2015 *Hydrilla* Survey and Management Plan for

**Coventry Lake**

*Coventry, Connecticut*

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Hydrilla
*Hydrilla verticillata*

Photo by Vic Ramey
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1.0 **Background**

Aquatic Control Technology (ACT) and Northeast Aquatic Research (NEAR) were contracted by the Connecticut Department of Energy and Environmental Protection (CT DEEP) to conduct a survey of Coventry Lake in Coventry, CT for invasive *Hydrilla (Hydrilla verticillata)* and develop a plan for its management.

The first indication of *Hydrilla* in Coventry Lake was the discovery of about half a dozen floating fragments by a University of Connecticut biology class in September of 2015. Following this report, a day long littoral survey using underwater camera, grapple and visual techniques was conducted in early October by the Connecticut Agricultural Experiment Station’s Invasive Aquatic Plant Program (CAES-IAPP). Only two additional plant fragments were observed during this survey. We understand that inspections of the lake were also performed by divers from Ecosystem Consulting Service but no additional observations of *Hydrilla* were made. All plant fragments were found in the vicinity of the boat ramp area indicating that Hydrilla growth in the lake was already subject to fragmentation and underscoring the potential for fragments to be transported from the lake to other waterbodies.

Recognizing the threat that *Hydrilla* poses to Coventry Lake and surrounding water resources, this project was funded by CT DEEP to perform a plant survey with the level of effort needed to locate the areas of *Hydrilla* growth in the lake. Originally proposed to include up to three days of survey with two crews, the entire littoral area of Coventry Lake was surveyed in detail over the course of two days (October 30th & November 2nd) by two survey crews. The following report documents the methodology, results and management recommendations for Coventry Lake.

2.0 **Methodology**

Coventry Lake has a surface area of approximately 374-acres with an average depth of 21 feet and a maximum depth of 38 feet. Two crews surveyed the littoral zone (water less than about twelve feet deep – See Figure to left) encompassing about 132 acres using a combination of underwater camera, viewscope, rake/grapple and visual observations. Aquatic plants were rarely found in deeper water at this lake, most likely limited by light penetration. The extensive span of shallow littoral area required numerous grid-like transects, spaced approximately 50-150 feet apart. In areas where the lake bathymetry was very steep a single transect, perpendicular to shore was made. In the coves where *Hydrilla* was eventually located, intensive transects were spaced less than 20 feet apart.

Waypoints were taken for invasive *Hydrilla* and the two native species of *Elodea (canadensis and nuttallii)*. The *Elodea* locations and densities were recorded as a precautionary measure because they are visually very similar to *Hydrilla* and are a good reference for future surveys.

The Coventry Lake littoral zone is highly variable and characterized by steep rocky ledges with very little plant growth, expansive shallow muddy bottoms with nearly one-hundred percent cover of aquatic vegetation, as well as very shallow sandy sediment bars with sparse plant cover.

3.0 **Survey Results**

Throughout the two-day survey, only one area of the lake exhibited growth of *Hydrilla*. As shown in the next figure, the infested area of the lake is a shallow cove located along the northeast shoreline. Within the cove area, only two moderate sized patches of *Hydrilla* were identified along with two small areas of trace growth. The northernmost, largest patch of *Hydrilla* was approximately 10 ft x 20 ft and the total
aggregate area of growth (which includes some buffer around the observed plant beds) was approximately 1,300 ft². Plant growth in the northernmost patch was near the surface in 3-4 feet of water while the southernmost patch was lower growing and about a foot below the surface in relatively shallow water (~2-feet). It should be noted that the lake was down 1-2 feet at the time of the survey. As expected, based on other regional infestations, the Hydrilla found in Coventry Lake is the monoecious biotype as determined by Dr. Don Les at the University of Connecticut via DNA analysis.

Figure 2 - Hydrilla Locations and Management Zone
The entire cove area of approximately 9‐acres is designated as the “active management” area for 2016. Additional and frequent surveys of the lake will be an important part of the ongoing program, both to evaluate management actions and to monitor the lake for additional areas of growth.

4.0 Recommended Management Program

The presence of *Hydrilla* in Coventry Lake is of great concern not only due to potential adverse effects on the lake itself, but also as a source of spread to other state waterbodies. Coventry Lake is a high‐use recreational waterbody, with significant boat traffic so the potential to spread *Hydrilla* into other public and private waterbodies is very high. The following sections discuss some basic information on the biology of *Hydrilla*, the potential vectors for its spread and the recommended management actions.

4.1 Hydrilla Ecology

*Hydrilla* is believed to be native to parts of Asia and Africa. *Hydrilla* is most often found growing in freshwater lakes, ponds, impoundments, and slow moving rivers. Although it usually grows in shallow water of less than 15 ft, it has been documented growing to depths of 15m (~49 ft) in clear water situations (Langeland 1996). *Hydrilla* can tolerate a wide range of habitat types from oligotrophic to eutrophic, acidic to alkaline, and even salinities of up to 33% seawater (Mahler 1979). These adaptive growth characteristics may allow *Hydrilla* to out‐compete many native New England aquatic plant species, which may result in the loss of species diversity and richness.

Species Taxonomy

*Hydrilla* is a rooted submerged aquatic perennial monocot. The plant produces many above ground stems called stolons from subterranean stems or rhizomes. The pointed leaves (6‐20mm long) are arranged in whorls of 3‐8. The margins of the leaves are distinctly saw‐toothed. *Hydrilla* is often confused with native elodea and/or Naiad species; however, *Hydrilla* can be positively identified by the presence of subterranean turions/tubers, as *Hydrilla* is the only one of these species to have those reproductive structures.

According to Crow and Hellquist (2000) the following characteristics can be used to identify *Hydrilla* to species:

- Plants submersed, rooted, or fragments free‐floating beneath the water surface, leaves basal or cauline, sessile.
- Leaves cauline, short, opposite or whorled, lacking lacunae band.
- Leaves 0.6‐1.7 cm long, flowers lacking nectarines.
- Leaves in whorls of (2) 4‐6, leaf margins conspicuously toothed, midvein of lower surface often with spine‐like teeth (fresh specimens rough to the touch), spathe or staminate flowers spiny.

U.S. Hydrilla Colonization & Spread

*Hydrilla verticillata* is the only species in the genus *Hydrilla* to occur in its native range, however, monoecious (both male and female flowers on the same plant) and dioecious (male and female flowers on separate plants) biotypes do exist (Haller 2009). Currently both the monoecious and dioecious biotypes occur in the United States. It is believed that the dioecious strain was first introduced into Florida sometime in the late 1950’s as a result of the aquarium trade. The monoecious strain is thought to have

Figure 3 - *Hydrilla* Line Drawings
been introduced on a separate occasion more recently. The monoecious biotype was first discovered in the Potomac River in the late 1970's. These two separate introductions of *Hydrilla* likely account for the segregated distribution of the monoecious and dioecious biotypes in the United States. Monoecious *Hydrilla*, which has proven to be cold weather tolerant, is found almost exclusively in areas north of North Carolina.

*Hydrilla* was not discovered in New England until the mid-1980s, when it was identified in a small pond at Mystic Seaport in Connecticut. The first Massachusetts *Hydrilla* infestation was confirmed in 2001 at Long Pond (~50 acres) in Barnstable, MA. Since the discovery of that infestation, *Hydrilla* has been documented at several more sites in Connecticut, three locations in the state of Maine, and in almost a dozen other waterbodies in Massachusetts. Based on the continued spread of the monoecious biotype within New England we can be certain that the plant has the ability to successfully over-winter and propagate in northern climates.

**Figure 4 - United States *Hydrilla* Distribution (8/4/2011)**

![Map of United States Hydrilla Distribution](image-url)
Species Reproduction

One of the primary reasons *Hydrilla* can out-compete many of our native aquatic plant species is that it is very efficient at propagating. *Hydrilla* is capable of reproducing, and thereby spreading itself in four different ways; axillary turions, subterranean turions (tubers), fragmentation, and seed production.

**Axillary Turions**

Axillary turions are small dark vegetative buds that form in the leaf axils of the plant. These vegetative propagules break off from the parent plant and settle to the bottom to form a new plant. Turion production is particularly important when dealing with the monoecious biotype, as the monoecious form produces turions more rapidly and of a greater quantity under short day conditions than the dioecious biotype (Steward and Van 1987). These turion production characteristics make the monoecious biotype better adapted for New England’s shorter growing seasons.

**Subterranean Turions (Tubers)**

Subterranean turions or tubers are yellowish potato-like structures that form at the tip of the underground rhizome several inches below the surface of the sediment. Monoecious *Hydrilla* puts more energy into tuber and turion production than the dioecious biotype (Spencer and Anderson 1986). Tubers can remain dormant in the sediment for many years and can also remain viable for several days out of water (Basiouny et al 1978). Like turions, tubers are of significant management importance, as they are produced prolifically by mature *Hydrilla* plants. In fact, studies have shown that a single sprouting tuber can produce over 200 tubers per square foot each year.
**Fragmentation**

*Hydrilla* fragments consisting of a single whorl of leaves can generate roots and create a new plant. These means of *Hydrilla* reproduction likely represent the greatest threat to accidental human dispersal of the plant. Greater than 50% of *Hydrilla* fragments consisting of at least three whorls of leaves can generate new plants (Langeland and Sutton 1980).

**Seed Production**

Sexual reproduction and viable seed production have been documented in monoecious *Hydrilla* under experimental conditions. The ecological significance of viable seed production, however, is not fully known, as *Hydrilla* seeds are very small and difficult to study in natural systems. Viable seed production may likely act as a means of long distance dispersal for *Hydrilla* (i.e. seed ingestion by birds). The dioecious biotype found in the southern states produce only female flowers and therefore lack the male flowers necessary for pollination and seed formation. Hence seed dispersal and/or reproduction are exclusive to the monoecious biotype.

4.2 **Vectors of Spread**

*Hydrilla* is a very hearty plant that has the ability to colonize a variety of habitats; therefore, the plant can spread throughout a region quickly and threaten aquatic ecology. This ability to spread is further enhanced by *Hydrilla*’s prolific reproduction habits which enable the plant to effectively move from one aquatic site via both means of natural dispersal and inadvertent transport. In the following section we will discuss the known vectors of *Hydrilla* spread and how they affect the risk of *Hydrilla* introduction into other waterbodies in the region.

**Boat Trailers & Outboard Motors**

Trailered boat traffic from one waterbody to another represents the most common means of *Hydrilla* transport. Plant fragments of at least one whorl of leaves attached to a trailer can remain viable for several days depending upon the moisture content of the trailer location they are attached to.

**Fishing Gear**

The transport of plant fragments, turions, or even tubers on fishing equipment is possible. Fishermen often fish multiple waterbodies during the course of the season and may even fish more than one waterbody during a single day of fishing. *Hydrilla* fragments or some vegetative propagules could become attached to fishing gear through general fishing practices and be unintentionally transported to other waterbodies. The best way to prevent spread from this vector is through aggressive signage and education of the public and fishermen alike.

**Live Bait Pails**

Although similar to fishing gear, live bait containers pose an even greater risk of *Hydrilla* transport. Anglers often transport live bait from one fishing spot to another and frequently exchange the water in their bait pails to sustain the bait fish. These practices could certainly result in the introduction of *Hydrilla* fragments and/or other vegetative propagules. Education of local bait suppliers and fishermen is an important step in lessening the threat of this possible vector of spread.

**Aquarium/Horticulture Industry**

The aquarium and water garden trade have long been a vector of spread for invasive aquatic plants. Aquatic plants that look similar to native plant species, like hydrilla, are often misidentified for commercial sale or included as a “hitchhiker” on mail order plant specimens. Hence the illegal dumping of private, potentially infected aquaria represents a threat to possible introduction. As with many of the human influenced modes of transport public education is the best way to mitigate their threat in this case.
Waterfowl/Birds

The transport of *Hydrilla* fragments, tubers, or turions from Coventry Lake can occur by waterfowl and/or other semi-aquatic birds. Although there is no direct means of preventing this natural dispersal mechanism, efforts can be made to lessen the potential. The most effective and likely the only way to reduce the possibility of this occurring would be to effectively control the *Hydrilla* infestation. Effective elimination of biomass will prevent the *Hydrilla* from reaching the lake surface, where it is more easily fragmented and more likely to come in contact with waterfowl or wading birds.

The fact that monoecious *Hydrilla* potentially produces viable seeds, suggests that *Hydrilla* transport could possibly occur by birds ingesting seeds. Preventing the formation of mature, sexually reproducing *Hydrilla* plants within the area is the only way to prevent possible *Hydrilla* spread by seed.

Wildlife

Aquatic mammals could possibly transport *Hydrilla* fragments over short distances. Albeit a less likely method of dispersal, wildlife could transport *Hydrilla* to nearby waterbodies, which along with waterfowl transfer, make local lakes and ponds more susceptible.

Water-flow

Aquatic plants generally have propagules that are readily dispersed by natural water flow. The outflow of Coventry Lake forms Mill Brook, which travels southeast through a series of small ponds into the Willimantic River. If possible, these small ponds should be checked regularly for signs of *Hydrilla*.

4.3 Recommended Management Plan

The management of *Hydrilla* in Coventry Lake will require a combination of public education, active management and monitoring. The goal of these techniques will be to eliminate *Hydrilla* biomass to the extent possible throughout the growing season, reduce the risk of spread within and outside of Coventry Lake and monitor for any new areas of growth in the lake and possibly other regional waterbodies.

Monitoring

As pioneering infestations of *Hydrilla* can be very elusive, especially in waterbodies with widespread growth of Elodea, it is important to monitor the entire littoral zone of Coventry Lake periodically through the growing season so that any additional areas of growth can be addressed. Intensive surveys of the known infested areas will also be needed to evaluate the efficacy of the proposed management options.

We suggest that thorough littoral surveys of the lake be conducted at least three times during the growing season, *Hydrilla* growth in the northeast typically emerges later in the spring and early summer, so the first survey should initially be targeted for late May, but may be adjusted based on weather conditions and as the specific characteristics of the population in Coventry Lake are determined. Additional surveys would be conducted later in the summer on a schedule to be determined, but likely sometime in July and again in September.

Surveys should be conducted using a variety of techniques including SCUBA/snorkel, underwater camera, viewscope and visual observations. Given the size of the littoral area, it is likely that each survey will require at least two field days for one crew.

The CT DEEP may want to consider monitoring regional waterbodies as they are particularly susceptible to the spread of *Hydrilla*. Within close proximity to Coventry Lake are the Bolton Lakes, Eagleville Lake, Columbia Lake and Andover Lake as well as numerous smaller waterbodies. Many of these waterbodies are being managed to some degree for other reasons and already have consultants working on them regularly. Existing monitoring on these lakes should be modified to monitor for *Hydrilla* and those waterbodies that are not being surveyed regularly should initiated such action right away. The outflow watercourse from Coventry Lake to the Willimantic River should also be monitored. As there is considerable boat traffic at Coventry Lake that may end up at lakes and ponds throughout the state,
everyone should be made aware of the discovery and be on the lookout for *Hydrilla*. This also underscores the importance of public education for boaters at Coventry Lake.

**Public Education**

There are a number of human induced vectors of *Hydrilla* spread that are best combated through diligent education of the public. Educating and making the public aware of the threat of *Hydrilla* and their potential role in its spread is an important component of the management plan. Educational efforts need to encompass the public at large, but particular focus should be placed on those groups (boaters, anglers, bait and tackle proprietors, etc.) that have the greatest potential to serves as conduits for *Hydrilla* transport and dispersal. The following steps are recommended to facilitate public awareness and education.

**Signage**

Posting signs at conspicuous public access points at Coventry Lake will be important to get the message out to users. These signs should be specific to Coventry Lake and include information on the identification of *Hydrilla*, its ecological threat, how it can be spread, and who to contact if the plant is observed.

**Educational Pamphlets**

A pamphlet or flyer can be developed to include information about the biology of *Hydrilla*, the threat of it spreading to nearby waterbodies and specific information on steps the public can take to prevent the plant from being inadvertently transported to area waterbodies. This pamphlet could also provide periodic updates on the ongoing program and the status of *Hydrilla* spread in the lake, in order to keep the concern fresh in the public's mind. The pamphlet could be distributed to local bait and tackle shops, at sportsman's shows/events, it could accompany local fishing license sales, and even be mailed to area watershed residents.

**Increased Inspection of Boats, Equipment and Gear**

As part of the educational campaign CT DEEP staff can make an increased effort to inspect boats at Coventry Lake and other regional waterbodies. These face to face public interactions and cursory inspections of equipment will further guard against the spread of *Hydrilla* through this vector, and will also create a higher level of awareness within the user group about the *Hydrilla* situation and their role in protecting other lakes from this invasive plant.

**Information to Local Media Outlets (Newspaper, Cable, etc.)**

Public address information should be prepared for dissemination to the local media. Newspaper articles and local cable access television can be an effective means of alerting the public to the threat of *Hydrilla* in Coventry Lake and other waterbodies. This information should include details about the ongoing management and monitoring efforts as well as more general concerns about the public's possible role in the spread of the plant.

**Active Management of *Hydrilla***

To manage the existing biomass of *Hydrilla* in Coventry Lake, we recommend a multi-faceted approach initially utilizing herbicide treatment and benthic barriers, but potentially expanding to diver handpulling/diver assisted suction harvesting and other techniques as needed. Herbicide treatment is recommended as the initial approach due to its proven record to effectively control *Hydrilla* foliage/biomass, especially in areas where unidentified, trace or sparse growth likely exists. Herbicides provide this without any adverse effects to fish/wildlife and typically at lower unit costs than other techniques.

For 2016, treatment with Aquathol-K (endothall) is recommended to eliminate *Hydrilla* biomass. Recent treatments, including our work with the US Army Corp of Engineers (USACE) on the Erie Canal, suggests that Aquathol-K (Endothall) is the preferred contact herbicide for control of *Hydrilla*. Moreover, a staggered series of two 1.5 parts per million (ppm) treatments spaced about 16-24 hours apart is providing
a longer effective exposure time and increased efficacy over a single treatment or treatment with Reward (diquat) and Cutrine Plus. In terms of timing, recent experience suggests waiting until most of the plants have begun active growth, which may occur as late as mid-late July.

Based on the growth characteristics of Hydrilla, specifically its reproduction from tubers, recent experience has shown that systemic herbicides (like fluridone) generally do not provide any better or longer duration of control than contact herbicides like endothall, especially when conducting partial lake treatments. If growth is more diffuse or if the entire waterbody needs to be treated, systemic herbicides may be a better option.

Based on the observations of growth in 2015, the initial treatment will be conducted in the ~9-acre management zone shown in Figure 2. In order to proceed with treatment, a permit must be obtained from the CT DEEP. If needed later in the summer to manage any observed re-growth, spot treatment with either Aquathol-K or a Reward (diquat) and copper combination treatment would be performed. Multiple treatments with several products can be applied for on the CT DEEP permit application.

Depending on the efficacy of the initial treatment and based on any interim observations of additional areas of growth, it may be appropriate to also utilize benthic barriers to manage Hydrilla biomass. In general, we would not recommend covering known areas where plants may germinate because the control effort is actually better served by allowing the plants to sprout and then controlling the foliage as this will help deplete the tuber bank. If areas of growth are covered during the growing season it will only delay the eventual sprouting of Hydrilla as has been demonstrated at several other New England sites such as Mystic Lake in Barnstable, MA. Should some areas of growth be observed between treatment efforts or if treatment activities are limited for some reason, benthic barriers as well as diver hand-pulling and DASH are appropriate alternatives. Black PVC barrier or Tyvek-like material is recommended for this project as past experience with materials like Aquascreen (which has small window screen like apertures) has shown that the Hydrilla can grow under and through such barriers. For ease of handling, the barriers can be attached to frames which are placed over the areas of Hydrilla growth.

The following is a summary of the recommended management plan for 2016.

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Task</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Permitting</td>
<td>Prepare &amp; File CT DEEP Permit</td>
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<td></td>
<td>Filing Fees</td>
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<td>Monitoring</td>
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<td>Herbicide Treatment</td>
<td>Initial treatment with two 1.5 ppm sequential applications of endothall</td>
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<td></td>
<td>Follow-Up Treatment with Reward for late season re-growth</td>
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<td>Benthic Barrier</td>
<td>Material Cost for barrier and framing material</td>
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<td>Construction &amp; Installation</td>
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<tr>
<td>Public Education</td>
<td>Signage, Education Pamphlets, Increased boat monitoring</td>
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</table>
In subsequent years, the management program must remain flexible to properly address re-growth as well as any new areas of growth that may be observed through monitoring. The overall goals of management are to minimize the presence of hydrilla biomass in Coventry Lake and decrease the overall extent of the infestation over time or at least prevent its further expansion. Eradication is most often difficult to achieve, but is possible especially as it would appear that the infestation has been caught in the early stages.

Another topic of management that will require additional discussion with CT DEEP and regional parties is possibly quarantine, either of the infested areas of the lake or the entire lake. All things being equal, the safest method would be to restrict boat traffic in the lake, however the lake is a valuable resource to residents and the general public. Given the limited distribution of the Hydrilla, it may make more sense at least initially, to quarantine the management area to prevent boat traffic.

We trust this report provides the CT DEEP with the information necessary to begin planning management actions for 2016. We welcome the opportunity to be involved with the process as needed. Please contact us anytime with questions or if further assistance is needed.
LITERATURE CITED


