Eradication - Whole Lake Fluridone Treatment

Fluridone (aquatic herbicide):

Fluridone is a systemic herbicide that kills the entire plant and is generally non-selective since most submersed plants will be killed or affected by a whole lake treatment. Fluridone inhibits the formation of carotene (pigment) in growing plants. In the absence of carotene, chlorophyll is degraded by sunlight. Because this is a slow process and the plants can "grow out" of this if fluridone is removed, the contact time between the plant and chemical needs to be maintained for many weeks. Sonar® and Avast!® are the trade names for aquatic herbicides that contain fluridone as the active ingredient. The liquid formulation of fluridone has been used for whole-lake milfoil eradication projects. New slow release granular formulations are also available, and are now being used for whole lake treatments. The premise for using fluridone as an eradication tool is that milfoil rarely produces viable seeds, so killing the vegetative growth will prevent spreading through fragmentation. Milfoil is particularly susceptible to fluridone and it is theoretically possible to achieve 100 percent kill. If all the milfoil plants are killed by fluridone treatment the only way that milfoil can reinfest the lake is to be reintroduced or germinate from seeds. Germination by seeds is considered rare.

Water bodies suitable for whole-lake fluridone treatment:

Lakes and ponds suitable for whole-lake fluridone treatment are heavily infested with Eurasian watermilfoil throughout the littoral zone. Fluridone is not suitable for spot treatments (sites less than five -acres within a larger waterbody) since it is difficult to maintain enough contact time between the plant and the herbicide to kill the plant. However, the newer granular formulations are slow-release and are beginning to be proved effective for treating smaller areas. If milfoil is limited to patches within the littoral zone, selective herbicides such as 2,4-D or triclopyr may be a more effective treatment method (see the 2,4-D milfoil eradication strategy). Due to the high treatment costs, fluridone treatments have been limited to smaller sites in Washington. The largest lake in Washington where this method has been used for milfoil eradication has been Long Lake (about 330 acres). In larger lakes, treatment of selected coves or embayments is possible, although milfoil will eventually reinvade from untreated areas.

Special considerations:

While there are no swimming, fishing, or drinking water restrictions when fluridone is in the water, the label warns against using the water for irrigation for seven to thirty days after treatment. Even at the low fluridone concentrations used to treat milfoil, some terrestrial plants may be sensitive to fluridone if they are watered with treated lake water.

Washington has had excellent success using this fluridone for milfoil eradication/control, but there is no guarantee that every lake group who tries this method will achieve the same results. Each site is different and many environmental factors may affect the treatment. Developing a site-specific plan for each lake is crucial to identifying environmental factors or concerns that may impact the treatment outcome.

Fluridone needs to be applied correctly and with an expert applicator to achieve the desired result. Because it is crucial to maintain a long contact time between fluridone and the targeted plants, designing a treatment plan and monitoring concentrations over time is an important part of each project.

A permit called a National Pollutant Discharge Elimination System Permit (NPDES) permit is needed to treat water bodies with aquatic herbicides. You can obtain NPDES coverage under the Aquatic Plant and Algae Management general permit. Click here for more details of the permitting process. **In Washington only state-licensed applicators may legally apply aquatic herbicides**.

Description of a milfoil eradication project using fluridone:

When the project goal is eradication, a whole lake fluridone concentration of 8-10 ppb (parts per billion or Ūg/liter) should be maintained in the lake for approximately ten weeks during the spring and/or summer. While it is possible to achieve successful milfoil control at lower concentrations (as low as 3-6 ppb), these higher levels are recommended to ensure that all milfoil plants are killed.

Before application, the lake volume must be determined to ensure fluridone is applied in a sufficient amount to result in the target whole lake concentration. If the lake is shallow and not thermally stratified, concentrations throughout the water column must remain in the 8-10 ppb range. If the lake is deep and thermally stratified (warm above and cold below), these concentrations can be maintained in the epilimnion (warmer surface layer of water) rather than throughout the water column.

Treatment costs will vary based on lake surface area, water volume treated, and the number of treatments needed to maintain the target concentration for ten weeks. The SePRO Company (distributor for Sonar╟) has developed a new patented test called planTEST™ that their preferred applicators may use. Treated plants are collected a few weeks prior to treatment and planTEST™ determines the concentration of Sonar® needed to kill the target weed. If milfoil in the lake is particularly susceptible to fluridone, it may be possible to reduce the concentration of fluridone needed to effectively treat the infestation.

Treatments can start as soon as milfoil begins rapidly growing. This can be as early as April or May and as late as early July and is site-specific. A critical factor particularly in western Washington is water flow. A heavy rainfall may wash the herbicide out of the system. For deeper lakes, treatment should be delayed until the thermocline develops and stabilizes in summer. For these reasons, fluridone treatments in Washington typically start in June or July rather than earlier.

Fluridone is applied in a liquid formulation by sub-surface injection from trailing hoses by a state-licensed applicator. About a day or two after treatment, water samples should be collected to determine fluridone concentrations. The number of samples required depends upon the size and shape of the lake. In a long narrow lake, three samples may be enough to determine lake concentration. In a small round lake, one sample taken in the middle may be sufficient. In a lake with many coves or channels, a number of samples may be needed to determine a whole lake concentration. Testing the water ensures that the target concentration of fluridone has been met. The SePRO Company has fluridone analysis test kits. Test results can be available within 48 hours and each sample costs about $100. Other laboratories can also perform fluridone analysis, but turn around times for results may be longer.

Fluridone concentrations are maintained in the lake over time by the application of additional herbicide at about bi-weekly intervals or as needed. To determine how much herbicide to add, water samples are collected about 10 to 14 days after the initial treatment and analyzed for fluridone. Generally during this two-week period, fluridone concentrations decrease by about half, due to plant uptake and exposure to sunlight. Fluridone is also more persistent in cooler waters. After fluridone concentrations are determined, the applicator applies enough herbicide to the lake to bring the whole lake concentration back up to the 8-10 ppb range. This scenario continues until fluridone concentrations have been held at 8-10 ppb in the lake for ten weeks. This fluridone concentration and exposure time should be sufficient to kill milfoil plants. During a typical treatment, the applicator may apply fluridone to the lake four times.

The SePRO Company has also developed a new patented test called effecTEST™ that their preferred applicators may use. Treated plants are collected at about five to six weeks after the initial treatment and effecTEST™ determines whether these plants have received enough herbicide to kill them or if a higher (or lower) concentration is needed.

Granular formulations have begun to change the way that some whole-lake treatments are being conducted in Washington. These formulations are being applied using a blower-type apparatus that evenly applies the pellets to the area. The pellets release slowly over the course of days or even weeks,

depending on the formulation selected. This lessens the need for repeated visits to the water body by an applicator to maintain lake concentrations of fluridone, and may potentially lower treatment costs.

General impacts of fluridone treatment:

There can be significant impacts to the water body during and following treatment. Fluridone is a generally non-selective herbicide, which means most submersed plants and some floating leaved plants will be killed by fluridone during the treatment. Emergent species like cattails will be impacted but will recover. A week to three weeks after the initial treatment, observers will see the growing tips of aquatic plants bleach pink to white. Water lilies will appear bleached and cattails and other emergent species may look variegated. Since this is a slow process, low oxygen conditions do not develop. The plants eventually drop out of the water column by about six weeks post-treatment.

While there is no direct toxicity of fluridone to animals, the loss of habitat does cause indirect impacts. The smaller fish lose their hiding places and because the larger fish can find them easily, they have greater chances of being eaten. Waterfowl that eat vegetation tend to move onto other vegetated waterbodies while waterfowl that eat fish enjoy better fishing opportunities on the treated lake. Sometimes increased algal blooms are observed in the year of treatment and for a year following treatment. However, eventually the lake reaches a new equilibrium and native aquatic plants recover. Naturally occurring plants have viable seeds, tubers, and overwintering buds that allow them to revegetate the lake the year following treatment, while milfoil does not. In Washington the colonization of the lake bottom by plant-like algae called brittlewort (*Nitella* spp.) and stonewort (*Chara* spp.) is often observed following a fluridone treatment. This is because algal species are resistant to fluridone and removing milfoil opens up space for them to colonize.

Up to 100 percent of the Eurasian watermilfoil in the lake should be killed. However in inlets or areas where the herbicide may be diluted by flowing water (including in-lake springs), milfoil may be under-treated and must be physically removed if eradication is to be successful. These areas should have been identified during plan development and alternative methods planned for milfoil removal. Under-treatment or no treatment of milfoil in inlet areas may result in the lake being reinfested unless immediate management methods are undertaken.

Follow-up:

For lakes that are heavily infested with milfoil, the goal of eradication should only be sought when lake residents are willing to finance and conduct the follow-up monitoring and treatments that are essential to ensure long term success. The littoral zone of the lake should be thoroughly inspected by divers in the fall of the treatment year and the next spring as well to identify any milfoil plants that may have been under-treated. Areas where this might happen include areas of lake bottom with springs or near inlet streams. Any remaining milfoil plants should be hand pulled or covered with bottom barriers (See: Eradication - Hand Pulling and Bottom Barrier Installation). Diver and surface inspections should continue at least twice a year during the growing season on an ongoing basis. Survey work should be as frequent as can be afforded, since small milfoil plants may be easily overlooked. Often divers report finding two to three foot tall milfoil plants in areas that they had extensively searched only three weeks earlier. As native plants recover, it will become more difficult to locate any milfoil plants.

Very important note!

In most Washington lakes treated with fluridone, milfoil is found growing in the lake from two to five years later. It is suspected that milfoil is reintroduced via boating activity, since it is often discovered near a public boat launch. However, anecdotal evidence also suggests that milfoil seeds can germinate during dewatering. During long, dry summers lake levels may drop. **Check these areas for milfoil growth after the water returns**. As long as the lake group has continued the survey work, these new introductions can be identified quickly and targeted for removal before milfoil reestablishes. In treated lakes where lake groups have continued the diver and surface inspections, milfoil remains at extremely low levels and recreation, fishing, and habitat remain healthy. A few lakes in Washington have achieved eradication. In the few lakes where inspections did not continue, milfoil reinvaded and the lakes returned to pre-treatment infestation levels.

Follow-up is the key!

While it is very difficult to totally eradicate milfoil from a lake forever, extensive and long-term follow-up activities make it possible to maintain extremely low levels of milfoil that will not impede recreational activities or impact native plant communities. As an example, Long Lake in Thurston County was treated with fluridone in 1991. In 1995, milfoil was discovered growing near the public boat launch. Since then the lake residents and Thurston County have been successfully maintaining extremely low levels of milfoil in the lake by surface and diver survey and hand pulling. In 2001 about 90 pounds total wet weight of milfoil was removed from the 330-acre lake (Ryan Langen, personal communication). Much less milfoil was found in 2002. These activities are not inexpensive, but are considered a necessary cost to maintain this lake in good condition for recreation and habitat. Should these management measures cease, milfoil would probably reinfest the lake within three to five years.

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