Pond and Lake Management Part IV:
Aquatic Invasive Species: Water Chestnut (Trapa natans) - Prevention and Management

Fact Sheet FS1119





Cooperative Extension

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Aquatic Invasive Species, also referred to as Aquatic Nuisance Species (ANS), are a threat to aquatic resources and ecosystems, and are a considerable issue of concern in many lakes in New Jersey. Ecologically, an aquatic invasive species impacts the waterbody starting with the exclusion or replacement of native aquatic plants which can eventually lead to water quality impairments, disruption of the food web, and a decline in the quality of the fishery. Aquatic invasive species adapt easily to a broad range of conditions, produce many offspring and are free of natural controls. Aquatic invasive species can have major impacts on water uses including boating, swimming, water transport, human and animal health, drinking water quality, fish and wildlife habitat, flood control, commercial and sport fishing, irrigation, navigation and hydropower generation, and can degrade aesthetic, habitat and even real estate values. From the lake user's perspective, these species impact recreational opportunities and compromise aesthetics. When determining the economic impacts, the loss of use should be included along with the cost of treatment. For example, if a house with shoreline property decreases in value due to a real or perceived decrease in the value of the recreational aspect of the lake, this could be included as an economic impact. Although it is difficult to determine the loss/gain of recreational and indirect impacts of aquatic invasive species, studies estimate anywhere from $176,000 to $100 million is spent nationwide on an annual basis to remove them, and one study estimated that the costs were closer to $10 billion.

Water chestnut [*Trapa natans* L. (Trapaceae)], also known as bull nut, European water chestnut, water nut, or water caltrop is an invasive aquatic plant species that is native to Asia and Europe. As is the case with most aquatic invasive species it can have major impacts on water uses. Although some New Jersey lakes and streams are already infested with water chestnut, the most efficient and cost effective management measure for water bodies without a water chestnut presence is prevention. In cases where water chestnut is already occurring, rapid response is important. In either case proper identification of water chestnut by local residents can be extremely helpful.

Biology

Water chestnut is an annual floating herb. It is easily distinguished from other floating aquatic plants by its distinctive rosette of leaves clustered around a central stem. As new leaves are formed, the older leaves and developing fruit move and are pushed further down the stem and under-water, leading to the development of several layers of leaves during a single growing season. The identifying features of water chestnut that differentiates it from other species of the genus (i.e., *Trapa bicornis* Osbeck and *Trapa bispinosa* Roxburgh) are the shape of the leaves and the four "horns" on the fruit, or "chestnut".

The mature fruit falls from the plant and sinks to the bottom of the water body and may remain viable in the sediments from four (4) months to five (5) years, with some reports of viable seeds after twelve (12) years. The horns on the fruit, sometimes referred to as a nut, anchor the seed in the sediment and can be a nuisance to people because the spines are sharp and may hurt bare feet. The seeds overwinter and germinate during, and throughout much of the warm season. Each plant can produce 300 new seeds in a year.

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Although a type of water chestnut is sold in stores and served in Asian cuisine, that "water chestnut" (*Eleocharis dulcis*) should not be confused with the *Trapa natans*. **Another common invasive species,** kidneyleaf mudplantain (*Heteranthera reniformis* Ruiz & Pav), is often misidentified as water chestnut. A distinguishing characteristic between the two plants is the "toothed" leaves of the water chestnut, whereas the leaves on the kidneyleaf mudplantain are smooth.



Toothed edges on leaves. Photo courtesy of Lauren Thesis, Upper Raritan Watershed Association

Ecology

Water chestnut grows best in shallow (i.e., less than 16 feet deep with an optimum depth of 1-6 feet) soft-sediment, nutrient-rich lakes and rivers. It also tends to prefer waters with a pH range of 6.7 to 8.2 SU. Water chestnut has a great capacity to reproduce and can grow up to five (5) rosettes within one square foot, with an individual plant having leaves up to three layers deep in the water. Growth of this density can readily suppress not only the growth of submersed aquatic plants through a shading effect, but eliminate the occurrence of other floating aquatic plant species. As noted above, due to its rapid growth rate, highly resilient fruits, and ability to outcompete native plants, water chestnut can rapidly infest a lake or pond. A prime example is Lake Musconetcong, Morris County, New Jersey. As recent as 2008, the results of comprehensive aquatic plant survey of the lake documented low density occurrences of water chestnut in a few of the lake's shallow coves. By the following summer water chestnut was impacting literally acres of the lake.

Dispersal of water chestnut occurs as the rosettes detach from stem and float to a new area or can occur by the movement of the fruit either by currents or by human and wildlife transport.



Illustrated flora of the northern United States, Canada and the British Possessions. Drawing courtesy of USDA-NRCS Plants Database.

Distribution

Water chestnut was first recorded in North America near Concord, Massachusetts as early as 1859. Water chestnut currently occurs in Connecticut, Delaware, Maryland, Massachusetts, New Hampshire, Pennsylvania, Vermont, Virginia, and Washington, D.C., and the Great Lakes Basin. Water chestnut has been found in several state lakes in New Jersey, notably Lake Waywayanda and Lake Musconetcong.

The New Jersey Department of Environmental Protection (NJDEP) Pesticide Control Program is aware of occurrences in the following counties: Burlington, Hunterdon, Monmouth, Bergen, and Morris Counties. Princeton Hydro, a lake management company that works extensively with various lakes throughout New Jersey, has identified the following water bodies as being infested with water chestnut: Kitchell Pond in Morris County; Goldens Run, Lake Baldwin, and Wall Street Journal pond in Mercer County; Sidney Brook and several small private farm ponds in Hunterdon County and a pond located within New Jersey's Stokes Forest State Park. Other sightings of water chestnut infestation have been documented by the Ewing Environmental Commission, identifying Goldens Run in Ewing as being heavily impacted and the Upper Raritan Watershed Association has identified water chestnut in Pacale Park in Hunterdon County. It is noteworthy that some of the documented waterbodies infested with water chestnut are tributary to some of the State's major river systems, such as the Musconetcong River, Stony Brook/Millstone River and the Raritan River. This only increases the likelihood of the additional spread of this invasive species to other waterbodies.



Kidneyleaf mudplantain. Photo courtesy of Mike Haberland.

Management

Education

Education of homeowners, lake associations, boaters, fishermen and others that utilize lakes are critical in stopping the spread of water chestnut. Simple tactics to prevent the spread of water chestnut and other pest species between waterbodies should be stressed and include: remove all visible mud, plants, fish or animals from equipment, trailers,





clothing, boots, buckets, etc., and eliminate all water, even water in small spaces where it may become trapped. Clean trailers, boats and other equipment that have come in contact with the plant with hot or salt water and allow the surfaces to adequately dry. This includes boats, equipment, trailers, wading boots, clothing and buckets. Dipping equipment into a 100% vinegar solution for 20 minutes or a 1% table salt solution for 24 hours can also kill many plants that would be transported between lakes.

Harvesting

A combination of mechanical harvesting and hand harvesting has been successful in other states, such as Maryland, New York, Pennsylvania and Vermont. Harvesting can be a viable alternative to chemical treatments, especially when dealing with small or confined growths of water chestnut.

Given that water chestnut is weakly rooted and prefers littoral areas (near shore areas) that are often too shallow for mechanical harvesters, hand harvesting is often a good method of removal. Harvesting is best done early in the summer in advance of the plants dropping fruit (seed). Examples of two successful New Jersey hand harvesting ventures are a Lake Musconetcong two day volunteer event, and an Upper Raritan Watershed sponsored event, both of which took place in 2009. Lake Musconetcong had a two day volunteer hand-pulling event in the fall of 2009 to attack the water chestnut problem. The volunteers removed seven (7) tons wet weight of water chestnut during the two day event. Volunteers from the Upper Raritan Watershed Association and others removed the water chestnut from Pascale Lake in 2009, and have plans to return in 2010.

For cases of large areas with heavy infestation, mechanical weed harvesting is usually the more effective approach. Even in such cases though, hand harvesting can be implemented as a means of controlling plant growth in shallow waters.

Biological Control Measures

One of the reasons invasive species are so competent at taking over a waterbody is due to the lack of natural predators or enemies. Biological controls are practices that use a specific introduced predatory species (insect, disease, and organism) to target the organism of concern. When done properly, it is possible to reduce the density of the pest species without causing any other environmental impacts. For water chestnut, attention is being given to such biological control agents as the Asian leaf beetle (*Galerucella birmanica*). In China this beetle has been documented to defoliate large areas of water chestnut. Although such a biological control will not kill the previously settled fruit, if successful it can prevent or reduce the number of plants that actually produce fruit, and in turn control the plants produced in subsequent years from the germinating fruit.

Chemical

The chemical control of water chestnut is a regulated activity in New Jersey by the Department of Environmental Protection (NJDEP). This means that before any aquatic pesticide applications are conducted, an aquatic pesticide use permit (APP) must be approved and issued from NJDEP's Pesticide Control Program (PCP). Additionally, any such pesticide applications must be performed by a licensed pesticide applicator/business certified in category 5 aquatics. Aquatic pesticide applications addressing the control of water chestnut is best conducted during the early growth phase of the plants; typically between mid-May and early July. There are several aquatic pesticides on the market that are currently used to control water chestnut, with the most common possessing the active ingredient 2, 4-dechlorophenoxy acetic acid (2, 4-D). This is a systemic herbicide that is readily absorbed by the plant and affects the plant's metabolic processes. 2, 4-D can be applied as liquid or in a granular formulation. The selection and use of this material, as with others, must be based on such factors and product label directions. In addition, there maybe water-use restrictions enforced following an application of 2, 4-D that limits how soon after a treatment is conducted that the treated water may be once again used, for irrigation or other recreational purposes. It is recommended that 2, 4-D not be used in potable water supplies.

For More Information

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