# 2008

## Statewide Strategic Plan for Eurasian Watermilfoil in Idaho

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**Prepared by the Idaho Invasive Species Council and the Idaho State Department of Agriculture**
**Boise, ID**

***The Idaho Invasive Species Council and the Idaho State Department of Agriculture prepared this document to provide a framework and strategy for the State of Idaho's Eurasian watermilfoil Eradication Program. Additional copies of this publication can be found online at http://www.agri.idaho.gov/ or by contacting the Idaho State Department of Agriculture, 2270 Old Penitentiary Rd., Boise, ID 83701.***

# A Statewide Strategic Plan for Eurasian Watermilfoil in Idaho

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## I. Introduction

In April 2006 the Idaho State Legislature and the Governor approved $4 million for the purpose of eradication of Eurasian watermilfoil (*Myriophyllum spicatum*) from water bodies in the state of Idaho. In 2007, an additional $4 million was appropriated for this program, which is administered by the Idaho State Department of Agriculture (ISDA). Although Idaho is a leader in the field of terrestrial plant management, pioneering the Cooperative Weed Management Area (CWMA) strategy, the state had never before administered a major aquatic plant control program.

This document is intended to provide a framework and strategy for the State of Idaho and its cooperators. Information included herein is considered "the state of knowledge" in Eurasian watermilfoil management. It will be updated annually through the Idaho Invasive Species Council (IISC). Much of the information included was taken directly from professional organizations such as the Western Aquatic Plant Management Society (WAPMS) and the Aquatic Ecosystem Restoration Foundation (AERF), and is noted as such.

## II. Problem Statement

**Figure 1.** Eurasian watermilfoil infestation

Eurasian watermilfoil is a submersed perennial aquatic plant. It adversely impacts aquatic ecosystems by filling the water column and forming dense canopies that shade out native aquatic vegetation (Figure 1). Eurasian watermilfoil is adaptable, able to survive in a variety of environmental conditions. It grows in still to flowing waters, can tolerate relatively high salinities, can tolerate a wide range of pH levels, grows rooted in water depths from 1 to 10 meters, and can survive under ice. This species regenerates readily from plant fragments which are easily transported to uninfested water bodies on boats and boat trailers.

Pure stands of Eurasian watermilfoil provide poor habitat for waterfowl, fish, and other wildlife. Significant plant sloughing, leaf turnover, and decomposition of large amounts of plant material at the end of the growing season increase phosphorus and nitrogen in the water column. Dense Eurasian watermilfoil mats alter water quality by raising the pH, decreasing oxygen under the mats, and increasing temperature.

Eurasian watermilfoil impacts power generation and irrigation by clogging intake pipes and dam trash racks, and can affect the hydraulic conductivity (water-handling capacity) of water management systems. Stagnant water created by Eurasian watermilfoil mats provides mosquito breeding grounds. This aquatic plant interferes with recreational activities such as swimming, boating, fishing, snorkeling, and water skiing. Eurasian watermilfoil degrades water body aesthetics by forming windrows of decaying plants along shorelines. It has a negative impact on native biota and impedes general access and enjoyment of water bodies.

## III. Goals

The overall goal of the Idaho Eurasian watermilfoil eradication program is to protect the integrity of the state's water bodies from the biological degradation caused by the invasion of Eurasian watermilfoil. By achieving this goal, economic, recreational and aesthetic uses of water bodies are protected, water quality is maintained, and natural aquatic systems are not impaired. As described in Section IX, Idaho's Eurasian watermilfoil populations can be divided into three fairly distinct regions, 1) North, 2) Southwest and 3) East. Specific goals and tasks for each of these regions vary, and this regionalized concept is discussed in detail in Section VI.

The purpose of this document is to present a set of strategies that when implemented can lead to the eradication of Eurasian watermilfoil from an Idaho water body. Users of this document should take local uses, conditions and constraints into consideration when developing site-specific management strategies. Eradication may take a number of years and require a sustained, concerted effort on the part of local governments and/or lake management groups. Follow-up and maintenance are key and will require the development of long-term water body-specific management plans and dedicated funding for continuous management. It should be understood that once an invasive species like Eurasian watermilfoil enters a water body, management activities such as surveys and spot treatments must be continued in perpetuity. Even if eradication is achieved, Eurasian watermilfoil or other invasive species can be easily re-introduced.

## IV. Objectives

The overarching goal can be achieved through the following objectives:

1. Achieve an overall reduction of Eurasian watermilfoil such that maintaining Idaho's water bodies Eurasian watermilfoil-free is economically feasible.

2. Support an effective public information awareness and participation program that will encourage support for Eurasian watermilfoil management in Idaho and alert citizens and visitors of the dangers associated with spreading Eurasian watermilfoil.

## V. Idaho Eurasian Watermilfoil Peer Panel Recommendations

In September 2006, the ISDA invited the University of Florida, Center for Aquatic and Invasive Plants to convene and chair an independent panel of recognized aquatic plant management experts to review Idaho's Eurasian watermilfoil program and to recommend short- and long-term program enhancements. Aquatic plant management and research personnel from Florida, California, and Minnesota (Figure 2) reviewed the program during the period of October – December 2006 and submitted a report to the ISDA on December 22, 2006.

The review process had four phases: (1) initial review of numerous documents related to grant applications for the 2006 Eurasian watermilfoil eradication program; (2) a visit to northern Idaho lakes and interaction with the Milfoil Task Force by one panel member; (3) review panel formal meetings at the ISDA headquarters with various entities, visit to two sites that received treatments in 2006, and exit briefing with selected ISDA personnel; and (4) information synthesis and report preparation.

**Figure 2.** Idaho Eurasian Watermilfoil Peer Panel. From left to right, Joseph Joyce, Robert Leavitt, Jeff Schardt, Bill Haller, Chip Welling and Ken Langeland (not pictured).

During the review, the panel identified major and minor issues and provided specific and general recommendations. Several issues and recommendations addressed short term improvements in the administration and operations of the current Eurasian watermilfoil program. The panel also offered long-term recommendations necessary to ensure a responsive and effective aquatic invasive species program. These long term recommendations will require ISDA organizational changes, interagency cooperation and delegation of authority, educational programs, stable/recurring funding, and action by the Idaho Legislature. The full report and ISDA responses to these recommendations can be found in Appendix 1. A summary of the identified issues and recommendations are:

### A. General

- The ISDA and county weed superintendents have extensive experience in the management of noxious terrestrial weeds. However, the influx of significant funding for Eurasian watermilfoil eradication by the Idaho Legislature in April 2006 required rapid action by the ISDA to develop an aquatic weed eradication effort. It is the opinion of the panel that the 2006 Eurasian watermilfoil eradication program was a monumental effort of agency action and interagency cooperation and was an overall success in meeting its objectives. The panel was very impressed with the amount and quality of the work accomplished, given the extent of the Eurasian watermilfoil infestation in Idaho, the timing of the legislative authorization, and funding for the program, the need to survey the Eurasian watermilfoil infestations to be controlled, request proposals for eradication efforts, evaluation and award of the contracts, public involvement and notification, and operational logistics involved in the first year of this program. Input received from cooperators and grant recipients ranged from total satisfaction to various levels of concern relative to the issues noted above. Overall, the ISDA should be commended for its efforts.

- Recommended program planning improvements include longer lead time for surveying and selecting priority Eurasian watermilfoil infestations to be controlled and techniques to be used; longer solicitation and evaluation periods; more accessible information regarding the granting process; more flexible cash flow considerations for contractor reimbursement; more citizen involvement and outreach; and more independent quality control and assurance measures for contracted activities.

- Eradication should remain a priority in those areas where realistic confinement and control technologies provide reasonable opportunities for success. In other areas, management programs should be applied to reduce environmental, recreational, and economic impacts. The goal of eradication should be the total elimination of the nuisance plant in the specific body of water where practicable and feasible. Otherwise the goal should be to reduce the population to a non-readily detectable level or to levels that do not interfere with predominant water uses.

**B. Program organization**

- The ISDA should be designated as the lead or responsible agency for nuisance aquatic species by the Idaho Legislature. The ISDA should develop a statewide strategic Eurasian watermilfoil management plan, cooperative agreements and/or delegated authority for coordination, permitting, and administration of the program.

- The county-based weed management agencies should be the operational entities responsible for the management of control activities in their counties under the generalized management and coordination of the ISDA Noxious Weed program as specified by state law.

- At least one overall, statewide coordinator and three regional aquatic species management specialists should be allocated to the ISDA by the Idaho Legislature. The statewide coordinator should be assigned to the ISDA Division of Plant Industries. Initially, one regional specialist should be allocated north of the Salmon River, and two south of the Salmon River. These personnel will be responsible for implementing the strategy, planning, local interagency coordination, assessing program effectiveness, and contractor oversight to effectively implement a responsive and acceptable nuisance aquatic species management program.

**C. Funding**

- A sufficient and recurring funding source for the management of nuisance exotics should be established as a revolving trust fund (Idaho Aquatic Species Management Trust Fund), subject to annual allocation of spending authority by the Idaho Legislature. This is necessary to ensure that the gains made in the current program will not be lost.

- Efforts should be pursued to increase cost-sharing opportunities with local governmental agencies, lake associations, and Federal agencies.

**D. Regulatory and Permitting**

- Delegation of authority for “one stop” contract or work assignment coordination or permitting should be provided to the ISDA. This would include aquatic herbicide application and label requirements, water quality assurance, mechanical harvesting, benthic barrier placement, and biological control with the exception of the sterile grass carp which should remain the primary responsibility of the Idaho Department of Fish and Game.

- The benefit of sampling of water quality and expensive herbicide residues need to be evaluated to ensure that it is justified by herbicide label restrictions and economics.

**E. Research Needs**

- There is a current lack of research/demonstration efforts focused on the short-term need to develop and evaluate management techniques for Eurasian watermilfoil and other potential nuisance species. Both funding and statewide leadership by ISDA is needed, as is the development of cooperative research projects/programs with state universities.

**F. Agency and Public Education Needs**

- Idaho freshwater ecosystems are critical to the environmental quality and economy of the state and region. Idaho water quality, habitat, and recreational opportunities are being threatened by Eurasian watermilfoil and potentially other invasive aquatic plants. Funding for public and agency personnel education and training relative to aquatic species management is an excellent and priority investment in the state’s future.

- Maximum use of the University of Idaho and county Cooperative Extension Service should be made for the development and dissemination of educational materials

### G. Proposed Legislation

- A comprehensive statute that would establish the ISDA as the lead agency responsible for permitting, funding, research, public education, program organization and coordination is needed.

- An earmarked source of funding needs to be identified that will allocate sufficient and recurring funds to an Idaho Aquatic Plant Management Trust Fund.

- The Idaho Aquatic Nuisance Species Task Force should be established by legislation to provide for interagency and public coordination and input into the development of long term strategy and policy, educational opportunities, and research concerning the control of nuisance aquatic species. The ISDA should also have the authority to establish other councils and committees as needed to carry out its responsibilities.

## VI. Idaho's Regionalized Management Approach

Idaho is a geographically diverse state. Given the differences in water bodies and Eurasian watermilfoil infestation levels statewide, a Regionalized Management Approach has been developed. The approach aims to prioritize areas based on local conditions. Each of the three regions (North, Southwest and East) has its own set of Goals and Tasks (Figure 3).

These Goals and Tasks can be classified as "Prevention," "Containment," and "Eradication." Management strategies in all of these regions are adaptive. That is, the management process integrates the lessons learned from outcomes of previous management activities into current conditions. This type of strategy requires periodic monitoring for effectiveness and management as a long term process rather than a one time event.

The regionalized approach should also have components which aim to educate and inform permanent residents and visitors about Eurasian watermilfoil. It is important to inform these audiences as to how Eurasian watermilfoil is transported and how accidental and deliberate introductions of aquatic nuisance species can be prevented.

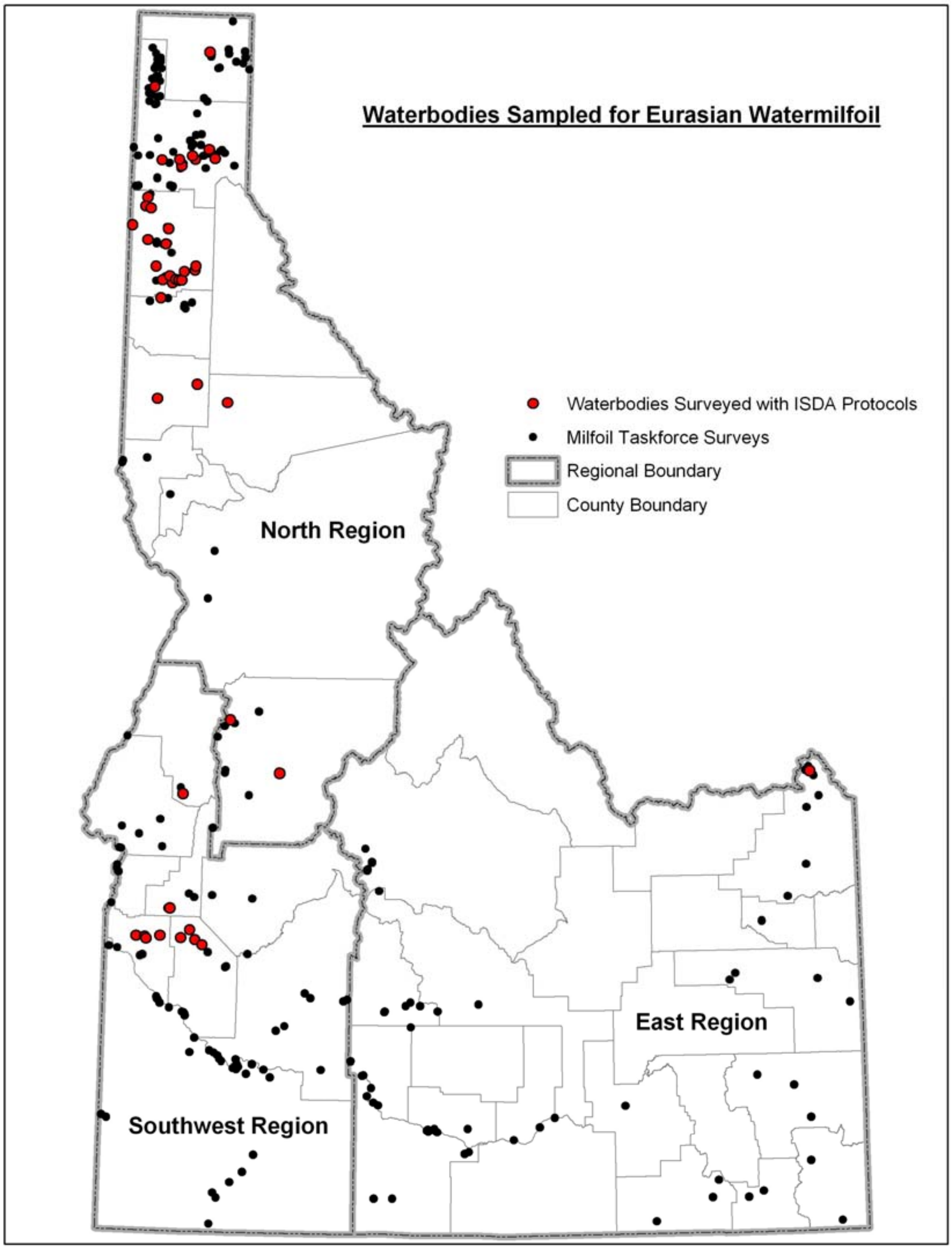


**Figure 3.** Eurasian watermilfoil survey points in the three Idaho regions

## A. North Idaho

North Idaho is characterized by many natural lakes and water bodies. The area has extensive glacial valleys with many wetlands and open water areas. The surrounding geography is characterized by coniferous forest, open granite peaks, talus slopes and permeable well drained granitic soils which are at risk for invasion by many terrestrial invasive species. In contrast to the rest of Idaho, irrigation and agriculture is not the primary use of the water resources. Recreation, tourism, wildlife and water fowl production are the primary water uses in this region of the state.

The region also has the densest known populations of Eurasian watermilfoil in Idaho. Although the weed is considered to be widespread in North Idaho, it occurs in a relatively small percentage of water bodies in the region. For this reason, prevention, containment, education and the use of appropriate control technologies are all viable Eurasian watermilfoil strategies for North Idaho. Many of the water bodies in this region have high levels of flowing water. This makes the choice of an appropriate control technique critical. Some herbicides are ineffective in flowing water systems because they require too long a contact time with the weed. The high level of recreational use also factors into choosing the appropriate control technique. A diverse native plant community is an additional characteristic of this region's impacted water bodies. Non-target impacts to native plant communities are important to consider in an effort to achieve long term control.

## North Idaho Goals and Tasks:

**1. Goal: Prevent Eurasian watermilfoil from establishing in water bodies where it does not currently occur (Prevention)**

- Task 1: Survey water bodies to determine which ones are Eurasian watermilfoil-free
- Task 2: Establish a monitoring schedule to visit un-infested water bodies
- Task 3: Educate the public as to the dangers associated with spreading Eurasian watermilfoil to un-infested waters
- Task 4: Develop incentives for the public to voluntarily take actions to prevent the spread of Eurasian watermilfoil into un-infested water bodies
- Task 5: Develop Early Detection and Rapid Response (EDRR) plans for un-infested water bodies in the event Eurasian watermilfoil is discovered

**2. Goal: Contain Eurasian watermilfoil so that it does not spread beyond the area it currently covers within water bodies where it does occur (Containment)**

- Task 1: Survey water bodies to determine the extent of the Eurasian watermilfoil populations
- Task 2: Develop treatment priorities based on containing current Eurasian watermilfoil populations
- Task 3: Educate the public on the benefits of controlling Eurasian watermilfoil and preventing its spread

**3. Goal: Eradicate Eurasian watermilfoil from water bodies where it does occur (Eradication)**

- Task 1: Prioritize areas for treatment based on water body uses
- Task 2: Develop water body-based strategies for eradication based on the maximum use impact on the water body

- Task 3: Establish appropriate maintenance schedules for follow-up control in previously-treated areas
- Task 4: Survey water bodies to ensure re-infestation does not occur
- Task 5: Educate the public on the importance of maintaining the water body Eurasian watermilfoil-free
- Task 6: Develop and implement eradication program via contacts with public and private groups

**4. Goal: Maximize and measure control technology effectiveness (Eradication)**

- Task 1: Use appropriate proven control technologies in operational programs
- Task 2: Quantify results of operational control programs and provide recommendations for adaptive management
- Task 3: Institute maintenance standards for control techniques that are used
- Task 4: Survey impacted water bodies for aquatic plant cover through time and document trends in native plant composition throughout operational control process

## B. Southwest Idaho

A majority of the water bodies in Southwest Idaho are manmade “gravel pits” that were excavated, and now have been developed for urban waterfront property use. Numerous rivers and irrigation canals also flow through this region. Many of the manmade gravel pits have limited native vegetation. This is a double edged sword – control methods can be used in these Eurasian watermilfoil monocultures without fears of non-target damage, but little else *except* Eurasian watermilfoil is likely to re-grow, which may lead to perpetual maintenance

As with the other regions, the best strategy for dealing with Eurasian watermilfoil is to survey water bodies for small infestations that can be easily and cheaply controlled. Prevention is the key. Follow up treatments are also vital to the success of an eradication program. Eradication takes years of treatment, years of follow up, and perpetual monitoring.

## Southwest Idaho Goals and Tasks

**1. Goal: Prevent Eurasian watermilfoil from establishing in water bodies where it does not currently occur (Prevention)**

- Task 1: Survey water bodies to determine which ones are Eurasian watermilfoil-free
- Task 2: Identify leading edge of Eurasian watermilfoil infestation in the Snake River
- Task 3: Educate the public as to the dangers associated with spreading Eurasian watermilfoil to un-infested waters

- Task 4: Develop EDRR plans for un-infested water bodies in the event Eurasian watermilfoil is discovered

**2. Goal: Contain Eurasian watermilfoil so that it does not spread beyond the area it currently covers in water bodies where does occur (Containment)**

- Task 1: Survey to determine and characterize Eurasian watermilfoil-free water bodies
- Task 2: Develop prioritized treatment plans for populations that are containable
- Task 3: Develop an approach for the Snake River to conduct control operations in a systematic manner, working downstream of the leading edge
- Task 4: Educate the public on the benefits of controlling Eurasian watermilfoil and preventing its spread

**3. Goal: Eradicate Eurasian watermilfoil from water bodies where it does occur (Eradication)**

- Task 1: Prioritize areas for treatment based on water body uses and surrounding land use
- Task 2: Develop water body-based strategies for eradication based on the maximum use impact on the water body.
- Task 3: Establish appropriate maintenance schedules for follow-up control in previously-treated areas.
- Task 4: Survey water bodies to ensure re-infestation does not occur
- Task 5: Educate the public on the importance of maintaining the water body Eurasian watermilfoil-free

**4. Goal: Maximize and measure control technology effectiveness (Eradication)**

- Task 1: Initiate control early in the summer (June) to maximize control and minimize spread via fragments
- Task 2: Use appropriate proven control technologies in operational programs
- Task 3: Quantify results of operational control programs and provide recommendations for adaptive management
- Task 4: Institute maintenance standards for control techniques that are used

## C. East Idaho

To date, Eurasian watermilfoil has not been found East of Swan Falls Dam near the border of Ada and Owyhee Counties in the Snake River. Eastern Idaho has the opportunity to prevent Eurasian watermilfoil from becoming established in its water bodies. The first line of defense is an active survey program so that infestations can be caught early. Resource managers should be on the lookout for this species around boat ramps and high-use areas as this is where it is likely to appear first. Eastern Idaho should be prepared to deal with an outbreak of Eurasian watermilfoil if it is found.

Control techniques will vary on a site-by-site basis. A key component in this region is the use of public awareness and water body user outreach. Boaters need to be made aware of the dangers associated with transporting boats, trailers and other equipment from Eurasian watermilfoil-infested areas into Eastern Idaho.

## Eastern Idaho Goal and Tasks

**1. Goal: Prevent Eurasian watermilfoil from establishing in Eastern Idaho (Prevention)**

- Task 1: Survey water bodies for Eurasian watermilfoil
- Task 2: Develop an EDRR Plan that can be implemented in the event that Eurasian watermilfoil is found in the region
- Task 3: Educate the public on the importance of maintaining Eastern Idaho Eurasian watermilfoil-free

## VII. Eurasian Watermilfoil Technical Background

*(The following section is modified from the Western Aquatic Plant Management Society website, http://www.wapms.org/, the State of Washington Department of Ecology website, http://www.ecy.wa.gov/, and the following unpublished document: Matthew J. W. Cock, Hariet L. Hinz, Gitta Grosskopf, and Patrick Häfliger (2006) Development of a biological control program for Eurasian watermilfoil (Myriophyllum spicatum) CABI Europe-Switzerland, unpubl. Report prepared for U.S. Army Corps of Engineers, Washington, DC 20314-1000. 27pp.)*

### A. Distribution

Eurasian watermilfoil is native to Europe, Asia, northern Africa and also occurs in Greenland. Eurasian watermilfoil is mainly a weed in North America, but it has also been reported as problematic in Australia, South Africa and India. It may have been introduced to North America at Chesapeake Bay in the 1880s, though there is evidence that the first collection of Eurasian watermilfoil was made from a pond in Washington, D.C. during the fall of 1942. The history of the spread of this species in North America is unclear because of its initial confusion with *M. sibiricum* (northern watermilfoil), a native North American species. Eurasian watermilfoil is now considered one of the worst aquatic weeds in North America, occurring in at least 45 states and the Canadian provinces of British Columbia, Ontario, and Quebec.

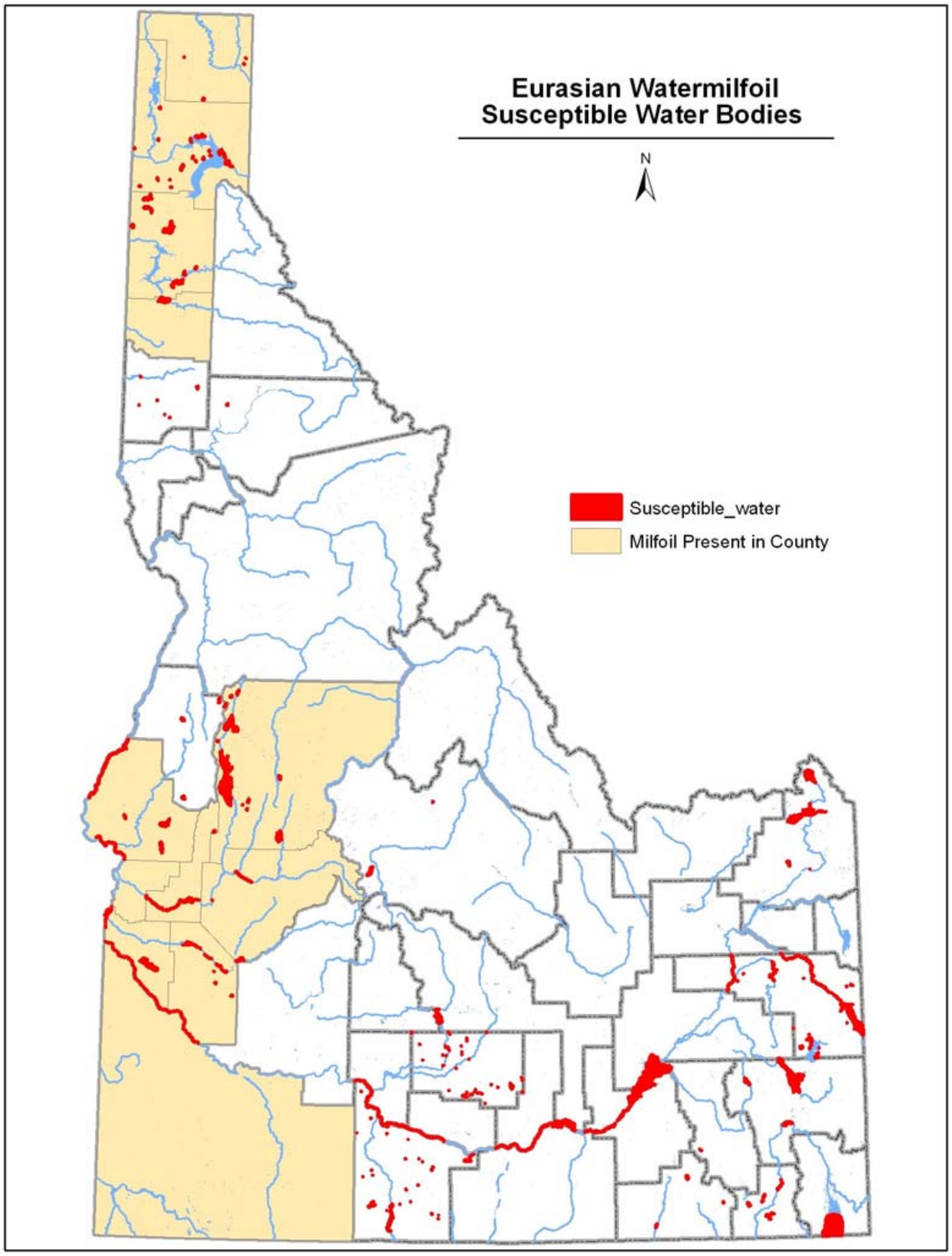


**Figure 4.** Eurasian watermilfoil confirmed and potential areas of establishment in Idaho

In Idaho, Eurasian watermilfoil was first found in Bonner County, then Kootenai County in 1998 where it infested three local waterways. The weed was then discovered in Payette Lake (Valley County), followed by other counties in southwest Idaho. By 2000, Eurasian watermilfoil was considered a widespread weed in North and Southwest Idaho (Figure 4).

**B. Description**

A number of milfoil species occur in the western United States, and many of these species are similar in appearance. Eurasian watermilfoil closely resembles its native relative northern milfoil (*M. sibiricum*), and was once thought to be a variety of that species.

Eurasian watermilfoil is a rooted, perennial dicot that is submersed except for the upper flower-bearing portions. The stem branches underwater and produces whorls of 4 (rarely 5) leaves around the stem at each node. The leaves have a grayish cast and feathery appearance. They are finely divided into leaflets, each of which generally has 14 or more paired divisions. This feature can be used to distinguish Eurasian watermilfoil from other milfoil species about 70 percent of the time. However, the number of pairs of leaflet divisions is variable and can range from 5 to 24,

Eurasian watermilfoil is one of several aquatic invasive weeds that reproduce primarily by fragmentation. Viable propagules can be as small as a stem portion carrying a single leaf node. Young plants and free-floating plant fragments often develop leaflets with fewer than 14 divisions.

In Figure 5, the leaflet on the left is Eurasian watermilfoil; on the right is northern milfoil, *M. sibiricum*. Note the difference in leaflet shape, number of divisions, and spacing of the divisions between the two species. Although the two species appear easy to distinguish in this photograph, frequently these characteristics are not as distinctive.

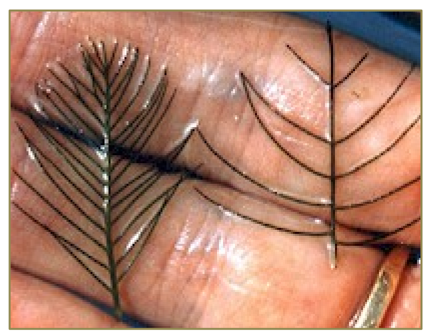

**Figure 5.** Eurasian watermilfoil (left) and northern milfoil (right)

The growing stem tips of Eurasian watermilfoil (and other milfoil species) are tassel-like and often red; especially early in the growing season. Tiny pinkish flowers occur on reddish spikes that stand several inches above the water and submerge when pollination is complete (Figure 6). The stem width of Eurasian watermilfoil almost doubles below the inflorescence. Lower flowers are pistillate, upper flowers staminate. Seeds are produced, but seedlings are rare in the field. In situations where water evaporates slowly and the plants become stranded gradually, Eurasian watermilfoil can develop into a terrestrial form. The leaves of the terrestrial form are smaller, stiffer, and have fewer divisions. If these plants are submerged, new aquatic leaves develop in 7-10 days, but the first leaves formed have relatively


**Figure 6.** Eurasian watermilfoil in flower

few divisions. Only later does the number of divisions increase to more than 12 leaflet pairs.

**C. Habitat**

**Figure 7.** Eurasian watermilfoil fragment

Eurasian watermilfoil is a highly invasive species that colonizes a variety of habitats including reservoirs, lakes, ponds, low-energy streams and rivers, and brackish waters of estuaries and bays. Its rapid growth rate allows it to cover water surfaces and form thick underwater stands of tangled stems. It is able to displace native aquatic vegetation within a few growing seasons. Because Eurasian watermilfoil elongates from shoots started in the fall and is tolerant of low water temperatures, it can begin spring growth earlier than other aquatic plants, and grow quickly to the surface to form dense canopies, overtopping and shading out surrounding vegetation (Figure 7).

**Figure 8.** Eurasian watermilfoil fragments in boat propeller

Eurasian watermilfoil spreads by dispersal of plant fragments into lakes, rivers and streams, and water currents readily disperse vegetative propagules through drainages. Boat propellers contribute to seasonal fragmentation and distribution of propagules (Figure 8). Transport on boats and trailers plays the largest role in introducing this plant to new water bodies.

Eurasian watermilfoil is an extremely adaptable plant, able to tolerate and even thrive in a variety of environmental conditions. It grows in still to flowing waters, can tolerate salinities of up to 15 parts per thousand, grows rooted in water depths from 1 to 10 meters, and can survive winters under ice. It is able to tolerate pH levels ranging from 5.4-11. Relative to other submersed plants, Eurasian watermilfoil requires high light, has a high photosynthetic rate, and can grow over a broad temperature range. This species grows best on fine-textured, inorganic sediments and relatively poorly on highly organic sediments.

**D. Reproduction**

Eurasian watermilfoil can spread by both sexual and vegetative means. Seedlings are rarely observed in the field. Therefore, colonization of new sites is mainly by vegetative fragments. The plant autofragments during the growing season. The abscising fragments often develop roots at the nodes before separation from the parent plants. Fragments are also produced by wind, water currents, wave action, and boating activities, with each fragment having the potential to develop into a new plant. Once introduced, Eurasian watermilfoil can spread exponentially.

**E. Growth and Development**

Eurasian watermilfoil exhibits an annual pattern of growth. In the spring, shoots begin to grow rapidly as water temperatures approach 15 degrees centigrade. Shoots branch profusely when they near the surface, forming a dense canopy. The leaves below 1 meter senesce in response to self-shading. Plants typically flower when they reach the surface. After flowering, plant biomass declines as the result of stem fragmentation. Where flowering occurs early, plant biomass may increase again later in the growing season, and a second flowering can occur. During the fall, plants die back to the root crowns, which sprout again in the spring. In areas with mild winters (such as western Washington and Oregon) Eurasian watermilfoil frequently overwinters in an evergreen form and may maintain considerable winter biomass. Eurasian watermilfoil plants do not form specialized overwintering structures such as turions. Carbohydrate storage occurs throughout overwintering shoots and roots.

**F. Economic Importance**

Eurasian watermilfoil is the most important waterweed in the continental United States, with extremely high annual control costs. States such as Idaho, Minnesota, Wisconsin, Vermont, New York, and Washington spend millions of dollars per year on Eurasian watermilfoil control.

**Figure 9.** Eurasian watermilfoil infestation interfering with recreation

Eurasian watermilfoil adversely impacts aquatic ecosystems by forming dense canopies that shade out native vegetation. Species diversity and native macrophyte declines have been reported associated with invasions by this aquatic weed. Pure stands of Eurasian watermilfoil provide poor habitat for waterfowl, fish, and other wildlife. Significant rates of plant sloughing and leaf turnover, as well as the decomposition of high biomass at the end of the growing season, increase phosphorus and nitrogen in the water column. Eurasian watermilfoil impacts water control structures, navigation, power generation and irrigation by clogging infrastructure. Stagnant water created by Eurasian watermilfoil mats provides breeding grounds for mosquitoes, which carry West Nile virus. Eurasian watermilfoil interferes with tourism and recreational activities such as swimming, boating, fishing, snorkeling and water skiing (Figure 9).

**G. Taxonomy**

The genus *Myriophyllum* belongs to the watermilfoil family, Haloragaceae, in the order Saxifragales. Only one other genus within the Haloragaceae occurs in eastern North America and is represented by two species of mermaid weeds: *Proserpinaca palustris* and *P. pectinata.* There has been much confusion regarding the taxonomic status and identity of *Myriophyllum* species. During a literature and internet survey conducted by CABI Europe, nearly 70 accepted *Myriophyllum* species were found to be described worldwide. The center of diversity of the genus *Myriophyllum* is in Australia, where about 40 species occur. North America has eleven native species, plus introduced species from Europe (*M. spicatum*), Asia (*M. ussuriense*), and South America (*M. aquaticum*) (United States Department of Agriculture Plant Database). About 13 species are described from Asia, and only 2-4 species each from Africa, South America and Europe. However, since many of these species are difficult to distinguish from each other using morphological characteristics, a considerable number of misidentifications are likely to have been made in the past and some distribution data may not be reliable.

A phylogenetic study including several of the North American *Myriophyllum* species indicates that *M. spicatum* is most closely related to the holarctic species *M. sibiricum* and *M. alterniflorum.* There is also a relatively close relationship to *M. verticillatum* and the native South and North American disjunct *M. quitense.* All other native North American species analyzed (*M. heterophyllum, M. laxum, M. hippuroides, M. tenellum, M. pinnatum*, *M. farwellii* and *M. humile* are well-separated from *M spicatum.*

*M. spicatum* was recently recognized to hybridize with the holarctic *M. sibiricum* in North America, and investigations are underway into the distribution of hybrid and parental populations in North America. While *M. spicatum* and *M. sibiricum* may be distinguished by morphological characteristics related to leaf segments and the presence (*M. sibiricum*) or absence (*M. spicatum*) of turions (overwintering buds), hybrids overlap with both parents in leaf characters and lack turions, and can only be reliably distinguished using molecular analyses.

**H. Proposed and Enacted Laws**

The control and enforcement of listed noxious weeds and other plant pests is well defined and established in Idaho. The Idaho Legislature updated the Noxious Weed Law 22-2401-13 in the 2006 Legislative session, the same year that the first Eurasian watermilfoil eradication appropriations were made to ISDA. The majority of the changes in the law center on updating terms and definitions; however, there were other important elements included in the new language. Idaho has the ability to bring standard enforcement against landowners or counties, and may now also levy criminal charges with fines up to $3,000 or civil action with fines up to $10,000 for violations to the Idaho Weed Law.

Idaho’s noxious weed list, IDAPA 02.06.22- Noxious Weed Rules, was updated in the 2007 Legislative session and now includes three levels of noxious weeds in the state. The highest priority weeds are listed on the “Early Detection Rapid Response” (EDRR) list, (which now contains three new obligate aquatic plants), the second tier of weed species are those listed on the “Control” list. This list contains two obligate aquatic noxious weeds - parrotfeather milfoil and Eurasian watermilfoil. The third tier weed species is the “Contain” list. This list currently does not include any aquatic species.

Idaho’s ISDA Plant Division uses one other powerful tool to combat invasive plant and insect species. The Plant Protection Act allows the plant division to work cooperatively to “search and destroy” noxious weeds and harmful insects before they are released in Idaho. The plant division inspectors regularly visit nurseries, horticultural centers, aquatic pet supply shops, and other plant market outlets to inspect for violations and place “stop sale orders” or “destroy orders” for listed aquatic and terrestrial species.

## VIII. Eurasian Watermilfoil Survey for Idaho

The Idaho Invasive Species Council’s Milfoil Task Force developed a risk assessment for Idaho in 1999. Idaho’s water bodies were prioritized for surveys based on a flow chart of important water body characteristics (Figure 10 and Table 1). The objective of this work was to gather data on infested and un-infested waterways to determine factors that contribute to susceptibility or resistance to invasion by Eurasian watermilfoil in Idaho. This risk assessment was extremely valuable to program planning and is being refined to reflect new information about Eurasian watermilfoil in Idaho.

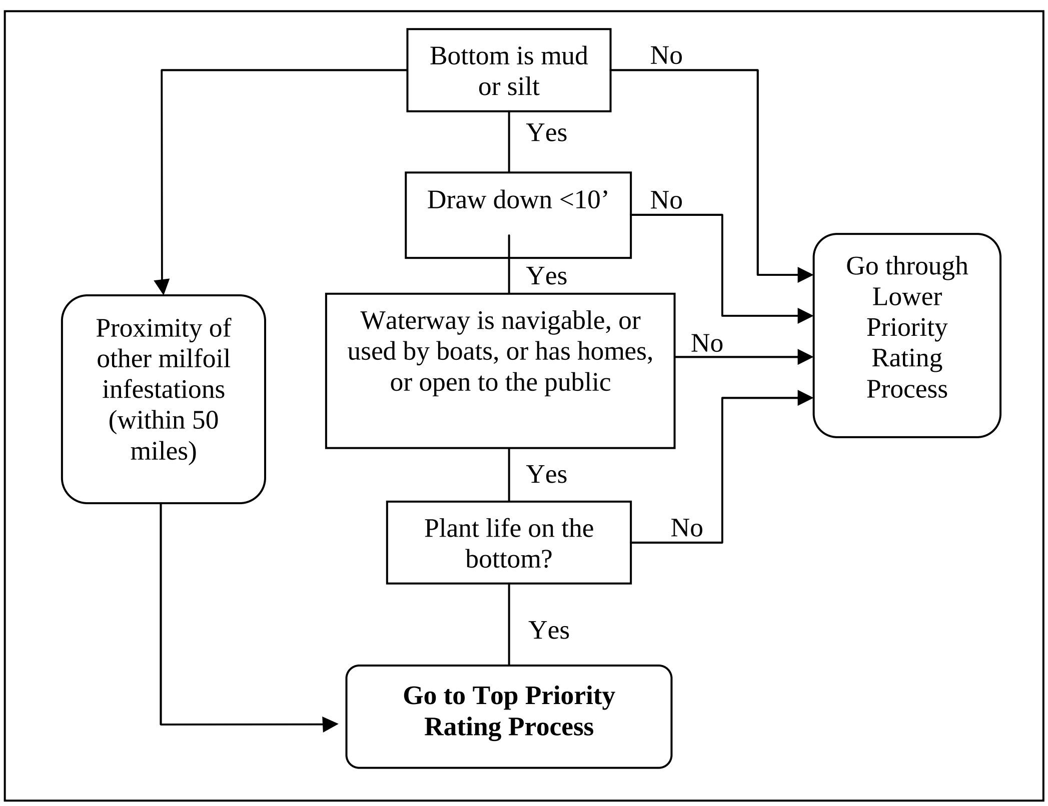


**Figure 10.** Physical Survey Flow Chart for Site Rating

**Table 1.** Priority Rating Assessment

| Top Priority Rating Process | | |
|---|---|---|
| | Yes | No |
| **Is it open to the public?** | 20 | 0 |
| **Is it navigable?** | 10 | 0 |
| **Does it have a boat launch?** | 15 | 0 |
| **Are there homes on it?** | 10 | 0 |
| **Is there plant life on the bottom?** | 20 | 0 |
| **Is it primarily wildlife habitat?** | 5 | 0 |
| **Is it a substantial fishery?** | 10 | 0 |
| **Is it used for irrigation?** | 5 | 0 |
| **Is it used for drinking?** | 5 | 0 |
| **Possible 100 Points** | | |

Table 2 can be used to assess the risk of infestation to water resources. If a water body is high risk in the proximity category and high risk in one or more other categories, it is considered a "High Risk" water body.

**Table 2.** Water Body Risk Assessment

| Category | Description | Risk |
|---|---|---|
| **Proximity** | Lake or pond connected to a currently-infested water body | **High** |
| | Lake or pond within 1 day travel distance of currently-infested water body | **High** |
| | Lake or pond within weekend travel distance of a currently-infested water body | **Moderate** |
| | Lake or pond more than weekend travel distance of a currently infested water body | **Low** |
| **Access** | Lake or pond with public access boating ramp | **Moderate** |
| | Lake or pond without public access boating ramp | **Low** |
| **Water Body** | Significant depth at shoreline less than 30 feet | **High** |
| | Lake or pond less than 30 feet deep | **High** |
| | Lake or pond more than 30 feet deep | **Low** |
| | Muck, clay, or silt bottom | **High** |
| | Sand or gravel bottom | **Low** |
| | Water level fluctuation more than 30 feet | **Low** |
| | Water level fluctuation more than 10 feet but less than 30 feet | **Moderate** |
| | Water level fluctuation less than 10 feet | **High** |
| | Lake or pond shaded | **Low** |
| **Aquatic Vegetation** | Native milfoil present | **Moderate** |
| | Richardson pondweed, potamogeton, fern leaf pondweed well established | **Low** |

## A. ISDA Aquatic Plant Sampling Protocols

Once water bodies are prioritized, the following procedures are used to conduct the Idaho aquatic plant surveys. These sampling protocols are used to provide consistent quantifiable data to statistically evaluate the effectiveness of Eurasian watermilfoil treatments, to identify and map Eurasian watermilfoil populations (especially new infestations), and to monitor aquatic plant community characteristics in the state.

Sampling plans vary depending on the lake size and the complexity of Eurasian watermilfoil treatments. ISDA provides maps and sampling plans for each project, and provides assistance to cooperators with the implementation of these protocols.

The goals and objectives of this survey program are as follows:

1. To identify and delineate populations of Eurasian watermilfoil in water bodies receiving state funding for treatments.
2. To quantify the distribution and frequency of Eurasian watermilfoil populations before and after control treatments to gauge treatment efficacy.
3. To quantify the distribution and frequency of all aquatic vegetation on a water body-wide scale.
4. To identify new populations of invasive aquatic and emergent plants.
5. To identify new populations of other aquatic nuisance species (ANS).

**1. Littoral Survey**

**Figure 11.** Scuba diving for Eurasian watermilfoil

In order to identify Eurasian watermilfoil and other exotic plant populations, a survey of the lake's littoral area is conducted. The littoral zone is defined as the shallow area near the shore of a body of water that extends from the shoreline lakeward to the limit of occupancy of rooted plants. This survey may be conducted from a boat using rake throws and/or underwater viewers, by snorkeling, or by SCUBA divers (Figure 11). The littoral zone is surveyed by navigating in a regular pattern. If surveying from a boat, regular rake throws are used to check for Eurasian watermilfoil in areas with limited visibility. As water clarity decreases, rake sampling increases. When Eurasian watermilfoil or other aquatic nuisance species are found, the location is recoded, the area is outlined with a GPS, and an estimate the percent Eurasian watermilfoil cover is recorded. Cover estimates are recorded as dense, sparse or no Eurasian watermilfoil cover.

The location of invasive emergent shoreline plants are also recoded as they are detected (purple loosestrife, garden loosestrife, phragmites, yellow iris, tamarisk, Russian olive, etc.). Littoral surveys are conducted by agencies, universities, groups or individuals that are not affiliated with the contractor applying control treatments. Contractors may, however, provide aerial images to assist in the littoral survey. If the system has some kind of stage measuring device (downstream dam, stage gage) a stage reading should be included in the survey data set.

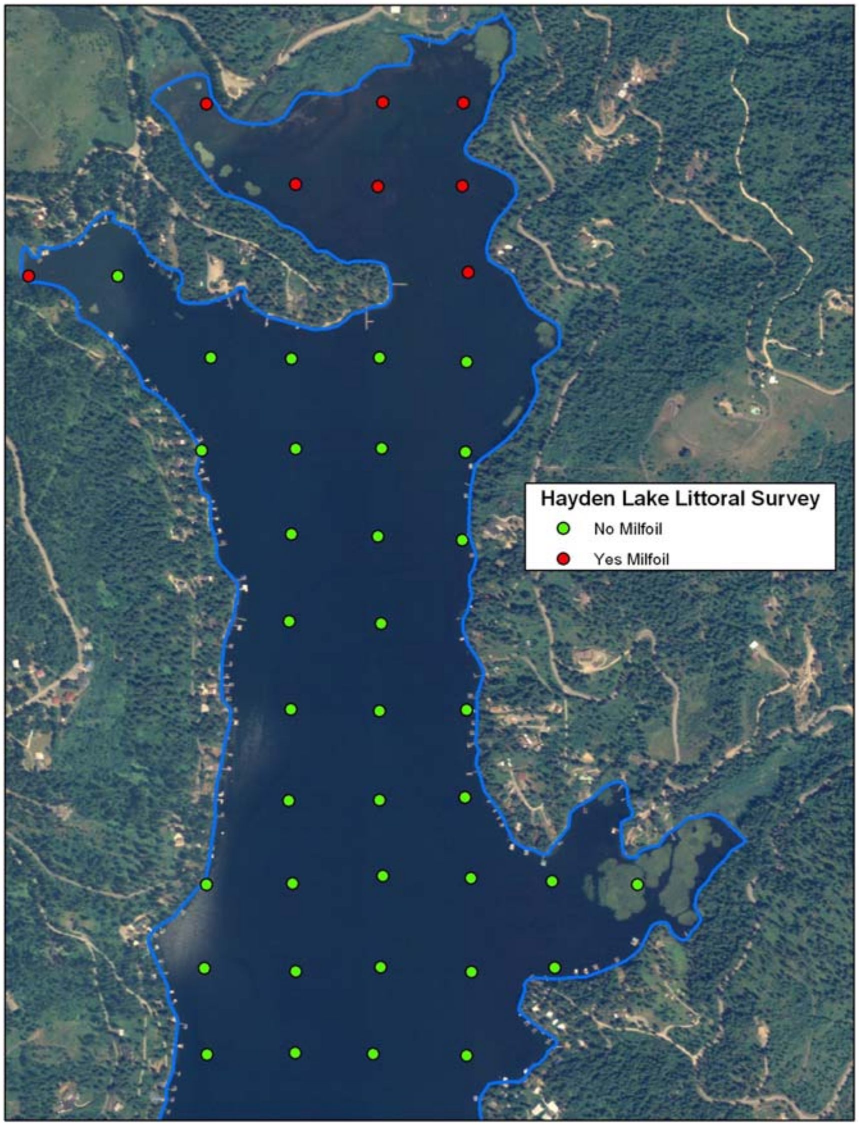


**Figure 12.** Hayden Lake Littoral Survey

**2. Point Intercept Survey**
The point intercept method is a relatively quick and effective way to quantify distribution and frequency of aquatic vegetation. Points are pre-selected and are placed in a regularly spaced grid or at random points on a map of the water body (Figure 12). Sampling in this manner tracks changes over time in the aquatic plant community by repeatedly returning to the same points for sampling (Madsen 1999) through time.

**Figure 13.** Sampling rake

A point intercept survey of a body of water is typically conducted in two person teams. One person navigates the boat with a GPS to the predetermined point and a second person makes observations. Depth and, if possible, the sediment type (mud, sand, rock, or organic) are also recoded at each sampling point. The reader observes an area of water over the side of the boat using the same side of the boat every time. Species observed from the surface within the area are recorded on a data sheet. A sample rake is used in areas where the bottom cannot be clearly seen (Figure 13). Sample with two rake throws in a crossing pattern within a 1m x 1m sampling area and record all species (Parsons et al. 2001). Any Eurasian watermilfoil that is observed while traveling between sampling points is also recorded.

A species is only recorded once at each sampling point, even if it is observed multiple times on the surface and in rake throws. The data sheets are arranged with all suspected species listed across the top and sample coordinates listed in the left column. When a species is found, a 1 is marked in the appropriate column for that species. A 0 is entered to indicate the absence of a species at that point. Spaces are available for listing new species as they are found. A column is provided to list various physical states of Eurasian watermilfoil in order to gage the effectiveness of treatments. A scale of 1 through 5 is used to record the status of plants observed. 5 indicates no live Eurasian watermilfoil present, 4 indicates only a small sprig of Eurasian watermilfoil (very little live Eurasian watermilfoil present), 3 indicates sparse Eurasian watermilfoil (plants appear stressed, sparse growth, no plants on the surface), 2 indicates Eurasian watermilfoil but not on water surface (some plants appear distressed but fairly healthy, no plants on the surface) and 1 indicates Eurasian watermilfoil on surface (plants appear fairly healthy with little to no apparent control effects, plants on water surface). In addition, a column is provided for a cover estimate. Cover is reported as either dense, sparse, or no Eurasian watermilfoil cover.

In small lakes pre- and post-treatment point intercept surveys are conducted over the entire water body. The pre-treatment survey is conducted before treatments are applied, preferably within several weeks prior to treatment. The post-treatment survey revisit the same points and are conducted late in the year (late August or September) in order to assure the maximum treatment effect is observed. In small lakes the pre-treatment survey can be conducted concurrently with the littoral survey.

Surveys conducted in large lakes that receive Eurasian watermilfoil treatments may have two types of point intercept surveys conducted:

> *Pre/Post Treatment Point Intercept Survey*: The pre/post point intercept survey consists of multiple sampling points arranged in areas where Eurasian watermilfoil treatments are planned. The points are established in the treatment areas and are monitored before and after treatments in order to quantify treatment efficacy (Madsen 2006). Points are arranged in either a regular grid pattern or in a random distribution, depending on the size of the treatment area. ISDA provides maps and sample point locations to the

surveying party prior to the scheduled survey. All pre/post point intercept surveys are conducted by agencies, universities, groups or individuals that are not affiliated with the contractor applying control treatments in order to avoid the perception of bias.

*Lake-Wide Point Intercept* Survey: The second type of point intercept survey consists of a large grid covering the entire littoral zone of the lake. Sampling in this manner provides lake-wide sampling points to track the lake's aquatic plant community over time. ISDA provides maps and sample point locations to the surveying party prior to the scheduled survey. Lake-wide point sampling on larger lakes may be conducted concurrently with the littoral survey.

Voucher Specimen Photos

Voucher specimen photos are taken of each species of aquatic plant encountered in each water body. The group or organization receiving Eurasian watermilfoil state funding catalogs and stores the photos for future reference.

Water Quality Monitoring

Basic water quality data is collected at a single point in each surveyed water body. Secchi disk, temperature, and dissolved oxygen profile data is collected in an open-water portion of the water body, in an area with minimal influence from inflowing waters. Temperature and dissolved oxygen profiles are collected in profile, from surface to bottom, at 0.5 meter intervals. GPS coordinates are recorded at each sampling point and survey parties return to the same point for water quality sampling on subsequent visits.

Aquatic Nuisance Species Monitoring

Surveyors are vigilant and note and sample any species that is strange, suspicious, or out of the ordinary. Special attention is paid to any plant or animal species exhibiting aggressive growth. Digital photos are taken of anything unusual and samples are collected, if possible. Substrate samplers (provided by Portland State University) will be installed at each sampled water body in order to monitor for zebra and quagga mussels in Idaho.

## IX. Eurasian Watermilfoil Management Techniques Available in Idaho

*This section is modified from the Aquatic Plant Management Best Management Practices in Support of Wildlife Habitat Report (AERF, 2005), the State of Washington Department of Ecology website (http://www.ecy.wa.gov/programs/wq/plants/management/index.html), and U.S. Army Corps of Engineers Technical Report ERDC/EL MP-00-1, Madsen (2000), A Citizen's Manual for Developing Integrated Aquatic Vegetation Management Plans (Gibbons et al. 1994), and Aquatic Plants and Fish (WDFW 1998b).*

### Control Options

As a nationally pervasive invasive aquatic weed, considerable effort has been expended to develop control techniques for Eurasian watermilfoil. Typically, prevention is the best method of avoiding the development of uncontrolled monocultures of this aquatic weed. Chemical, manual and mechanical methods are well developed, and research on long-term biological control of Eurasian watermilfoil is continuing in North America and throughout the world. At this time, no classical biocontrol agents are available. Information is provided here that describes each available control technique, summarizes the pros and cons of using each, and describes the situations where these techniques are suitable for use in Idaho (Appendix 2).

***Note: The use of trade names is for clarity by the reader. Inclusion of a trade name does not imply endorsement of that particular brand of herbicide and exclusion does not imply non-approval.***

### A. No Action Alternative

It should be noted that Eurasian watermilfoil is considered a noxious weed in Idaho and as such, treatment is considered mandatory per Idaho Weed Law (2007).

### B. Physical Controls

#### 1. Water level drawdown

A drawdown involves exposing plants and roots to prolonged freezing and drying. It is generally performed in winter months. The use of drawdown as an aquatic plant management tool is more common in reservoirs and ponds than in natural lakes. A water control structure or high capacity pumps are needed to draw the water down.

Although freezing can have a dramatic impact on some plants, Eurasian watermilfoil is known to survive under ice. The effectiveness of Eurasian watermilfoil control is determined by several factors including the amount of the water body bottom exposed, duration of exposure, presence of springs, and the weather at the time of drawdown. The success or failure of drawdowns in controlling Eurasian watermilfoil can be highly variable from water body to water body and from year to year within the same water body. Conditions suitable for

Eurasian watermilfoil control may not occur with heavy snowfall or during milder, rainy winters.

Water bodies suitable for drawdown control are those where drawdown occurs on a prolonged and regular basis. Because a drawdown impacts the entire water body, it should be conducted only under the direction of an integrated aquatic vegetation management plan. Except for reservoirs, few water bodies in Idaho have water control structures and the means to lower the water level to the extent necessary to achieve significant Eurasian watermilfoil control. Because impacts to habitat can be dramatic, a drawdown should only be considered for Eurasian watermilfoil control after these impacts are carefully considered by resource agencies.

**2. Bottom barrier**

Barrier material is applied over the lake bottom to prevent plants from growing. Bottom covering materials such as sand-gravel, polyethylene, polypropylene, synthetic rubber, burlap, fiberglass screens, woven polyester, and nylon film have all been used with varying degrees of success (Figure 13). Typically, synthetic (geo-textile) fabrics or burlap are used. Bottom barriers can be used at any depth.

**Figure 14.** Installing bottom barriers

Bottom barriers create an immediate open water area. Duration of control depends on a variety of factors, including type of material used, application techniques, and sediment composition. Synthetic materials have eliminated Eurasian watermilfoil for at least the season of application. In some situations, after satisfactory control has been achieved, bottom barriers may be relocated to other areas.

Bottom barriers can usually be easily applied to small, confined areas such as around docks, boat launches, or swimming beaches. Bottom barriers are hidden from view and do not interfere with recreation or shoreline use. They can be installed around obstructions. Bottom barriers do not result in significant production of plant fragments, which is advantageous for Eurasian watermilfoil control. Barriers are most appropriately used for localized, small-scale control where exclusion of all plants is desirable.

Depending on the material, major drawbacks to the application of bottom barriers include some or all of the following: control not species-specific, expensive if used on a large scale, labor-intensive installation, limited material durability and possible suspension due to water movement or gas accumulation beneath material. Periodic maintenance (yearly) of bottom barrier materials is necessary to remove accumulations of silt and any rooting fragments. Bottom barrier material costs vary depending on the type of material used.

Bottom barriers are appropriate in water bodies that have Eurasian watermilfoil lightly scattered singly or in small patches within the littoral zone, around docks where there are no large obstructions and also along short stretches of shoreline. Cost and maintenance of bottom barriers confine them to very small-scale use.

Follow-up is essential to ensure success with bottom barriers. Even a few Eurasian watermilfoil fragments left in the water can start a new infestation. Diver and surface inspections should continue at least twice a year during the growing season. Survey work should be as frequent as can be afforded since small Eurasian watermilfoil plants or fragments may be easily overlooked.

### C. Manual Controls

#### 1. Hand-pulling

Hand-pulling and removal of rooted, submerged plants is a labor intensive control method. This method involves digging out the entire plant with its roots. Plants are then deposited in a dry disposal area away from the shoreline. No specialized gear is required in waters less than three feet. In deeper waters, hand pulling is most efficient with divers using snorkeling equipment or SCUBA gear. Divers carry mesh bags to collect plants. Plants must be disposed of on shore. Hand pulling can begin as soon as Eurasian watermilfoil can be easily seen and identified - generally in the spring or as soon as it is discovered in the water body.

Sediment type, visibility, and thoroughness in removal of the entire plant, particularly the roots, all affect the efficacy of hand-pulling. A high degree of control, lasting more than one season, is possible when complete plant removal is achieved.

Advantages of hand-pulling include immediate clearing of the water column. The technique is selective and is most useful in sensitive areas where disruption must be kept to a minimum. It is a highly labor intensive control option, most appropriate in small or low density areas. Environmental impacts, including turbidity and bottom disruption, are short-term.

Hand-pulling is time-consuming and can be costly. Diver visibility may become obscured by the digging process, making it difficult to see and remove roots. Hand-pulling is not practical for large areas. This method is useful for small-area, short-term control of Eurasian watermilfoil around docks and along short shoreline segments.

#### 2. Diver Dredging

Divers operate portable dredges with suction heads that remove plants and roots from the sediment - essentially vacuuming the bottom of the lake (Figure 14). The suction hoses draw the plant/sediment slurry up to a small barge or boat carrying the dredge. On the barge, plant parts are separated from the sediment slurry and retained for off-site disposal. The sediment slurry can be returned to the water column.

Diver dredging can be highly effective under appropriate conditions. Removal efficiency depends on sediment condition, density of aquatic plants, and underwater visibility. This technique works well to control early, low-level infestations of Eurasian watermilfoil. It can also be used as a maintenance tool following herbicide treatments.

**Figure 15.** Diver dredging

This control method is site and species-specific. Plant parts are collected for later disposal, minimizing the spread of fragments, which is important in the control of Eurasian watermilfoil. Diver dredging can cover a much larger area than is practical for hand-pulling and it can be effective in soft sediments. It can also be easily operated around obstacles.

Diver dredging is labor intensive and very costly. Turbidity caused by the machine can create poor visibility, slowing the process. Some sediment and nontarget vegetation may inadvertently be removed during the process. Some fragments may be expected if dredged slurry is directly returned to the lake.

Sites suitable for diver dredging include water bodies lightly to moderately infested with Eurasian watermilfoil and for follow-up Eurasian watermilfoil removal after a herbicide treatment. Diver hand-pulling is more effective in lightly scattered patches of Eurasian watermilfoil, whereas diver dredging may be more appropriate in denser milfoil beds. Diver dredging may also be applicable in water bodies where herbicide use may not be appropriate. Theoretically diver dredging could be used in any water body to eradicate Eurasian watermilfoil; however the costs for large scale projects would be astronomical.

**3. Hand-cutting**

This is also a manual method but does not involve hand-pulling the roots. The plants are cut or torn using tools that can be pulled through the weed beds manually or by boat. This work can be done using hand held cutting tools, some of which may be powered. Items such as rakes, chains, logs, railroad ties are dragged across the bottom to collect plants. Collected plants are disposed of on shore. Because roots are not removed, this is a less intensive removal technique. Mechanized weed cutters are also available that can be operated from the surface for small-scale control (similar to an underwater lawnmower). Mechanized weed rollers, which flatten and wear down weeds by frequent agitation, are also available for consideration.

Root systems and lower stems are left intact with the hand-cutting technique. As a result, effectiveness is usually short-term as rapid regrowth is possible from the remaining root masses. Duration of control is limited to the time it takes the plant to grow to the surface (probably less than one season).

Hand-cutting and mechanized weed cutters or rollers result in immediate removal of the nuisance plant and quickly create open water for swimming, boating or fishing. Hand-cutting is site specific and can be species specific, if care is used. Visibility may become obscured by turbidity generated during cutting activities. Cut plants must be removed from the water. Fragments may also increase the problem by spreading Eurasian watermilfoil to additional areas within the water body. This method is not practical for large areas.

Weed rollers are not recommended for removal of early infestations of Eurasian watermilfoil because they create fragments and might help spread the plant to new locations. Hand-cutting of Eurasian watermilfoil would be most applicable for short-term and small-scale control around docks and along the shorelines.

### D. Mechanical

#### 1. Rotovation

The British Columbia Ministry of Environment developed a barge-mounted rototilling machine called a rotovator to remove Eurasian watermilfoil roots. Underwater tiller blades churn up to 8 inches into the sediment and dislodge buoyant Eurasian watermilfoil roots. Floating roots may then be collected from the water. Control with rotovation, generally extends 2 or more growing seasons. A high percentage of entire plants, including the roots, can be removed during tillage. Plant density is generally reduced.

Bottom obstructions limit the use of rotovation. Tillage should not occur where water intakes are located. Short term turbidity increases in the area of operation, and short-term impacts on water quality and the benthic invertebrate community can occur. Rotovation is not advised where bottom sediments have excessive nutrients and/or metals because of their potential release into the water column. Rotovation is not species selective. Plant fragments are produced and the machine does not collect plants. The process is very labor intensive and expensive.

Rotovation is a way to mechanically remove Eurasian watermilfoil to provide open areas of water for recreational activities and navigation. Water bodies suitable for rotovation include larger lakes or rivers with widespread, well-established Eurasian watermilfoil populations. Rotovation is not recommended in water bodies with early infestations of Eurasian watermilfoil since fragments are created and rotovation may increase the spread of Eurasian watermilfoil throughout the water body.

### 2. Harvesting

Plants are cut as deep as 5-7 feet below the water's surface, collected by conveyer, and stored until they are disposed on land. Harvesting removes surfacing mats and creates open areas of water. However, because of its rapid growth rate, Eurasian watermilfoil generally needs to be harvested twice during the growing season.

Harvesting immediately creates open water, but the duration of control is variable. Factors such as frequency and timing of harvest, water depth, and depth of cut may influence the duration of control. Harvesting has not proven to be an effective means of sustaining long-term reductions in the growth of Eurasian watermilfoil. Regrowth of Eurasian watermilfoil to pre-harvest levels typically occurs within 30-60 days depending on water depth and the depth of cut. Any effects on the control of Eurasian watermilfoil are short term.

Harvesting is most suitable for large lakes (100 acres or more) and open areas with few surface obstructions. A specific location can be targeted leaving an area open for fish and wildlife. There is usually little interference with recreational use of the water body during harvesting operations. By cutting only the top several feet of the plant, some habitat remains. However, since mechanical harvesting removes both Eurasian watermilfoil and native submersed plants, repeated harvesting may select for Eurasian watermilfoil if it grows back faster than native species and forms a light-excluding canopy.

Cut plant material requires collection and removal from the water, and off-loading sites are needed for plant disposal. Collecting machines fill quickly which makes the process time consuming. Harvesting creates numerous plant fragments which contributes to the spread of Eurasian watermilfoil. It is not species specific and can enhance the growth of opportunistic plant species that invade harvested areas.

Mechanical harvesting is most appropriate for water bodies with widespread, well-established Eurasian watermilfoil populations. Harvesting is not recommended in water bodies with early infestations of Eurasian watermilfoil since the resulting fragments are never completely contained and harvesting may increase the spread of Eurasian watermilfoil throughout the water body.

## E. Biological Controls

### 1. Classical Biological Control

Classic biological control uses control agents that are host specific. These organisms attack only the species targeted for control. Generally these biocontrol agents are found in the native range of the plants. With classic biological control a nonindigenous species is introduced to control another nonindigenous species. However, extensive research and screening is conducted before release to ensure that biological control agents are host specific and will not become invasive and harm the environment in other ways.

Search for a classical biological control agent typically starts in the region of the world that is home to the invasive plant. Researchers collect and rear insects and/or pathogens that appear to have an impact on the growth or reproduction of the target species in its native range. Those insects/pathogens that appear to be generalists (feeding or impacting other plant species) are rejected as potential biological control agents. Agents that impact the target species (or very closely related species) exclusively are considered for further study.

Once collected, these insects are reared and tested for host specificity and other parameters. Only extensively researched, host-specific organisms are cleared by the United States Department of Agriculture for release. It generally takes a number of years of study and specific testing before a biological control agent is approved for release.

Even with an approved, host-specific biocontrol agent, control can be difficult to achieve. Some biological control organisms are successful in controlling invasive species while others are of little value. A number of factors come into play. It is often difficult to establish reproducing populations of a biocontrol agent in its introduced range. Sometimes the impact of the agent on the target plant does not provide enough stress to control the growth and reproduction of the invasive species, and the agent is ineffective.

Even when biological control works, a classical biological control agent generally does not totally eliminate all target invasive plants. A predator-prey cycle establishes where increasing predator populations will reduce the targeted species. In response to decreased food supply (the target plant is the sole food source for the predator), the predator species will decline. The target plant species rebounds due to the decline of the predator species. The cycle continues with the predator populations building in response to an increased food supply.

Although a successful biological control agent rarely eradicates a problem species, it may reduce weed populations substantially, allowing native species to return. Used in an integrated approach with other control techniques, biological agents can stress target plants making them more susceptible to other control methods. Classical biological control agents have been approved to manage a number of nonindigenous plants with varying degrees of impact, including hydrilla, alligatorweed, water hyacinth and purple loosestrife.

**2. Other Biological Control Insects**

A native insect (a North American weevil, *Euhyrchiopsis lecontei*) that feeds and reproduces on *M. sibiricum* was found to also feed on *M. spicatum*. Several researchers have been working to determine the suitability of this insect as a biocontrol agent, but to date it has not proven to be a viable control method for Eurasian watermilfoil. The effectiveness of this weevil has been mixed, with good results at some sites and poor results at others. Predation by sunfish appears to be a limiting factor to the weevil in some lakes. Various individuals have evaluated or are evaluating two other native insects for biological control for Eurasian watermilfoil; the midge (*Crictopus myriophylii*) and the moth (*Acentria nivea*), but neither is considered operational. Many states regulate the use and transport of these agents, and state authorities should be contacted before introduction or augmentations are conducted.

### 3. Grass Carp

Another type of biological control uses general agents such as grass carp (Figure 15, *Ctenopharyngodon idella*) to manage problem plants. A sterile, triploid variety of grass carp can be produced. Unlike classical biocontrol agents, these fish are not host specific. Although sterile triploid grass carp will eat Eurasian watermilfoil, it is not a highly palatable or preferred food species. To achieve control of Eurasian watermilfoil, more palatable native aquatic species are generally consumed before the grass carp will eat Eurasian watermilfoil. In situations where Eurasian watermilfoil is the only aquatic plant species in the lake, this may be acceptable. Grass carp should not be released into open water systems in which they cannot be contained. Also once released, triploid grass carp have proven extremely difficult to remove from a water body.

**Figure 16.** Grass carp

### 4. Pathogens

Interest in pathogens of Eurasian watermilfoil was stimulated by extensive mortality of Eurasian watermilfoil in Lake Venice and the Northeast River, Maryland in the late 1960s. At that time, the declines (called Northeast Disease) were suspected to be caused by a pathogen, although no pathogens were ever isolated. However, Northeast Disease stimulated research into the use of plant pathogens for biological control. The plant pathogenic fungus *Mycoleptodiscus terrestris* (sometimes called “Mt”) has been shown to significantly reduce Eurasian watermilfoil biomass in laboratory studies. A commercial biotechnology firm spent several years developing this fungus as a biological tool to control Eurasian watermilfoil, but has been unable to achieve control of the plant in field settings to date. Research is continuing to integrate Mt with various herbicides to control Eurasian watermilfoil and hydrilla.

## F. Chemical Controls

Herbicides currently used for the management of Eurasian watermilfoil, as well as information on various commercial formulations are shown in Appendix 2. Since Eurasian watermilfoil is a dicot it can be controlled using selective herbicides that specifically target this group. Effective broad spectrum chemicals are also available for this species. Chemical control can provide short- to long-term control, and is often appropriate for immediate use on small pioneer infestations, with additional potential for use on larger scale or whole-lake infestations where deemed necessary. Since herbicides often are used to treat the entire water column, it is important to assess the water volume prior to treatments. Also, likely sources of dilution need to be investigated such as stream flow, springs, wind and wave action, etc.

**Figure 17.** Herbicide application equipment

Many criteria and evaluations are used to select an appropriate herbicide suited to site-specific and environmental conditions at the time of application. Specific herbicide guidelines and information to consider are provided in Appendix 2 of this document.

Because the labels from which this information was summarized can change, the most current herbicide label should always be reviewed for conditions or restrictions before use. It should also be noted that changes in labeling can result in the addition of available aquatically-labeled products. As these products become available, they will be incorporated into these recommendations, as appropriate. Please refer to www.epa.gov website for more information on the federal herbicide registration process for aquatic use herbicides.

***Note: The use of trade names is for clarity for the reader. Inclusion of a trade name does not imply endorsement of that particular brand of herbicide and exclusion does not imply non-approval. It is the responsibility of the applicator to read and follow the label directions. It is a violation of State and Federal law to use a pesticide in a manner inconsistent with its labeling.***

**1. 2,4-D**

There are two formulations of 2,4-D approved for aquatic use. The granular formulation contains the low-volatile butoxy-ethyl-ester formulation of 2,4-D (Trade names include: AquaKleen® and Navigate®). The liquid formulation contains the dimethylamine salt of 2,4-D (Trade name - DMA*4IVM). 2,4-D is a relatively fast-acting, systemic, selective herbicide used for the control of Eurasian watermilfoil and other broad-leaved species.

Granular formulations are applied where dilution or dissipation may be a concern, but may not be suitable in flocculent or thick organic sediments. Both the granular and liquid formulations can be effective for spot treatments of Eurasian watermilfoil. 2,4-D has been shown to be selective in controlling Eurasian watermilfoil when used at the labeled rate, leaving native aquatic grass species relatively unaffected.

Sites suitable for treatment include water bodies partially infested with Eurasian watermilfoil and water bodies where Eurasian watermilfoil has recently invaded, but where the extent of the infestation is beyond what can be removed by hand pulling or bottom screening. In these situations, a herbicide like 2,4-D can be used to reduce the amount of Eurasian watermilfoil so that hand pulling can remove any Eurasian watermilfoil plants that are not killed by the herbicide. 2,4-D is suitable for spot treatments because it is a fast-acting herbicide that only needs a 48-hour contact time with the plant. Because some plants remain alive and scattered throughout the littoral zone after 2,4-D treatment with the granular product, hand pulling extensive areas after this treatment may not be effective in heavily infested lakes.

A few days after the 2,4-D treatment, the growing tips of Eurasian watermilfoil plants twist and look abnormal. These plants will sink to the sediments usually within one to two weeks after treatment. Unless treatment takes place in dense beds of Eurasian watermilfoil, it is unlikely for low oxygen conditions to develop during the decomposition process. Results of spot treatment may be variable depending on water movement, size of treatment plot, size of the water body, density of Eurasian watermilfoil, weather conditions, underwater springs, etc.

Follow-up is essential to ensure eradication. Without follow-up, 2,4-D is not an eradication tool. Some plants will likely survive the treatment and re-grow (particularly when using the granular formulation of 2,4-D), so these plants must be removed by other means or controlled with a follow-up treatment.

**2. Diquat and Endothall**

Diquat (active ingredient Diquat dibromide, Trade name, Reward) and Endothall (active ingredient endothall acid, 7-oxabicyclo(2,2,1)heptane-2,3-dicarboxylic acid, Trade name, Aquathol K) are contact-type herbicides; they are not translocated. Contact herbicides kill only the plant parts that they come into contact with. The entire plant is not killed when treated with Diquat or Endothall, so these herbicides are generally used for short-term control or in conjunction with other methods. Contact efficiency (duration, concentration and thoroughness) and re-growth from the unaffected root masses determine extent of control. Effective reductions in plant biomass can occur. In some circumstances, season-long control can be achieved but carryover control into the next season is not typical.

This type of herbicide treatment generally acts faster than translocating herbicides such as fluridone; evidence of tissue death is often apparent in one to two weeks. The benefit of using low levels of diquat or endothall is to remove invasive weeds like Eurasian watermilfoil, while allowing native species to recover. These herbicides may be useful for maintaining more acceptable levels of Eurasian watermilfoil in a water body by periodically treating the littoral zone with low concentrations. It is possible that treatments can occur as infrequently as every three years. Contact herbicides such as Endothall and Diquat may be used where it is considered too expensive, or the water body is too large to use other Eurasian watermilfoil eradication strategies.

**3. Fluridone**

Fluridone (Trade names include: Sonar® and Avast!®) is a slow-acting systemic herbicide used to control Eurasian watermilfoil and other submersed plants. It may be applied as a pellet or as a liquid. Fluridone can offer excellent control of submersed plants where there is very little water movement and an extended time for plants to absorb the herbicide is allowed. Its use is most applicable to whole-lake or isolated bay treatments where dilution is minimized.

Since fluridone interferes with a susceptible plant's ability to synthesize chlorophyll, symptoms of fluridone use are whitened leaves, retarded growth, and plant mortality. Effects of fluridone treatment are noticeable 7-10 days after application with control of target plants often taking 60-90 days to become evident. Because of the delayed nature of control, the herbicide is best applied during the early growth phase of the target plant, usually spring or early summer.

Lakes and ponds suitable for whole-lake fluridone treatments are heavily infested with Eurasian watermilfoil throughout the littoral zone. Fluridone is not suitable for spot treatments since it is difficult to maintain enough contact time between the plant and the herbicide to kill the weed. Fluridone is available in slow and fast release pellet formulations to adapt treatment application strategies to water flow, depth, and control site parameters.

Up to 100 percent of the Eurasian watermilfoil in a lake can be killed. However, in inlets or areas where the herbicide may be diluted by flowing water, Eurasian watermilfoil may be under-treated and must be physically removed or treated with a contact-type herbicide for control to be successful. These areas should be identified during plan development and additional methods should be evaluated and/or integrated into the management strategy as warranted. For example; while Eurasian watermilfoil is under stress from a fluridone treatment, a contact-type herbicide like 2, 4-D or triclopyr may be applied at a lower rate than is typically required to provide additional control over large areas.

The littoral zone of the lake should be thoroughly inspected by divers in the fall of the treatment year and the following spring to identify any Eurasian watermilfoil plants that may have been under-treated. Susceptible areas include lake bottoms with springs or near inlet streams. Any remaining Eurasian watermilfoil plants should be hand pulled or covered with bottom barriers. Inspections must 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 Eurasian watermilfoil plants may be easily overlooked.

**4. Triclopyr**

Triclopyr (Trade names include Renovate and Renovate OTF). There are two formulations of triclopyr. Triclopyr, applied as a liquid, is a relatively fast-acting, systemic, selective herbicide used for the control of Eurasian watermilfoil and other broad-leaved species such as purple loosestrife. Triclopyr can be effective for spot treatment of Eurasian watermilfoil and is relatively selective to many native aquatic grass species.

Triclopyr typically is used for treating isolated Eurasian watermilfoil beds as opposed to whole lake treatments. Triclopyr is a good alternative to fluridone when Eurasian watermilfoil is not abundant throughout an entire water body. One drawback to using triclopyr has been the fact that only a liquid formulation was available, dramatically increasing costs for treatments in deep water areas. In 2007, a granular formulation called Renovate OTF was approved for aquatic use in Idaho. The use of Renovate OTF allows for the bottom portion of the water column to be treated in deeper water before plants reach the water surface.

**G. Cultural Control**

Because this plant is so difficult to control once it has become established, prevention and early detection of Eurasian watermilfoil is essential in stopping the plant from becoming a widespread problem in a lake, stream, or river. Human recreational activities account for the majority of invasive aquatic plant spread, and this is especially so for Eurasian watermilfoil in Idaho. Fragments of the plant cling to the propellers of boat motors or trailers and, if not removed, can start new populations when the boat is launched into another water body. To stop further spread, it is imperative that all plant fragments are removed from boats before putting into or leaving a water body's access area. Once removed, plant material should be properly disposed of in a trash receptacle or on high, dry ground where there is no danger of it washing into any water body.

**1. Prevention**

A prevention program that educates the public about invasive aquatic weeds is a valuable and important part of aquatic management planning in Idaho. This can be accomplished in the form of periodic and frequent newsletters, flyers, and newspaper articles. Neighborhood and stakeholder workshops on the identification of troublesome aquatic species (plant and animal) can encourage citizens and recreationalists to assist with early detection of different aquatic nuisance species. Public monitoring and signage at boat ramps swimming beaches adds to the knowledge of Eurasian watermilfoil in Idaho and builds support for the statewide program (Figure 17).



**Figure 18.** Prevention and awareness signs posted at boat ramps in Idaho.

# X. Current Eurasian Watermilfoil Management Efforts in Idaho - 2007

The following summaries provide a breakdown of FY 2007 Eurasian watermilfoil projects funded through the ISDA program:

### A. Statewide

### 1. Milfoil Task Force

Under the authorities and responsibilities established for the Idaho Invasive Species Council (IISC), the Governor directed the IISC to undertake a survey and review of Eurasian watermilfoil in the state. The IISC first assessed the scope of the problem by county, for both risk and actual infestation, and developed a map of these areas. The Milfoil Task Force (MTF) was formed as a sub-committee of the IISC to conduct this work.

The Milfoil Task Force was created with specific goals:
1. Identify the extent of Eurasian watermilfoil in Idaho.
2. Research & identify additional means of control and determine efficacy of available controls.
3. Assist and support the Idaho Weed Awareness Campaign in raising public awareness of the problems associated with Eurasian watermilfoil.

The Task Force has been conducting surveys of Idaho water bodies since 2000. The Milfoil Task Force inspected water bodies throughout Idaho and maintained a distribution database. The project includes reprioritization of water bodies where Eurasian watermilfoil has not been found and funds to work on bottom barrier efficacy.

2007
Total project cost: $35,271
ISDA Funds: $28,371
Match: $6,900

### B. North

### 1. Bonner County, Sandpoint, Idaho

Bonner County treats Lake Pend Oreille using Sonar and Renovate herbicides and bottom barriers. Education and outreach components include signs at boat launches, public notifications, and radio advertisements. A Eurasian watermilfoil information office was set up in the town of Sandpoint. The information office tracked inquires and feedback from the public (see Appendix 4).

2007
Total project cost: $1,882,588
ISDA Funds: $1,814,260
Match: $68,328

**2. Boundary County, Bonners Ferry, Idaho**
Boundary County's project includes surveys and mapping, bottom barriers, and diver hand-pulling on the Kootenai River.

2007
Total project cost: $120,000
ISDA Funds: $120,000
Match: $0

**3. Cocolalla Lake Association, Cocolalla, Idaho**
Cocolalla Lake, located in Bonner County, is treated with 2,4-D and Diquat. Sparsely populated areas are hand-pulled. The project also includes an educational component to provide information to local elementary schools and a Lake Host Program at a boat launch site.

2007
Total project cost: $79,307
ISDA Funds: $69,307
Match: $10,000

**4. Coeur d'Alene Tribe, Plummer, Idaho**
The Coeur d'Alene Tribe's project includes surveys and mapping of infestations. Control efforts include bottom barrier installation, 2, 4-D herbicide treatments and diver hand-pulling. The project also includes public education efforts.

2007
Total project cost: $310,835
ISDA Funds: $289,523
Match: $21,312

**5. Inland Empire Cooperative Weed Management Area, Coeur d'Alene Idaho**
The Kootenai County Noxious Weed Control Department, Idaho Department of Fish and Game, the Coeur d'Alene Tribe, and the Inland Empire Cooperative Weed Management Area conduct surveys using SCUBA divers, surface sampling, and Civil Air Patrol aerial surveys. Herbicide treatments include the use of Renovate and Navigate. The project also includes the use of bottom barriers and diver hand-pulling, as well as public awareness and education activities.

2007
Total project cost: $325,292
ISDA Funds: $300,992
Match: $24,300

**6. Spirit Lake Property Owners Association, Spirit Lake, Idaho**
Surveying and diver hand-pulling are conducted on Spirit Lake. The project also includes an education and awareness component.

2007
Total project cost: $19,400
ISDA Funds: $13,400
Match: $6,000

**C. Southwest**
**1. Ada County Noxious Weed Control, Boise, Idaho**
Ada County treats Silver Lake, Lakeland Village and Estates ponds, Moon Valley Estates ponds, and the Toni Smith pond with Navigate and Reward herbicides.

2007
Total project cost: $32,462
ISDA Funds: $32,462
Match: $0

**2. Boise County, Idaho City, Idaho**
Boise County and its cooperators, which include Upper Payette Cooperative Weed Management Area (CWMA), Boise Basin CWMA, Boise National Forest, and Idaho Department of Fish and Game, continue to survey Boise County's water bodies and treat Horseshoe Bend Millpond using Navigate herbicide. The project also includes boat launch signage.

2007
Total project cost: $10,808
ISDA Funds: $6,305
Match: $4,503

**3. Canyon County Weed Control, Caldwell, Idaho**
Canyon County Weed Control is treating 4 ponds with Sonar herbicide, as well as conducting surveys to locate other populations of Eurasian watermilfoil within the county.

2007
Total project cost: $39,308
ISDA Funds: $34,312
Match: $6,896

**4. Gem County Weed Control, Emmett, Idaho**
The Gem County Weed Control District and the Idaho Department of Fish and Game are surveying, mapping, and treating an infestation of Eurasian Watermilfoil in Sawyer's Pond using Navigate.

2007
Total project cost: $19,520
ISDA Funds: $16,181

Match: $3,339

**5. Stonegate Ranch, Eagle, Idaho**

Four self-contained ponds that are infested with Eurasian watermilfoil are being treated with Sonar and Diquat by a private applicator hired by the participant, Stonegate Ranch.

2007
Total project cost: $6,500
ISDA Funds: $6,500
Match: $0

**6. Valley County Extension, Cascade, Idaho**

Participants in this project include Valley County, University of Idaho Extension, and University of Idaho Master Gardeners. The University of Idaho Extension is presenting educational materials and training to the public. Educational materials include a brochure and PowerPoint presentations.

2007
Total project cost: $10,195
ISDA Funds: $4,695
Match: $5,500

**7. Payette Lake, Valley County, Idaho**

Project partners continue to control and eradicate Eurasian watermilfoil in Payette Lake and prevent it from spreading to nearby waterways. Activities include diver hand-pulling, use of bottom barriers and continued surveys. Project partners include Valley County; Bureau of Reclamation; City of McCall; University of Idaho; Portland State University; University of California, Davis; SW Idaho Resource Advisory Committee; Payette Lake Property Owners; Valley County Waterways; Big Payette WAG Committee; Upper Payette CWMA; and the Idaho Departments of Agriculture, Parks and Recreation, Fish and Game, Environmental Quality, and Lands.

2007
Total project cost: $25,800
ISDA Funds: $8,000
Match: $17,800

**D. East**

**1. Bonneville County Weed Control, Idaho Falls, Idaho**

This project is a cooperative effort by 13 counties located in Southern Idaho. Project focus is on surveys for early detection and rapid response of Eurasian Watermilfoil and to prevent Eurasian watermilfoil infestations from establishing in this region.

2007
Total project cost: $82,660
ISDA Funds: $12,000
Match: $70,660

**2. Bingham County, Blackfoot, Idaho**
This project aims to inform boaters and the general public to be on the lookout for Eurasian Watermilfoil. Waterways signage will be installed throughout the Upper Snake River water system. Project cooperators include Bingham County, Fremont County, Upper Snake River CWMA, Henry's Fork CWMA, and the Idaho Weed Awareness Campaign.

2007
Total project cost: $4,444
ISDA Funds: $2,564
Match: $1,880

# XI. Applied Research and Related Work

The Idaho Invasive Species Council's Milfoil Task Force conducted research into the use of bottom barriers for the control of Eurasian watermilfoil in North Idaho's lakes. In addition, CABI Europe recently conducted a feasibility study into the potential for a classical biological control program for Eurasian watermilfoil in the United States. The Milfoil Task Force work was funded by the Idaho State Department of Agriculture. The CABI biological control feasibility study was funded by the US Army Corps of Engineers. A summary of the Task Force's research program and the CABI biocontrol feasibility study is provided here in summary form.

**A. Bottom Modifications Summary**
The objective is to complete research to determine bottom modifications that control and prevent establishment of Eurasian watermilfoil. This study involves one lake bottom modification treatment using fabric panels. The project was a cooperative effort between the University of Idaho, the Coeur d'Alene Tribe and ACE Diving.

The primary experiment was designed to answer the question: "How long should a weed fabric panel be left in place to kill Eurasian watermilfoil?" Experimental plots containing moderate to dense Eurasian watermilfoil growth were "treated" with 10 foot x 10 foot fabric panels in May 2006. These panels were removed at approximately one month intervals. Each removal interval was repeated in four plots. Following initial barrier panel trials in 2005, it appeared that approximately 10 weeks are needed to provide control of milfoil. The 2006 study indicates that the eight week benthic barrier coverage time resulted in the greatest reduction of Eurasian watermilfoil biomass with the least reduction in native plant biomass. These panels would be used in the course of a control program to provide a non-chemical method of control that would not require divers to find every plant within small infestations. The frames could be moved throughout the control season as new infestations are found. It would also allow removal of the frames to minimize the loss of beneficial aquatic vegetation that may re-establish after treatment.

The secondary experiment was a laboratory growth chamber trial to evaluate the effect of sediment deposition on the bottom barriers on Eurasian watermilfoil establishment and growth. Based on this study, sediment deposition of 4 cm or greater over benthic barrier treatments would enable reestablishment of Eurasian watermilfoil, and should be removed.

**B. Efficacy of benthic barriers as a control measure for Eurasian watermilfoil**
A study was established in Coeur d'Alene Lake near Plummer, ID in 2006 to evaluate optimum coverage time and non-target plant community response to removable fabric weed barriers as a control measure for Eurasian watermilfoil. The experimental design for the study was a randomized complete block design with four replications and five treatments including one untreated check per replicate block resulting in twenty test plots. A total of 16 10 ft x 10 ft panels were constructed from Typar® spun geotextile fabric mounted on a frame of weighted (sand filled) one-inch diameter PVC pipe. Disassembled panels were transported to the study site by boat, assembled, and placed in test plots by a diver. Barriers were installed over four subplots within each block and one control area was left uncovered. One randomly selected barrier from each of the four blocks was removed after 4, 8, 10, and 12 week intervals. Above sediment biomass (0.22 $m^2$) was collected within each sub-plot pre- and post- treatment. Samples were sorted by species, dried at 70°C for 72 hours, and weighed. Statistical analysis was conducted to determine the effect of benthic barrier duration on Eurasian watermilfoil and existing native plant biomass.

When compared with the untreated control, the four week benthic barrier placement reduced Eurasian watermilfoil biomass 75%, and the eight, ten, and twelve week treatments reduced Eurasian watermilfoil biomass 100%. The four week treatment had no effect on existing native plant biomass, the eight week treatment reduced native plant biomass 79%; the ten week treatment reduced native plant biomass 93%; and the twelve week treatment reduced native plant biomass 92.5% compared with the untreated control. By the end of the twelve week trial, Eurasian watermilfoil biomass increased 38.4% following the four week treatment, but did not reestablish in the eight, ten, and twelve week treatments. Native plant biomass increased to 21.4% compared with the untreated control four weeks after removal of the eight week barrier treatment.

The study indicates that the eight week benthic barrier coverage time resulted in the greatest reduction of Eurasian watermilfoil biomass with the least reduction in native plant biomass.

**C. Effect of sediment on efficacy of benthic barriers as a control measure for Eurasian watermilfoil**

A study was established in a walk-in growth chamber at the University of Idaho in 2006 to evaluate the effect of sediment deposition on Eurasian watermilfoil establishment and growth. The experimental design of the study was a randomized complete block design with five sediment depth treatments and four replications. Typar® spun geotextile fabric was fitted to 4.8 cm diameter PVC pipe sections with heights ranging from 0.5 to 5 cm. Sediment collected from Lake Coeur d'Alene near Plummer, Idaho was placed within the rings over the geotextile fabric at depths of 0, 2, 3, 4, and 5 cm and the rings were placed in aquaria filled with water treated with an appropriate culture solution. A 10 cm apical shoot section of Eurasian watermilfoil was placed on the surface of the sediment or fabric (0 cm sediment) to simulate naturally occurring vegetative reproduction of Eurasian watermilfoil. Four weeks after planting, shoot and root biomass was harvested, dried at 70$^{o}$C for 72 hours, and weighed. A statistical analysis was conducted to determine the effects of sediment depth on above sediment plant biomass production and root biomass production. The 1-3 cm sediment depth shoot and root biomass were not different from the control (0 sediment), indicating the plant material was able to draw nutrients from the water without establishing on the fabric barrier material. At sediment depths of 4 and 5 cm, root and shoot biomass increased, indicating the plant's ability to establish and draw nutrients from the sediment. Based on the growth chamber study, sediment deposition of 4 cm or greater over benthic barrier treatments would enable reestablishment of Eurasian watermilfoil, and should be removed.

**D. Biocontrol Feasibility Study**

*Note: the following section was taken directly from Matthew J. W. Cock, Hariet L. Hinz, Gitta Grosskopf, and Patrick Häfliger (2006) Development of a biological control program for Eurasian watermilfoil (Myriophyllum spicatum) CABI Europe-Switzerland, unpubl. Report prepared for U.S. Army Corps of Engineers, Washington, DC 20314-1000. 27pp.*

A thorough survey of the European literature was carried out at CABI Europe - Switzerland, complemented by library visits and contacts with taxonomists, and the Russian literature by CABI collaborator Dr. Margarita Dolgovskaya (Russian Academy of Sciences, Zoological Institute, St Petersburg, Russia). The European literature survey revealed 14 additions to the existing lists compiled by Ghani et al. (1970) for Pakistan and Bangladesh, Buckingham (1998) for China, Japan, Korea, and Spencer and Lekic (1974) for Yugoslavia. In total, 44 phytophagous insects have been associated with *Myriophyllum* spp. in Eurasia. The majority are Lepidoptera (n=12) and weevils (beetles in the family Curculionidae n=15). The latter is especially rich in aquatic weevils in the genus *Bagous* (n=6). Most insects are recorded as polyphagous, i.e. feeding on plants in different families. However, ten species are recorded to only feed on *Myriopyllum* spp. or the indication of other host plants needs to be verified by tests. There is no obvious pattern as to which region the most specialized phytophagous insect species can be found.

Although only limited information is available for most of these species, none appears to be strictly monophagous, i.e. only feeding and developing on *M. spicatum.* However, due to their concealed development and their inaccessibility, the phytophagous insect fauna of watermilfoils might have been underestimated. In addition, only a relatively small area of the total native range of Eurasian watermilfoil has been surveyed during relatively short windows in the growing season. It is therefore unlikely that the full spectrum of natural enemies associated with this plant has been captured.

Eight of the insects recorded in the literature occur also in North America on *M. spicatum.* Some of these species appear to be native to North America and to have switched from their original hosts, e.g. *Euhrychiopsis lecontei*, which feeds on the native *M. sibiricum* (Sheldon and Creed, 1995); others may have been accidentally introduced from Europe (Buckingham et al., 1981). Three insects are particularly common in the U.S.: the naturalized pyralid moth *Acentria ephemerella* Denis & Schiffermüller, the native North American weevil *Euhrychiopsis lecontei*, and the Chironomid *Cricotopus myriophylli* Oliver which is most likely an accidental introduction since it occurs only in the distribution range of *M. spicatum* in the U.S. (MacRae et al., 1990). All three insect species can cause a decline of Eurasian watermilfoil in some lakes but not in others. One reason could be the partial resistance of hybrids to insect attack (Moody and Les, 2002).

**Insect species with potential as biological control agents for Eurasian watermilfoil based on existing surveys**

The most host-specific herbivores associated with *M. spicatum* in Europe and Asia are weevils in the genera *Bagous, Eubrychius*, and *Phytobius*, as well as a gelechid moth. A clear advantage of weevils as potential biological control agents is the fact that the feeding habitat of the adults is identical with that of the larvae resulting in a higher feeding pressure on the host plant. In contrast, only the immature stages of Lepidoptera damage the plants.

### *Bagous longitarsis* Thomson

*Bagous longitarsis* Thomson has a Palaearctic distribution and occurs as far south as southern France and northern Italy (Dieckmann, 1983; Sprick, 2000). The weevil lives submerged on milfoils and feeds on the leaves from May onwards until August/September but overwinters outside the water (Dieckmann, 1983). Larval development is unknown (Sprick, 2000). *Bagous longitarsis* is exclusively known from watermilfoils in the field. In Germany, it has been collected from *M. verticillatum* (Dieckmann, 1983; Wimmer and Sprick, 2000), a holarctic species of watermilfoil which is widely distributed across Europe, and from *M. spicatum* (pers. communication Suikat and Gruschwitz, 1999, in Sprick 2000). During field surveys on watermilfoils in northern Germany, Wimmer and Sprick (2000) did not record *B. longitarsis* on *M. heterophyllum*. Contact has been made with these scientists and weevils could easily be collected and used in host specificity and preference tests.

***Bagous collignensis* (Herbst)**

This weevil occurs throughout Europe and Western Asia (Sprick, 2000). In the field, *B. collignensis* was so far sampled on *M. heterophyllum* (Wimmer and Sprick, 2000) and on *M. spicatum* (Sprick, 2000). According to Sprick (2000), *B. collignensis* is not associated with *Equisetum* as indicated in Dieckmann (1983).

***Bagous geniculatus* Hochhuth**

*Bagous geniculatus* is a very widespread species and has been reported from Pakistan, Bangladesh (Ghani et al., 1970), Southern Europe, Central Asia and the Caucasus (Freude et al., 1983). *Bagous geniculatus* appears to be univoltine. The larvae feed inside the stems and roots (Ghani et al., 1970). The weevil requires submerged plants for feeding and sprouted plants outside the water for breeding (Ghani et al., 1970).

***Bagous vicinus* Hustache**

This weevil was sampled in Pakistan and Bangladesh. The larvae of *B. vicinus* bore into the stem and the roots and pupate in the soil (Ghani et al., 1970). Based on the observed developmental times, Ghani et al. (1970) assumed that *B. vicinus* has at least 10 to 12 generations per year. Both *Bagous geniculatus* and *B. vicinus* caused considerable damage to submerged watermilfoil plants in Pakistan and Bangladesh (Ghani et al., 1970). Preliminary screening tests indicate that both species are specific to *Myriophyllum* or more narrowly within the genus (Ghani et al., 1970). However, native North American *Myriophyllum* spp. were not included in the host-range tests reported.

***Eubrychius velutus* Beck**

*Eubrychius velutus* Beck is an aquatic weevil distributed throughout Europe and northern Asia (Dieckmann, 1972). The weevil develops submerged in the meristem and outer portions of the plant and pupates in a cocoon near the shoot tip. Wimmer and Sprick (2000) observed that shoots of *M. heterophyllum* break easily near the cocoon. *Eubrychius velutus* is closely related to the native North American weevil *Eubrychius lecontei* which mines and pupates inside the stem of *M. sibiricum* and *M. spicatum* (Newman et al., 2006). During field investigations in Northern Germany carried out by Wimmer and Sprick (2000), *E. velutus* was the most abundant weevil recorded on the natives *M. spicatum* and *M. verticillatum* as well as on the naturalized *M. heterophyllum*. Larvae, pupae and adults of *E. velutus* were found on all three watermilfoil species (Wimmer and Sprick, 2000). Developmental rates and survival of *E. velutus* were similar on *M. heterophyllum* compared to the native hosts *M. spicatum* and *M. verticillatum* (Newman et al., 2006). Therefore, all three watermilfoils can be regarded as field hosts of *E. velutus*. However, multiple-choice host range tests would give an indication as to whether *E. velutus* has feeding and oviposition preferences within the genus *Myriophyllum*.

***Phytobius* spp.**

Several *Phytobius* spp. are listed in Buckingham (1998) and Ghani et al. (1970), all of which feed at least temporarily on aerial shoots of watermilfoil. *Phytobius* (*Pelenomus*) *canaliculatus* Fahraeus is the only species recorded from Europe (Dieckmann, 1972) whereas three other species have been found in China (Buckingham, 1998) and Bangladesh (Ghani et al., 1970). All *Phytobius* spp. were recorded from *M. verticillatum* or other *Myriophyllum* spp. in the field and are thus not monophagous on *M. spicatum*.

***Aristotelia* sp. ? *subdecurtella* (Stainton)**

Larvae of this gelechid moth feed on the floral parts of *M. indicum* and *M. tuberculatum* (Ghani et al., 1970). Medvedev (1981) reports larval feeding by *A. subdecurtella* on *Lythrum salicaria* L. (purple loosestrife). Although some species of *Aristotelia* are known pests of crop plants, no other host records were available for *A. subdecurtella* (Ghani et al., 1970). Single-choice oviposition tests showed that no oviposition occurred on other plant genera when simultaneously exposed to *M. spicatum*. In no-choice larval transfer tests, complete larval development occurred on *Trapa bispinosa* Roxb. As mentioned for *B. vicinus* and *B. geniculatus*, this moth had not been exposed to native North American *Myriophyllum* spp. (Ghani et al., 1970).

**Classical Biological Control gaps**

*Only a limited area of the total native range has been surveyed.*

Based on results of previous field surveys and our additional literature search, no strictly monophagous species, i.e. only feeding and developing on *M. spicatum* have been found so far. However, only a relatively small area of the total native range of Eurasian watermilfoil has been surveyed during relatively short windows in the growing season. It is therefore unlikely that the full spectrum of natural enemies associated with this plant has been captured.

In Asia, surveys for arthropods carried out so far were limited to Pakistan, Bangladesh, the northern parts of China and two short visits of one week each to Japan and Korea. Buckingham (1998) therefore concluded that substantially more work would be needed before concluding that no suitable insect natural enemies occur in these countries. Central Asian countries, such as Kazakhstan, Uzbekistan and Mongolia have not been surveyed at all yet.

The European survey for phytophagous insects was only done in former Yugoslavia. Additional surveys should therefore be conducted in France, Spain, Switzerland, Germany, Sweden, Poland, Romania, Russia, and the Ukraine. Furthermore, the roots of *M. spicatum* were probably never systematically sampled and analyzed for insect damage during previous samplings (Buckingham, 1998).

Surveys for pathogens were restricted to Western Europe and China. North Africa has not been surveyed at all. Although this work was not intended to specifically include pathogens as potential biological control agents for *M. spicatum*, future work should try, where possible, to combine insect and pathogen surveys. This would not only be most cost-effective, but it has also been our experience that such an approach is synergistic in understanding the interactions of fungi, insects and the damage that they cause, and reducing the chance of obscure types of damage being overlooked. In addition, pathogens can be even more specific than insects, which could be important in the case of *Myriophyllum* (see below).

***Limited host-specificity tests conducted with potential agents***

Only limited or no host-specificity tests were conducted with potential agents selected or found during previous surveys. At the time of these studies, there was no great concern over the possibility of indigenous plant species being attacked by introduced weed biological control agents. This is no longer the case. Thus, tests did not include North American *Myriophyllum* species, which would obviously be the most critical species to test now. A few critical North American *Myriophyllum* species as well as the two representatives of the only other genus within the same family (Haloragaceae), the mermaid weeds: *Proserpinaca palustris* and *P. pectinata* should therefore be obtained, and immediately included in test of any potential biological control agent selected.

Since laboratory tests could underestimate host specificity of some agents, field surveys on other *Myriophyllum* species would give additional valuable information regarding the field host range of the existing herbivores. For instance, the naturalized North American twoleaf milfoil, *M. heterophyllum,* and three watermilfoil species which are native to Europe and North America, i.e. *M. alterniflorum, M. verticillatum,* and *M. sibiricum*, should also be sampled during surveys in Europe.

In addition, any potential biological control agent will need to be tested against the hybrid and its two parental species, *M. spicatum* and *M. sibiricum,* preferably using material from both continents to determine potential preferences for any of these types or their potential resistance to insect attack.

At this stage, there is no clear indication of the level of specificity or preference, within the genus *Myriophyllum* that might be expected from the potential biocontrol agents selected. However, preferences have been reported for the insects present in North America that feed on *Myriophyllum* spp. Furthermore, *Lysanthia* n. sp. (Chrysomelidae), a leaf-feeding beetle introduced from South America to control parrot's feather, *M. aquaticum* in South Africa only develops and feeds on *M. aquaticum* but not on *M. spicatum*, the only *Myriophyllum* species tested (Cilliers, 1999). Thus, a degree of specificity or preference within the genus is certainly possible.

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**Appendix 1. Idaho Eurasian Watermilfoil Peer Panel Report**

# ISDA Responses to Eurasian Watermilfoil Peer Panel Report Submitted to ISDA on 12-22-06

**ISSUES**

The review panel was repeatedly informed by a variety of individuals that ISDA did a remarkable job in getting the program organized, funded and implemented in such a short time frame given the legislative and executive mandate under which it operated. It is the opinion of the review panel that the 2006 EWM eradication program was a monumental effort of agency action and interagency cooperation and was an overall success in meeting its objectives. The panel was very impressed with the amount and quality of the work accomplished in a very short timeframe.

The review panel found there was considerable confusion relative to the review process and who was on the various review committees, concern over the short length of time to assemble the necessary information, availability of EWM survey data and contractors to prepare the applications, difficulty in scheduling qualified aquatic herbicide applicators, concerns about a perceived over-reliance on herbicides for eradication efforts, cash flow issues based on the 25-50-25% distribution schedule, and lack of coordination with other management agencies for lake drawdowns and wildlife issues. Most of these issues and those identified elsewhere appear to have been caused by two circumstances: i.e. (1) the shortness of the time available to implement a new and much more complex weed control program than ISDA or the state had previously experienced and (2) the lack of adequate communications with the public and potential grant applicants.

**PROGRAM ORGANIZATION**

**Issue: 1.0 Granting process**

There were several comments regarding the grant review and award process that seemed to stem from a misunderstanding of the process and composition of the various committees involved in the program. There also were repeated comments regarding the time available to complete required steps in the grant request process as well as delays in receiving reimbursement for work performed. Finally, there were requests for clarification of requirements for preparing reports necessary to receive final payments.

The objectives, functions, composition and roles of the various milfoil task forces and committees, some formed rapidly in Spring 2006 to facilitate selection of grant recipients, caused confusion and consequently some concern over possible conflicts of interest. For example:

- The Milfoil Task Force has been in place for 2-3 years and has prioritized research projects and weed surveys.
- The EWM Control Program Application Committee was formed in Spring of 2006 to review grant applications and provide a priority list of projects to receive funding from the department. There were no ISDA staff members on this committee.
- The ISDA Technical/Consulting Committee was also formed in Spring of 2006 and consisted of entirely ISDA staff to evaluate legality and feasibility of proposed projects.

**Recommendation 1.1. Transparency of grant review and award process**

The ISDA has to ensure both a transparent and unbiased process for grant selection in the future and the selection process has to be made known and readily available to applicants as well as to the public. In future grant application cycles, the ISDA should insure that the grant application is as transparent and publicly available as possible. One possible mechanism would be the refinement of a web site that delineates the application process, timelines for application, cost sharing requirements, the review process (to include the membership and roles of the various review committees), financial management requirements, and reporting requirements. Given the seasonal nature of the EWM infestations, latitude and flexibility should be allowed between the number of acres estimated to be managed in the application process and the actual need at the time of management.

*ISDA Response: The ISDA Noxious Weeds website will include a narrative of the application process, timelines for application, cost sharing requirements, reporting requirements and a description of the review process. This should provide timely transparency to the process. Additionally a financial and project amendment process has been developed, implemented and posted in the application guidelines.*

**Recommendation 1.2: Program leadership**

The stated purpose of the program is to eradicate and control EWM infestations. While this is the responsibility of the ISDA, all phases of monitoring, control, education, outreach, etc. are carried out by other stakeholders. Therefore, it is incumbent upon ISDA to ensure EWM is managed according to a comprehensive state plan. ISDA should focus on EWM management by identifying priority management or information needs and seeking, encouraging, or assisting entities to apply for grants to fulfill these needs. Currently, grants may be denied even for work in priority areas if they do not meet administrative criteria. ISDA should work with grant applicants to ensure complete applications are submitted within the appropriate time frame that adequately address program needs. For example, ISDA should work with applicants, especially first time applicants requesting to apply herbicides, to assist in procuring a Short Term Activity Exemption. Additionally, ISDA should enter into agreements with other environmental agencies to delegate authorities or modify statutes to eliminate dual permitting. For example, if ISDA issues a grant to control EWM using herbicides or small area benthic barriers, then additional permits should not be required from the Idaho Division of Environmental Quality (IDEQ) or the Idaho Department of Lands (IDL). IDEQ and IDL interests can be addressed during the development of grant application criteria, by delegation of authority for the purpose of EWM management and/or by including agency representatives on the grant review committee.

*ISDA Response: The permit and application processes are being centralized and streamlined within ISDA . ISDA is in the process of hiring an Aquatic Plants Program Manager. A major responsibility of this staff member will be to develop a statewide strategy for dealing with EWM. Areas of the state will be prioritized in general terms and the Program manager will work to encourage local control in high priority areas. Additionally, this staff member will be available to answer questions related to the grant application process and to help streamline permitting issues as they arise.*

**Recommendation 1.3: Grant administration process**

ISDA distributed notebooks to the Panel that describe the grant review and reimbursement process including a timeline. This information seemed comprehensive and should be modified and made available on the ISDA website during the grant application and review process. What is not clear to several grantees that were interviewed is the information needed by ISDA in the final report to evaluate project effectiveness and release the last payment. ISDA should meet with stakeholders to further develop, streamline, and clarify all application and reporting documentation within Idaho rules and regulations prior to distributing requests for grants in 2007.

ISDA should consider and discuss with stakeholders moving the grant application submission time table earlier in the year to allow more time to prepare and review applications. Final reporting requirements and deadlines can be fairly standard for administrative projects like outreach and education that produce a clear product or outcome, but may be more difficult for management operations, especially if operations or follow up management is not applied until the end of the fiscal year. Rather than waiting for an end-of the year report, ISDA should consider disbursing management funds based on proper execution of an approved management plan and not necessarily on successful reduction of EWM. ISDA field biologists should observe applications to verify that management techniques are applied according to an approved plan. Moreover, results may take months to assess, especially for a fluridone herbicide treatment, or control may not be achieved because of extenuating environmental conditions. Grantees should not be penalized by withholding reimbursements for conditions that are beyond their influence or control.

Where possible, ISDA should attempt to ensure more uniform contracting/bidding processes at the county level. There appeared to be some concerns relative to different processes in the counties involved in the 2006 program.

*ISDA Response: ISDA has developed a report template for distribution to all awardees. ISDA's Noxious Weeds website will include a narrative of the application process, timelines for application, cost sharing requirements, reporting requirements, the report template and a description of the review process. This aims to provide timely transparency to the process and will hopefully clarify and define a uniform contracting/bidding process. ISDA is aware of the issues associated with the unavoidable short submission timeframe of the 2006 program, and will provide additional time for application preparation and submission in future cycles. The ISDA Aquatic Plants Program Manager will assist in assuring the proper execution of the approved management plan.*

**Recommendation 1.4: ISDA auxiliary contracts**

ISDA should take innovative steps to facilitate management operations, especially for early detection and rapid response (EDRR) situations and to assist local entities in funding management operations requiring large financial outlays. ISDA should consider entering into statewide contracts to purchase herbicides in order to stabilize and reduce costs. These contracts should be available for other governments to share or "piggyback" or ISDA should consider purchasing herbicides outright and coordinating delivery to control sites. ISDA should keep herbicide suppliers appraised of potential control locations and anticipated quantities of herbicides needed to ensure availability and timely delivery of herbicides.

In addition, ISDA should consider entering into longer-term contracts (subject to annual renewal) with entities independent of contracted applicators to map and control EWM. These entities can augment existing local government management personnel, supply services that local governments do not provide, or respond quickly where no local government program yet exists.

*ISDA Response: ISDA is considering the creation of a state "herbicide bank" for cooperators, or at a minimum, working with distributors to establish price agreements for herbicides that other governmental entities could use. As for the use of independent parties in the program (i.e. to map treatment areas), this process will need to evolve over time as the available resources of aquatic plant management expertise is limited in Idaho. As the EWM program becomes established, ISDA hopes to encourage additional interest in working in the state.*

**Recommendation 1.5: Contract/Task assignments vs. grant**

ISDA should consider actively seeking contracts with counties and other local entities to control EWM in high priority areas rather than passively waiting for local entities to apply for grants. Further, long-term contracts should be considered for counties with waters where eradication may not be feasible and long-term management programs to contain EWM are anticipated. For example; contracts could be valid multiple years with local governments and with private companies contingent upon funding availability and contractor annual performance. Once a long-term contract is in place, annual management plans or specific control operations can be authorized through task assignments. Contract or grant amendments can take considerable time to amend if they require legal review, while task assignment amendments are operational in nature, requiring fewer levels of review. Such contracts would also facilitate EDRR operations.

*ISDA Response: Through the development of the Statewide EWM Strategy, high priority areas will be identified. The Aquatic Plants Program Manager will be tasked with making contacts with local governments and facilitating local government involvement when it is deemed necessary. ISDA may consider the use of long-term contracts in some situations.*

**Recommendation 1.6: Funding allocation flexibility**

A percentage of the funds available each year should be held in reserve by ISDA to direct toward high priority problems that may arise during the year. The program should remain flexible to allow for additional funds to be allocated to projects when unforeseen problems arise that were not included in the original grant. Likewise, provisions need to be in place to expedite the return of funds if anticipated problems do not arise or do not require the originally anticipated funding level. Returned funds should then be allocated to areas of greater need. Funds from one fiscal year should be allowed to be certified forward for several weeks or months to pay for work completed at the end of a fiscal year but not invoiced until the beginning of the new fiscal year. Funds not expended by the end of the fiscal year should be directed to a EWM management trust fund for use when conditions are more favorable for control. A cap can be applied to the trust fund, so if funds continue to build beyond a prescribed level, they can be redirected to the state's general revenue fund or to other invasive species issues. Allowing funds to be certified forward in an established trust fund allows managers to control plants based on science and current conditions and not on a prescribed administrative schedule. Another advantage of the establishment of a trust fund is to avoid the common perception that herbicide applications are done simply to utilize funds remaining at year's end to insure receipt of additional funding the next fiscal year.

*ISDA Response: ISDA realizes the value of this flexibility and will consider this recommendation.*

**Recommendation 1.7: Reimbursement flexibility**

While administrative-type grants like outreach or education projects can be completed on an incremental schedule throughout the year, effective EWM management in Idaho waters seems to be confined to June through August or September; across fiscal years which run from July 1 – June 30. Future year grant applications may need to be made many months prior to operations; before the current year management results have been fully assessed or before current year management programs have even been completed. Rather than releasing funds according to a prescribed percentage formula (25% - 50% - 25%), the program should remain flexible allowing reimbursement after large funding outlays for control. Reimbursements should be considered on a quarterly or monthly basis especially to entities that received a large grant and have large monthly expenditures. For example: a county with relatively low internal fund availability receiving a million dollar grant with monthly expenditures of $200,000 during the prime control period may need more frequent reimbursements. Centralized statewide contracting by ISDA for herbicides could reduce the local cash flow impacts and realize significant savings.

*ISDA Response: ISDA realizes the need to consider alternate reimbursement scheduling, especially in the case of large operational programs. This recommendation will be considered.*

**Issue 2.0: EWM management program direction**

In 2003, the Milfoil Task Force (MFT) initiated a survey of Idaho waters to determine the extent and cover of EWM. By 2005, EWM was identified in 10 of the 44 Idaho counties with an estimated cumulative cover of about 7,500 acres. The MTF estimates that EWM could expand to cover more than 210,000 acres and recommends immediate action to eradicate EWM where possible and to reduce or contain EWM where eradication does not seem feasible.

Statutes and rules have been revised to address EWM control authority and expenditures within the ISDA. This enabled ISDA to quickly establish an invasive aquatic plant management program where none existed previously. Early detection and rapid response (EDRR) is important when eradicating or attempting to contain early infestations of invasive aquatic species. Several federal, state, and local government agencies as well as Native American tribes have authorities in waters susceptible to or already infested by EWM. A comprehensive state strategy needs to be developed to locate, manage, and assess control impacts related to EWM to conserve surface waterbody uses and functions within the state of Idaho.

*ISDA Response: The Aquatic Plants Program Manager will be charged with developing a statewide strategy and tracking EWM population trends through time.*

**Recommendation 2.1: Program responsibility**

The Idaho Legislature has designated the ISDA as the lead agency with the specific responsibility to coordinate invasive aquatic weed management issues. However, weed management operations are the responsibility of County Weed Superintendents. Pertinent statutes and rules should be revised to: routinely monitor the level of EWM infestation, clarify EWM management objectives, provide sufficient and recurring management funding, and evaluate the cost-effectiveness of management programs. This includes the adoption of standard assessment techniques and weed mapping protocols. It is important for these parameters to be codified in statute and rule to provide program consistency throughout the state as well as longevity of the program necessary for invasive aquatic plant management. While most of the EWM management may be conducted by local entities, there needs to be statewide coordination and oversight. This level of oversight can be supplied with minimal ISDA staff through statutory authorizations, delegations of authority and memoranda of understanding among agencies with water resource management responsibilities, and through contracts with private companies to augment agency staff.

*ISDA Response: ISDA will explore the potential of additional statutory authorizations, but acknowledges its existing role to coordinate weed management in the state. The Aquatic Plants Program Manager and ISDA GIS staff will evaluate standard assessment techniques for mapping protocols for submersed aquatic vegetation and provide some guidance as to which methods are feasible in Idaho.*

**Recommendation 2.2: Staffing**

The review panel feels strongly that to develop an efficient and publicly acceptable EWM management program it must increase staffing particularly at the field level. An overall program coordinator should be stationed at the ISDA headquarters in Boise. Given the current distribution of EWM in Idaho, two field level regional biologists should be authorized by the legislature. These two initial positions should be stationed one each in the northern area of the state, north of the Salmon River, and a second position stationed in the southwestern portion of the state. Periodic surveys of waterbodies in the southeastern portion of the state should be conducted and if EWM or other invasive aquatic species are detected in that area, a third regional biologist should be allocated to that region. These positions will be a tremendous asset in the regional management and grantee oversight of the EWM management efforts. They could also play key roles in public coordination and education. Appendix 7 provides a position description for the Florida Regional Biologist with aquatic plant management, coordination and oversight responsibilities.

*ISDA Response: In response to this recommendation, ISDA is in the process of hiring an Aquatic Plant Program Manager. Additional staff is subject to the availability of funding to support these positions. ISDA concurs with this recommendation in that a regionalized ISDA presence is important to the long-term success of the program.*

**Recommendation 2.3: Program intent**

Section 22-2402, Idaho Code, should be amended to further clarify the definitions of eradication and control (see Issue 6.0). The ISDA has been given funds to eradicate and control EWM. Sections within the Noxious Weed Rules (02.06.22) suggest there are EWM populations that can be eradicated (Statewide EDRR Noxious Weed List) and others that can be controlled or contained. EWM is currently on the Statewide Control Noxious Weed List, but the Milfoil Task Force suggests that there are some instances where EWM can be eradicated and others where EWM may only be controlled. Clarifying Legislative intent that efforts should be made to eradicate new or isolated EWM infestations while established populations should be managed at the lowest feasible levels that technologies, waterbody conditions, and funding allow will assist in long-term program understanding and stability.

*ISDA Response: ISDA staff will work to clarify this definition.*

**Recommendation 2.4: Management plan and priorities**

Legislation should direct ISDA to develop an annual EWM management strategy for Idaho waters. This plan should include ISDA management objectives for waters infested with EWM so that County Weed Superintendents or other local entities can accordingly apply for ISDA funds to achieve these management objectives. There also should be an annual or ongoing assessment of EWM populations and management efforts to gauge the overall effectiveness of the program and to support funding requests on a priority basis. Thus, program funding will be come performance-based as well as needs-based.

*ISDA Response: ISDA is in the process of hiring an Aquatic Plants Program Manager. A major responsibility of this staff member will be to develop a statewide strategy for dealing with EWM. Areas of the state will be prioritized in general terms and the Program manager will work to encourage local control in high priority areas.*

**Recommendation 2.5: Funding**

Given that EWM is fairly widespread within Idaho waters and in neighboring states and provinces, it likely will not be eradicated from all Idaho waters, or if eradicated in a given waterbody, will likely be reintroduced. Therefore, legislation should be developed for a long-term source of funding for EWM management and personnel and appropriate equipment within the ISDA to coordinate monitoring efforts and oversee the management program. Numerous examples of such funding sources exist including a surcharge on boat trailers and/or boat licenses, allocation of a proportion of state gasoline taxes in proportion to the amount estimated to be used by the boating public, a fee on property sales, a portion of fishing licenses, a fee on ad valorum property tax bills for water front properties, etc. The choice of funding sources must be seen as fair and linked to the management of the resource.

*ISDA Response: ISDA concurs and would be willing to work internally and with other parties to explore the potential of dedicated funding sources for EWM that are responsible and fair to the state.*

**Issue 3.0: Herbicide residue analysis and Adjuvants**

Costly residue analyses of herbicides and adjuvants were required of contractors by the Idaho Department of Environmental Quality programs and to determine when water can be used for potable or irrigation use per label directions. Contractors treating potable or irrigation water sites individually contracted with private laboratories for residue analysis. The added requirement for a quick turn around time on the samples added significant costs. Contractors had to spend time to get these bids, and in at least one example, the cost of residue analyses exceeded the cost of the herbicides used in the project.

**Recommendation 3.1: Herbicide residue analysis**

- Minimize the number of samples required to be analyzed that will be collected from treatment sites to those necessary to document contract performance or to ensure adherence to required residue levels.

- During the 2006 program, the Idaho Department of Environmental Quality required that residue samples be analyzed from some herbicide applications beyond those required by the herbicide labels. These data should be compiled and evaluated to determine if this policy needs to be continued, and if so, how the number of samples can be reduced significantly.

- Residue analytical costs can be greatly reduced by ISDA placing out to bid annual contracts for herbicide residue analyses from all the state contractors. This will save contractors time and the higher number of samples in one performing laboratory may reduce per sample costs.

*ISDA Response: ISDA will work with DEQ to review these requirements and provide clear recommendations on the number of samples that are required. Additionally, the Aquatic Plants Program Manager will explore the possibility for annual contracts for herbicide residue analysis to reduce per sample costs.*

**Issue 3.2: Use of adjuvants**

While there is no doubt that surfactants/adjuvants are important in foliar applications of herbicides, there is little data to support use of adjuvants to improve efficacy against submersed aquatic weeds. Granular formulations and fluridone liquid most likely do not benefit from the addition of adjuvants due to the release rates of granules and the mode of action of fluridone. The only possible benefits of the addition of adjuvants may be for liquid herbicides that are absorbed rapidly, such as 2,4-D amine, diquat and endothall. Data supporting this premise are not available, despite the fact that some applicators are convinced that improved efficacy results from addition of surfactants for herbicide absorption and sinking agents for herbicide placement

There is concern by some state agencies that certain surfactants may be toxic to zooplankton and other invertebrates. Combine this with the fact that EPA does not regulate nor register surfactants makes regulatory agencies hesitant to allow their use. Washington State has developed a list of approved adjuvants which seems to be a reasonable approach until additional studies or data are collected which would either a) show toxicity or lack thereof of surfactants to invertebrates or b) definitive data are provided which clearly shows significantly improved efficacy of the addition of adjuvants to herbicides used for submersed weed control. Adjuvants used in this context includes surfactants, foams, sinking agents or other chemical spray additives

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**Recommendation 3.2:**

Allow applicators to use approved adjuvants from the Washington State list at http//www.ecy.wa.gov/programs/wq/pesticides/final.pesticide.permits/registered_pesticides.html.

*ISDA Response: ISDA will review lists from other states and may adopt them for use in Idaho.*

**Issue 4.0: Exemption from state water quality standards by temporary water quality degradation caused by aquatic weed control activities.**

Excessive uncontrolled growth of aquatic weeds alters water quality by changing dissolved oxygen patterns, pH, carbon dioxide, alters light penetration, zooplankton and phytoplankton populations, among other parameters. Likewise, weed control activities, whether mechanical or herbicidal can cause short term water quality changes depending upon the method of control and the amount (area and biomass) of vegetation controlled.

For example, Chapter 403.088, section 1 of the Florida Statutes (www.leg.state.fl.us/statutes) essentially allows the Florida Department of Environmental Protection (FDEP) to conduct and permit aquatic weed control activities without having to get a pollution control permit from the same agency. This statute has saved the FDEP as the lead aquatic plant management agency in public waters extensive and unnecessary water quality monitoring and submission of permit applications. The relevant section of the statute is reprinted below.

> **403.088 Water pollution operation permits; conditions.**--
> (1) No person, without written authorization of the department, shall discharge into waters within the state any waste which, by itself or in combination with the wastes of other sources, reduces the quality of the receiving waters below the classification established for them. However, this section shall not be deemed to prohibit the application of pesticides to waters in the state for the control of insects, aquatic weeds, or algae, provided the application is performed pursuant to a program approved by the Department of Health, in the case of insect control, or the department, in the case of aquatic weed or algae control. The department is directed to enter into interagency agreements to establish the procedures for program approval. Such agreements shall provide for public health, welfare, and safety, as well as environmental factors. Approved programs must provide that only chemicals approved for the particular use by the United States Environmental Protection Agency or by the Department of Agriculture and Consumer Services may be employed and that they be applied in accordance with registered label instructions, state standards for such application, and the provisions of the Florida Pesticide Law, part I of chapter 487.

**Recommendation 4.1: Establish temporary water quality exemption by statute.**

The Idaho Department of Agriculture should codify the exemption of approved aquatic weed control operations from state water quality standards as necessary to facilitate the control of aquatic weeds within the framework of Idaho law/rules and regulations.

*ISDA Response: ISDA will work with DEQ to resolve this issue.*

**Issue 5.0 Invasive aquatic weed list**

The aquarium and water garden industry and aquatic and wetland restoration projects have high potential to introduce new and even more aggressive invasive weeds into Idaho. Recent research conducted in Minnesota clearly shows that not only state listed noxious weeds, but even federally designated noxious weeds were commonly found in shipments of aquatic and wetland plants imported into that state (Maki and Galatowitsch, 2004, Biological conservation 118:389-396). Current draft revisions to IDAPA02, Title 06, Chapter 22, Noxious Weed Rules, proposes addition of *Egeria densa, Hydrilla verticillata* and *Eichhornia crassipes* to the Idaho Noxious Weed list. There are two known species of *Egeria, densa* and *najas*, and there are additional potentially noxious species of *Eichhornia*.

Other genera of aquatic plants causing major problems in northern states and also in states near Idaho include species (or lower taxa) of *Phragmites, Cabomba, Potamogeton crispus, and Trapa.* These genera are expanding and becoming increasingly problematic in the USDA plant hardiness zones 4, 5 and 6 in the Northeast, Michigan and Kansas/Nebraska (www.usna.usda.gov/hardzone) which have similar climatic conditions to large portions of western Idaho.

**Recommendation 5.1: Additions to the Invasive Species List.**
Additional aquatic plants need to be added to the noxious weeds rules to prohibit introduction of known noxious invasive aquatic weeds into the state to protect the natural beauty and value of Idaho waters. Serious consideration should be given to revision of current draft legislation to designate the following (and possibly others) to the statewide EDRR Noxious Weed List:

*Egeria sp.*
*Eichhornia sp.*
*Hydrilla verticillata*
*Hydrocharis sp.*
*Trapa sp.*
*Phragmites sp.*
*Cabomba sp.*
*Potamogeton crispus*
*Hydrocharis morsus-ranae*

Further it is recommended that:

- A panel consisting of botanists, invasive aquatic plant experts and regulators from adjacent states should be convened to review additions to the above list. The movement of invasive plants is at the very least a regional issue.
- Plant surveys should be conducted of Idaho lakes and waterways to determine the extent of these invasive plants, if present, which might allow a rapid response and eradication effort.
- Internet sales and culture of plants for sale in private aquaculture ponds (particularly in Eastern Idaho) may be a significant source of potentially invasive aquatic plants that should be monitored on a regular basis.
- Training should be sponsored by ISDA for persons involved with monitoring and managing Idaho waters in order to identify all invasive aquatic weeds so that appropriate management efforts can be quickly applied.
- ISDA should develop a program to inspect nurseries and retail outlets that grow or sell aquatic and wetland plants. Businesses and activities of persons that engage in aquatic and wetland plant revegetation or restoration should be inspected or permitted by the appropriate agency to ensure that plants are not collected and transported from a waterbody infested with EWM or other noxious weed to previously uninfested Idaho waters.

*ISDA Response: ISDA staff agrees with this recommendation and has made progress in this area by proposing the addition of several noxious aquatic weeds to its Noxious Weed Rule. The Rule changes go before the Idaho State Agriculture Committee in January, 2007. Once these species are added to the list, inspections of nurseries and pet shops will be carried out by ISDA staff. Additionally, ISDA hopes to support work to encourage increased skills in aquatic plant identification in Idaho.*

**Issue 6.0: Eradication goal**

The stated objective of the Idaho State Department of Agriculture's (ISDA) EWM Eradication Program is to eradicate EWM from all the state's infested waterways. The definition of "eradication" in the authorizing legislation is "Eradication means the elimination of a noxious weed based on absence as determined by a visual inspection by the control authority during the current growing season" (Idaho Code Section 22-2402 (10)). This is an operational definition, which provides guidance to project managers in the field, and provides a measurable objective to program managers at ISDA. The EWM Program Review Panel understands that, in the context of the ISDA EWM Eradication Program, this definition includes the meaning that, to be considered eradicated, all EWM must be controlled in a given waterway.

Judith Myers, in a paper on pest eradication in general, has defined the term "eradication" in a more abstract way as "Eradication is the removal of every potentially reproducing individual of a species or the reduction of their population density below sustainable levels" (Myers, et al 2000). Leavitt, in regards to weed eradication in California, has given a similar definition and also contrasts eradication with control: "What exactly does eradication mean? It means that every plant or plant part capable of reproduction is removed from a defined area… whereas control means the temporary suppression of plant germination, emergence, or growth sufficiently enough so that crop, forest, range production, highway safety, or other goals can be achieved for a season. Once eradication is accomplished, treatments can stop; with control, treatments must continue year after year" (Leavitt 2006).

Abstract definitions do not give operational guidance as program endpoints are difficult, if not impossible, to define in practice. For this reason, the California Department of Food and Agriculture (CDFA) adopt the following operational definition of eradication in its Hydrilla (*Hydrilla verticillata*) Eradication Program: "If no hydrilla plants are detected after three years of intensive survey, a Declaration of Eradication will be issued by the Department. However, if a plant is detected during this period, treatments would be initiated and another three consecutive years of negative survey will be required before a declaration can be issued" (CDFA 2005). The CDFA's terrestrial weed eradication programs also use the negative survey for "three consecutive years" rule (Rejmanek and Pitcairn 2002). In Australia, weed control managers used a "no plants had been detected for 5 years or more" as the operational definition of "eradication" for a kochia (*Bassia scoparia)* eradication program (Dodd and Randall 2002). Five years was adopted because this was considered the upper limit for seed persistence of this species.

The elimination of EWM from a defined area will require control of all EWM stems and leaves, control of the root crown and stolons, and control of new plants sprouting from EWM fragments and seeds. Therefore, the ISDA definition of "eradication" may be an adequate operational endpoint for their EWM Eradication Program if adequate underwater surveys are conducted to ensure control of all plant parts, the root crown, and new sprouts from defined areas. However, the review panel did detect considerable confusion over the statutory definition from both an operational and public understanding perspective.

Panetta and Lawes have introduced three criteria "by which progress towards the weed eradication objective may be evaluated" (Panetta and Lawes 2005). These are: delimitation, containment and extinction. "Delimitation" refers to the ability to find all the plants. "Containment" refers to prevent further spread and to prevent re-infestation. "Extinction" is their word for elimination.

**Recommendation 6.1: Clarification of the program goals**

The ISDA EWM Eradication Program can be successful if it detects and delimits all of the EWM infestations statewide (not just in cooperating Weed Management Areas), if it prevents movement of EWM fragments into new areas or prevents them from re-infesting old areas, and if it eliminates all plant parts as described above. However, one concern of the EWM Program Review Panel is that prevention of re-infestation may not be an achievable goal in Idaho waterways that are contiguous with EWM infested adjacent states. Long-term eradication may not be achievable in these waterways, but eradication in the current growing season, as per the ISDA definition of eradication, may still be achievable. A more workable program goal would be to (1) aggressively reduce the presence of EWM to non-readily detectable levels in those enclosed waterbodies where deemed practically and economically feasible and (2) reduce EWM populations to levels that do not significantly interfere with fish, wildlife or public recreation use of the water body in those large open, moving water systems. Such a program will require the development of site specific management objectives in cooperation with concerned entities.

*ISDA Response: ISDA will consider the proposed definitions.*

## Issue 7.0: Methods for survey of Eurasian watermilfoil

The review panel heard concerns relative to the proper method to survey EWM infestations, as well who should have the authority and responsibility for pre- and post-treatment surveys of contracted aquatic plant treatment operations. This appears to be a concern due to perceived conflicts of interest of commercial applicators surveying and mapping pre- and post-treatment weed control efforts. Additionally, there was some confusion over the actual areas treated and in some cases weed beds expanded between initial surveys and application, as well as concern over treatments of areas that contained native vegetation instead of the targeted EWM.

*ISDA Response: The Aquatic Plants Program Manager and ISDA GIS staff will evaluate standard assessment techniques for mapping protocols for submersed aquatic vegetation and provide some guidance as to which methods are feasible in Idaho. The Program manager will also work to encourage participation in surveying that is not tied to control contracts.*

### *Recommendation 7.1: Review survey techniques appropriate for the program goals.*

Before selecting a survey method, it is important to identify and describe the goals of a survey. If the purpose of a survey is to serve as a basis for control, then one needs to consider the type of control to be undertaken. Control of EWM or other invasive plants might be categorized as eradication, high intensity management or maintenance management (Smith et al. 1991). Eradication is control meant to completely eliminate the non-native, invasive plant from a water body and is rarely achieved. High intensity management involves the expenditure of large amounts of money and effort to reduce the abundance of the plant and slow its spread. Maintenance management is focused on reducing nuisances caused by the plant for recreational or other uses of a waterbody. In the case of a well-established and extensive population of EWM, maintenance management was considered by Smith et al. (1991) as the only realistic option for management.

In the cases of eradication and high intensity management, one wants to know, to the extent possible, where all of the EWM plants in a lake are located so that they may be controlled. Ideally, this requires as complete a census of the plants in a water body as possible. Such a census would likely be performed by SCUBA divers and require a high level of investment per unit area.

In the case of maintenance management, it is important to know where EWM causes problems, such as interference with fishing, boating, swimming or water management. Problems such as these usually arise because the plant is abundant and growing near the water's surface or matted at the surface. Areas with problems such as these can be readily identified and delineated by people working either from boats (Newroth 1993) or, less commonly, from aircraft (Newroth 1993, Farone and McNabb 1993). After this is done, control may be planned and then carried out.

If the purpose of survey were to evaluate the efficacy of control, in the cases of eradication and high intensity management, one would expect to repeat the census done before control. In the case of maintenance management, one might consider a number of different approaches to evaluating abundance, including an assessment of the extent of matting at the water's surface, biomass, distribution or some combination thereof. Techniques for the assessment of biomass were described by Madsen (1993); these techniques included the use of hydroacoustic systems, which also were described by Sabol et al. (2002). Assessment of the distribution, i.e., presence or absence, of EWM and other species may be done by line transect sampling (Titus 1993) or, as is more commonly done at present, point-intercept surveys (Madsen 1999).

Some or many of these techniques are used mainly for research. Few of them are used for operational control programs. In deciding which survey techniques to use for a control program, consideration should be given to the costs and practicality of different approaches.

Considering the difficulty that may be encountered in distinguishing between the non-native Eurasian and various native watermilfoils, it is important to remember to collect voucher specimens (Haynes 1984, Hellquist 1993). Difficulties of this sort in southern British Columbia were described by Newroth (1993). In addition, identification of watermilfoils can be made difficult by the occurrence of hybrids between *Myriophyllum spicatum* and *M. sibiricum* (Moody and Les 2002). It is recommended that people working on the identification of watermilfoils in Idaho cooperate with the L.C. Erickson Weed Diagnostic and Invasive Plant Mapping Laboratory at the University of Idaho and other sources of technical assistance.

*ISDA Response: ISDA is aware of the issues related to the potential of milfoil misidentification as this genus is notorious for these types of problems. ISDA will seek technical assistance as necessary and will encourage local cooperators to conduct detailed surveys in their areas and collect voucher specimens for as many populations as are feasible.*

**Recommendation 7.2: Operational surveys**

Assessment of EWM before and after control may be done by staff of the ISDA or a Cooperative Weed Management Association or a county or another unit of government. If contractors are used to conduct the surveys, the ideal situation would be to separate the contracts for surveying and control operations. Alternatively, such an assessment may be done by a contractor, who may also conduct the EWM control operations. When funds from the ISDA are used to cover at least a portion of the costs of control, some effort by staff of the ISDA or other unit of government as described above is needed to verify the reliability of the assessment done by the contractor.

In Florida, the monitoring of plant populations is greatly facilitated by GIS/GPS mapping programs and done annually by 16 FDEP biologists in 450 lakes in Florida covering an area of 1.3 million acres (http://www.dep.state.fl.us/lands/invaspec). The FDEP biologists utilize GPS to outline weed beds, develop maps and compile acreage estimates quickly with this method. Other states including California and Minnesota and others regularly survey state water resources. Monitoring of herbicide treated areas can be as sophisticated (and costly) or as simple (cheap) as a visual comparative observation.

As noted above, there are many ways to determine treatment effectiveness. Post-treatment sampling for contact herbicides 2,4-D and triclopyr can be done 4-6 weeks post-treatment. Post-treatment evaluation for fluridone is best accomplished in late fall, 10-12 weeks post-treatment.

Regardless of the survey methods chosen, it is imperative that a separate organization from the applicator does the pre- and post-treatment surveys to avoid real or perceived conflict of interest.

*ISDA Response: The ISDA Aquatic Plants Program Manager will make contact with other states where large scale submersed aquatic vegetation control programs are ongoing. Through these professional contacts and other technical assistance, the Program Manager will summarize available pre and post-treatment survey methods and draft general recommendations for evaluating control programs in cold water systems. This information will be provided to local cooperators for informational purposes, but it should be noted that the EWM programs are locally-managed and the responsibility of project efficacy rests with the local cooperator.*

## Issue 8.0: Boat washing stations to prevent the spread of Eurasian watermilfoil and other invasive species.

During the 2006 granting process a contract was let for the construction of a boat washing station. The panel received questions as to whether or not boat washing stations are effective or practical.

### Recommendation 8.1: Practicality of boat washing stations

The washing of boats to prevent the spread of EWM and other invasive species has been proposed in a number of states and Canadian provinces. While this activity may have merit under certain circumstances, it is only one of a number of 'tools' that may be used to prevent the spread of non-native, invasive species. In areas of low usage, where the use of the station is closely managed, the construction of the wash station may have merit if certain concerns are addressed. However, in waterbodies with heavy boating activity, thousands of boats may be launched during peak use periods, there is very low expectation that the wash station can be used with any degree of practicality. A more thorough discussion of boat washing produced by the Wisconsin Department of Natural Resources is included in appendix 10. More practical approaches are (1) on site education efforts to encourage removal of EWM observed on or in vessels and/or trailers, and (2) intensive management of EWM at boat access points to insure weed free areas for boat launching and retrieval.

*ISDA Response: ISDA will consider this recommendation.*

## *Issue 9.0: Methods of control of Eurasian watermilfoil*

As is the case in any large scale aquatic nuisance management program, there are questions, concerns and even uncertainty as to the best methods to operationally manage the infestation. Six principal methods of control of EWM were described to the panel:

1. Hand-pulling, especially by divers
2. Vacuum-assisted hand-pulling by divers
3. Bottom barriers
4. Treatment with herbicides
5. Grass carp
6. Drawdown

In addition, there was discussion of the use of milfoil weevils, *Euhrychiopsis lecontei*, and Solar Bee® circulators as possible approaches for controlling EWM.

### Recommendation 9.1: Methods of control of Eurasian watermilfoil.

Useful overviews of the advantages and disadvantages of all of these approaches with the exception of the Solar Bee may be found in Madsen (2000) and Getsinger et al. (2002). The review panel recommends that ISDA conduct a literature review of the various control methods available for EWM control. ISDA should also assess these techniques in light of the various uses and functions of Idaho water bodies of concern and compatibility of the available control techniques and strategies within these waters.

It should be noted that though the potential for milfoil weevils has been studied (see Getsinger et al. 2002:16-27), their effectiveness is difficult to predict and not necessarily sustainable. There is little evidence they will ever provide any level of acceptable control in large, open water systems particularly with flowing water. More research/evaluation on this approach would be useful but only in areas where there is a potential for adequate assessment. There are also various regulatory issues associated with the interstate transport of the weevils into Idaho from other states where the weevils are reared (the weevils are grown and transported as larvae on EWM populations from a different state).

The review panel is not aware of any published studies of the possible effects of the Solar Bee® circulators on milfoil or other submersed aquatic plants. Evaluation of this approach might be useful, particularly if conducted by an established "third party" research organization.

*ISDA Response: Given that ISDA does not wish to exclude potential effective control methodologies, the Aquatic Plants Program Manager, in conjunction with the Invasive Species Program Manager will conduct or commission a research review to summarize all known information on the abovementioned EWM control methodologies.*

**Issue 10.0: Expenditures for research.**

Eurasian watermilfoil research is conducted in many states across the northern half of the US. Despite this wide occurrence and interest, most states continue to conduct short term operational research projects to determine the most feasible management options in each state's waters. In Idaho, despite the relative recent concern over invasive aquatic plants, research programs are underway, prioritized by the Milfoil Task Force and funded by the ISDA and other sources. The major projects include mapping of milfoil infestations and genetic studies of milfoil and possible hybrid plants. However, expenditures for research are not permitted under current legislative appropriations. Additional operational studies such as these are needed to accomplish two objectives:

1. Develop expertise in the state, independent of financial interests, to identify best management practices (BMP's) and gain experience predicting results of management activities in Idaho waters and,

2. To develop a group of BS/MS level students in Idaho with experience in invasive aquatic plants and various management programs.

**Recommendation 10.1: Establishment of an applied research program.**

The administration of the ISDA should meet with the Director of the Idaho Agricultural Experiment Station and Director of the Idaho Cooperative Extension Service to jointly seek methods to increase university research and extension programs in aquatic plant management. Essentially, all states that have active aquatic plant management programs work cooperatively with state universities, and particularly, with land grant institutions to leverage short term and long term research projects with existing university programs and funding. These cooperative projects include agency funding of applied research projects and public education programs. Also, some state agencies and universities have worked together through legislative appropriations to attain additional faculty positions to support agency objectives and research priorities to benefit both institutions.

*ISDA Response: ISDA has a well-established relationship with the University of Idaho. The state's EWM Program was established to provide "on the ground" funding for control operations. That said, there may be a need for focused and applied research to answer specific operationally-related questions. When these needs arise, ISDA does see the value in working with universities in this manner. ISDA encourages university scientists to seek additional outside funding to conduct basic aquatic plant research and would be willing to partner with cooperators if the research is applied in nature and can be tied to an operational program.*

**Recommendation 10.2: Allocation of research funding.**

The ISDA should seek funding or change current statutes to allow limited, but critically needed applied aquatic weed research.

The amount of funding sufficient for necessary research is difficult to determine, but based upon other states' programs, would be in the area of 5% of management funding. The Florida DEP has historically provided approximately 5% of their operations budget ($1 million of $20 million) to short term (1-2 years) specific applied aquatic management research grants. Priority projects are developed by DEP staff, advertised and grant applications screened for funding.

- Thus, due to the interest shown by some stakeholders in Idaho, it is suggested that short term research and /or extensive literature reviews be conducted by independent third parties on such subjects as the effects of aeration (such as, Solar Bee's) and possible biocontrol insects on EWM. Additional short term research projects should include evaluation of old and new herbicides by Idaho regulatory staff or scientists to develop expertise within the state over a short time to allow development of optimum management programs or best management practices not only for milfoil, but also for potentially new invasive aquatic species.

- Additional applied research and demonstration projects are needed to refine control methodologies for Idaho waters including:
    - Economic impacts of invasive aquatic plants
    - Current knowledge of effects of newer herbicides
    - Survey techniques and continued survey needed
    - EWM hybridization issues
    - Comprehensive bibliography of EWM publications
    - Effectiveness and past extent of the use of the sterile grass carp

*ISDA Response: The state's EWM Program was established to provide "on the ground" funding for control operations. That said, there may be a need for focused and applied research to answer specific operationally-related questions. Short term projects as mentioned above do fall into this category. ISDA concurs with this recommendation to encourage applied research and will evaluate the list provided here to determine applicability to the state.*

**Issue 11.0: Lack of experienced state/county staff in aquatic weed management.**

Idaho has well trained and experienced weed staff/county superintendents for terrestrial weeds, but aquatic weed management is significantly different. Compared to terrestrial weed control,

- Aquatic weed control is usually more costly
- Public has great concern over pesticides in water
- Public can contact pesticides in water
- Control options are usually very limited
- Visibility of plants is poor and often weeds are undetected
- Identification and taxonomy of plants are difficult and often not clear
- Herbicides can move off site due to various weather events
- Monitoring success or failure of treatments is much more difficult
- Control failures do occur.

It appears that in Idaho, there is currently more aquatic weed management experience/knowledge vested in commercial and public applicators than in state regulatory staff. Most weed control superintendents have little experience in aquatics and all those the panel met with requested training programs. The future success of the Idaho aquatic plant management program will only occur as the regional biologists and county weed personnel become better trained. This lack of unbiased agency expertise has raised public concerns over the conduct and evaluation of success/failure on some of the treatment areas. Differences in opinion also exist in some areas as to whether weeds were actually present or if the plants in question were native plants.

**Recommendation 11.1: Agency staff expertise**

Knowledgeable staff must be hired or trained to assume the new responsibilities of an expanded aquatic plant management program (See Recommendation 2.2: Staffing). There are not a large number of people with extensive aquatic weed control experience in the US with most of the expertise found in warmer climates.  The situation in Idaho is somewhat unique due to the fact that historically there have been limited need and thus aquatic plant control funds.  Therefore, limited opportunities for weed control personnel to gain aquatic weed experience is available locally.  In a specialized field like aquatic plant management, there is a continuing need for additional and updated training.

There are, however, numerous educational opportunities available to individuals through meetings, symposia and training courses.  The website at http://plants.ifas.ufl.edu lists educational opportunities in which staff can participate to gather technical knowledge. ISDA should cooperate with regional aquatic plant management societies and other professional groups to offer at least annual aquatic training short courses.  In addition, most applicators will allow people to accompany or even assist with operational projects.  Examples of such training and professional development activities include:

- University of Florida, IFAS Aquatic Plant Short Course - Spring every year, Ft. Lauderdale, FL
- University of California, Davis - Fall every other year, Davis, CA
- Midwest Aquatic Plant Management Society, Annual meetings
- Florida Aquatic Plant Management Society, Annual meetings - Fall
- Aquatic Plant Management Society, Annual meetings, Summer
- Interagency visits to various states with established programs

*ISDA Response: ISDA concurs with this recommendation and the Noxious Weeds and Invasive Species Programs will work together to encourage and enable local weed managers to participate in aquatic plant management training and "job shadowing."*

**Recommendation 11.2: Regional Biologists:**

The regional aquatic biologists that the panel has most strongly encouraged Idaho to hire will be the key element in all programmatic aspects of aquatic weed management.  Background and training of these biologists is critical if the ISDA noxious aquatic weed program is to be successfully coordinated.  These biologists, BS/MS degrees have much information available for their use.  Training courses, symposia, websites and meetings occur regularly in various parts of the country (see recommendation 11.1).  A four day aquatic weed short course will be held in Florida May 14-18, 2007 and will cover many of these same issues and herbicides used in Idaho (http://Conference.ifas.ufl.edu/aw).  There are numerous opportunities for specialized training of biologists, but these people will become well trained by simply working with applicators and gaining experience on the job.

*ISDA Response: ISDA concurs with this recommendation.*

**Recommendation 11.3 Applicator training programs:**

As soon as possible, devote 1.5 to 2.0 days to aquatic weed management  training in Idaho, in conjunction with annual weed superintendents meetings.  Funds for this educational program can come from existing appropriations.  Panel members, as well as the Aquatic Ecosystem Restoration Foundation (AERF) have volunteered to assist in this effort.  Topics to include would be:  toxicity, selectivity, degradation and label reviews of each registered aquatic herbicide, EPA registration requirements, biological, mechanical and drawdown control, risk assessment, public relations, plant identification, and contract monitoring/plant surveying.  The Idaho Cooperative Extension Service could perhaps take the lead in organizing this event annually.

*ISDA Response: ISDA appreciates the willingness of the aquatic plant management community to assist our state in this training and education and will make contact with the parties described to establish these valuable professional relationships.*

**Issue 12.0: Public coordination and education**

Education is essential for public acceptance of any aquatic plant management program. We live in a society that has many fears associated with pesticide use, which have developed over many years of misinformation perpetuated through mass media. It is understandable that a misinformed populace can have concerns over application of pesticides to water systems for which they depend on for potable water, in which they swim, and consume fish from. Concerns also arise over potential and perceived detrimental effects to wildlife. These concerns can turn to alarm and reach panic proportions at the will of only a small number of vocal activists.

Environmental and health concerns were expressed in Northern Idaho, in particular, Bonner County, by several respected environmental groups, e.g. Kootenai Environmental Alliance, Idaho Conservation League, Panhandle Environmental League, Idaho Native Plant Society. Their greatest concern was for potential health related effects, particularly children, from swimming in herbicide treated water. It was stated that individuals avoided swimming during the 2006 summer for this reason. One resident stated concerns over a report she had read "more herbicide was absorbed by swimmers wearing sun screen." Similarly, residents expressed concern they learned different information from various sources, suggesting the Internet, newsletters, and newspaper among their sources of information. This is clear indication of the need to provide factual, science-based information in printed format, such as fact sheets and newsletters, and public meetings via a respected source of information such the Cooperative Extension Service.

Concerns were expressed by citizens relative to adverse effects of weed control on wildlife. Again, residents expressed concern based upon what they learned from various sources. A concern was expressed over whether consultation with USFWS occurred in a timely manner prior to herbicide application, and application of herbicide to Denton Slough, an area heavily used by wildlife and popular to passive recreation such as birding and kayaking. The density of Eurasian milfoil, and consequently the need to treat this area reported by County staff and the aquatic weed control contractor, was disputed by environmental groups. It was learned by the panel that the decision was made to treat this area to eliminate the source upstream of plant fragments in such a way to minimize harm to non-target vegetation. Whether this area should have been treated in 2006 is beyond the scope of the panel but the confusion could have been eliminated by better communication with the public prior to treatment. Citizens also disputed the level of control reported by County staff in certain areas and this may have resulted from confusion between the two over where treatment areas were located.

**Recommendation 12.2: Public coordination of management programs.**

It is recommended that public information meetings be organized by ISDA in the north and south regions of the Idaho, and include all agencies involved in planning and implementing EWM management following development of a preliminary, seasonal management plan for the purpose of receiving public comment and a second meeting to respond to public comment and explain the final management plan. The preliminary meeting should include a report of success of the previous year's management program.

*ISDA Response: The Aquatic Plant Program manager will take the lead on coordinating these sorts of ISDA-sponsored outreach efforts.*

**Recommendation 12.3: Public education.**

During the site visit by the review panel we received several educational brochures on invasive watermilfoil and other invasive species. The Idaho Weed Awareness Campaign is very active in providing educational materials and messages through radio, television and other media. These programs are largely targeted to educate people about the dangers and costs (environmental and economic) of invasive species. This message needs to be continuously distributed, but there is an additional public education need identified by the panel. An example of this need is concerns, rumors and public fear of management programs, particularly chemical applications. Current herbicide use is usually linked in popular media to Agent Orange (Vietnam), “Silent Spring” (insecticides), Love Canal (PCB, Dioxin) or other emotional issues. Our experience has been that information needs to be provided to the public on herbicide registration procedures, degradation times and products, issues regarding exposure/risk and other topics of concern. There is a feeling among the public that nothing is known about these herbicides, when in fact they have been in use for at least 30 years and some over 50 years, and much has been published/written about them. The often non-chalant attitude of applicators/regulators and weed scientists towards herbicides due to familiarity with them simply add to these concerns. Education is the key element in utilizing herbicides which are very important components with other control methods in an aquatic plant management program.

*ISDA Response: The Aquatic Plants Program Manager will work with the Idaho Weed Awareness campaign to assure that the public information segment of this program is meeting the needs of the state. ISDA may consider providing links to information related to herbicides on the website.*

## Appendix 2. Control Options Available for Idaho

| Option | | How it Works | Pros | Cons | Suitable Areas for use in Idaho |
|---|---|---|---|---|---|
| **1. No Treatment** | | Don't treat EWM | No control cost, but financial cost of doing nothing could be astronomical if the plant becomes widespread. | Could eventually impair all uses and functions associated with the water body. | None per Idaho Noxious Weed Law 22-2401 |
| | | | | Certain recreational uses may be impeded or lost | |
| | | | | Navigation and water flow may be impeded | |
| | | | | Allows EWM to spread | |
| **2. Cultural Control** | | | | | |
| | Boatwashing Stations | Boatwashing stations are installed at boat launches to prevent the spread of EWM | Relatively inexpensive compared to control | Maintenance and upkeep ongoing | Any public boat launch facility |
| | | | | Effectiveness questionable | |
| | | | | Must monitor boat launches | |
| | | | | Rely on volunteerism | |
| **3. Biocontrol** | | Living organisms eat or infect plants | May be self-sustaining | Insects such as the weevil may accelerate fragmentation | Suitable in areas where EWM populations are dense. Currently none of the available agents are eligible for state funding. |
| | Insects | | May stress problem plant to allow growth of natives or facilitate other control methods | Provides no to moderate control - complete control unlikely | |
| | | | | Effectiveness questionable, none are considered operational | |
| | | | | Control response may be slow | |
| | Grass Carp | Plants eaten by stocked grass carp | Effective at removing plants | Overstocking may result in impacts to non-target vegetation | Isolated waterbodies, urban lakes and ponds with virtual monocultures of EWM. Not suitable in natural waterbodies. |
| | | | Fairly inexpensive | Difficult to contain in open, multiple use waterbodies | |

| Option | | How it Works | Pros | Cons | Suitable Areas for use in Idaho |
|---|---|---|---|---|---|
| 3.Biological | Grass Carp | | Long term control | Cannot control feeding sites<br>EWM is not a highly perferred food | |
| **4. Physical control** | | | | | |
| | Drawdown | Lake water lowered; plants killed when sediment dries, compacts or freezes | Can be effective provided freezing and drying occur | Species such as EWM growing in deep water can survive and increase, particularly if desirable native species are reduced | Only useful for man made-made lakes or regulated rivers with a dam or water control structure. EWM seems well adapted to drawdowns in Idaho. |
| | | | Reduces water volume to accommodate herbicide treatment – lowers cost. | | |
| | | | Emergent plant species often rebound near shore, providing fish and wildlife habitat | Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning | |
| | | | Low cost | Effectiveness questionable | |
| | Bottom barriers | Use natural or synthetic materials to cover plants | Direct and effective | Expensive, small scale, not selective | Around docks, boat launches, swimming areas and other small intensive use areas. Not suitable for infestations over 5 acres. |
| | | | Does not result in fragments (although they may occur during installation) | May inhibit fish spawning in some areas | |
| | | | May last several seasons | Need maintenance or will become covered with sediment and ineffective | |
| | | | | Gas accumulation under material can cause them to dislodge from the bottom | |
| | | | | Anchored barriers can be difficult to remove | |
| | | | | Need to be moved on a regular basis | |
| | | | | Inhibits native species | |

| Option | | How it Works | Pros | Cons | Suitable Areas for use in Idaho |
|---|---|---|---|---|---|
| 4.Physical | Native vegetation | Planting a diverse native plant community to compete with EWM | Native plants provide food and habitat for native fauna<br><br>Supplements other techniques | Initial transplanting slow and labor intensive<br><br>EWM may outcompete plantings<br><br>Largely experimental: few well-documented cases and it is questionable if native plants significantly reduce the invasive potential of Eurasian watermilfoil<br><br>Effectiveness questionable<br><br>Plantings from non-local sources may genetically swamp local populations | Relatively small areas. None are eligible for state funding. |
| **5. Manual and Mechanical control** | | Plants reduced by mechanical means | Flexible Control | Must be repeated, often more than once per season | |
| | | | Can balance habitat and recreational needs | Can suspend sediments, increase turbidity and nutrient release | |
| | Hand pulling | SCUBA divers and snorkelers remove plants by hand or plants are removed by a rake | Little or no damage done to native plant species | Very labor intensive | Shallow, small area. Sensitive areas |
| | | Works best in soft sediments | Can be effective, particularly in early phases of infestation | Roots, runners and fragments will start new plants, so care must be taken to ensure complete removal | May be suitable in areas where other methods are not effective or practical |
| | | | Can be done by shoreline property owners | Small scale control only | |
| | | | Highly selective | Sediment disturbance | |
| | Harvesting | Plants are "mowed" at depths of 2-5 feet, collected with a conveyor, off-loaded onto shore | Harvested lanes through dense beds can increase growth and survival of some fish | Not selective – removes non-target plants and animals | Larger lakes (100+ acres), rivers with widespread, well-established EWM. Requires machinery launch sites and disposal off-loading sites |

| Option | | How it Works | Pros | Cons | Suitable Areas for use in Idaho |
|---|---|---|---|---|---|
| 5.Manual and Mechanical | Harvesting | | EWM cut before it is allowed to autofragment | Cannot access shallow areas along shores, around trees, pilings, etc. | Does not meet criteria for state funding under legislative language or Idaho Weed Law (22-2401-13) |
| | | | Immediate results | Fragments can re-root | |
| | | | Creates open areas rapidly | Root systems remain for regrowth<br><br>Not considered a long term control strategy | |
| | | | | Small scale only | |
| | Diver dredging | Vacuum lift used to remove plant stems, leaves and roots | Can be used near and around obstacles such as piers and marinas where a harvester cannot work | Unskilled divers can create fragments | Useful in early, smaller populations where plant density is moderate. Can be used as a follow-up treatment after herbicides. |
| | | | Direct removal of plants, no floating fragments | Increased turbidity | |
| | | | Moderately selective | Expensive | |
| | | | | Slow and labor intensive | |
| | Rotovation | Sediment tilled to uproot plant roots and stems | Disrupts EWM stem bases | May spread large numbers of fragments | Larger lakes and rivers with widespread, well-established EWM populations. Used extensively in PNW and BC with mixed results |
| | | | | Creates turbidity | |
| | | | | Native fauna killed, disturbed | |
| **6. Chemical Control** | | | | | |
| | 2, 4-D | Systemic herbicide selective to broadleaf plants that inhibits cell division | Can be used in synergy with endothall for early season treatments | May cause oxygen depletion after plants die in large, heavily infested areas | Lakes or ponds partially infested, such as areas where EWM has just invaded but where the extent of the infestation is beyond hand pulling or botton screening. Effective for spot treatments. Fast acting, only requires 48-hour contact time so can be used in areas where water is flowing |
| | | Applied as liquid or granular form for EWM during early growth phase | Monocots such as pondweeds and other natives not affected | Imposed water use restrictions on drinking, irrigation, livestock watering and recreation | |

| Option | | How it Works | Pros | Cons | Suitable Areas for use in Idaho |
|---|---|---|---|---|---|
| 6.Chemical | 2,4-D | | Moderate to highly effective | Public perception | |
| | | | Inexpensive | | |
| | | | Systemic, can kill entire plant, longer control | | |
| | Endothall | Broad spectrum, contact herbicide that inhibits protien synthesis | Effective | May impact non-target plants, especially native pondweeds, coontail, elodea, niads | Shoreline, localized treatments. Waterbody littoral zones heavily infested with EWM. Endothall is a contact herbicide that can supress EWM, typically short term. Could be good choice in flowing waters where plant suppression is the goal |
| | | Applied as liquid or granules | Can be selective depending on concentration and seaonal timing | Needs to be applied several years in a row | |
| | | | Can be combined with 2, 4-D for early season treatments | Ineffective in muddy of cold water (<50F) | |
| | | | Limited off-site drift | Imposed water use restrictions for recreation, irrigation and fish consumption | |
| | | | Limited toxicity to fish at recommended doses | Does not affect underground portions, essentially "mows" the plant | |
| | Fluridone | Systemic herbicide that inhibits photosynthesis | Effective on EWM with aggressive follow-up treatments in contained and/or non-flowing water | Affects many non-target plants, particularly native milfoils, coontails, elodea, niads, even at low concentrations | Lakes and ponds heavily infested throughout the littoral zone. Not suitable for spot treatments since it is difficult to maintain enough contact time with the plant. |
| | | Must be applied during early growth stage | Applied at very low concentrations | Should not be used in flowing waters | Not suitable for areas where water is flowing. Whole lake or isolated bays where dilution can be minimized |
| | | | Slow decomposition of plants may limit decreases in dissolved oxygen | Demonstrated herbicide resistance in hydrilla subjected to repeat treatments, EWM has potential to develop resistance | |

| Option | | How it Works | Pros | Cons | Suitable Areas for use in Idaho |
|---|---|---|---|---|---|
| 6. Chemical | Fluridone | | Few label restrictions on use after treatment | Requires long contact period | |
| | | | | Some water use restrictions | |
| | Triclopyr | Systemic herbicide selective to broadleaf plants that disrupts enzyme function | More effective on dicots | Impacts may occur on native plants at high doses | Effective for spot treatments of EWM and is somewhat selective |
| | | Applied as flake or liquid | Fast acting | Re-treatment opportunities may be limited due to max. seasonal rate | |
| | | | | Some water use restrictions | |
| | Diquat | Broad-spectrum, contact herbicide that disrupts cellular function | Rapid action | May impact non-taget plants, especially native pondweeds, coontail, elodea, niads | Shoreline, localized treatments. Used for short term control, fast acting, suitable for spot treatments. |
| | | Applied as liquid | | Needs to be applied several years | Can be used on flowing water. |
| | | | | Does not affect underground portions of plant | Turbid water or algae can interfere with effectiveness |
| | | | | Some water use restrictions | |

## Appendix 3. Treatment Method Summary

| Method | Treatment Cost | Cost/Acre Applied* | Areas for use |
|---|---|---|---|
| **Physical Treatment** | | | |
| Diver Dredge | $140/hr, 2 divers, 30hrs for 1 acre | 4,200.00 | Light infestations. |
| Bottom Barrier | $1/sq ft, includes maintenance | 43,560.00 | Idaho Department of Lands permit required. Best for use in dock/marina areas |
| **Biological Treatment** | | | |
| Grass Carp | $20/fish, 20/acre | 400.00 | Only for use in closed systems. Requires F&G permit and outlet/ inlet barrier construction. Best in EWM monocultures |
| **Chemical Treatment** | | | |
| 2,4-D Liquid | $115 - $230 (systemic herbicide) | 380.00 | Quiescent water |
| 2,4-D Granular | $261 - $522 (systemic herbicide) | 670.00 | Deep or flowing water |
| Triclopyr Liquid | $339 - $898 (systemic herbicide) | 950.00 | Shallow still water |
| Triclopyr Granular | $325 - $877 (systemic herbicide) | 1,030.00 | Deep or flowing water |
| Fluridone Liquid | $81 - $710 (requires multiple "bumps") | 1,160.00 | Not eligible for use in moving waters |
| Fluridone Granular | $114 -$666 (requires multiple "bumps") | 1,110.00 | Not eligible for use in moving waters |
| Diquat | $97 - $194 (contact herbicide) | 340.00 | Moving waters and spot treatments |
| Endothall liquid | $116 - $159 (contact herbicide) | 310.00 | Spot treatments |
| Endothall granular | $207 - $277 (contact herbicide) | 430.00 | Moving waters and spot treatments |

*Cost/acre is only an estimate. Costs can vary widely depending on water depth, water exchange, level of infestation, and treatment costs.

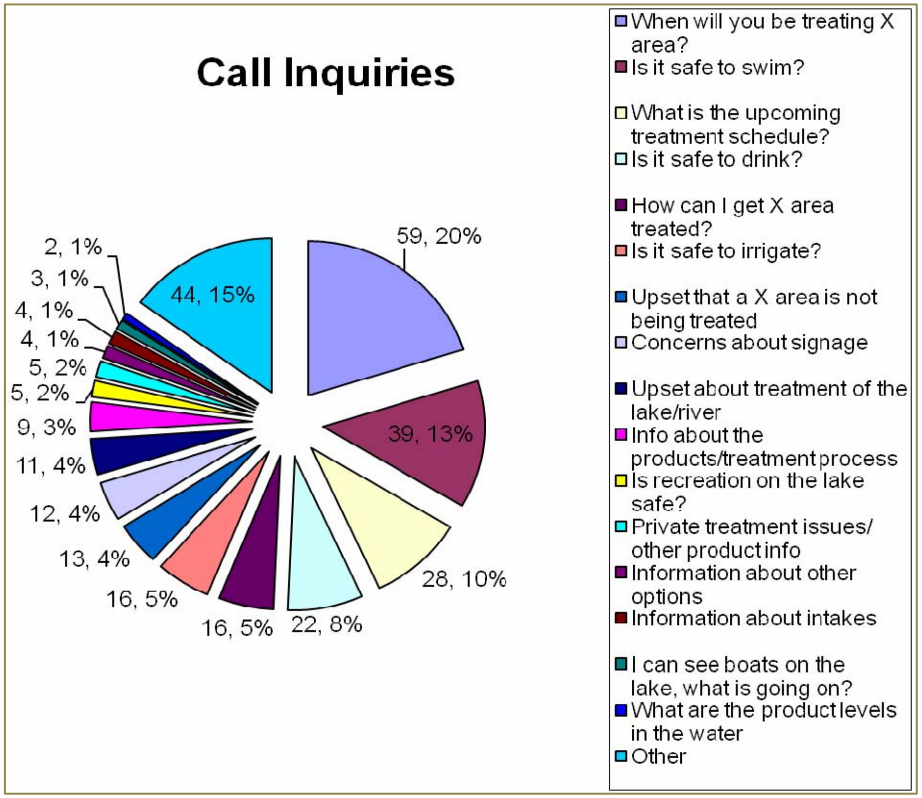
Costs include estimated raw material and estimated application costs.
Estimates for chemicals assume high treatment rates and $150.00 per acre application costs for herbicide application.
Cost estimates based on 2007 prices.  Prices subject to change

## Appendix 4. 2007 Eurasian Watermilfoil Information Center Update

### 2007 Bonner County EWM Information Center
### Inquiry Types

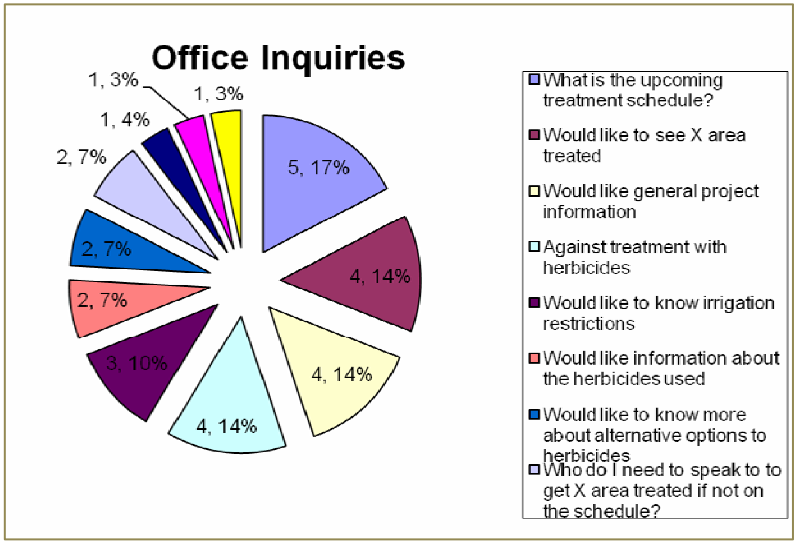
**Phone Calls**

| | Quantity |
|---|---|
| When will you be treating X area? | 59 |
| Is it safe to swim? | 39 |
| What is the upcoming treatment schedule? | 28 |
| Is it safe to drink? | 22 |
| How can I get X area treated? | 16 |
| Is it safe to irrigate? | 16 |
| Upset that a X area is not being treated | 13 |
| Concerns about signage | 12 |
| Upset about treatment of the lake/river | 11 |
| Info about the products/treatment process | 9 |
| Is recreation on the lake safe? | 5 |
| Private treatment issues/ other product info | 5 |
| Information about other options | 4 |
| Information about intakes | 4 |
| I can see boats on the lake, what is going on? | 3 |
| What are the product levels in the water | 2 |
| Other | 44 |
| **TOTAL** | 292 |



## Office Visits

| | Quantity |
|---|---|
| What is the upcoming treatment schedule? | 5 |
| Would like to see X area treated | 4 |
| Would like general project information | 4 |
| Against treatment with herbicides | 4 |
| Would like to know irrigation restrictions | 3 |
| Would like information about the herbicides used | 2 |
| Would like to know more about alternative options to herbicides | 2 |
| Who do I need to speak to to get X area treated if not on the schedule? | 2 |
| What are the swimming restrictions | 1 |
| Would like information about getting a private waterbody treated | 1 |
| Irrelevant | 1 |
| **TOTAL** | 29 |




## Emails

| | Quantity |
|---|---|
| What are the herbicide restrictions? | 5 |
| Would like treatment schedule information | 4 |
| Would like to see X area treated | 4 |
| When will you be treating X area? | 3 |
| Would like information about herbicides used | 2 |
| Would like information about getting a private waterbody treated | 1 |
| What are the herbicide levels after treatment in X area? | 1 |
| **TOTAL** | 20 |