

A Water Chestnut (*Trapa natans*) Management Plan for Central New York Waterways



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*Prepared By the Central New York Water Chestnut Task Force and
Cornell Cooperative Extension of Onondaga County*



Cornell University
Cooperative Extension

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The CNY Water Chestnut Task Force

Cayuga Lake Watershed Network

Central New York Regional Planning & Development Board

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Ecology and Management of Invasive Plants Program, Cornell University

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NYS Canal Corporation

NYS Department of Environmental Conservation

NYS Sea Grant

Oneida Lake Association

Onondaga County Department of Health

Onondaga Lake Yacht Club

Oswego County Soil and Water Conservation District

Save Our Sodus

Wayne County Soil and Water Conservation District

Wayne County WQCC

Executive Summary

Water chestnut is an invasive aquatic plant that wreaks havoc on Central New York (CNY) waterways by clogging lakes, ponds, and rivers with floating mats of thick vegetation and thorned nutlets. As of 2005, the distribution of water chestnut in CNY includes the western end of Oneida Lake, the Oneida-Seneca-Oswego River System, Cross Lake, and Sodus Bay on Lake Ontario. Water chestnut infestations lead to a succession of problems including impaired navigation, decreased swimming and water recreation opportunities, anoxic water conditions, increased mosquito habitat, damage to natural plant and fish communities, lower property values, and decreased tourism. The plant's aggressive growth habits are a result of its ability to produce hundreds of seeds per year. In just the course of a few summers, a handful of seeming "harmless" plants can multiply into hundreds - transforming a scenic, enjoyable waterway into an impenetrable mat of floating leaves that tangle boat propellers, shade-out the native aquatic community, and deter swimmers, paddlers, and anglers.

The difficulties in controlling and reducing water chestnut infestations have been well documented by agencies and communities on Lake Champlain, the Hudson River, and across the northeastern United States. Early and consistent management is critical to keeping up with and controlling water chestnut's rapid growth. Reclaiming a water body from a widespread and unbridled water chestnut infestation is costly and complicated. The key to successful water chestnut management in Central New York will be persistent and strategic control efforts that incorporate preventative measures to stop the spread of water chestnut, biological control research, educational outreach, and appropriate physical, mechanical, and chemical removal techniques.

The CNY Water Chestnut Task Force is an ad hoc group of state and local agency personnel, university researchers, lake and watershed associations, community stakeholders, regulators, and educators. The Task Force works toward a common goal of controlling the spread and reducing the range of water chestnut in CNY waterways. Funding is an integral component of long-term success. Due to the fact that a water chestnut nutlet can house a viable seed in the sediment for as many as 10 years, repetitive control techniques must be carried out over several years to have a lasting impact. The water chestnut Task Force supports a multi-tooled approach to control that includes:

- **Public Education and Prevention-** Citizen awareness about the ways in which water chestnut spreads, and actions they can take to keep invasive species out of local lakes and rivers is a critical component to long-term success.
- **Mechanical Harvesting** - Mechanical harvesting is an effective tool for the removal of water chestnut, however challenges continually

arise in locating shoreline access in close proximity to the infestation site, as well as nearby disposal sites for the harvested vegetation.

- **Chemical Treatment-** Chemical applications are an effective tool for the treatment of large infestations with limited access.
- **Physical Hand-pulling** - Small infestations and satellite populations must be addressed and removed to prevent the establishment of larger infestations.
- **Biological Control Research-** Funding is needed for the continuation of research on an Asian leaf beetle, a potential tool for biological control.
- **Community-based Monitoring-** Long term monitoring must be secured to ensure new infestations are responded to rapidly. Public participation is needed to provide a regional “watch” service for translocated water chestnut plants.

Implementing the appropriate combination of control measures requires both funding and the support of local municipalities, elected officials, and community members. This management plan was designed to provide a history of water chestnut in CNY and to outline some of the past, present, and future needs and challenges associated with water chestnut control. The actions of the Task Force and the strategy outlined in this plan focus around three main goals: 1) Eradicate water chestnut from Oneida Lake; 2) Prevent its spread and ultimately eliminate or severely reduce the river distributions to levels that can easily be contained with minimal resources; and 3) Prevent the spread of water chestnut from the Three Rivers to the Finger Lakes and Montezuma Wildlife Refuge. To achieve these goals and facilitate communication and strategic management of water chestnut across Central New York, the Task Force will work with regional partners and stakeholders to undertake actions according to the following ten objectives (*in no particular order*):

1. Establish and Organize a Regional Water Chestnut Task Force.

Progress: An ad hoc group was formed in 2002, consisting of stakeholders from state and local agencies, regional lake and watershed associations, educators, researchers, and community groups. The Task Force has continued to meet 2-3 times per year to discuss control technique plans and outcomes, share updates about biological & chemical research, and communicate about new and upcoming educational materials and programs.

Challenges: None Noted. Currently, the establishment of a regional Task Force has been successful and will continue with regular meetings.

2. Secure Logistical and Financial Support.

Progress: Stakeholder groups and Water Chestnut Task Force members have received funding for limited mechanical, physical, chemical, and edu-

cational control programs that have primarily focused on Oneida Lake and adjacent waters in the Oneida and Seneca Rivers.

Challenges: Short-term management has been funded through grants, special funds, and line-items. As a result, control techniques have been concentrated at high-priority water chestnut infestations. Long-term funding, including the continuation and expansion of established programs and techniques, is needed to manage western populations, exhaust the seed bank, and prevent the spread of water chestnut from its current range.

3. Develop a Water Chestnut Distribution Monitoring Method.

Progress: A primary synopsis of the locations and levels of water chestnut infestation have been outlined by various agencies and community volunteers. Widespread, established infestations have been documented in Oneida Lake, Sodus Bay, & the Three Rivers System. An overview of primary infestations has been mapped by the Madison County Planning agency. Cornell Cooperative Extension interns have completed a more detailed mapping on Oneida Lake, the Oneida River, and sections of the Oswego and Seneca Rivers in Onondaga County. Additionally, the Adopt-A-Shoreline program utilizes private property owners to monitor and report water chestnut infestations.

Challenges: New “satellite” and outlying populations can crop up in new locations each growing season. Infestations can also grow undetected in back streams and more remote reaches of tributaries where boaters and homeowners are less likely to discover them. The plant’s distribution also changes annually in a response to control treatments. Keeping an up-to-date map and database of the distribution will require time and compensation for the coordination of volunteer efforts, as well as boat access.

4. Involve Local Government and Communities.

Progress: Support from local municipalities and community groups has been instrumental in the control measures implemented to date, but also limited. Local supporters, such as the Oneida Lake Association, Finger Lakes-Lake Ontario Watershed Protection Alliance (FL-LOWPA), and other local clubs have partnered with Task Force Members to provide funding, Boats, water access, and disposal sites for the harvested plant material.

Challenges: As valuable as supporters have been to water chestnut management in the region, there is an increasing need for more local involvement, particularly from municipalities. Access and unloading points for boats and mechanical harvesters continue to be an obstacle to efficient removal. Despite the fact that harvested plant material is a valuable addition to compost, convenient disposal sites are lacking.

5. Implement Appropriate Eradication and Control Techniques.

Progress: Chemical, mechanical, and physical control techniques have been used to target water chestnut infestations in the Three Rivers System for over a decade. Priority is given to infestations according to residential & commercial use of waterway, proximity to convenient unloading and disposal sites, and geographic outliers & seed sources.

Challenges: Unloading and disposal sites are a constraint to mechanical harvesting and hand-pulling efforts. Small satellite populations and individual plants present a challenge because of the time-intensive nature of locating them.

6. Support Biological Control Research.

Progress: The Ecology and Management of Invasive Plants Program at Cornell University has identified a potential biological control agent.

Galerucella birmanica, an Asian leaf beetle with a strong preference for water chestnut, was found to defoliate the rosette and therefore suppress the plant's reproduction.

Challenges: Funding for further research is needed in order to conduct host specificity studies that will determine whether the beetle is a threat to native North American plants.

7. Support Chemical Control Research.

Progress: Oswego County received an experimental permit for the topical application of 2,4-D Amine and Glyphosphate for the control of water chestnut. Treatment results from the test plots found that a mid-season topical application of 2,4-D prevented seed formation. Topical application of Glyphosphate had similar impacts when applied later in the season when the plants translocated nutrients to the seeds. These findings resulted in a FIFRA 2(ee) recommendation for the use of Weedar 64 and Rodeo to control water chestnut in New York State using liquid, topical formulations.

Challenges: Topical applications will be a tool in overcoming past difficulties of using granular formulations in flowing or deep waters. An additional challenge in chemical treatment is the ability to predict the size of infestation to be treated, which is required in order to receive a permit.

8. Increase Public Awareness Through Education.

Progress: Water chestnut education has focused on teaching best-management practices for preventing the spread and transportation of water chestnut, as well as plant identification, reporting, and control techniques. Outreach has occurred via numerous workshops, presentations, mailings, publications, radio/television programs, grocery bags, and signs.

Challenges: A majority of outreach has been concentrated on Oneida Lake and the adjacent river sections; additional education is needed further

west on the Seneca River and further north on the Oswego River. Audience-specific education is also needed for particular user groups, such as boaters. To prevent new infestations and re-infestations at treated areas, public education about water chestnut and other invasive aquatic plants must be an ongoing process.

9. Incorporate Public Involvement and Participation into Control Techniques.

Progress: Shoreline residents, boaters, anglers, and community groups have been engaged in organized hand-pulling efforts and monitoring programs. The “Adopt-A-Shoreline” program and “Weeds Watch Out!” initiative utilized citizen-monitors and trained volunteers to survey local waterways and report the presence and abundance of water chestnut, as well as eight other invasive aquatic plants.

Challenges: A majority of the “Adopt-A-Shoreline” recruitment efforts have focused on Oneida Lake and the eastern-most portion of the Seneca River. A future need is to expand the program throughout the Three River System, as well as other at-risk water bodies across CNY.

10. Improve Public Outreach Efficiency By Expanding to Multiple Invasive Aquatic Plants.

Progress: In 2004-2005, the “Weeds Watch Out!” program trained more than 40 volunteers to identify and report nine species of invasive aquatic plants that threaten CNY waterways.

Challenges: While this program incorporates a variety of invasive species, in addition to water chestnut, other education and outreach efforts could include “watch weeds” (such as European frogbit) as well. Expanding invasive plant awareness could be a proactive step that would also improve the cost-effectiveness of public education programs.

The successful management of water chestnut populations in and between CNY waterways will inevitably play a role in future tourism, recreation, property values and quality of life for local communities, as well as the condition of native aquatic ecosystems. The Central New York Water Chestnut Task Force will continue work together to further the ten objectives outlined in this plan and to advocate the importance of long-term collaboration and funding that addresses water chestnut issues at a regional level.

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I. Introduction

Water Chestnut (*Trapa natans*) is a non-native aquatic plant that grows aggressively in shallow and nutrient-rich water bodies. Indigenous to Europe and Asia, water chestnut was first introduced into North America in the late 1870s as an ornamental for garden ponds, and subsequently became established in New York State in 1884. Although the nut of *Trapa natans* is edible, and used as a food source in some parts of the world, it is not the same variety of water chestnut commonly served in Chinese restaurants in the United States. The one familiar to many Americans is the oriental water chestnut, (*Eleocharis dulcis*), a spikerush native to Madagascar, India, and southeast Asia.

A. Biology/ Life History

Water Chestnut plants are annuals that over-winter as seeds after sinking to the bottom sediments. Seedling growth is rapid in the spring, and by early summer the plants have a floating rosette of leaves on the surface of the water that is anchored to the bottom by a cord-like stem. The submersed stem, which can grow up to 16 feet in length, bears opposite pairs of feather-like leaves. The floating rosette (which can grow up to one foot in diameter) is formed from triangular, toothed leaves that are waxy on top and hairy underneath. Spongy petioles are connected to the floating leaves and act as air bladders that provide buoyancy to the rosette. The plants, which have flowers with four white petals up to ¼ inch long, bloom from late June to September. Upon pollination or self pollination, the flowers produce thorny nutlets that ripen approximately one month later and eventually sink to the bottom. The mature nutlets, or seeds, each have four sharp, barbed spines and hard shells that are resistant to decomposition even after germination. Once the seeds are set, each nutlet can remain viable in the sediment, or “seed bank”, for 5 to 12 years - although most have been found to germinate within the first two years. Flowering and seed production continues into the fall, until a hard frost

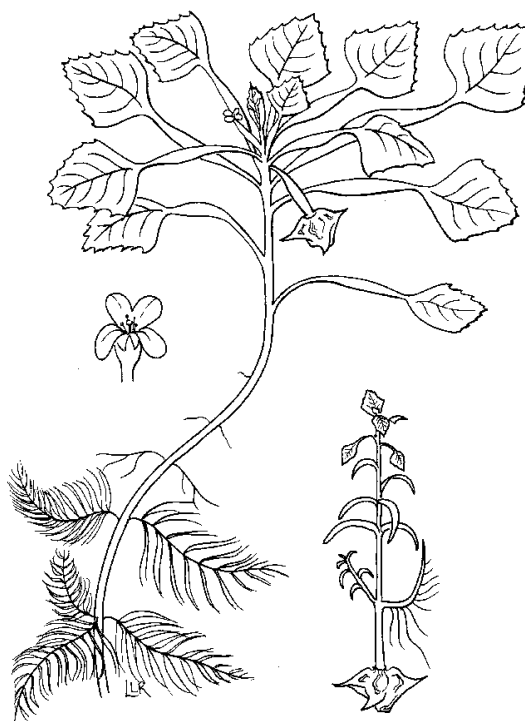
Water chestnut is an invasive aquatic plant that wreaks havoc on water bodies in the northeastern U.S.

kills the floating rosette. Each rosette can produce up to 20 seeds, each of which can give rise to 10-15 rosettes and in turn produce 15-20 seeds of their own. Therefore, in a single year, one seed can result in new plants that produce 300 new seeds!

Water Chestnut grows best in water that is still or slow flowing, shallow (a few inches to 16 feet in depth), nutrient-rich, generally with a pH range of 6.7 to 8.2, and alkalinity of 12 to 128 mg/L of calcium carbonate. The floating rosette can detach from the submerged stem and float downstream, carrying with it seeds that can colonize new areas, and consequently result in new infestations. Dispersal also takes place when the thorny seeds attach to boating equipment, ropes, or waterfowl feathers and are transported from one body of water to another.

Identifying Water Chestnut (Trapa natans).

- Floating “rosettes” are composed of triangular shaped leaves with toothed edges
- Leaves are waxy on top, and hairy underneath
- Produces thorny, four-pointed nutlets in early summer
- Submersed leaves are feather-like and arranged opposite along stem



B. Impacts of Water Chestnut Infestations

The ability for water chestnut to multiply so profusely often results in the complete coverage of a water surface with a dense mat of floating rosettes. This has negative implications for both human and aquatic communities alike (Table 1). In terms of habitat, a continuous cover of water chestnut floating on the surface displaces native plants by shading out submerged plants, such as *Vallisneria americana*, that are a more valuable source of food and shelter for fish and waterfowl. Water chestnut itself has very little value as waterfowl forage. Below the floating mat of rosettes, a lack of sunlight and in some cases oxygen, limit aquatic habitat diversity to a web of stems, submerged leaves, and sharp nutlets. When large mats of water chestnut decompose, reduced oxygen levels can consequently threaten water quality and other aquatic organisms. The rate of sedimentation may be increased in a water body that is infested with water chestnut, as the dense mats of plant material slow water movement and trap silt. For communities nearby infested waterways, as well as visitors and tourists, a mat of water chestnut interferes with boating navigability, and can severely limit fishing, swimming, and other recreational opportunities. The sharp thorns of the water chestnut seed are a painful hazard for any swimmer. In addition to the high economic cost of managing an infestation, the cumulative effects of water chestnut can hurt communities by decreasing waterfront property values, deterring tourism, and diminishing the overall enjoyment and aesthetic values of a local water body.



A thick vegetative mat of water chestnut covers the water along a shoreline of the Seneca River.

Water chestnut infestations clog waterways to the point of restricting navigation and limiting recreational activities.

The economic impacts of aquatic invasive plants, such as water chestnut, are large and far-reaching. Research conducted by David Pimentel and others at Cornell University (2000) estimated the total annual costs associated with alien aquatic weeds in the United States to be \$110 million dollars (\$10 million due to losses and damage caused by the weeds and \$100 million spent on control measures). Throughout the Oswego River Basin and across Central New York, both public and private funds are spent on harvesting and herbicide applications aimed at controlling water chestnut infestations. But the costs associated with water chestnut infestations go beyond just the price of control efforts. Prime waterfront property values, water-related tourism, sport-fishing, and boating contribute significant amounts of income at a local, state-wide, and even national level. Healthy, productive, navigable, swimmable, and aesthetically-pleasing waterways are essential components to enjoyable experiences that will attract and sustain tourists, vacationers, and the businesses that support them year after year. The following figures offer a broad glimpse at the economic benefits that may be lost if water chestnut was left to clog popular local waterways:

- ◆ In 1996, the net economic value of Oneida Lake's freshwater fishery was estimated to be more than \$9.4 million—ranking it first among New York State's inland waters. (*CNYRPDB, State of Oneida Lake Report*)
- ◆ Sport fishing contributes an estimated \$1.4 billion annually to the New York State Economy (*NYS DEC*)
- ◆ Tourism in Oswego and Onondaga counties alone is estimated at \$675 million per year, supporting approximately 23,670 jobs and catering to more than 1.5 million visitors (*Oswego County Business, 2004*)
- ◆ Recreational boaters in the Great Lakes/Finger Lakes region spent \$173 million in trip-related expenses in 2003 alone (*NY Sea Grant, 2004*)
- ◆ A survey found that recreational boating in New York State has a \$1.8 billion dollar impact and creates 18,700 jobs (*NY Sea Grant, 2004*)
- ◆ Studies have shown that water clarity, quality of swimming, and scenic beauty impact people's choices in the lakes they choose to visit and where they buy property, and additionally, that water quality affects property prices (*Maine DEP, 2005*)

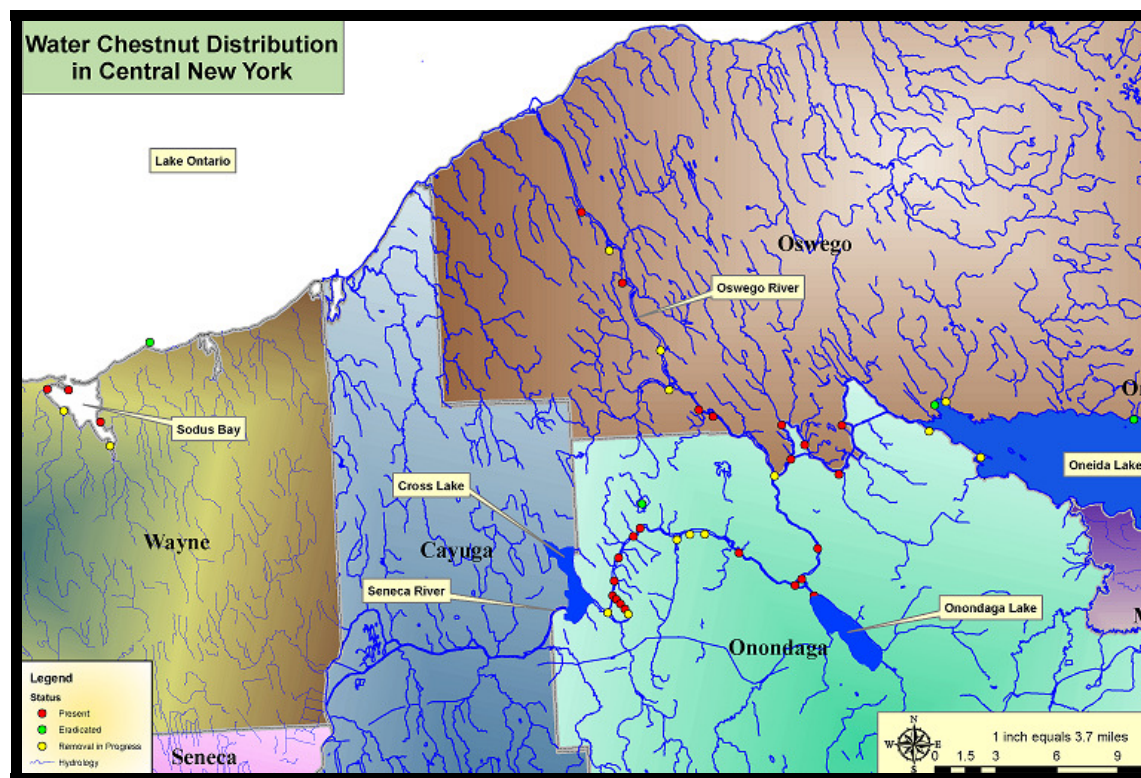
Table 1. Problems and Impacts Associated with Water Chestnut Infestations.

Impacted by Water Chestnut	Effect
Fisheries	Decreased habitat diversity; sunlight is blocked from water column; increased potential for fish kills caused by oxygen depletion; reduces forage base (zooplankton)
Local Economy	High cost of managing water chestnut; decreased tourism
Navigation	Impeded navigation and boating due to impenetrable mats of floating plants
Property Values	Decreased property values; homeowners who own/buy waterfront property are unable to utilize the water
Quality of Life	Decreased aesthetic value and enjoyment associated with water body; floating mats may provide mosquito breeding grounds
Recreation	Dense plant beds interfere with fishing; sharp, thorny nutlets pose a hazard in swimming and wading areas; impeded canoeing/kayaking opportunities
Water Quality	Reduced dissolved oxygen levels; increased rate of sedimentation
Wildlife	Displacement of native food sources; reduced foraging opportunities for waterfowl

C. History of Water Chestnut in Central New York

By the early 1990s, some Central New York waters had become infested with water chestnut. In 1999, the infestation had spread beyond the river system and into Oneida Lake. By 2002, the water chestnut populations in Oneida Lake and the Three Rivers System (Oswego, Seneca, and Oneida Rivers) covered more than 200 acres, with particularly dense infestations on the Seneca River near Baldwinsville and at Ox Creek on the Oswego River. Concern grew over the spread of the plant, both by boats as well as through the canal system. Of particular alarm was the potential for water chestnut to spread throughout Oneida Lake, to the Finger Lakes, additional water bodies, and counties out-

side of Onondaga and Oswego. In 2004 a number of sightings reported new infestations near the Onondaga Lake outlet (Onondaga County), Cincinnatus Lake (Cortland County), and findings of floating rosettes in Cayuga County.



As of 2005, the range of water chestnut in CNY spans from western Oneida Lake through the Three River System to Cross Lake, as well as in Sodus Bay on Lake Ontario.

II. Management Tools

Since water chestnut is an annual plant, successful control can be achieved by preventing or reducing the production of seeds. Since smaller, less established plant populations are easier to eliminate than larger ones, early detection and rapid response¹ is crucial to effectively manage water chestnut infestations. Newly established infestations and small populations are also less costly to manage because the plants can be hand-pulled and have smaller seed banks. Large and well-established populations of water chestnut often require a more

¹ "early detection and rapid response" refers to the strategy by which monitoring is conducted for the purpose of identifying and reporting a new introduction/infestation immediately, so that control measures can be implemented quickly before the population becomes well established.

costly, multi-faceted control plan that calls for mechanical harvesters and/or the application of aquatic herbicides over a longer period of time.

Control techniques (Table 2.) can be most efficiently prescribed on a case-by-case basis, depending on the degree of infestation, conditions and accessibility of the water body, local resources, and available funding. A multi-tooled approach provides insurance that control techniques are applied appropriately and comprehensively. For example, a few plants discovered in a new location would be best eradicated by hand-pulling rather than through the hiring of a mechanical harvester. Alternatively, a large-scale infestation that requires the use of herbicide treatment may be reduced over time to the point where hand-pulling is a more effective and appropriate use of resources. Regardless of the techniques employed, the core of a successful management strategy is diligence. Infested waters must be treated in order to exhaust the seed bank; continuous maintenance and long term monitoring are needed to prevent a re-infestation. Most infestations are so extensive (e.g. >300 acres in Lake Champlain) or well established that complete eradication may never be achieved. The continuous need for funding of mechanical or chemical control has increased the interests in more permanent and less expensive biological control, but control agents are not presently available.

A multi-tooled management approach involves combinations of educational, mechanical, chemical, and physical techniques.

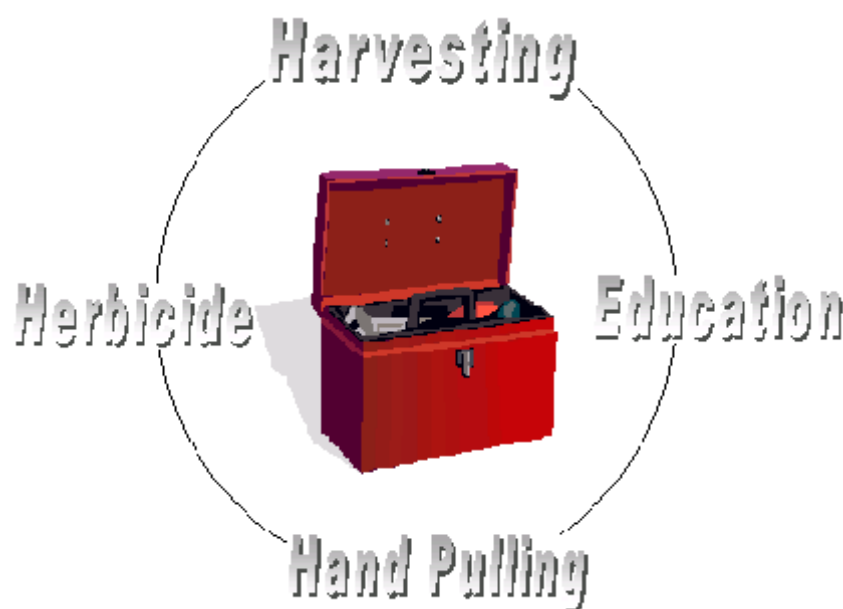


Table 2. Control Techniques for the Management of Water Chestnut

Management Method	Description	Advantages	Disadvantages	Systems where used effectively
Mechanical Harvesting	Mechanical cutting with plant removal	Removes plant biomass	Slow, more expensive than cutting alone, non-selective, operating depth limited	Wide-spread infestations, navigational corridors
Hand Pulling	Direct hand pulling or use of hand tools	Low technology, affordable, selective, very effective in localized areas	Labor-intensive, short-term turbidity increase	Small scale, localized areas
Chemical Application	Herbicide treatment with granular or liquid formulations	Cost effective for wide-spread infestations	Impacts on non-targeted plants/environment; Public concerns; site/regulatory restrictions	Larger, but not widespread infestations; non-flowing water
Biological Control	Introduction or augmentation of target plant's natural enemies (herbivore)	Cost effective, long-term control of plant, low maintenance	Research intensive, high preparation, permit required, potential for unwanted side effects, does not eradicate plant	*More Research Needed
Cultural Control	Public campaigns & education; prevention, assessment, monitoring	Contributes to long-term strategy; emphasizes prevention	Primary effectiveness is prevention/detection; can not control established populations	Areas adjacent/nearby infestations; Impacted watersheds
Lake Sweeper	Mechanical "sweeping" apparatus inhibits growth	Affordable, effective in localized areas	Non-selective, must be used early in season, more research needed	Small scale control around localized areas, such as docks

A. Mechanical Harvesting

Harvesting consists of mechanical cutting, followed by the removal of the cut plants from the water by a conveyor belt system. Harvesting is used to clear water chestnut mats from the upper portions of the water column, and provides short-term control that results in immediate areas of open water. Because harvesting is costly and often time-intensive, it is typically used to control small to moderate sized infestations or to clear a corridor for navigational purposes. Harvesting is typically scheduled for the middle part of the plant's growing season in order to prevent the nuts from maturing and detaching from the plant. To prevent seed production and reduce the area infested, sites must be treated (before seed set) at least annually for five years or more. The timing of the harvesting is a balancing act between long-term control and short-term access. Care should be taken that harvesting is not done too early in the season, otherwise mature nuts in the bottom sediment can germinate after the floating mats above are removed. However, although the goal of preventing seed set may warrant a "late season" removal of the plants, this approach does not satisfy seasonal water users who want access for boating and recreation during the summer. If funding does not permit multiple harvests, the timing of implementation can become an issue. Large harvesters are not easily maneuverable in shallow waters. However, hand pulling can be used in conjunction with harvesting to remove plants in the inaccessible areas, as well as any lingering plants.

Other disadvantages of mechanical harvesting include the high operational costs (contractors may charge anywhere from \$1000/acre and harvesting equipment costs can reach \$225,000-\$110,000), plant frag-



The goal of mechanical harvesting is to clear clogged waterways and remove the plants before the release of the new seed crop.

ments can escape collection and wash up onto nearby shorelines, and small fish, insects, and other aquatic animals may be killed or harvested with the plants. Challenges in coordinating an efficient and productive harvest include convenient access to the harvesting location and cost-effective disposal of the plants once they are removed. The cost of operation can fluctuate dramatically depending on the distance the harvester must travel to unload the plant material each time the boat's capacity is reached, the number of trips between the harvesting site and the unloading area, and the truck mileage to and from the disposal drop-off. Convenient water access and nearby disposal sites (including disposal in residential/camp compost heaps) can help reduce travel time and increase the cost effectiveness of mechanical harvesting. Additional attention should be given to the need for thorough cleaning of any harvesting equipment that is used on multiple water bodies (to prevent the transport and spread of invasive aquatic plants/seeds). Advantages of harvesting include an immediate clearing of floating mats and the ability to target specific locations. The removal of the plant material also removes nutrients such as nitrogen and phosphorus from the water system, and helps slow sedimentation rates by reducing organic matter.

B. Hand Pulling Removal

The pulling of water chestnut plants, which have shallow roots in soft sediment, can be done easily by hand or with a rake. Infested areas can be accessed by canoe or by wading into the water while wearing protective footwear. Hand pulling should be scheduled to eliminate the plants before seeds are set, and each plant should be removed from the water to prevent the whole plants from floating away and initiating a new infestation. Once brought ashore, piles of water chestnut can create an unpleasant odor for a few days as the plant material decomposes. If this presents a problem, pulled plants can be composted, or disposed of in plastic garbage bags. In many situations hand pulling is an appropriate or complimentary technique; pulling

Hand-pulling selectively removes water chestnut and can be used to complement other techniques, as well as treat small infestations.

involves a very low degree of technology, it is affordable, it selectively removes the targeted plants, and is very effective in localized areas. Because hand pulling is easy to do, and very effective at eradicating smaller populations of water chestnut, it can also be used to promote community involvement and be a strong component of monitoring and early detection programs. In situations of extensive infestation, hand pulling alone is often too labor-intensive to be used as a control, and must be used in conjunction with other techniques. Hand pulling is often included in management strategies as a means to eradicate plants at newly infested locations, as well as a means to “clean up” any missed or remaining plants following herbicide or mechanical treatments.



C. Chemical Treatment

In cases of widespread infestation, herbicide applications are often less expensive and less labor intensive than other plant control techniques. Herbicides can be applied easily by boat or from docks. Like hand pulling and mechanical harvesting, herbicides are used to eliminate the current year's growth before seeds set. The chemical used for control is 2,4-D, a relatively fast-acting, systemic, selective herbicide used to control broad leaved species. The granular formulations (known as Aqua-kleen and Navigate) contain the low-volatile butoxy-ethyl-ester form of 2,4-D and when applied, sink to the bottom and release the chemical to the entire water column. Liquid formulations include DMA*4IVM, which contains the dimethylamine salt form of 2,4-D, and Weedar 64, which is 2,4-D Amine. The timing of the chemical application is an important component of successful treatment. The herbicide is applied early in the season (often around the end of June) when the small plants begin to grow up through the water column. In this way, the growing plants absorb the chemical and up to 75% of the water chestnut in the treated area will brown, wilt, shrivel and die. An effective method of dealing with any

A disadvantage of chemical treatment is the excess nutrients released into the water as the plants decompose.

surviving plants is hand pulling. Potential disadvantages associated with chemical control of water chestnut include unwarranted impacts and perceived threats to people and the environment, the potential for non-targeted plants to be impacted, and negative public feelings on the use of chemicals in local water. Another side effect of chemical treatment can include low dissolved oxygen levels during the time period when water chestnut plants are decomposing in the water. In New York State, chemical applications require a permit and must be conducted by a certified pesticide applicator. Prior to 2005, the only herbicide approved for the treatment of water chestnut in New York was 2,4-D (sold under the trade name of AquaKleen). As a result of success using liquid herbicides Oswego County, the NYS DEC approved a FIFRA 2(ee) recommendation for the use of two topical, liquid herbicides in March of 2005: Weedar 64 Broadleaf Herbicide and Rodeo. The permit process also includes a public notice of the scheduled application, and usually a water quality sampling requirement.



D. Biological Control

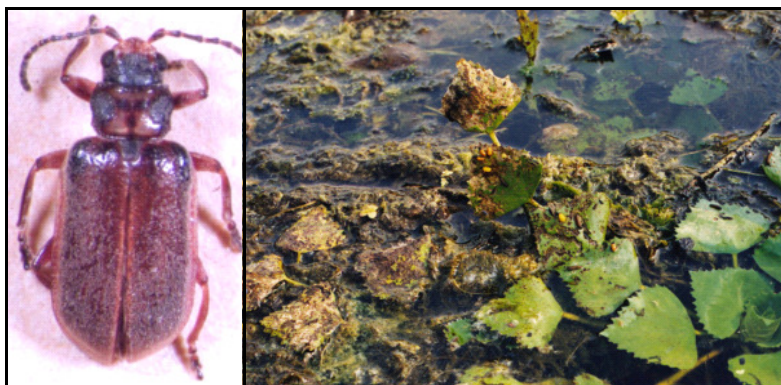
The purpose of biological control is to manage the invasive species long-term by reuniting it with its native predator(s), usually insects or pathogens. Bio-control does not aim for the eradication of the invasive plant, but a permanent reduction of its population to lower, more acceptable levels. In successful programs reductions of >90% have been achieved. In the case of water chestnut, possible biological control agents were investigated in the early 1990s by the USDA, but questions about host specificity of the main agent led to the termination of the project in the 1990s.

In 2002, researchers from Cornell University revisited the project and began more detailed investigations of a beetle found to attack water chestnut in

The objective of biological control is not total eradication of the plant, but a long-term reduction in it's numbers.

Asia, which had been identified as *Galerucella birmanica*, as well as other possible biological control agents found on water chestnut in North America. Initial concerns over observations that *G. birmanica* was not only defoliating water chestnut but also water shield, *Brasenia schreberi*, (a species native to Asia and North America) which had led to the termination of the USDA project were found to be the result of taxonomic confusion and language problems. Researchers found that the appearance of adult beetles and the attack-markings of another leaf beetle, *Donacia*, closely resemble the feeding of *G. birmanica*. This discovery revealed that the beetles reported as pests on *Brasenia* are not the water chestnut leaf beetles. Field studies in Asia showed that all *G. birmanica* adults and larvae strongly prefer water chestnut, and that even once the water chestnut plants had been completely defoliated the beetles did not switch to the nearby growing water shield. Although *G. birmanica* strongly prefers water chestnut, the beetles are capable of completing their life cycle on *Brasenia* in captivity. Beetles living on *Brasenia*, however, were found to have lower survival rates and longer development times than those on water chestnut. When *Brasenia* and water chestnut plants are found together, some beetles may “spill over” onto *Brasenia* plants, resulting in only minor feeding damage to the plants.

Most importantly, attack by even low numbers of *G. birmanica* has a severe impact on water chestnut growth and reproduction. This leaf beetle is highly prolific and considered a pest on Chinese farms growing water chestnut for local markets. As few as 3 pairs may lead to defoliation of 7 rosettes in three weeks, due to heavy grazing by adults and larval offspring. Attack by more than 50



1st instar larvae per rosette could substantially suppress reproduction of the plants. Field visits in China revealed that large beetle populations can develop to the point of entirely defoliating water chestnut plants and completely preventing seed set. These findings suggest that *G. birmanica* may be a safe and effective biological control agent for water chestnut in North America. Further host specificity tests with North American *Brasenia* and many other native water plants are needed. Such research will be completed as additional resources become available. In contrast to the findings with *G. birmanica*, work with the native water lily leaf beetle, *Galerucella nymphaeae*, showed that this native species has no potential as a biological control agent. While the species is frequently found on water chestnut in North America, survival rates are very low and larval feeding has no measurable impact on growth and reproduction of water chestnut. If mass releases of this native beetle are made into water chestnut infestations, the preference of *G. nymphaeae* for yellow water lily, may in fact accelerate the decline of native plant species (which would be attacked before water chestnut is eaten).

E. Cultural Control

In many situations, the initial introduction of a non-native species or the spread of an invasive weed from one place to another is the result of human activity. Cultural control incorporates human activities to thwart the spread



of invasive plants using methods such as education and outreach campaigns, proactive and preventive measures, and mapping and monitoring.

Water chestnut plants were originally thought to be introduced to North America as an ornamental water garden plant. Now present, the spread is facilitated from one body of water to another by the unintentional transport of plants and seeds on recreational equipment and watercraft. Because of this, the management of water chestnut is a never-ending process whereby even a successful local eradication of the plant cannot ensure against a future introduction and re-infestation. Public awareness and education is therefore necessary component of any management strategy that includes prevention and long-term monitoring. Cultural control techniques are methods that enable people to identify water chestnut and teach them ways to stop its spread. Educational workshops, media messages, web sites, publications, and signage can inform people about the importance of checking and removing all plant fragments and seeds from their boats and recreational equipment each time they leave and enter a body of water. Volunteer monitoring programs, citizen lake watch campaigns, mapping and assessment programs, and professional surveys are all cultural techniques that help stop the spread of water chestnut by providing information about its distribution and enabling a rapid response for the control of new populations. Cultural approaches to controlling water chestnut infestations are similar to other management methodologies in that they have increased effectiveness when applied in conjunction with other techniques such as harvesting, hand pulling, or chemical treatment.

Public awareness and education is a critical component to any long-term management strategy.

III. Case Studies

A. Lake Champlain

After the introduction of water chestnut in New York State, the infestation spread rapidly northward in the Hudson River Basin and was first reported in the southern end of Lake Champlain in the 1940s. A control program involving mechanical harvesting and hand pulling was instituted that successfully reduced the infestation throughout the 1950-60s. By 1971, the eradication of water chestnut was thought to have been achieved, and consequently funding was lost and the control program was terminated. In absence of control, the residual seed bank gave life to a few plants, which produced seeds and quickly multiplied in number. By 1982, the allegedly controlled water chestnut population had extended across a 20-mile range at the south end of the lake and re-infested more than 200 acres of the lake. The control program was re-instituted and mechanical harvesting and hand pulling began to reduce the weed population once again. The control efforts were hampered by a reduction of funding in the early 1990s, and by 1996 water chestnut rebounded. All the progress made in the 1980s was lost as the plants re-infested the entire original range, as far north as Converse Bay (VT). Recent efforts have included continued funding of mechanical harvesting and hand pulling removal by the states of Vermont and New York, USFWS, Ducks Unlimited, NYS Canal Corporation and the Army Corp. Water Chestnut is managed in 57 sites on Lake Champlain, as well as in 6 tributaries, and associated wetlands and in 6 other Vermont water bodies. Since 1982, over \$5,249,685 has been spent controlling water chestnut in

both sides of Lake Champlain. During implementation of the control activities, several challenges have been found:

- Need for disposal sites close to the harvesting locations.
- Need for additional staff and a dedicated crew to operate the harvester and ancillary equipment. The ability to properly load the conveyor and prevent weeds from escaping and drifting downstream during the harvesting operation is an experience that is not passed on through the use of seasonally hired operators.
- Need for adequate land transport equipment - a truck(s) that has a load capacity comparable to that of the harvester.



III. Case Studies

B. Chesapeake Watershed

The earliest water chestnut infestations (found in the mid-1950s) on the Bird and Sassafras Rivers, of the Chesapeake Watershed, were controlled using mechanical harvesting and chemical treatment with the herbicide 2,4-D (Table 4). By 1966, no plant sightings were found and eradication was thought to be successful. In 1997-1998 re-infestations were discovered on both rivers. The fact that water chestnut populations on both rivers were located in the same areas that had been treated in the 1960s suggests that the plants germinated from the seed bank of the original populations. Although aquatic plant control experts recommended herbicide application for control of the expansive infestations, public and state concerns led the Maryland DNR to reserve chemical treatment as a last resort. A custom-made aquatic plant harvesting boat was built that could cut a 10-ft wide path through vegetation and store 4 tons of plants on board. The combination of mechanical harvesting and volunteer hand pulling from 1999-2004 has since proven so successful that there has been no need to use herbicides. However, continued hand pulling and monitoring efforts is planned for several more years to ensure the exhaustion of the seed banks and prevent future re-infestations.

Table 4. Timeline of Water Chestnut Infestation and Management in Bird and Sassafras Rivers in the Chesapeake Watershed.

Time	Location	Degree of Infestation	Management Response
1955	Bird River	Unknown	Mechanical removal & chemical treatment
1964	Bird River Sassafras River	100 acres	30 acres mechanically removed
1965	Bird River Sassafras River	200 acres	Mechanical removal & chemical treatment
1966-1996	No plants recorded		Control was thought to be successful
1997	Bird River	50 plants	No control implemented
1998	Bird River	3+ acres	No control implemented
1999	Bird River Sassafras River	30 acres 30+ acres	Harvesting & hand pulling 260,000 pounds removed 140,000 pounds removed
2000	Bird River Sassafras River	Reduced Range & Density	Harvesting & hand pulling 1,000 pounds removed 1,000 pounds removed
2001	Bird River Sassafras River	Reduced Range & Density	Harvesting & hand pulling 200 pounds removed 600 pounds removed
2002	Bird River Sassafras River	Reduced Range & Density	*Hand pulling only Few bushels removed 200 pounds removed
2003-2004	Bird River Sassafras River	~100 plants ~100 plants	Shoreline Monitoring Survey Remaining plants pulled Remaining plants pulled

III. Case Studies

C. Alewife Brook Watershed

Alewife Brook is one of the main tributaries to the Mystic River, one of the most densely populated and urban watersheds in Massachusetts. In the fall of 1999, Roger Frymire decided to attempt a three-year eradication of water chestnut in the Alewife Brook Watershed. The goal was to remove all water chestnut plants in the watershed, and to conduct patrols to prevent new viable seeds from forming. Harvesting took place entirely from non-motorized craft and removal was done by hand pulling. With the exception of a few instances where up to five volunteers were used, Frymire did the bulk of hand pulling on his own. Successful reduction of water chestnut populations on seven different water bodies was achieved by hand pulling by kayak. A key strategy that was adopted to increase the feasibility of controlling large, dense infestations was early-season removal. For example, at Blair Pond hand pulling was conducted over a period of 31 days in 2001. The extensive amount of time resulted in the removal of 6 tons of water chestnut, however, only 1/3 of the pond was cleared. The remaining 2/3 of the pond had set seed before it could be pulled. The next year, hand pulling began as soon as the plants were recognizable and before they were “full grown”. All of the plants in the entire pond could then be removed in only 12 days, and the plant material weighed less than 800 pounds. By pulling early the weight and volume of the water chestnut was only 2% of that of mature plants. By 2002 the once widespread infestation had been reduced to 5 pounds of plants that were hand pulled in two hours.



III. Case Studies

D. Connecticut River Watershed

A 20-acre water chestnut infestation was discovered in Log Pond Cove in Holyoke in 1997. Partners of the Connecticut River Watershed established a control strategy to prevent the spread of water chestnut into nearby coves, lakes, ponds and wetlands. The strategy was designed to promote an early detection and response system for new infestations in the region before plants become established, at which point control becomes more difficult and costly (Table 5).

Table 5. Objectives and actions established as part of the water chestnut management strategy in the Connecticut River Watershed.

Strategy Objective	Action Taken
1) Garner partner resources toward the hiring of a contractor to mechanically harvest the two main infestations in the watershed	<ul style="list-style-type: none">• A partnership formed between a local NFW Refuge, State Executive office of Environmental Affairs, the water power company, local conservation commissions, NRCS, and the CT DEP• From 1998- 2001, many partners contributed funds and secured grants to implement mechanical harvesting.• In 1999, 4 weeks of harvesting removed 135 tons• In 2000, operations increased & in 2 weeks 425 tons were removed
2) Concentrate volunteer efforts on the monitoring of nearby water bodies for new infestations	<ul style="list-style-type: none">• Several satellite populations were discovered and pulled: 9 in 1999, 17 in 2000, 20 in 2001, 26 in 2002• Monitoring is planned for next 10 years to remove plants germinating from longer lived seeds
3) Utilize partner-organized volunteer events to hand pull smaller populations and prevent new infestations from establishing	<ul style="list-style-type: none">• In 2000, a limited number of volunteers pulled plants in shallow water• In 2001, professional company hired to hand pull the dense growth in cove- volunteer pulling directed to smaller populations



IV. Water Chestnut Management Plan for Central New York

A. History of Water Chestnut Management in Central New York

1. County and Multi-County Efforts

In Central New York, the distribution of water chestnut has expanded within the Three Rivers System, to Oneida Lake, towards Onondaga Lake, west to Cross Lake, and even to waters beyond Onondaga and Oswego County. A 2002 report by the Central New York Regional Planning and Development Board summarized the control measures taken across Central New York (Appendix A). Since that time, efforts have continued and new advances have been made in controlling water chestnut infestations in this six-county area (Table 6).

Table 6. A summary of water chestnut infestation and management techniques in a six-county area of Central New York.

County	Water Chestnut Distribution	High-Risk Locations	Cultural Control: Education, Prevention, Monitoring	Physical Control: Hand pulling, Mechanical harvest- ing, Chemical Treatment
Cayuga	No established populations confirmed; two incidents of floating rosettes were found and removed in 2004; 2005 sightings suggest the plant may be in Cross Lake	Cross Lake, Cayuga Lake	News releases, workshops, newsletters, signage, web sites, "Weeds Watch Out!" initiative, targeted monitoring, coalition of partners	N/A
Cortland	Cincinnatus Lake was reported in 2004	No specific concern expressed	Aquatic vegetation survey (2002)	All plants were hand pulled and Lake Association continues monitoring
Madison	No established populations reported	Oneida Lake, tributaries with favorable habitat	Pamphlets, brochures, signage, targeted monitoring, mapping	Assist Onondaga & Oswego counties with control techniques
Onondaga	Oneida Lake, Around Kline Island near the Onondaga Lake Outlet, Three Rivers	Finger Lakes	Brochures, news releases, articles, public workshops, web sites, "Weeds Watch Out!" initiative, "Oneida Lake Adopt -A-Shoreline" program, Water Chestnut Task Force Coalition	Hand Pulling, Mechanical Harvesting, Chemical Treatment
Oswego	Oneida Lake, Three Rivers, Ox Creek	Oswego River Tributaries	Mapping, public education programs	Mechanical harvesting, Hand pulling
Wayne	Sodus Bay	Lake Ontario	Public education programs	Hand pulling, mechanical harvesting

A large amount of resources have supported water chestnut control efforts that focus around two main goals: the containment of the current population and the reduction of the infestation. Communication about management strategies, organization, and the coordination of control efforts is facilitated by the Water Chestnut Task Force, an ad hoc collaboration of state and local agency personnel, stakeholder groups, researchers, and plant control professionals (See page *i* for list of Task Force Partners). A number of control techniques have been utilized in the past 10 years.

Water chestnut control techniques have been applied to priority areas. Prioritization of water chestnut infestations are based upon three main factors: 1) infestations that are located in waterways adjacent to residential and commercial areas, 2) infestations that are located in accessible areas within reasonably close proximity to unloading/disposal areas, and 3) infestations that are located in geographically strategic management locations, such as those that make up outlying populations, the “rims” of established populations, and sources of seedling production. Each management season, these three factors help to determine which water chestnut populations will be treated. While geographic location is an important factor in a long-term management and eradication program, limited funding for control techniques and limited access make reaching all infestations impossible. Therefore, waterways that are in close proximity to homes, marinas, and parks are a priority so that residents may make use of the “cleared” waterway. Access and proximity to unloading and disposal sites also plays a large role in the efficiency and cost of a control project, particularly with harvesting techniques which require frequent trips between the water chestnut infestation and the shore where the plants will be unloaded. The distance between the unloading site and the disposal site, and where the harvested plants will be composted, can add a significant time and mileage cost to the operation.

The type of control technique chosen for a particular water chestnut infestation is site specific, and also changes over time with the degree of the infestation. In general, it has been found that chemical treatment is most appropriate for moderate infestations (5 to 10 acres in size) and particularly for infestations that do not have close access/unloading sites that would be needed for mechanical harvesting. A benefit of using chemical treatment for the “first round” of control on a water chestnut bed that has not been managed in the past, is the capability for the managers to estimate the size of the infestation that will be treated. Because chemical applications require a permit from the NYS DEC, it is important to know in advance the specific size and location of the area that will be treated. Once an infestation is treated, these parameters will change the following year and are therefore more difficult to predict during the permitting process. Another factor to consider with the use of chemical treatment is the degree of “isolation” of the infestation. A chemical application is more appropriate for a water chestnut bed that is “isolated” rather than acres of continuous infestation wherein only part of the plants will be treated. Mechanical harvesting may be an appropriate “second round” of treatment, after a preliminary year of chemical control. In general, harvesting is best suited to infestations that have convenient shoreline access, and nearby disposal sites. Another factor that it is taken into consideration with mechanical harvesting is the water depth at the infestation site, since the harvesting equipment requires an adequate depth to operate. Hand-pulling is a viable control option for small infestations and infestations that have been reduced over time with chemical and/or mechanical harvesting. In most cases, access to unloading and disposal areas are also taken into consideration when hand-pulling.

Mechanical harvesting and chemical treatments (funded by the National Fish and Wildlife Foundation, the Oswego County Planning and Community Development Board, and administered through the Finger Lakes - Lake Ontario Wa-

tershed Protection Alliance (FL-LOWPA) have been implemented by the Oswego County Soil and Water Conservation District for water chestnut removal in:

- Oswego River
- Ox Creek
- Seneca River
- Oneida River

Oneida Lake hand pulling efforts have been coordinated by Cornell Cooperative Extension of Onondaga County, in conjunction with the Oneida Lake Association, Rotary Club, and Boy Scouts of America to remove water chestnut along the southwest shore of Oneida Lake at Long Point. In 2002, volunteers removed all of the water chestnut growing at Long Point (about 300 pounds worth). A year later, there were less than half as many plants to pull.

The “Weeds Watch Out!” initiative (funded by the EPA Great Lakes Grants Program, EPA Great Lakes National Program Office, & the National Fish and Wildlife Foundation) was developed by Cornell Cooperative Extension of Cayuga and Onondaga counties, the Cayuga County Department of Planning and Development, the Oswego County Department of Planning & Community Development, the Cayuga Lake Watershed Network, and the Seneca Lake Pure Waters Association. The program serves as an education and outreach mechanism designed to stop the spread of invasive aquatic plants by means of volunteer training. Once trained, volunteers map and monitor Central New York waterways and become an early detection system for new infestations. More than 25 Weeds Watch Out! volunteers were trained in the summer of 2004. Later that season, Weeds Watch Out! volunteers detected and reported a new infestation of water chestnut growing near the outlet of Onondaga Lake. Populations were found in both the east and west channels around Klein Island, located between the Onondaga Lake Outlet and the Seneca River. A

dozen volunteers hand-pulled more than 20 bushels of water chestnut plants growing in these two areas. Volunteers from the Onondaga Yacht Club will continue to monitor the infestation, as well as Onondaga Lake itself, in the future and work towards successful control.

Extensive public outreach and education campaigns also continue across the region to spread water chestnut awareness and promote infestation prevention. Public workshops, newsletters, web sites, brochures (Appendix B), pamphlets, news releases, articles, and signs have been made available through the work of Lake Associations, County Extension Offices, Planning Departments, County SWCDs, Water Quality Agencies, the CNY Regional Planning Board, and other community groups and county agencies. Since 2001, when an informal survey found that most people recognized water chestnut as a problem but were not able to identify it, public awareness campaigns have grown. In 2004 a Cornell University student reported two sightings of floating water chestnut rosettes in Cayuga County. In both cases, the plants were not connected by a stem and appeared to have floated through the canal system. The plants were removed, and thought not to have set seed.

While funded through FL-LOWPA or State member item funds, permits have been issued by the NYS DEC for the chemical treatment of water chestnut in the Three Rivers System and Oneida Lake using granular 2,4-D. The Oswego County Soil and Water Conservation District, Onondaga County Health Department, Madison County Planning Department, CNY Regional Planning & Development Board and the provided assistance to ensue herbicide applications at the following sites:

- In 2003 and 2004 the Oneida Lake Association, Inc. was granted a permit to treat 10 acres of water chestnut along the south shore of Oneida Lake between the Route 81 and 11 bridges with herbicide. The successful reduction in the degree of infestation at this site has made the need

for chemical treatment in 2005 unlikely.

- Two acres at the mouth of Ox Creek, near the Oswego River, was treated with herbicide in 2004 and then cleaned up with a mechanical harvester later in the season. Another site along the creek, at Wybron Road, was also treated with herbicide in 2003 (1 acre) and 2004 (3 acres); the plants were successfully killed and later cleaned up with a mechanical harvester.
- In 2004, the Horseshoe Island Homeowners Organization, Inc., was granted a permit and a 1-acre area of water chestnut near the north-west corner of the island was treated with herbicide. Application difficulties resulted in the population only being stunted for about 10 days before recovering from the treatment. It was concluded that in 2005, a higher-level dosage (2–lbs/acre) is needed for effective control.
- The Central New York Waterways Association was granted a permit to chemically treat one-acre area of water chestnut south of the western end of the State Ditch near Cross Lake. An approximate 25-35% plant mortality was obtained in the first year of application.
- In 2005, funds from the Oneida Lake Association, Onondaga County, and FL-LOWPA resulted in mechanical harvesting around Horseshoe Island, and in the Seneca River, north of Route 31 and between Baldwinsville and Route 690.
- National Fish and Wildlife Foundation funds provided chemical treatment in the Seneca River near Jack's Reef and Baldwinsville.

In 2003-2004, the NYS DEC permitted Oswego County to test the topical application of liquid formulations of 2,4-D Amine and Glyphosphate (Rodeo) for the control of water chestnut in Ox Creek. John DeHollander (Oswego County SWCD) and Jan van der Heide (CCE-Oswego County) reported their findings of the two experimental formulations on water chestnut in the Fall of 2004. Treatment of water chestnut in test plots revealed that 2,4-D is very effective

in killing water chestnut when applied early in the season as a granular application, and in mid-season as a topical application (which prevented the formation of seeds). Late season application was found to do little to kill the plants, and did not affect the development or viability of seeds. Conversely, late-season application of Rodeo killed the plants, and when applied at the time when the plants are translocating materials from the leaves to the overwintering storage organs (the seeds) it reduced viability of the seeds as well. Use of Rodeo earlier in the season only killed the outer leaves of the rosettes, and did not affect plant mortality. The potential use of topical applications of herbicides in the future could be another tool for the control of water chestnut, and be of particular importance where the use of granular formulations presents a challenge because of flowing water, drift, etc.

Advances in the biological control of water chestnut was also continued by Dr. Bernd Blossey and Dr. Jianquig Ding at Cornell University. Their research of the potential agent, a Chinese leaf beetle (*Galerucella birmanica*), during 2003-2004 suggests that potent and safe biological control options exist on the horizon for management in the United States. Their projected feasibility study was completed in December of 2005. A continuation for an additional 2-3 years will be required to complete further host specificity studies to assure that that beetle is not a threat to native North American plants. Only after these tests with approximately 50 different plant species are successful, will a petition for field release be considered by the USDA and APHIS. Annual costs for this second phase are 80-100K, requiring a total of 300-500K for the second phase of the program.

2. Financial and Political Support

To date, control efforts and the management of water chestnut has been supported by a host of state and federal associations, special interest groups, regional working groups, and concerned elected officials. (A summary table of

water chestnut control measures, funding sources, and management partners is located in Appendix C.)

3. *Challenges and Obstacles*

Shoreline access, financial support, and proper equipment present a number of challenges to the successful management of water chestnut at a local and regional scale.

Challenge	Needs
Limited shoreline access to water chestnut infestations.	Convenient and accessible access to shorelines in close proximity of water chestnut infestations is needed to provide efficient transportation of harvested plant material by land equipment/trucks.
Insufficient sites for disposal and composting of harvested/pulled plant material.	Disposal sites in close proximity to harvesting/removal efforts are needed to facilitate cost-efficient transportation of plant material.
Time-efficient transport and disposal.	Truck and land equipment needs to have load capacity comparable to that of the harvester.
Continued cost of supporting biological control research.	At least 2-3 more years of funded research will be required to complete host-specificity testing to obtain permits from federal and state authorities for field release.
Maintaining financial support for the facilitation and continuation of citizen-watch and invasive plant monitoring programs.	Citizen and community volunteer training program to provide a early-detection and monitoring system across waterways of concern.

B. Future Planning

Decisions regarding where and how to control water chestnut infestations in the future will continue to revolve around available funding, local support, and prioritization that considers infestations near residential and commercial use, adequate shoreline access and disposal sites, and geographic edges and outliers of water chestnut populations. In addition to the continuation of qualitative post-treatment assessment, the development of a more quantitative survey tool is needed to evaluate the effectiveness of water chestnut control methods. A public attitude/input survey is also needed to compile local homeowner and resident feedback about water chestnut control projects completed in their communities. Educational outreach will be an ongoing need to increase public awareness across CNY and to prevent new and re- infestations.

Priority areas for mechanical harvesting include:

- Continuation of harvesting at the Belgian Bridge to Three Rivers.
- Continuation of harvesting at the Baldwinsville Dam to Route 690.
- Continuation of harvesting around Oak Orchard on the Oneida River.
- Expansion of harvesting to the Seneca River, West of Route 690.
- Expansion of harvesting around Horseshoe Island.
- Continuation of harvesting in Ox Creek.
- Expansion of harvesting in Oneida River.

Priority areas for chemical treatment include:

- Expansion of the topical formulation starting in 2006, over the granular formulation, in river and deep water areas.
- Focus on infestations 5-10 acres in size that have not been treated previously.
- Expansion of chemical treatment to infestation at Jack's Reef.
- Continuation of chemical treatment in Ox Creek.
- Expansion of chemical treatment in Oneida River.

Priority areas for hand-pulling and public participation:

- Expand engagement of local communities and residents in conducting hand pulling removal of single outlying plants/ satellite populations.
- Organize a water chestnut steward fellowship program for students; youth corps of water chestnut removal that focuses on the prevention of water chestnut expansion by hand pulling outlying satellite populations and educating public about the impacts of neglecting single plants at new locations.

Priority projects for public education and outreach:

- Continue and expand informational workshops, presentations, and volunteer trainings in the Oneida Lake, Three Rivers, and Finger Lakes region.
- Continue to develop and publish informational brochures, booklets, posters, and mailings.
- Expand some outreach materials to cover additional invasive aquatic plants.

C. Management Goals

Goal 1: Eradicate water chestnut from Oneida Lake and prevent its reintroduction from potential source locations in the Oneida River.

Goal 2: Prevent further expansion of water chestnut in the Oswego-Seneca-Oneida (Three Rivers) Corridor, and ultimately eliminate or severely reduce the distribution to levels that can easily be contained with minimal resources.

Goal 3: Prevent the spread of water chestnut from the River System to the Finger Lakes and Montezuma Wildlife Refuge.

To meet these goals, the following objectives have been outlined according to three main focus categories: Leadership & Logistical/Financial Support, Control Techniques, and Public Education.

D. Action Plan

Leadership and Logistical/Financial Support

Objective 1: Establish a regional taskforce that will facilitate communication and coordination of water chestnut control activities performed by stakeholder and regulatory groups.

▣ ACTION PLANNED

1. The task force will continue to meet to collaborate on water chestnut control strategies, and share information.

▣ RESPONSE

1. A regional task force was formed in 2002, consisting of ad hoc individuals from state and local agencies, regional watershed and lake associations, community groups, and educational/research institutions.
2. From 2002-2005, the Water Chestnut Task Force met 1-2 times per year to discuss upcoming water chestnut control practices, the latest updates on experimental research and outcomes, and future plans and strategies.

Objective 2: Secure financial and logistical support for continued control and management initiatives.

▣ ACTION PLANNED

1. Task force will finalize a water chestnut management plan to outline a comprehensive and adaptive-strategy that can be used to garner funding for control treatments, and education & prevention campaigns.

Objective 1:

***Establish a
Regional Water
Chestnut Task
Force***

Objective 2:

***Secure financial
and logistical
support***

▣ **RESPONSE**

1. Funding was successful for control treatments on prioritized water chestnut beds in Onondaga and Oswego Counties, and public outreach/education on Oneida Lake, as well as portions of the Three Rivers System.

Control Techniques

Objective 3: Develop a regional water chestnut monitoring system to provide current plant distribution information for control program planning and evaluation, and to provide early detection of new infestations to minimize the risk of spread through satellite populations.

Objective 3:
Develop a regional water chestnut monitoring system

▣ **ACTION PLANNED**

1. Quantify the “baseline” water chestnut distribution and update regularly.
2. Develop and maintain a citizen water chestnut monitoring program.
3. Create and maintain a web site with access to the water chestnut distribution in CNY.

▣ **RESPONSE**

1. The “baseline” water chestnut distribution was estimated based on geographical extents and water body. The Madison County Planning Agency and Cornell University Cooperative Extension of Onondaga County have partnered to create a map of water chestnut in Oneida Lake and the Three Rivers System.
2. In 2002, a “Water Chestnut Watch Out” reporting program was established on Oneida Lake. In 2004, the “Weeds Watch Out!” and Oneida Lake Adopt-A-Shoreline programs were initiated with community volunteers.
3. In 2001, the Madison County Planning Agency established a water chestnut distribution GIS database. The Ecology and Management of Invasive Plants Program at Cornell University developed a reporting and information shar-

ing web site in 2002. The next steps will be to establish public access to the database via the website, through an interactive data-entering that will allow volunteer monitors to enter their findings.

Objective 4: Encourage local government, municipalities, and community residents to take a proactive role in preventing the spread of water chestnut.

▣ **ACTION PLANNED**

1. Develop informational resources for local groups to clarify the threats and impacts to communities.
2. Facilitate communication with municipalities and stakeholder groups concerning opportunities for support, involvement & participation.

▣ **RESPONSE**

1. Local groups and supporters, including the Oneida Lake Association, Oneida Shores Rotary Club, Onondaga Yacht Club, Senator Jim Wright (48th District), Baldwinsville Rotary Club, Senator John DeFrancisco (50th District), Seneca River Estates Homeowner Association, and regional Bassmasters groups, have taken a role in learning more about water chestnut and the associated threats through meetings, presentations, boat tours, and financial support.
2. Meetings/workshops will be organized for municipal officials and leaders. Particular focus will be directed at the need for assistance with the transport and disposal of harvested plant material.

Objective 5: Implement appropriate eradication and control measures at priority sites.

▣ **ACTION PLANNED**

1. Continue to organize hand-pulling efforts, and encourage local community
-

Objective 4:
Involve local government officials and community groups

Objective 5:
Implement appropriate eradication and control techniques

-
- groups to take active role in coordinating community hand-pulling days.
2. Continue and expand mechanical and chemical control treatments for prioritized areas.
 3. Perform follow-up post treatment evaluation and assessment of public comments and needs regarding water chestnut management in CNY.

▣ **RESPONSE**

1. Over the past 4 years, more than eight organized hand-pulling events have been conducted, resulting in the removal of water chestnut from Oneida Lake and the Seneca River. Future plans include organizing homeowners and boaters to pull small “satellite” populations and individual plants on their own.
2. Water chestnut infestations have been prioritized for control treatments according to residential/commercial use of waterways, adequate access and nearby disposal locations, and potential as seed sources (geographic outliers and “rims”).
3. Post-treatment assessments of control treatments have been done following chemical applications and harvesting. Future needs call for the development of a quantitative method to determine the impact of control techniques, that is quick and relatively simple to perform. A public survey is also needed to compile community comments regarding the degree of satisfaction with water chestnut control efforts over time.

Objective 6: Support research concerning the biological control of water chestnut.

▣ **ACTION PLANNED**

1. Remain up to date on most recent research progress and news concerning status of Asian Leaf Beetles as potential control agents for water chestnut.
2. Support research at the Ecology and Management of Invasive Plants Pro-

Objective 6:
***Support
research of
biological
control.***

gram, directed by Bernd Blossey at Cornell University.

▣ **RESPONSE**

1. In Phase I of research (2003-2004), a species of Chinese Leaf Beetle was identified as a potential control agent for water chestnut in the U.S. Phase I will be completed in the Summer of 2005. Future needs include research funding of \$80-100K per year for 2-3 additional years of Phase II research.

Objective 7: Support research concerning the chemical control of water chestnut.

▣ **ACTION PLANNED**

1. Determine the effectiveness of liquid applications of 2,4-D Amine and Glyphosphate for topical treatment of water chestnut using a NYS DEC experimental permit.
2. Communicate the results of the test plot results and determine how topical chemicals may/may not be used as a tool in managing water chestnut in CNY.

▣ **RESPONSE**

1. In 2003-2004, experimental permits were granted for the liquid 2,4-D Amine and glyphosphate. The results of this treatment on water chestnut in flowing waters led to a FIFRA 2(ee) recommendation in March of 2005 for the use of 2,4-D amine (Weedar 64 Broadleaf Herbicide) and glyphosphate (Rodeo) to control water chestnut in New York State (see Appendix D).
2. Future plans focus on increasing the use of these topical applications for infestations found in moving waters, such as the river system, where granular formulations have been found to have inconsistent or ineffective results.

Objective 7:
***Support
research of
chemical
control
techniques***

Public Education

Objective 8: Increase awareness through education of public and natural resource managers.

Objective 8:
Increase public awareness through education

▣ ACTION PLANNED

1. Provide outreach and educational programming at public workshops, volunteer trainings, and community meetings.
2. Distribute educational publications about water chestnut identification, prevention, and opportunities for public involvement.
3. Develop and distribute informational signage regarding water chestnut and other invasive aquatic plants.
4. Develop and maintain up-to-date water chestnut information on-line.

▣ RESPONSE

1. Water chestnut and invasive aquatic plant workshops have been held throughout the Oswego River Basin; water chestnut programs have been specifically concentrated around Oneida Lake and the Seneca River. Future plans focus on expanding outreach to the Three Rivers System and westward.
2. Water Chestnut Alert Cards, Invasive plant ID booklets, water chestnut grocery bags and numerous brochures & pamphlets have been distributed throughout the Oswego River Basin. Future plans focus on continuing information about prevention, control, and reporting, as well as targeting boaters and shoreline homeowners.
3. Invasive aquatic plant signs have been developed and distributed throughout the Oswego River Basin as part of the Weeds Watch Out! program.
4. Online information about water chestnut is provided via numerous web pages (see Appendix E). Future plans include the development of a central web site which will provide complete information and links to the many lo-

cal web pages and programs.

Objective 9: Engage community groups, local educators, and stakeholders by involving them in water chestnut “citizen science” projects and control efforts.

▣ **ACTION PLANNED**

1. Train a volunteer group of citizens to identify and report water chestnut (as well as other invasive aquatic plant) infestations.
2. Involve community groups in hand-pulling control and removal efforts.
3. Expand monitoring coverage of CNY waterways through an Adopt-A-Shoreline Program.
4. Collaborate with local community groups to expand water chestnut control and education projects across CNY.

▣ **RESPONSE**

1. As of July 2005, the Weeds Watch Out! program has trained more than 40 residents throughout the Oswego River Basin to monitor for nine invasive aquatic plants, including water chestnut. Future plans will focus on expanding the concentration of volunteers along the Three Rivers System.
2. Boy Scout Troops, community organizations, and local residents have participated in water chestnut hand pulling days during the past four years.
3. As of July 2005, more than 30 residents on Oneida Lake have adopted over 65% of the shoreline to monitor for water chestnut. Future plans will expand the Adopt-A-Shoreline program along the Three Rivers System, and Finger Lakes.
4. Local community organizations and youth groups have participated in water chestnut education programs.

***Objective 9:
Incorporate
public
involvement
and participation
into
control
techniques***

Objective 10: Improve cost-effectiveness and efficiency of public education program by combining water chestnut education with education about other potentially invasive aquatic plants.

▣ **ACTION PLANNED**

1. Take a proactive approach to additional invasive aquatic plants that have the potential to create problems in CNY waterways.
2. Expand some water chestnut educational outreach to include information and reporting procedures for other invasive species.

▣ **RESPONSE**

1. The Weeds Watch Out! program focused on a total of nine invasive aquatic plants (including water chestnut).
2. Weeds Watch Out! volunteers were trained not only to identify and report water chestnut, but 8 other invasive aquatic plants as well.
3. Future plans include introducing Adopt-A-Shoreline participants to plant identification resources that will allow them to monitor for a larger number of invasive species.

V. Conclusion

The successful management of water chestnut populations in and between Central New York waterways will inevitably play a role in future tourism, recreation, property values and quality of life for local communities, as well as the condition of native aquatic ecosystems. Persistent and strategic control efforts, coupled with collaborative support from local and regional stakeholders and municipalities, will be necessary to achieve the long-term goals outlined in this plan. The proposed strategies and goals outlined in this plan were developed in recognition of the fact that invasive plant issues cannot be dealt with in geographic isolation, and are intended to serve as guidelines for communities and partners across the region in their collective efforts to prevent the spread of water chestnut.

Objective 10:
Improve public outreach efficiency by expanding multiple invasive aquatic plants.

Appendix A
Regional Water Chestnut Investigation Project Summary Report

Regional Water Chestnut Investigation Project Summary Report

Summer 2002

Kristy Szprygada, Intern

CNY Regional Planning and Development Board

Introduction

Water chestnut, *Trapa natans*, is a highly aggressive invasive plant. Native to Asia, it was first recorded in North America near Concord, Massachusetts in 1859. (http://www.dnr.state.md.us/bay/sav/water_chestnut.html)

Water chestnut plants can reach up to 16 feet in length. They produce a white flower with four petals up to ¼ inch long and bloom from late June to September. Germination occurs in the springtime; one seed can give rise to 10-15 rosettes, each of which can produce 15-20 seeds. This annual plant has a high reproductive capacity. Each seed can produce 300 new seeds in a single year. One acre of water chestnut can produce enough seeds to cover 100 acres the following year. (http://www.dnr.state.md.us/bay/sav/water_chestnut.html) Each plant produces a nut that has four extremely sharp horns connected to a spine with several barbs. The mature nuts sink to the bottom, can withstand drying and other extreme environmental conditions, and germinate up to 8-12 years later. Dispersal of the water chestnut is limited to the rosettes detaching from their stems and floating to a new area or displacement of the nuts by waves, winds, or human and wildlife interactions. The nut is the only part of the plant that will overwinter successfully. (Parts taken from the Oswego County EMC Water Chestnut Alert fact sheet)

In the Spring 2002 issue of the Cayuga Lake Watershed Network newsletter, J. DeHollander (Oswego Co. SWCD) wrote “It now consumes well over 100 acres of our beautiful, quiet interior waterways, and its range is ever expanding.” Population estimates have exceeded 200 acres in CNY, since the Summer of 2002. This highly invasive plant can wipe out native bay grasses, prevent nearly all water recreation use where it occurs, create breeding grounds for mosquitoes, and provide only marginal habitat to native fish and birds. (http://www.dnr.state.md.us/bay/sav/water_chestnut.html) Once an area is infested with water chestnut, it is only a matter of time before the channel is deemed unnavigable due to the dense mat of aquatic vegetation taking over the surface waters.

Public awareness and cooperation, along with public agency control efforts are required to eliminate water chestnut from our waterways and prevent its spread into new areas. Mechanical harvesting and hand pulling are two methods to help control the populations, but follow-up “maintenance” harvesting must be done to keep the areas free of future infestations. (Parts taken from the Oswego County Water Chestnut Alert fact sheet)

Water Chestnut: County Concern and Work Effort Summary

The DEC Region 7 office has received numerous complaints and concerns about water chestnut infestations within Onondaga, Oswego and Cayuga counties. Recently, the Central New York

Regional Planning and Development Board (CNY RPDB) was assigned to determine the extent of the problem and summarize the education, outreach and control measures that have been taken throughout the five county region. This report is a summary of the CNY RPDB's investigation, broken up by county, to describe the extent of infestation, areas of concern, funding proposals and work efforts in each area. A GIS map was created to depict the areas of infestation summarized by this report (see Attachment 1). The original map, created by John DeHollander of the Oswego County Soil and Water Conservation District (SWCD), was a topographic paper map. It was then given to Scott Ingmire, of the Madison County Planning Department, who turned it into a GIS map. The CNY RPDB then updated it to include recent and more heavily infested areas since the Oswego County SWCD original paper map was created.

County Assessment

Cayuga: Cayuga County Cornell Cooperative Extension (CCE) is working in conjunction with the Cayuga Lake Watershed Network and the Owasco Watershed Lake Association (OWLA) to help educate the public on the identification and prevention of water chestnut. Their main concern is that the infestation in the Seneca River will make its way into Cross Lake and Cayuga Lake. In particular, they are closely monitoring the north end of Cayuga Lake; that is where they feel conditions are most favorable for an infestation. Their public education efforts have consisted of news releases, newsletters, aquatic plant workshops, and signs (made by the NYS DEC) posted at county lakes. There is also a display at the Cornell Cooperative Extension office that instructs the public on how to identify water chestnut and what to do if they find it in their area. Cayuga County CCE, the Water Quality Management Agency (WQMA), DEC, Cayuga County Planning Department, and the lake associations have organized an informal coalition of members to spread awareness and discuss strategies to prevent the spread of water chestnut into Cayuga County. In terms of funding, a proposal has been submitted to the Great Lakes Protection Fund by the Cayuga County CCE that would fund the continuation of their public education efforts and initiate monitoring programs throughout the county. (As per 7/02 phone conversation with Kelly Fallone, Cayuga County CCE)

According to the WQMA report distributed in June 2002, the Cayuga Lake Network, CCE of Cayuga County, Planning Department, SWCD, and OWLA have been active in developing and organizing educational programs for invasive species in the watersheds of Cayuga and Owasco Lakes. In Duck Lake, initiatives to design programs that encourage education and awareness of the dangers of spreading unwanted weeds and zebra mussels have been developed. The Cayuga County Planning Department is also searching for funding to inventory and map aquatic vegetation in Owasco Lake, to train CCE and Planning Department personnel to identify aquatic vegetation and to initiate a regular inventory and monitoring program for exotic and invasive species in Owasco Lake and its watershed.

Cortland: Cortland County does not have water chestnut in any of its waterways. According to a Cortland County SWCD representative, the county is not worried about the spread of water chestnut into their region and they have not taken any steps to prevent it. They would, however, like to be kept up to date on the spread of this invasive plant. They would like to distribute copies of the water chestnut educational/awareness brochures to the residents of Cortland County to keep them informed of the potential threats of invasion by water chestnut, before it becomes a

reality in Cortland County. A recent aquatic vegetation survey verified the absence of water chestnut from the Cortland County area. (As per 6/02 phone conversation with Patrick Reidy, Cortland County SWCD)

Madison: The Madison County Planning Department is working closely with the Onondaga County DOH and the Oswego County SWCD to keep current populations of water chestnut under control and prevent the spread into Madison County. Pamphlets and brochures are available to Madison County residents which inform them of the water chestnut's potential to invade their area. Large educational signs, designed by Madison County Planning Department (with the help of the Oswego Co. SWCD), were placed at DEC boat launches, marinas, and waterfront parks to help the public identify the invasive plant; while learning how to control its spread via transport on or in their boats and recreational equipment. Madison County agencies have been assisting in the development and execution of programs, including hand-pulling and mechanical harvesting sessions to help remove water chestnut from the Oneida Lake and Three Rivers area; preparing many large signs for use in public education and outreach efforts; and seeking funding for future work with water chestnut. The highly favorable areas for water chestnut infestations are some of the shallow, slow moving, mucky bottom tributaries of the lake (e.g., Cowaselon Creek). These waterways are being watched closely by the Madison County Planning Department to ensure that water chestnut does not become established. At this time, water chestnut has not been reported in any waterbody within Madison County. (As per many Summer 2002 phone conversations with Scott Ingmire, Madison County Planning Department)

Onondaga: Mechanical harvesting and hand-pulling programs have been implemented in the Three Rivers area and the Western Basin of Oneida Lake to help contain and eradicate water chestnut populations. There have been no reports of water chestnut presence in Cross Lake. Funding has been secured from the Fish and Wildlife Foundation to develop public education and harvesting programs based on multiple-year goals (see Attachments 2 and 3). Working closely with Madison and Oswego Counties, the goal is to remove existing populations of water chestnut from Oswego and Onondaga Counties and to prevent future infestations into these two counties as well as into Madison County.

In order to prevent future infestations and control current populations, public education along with hand-pulling and mechanical harvesting methods are being used. CCE of Onondaga County has focused their efforts towards educating the public on the identification of and control measures for water chestnut in local waterways. They held two hand-pulling sessions in the summer of 2002 on the southwestern shores of Oneida Lake. In total, approximately 70 people representing the Boy Scouts of America, the Oneida Lake Association, CNY RPDB, CCE and lakeshore communities participated in the event.

CCE and other agencies in Onondaga, Madison and Oswego counties intend to continue these programs (education, hand pulling, mechanical harvesting) in the future and expand the harvesting practices to infested waterways in Onondaga County in addition to Oneida Lake. (As per 7/02 phone conversation with Russ Nemecek, Onondaga County DOH and 6/02 and 7/02 phone and in-person communications with Sheila Myers and Amy Samuels, CCE of Onondaga County)

Oswego: In the summer of 2001, John DeHollander surveyed Oneida Lake and the Seneca, Oswego, and Oneida Rivers to determine the extent of water chestnut infestations and assess the level of public awareness of the problem. A topographic map was produced with dots used to denote water chestnut presence. DeHollander found that most people were not able to identify the aquatic vegetation as water chestnut, but recognized it as a problem in their local waters. Working closely with Onondaga and Madison County agencies, grants have been proposed and funding secured for mechanical harvesting, public education programs and hand-pulling sessions. (As also referenced in the Onondaga and Madison County sections.)

The Oswego County SWCD has been in charge of conducting the mechanical harvesting in Oneida Lake through funds administered by the Oswego County Planning and Community Development which were provided through annual Finger Lakes – Lake Ontario Watershed Protection Alliance (FL-LOWPA) funding. Mechanical harvesting in Oneida Lake is scheduled for the summer of 2002, but no definitive dates have been set. Oswego County Environmental Management Council (EMC) has produced several informative handouts including a small water chestnut alert card and a two-sided water chestnut alert fact sheet to educate the public on water chestnut.

Annual harvesting is conducted in Ox Creek, a tributary of the Oswego River. Once noted as a top location for bass fishing, since 1990 it has been so heavily infested with water chestnut that the waterway becomes unnavigable each summer. Mechanical harvesting is performed each year, but is difficult to do since the creek is filled with submerged stumps and debris. Unfortunately, the current goal of the harvesting in Ox Creek is only to clear a navigation pathway to allow recreational activities to resume, not to eliminate the water chestnut population.

Wayne County: Water chestnut was discovered in the southern end of Sodus Bay in the late 1980s. Hand-pulling programs were organized by the Boy Scouts of America to help keep the waterway navigable by canoe (non-motorized area). Over the past 5 to 10 years, water chestnut populations have increased and been established north of Bay Bridge. Mechanical harvesting, along with hand-pulling sessions, have been organized by the Wayne County SWCD with continued support from the Boy Scouts and concerned lakeshore residents. In July 2002, 42 tons of water chestnut were mechanically harvested from Sodus Bay with an additional 1.5 tons harvested via hand pulling. In the summer of 2002, a new infestation site was discovered in East Bay. East Bay is located east of Sodus Bay and before Port Bay. Coincidentally, this was the first summer that the Bay had been opened to traffic from Lake Ontario. The population covered an area 10 feet long x 15 feet wide. Plans are currently being made to remove the water chestnut from East Bay. The spread of water chestnut to these bays is said to have been by “hitchhikers.” (As per a 7/02 phone conversation with Tiffany Boas, Wayne County SWCD)

Future Funding and Continued Efforts in the Central New York Region

Madison, Onondaga and Oswego Counties, in conjunction with FL-LOWPA, were awarded a \$25,000 grant from the National Fish and Wildlife Foundation towards public education and organized harvesting of water chestnut in Oneida Lake and the Three Rivers area. As part of the grant requirement, multiple-year goals were established (see Attachments 2 and 3). Educational brochures and pamphlets were prepared and public hand-pulling sessions were organized with a portion of the grant money to encourage public support and awareness. The majority of this

grant money is being applied towards mechanical harvesting within Oneida Lake and the Oneida River area.

Madison, Onondaga and Oswego Counties, with FL-LOWPA, plan to re-apply for the annual grant opportunity with the National Fish and Wildlife Foundation to continue funding their public education and outreach programs and expand mechanical harvesting and hand-pulling programs to newly infested and continually infested waterways throughout Onondaga and Oswego Counties. As a guideline, the three counties will work together and continue to follow the multiple-year goals (see Attachments 2 and 3) developed to help control and eradicate water chestnut from Central New York. However, with this minimal level of grant funding plus the provided match, preventing the further spread of water chestnut into Oneida Lake will remain the primary objective in the short-term.

In addition, as part of the continuing control measures against water chestnut, Dr. Bernd Blossey (Cornell University) is working to find a biological control agent for non-indigenous aquatic plants, including water chestnut, with funds provided through Congressman James Walsh.

To fully eliminate water chestnut from Oswego and Onondaga Counties and keep it from spreading into other areas of CNY will take persistence, determination and cooperation from lakeshore communities, private organizations, and county, state and federal agencies. With the continued support from private groups and organizations within the region, Madison, Onondaga and Oswego Counties hope to see a surge of public interest and participation in the control efforts of water chestnut. An increase in organized hand-pulling sessions will not only help to control the noxious weed populations, but spark community involvement and education. An increase in funds allocated towards mechanical harvesting will also help to eradicate dense populations of water chestnut in a timely manner. ***Above what is currently available, the need for funding and harvesting equipment to address the water chestnut problem is substantial. It would appear that a federal interest, especially in terms of funding, is essential to enable adequate control of water chestnut in the Central New York area given the current lack of a biological or chemical remedy. While research is underway to identify biological control measures, whether chemical treatment is a possibility must be determined soon.*** It is through a combination of all these efforts that water chestnut will be eradicated from Central New York, improving recreational activities and enjoyment of our waterways.

Appendix B

Public Outreach Brochure: Shoreline Adoption Program

Eagle Scout Chaz Foland loads water chestnut pulled from Long Point



We Need You!

Shoreline Adoption Program:

Cornell Cooperative Extension of Onondaga County is offering an educational program to teach people how to detect and control water chestnut in order to prevent its spread. We are looking for organizations and individuals interested in learning about these invasive plants, and “adopting” part of Oneida Lake or the three-rivers shoreline. Our goal is to have the entire shoreline patrolled by the community. If you or someone you know may be interested in this community-wide project, please contact us!

Other Volunteer Opportunities:

Weeds Watch Out! (W₂O!): This program is designed to educate community members about all aquatic invasive plant species throughout all the waterways of Central New York. If you are interested in more in depth training you may want to be a Weeds Watch Out! volunteer in addition to being a water chestnut adopt a shoreline volunteer.

Employment and program opportunities are offered to all people regardless of race, color, national origin, gender, age or disability.

Non-Profit Org.,
U.S. Postage
PAID
Permit No. 3381
Syracuse NY

**Cooperative Extension
Onondaga County**
220 Herald Place, 2nd Floor
Syracuse NY 13202



THE WATER CHESTNUTS
ARE HERE, BUT IT'S NOT TOO
LATE TO ACT!



Cooperative University Extension of Onondaga County

Water Chestnut Education and Shoreline Adoption Program



You can help make the Oneida,
Oswego, and Seneca rivers
water chestnut free
with CCE!



Cornell University

Cooperative Extension 220 Herald Place, 2nd Floor
Onondaga County Syracuse NY 13202

Tel: (315) 424-9485

Fax: (315) 424-7056

www.cce.cornell.edu/



Let's Get Those Nuts!



Who: Cornell Cooperative Extension, the local community, and YOU.

What: Learn to locate, map, & remove water chestnut on the River system.

Where: Shallow waters of the river.

Why: To keep the lake open for boating and fishing and to preserve the river's natural ecosystem.

How: You sign up, and we'll provide the training.

WANTED!



WATER CHESTNUT

Known whereabouts: The Three Rivers and Oneida Lake

Wanted for: Attacking and taking over boating areas, distributing sharp, potentially dangerous nuts, decreasing lakefront property values, crowding out native plants and animals, hampering fishing, and hurting local businesses.



Oneida Shores Rotary Club members unload water chestnuts pulled from their adopted portion of Oneida Lake

Contact Information

Amy Samuels

315-424-9485 ext. 233

ams71@cornell.edu

Kelly Somerlot

315 424-9485 ext. 230

kes56@cornell.edu

Funding for this program is provided by the Onondaga County Environmental Health Council.

Appendix C

Summary of Water Chestnut Control Measures, Funding and Partners

Appendix C

Summary of Water Chestnut Control Measures, Funding Sources, and Management Partners (2002-2005)

Grants/contracts by year that focus on water chestnut education control (only major deliverables/activities listed)

2002	Funding Source: Onondaga County Environmental Health Council Recipient: Cornell Cooperative Extension of Onondaga County <ul style="list-style-type: none">▪ Publication & distribution of a water chestnut brochure to Oneida Lake and Three Rivers shoreline property owners
2002	Funding Source: Finger Lakes-Lake Ontario Watershed Protection Alliance Recipient: Oswego County Soil and Water Conservation District (SWCD) <ul style="list-style-type: none">▪ Water Chestnut Harvesting on Oneida Lake and the Oswego River
2002-2005	Funding Source: Congressman James Walsh Recipient: Ecology and Management of Invasive Plants Program at Cornell University <ul style="list-style-type: none">▪ Evaluation of potential biological agents for water chestnut
2002/2003	Funding Source: National Fish and Wildlife Foundation Recipient: Cornell Cooperative Extension of Onondaga County <ul style="list-style-type: none">▪ Four workshops/hand-pulling sessions on Oneida Lake▪ Creation of CNY Water Chestnut Task Force▪ Oversee Eagle Scout/Boy Scout education/outreach projects on water chestnut on Oneida Lake
2003	Funding Source: Finger Lakes-Lake Ontario Watershed Protection Alliance Recipient: Oswego County SWCD <ul style="list-style-type: none">▪ Mechanical Harvesting of 15 acres of water chestnut on the Seneca River * Partners: Onondaga County DOH, Oswego County Department of Planning and Community Development
2003	Funding Source: Finger Lakes-Lake Ontario Watershed Protection Alliance Recipient: Madison County Planning Department <ul style="list-style-type: none">▪ Experimental Chemical Treatment of appx. 8 acres of water chestnut in Oneida Lake and one acre near mouth of Ox Creek with 2,4-D *Partners: CNY Regional Planning and Development Board
2003	Funding Source: Finger Lakes-Lake Ontario Watershed Protection Alliance Recipient: Oswego County SWCD <ul style="list-style-type: none">▪ Experimental Chemical Treatment of water chestnut plots in Ox Creek
2004	Funding Source: FL-LOWPA funds to Onondaga County Recipient: Cornell Cooperative Extension of Onondaga County

- One educational workshop for Oneida Lake residents
- Two educational workshops for Seneca River residents
- Enlist and support 3 volunteer groups to monitor/remove water chestnut on Oneida Lake
- Facilitate CNY Water Chestnut Task Force

- 2004 Funding Source: Finger Lakes-Lake Ontario Watershed Protection Alliance
 Recipient: Oswego County SWCD and Onondaga County DOH
- Experimental Chemical Treatment of Water Chestnut with Aqua Kleen in Jack's Reef, Ox Creek, Oneida Lake, Horseshoe Island and Oneida River
- *Partners: CNY Waterways Association Inc., Granby Clear Water Association, Oneida Lake Association, NYS DEC, Cornell University, Horseshoe Island Homeowners Organization Inc.
- 2004/2005 Funding Source: Oneida Lake Association
 Recipient: Cornell Cooperative Extension of Onondaga County
- Initiate Oneida Lake "Adopt A Shoreline" program
 - Hire and supervise interns to promote "Adopt A Shoreline" program
 - Support volunteers in the monitoring and removal of water chestnut on Oneida Lake
- 2005 Funding Source: FL-LOWPA funds to Onondaga County
 Recipient: Cornell Cooperative Extension of Onondaga County
- Initiate Seneca River "Adopt A Shoreline" program
 - Hire and supervise intern to promote "Adopt A Shoreline" program
 - Organize volunteers for targeted hand-pulling efforts
 - Develop water chestnut management plan with support of CNY Water Chestnut Task Force
- 2004/2005 Funding Source: Great Lakes National Program Office
 Recipient: Weeds Watch Out Program Partners
- Enlist and train volunteers throughout Onondaga County to identify invasive aquatic plants, in order to prevent the establishment and spread of problem species not currently in our area and to control established problem plants while numbers are low and manageable.
 - Distribute educational signs and booklets throughout Onondaga County
- 2005 Funding Source: Funds from Senator Wright
 Recipient: Oneida Lake Association
- Mechanical harvesting of water chestnut in Horseshoe Island Area
- 2005 Funding Source: Funds from Senator DeFrancisco and FL-LOWPA
 Recipient: Onondaga County
- Water chestnut harvesting in Seneca River, north of Rte 31 and Baldwinsville to Rte 690

- 2005 Funding Source: FL-LOWPA Special Grant
Recipient: Oswego County SWCD
- Chemical treatment at Horseshoe Island, Oak Orchard (Oneida River), and Ox Creek (Oswego River)
- 2005 Funding Source: National Fish and Wildlife Foundation
Recipient: Onondaga County
- Chemical treatment at Jack's Reef (Seneca River) and Baldwinsville Area

More Major Results Since 2002

- Almost 70% of the shoreline of Oneida Lake has been adopted by individual homeowners, marina owners, and civic organizations that monitor and control water chestnut along their adopted stretch.
- 100% the shoreline around Onondaga Lake has been adopted by the Onondaga Yacht Club.
- Volunteers have removed a couple tons of water chestnut from Onondaga County waterways
- As a result of water chestnut educational materials, a homeowner in Bernhards Bay found and pulled what would have been the eastern most point of infestation on Oneida Lake, helping stop the eastward expansion of water chestnut on Oneida Lake.
- Volunteer hand-pulling has been coordinated with mechanical harvesting and herbicide treatment to reduce the eastern and western edges of the infestation.
- About 70 homeowners on the Seneca River attended two workshops on water chestnut management.
- Almost 150 volunteers have participated in water chestnut control days on Oneida Lake, the Onondaga Lake Outlet and the Seneca River.
- A water chestnut management powerpoint has been presented to numerous organizations including the Seneca River Estates Homeowner association, the Baldwinsville Rotary Club, the Oneida Shores Rotary Club, Salt City Bassmasters, Crown City Bassmasters and the Oneida Lake Association.
- Educational signage has been placed at marinas on Oneida Lake, the Seneca River, Otisco Lake and Skaneateles Lake.
- Educational brochures were developed and distributed to shoreline homeowners along Oneida Lake, Skaneateles Lake and the Three Rivers System.

Appendix D

FIFRA 2(ee) Recommendation for the Use of Weedar 64 Broadleaf Herbicide
and Rodeo to Control Water Chestnut.

New York State Department of Environmental Conservation

Division of Solid & Hazardous Materials

Bureau of Pesticides Management

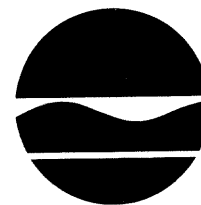
Pesticide Product Registration Section

625 Broadway, Albany, New York 12233-7257

Phone: 518-402-8768 FAX: 518-402-9024

Website: <http://www.dec.state.ny.us/website/dshdm/pesticide/pesticide.htm>

E-Mail: ppr@gw.dec.state.ny.us



Denise Sheehan

Acting

Commissioner

March 28, 2005

CERTIFIED MAIL

RETURN RECEIPT REQUESTED

Mr. Will Smith
Pesticide Management Education Program
Cornell Business & Technology Park
20 Thornwood Drive, Suite 106
Ithaca, NY 14850

Dear Will:

Re: FIFRA 2(ee) Recommendation for the Use of Weedar 64 Broadleaf Herbicide (EPA Reg. No. 71368-1) and Rodeo (EPA Reg. No. 62719-324) to Control Water Chestnut.

The Department of Environmental Conservation has approved your FIFRA 2(ee) recommendation for the use of Weedar 64 Broadleaf Herbicide (EPA Reg. No. 71368-1) and Rodeo (EPA Reg. No. 62719-324) to control Water Chestnut.

Enclosed is the stamped "accepted" copy of the recommendation, as it should appear in the Cornell Pest Management Guidelines. If you have any questions regarding this letter please contact me at (518) 402-8768.

Sincerely,

Samuel J. Jackling

Chief

Pesticide Product Registration Section

Enclosure

cc: w/enc. - Robert Mungari, NYS Dept of Agriculture and Markets

FIFRA 2(ee) Recommendation

Control of water chestnut in aquatic environments

Researcher and Title:

John DeHollander, District Manager
Oswego County Soil and Water Conservation District
3095 State Route 3
Fulton, NY 13069
315-592-9663

Jan van der Heide
Cornell Cooperative Extension of Oswego County
3288 Main Street
Mexico, NY 13114
315-963-7286/ 315-963-7287

Pesticide Name and EPA Registration No.:

Weedar 64, EPA Reg. No. 71368-1

Rodeo, EPA Reg. No. 62719-324

Target Site:

Aquatic environments

Target Pest:

Water Chestnut

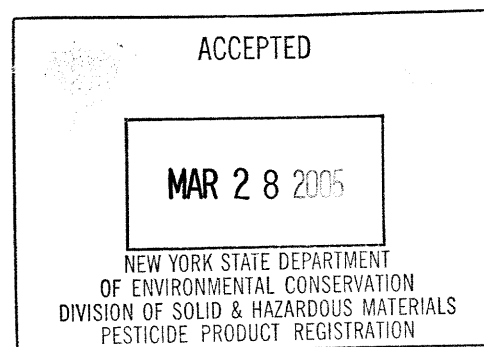
Proposed Application Rate:

Weedar 64 EPA Reg. No. 71368-1 (1.3 oz/gallon plus spreader/sticker @1.5 % v/v (Cygnat Plus)

Rodeo EPA Reg. No. 62719-324 (1.5% v/v plus spreader/sticker (Cygnat Plus) applied to run-off

Nature of 2(ee) Variation from Product Label:

Addition of unlabeled pest (site is labeled). See attached efficacy data



Complete Recommendation as it will appear in the Cornell Pest Management Guidelines or other professional media

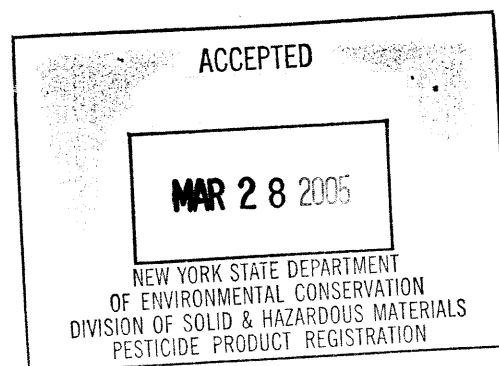
Pests

Water Chestnut

Materials and Rates

2,4-D amine (Weedar 64 EPA Reg. No. 71368-1) -- 1.3 oz/gallon plus spreader/sticker @1.5 % v/v (Cygnet Plus

glyphosate (Rodeo EPA Reg. No. 62719-324) -- 1.5% v/v plus spreader/sticker (Cygnet Plus) applied to run-off



Appendix E

Summary Listing of Online Resources and Websites Relevant to Water Chestnut

Appendix E

Summary Listing of Online Resources and Websites Relevant to Water Chestnut in New York State.

Adirondack Park Invasive Plant Program
Aquatic Invasive Plant Project: Water Chestnut
www.adkinvasives.com/Aquatic/PlantID/Chestnut.html

Cayuga Lake Watershed Network News
Water Chestnut Focus
www.cayugalake.org/newsletter/spring/2002/waterchestnuts.html

Central New York Regional Planning and Development Board
Regional Strategy for Addressing Water Chestnut
www.cnyrpdb.org/programs/env/reg/wc.asp

Cornell Cooperative Extension of Onondaga County-
Water Chestnut Fact Sheet and Electronic Reporting Form
www.cce.cornell.edu/onondaga/Water%20Chestnut/Focus%20on%20Water%20Chestnut.htm

Ecology and Management of Invasive Plants Program at Cornell University –
Water Chestnut Pest Status and Biological Control Research
www.invasiveplants.net/invasiveplants/InvasivePlants/WaterChestnut/WaterChestnut.asp

Invasive Plant Council of New York State
Water Chestnut: Target Plants
www.ipcnys.org/sections/target/water_chestnut_overview.htm

Lake Champlain Basin Atlas
Water Chestnuts
www.lcbp.org/atlas/HTML/is_chestnut.htm

New York Sea Grant
Northeast Water Chestnut Web
<http://www.waterchestnut.org>

Oswego County Soil and Water Conservation District
Aquatic Vegetation Control Program
http://oswegosoilandwater.com/aquatic_vegetation.htm

Weeds Watch Out Program-
Water Chestnut Information, and Invasive Plant Volunteer Monitoring Program
<http://co.cayuga.ny.us/wqma/weedswatchout/plants/waterchestnut.htm>