Hydrilla (*Hydrilla verticillata*)

(Hydrilla, Photo credit: Kerry Dressler)

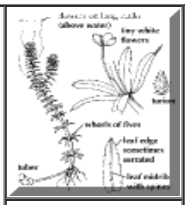
Introduction

DESCRIPTION

The **Hydrilla** (*Hydrilla verticillata*) is thought to have been introduced to North America in Florida sometime during the 1950's. It is an aggressive, invasive species and has spread throughout Florida and most southern states, as well as California, Delaware, and the District of Columbia. Hydrilla has been categorized as one of the world's worst weeds, and it is certainly among the most notorious of submerged aquatic plant species. Infestations of Hydrilla are extremely severe and can completely choke entire lakes and public water supplies.

Submersed perennial herb. Rooted, with long stems that branch at the surface where growth becomes horizontal and dense mats form. Small, pointed leaves are arranged in whorls of 4 to 8. Leaves have serrated margins and one or more sharp teeth under the midrib (Godfrey and Wooten 1979). Development of these features may vary with location, age, and water quality (Kay 1992).

- Long, sinewy, underwater plant.
- Leaves are small and pointed, oppositely arranged, and generally grow in whorls of five.
- Leaves are sometimes serrated along the edges; midrib of leaf is often reddish and has one or more sharp spines.
- Flowers are tiny, white, and grow on long stalks.
- Distinct tubers are 1/4 to 1/2 inches long, off-white to yellowish, potato-like structures that attach to the roots.



(Sources: 1. Sea Grant Nonindigenous Species Site (SGNIS), http://www.iiseagrant.org/; 2. U.S. Geographic Survey, http://nas.er.usgs.gov/plants/docs/hy_verti.html; 3. King County, WA Noxious Weed Control Program, http://dnr.metrokc.gov/wlr/waterres/smlakes/hydrilla.htm).

IMPACTS

When **Hydrilla** established, it results in an array of ecosystem disruptions. Changes often begin with its invasion of deep, dark waters where most plants can not grow. **Hydrilla** grows aggressively and competatively, spreading through shallower areas and forming thick mats in surface waters that block sunlight penetration to native plants below (van Dijk 1985).
It has been shown to alter the physical and chemical characteristics of lakes. Colle and Shireman (1980) found sportfish reduced in weight and size when hydrilla occupied the majority of the water column, suggesting that foraging efficiency was reduced as open water space and natural vegetation gradients were lost. Stratification of the water column (Schmitz et al. 1993; Rizzo et al. 1996), decreased oxygen levels (Pesacreta 1988), and fish kills (Rizzo et al. 1996) have been documented. Changes in water chemistry may also be implicated in zooplankton and phytoplankton declines (Schmitz and Osborne 1984; Schmitz et al. 1993).
Hydrilla seriously affects water flow and water use. Recent infestations in the Mobile Delta are reducing flow in small tidal streams and creating a backwater habitat (J. Zolcynski pers. comm. 1998). Its heavy growth commonly obstructs boating, swimming and fishing in lakes and rivers and blocks the withdrawl of water used for power generation and agricultural irrigation.

Effects of Hydrilla Infestation

- waters may become unnavigable
- overheated boat motors are common
- fishing in shallow waters becomes impossible
- fish populations may become stunted
- alteration in fish predator-prey kills
- massive fish kills may occur due to depression of dissolved oxygen concentration
- changes in water quality
- loss of wildlife habitats
- clogging of rivers, streams, canals and ditches occurs, impacting agricultural, domestic and industrial uses
- prevents the use of water systems for recreation
- drownings occur due to entanglement
- impacts the economy of surrounding community
- depresses water-site property values

(Sources: 1. U.S. Geographic Survey, http://nas.er.usgs.gov/plants/docs/hy_verti.html; 2. California Department of Boating and Waterways, http://www.dbw.ca.gov/Hydrilla.htm)

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Geographic Information

LIGHT FOR SAFARI SETTINGS

Native Range

The common dioecious type originates from the Indian subcontinent. Historical reports specify the island of Sri Lanka (Schmitz et al. 1991) while random amplified polymorphic DNA (RAPD) analysis point to India's southern mainland (Madeira et al. 1997). Korea appears the likely origin for the monoecious type (Madeira et al. 1997).

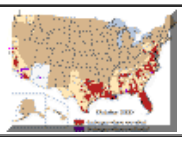
Hydrilla is mainly introduced to new waters as castaway fragments on recreational boats, their motors and trailers and in live wells. Stem pieces root in the substrate and develop into new colonies, commonly beginning near boat ramps. Once established, boat traffic continues to shatter and spread hydrilla throughout the waterbody. Both types propagate primarily by stem fragmentation, although axillary buds (turions) and subterranean tubers are also important. Tubers are resistant to most control techniques (Schardt 1994) and

may be viable as a source of reinfestation for years (Van and Steward 1990).
Hydrilla may be unknowingly transplanted into private ponds as a contaminant on watergarden plants. It is often found spreading after extensive 2,4-D use in public waters once heavily populated with Eurasian water-milfoil (*Myriophyllum spicatum*) (Bates and Smith 1994).

(Source: U.S. Geographic Survey, http://nas.er.usgs.gov/plants/docs/hy_verti.html)

DISTRIBUTION

Link to USGS Hydrilla U.S. Distribution Map Link
http://nas.er.usgs.gov/plants/docs/hy_verti.html

	**Hydrilla** **October 2000** Link	**Map indicates recorded presence in at least one site within the drainage.**

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Control Methods

Control Hydrilla

BIOLOGICAL CONTROL

Different methods or combined methods can be used to control **Hydrilla** depending on the management goal. In recreational waters the challenge is to control **Hydrilla** selectively amid native vegetation. Management methods include herbicide, grass carp, and mechanical removal.

Experiments have been done on the **Hydrilla** fly which eats only **Hydrilla**. This Asian fly was released in Alabama in 1998. The fly did destroy much of the plant, but populations varied from year to year. Another species being implemented is the grass carp, although possession of the fish is illegal in many states because of the risk of overpopulation. They have been used in small ponds and sterile fish have also shown to be effective. Herbicides are a common control method including copper, diquat, endothall, and fluridone. These chemicals have been effective and have little to no effect on native aquatic plants.

Sources: 1. Langeland, K. A. 1996. *Hydrilla vertcillata* (L.F.) Royale (Hydrocharitaceae), "The Perfect Aquatic Weed". Castanea 61:293-304, http://plants.ifas.ufl.edu/hydcirc.html; 2. King County, WA Noxious Weed Control Program, http://dnr.metrokc.gov/wlr/waterres/smlakes/hydrilla.htm)

MECHANICAL CONTROL

▶ Hand Cutters
Hand cutting tools are often used against submerged aquatic weeds, including **Hydrilla**, to combat the plants in small sections of lake or river systems. Hand cutting tools are very effective at providing short-term local control of **Hydrilla**. As this weed is aggressive, the operator should expect some regrowth in the treatment area during the course of the growing season and understand that repeat treatments could be necessary. If the operator finds that the area infested with this weed is too large to effectively clear, aquatic plant harvesting should be considered as a mechanical alternative.

▶ Harvesting
Although there are a number of manufacturers of aquatic plant harvesting equipment, the design concepts are similar. Most aquatic plant harvesting systems will cut and remove **Hydrilla** to a depth of 5 to 7 ft. As this biomass is removed from the lake, the water is ready to use at once and there are no restrictions on the use of the area that might be experienced with an herbicide or some biological control treatments.
Harvesting system performance is in the 1- to 3-acre per day range, depending on the equipment mix and shoreline access available. As such, large areas cannot be cleared rapidly. A manager has to factor the

shoreline access available. As such, large areas cannot be cleared rapidly. A manager has to factor the amount of acreage to be cleared and the amount of time available before the area needs to be weed free. In some cases other tools may be appropriate if the water needs to be cleared more rapidly.

▶ Rotovation

Rotovators are basically large underwater rototillers. The knives penetrate the soil, till it, and release the root crowns and other plant tissue. The tiller is mounted on an arm similar to a backhoe and can be lowered into the water and held against the sediments. Rotovators can reach the bottom sediments to depths of 20 ft. The rotovator operator tills the vegetation in target areas using a cross-hatch pattern. A number of lines are tilled in one direction; the equipment repositions itself and cuts a number of tillage lines across the original lines at a 90-deg angle. Intensive tilling results in removal of the root crowns of the plant and/ or the below-sediment structures. It will also cut and disturb any crowns that are not removed. This provides long-term mechanical control of this weed.

Rotovation provides dramatically longer periods of control of hydrilla than does harvesting. This exotic weed poses a major threat to the infested water body and all surrounding waters. mechanical control methods should be considered when the plant is well-distributed as a maintenance tool or where there are limited options.

▶ Bottom Barrier

Bottom barriers have played a critical role in the management of hydrilla, and they have two basic applications when targeting this plant. Bottom barriers have effectively been used to cover pioneering infestations of this weed and prevent the spread of the plant. They have also been used in a maintenance role, opening water around docks or swimming areas for use.

Bottom barriers are materials that are laid across sections of lake or river bottoms infested with this noxious weed. These barriers are attached to the bottom by pins or sand bags. Common bottom barrier materials are geotextile ground cover cloth or erosion control materials.

Bottom barriers provide 100 percent control of this weed in areas where they are installed. They also provide long-term control. An ongoing maintenance operation is required to inspect the bottom barrier and clear the mats of sediment buildup.

▶ Driver Dredge

Diver dredge technology is a mechanical control technology that was pioneered by the British Columbia Ministry of Environment. Diver dredging is especially effective against pioneering infestations of **Hydrilla**. In diver dredging operations, divers use venturi pump systems to collect plant and root biomass. The pumps are mounted on barges or pontoon boats and, normally, each craft will support two dredge systems. The dredge hoses are from 3 to 5 in in diameter and are handled underwater by one diver. Diver dredging can provide excellent results when targeting **Hydrilla**. When properly applied, this technology will remove the plant and tubers from the lake system and stem the spread of the weed. Pioneering infestations can be eradicated through careful application of this technology. Larger infestations can also be controlled through repeated treatments.

Other CONTROL

The spread of **Hydrilla** from one body of water to another can be greatly reduced if boaters remove all aquatic weeds from boats, trailers and fishing gear before leaving lakes, rivers, ponds and streams. Fragments can get caught underneath boats and spread the weed from one location to another. Also, aquarium contents should be dumped on ground, not in a body of water or down a drain. A plant suspected of being **Hydrilla** should be taken to the local County Agricultural Commisioner.

(Source: 1. The U.S. Army Engineer Waterways Experiment Station (WES), http://www.wes.army.mil/el/aqua/apis/mechanical/hydrilla.html; 2. California Department of Boating and Waterways, http://www.dbw.ca.gov/Hydrilla.htm).

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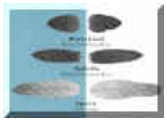
Useful Picture Collections

	Credit: Alison Fox Org: Center for Aquatic Plants (Hydrilla)		Credit: Alison Fox Org: Center for Aquatic Plants (Biological control insects for aquatic and wetland weeds)
	Credit & Org: California Department of Food and Agriculture (Physical Removal of Hydrilla Following Backhoeing of Canals)		Credit & Org: California Department of Food and Agriculture (Hydrilla in Aquarium)
	Credit & Org: California Department of Boating and Waterways (Hydrilla & boat)		Credit & Org: California Department of Boating and Waterways (Hydrilla identificaiton)

Related Sites

Nonindigenous Aquatic Species-Hydrilla: U.S. Geographic Survey (USGS)
http://nas.er.usgs.gov/plants/docs/hy_verti.html
This site provides very useful and comprehensive information about hydrilla, including origin, distribution, control methods, maps and references.

King County, WA Noxious Weed Control Program
http://dnr.metrokc.gov/wlr/waterres/smlakes/hydrilla.htm
This page includes brief history, method of spread, control, and identification.

The Perfect Aquatic Weed-*Hydrilla verticillata*: University of Florida
http://plants.ifas.ufl.edu/hydcirc.html
This page includes introduction, detailed identification with pictures, description, biology and physiology, and management.

Boater Alert: Hydrilla: California Department of Boating and Waterways
http://www.dbw.ca.gov/Hydrilla.htm
This site contains description and control methods of hydrilla

Prohibited Aquatic Plants- Florida
http://aquat1.ifas.ufl.edu/prohib.html
This page contains a list of all of the prohibited plants in the state of Florida. It also contains links to other sites with further information on these prohibited plants.

Biocontrol of Hydrilla: University of Florida
http://aquat1.ifas.ufl.edu/hydrill.html
This page contains general background information on hydrilla. It also contains many images of various types and species of hydrilla.

TEKTRAN Invasive Species Research Agricultural Research Service: Hydrilla Research
http://www.nal.usda.gov/ttic/tektran/news/hydrilla.htm
This site contains 28 research articles.

The U.S. Army Engineer Waterways Experiment Station (WES)
http://www.wes.army.mil/el/aqua/apis/mechanical/hydrilla.html

This site provides a list of mechanical control methods, such as hand cutters, harvesting, rotovation, bottom barrier, and diver dredge.

Hydrilla: Aquatic Plant Management Society Plant Fact Sheet
http://www.apms.org/plants/hydrilla.htm
This fact sheet includes general and brief information about hydrilla.

Lake County California Water Resources Division Hydriall Monitoring
http://watershed.lake-coe.k12.ca.us/topics/hydrilla/

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Educational Resources

Online Plant Fact Sheet - Hydrilla, Aquatic Plant Management Society

Link *http://www.apms.org/plants/hydrilla.htm*

Online brochure provides very detailed general and regional information, current extent, and control methods.

Help Prevent the Spread of Aquatic Plants and Animals (IL-IN-SG-98-1, *Free*): Illinois-Indiana Sea Grant

Link *http://www.iiseagrant.org/publication/br.htm*

Fact sheet describes how exotic aquatic species are spread by boaters. Provides easy steps boaters can take to prevent spread of exotics when transporting watercraft. 4p.

Hydrilla: Illegal Aquatic Plants of South Carolina (*Free*, PDF file): South Carolina Dept. of Natural Resources, Aquatic Nuisance Species Program

Link *http://water3.dnr.state.sc.us/dnr/water/envaff/aquatic/img/hydrilla.pdf*

References

References related to Hydrilla (provided by USGS)

Link

Articles related to Hydrilla (provided by SGNIS)

Link

Research Articles related to Hydrilla (provided by TEKTRAN Hydrilla Research) Link

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