

Adapted from the Washington State Department of Ecology "**Milfoil Infested Lake Control Strategies**" as found on their website:
<http://www.ecy.wa.gov/programs/wq/links/plants.html>

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This text has been slightly modified to reflect Wisconsin policy and regulation.

Hand Pulling Eurasian Watermilfoil:

During hand pulling, milfoil plants are manually removed from the lake bottom, with care taken to remove the entire root crown and to not create fragments. In deeper water, divers are usually needed to reach the plants.

Waterbodies suitable for handpulling and installation of bottom barriers:

Due to expense and the time intensive nature of manual methods, sites suitable for hand pulling and bottom screening are limited to lakes or ponds only lightly infested with Eurasian watermilfoil. This method is suitable for very early infestations of milfoil and for follow-up removal after a large scale control project. To be cost-effective, generally the total amount of milfoil in the waterbody should be three-acres or less in area, if all the milfoil plants were grouped together in one location. If the infestation has advanced beyond this point, it is more effective to consider other eradication techniques such as aquatic herbicides. This method may also be applicable in waterbodies where no herbicide use can be tolerated such as in a lake used as a municipal drinking water supply. Theoretically, these methods could be used in any waterbody to eradicate milfoil; however the costs for large scale projects would become astronomical.

Special Considerations:

Factors that affect the success of hand pulling include: water clarity, sediment type, suppression of milfoil fragments, density of native aquatic plants, and effort expended. It is especially important to have good visibility for the divers to locate milfoil plants. Sometimes diving is only effective in the spring or fall, or during periods between algal blooms. If water clarity is very poor, manual eradication methods may not be suitable for the waterbody.

Description of a milfoil eradication project in Washington using handpulling and bottom barriers:

Lakes where manual methods are being used for milfoil eradication typically have milfoil lightly scattered singly or in small patches within the littoral zone. To determine the extent of the infestation, the littoral zone of the lake is surveyed immediately prior to starting control work and milfoil locations are mapped and Global Positioning System (GPS) points established. The survey can be conducted prior to the removal effort or take place during the removal effort.

Hand pulling can begin as soon as milfoil can be easily seen and identified - generally in the spring or as soon as it is discovered in the lake. Despite milfoil's tendency to

fragment more readily during the fall, removal should be undertaken as soon as possible after the discovery of milfoil in the lake, no matter how late in the season.

Survey Techniques

Both surface and underwater surveys should be conducted several times during the growing season. During the surface survey, a surveyor moves slowly through the littoral zone in a boat, looking into the water (often using a viewing tube), and marking the locations of milfoil plants with buoys. Surveyors advise wearing wide-brimmed hats, polarized sunglasses, and looking straight down into the water. Wind, rain, or surface disturbance, such as boat wakes, interferes with the ability to see. Morning to noon is often the most suitable time for survey work.

The surface survey is immediately followed by an underwater diver survey. Because known milfoil locations have been marked during the surface surveys, the divers can concentrate their efforts at these locations. Since diver time is expensive, it can be cost-effective to conduct surface surveys before underwater surveys. Arline Fullerton, an experienced scientific diver, describes the survey techniques used by Thurston County to locate pioneering colonies of Eurasian watermilfoil in Long Lake.

"In Western Washington, the weather is usually so mild throughout the winter months that the hearty milfoil plants don't completely die back and are still recognizable. For this reason the diving schedule on Long Lake begins in March, when divers have the opportunity to carefully survey water lily areas for milfoil before spring growth begins.

Using two certified divers each day, the goal is to systematically examine the entire littoral zone of the lake, a section at a time. The diver's support system is a specially designed dive barge operated by another certified diver who stays close to the working divers at all times. The two working divers cover the entire shoreline depth in two sections: zero to seven feet deep and six feet to the edge of the plant line which is usually between ten and fourteen feet in Long Lake. Working substantially in tandem, they swim tight transects, continuously looking side to side for plants. They notify the barge operator of any milfoil finds so the location can be recorded. Plants are pulled and placed in the divers "goodie" bag.

In large shallow areas the barge operator might drop buoys marking appropriate width lanes for each diver to cover so as not to miss any area accidentally. It is advantageous for the divers to use a compass to keep a straight course. Following the silt trail from the previous transect can also guide the diver. The barge operator uses a map of the lake with all the hot spots from the previous year to aid in alerting divers."

Hand Pulling Techniques

During hand pulling, the divers dig around and beneath the plant roots with their hands or with a tool and gently lift the entire plant out of the sediment. The ease of removal is dependent on sediment type. Milfoil plants can be readily removed from loose or flocculent sediments. In hard sediments or rocky substrate, hand tools must be used to

loosen the root crown before the plant can be dislodged. Sometimes fine roots are left behind; these will not regrow, but it is important to remove the root crown (the fleshy, fibrous roots at the base of the stem). Once plants are removed, the diver places them into bags for transportation to the surface. Sometimes divers may use a suction device to deliver the plant to the surface. The plant is sucked up into the boat (generally using a gold dredge), the plants are retained in a sieve, and the water is discharged back into the lake.

In locations with denser milfoil colonies, divers should make several passes through the area to ensure that all plants have been located and removed. As the divers work, the people in the support boat mark the locations of milfoil plants. An accurate location is important since the areas need to be resurveyed a few weeks later. There have been instances when small fragments or plants have been overlooked and have become large plants upon resurvey. Removed plants can be used for compost rather than having to be discarded as solid waste.

If colonies are too large for efficient hand pulling or if repeated visits to the same site indicate that too many fragments or plants are being missed, bottom barriers should be installed. Burlap bottom barrier (or other biodegradable material) should be placed over the plants and anchored to the lake bottom using natural materials such as rocks or sandbags. The burlap should cover and extend well beyond the growth zone of the plants. Burlap or other natural materials are preferred because they will naturally decompose over a 2-3 year period.

Some lake groups hire contract divers and surveyors to conduct manual plant removal activities. Other lakes have relied on volunteer efforts. If volunteers are used, they must be trained in plant identification and proper removal methods.

General Impacts of hand pulling

Special care must be taken to prevent the release of milfoil fragments. At certain times of the year (generally after flowering), milfoil plants can fracture into hundreds of fragments, each having the potential to form a new plant. To help contain the fragments, individual plants may be covered with a mesh bag before they are pulled. The driver of the diver support boat must also be careful not to create additional fragments by keeping the boat and propeller out of the milfoil plants. People in the support boat should use net skimmers to retrieve any fragments accidentally released by the divers.

Hand pulling may increase turbidity in the area of removal. This can affect the efficacy of removal if the turbidity interferes with the ability of the divers to see the milfoil plants.

In a Diver's Own Words - A Description of Diver Hand Pulling

Arline Fullerton, scientific diver, provides this advice:

"When a large plant is located, the diver must approach slowly; taking note of any small fragments that may have rooted nearby. Once the diver enters the area and removes a plant the disturbed silt may make visibility next to impossible. Marking the spot with a buoy or a long stake helps the diver locate the exact spot later when the silt settles. Milfoil fragments can be wind blown into very shallow water and be hidden behind logs, sticks, rocks or

shore grass. In the case of a large pioneer infestation it is advisable to have someone on the surface in a canoe, kayak or small boat, catching any escaping fragments as the plants are dug up. Note of the wind direction should be made as wind direction may indicate the next place one will find new plants.

Sometimes plants that have died back may be difficult to identify. They can look like a black stick with roots, but they are not dead. The divers motto for milfoil removal projects is, "when in doubt, pull it out." Over the years I have become familiar with the look of milfoil roots as opposed to other lake plants and have used the roots as guides.

As a milfoil plant matures, its shorter side stem growth may develop white roots while still attached to the mother plant. A slight current caused by wind, or, even the wake of a passing ducks foot, will dislodge this growth. Being already rooted, it is instantly ready for life as a viable new plant. This ability to easily fragment needs to be considered when a diver tries to dig up the root system to remove a whole plant.

It is important to discuss the divers ability to achieve neutral buoyancy. This is the point at which the diver is neither too heavy nor too light but can maintain position in exactly the right position to work effectively without disturbing the plant. If it is a very large plant, five or six feet high, the ability to hover motionless can be an advantage. Also an advantage is the ability to hover in a slight feet up-head down position. Then if the diver needs to change position, the moving fins are less likely to disturb the plant and cause it to scatter. When wearing a dry suit, this can be done with some air trapped in the diver's boots.

Plants that will fragment easily can be recognized by the multiple stems and many rooted side branches. Sometimes some of the stems have collapsed and sunk into the surrounding vegetation rendering them practically invisible. If a diver simply pulled up what could be seen without some investigation, then stems would be broken off and left to root again. Depending on the size of the plant, the diver may elect to simply pick off some of the rooted fragments until the plant is of a size that can be more easily handled.

Divers have developed several different techniques for removing plants. One way is to grab hold of the top of the plant and wind it around the hand as you move down the stem toward the bottom. Then with the other hand dig up the roots and transfer the whole plant to the "goodie" bag. Another method is to carefully locate the bottom of the stem, loosen the roots and then wind the rest of the plant around the hand. Yet another method of capturing a fragmenting plant is to use the "goodie bag" as a butterfly net and cast the open bag carefully over the entire plant, dropping it down to the bottom and then free up the root system. Each method is effective under different conditions and the diver quickly learns which condition is best served by which method."