 inches below the sediment at the end of the underground stems, and allow the hydrilla to overwinter
- When removed from the water, hydrilla holds its form

Habitat:

Hydrilla can grow in almost any freshwater (springs, lakes, marshes, ditches, rivers, tidal zones). It can grow in very shallow water or in waters more than 20 feet deep. It survives in oligotrophic and eutrophic conditions, salinity up to 7%, in cold temperatures, and only needs 1% of full sunlight.



Lookalikes:

Elodea – native submersed plant that typically has 3 leaves per whorl, with smooth margins and no teeth on the mid-rib. It also lacks tubers and turions. Elodea commonly has a purple hue below each whorl. When removed from the water, elodea loses its form.



Elodea canadensis

Eurasian watermilfoil

Myriophyllum spicatum

Identification:

- Soft, feather-like leaves arranged in whorls around the stem
- 12+ pairs of leaflets on each leaf, closely-spaced
- Leaves have a blunt tip (the leaflets do not come to a point)
- Tends to collapse around the stem when removed from the water
- Thin stem (compared to other species)
- Mature leaves are arranged in whorls of 4 around the stem
- Stem is reddish-brown to whitish-pink

Habitat:

This plant is found worldwide, but prefers lakes, ponds, and slow-moving rivers and streams. It can also grow in fast-moving waters. It can tolerate spring water to brackish water, up to 10 ppt salinity. It is able to overwinter in frozen lakes and ponds as well as survive in shallow, over-heated bays.

Lookalikes:

Native Northern Watermilfoil; Fanwort (pictured above), coontail/hornwort (pictured above)



Northern Watermilfoil – native species with 7-10 leaflet pairs per stem. Leaves feel more rigid, but are still feather-like in appearance. Lower leaflets can be very long. Leaves are arranged in whorls of 4-6 around the stem. Leaves typically stay rigid and hold their shape when out of water.



Northern Watermilfoil

Brittle Naiad

Najas minor

Identification:

- Leaves are opposite, but can appear to be in a whorl at the tip
- Leaves are 1-2 inches long, toothed, stiff, and pointed
- Leaves are recurved with noticeable teeth on edges
- The plant can seem very bushy due to internodes being very short near the growing tips of the stems
- Small, inconspicuous flowers found on leaf axils
- Holds its form when out of water
- Stem is highly branched and fragments easily

Habitat:

Brittle naiad likes to grow in shallow waters along lake shores, sheltered lake inlets, ponds, streams with slow currents, wetlands and drainage canals. It is very common in young ponds and other wetlands that have been created through human agency.

Lookalikes:

Thread-Leaf Naiad

Thread-leaf naiad: branches occasionally, with slender stems that are medium green and flexible. Narrowly linear, and somewhat recurved leaves. Leaf margins have 10-20 minute, bristly teeth on each side



Thread-leaf naiad

Curly-leaf pondweed

Potamogeton crispus

Identification:

- Stiff, crinkled leaves approximately 2-3 inches long
- Green leaves arranged alternately around the stem and are directly attached to the stem
- Leaves become more dense toward the end of branches
- Leaf margins toothed
- Leaves appear translucent, olive green to red
- Produces overwintering buds (turions)
- Flower spikes emerge above the water surface
- Stems can grow up to 15 feet

Habitat:

Curly-leaf pondweed prefers soft sediment. It can grow in shallow or deep water, brackish or freshwater, and still or flowing water. It grows earlier than other plants, emerging in the spring and dying off mid-summer.

Lookalikes:

Clasping-leaf pondweed

Clasping-leaf pondweed has thin, oval shaped leaves that are wide with a broad base that 'clasps' the stem. It can look very similar to curly-leaf pondweed. A quick and easy differentiation is that curly-leaf pondweed's leaf tips are blunt and rounded, while clasping-leaf pondweed tips come to a point



Clasping-leaf pondweed

Water chestnut

Trapa natans

Identification:

- Floating plant with leaves arranged in a rosette
- Individual leaves are triangular, and are 2-4 cm long with serrated margins
- Lower surface has conspicuous veins and short, stiff hairs
- Submerged, lower leaves are alternate and feather-like, reaching 15 cm long
- Fruit is a four-horned nut-like structure reaching 3cm wide and develop underwater
- Stems are cord-like, spongy, and buoyant, reaching lengths of up to 16 ft

Habitat:

Water chestnut likes to grow in freshwater lakes and ponds, and slow-moving streams and rivers.

Lookalikes:

White water lilies, spatterdock

White water lily: leaves arise on flexible stalks. Leaves are more round than heart-shaped, bright green, 6-12 inches in diameter, with a slit about 1/3 the length of the leaf. Flowers arise on separate stalks and have brilliant white petals with a yellow center

Spatterdock: leaves are large and heart-shaped. Flowers are yellow and ball-shaped. Stems are rigid enough to hold the leaves out of the water when water levels drop.



Spatterdock

White water lily

Rake-Toss Surveying Protocol

- Find a **safe** access point to the water. Do NOT try to access the waterbody if you cannot find a location where you feel comfortable leaving your car or walking by yourself (due to traffic, steep slopes, unsteady terrain, etc.). Your safety is our top priority.
- Respect Private Property. Unless you get permission from the owner, always stay on public land.
- The goal is to survey as many locations as possible around the body of water. Surveying every 100 feet along the shore of the waterway is optimal. Shoreline surveys can be easily hampered due to access constraints, so if you are unable to survey every 100 feet, do as many as possible (one rake-toss is better than none!).
- Toss the rake twice at each location, once towards the left, and once towards the right. This is done to survey as much of the area as possible.
- Do a visual survey of the area – mark down if the **percent cover**. This refers to the amount of the bottom sediment obscured by vegetation. If you see that there is no plant material at the bottom, mark 0%. If you can't see the bottom floor at all due to the vegetation, mark 100%. Estimate all percentages in between. *If you cannot see the bottom because the water is too turbid, or because of the reflection on the water, mark with a dash (-).
- After you toss the rake (remember to hold on to the loose end of the rope), let it sink to the bottom and proceed to *s-l-o-w-l-y* pull the rake back towards you at a *steady pace*. When you lift the rake from the water, mark the **relative abundance** of plant material on the rake.
 - Z = zero (no plants)
 - T = trace (fingerful of plants on the rake)
 - S = sparse (handful of plants on the rake)
 - M = moderate (rake covered in plants)
 - D = dense (rake hard to pull out of water due to excess plants)
- When filling out the form:
 - write the name of the waterbody you are surveying and the town surveying in (if there is no name, give a description, location, and any other useful information so that others can determine what waterbody you surveyed later)
 - Mark down the time of the rake toss



Trace



Sparse



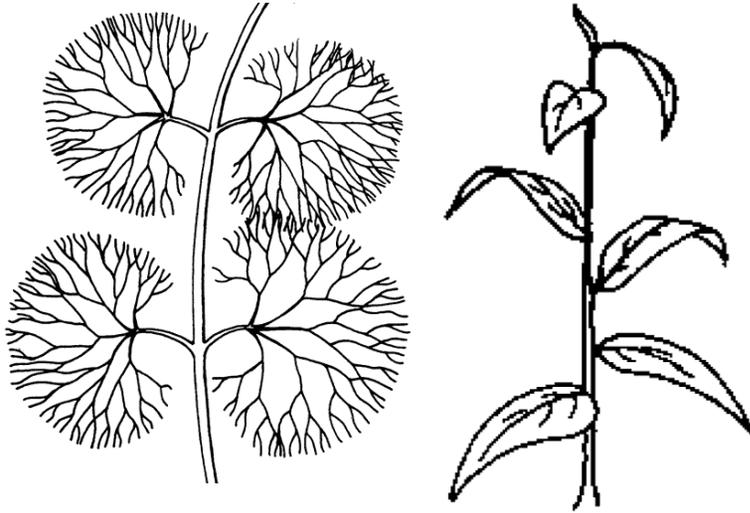
Moderate



Dense

- Include the GPS points for each location (the right/left rake toss can have the same GPS points)
- Mark down what number rake toss is (restart the count at each new waterbody)
- Write down what plants/animals you found
- Voucher Specimens
 - If you collect a sample and are unable to identify it but believe it is one of the species surveyed for:
 - Take pictures of the sample trying to include as many parts of the plant as possible (stem, leaf, leaf margin, flowers...). Take pictures with a white background when possible.
 - Put it in a plastic bag filled with water from the site. Label the bag with the time, location, and surveyor name.
 - **Always** collect a voucher specimen for hydrilla, didymo, and waterwheel unless sampling a location with a known infestation

Opposite v. Alternate



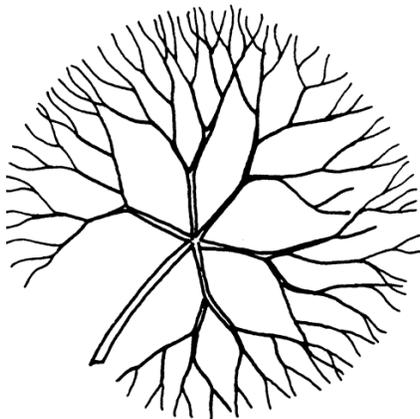
Serrated Leaf Margin



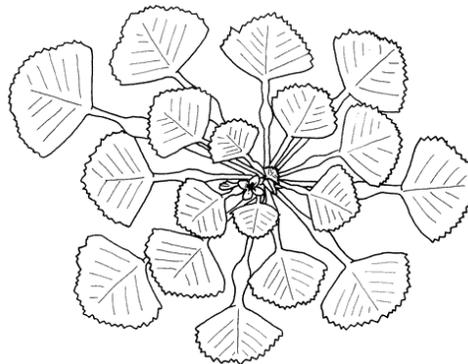
Spike (flowers)



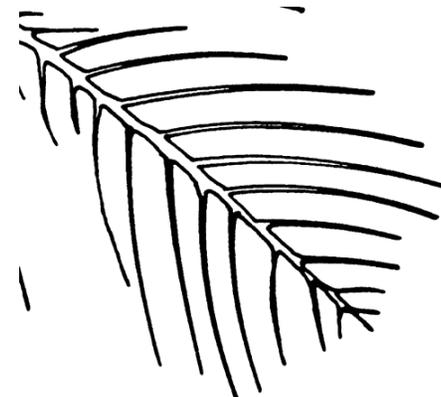
Branch-divided



Rosette



Feather Divided



Field Guide Sources

The following sources were used for multiple species:

1. *Pennsylvania's Field Guide To Aquatic Invasive Species*. Pennsylvania Sea Grant <http://www.anstaskforce.gov/Documents/AIS_Field_Guide_Finalweb.pdf>
2. Global Invasive Species Database <<http://www.issg.org/database/welcome/>>
3. *Common Aquatic Invasive Species of NY*. NYS DEC <<http://www.dec.ny.gov/animals/50272.html>>
4. *Lower Hudson Partnership for Regional Invasive Species Management (PRISM)* <<http://lhprism.org/>>

Additional sources listed below:

New Regulations

1. *New York State Regulations Target Aquatic Invasive Species*. NYS DEC <<http://www.dec.ny.gov/press/97442.html>>
2. *Bill A9927A-2013*. NY Senate <<http://open.nysenate.gov/legislation/bill/A9927A-2013>>

Prohibited Species

1. *6 NYCRR Part 575 Prohibited and Regulated Invasive Species Express Terms*. NYS DEC <<http://www.dec.ny.gov/regulations/93848.html>>

Stop Aquatic Hitchhikers

1. *Protect Your Waters* <<http://www.protectyourwaters.net/>>

Zebra mussel:

1. *New Hampshire Dept. of Environmental Services: Zebra Mussels Environmental Fact Sheet* <<http://des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-17.pdf>>
2. *USGS: Dreissena species, FAQs, A Closer Look* <http://fl.biology.usgs.gov/Nonindigenous_Species/Zebra_mussel_FAQs/Dreissena_FAQs/dreissena_faqs.html>
3. *Cary Institute of Ecosystem Studies: Zebra Mussel Fact Sheet* <http://www.caryinstitute.org/sites/default/files/public/downloads/curriculum-project/zebra_mussel_fact_sheet.pdf>

Waterwheel:

1. *Bugwood: Aldrovanda vesiculosa/NJ* <http://wiki.bugwood.org/Aldrovanda_vesiculosa/NJ>

Fanwort:

1. *Massachusetts Dept. of Conservation and Recreation: Rapid Response Plan For Fanwort In Massachusetts* <<http://www.mass.gov/eea/docs/dcr/watersupply/lakepond/downloads/rrp/fanwort.pdf>>
2. *Pennsylvania Dept. of Conservation and Natural Resources: Invasive Plants in Pennsylvania – Carolina Fanwort* <http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_012345.pdf>

Field Guide Sources Cont.

Didymo:

1. *NYS DEC: Didymo (Rock Snot)*
<<http://www.dec.ny.gov/animals/54244.html>>

Hydrilla:

1. New York Invasive Species Information
http://www.nyis.info/index.php?action=invasive_detail&id=16

Brittle naiad:

1. *Wetland Wildflowers of Illinois: Brittle Naiad*
<http://www.illinoiswildflowers.info/wetland/plants/br_naiad.html>

Curlyleaf pondweed:

1. *Aquatic Biologists: Weed Info – Clasping Leaf Pondweed*
<<http://www.aquaticbiologists.com/algae--weed-id-guide/submerged-weeds/clasping-leaf-pondweed>>
2. *Potamogeton crispus* (curlyleaf pondweed). Invasive Species Compendium
<<http://www.cabi.org/isc/datasheet/43664>>

Water chestnut:

1. *Texas A&M – Agrilife Extension: White Water Lily, Fragrant Water Lily* <<http://aquaplant.tamu.edu/plant-identification/alphabetical-index/white-water-lily/>>
2. New York Invasive Species Information
<http://www.nyis.info/index.php?action=invasive_detail&id=39>

Water Chestnut Cont.:

3. *Water Chestnut (Trapa natans) in the Northeast*. New York Sea Grant
<<http://www.seagrant.sunysb.edu/ais/pdfs/WaterChestnutFactsheet.pdf>>
4. *Water Chestnut*. National Park Service
<<http://www.nps.gov/plants/alien/pubs/midatlantic/trna.htm>>
5. *Water Chestnut*. Invasive Plant Atlas of New England
http://www.eddmaps.org/ipane/ipanespecies/aquatics/Trapa_natans.htm

Survey Protocol:

1. *Chris Doyle – Allied Biological: Rake Toss Aquatic Vegetation Survey*
<[http://nysfola.mylaketown.com/uploads/tinymce/nysfola/Rake%20Toss%20NYSFOLA2010%20\(2\).pdf](http://nysfola.mylaketown.com/uploads/tinymce/nysfola/Rake%20Toss%20NYSFOLA2010%20(2).pdf)>

Image Credits:

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Waterwheel:

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2. <<http://plantsrescue.com/wp-content/uploads/2013/09/Aldrovanda-vesiculosa.jpg>>
3. <<http://bugwoodcloud.org/images/768x512/5528181.jpg>>
4. <<http://www.britannica.com/plant/bladderwort>>

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5. <<http://www.aquaticbiologists.com/algae--weed-id-guide/problem-pond-and-lake-algae/weed-info---filamentous-algae>>

Hydrilla:

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2. <http://www.nyis.info/user_uploads/files/5345047.jpg>
3. <<http://www.eattheweeds.com/wp-content/uploads/2013/02/Hydrilla-verticillata.jpg>>

Image Credits Cont.:

Eurasian Water Milfoil

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2. <www.iowadnr.gov>
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Identification Key:

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**LOWER
HUDSON
PRISM**

This project was contracted by the Lower Hudson Partnership for Regional Invasive Species Management using funds from the Environmental Protection Fund as administered by the New York State Department of Environmental Conservation.