WASHINGTON STATE DEPARTMENT OF ECOLOGY

Aquatic Plants Technical Assistance Program

2002 Activity Report

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WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Aquatic Plants
Technical Assistance Program

2002 Activity Report

by
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Olympia, Washington 98504-7710

September 2003

Publication No. 03-03-033

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Table of Contents

Page

List of Appendices ... ii

List of Figures and Tables ... iii

Abstract ... v

Acknowledgments ... vi

Introduction ... 1

Technical Assistance ... 3

Site Visits ... 5
- Introduction ... 5
- Site Visit Objectives ... 5
- Field Methods ... 5
- Aquatic Plant Survey Results ... 6
  - General Results ... 6
- Rare Plants ... 7
- Kress Lake Study ... 7
  - Introduction ... 7
  - Study Site ... 8
  - Methods ... 8
  - Results and Discussion ... 10
- Loomis Lake Fluridone Study ... 13
  - Introduction ... 13
  - Study Site ... 14
  - Methods ... 14
  - Results and Discussion ... 15
- *Myriophyllum spicatum* Biological Control Project ... 18
  - Introduction ... 18
  - Project Objectives ... 19
  - Methods ... 19
  - Results and Discussion ... 22
- Myriophyllum aquaticum on the Yakima River ... 28

Herbarium ... 31
- Methods Used in Aquatic Plant Identification ... 31
- Methods Used in Collection and Preservation ... 31

Aquatic Weed Management Fund-Related Activities ... 32

References ... 33

List of Appendices

Appendix A Site Visit Table 2002

Appendix B Site Visit Summary Table 1994-2002

Appendix C *Myriophyllum spicatum, Egeria dens,* and *M. aquaticum* Distribution Maps

Appendix D Locations of Aquatic Invasive Non-native Species

Appendix E Herbarium Specimens, Grouped by Family

List of Figures and Tables

Page

Figures

Figure 1. .Kress Lake 8

Figure 2. .Chi-square analysis results of Kress Lake frequency data for the four sample dates.......11

Figure 3. .Loomis Lake 14

Figure 4. .Mattoon Lake 19

Figure 5. .Results of fish stomach contents analysis 27

Figure 6. .*Myriophyllum aquaticum* locations near the Yakima River 28

Tables

Table 1. Scientific and common plant names 1

Table 2. Aquatic plant technical outreach activities - 2002...3

Table 3: Aquatic plant species present in Kress Lake 200 - 2002 10

Table 4: Chi-square analysis p-value results of the frequency data comparisons 12

Table 5: Mean biomass and ANOVA results from common species in Kress Lake.......................12

Table 6: Herbicide treatment history, Loomis Lake, summer 2002 16

Table 7: Macrophyte species identified in Loomis Lake, June 2002 17

Table 8: Percent frequency of occurrence, submersed and floating species in Loomis Lake 17

Table 9: Biomass results from common species in Loomis Lake 18

Table 10: Weevil productivity data from six aquaria used in rearing, summer 2002.....................23

Table 11: Aquatic plant species found in Mattoon Lake, June 2002..24

Table 12: Mattoon Lake macrophyte mean biomass 25

Table 13: Frequency results for Mattoon Lake...25

Table 14. List of applicants for AWMF grant funds in fiscal year 2003 and the amount awarded 32

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Abstract

The objectives of the Aquatic Plant Technical Assistance Program are to:

- Provide technical assistance to government agencies and the public.
- Document aquatic plant distribution throughout Washington State.
- Assist with evaluating projects supported by Freshwater Aquatic Weed Program grant money.
- Conduct research projects as opportunities arise.

During the 2002 field season, aquatic plant data were gathered at 70 waterbodies throughout the state. Several previously unknown populations of non-native invasive aquatic plants were identified.

- The first known wild population of *Hydrocharis morsus-ranae* (European frog-bit) west of Michigan was identified by county personnel in Meadow Lake, Snohomish County.
- *Myriophyllum spicatum* (Eurasian watermilfoil) was found for the first time in Rotary Lake, Buena Lake, Pond 2, Pond 3, Pond 4, and Pond 5 near I-82 in Yakima County; and Red Rock Lake in Grant County. Also, new populations of *M. spicatum* were reported and confirmed in Connor Creek, Grays Harbor County; Horseshoe Lake, Pend Oreille County; McDowell Lake, Stevens County; and Newman Lake, Spokane County.
- New populations of *Myriophyllum aquaticum* (parrotfeather) were found in some ponds and channels adjacent to the Yakima River near Wapato, and also near the mouth of Cloquallum Creek in the Chehalis River, Grays Harbor County.

In addition to routine aquatic plant monitoring, we conducted several research projects. We continued monitoring effects of the contact herbicide endothall on the aquatic plant community of Kress Lake in Cowlitz County. We began a project studying the impacts of a whole lake fluridone treatment on *Egeria densa* (Brazilian elodea), *M. spicatum,* and the native plants in Loomis Lake, Pacific County. We also initiated a project to study biological control agents for *M. spicatum*.

Other accomplishments include gathering plants for the herbarium collection, providing technical outreach, and assisting with projects funded by Freshwater Aquatic Weed Program grant money.

Acknowledgments

There are many people we would like to thank for contributions to this document and the projects described within:

- The following volunteers for assistance with the milfoil weevil project: Mariana Tamayo, Steve Coleman, Cheri Johnsen, Dana Coggon, Tom Perkow, Joye Redfield-Wilder, Brian Dick, Mark Peterschmidt, and Greg Haubrich.

- Kathy Hamel, Allen Moore, and Sarah O'Neal for assistance with sampling Kress Lake and Loomis Lake.

- Marc Divens and Randy Osborne for collecting fish community and diet samples from Mattoon Lake.

- Dave Hallock, Rob Plotnikoff, Kathy Hamel, Michelle Harper, and Joan LeTourneau for reviewing and publishing the document.

- Dr. William Ehinger for assistance with statistical analysis of the data.

- Dr. Robert Haynes of the University of Alabama for confirming the identification of *Hydrocharis morsus-ranae*.

Introduction

Legislative action in 1991 (RCW 43-21A.660) established the Freshwater Aquatic Weed Account to provide expertise on aquatic plant issues and a source of grant money for local aquatic plant management projects. The need for this program was recognized when the spread of aquatic plant problems in the state's public waters outgrew the ability of agencies to adequately address them. To provide technical expertise for aquatic plants, one full-time position was created within the Environmental Assessment Program of the Department of Ecology. The objectives for this position are as follows:

- Provide technical assistance on aquatic plant identification and management to government agencies and the public.
- Conduct site visits to identify aquatic plants, evaluate plant community structure, and identify the existence or potential for problems, particularly as they relate to invasive non-native aquatic plants.
- Assist with rating grant applications to the Freshwater Aquatic Weed Account.

The purpose of this report is to document the progress of the Aquatic Plant Technical Assistance Program with respect to these objectives during 2002, concentrating on site visit results.

To reduce confusion, all plants in this document are referred to by their scientific names. Table 1 lists the common names for the plants most frequently mentioned in the text.

Table 1. Scientific and common plant names.

Scientific Name	Common Names
Cabomba caroliniana	fanwort
Egeria densa	Brazilian elodea
Hydrilla verticillata	hydrilla
Hydrocharis morsus-ranae	European frog-bit
Ludwigia hexapetala	water primrose
Lysimachia vulgaris	garden or yellow loosestrife
Lythrum salicaria	purple loosestrife
Myriophyllum aquaticum	parrotfeather
Myriophyllum spicatum	Eurasian watermilfoil
Nymphaea odorata	fragrant waterlily
Phragmites australis	common reed
Typha angustifolia	narrow leaf cattail
Utricularia inflata	big floating bladderwort

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Technical Assistance

After the Freshwater Aquatic Weed Account was established, an external advisory committee identified technical assistance for aquatic plant taxonomy, ecology, and management as a high priority for the new Freshwater Aquatic Weed Management Program. Technical assistance was later defined as "Provid(ing) technical expertise within Ecology and to other agencies, local governments, lakes groups, and the general public regarding aquatic plant ecology and taxonomy, aquatic plant management, development of integrated aquatic plant management plans, and other aquatic plant management issues. Assistance will be provided through on-site visits, development of technical reports, participation in public workshops, and presentations to private and public groups and societies."

Providing technical assistance involves working with public and private sectors to develop a broad understanding of the roles aquatic plants play in the ecosystem and how human behavior influences aquatic plant communities. Table 2 lists activities where we provided formal technical assistance. We also assisted the public and local governments on an informal basis through phone conversations, identification of mailed plant specimens, and informal meetings that are not listed. These functions are also performed to a large degree by Kathy Hamel of Ecology's Water Quality Program, though her accomplishments are not reported here.

Table 2. Aquatic plant technical outreach activities - 2002.

Function or Product	Date	Location	Role
Washington Lakes Protection Association Conference	4/02	Olympia, WA	Presented a talk on 'Aquatic plants to watch out for'. Attended annual conference
Assessment of *Hydrocharis morsus-ranae* population	6/02	Meadow Lake, Snohomish Co.	Assisted county personnel with population assessment
Training in aquatic plant ID	6/02	King County lakes	Provided training for Thurston County Noxious Weed Board personnel
Rare plant inventory	8/02	Arrowhead Lake, Mason County	Conducted a rare plant inventory and provided documentation
Lower Columbia River Aquatic Nuisance Species Inventory	8/02	Portland, OR	Assisted with aquatic weed inventory of the lower Columbia River
Aquatic Plant Identification workshop	8/02	Lake Sacheen, Pend Oreille Co.	Assisted with workshop on aquatic plant identification and control for lake residents
Assessment of *Myriophyllum aquaticum* population	10/02	Yakima River, Yakima County	Assisted with inventory to determine the population extent, including providing helicopter rental.
Interview with local newspaper reporter	10/02	Yakima, WA	Discussed *M. aquaticum* invasion of Yakima River, article published in Yakima Herald-Republic and picked up by the AP
Weed Conference	11/02	Yakima, WA	Attended selected sessions of the Washington Weed Conference.

Over the nine years of this program we have produced publications on various aspects of aquatic plant biology, ecology, identification, control, and sampling. Much of this information is available on Ecology's web pages at http://www.ecy.wa.gov/ under "Environmental Info/Watersheds" and under "Programs/Water Quality/Aquatic Plants and Lake Issues."

Site Visits

Introduction

This section documents aquatic plant surveys conducted during the 2002 field season. The general purpose of site visits was to identify aquatic plants, targeting exotic invasive species. We also evaluated plant community structures, estimated the extent of aquatic plant problems, and suggested possible management options if requested. Another important aspect of the site visits was to expand the aquatic plant database and herbarium collection. Three special projects were also undertaken this year and are reported in separate chapters.

Site Visit Objectives

The specific 2002 site visit objectives were as follows:

- Revisit selected lakes with exotic invasive plants in order to assess plant population changes since earlier surveys.
- Revisit other selected lakes considered to be at high risk for a non-native plant invasion to determine status.
- Conduct field surveys in selected lakes that had not been previously surveyed by this program to inventory them for presence of invasive non-native species and rare species.
- Continue plant community monitoring projects on selected lakes.
- Collect detailed plant biomass and frequency data from Kress Lake, Cowlitz County, and Loomis Lake, Pacific County.
- Conduct a *M. spicatum* biological control feasibility study.

After the site visits any newly discovered populations of invasive non-native species were reported to the local noxious weed control board representative or county lake monitoring personnel. Also, sightings of plants listed as rare by the State Natural Heritage Program (Washington Natural Heritage Program, 1997) were reported appropriately.

Field Methods

For a detailed discussion of field methods and data quality control, refer to Aquatic Plant Sampling Protocols (Parsons, 2001) and the Aquatic Plant Technical Assistance Final Quality Assurance Project Plan (Parsons, 1995). The main goal of field site visits is to create the most comprehensive species list possible for each waterbody. This facilitates the discovery of potentially problematic aquatic plants and provides baseline aquatic plant distribution information.

For most lakes the method used is to circumnavigate the littoral zone in a small boat. When a different plant or type of habitat is observed, samples are collected for identification using a weighted rake, by hand-pulling or by visual observation. In addition, notes on species distribution, abundance, and maximum depth of growth are made. This method was recommended by other aquatic plant researchers (Sytsma, 1994; Warrington, 1994) and was used successfully during the previous years of this program. However, it should be noted that because the surveys are conducted from the surface, small populations of any plant species may be overlooked. Secchi depth data were also collected at most lakes. The Secchi depth was measured in deep, open water using a 20.3 cm (8 inch) diameter black and white disk.

All field visits occurred between late spring and early fall to correspond with the time of plant growth and flowering. Sampling locations were recorded with a written description, visual placement on a map, and with a Global Positioning System (GPS) unit when appropriate. We collected voucher specimens of any unusual plant species and known or suspected exotic species. These were pressed, mounted, and retained in the herbarium collection (see Herbarium section in this report). All data were recorded on field forms and entered into a relational database.

In addition to the data collected for our program, we collected plankton samples to assist the Department of Fish and Wildlife in their search for zebra mussels.

Aquatic Plant Survey Results

During the 2002 field season more than 80 site visits were made to 70 different waterbodies. Highlights of results from these surveys are provided in this section. In addition, several projects will be elaborated on in subsequent sections. These include:

- Results from the Kress Lake herbicide assessment project.
- Results from the first year of the Loomis Lake herbicide assessment project.
- Results from the first year of the *M. spicatum* biological control project.
- Helicopter survey for *Myriophyllum aquaticum* on the Yakima River.

General Results

Appendix A lists the lakes where aquatic plant data were gathered during the 2002 field season, the extent of the survey, and any aquatic plants listed with the Washington State Noxious Weed Control Board that were found (Chapter 16-750 WAC). A table listing all waterbodies where we have aquatic plant data from the nine years of this program is contained in Appendix B. The primary author will provide additional information on any of the listed waterbodies upon request, or species lists can be obtained from Ecology's web site at http://www.ecy.wa.gov/apps/watersheds/aquaticplants/listbywria.asp.

The results of these surveys include the discovery of previously unknown populations of several listed noxious weeds. *Hydrocharis morsus-ranae* (European frog-bit) in Meadow Lake, Snohomish County, came to our attention from county personnel. This is the first known established wild population of this invasive plant west of Michigan. *Myriophyllum spicatum*

(Eurasian watermilfoil) was found for the first time in Rotary Lake, Buena Lake, Pond 2, Pond 3, Pond 4, and Pond 5 near I-82 in Yakima County; and Red Rock Lake in Grant County. Also, new populations of *M. spicatum* were reported and confirmed in Connor Creek, Grays Harbor County; Horseshoe Lake, Pend Oreille County; McDowell Lake, Stevens County; and Newman Lake, Spokane County. There were also two new populations of *Myriophyllum aquaticum* (parrotfeather) found. One is in ponds and channels adjacent to the Yakima River near Wapato, Yakima County and another near the mouth of Cloquallum Creek in the Chehalis River, Grays Harbor County.

Appendix C contains maps illustrating where known populations of the noxious invasive aquatic plants *Myriophyllum spicatum*, *Egeria densa,* and *Myriophyllum aquaticum* occur in Washington. Appendix D is a table listing the known locations of other aquatic invasive non-native species listed with the Washington State Noxious Weed Control Board (Chapter 16-750 WAC). The maps and tables include sites that have been visited by Aquatic Plant Management Program personnel and those reported by reliable sources. Also included are waterbodies where weed eradication efforts have been undertaken within the last five years. If no recurrence of the targeted weed occurs in five years, then the eradication program is considered successful and the lake or pond is removed from the list and maps. Locations that have had successful weed eradication programs include Goss Lake, Island County; Killarney and Youngs lakes in King County; and Silver Lake, Cowlitz County.

Rare Plants

In addition to the weedy species, populations of plants listed as rare by the Washington Natural Heritage Program (WNHP) (Washington Natural Heritage Program, 1997) were observed during the field surveys. One population of *Potamogeton obtusifolius* was revisited in Mason County, and a new population was found in Jefferson County. Two populations of *Lobelia dortmanna* were revisited in Mason County, and *Hydrocotyle ranunculoides* was observed in Pacific and Thurston Counties. One location with *Carex comosa* and *Cicuta bulbifera* was inventoried in Thurston County. All sightings were reported to the WNHP database manager.

Kress Lake Study

Introduction

The Kress Lake Project is a cooperative effort between Ecology, the Washington Department of Fish and Wildlife (WDFW), and Cerexagri (formerly ElfAtochem). In 2000, Cerexagri representatives approached Ecology with a proposal to treat a test lake in Washington with the contact aquatic herbicide Aquathol K® (active ingredient endothall). The project purpose was to demonstrate the ability of Aquathol K® to control an exotic species (*Myriophyllum spicatum*) and to improve the fishery and lake access for anglers. Ecology is monitoring the effects of the herbicide on the aquatic plant community. The WDFW agreed to track the effects on the fish community. The herbicide application was performed by a licensed applicator at the expense of the herbicide manufacturer.

Study Site

Kress Lake in Cowlitz County was selected as the test site because it is both a popular fishing lake and has a nuisance population of *Myriophyllum spicatum*. It was also attractive because the State owns the lake and shoreline, so no lake front property owners would be impacted by the study.

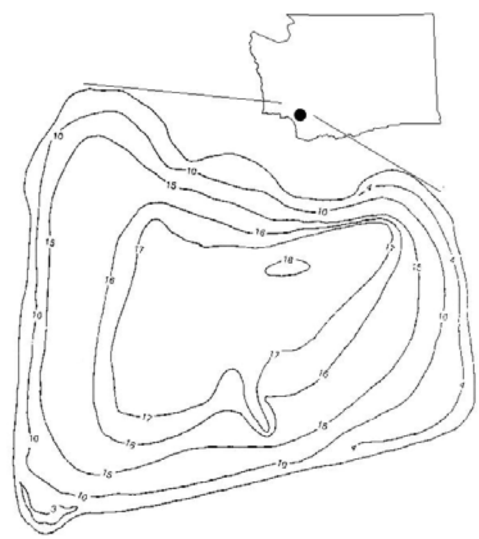

Figure 1: Kress Lake

Kress Lake is a 30 acre flooded gravel pit located just off of Interstate 5 about 8 miles south of Kelso in southwest Washington State (Figure 1). It is more or less trapezoidal in outline with a maximum depth of 18 feet. The shoreline consists of a short steep bank with trees and shrubs. A walking trail circles the lake at the top of the embankment. The lake is managed by WDFW for fishing from shore or small boats. No combustion engines are allowed.

Prior to initiation of this study the aquatic plant community extended throughout the lake. *Myriophyllum spicatum* was the dominant plant, and formed a ring of surfacing vegetation around the lake edge. Big leaf pondweed (*Potamogeton amplifolius*) and the macroalgae *Chara* sp. made up the majority of the remaining plants.

The WDFW manages Kress Lake for a mixed fishery. Fish species present include rainbow trout, brown trout, cutthroat, steelhead, channel catfish, largemouth bass, bluegill, pumpkinseed, crappie and warmouth. It is a popular recreation area for anglers as well as recreational boaters, hikers, and horseback riders (Kelsey, 2001).

Methods

Herbicide Application

The first herbicide application took place on June 21, 2000. Ten acres were treated around the edge of the lake using Aquathol K®. The application rate was 1.5 ppm, using about 6 gallons per acre. The second treatment was a month later. Another 10 acres were treated out from the shoreline toward the center of the lake using the same application rates and amounts (McNabb, 2001).

Aquatic Plants

The aquatic plant community has been assessed six times so far for this study: before the herbicide treatment (June 13, 2000), ten weeks after initial treatment (August 24, 2000), and at the beginning and end of the summer in 2001 and 2002. Frequency data were collected on all sampling dates, but biomass data were only collected at the beginning of summer in 2001 and 2002. In addition to the quantitative data, a composite species list and secchi depth data were collected on each sample date. Follow-up studies to collect the same suite of data are planned for June 2003.

Point-intercept Frequency

Plant samples were gathered systematically at points on a 30.5 meter (100 foot) grid for the frequency data analysis. The grid was developed using a Geographical Information System (GIS) (Madsen 1999). However, in the field, the point coordinates from the GIS did not correspond with the data the Global Positioning System (GPS) unit was providing. Due to the small size of the lake, the field personnel felt they could visually estimate the point locations with sufficient accuracy.

At each point, samples were gathered from the port side of the boat using a sampler consisting of two metal leaf rakes bolted back to back with a weight. The handles were removed and replaced with a 30 meter marked rope. The rake was thrown twice, and all recovered species were recorded. The depth of each sample site was also recorded.

Data were entered into a relational database and a Chi-square two-by-two analysis was performed on the common species to look for differences between all four sample dates. The probability was adjusted using a Bonferroni correction to account for multiple comparisons.

Biomass

Biomass data were gathered at points located throughout the lake. These points were randomly selected from the same point grid used for the frequency data collection. Samples were collected with a metal rake attached to a long aluminum handle. The rake was lowered to the substrate and turned 360° to collect the plants within the circle scribed by the rake tongs. The rake was 0.38 meters wide, and therefore sampled a 0.11 square meter area. The sample was brought to the surface and placed into a plastic bag labeled with the sample location and depth. The samples were transported to the lab where they were sorted by species and placed into pre-weighed and numbered paper bags. They were dried in a forced air oven at approximately 95° C, until they reached a constant weight. They were then weighed to .01 gram accuracy and the bag weight was subtracted to give the macrophyte dry weight. These data were entered into a relational database and analyzed for differences among the three dates using one-way Analysis of Variance (ANOVA). We performed a $\log_{10}+1$ transformation on the data to approximate a normal distribution. The resultant p-values were adjusted using a Bonferroni correction to account for multiple comparisons. Post-hoc analysis determined which of the comparisons were significant.

Results and Discussion

Aquatic Plant Community

The species list from each sample date shows that the species diversity was greatest in June 2001 (Table 3). A total of 12 different submersed taxa were present at that time; this is almost double the number found before the herbicide treatment. In 2002 new submersed and emergent species continued to be found, but there was also a decline in the diversity of *Potamogeton* species. However, as the disappearing species were not present before treatment, it is likely this result is due to competition by the dominant species rather than the herbicide treatments. One species, *Heteranthera dubia*, was identified before treatment but not during any of the sampling events after treatment. However, a recent study found that Aquathol K had no impact on *H. dubia* at the concentration used in this study (Skogerboe and Getsinger 2001). So it is possible that the plant was misidentified in 2000 or it may have disappeared from the lake for some reason other than a direct impact of the herbicide. The number of taxa observed decreased at the summer's end in both 2001 and 2002 compared to early summer samples. This is likely due to either increasing dominance by a few species making locating rare species more difficult, or the seasonal die off of selected species.

Table 3. List of species from Kress Lake and the dates when they were found. (The lake was treated in June and July, 2000).

Plant name	6/13/00	8/24/00	6/21/01	9/6/01	6/11/02	8/27/02
Callitriche sp. (water-starwort)	√		√		√	
Callitriche stagnalis (pond water-starwort)			√			
Ceratophyllum demersum (coontail)			√	√		√
Chara sp. (muskwort)	√	√	√	√	√	√
Elodea canadensis (common elodea)	√	√	√	√	√	√
Heteranthera dubia (water star-grass)	√					
Ludwigia palustris (water purslane)					√	
Myriophyllum spicatum (Eurasian watermilfoil)	√	√	√	√	√	√
Nitella sp. (stonewort)				√	√	√
Potamogeton amplifolius (large-leaf pondweed)	√		√	√	√	√
Potamogeton crispus (curly leaf pondweed)			√	√		
Potamogeton sp (thin leaved pondweed)		√	√	√		
Potamogeton sp. (pondweed)		√				√
Potamogeton zosteriformis (eel-grass pondweed)			√			
Ranunculus aquatilis (white water-buttercup)					√	
Ranunculus flammula (creeping buttercup)			√			
Sparganium sp. (bur-reed)					√	
Utricularia sp. (bladderwort)	√		√	√	√	√

Point-intercept Frequency

A total of 565 frequency samples were collected on the four sample dates: 91 in June 2000, 95 in August 2000, 95 in June 2001, 94 in September 2001, 95 in June 2002 and 95 in August 2002. Only the common species were included in the Chi-squared frequency data analysis. A graph of the species percent frequency is presented in Figure 2 and significance levels are in Table 4.

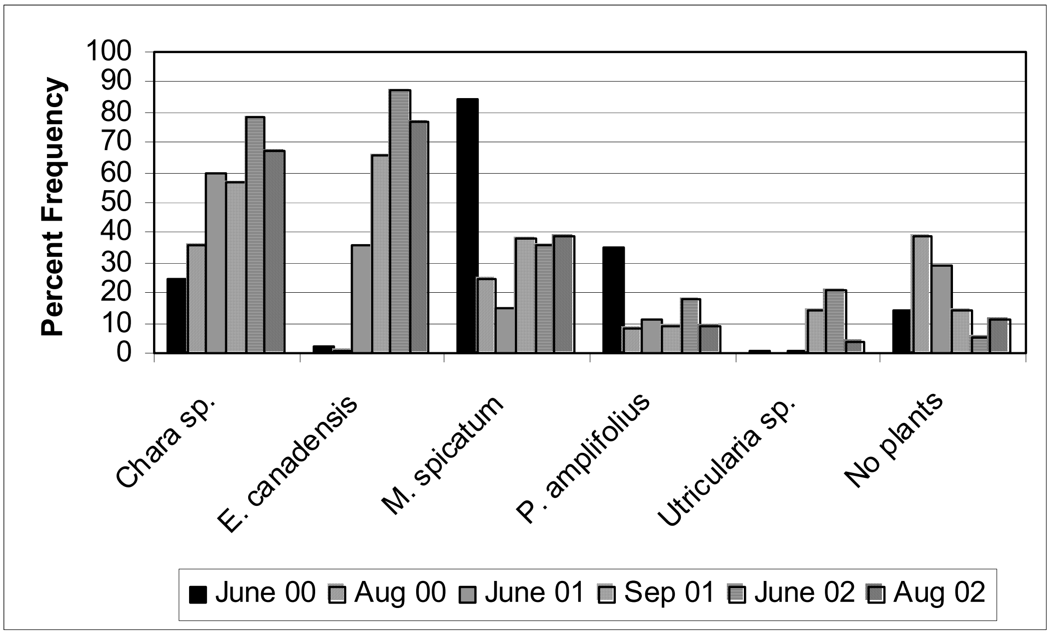

Figure 2: Chi-square analysis results of the frequency data for the four sample dates.

Table 4: Chi-square analysis p-value results of the frequency data comparisons.

Species	June '00 with Aug '00	June '00 with June '01	June '00 with June '02	June '00 with Sep '01	June '00 with Aug '02	Aug '00 with June '01
Chara sp.	0.120	**0.000***	**0.000***	**0.000***	**0.000***	**0.001***
E. canadensis	0.535	**0.000***	**0.000***	**0.000***	**0.000***	**0.000***
M. spicatum	**0.000***	**0.000***	**0.000***	**0.000***	**0.000***	0.070
P. amplifolius	**0.000***	**0.000***	0.008	**0.000***	**0.000***	0.620
Utricularia sp.	0.306	0.976	**0.000***	**0.001***	0.190	0.316
No plants	**0.000***	0.012	0.037	0.929	0.436	0.169

Species	Aug '00 with Sept '01	Aug '00 with June '02	Aug '00 with Aug '02	June '01 with Sep '01	June '01 with June '02	June '01 with Aug '02
Chara sp.	**0.003***	**0.000***	**0.000***	0.721	0.008	0.291
E. canadensis	**0.000***	**0.000***	**0.000***	**0.000***	**0.000***	**0.000***
M. spicatum	0.054	0.115	0.043	**0.000***	**0.001***	**0.000***
P. amplifolius	0.982	0.053	0.799	0.637	0.146	0.809
Utricularia sp.	**0.000***	**0.000***	0.043	**0.001***	**0.000***	0.174
No plants	**0.000***	**0.000***	**0.000***	0.009	**0.000***	**0.001***

Species	Sept '01 with June '02	Sept '01 with Aug '02	June '02 with Aug '02
Chara sp.	**0.003***	0.159	0.104
E. canadensis	**0.000***	0.098	0.058
M. spicatum	0.721	0.927	0.653
P. amplifolius	0.057	0.817	0.091
Utricularia sp.	0.191	0.021	**0.000***
No plants	0.045	0.487	0.179

* significant at $p \leq 0.008$

Biomass

Biomass data were gathered at 30 locations throughout the lake in June 2000, August 2000 and June 2001, and at 28 locations in June 2002. As with the point intercept frequency data, only the most common species were included in the analysis. Three species showed a significant change in their biomass between the sampling periods (Table 5).

Table 5. Mean biomass (with standard deviation in parentheses) and ANOVA results from common species.

	Biomass (g/m^2)				
	June '00	Aug '00	June '01	June '02	P-value
Chara sp.	211 (495)	254 (585)	106 (159)	255 (461)	0.32
E. canadensis	.03 (.2)	.01 (.07)	55 (159)	67 (119)	**0.00***
M. spicatum	76 (82)	.85 (2.2)	23 (112)	.83 (3.1)	**0.00***
P. amplifolius	20 (52)	.85 (4.6)	5 (28)	0	**0.02***
Utricularia sp.	0	0	6 (32)	8 (24)	0.05

* significant at $P \leq .05$

The frequency and biomass of the target plant, *M. spicatum,* was significantly lower at all post treatment sampling times than the pretreatment sample (June 2000). However, its frequency increased significantly between its lowest level in June 2001 and all subsequent sample dates. This rebound has so far leveled off and *M. spicatum* has maintained a reduced level compared with pretreatment data. Skogerboe and Getsinger (2002) also found *M. spicatum* to be very sensitive to endothall, and attained a 99% reduction in biomass even at the lowest treatment rates in their experiment (0.5 ppm).

Chara sp. and *E. canadensis* were found at significantly higher frequency and *E. canadensis* biomass was also significantly higher in all samples from 2001 and 2002 when compared with both of the samples from 2000 ($p \leq 0.005$). *Elodea canadensis* frequency also continued to increase significantly between June 2001 and the subsequent sample dates. *Chara* sp. is a large alga and apparently not affected by the herbicide and *E. canadensis* is resistant to Aquathol K (Sprecher et al 2002). It is therefore not surprising that these two plants have dominated the lake since the herbicide treatment.

The *P. amplifolius* followed the same pattern as the *M. spicatum,* with a significant reduction in post treatment biomass and frequency (except frequency in June 2002 compared with pre-treatment frequency). Skogerboe and Getsinger (2002 and 2001) found *P. crispus, P. illinoensis* and *P. nodosus* were susceptible to Aquathol K, so perhaps *P. amplifolius* is as well. The *Utricularia* sp. was present at significantly higher frequencies in September 2001 and June 2002 compared to the other dates. Samples where no plants were collected increased significantly three months after treatment and decreased significantly between August 2000 and the last three sample dates, and between June 2001 and both samples from 2002. This is likely due to increasing plant growth filling in the areas left bare of plants immediately after the treatment.

In conclusion, the endothall treatment in Kress Lake significantly reduced the frequency and biomass of the target plant *M. spicatum* for at least two years after treatment. This reduction has allowed the increase in biomass and frequency of native species resistant to the herbicide.

Loomis Lake Fluridone Study

Introduction

The US Army Corps of Engineers and the Washington Department of Ecology are jointly funding a study on the use of the systemic herbicide fluridone (brand name Sonar®) to control Eurasian milfoil (*Myriophyllum spicatum*) and Brazilian elodea (*Egeria densa*) in Loomis Lake, WA. All plants in the lake will be monitored pre-treatment and for three years post-treatment for impacts and recovery from the herbicide. The pre-treatment data were collected in June 2002 and the lake was treated with herbicide in July and August. Post-treatment monitoring will begin in June 2003.

The goals of the study are to:

- Determine the effectiveness of the herbicide in controlling *M. spicatum* one to three years after treatment.
- Determine the effectiveness of the herbicide in controlling *Egeria densa* one to three years after treatment.
- Determine the impact of the herbicide on other aquatic vegetation present in the lake for three years after treatment.

Study Site

Loomis Lake is located in the coastal dunes of Pacific County, about 10 km north of Long Beach, WA. It is 69 ha (170 acres) in area, with a shoreline length of 6.9 km (4.3 miles) (Figure 3). Development of the shore consists of homes and a public boat launch with a fishing dock along the west shore. It is a long, narrow lake, with a maximum depth of 3 meters (10 ft) and mean depth of 1.5 m (5 ft). It is classified as eutrophic, with tannin-stained water and secchi depth visibility usually between 1 to 2 meters (O'Neal et al., 2001), although occasional algae blooms can reduce this. Aquatic plants grow throughout the lake. We conducted a thorough aquatic plant inventory in 1994, and at that time neither *M. spicatum* nor *E. densa* were found. A consultant first identified *M. spicatum* growing in Loomis Lake in 1996. We identified *E. densa* growing in the lake for the first time in 1999.

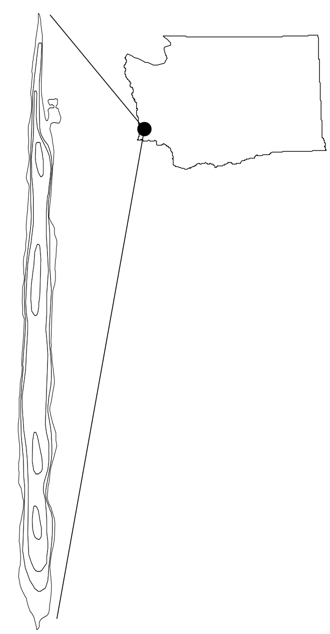

Figure 3: Loomis Lake
contour interval 3 feet

Methods

Herbicide

The herbicide fluridone (Sonar®) was applied in early summer. The application rate was determined based on what was expected to provide good control of both *E. densa* and *M. spicatum*. Periodic tests of the water column herbicide concentration were conducted using the FasTest® method developed by the herbicide manufacturer. The target concentration was maintained for a minimum of 8 weeks. When the concentration fell below the target concentration more herbicide was added to the lake. At the end of the 8 week period, the herbicide concentration was monitored into the autumn. A licensed herbicide applicator was contracted for this work. After the one-year post-treatment data are collected, physical methods such as hand pulling or bottom barriers will be used to treat surviving small patches of *M. spicatum* and *E. densa.*

Macrophytes

Aquatic plant biomass and frequency data were collected before the treatment occurred and will be collected annually for three years after treatment. Sample sites covered the whole lake since it is all within the macrophyte growth zone.

Species Frequency Data

The point-intercept method was used to gather macrophyte presence-absence data throughout the lake (Madsen 1999). A Geographic Information System (GIS) created a 50 by 50 meter grid over the whole lake. Each grid intersection was a sample point, provided as Universal Transverse Mercator (UTM) coordinates. A Geographical Position System (GPS) with real time correction was used to locate these points in the field. At each of the points macrophyte frequency data were collected with a sampling rake thrown twice. All species collected and the sample site depth were recorded

The data were entered into a relational database and a Chi-square two-by-two analysis will be performed on the common species to look for differences between the sample dates when we have collected the after-treatment data.

Biomass

Biomass samples were collected by a SCUBA diver. Before sampling, 50 intersections from the grid used for the frequency data collection were randomly selected. At each sample site the diver used a 0.1 m^2 PVC pipe frame to collect the sample (Madsen 1993). The frame was placed on the sediment, and all above-ground plant biomass was collected and placed in a mesh bag. On the boat the contents of the mesh bag were transferred to labeled plastic bags. The biomass samples were sorted by species and placed in pre-weighed and numbered paper bags. The samples were dried in a forced air oven at approximately 70 °C until a constant weight was reached. Then the samples were weighed to 0.01 g accuracy.

Analysis of Variance will be used to analyze the biomass data, comparing all sampling periods once post-treatment data have been collected.

Results and Discussion

Herbicide

Egeria densa is known to be more resistant to fluridone than *M. spicatum*, so the target herbicide concentration was 12 ppb for this study. (Concentrations of 5 ppb can control *M. spicatum*). The initial treatment was done on June 28, 2002. Table 6 provides data on when additional herbicide was added, and when the herbicide concentration was tested (averaged from three sites). The target concentration was maintained or exceeded on all but one date where samples were tested. The lake was still maintaining a moderate herbicide concentration into the fall (McNabb, 2003).

Table 6: Herbicide treatment history, Loomis Lake, summer 2002.

Date	Average fluridone concentration (ppb)	Action
June 28		initial herbicide treatment
July 9	21.25	
July 11		herbicide added
July 23	9.67	
July 30		herbicide added
August 9	16.25	
August 14		herbicide added
August 23	26.37	
August 28		herbicide added
October 30	10	

Macrophytes

The pre-treatment sampling occurred from June 24 through June 26, 2002. At that time 25 species were identified in the lake and along the shoreline (Table 7). Thirteen of these were submersed plants that should be most affected by the herbicide. Loomis Lake has been monitored several times over the nine years of this program, and as many as 45 species have been identified in the lake, including 16 submersed species. It is possible the increasing dominance of *M. spicatum* and *E. densa* was crowding out some of the native submersed plants.

Species Frequency Data

Aquatic plant frequency data were collected at 251 points located throughout the lake. Table 8 lists the species found and their percent frequency of occurrence. The two *Elodea* species were combined and the *Potamogeton* species other than *P. zosteriformis* were combined due to difficulty identifying them in the field. The most common plant collected was *M. spicatum*, in 82% of the samples. Next were *E. densa* and *P. zosteriformis*, each collected in greater than 50% of the samples. The other submersed species except *C. demersum* and *Elodea* spp. were rare in the lake. In 1994, before the invasive species *M. spicatum* and *E. densa* were present, the submersed plant community was dominated by the native plants *Nitella, Elodea* sp. and *P. zosteriformis.*

Table 7: Macrophyte species identified in Loomis Lake, June 2002.

Scientific name	Common name	Growth Form
Ceratophyllum demersum	Coontail; hornwort	submersed
Egeria densa	Brazilian elodea	submersed
Eleocharis sp.	spike-rush	emergent
Elodea canadensis	common elodea	submersed
Elodea nuttallii	Nuttall's waterweed	submersed
Hydrocotyle ranunculoides	water-pennywort	floating, rooted
Juncus sp.	rush	emergent
Myosotis sp.	forget-me-not	emergent
Myriophyllum spicatum	Eurasian water-milfoil	submersed
Najas sp.	water-nymph	submersed
Nitella sp.	stonewort	submersed
Nuphar polysepala	spatter-dock, yellow water-lily	floating, rooted
Nymphaea odorata	fragrant water-lily	floating, rooted
Phalaris arundinacia	reed canarygrass	emergent
Potamogeton richardsonii	Richardson's pondweed	submersed
Potamogeton zosteriformis	eel-grass pondweed	submersed
Potamogeton praelongus	white stem pondweed	submersed
Potamogeton spp.	pondweed	submersed
Potentilla palustris	purple (marsh) cinquefoil	floating, rooted
Sparganium eurycarpum	broadfruited bur-reed	emergent
Spiraea douglasii	spiraea, hardhack	emergent
Spirodela polyrhiza	great duckweed	free-floating
Tolypella intricata	macro-algae	submersed
Typha sp.	cat-tail	emergent
Utricularia sp.	bladderwort	submersed

Table 8: Percent frequency of occurrence, submersed and floating species in Loomis Lake.

Species	% frequency of occurrence
C. demersum	16
Egeria densa	59
Elodea spp.	35
M. spicatum	82
Najas sp.	1
Nitella sp.	2
No Plants	3
Nuphar polysepala	1
Potamogeton spp. (not *P. zosteriformis)*	2
P. zosteriformis	56
S. polyrhiza	10
U. vulgaris	<1

Biomass

Biomass samples were collected at 50 points by a SCUBA diver on June 25, 2002. As can be seen from Table 9, *E. densa* and *M. spicatum* were the plants with the greatest biomass. The biomass of each of these species was an order of magnitude greater than the next most prevalent plant, *P. zosteriformis*. This is similar to the results from the frequency analysis, although *M. spicatum* had the highest frequency while *E. densa* had the greatest biomass. *Egeria densa* is more robust than *M. spicatum*, so this finding is not surprising.

Table 9: Biomass results from common species in Loomis Lake.
The standard deviation is given in parenthesis.

Species	Mean Biomass (g/m^2)
C. demersum	1.3 (6.4)
Egeria densa	157.7 (263.9)
Elodea sp.	3.6 (12.6)
M. spicatum	129.4 (165.5)
P. zosteriformis	13.2 (23.8)

Conclusions

The biomass and frequency of occurrence of the two invasive non-native species in Loomis Lake are pretty typical of what we have seen in other lakes with populations of these plants. (See data for Kress Lake and Mattoon Lake in this report). The data will be analyzed beginning in 2003 when post-herbicide samples are collected.

Myriophyllum spicatum Biological Control Project

Introduction

The invasive non-native plant Eurasian watermilfoil (*Myriophyllum spicatum*) has become a widespread problem in Washington State since its original introduction sometime before 1965 (see Appendix C for a distribution map). When the distribution of an invasive non-native species reaches this proportion, biological control agents are often sought to aid in their management (Cofrancesco 1998). The milfoil weevil (*Euhrychiopsis lecontei*) has been implicated in causing *M. spicatum* declines in Midwestern and Northeastern States (Newman and Biesboer 2000, Johnson et al 2000, Creed 1998, Creed and Sheldon 1994). This weevil is native to the northern part of the United States, including Washington State (Tamayo et al., 1999). The weevil's native host is the native aquatic plant northern watermilfoil (*Myriophyllum sibiricum*). However, if the weevil is reared on *M. spicatum* then it will prefer that species over northern milfoil (Solarz and Newman 2001, Newman et al 1997, Creed and Sheldon 1993).

Project Objectives

The objectives for this study were three-fold in order of priority:

1. To gain experience collecting, rearing and augmenting a *Euhrychiopsis lecontei* (hereafter referred to as milfoil weevil) population, in order that we may advise members of the public who may wish to embark on a similar project.
2. To monitor the milfoil weevils introduced to the study site, and the aquatic plant community at the study site.
3. To collect data on the community composition and diets of resident fish at the study site to see if they target the milfoil weevils as a new or more prevalent prey item.

Methods

Milfoil Weevil Introduction Site

The milfoil weevils were introduced to Mattoon Lake, located near the town of Ellensburg in Kittitas County (T17N R18E sec 11) (Figure 4). This 26 acre lake is a former gravel pit presumably created when I-90 was constructed. It is owned entirely by the Washington Department of Fish and Wildlife (WDFW). It is shallow, with a maximum depth of about 5 m (16 ft). Aquatic plants grow throughout the lake, and reach the surface where the water is about 2 m (6 ft) deep or less. The dominant submersed plant is *M. spicatum*, which was introduced sometime after 1994. The shoreline is dominated by the non-native emergent plant *Iris pseudacorus* (yellow flag iris) with occasional patches of deciduous trees.

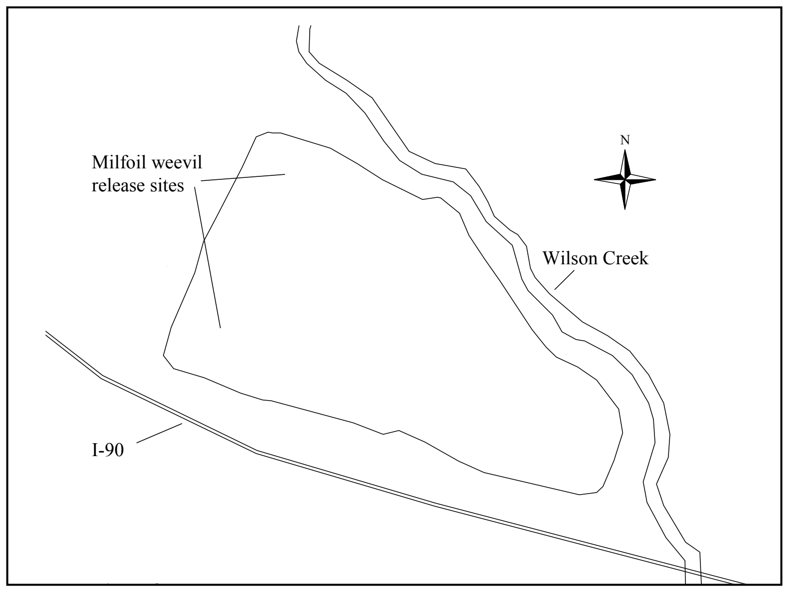

Figure 4: Mattoon Lake

The WDFW manages the lake for a year-round put-and-take trout fishery. Other fish species known to be present prior to the study included pumpkinseed sunfish (*Lepomis gibbosus*), northern pike-minnow (*Ptychocheilus oregonensis*), and largemouth bass (*Micropterus salmoides*) (WDFW, 1983).

Milfoil Weevils

Collection and Rearing

Collection of milfoil weevil parent stock occurred as early in the summer as possible based on the experience of Tamayo (2002). Stan Coffin Lake in Grant County just southwest of Quincy (T19N R23E sec 10) was chosen because it was known to host milfoil weevil populations (Tamayo, 1999). Up to 140 adult weevils were collected approximately once per week. The milfoil weevils were collected along with a section of the plant they were found on and placed in a sealable plastic bag with some lake-water. The bags were then placed in coolers with ice and transported to aquariums or directly to Mattoon Lake.

The aquariums were set up at the WDFW Yakima regional headquarters in the shop building. There were seven aquaria: two 10 gallon, two 15 gallon and three 20 gallon. Six were used for milfoil weevil rearing and one 10 gallon for milfoil storage. Full-spectrum fluorescent lights were suspended over them and maintained on a 16 hour day length with a timer. Aerators were inserted in each aquarium and bubbled through an air-stone or strip. The aquaria were covered tightly with a fine mesh screen to prevent escapement of adult weevils. Water temperature varied with ambient conditions. When the air temperature was very hot (> 100˚ F) we did partial water changes to cool the aquaria to about 80˚ F (27˚ C).

Rearing methods were modeled after Cofrancesco and Crosson (1999). Adult *E. lecontei* weevils were placed into each aquarium along with fresh high quality Eurasian watermilfoil collected from Mattoon Lake. Weevil densities in the aquaria were approximately one weevil per gallon of water. The milfoil was bundled in groups of 10 to 15 plants, held together with a zip-tie and weighted at the bottom with a stainless steel bolt or galvanized nail, allowing the milfoil to attain a natural upright stance in the tank. The weevils were transferred to the tank on the plants on which they were collected to avoid handling them directly.

After the milfoil weevils were introduced to the tanks they were observed periodically until they were counted and released. During this time fresh milfoil was added to the tank if necessary. At the end of this time period each milfoil bundle was carefully removed from the tank and all eggs, larvae and adults were counted with the aid of either a 20X dissecting scope or 10X hand held magnifier. The milfoil and weevils were then placed in sealable plastic bags with water and kept cool for transport to Mattoon Lake.

At Mattoon Lake the milfoil with weevils attached was carefully wound into existing rooted milfoil either from a boat or by snorkeling at two introduction sites. Records of the numbers of milfoil weevils introduced and their life stage were maintained. The collection, rearing, and release of milfoil weevils continued through the end of August.

Milfoil Weevil Monitoring

Prior to the initial introduction of milfoil weevils, Mattoon Lake was inspected for an extant weevil population. The lake was checked again using the same methods in early September and will be again in 2003. Two methods were used; a qualitative check for weevil damage on milfoil plants, and quantitative sampling at points throughout the lake.

We conducted the qualitative inventory by snorkeling selected areas for a set time, including the sites chosen for weevil introduction. Milfoil plants were visually inspected for signs of milfoil weevils or weevil damage. Any areas with damaged plants were marked on a map, and locations (or their boundaries) were noted with a GPS unit.

The quantitative data were collected at 25 points randomly selected from a 30 by 30 meter grid developed for the lake. At each point, stems from two milfoil plants were collected, placed in a sealable plastic bag, and kept cool while being transported to the lab. In the lab each plant was inspected for presence of all weevil life stages and weevil damage. Analysis of Variance (ANOVA) will be used to analyze the resulting data for significant trends if weevil presence is detected.

Aquatic Plant Monitoring

We collected both macrophyte biomass and frequency data in Mattoon Lake before initial weevil introductions occurred. These data will continue to be collected annually for several years to monitor for changes in these parameters as weevil densities (we hope) increase. Both methods utilized the same grid used for the weevil monitoring discussed in the previous section.

Biomass

Biomass samples were collected by a SCUBA diver at 30 points randomly selected from the point grid. Samples were collected using a 0.1 m^2 frame placed on the sediment at the sample location. All plants located in the frame were clipped at the sediment and the above-ground biomass was placed in a mesh bag and transported to a waiting boat where it was transferred to a labeled bag. In the lab the samples were sorted by species and placed in pre-weighed and numbered paper bags. These were dried in a forced air oven at 60˚Centigrade to a constant weight. When the samples were dry the bags were reweighed and the original bag weight subtracted from the final weight to obtain the plant dry weight per unit area. ANOVA will be used to determine if there are significant changes in the species biomass over time.

Frequency

Plant samples were gathered from each point on the 30 x 30 meter grid. At each point samples were collected from the boat using two metal leaf rakes bolted back to back with the handles removed and replaced with a 30 meter marked rope. The rake sampler was thrown twice, and all recovered species were recorded. The depth of each sample site was also recorded.

Data will be analyzed with a Chi-square two-by-two analysis to assess changes over time. The probability will be adjusted using a Bonferroni correction to account for multiple comparisons.

Fish Community and Diet Analysis

This part of the project was undertaken in cooperation with the WDFW, but a brief summary is provided here. The fish community was sampled at the end of May before any weevil stocking had begun. The species composition of the community was assessed by electroshocking. At this time we also collected stomach samples from each species that reaches a size big enough to consume adult weevils as part of their diet (i.e. the sunfish, bass, perch and trout) (Sutter and Newman, 1997). The stomach contents from a subset of the fish caught by electroshocking were flushed into a sample container and preserved in ethanol. Samples were analyzed in the lab by a contracted macroinvertebrate specialist. All stomach contents were identified to Order when possible, except for beetles (Order Coleoptera) which were identified to a taxonomic group low enough to determine if they were the milfoil weevil. Additional samples will be collected when weevils have (we hope) established in Mattoon Lake. Analysis of Variance will be used to analyze the data for a significant change in milfoil weevil predation at that time.

Results and Discussion

Milfoil Weevils

Collection, Rearing and Release

The initial weevil collection was made June 18, 2002 at the west end of Stan Coffin Lake. The weevils were fairly scarce, a four person crew found 30 adult weevils in a cold windy afternoon of snorkeling. We collected weevils 12 additional times from that lake and once from near-by Burke Lake between the end of June and September 24, 2002. We also continued to monitor weevil activity in Stan Coffin Lake until they forsook the plants for their overwintering habitat on shore. The weevils were still evident, though in reduced numbers in mid-October with a water temperature of 55˚ F (13˚ C). By November 1, 2002 the weevils were very difficult to locate (one weevil was found in 20 minutes of snorkeling); the water temperature was 43˚ F (6˚ C).

A total of 705 adult weevils were collected from *M. sibiricum* (northern milfoil) plants throughout the summer. The peak collection time was the end of July through the end of August, when an experienced snorkeler could collect at a rate of about one weevil per minute. Often there were two or three weevils per milfoil stem, a density thought to be great enough to control *M. spicatum* growth (Newman and Biesboer, 2000). In fact, although Stan Coffin Lake has *M. spicatum*, it was difficult to find. The native *M. sibiricum* was much more prevalent, perhaps because it can withstand the weevil's grazing and burrowing more successfully than *M. spicatum* (Creed and Sheldon, 1993).

Most of the adult weevils collected were taken to the rearing aquaria. However in a few instances we collected more weevils than we could accommodate, so those were taken directly to Mattoon Lake and released the same day. We kept the weevils in the aquaria for between 4 and 18 days (Table 10). At the end of that period we counted the eggs, larvae, pupae and adults, then released them along with the milfoil on which they were growing to Mattoon Lake. We then cleaned the tank and added fresh adults collected from Stan Coffin Lake. The productivity results are also provided in Table 9. Analysis of Variance showed no significant difference between the productivity based on the number of incubation days (days in the aquaria) nor based on the tank in which they were raised. However, general observation indicates that the highest levels of productivity occurred between 7 and 14 days. Others have found that the optimum rearing time is 8 to 14 days (Hanson et al., 1995). The average production rate was 6 (combined life stages) per original adult. In a similar study an average production rate of 3 for the first year and 6 for the second were obtained (Hanson et al., 1995).

Table 10: Weevil productivity data from six aquaria used in rearing, summer 2002.

Aquarium Number	Date planted	Original Adults	Days Incubation	Adults	Pupae	Eggs	Larvae	Production per Original Adult
1	28-Jun-02	24	13	20	0	91	28	6
1	17-Jul-02	19	9	16	2	65	77	8
1	02-Aug-02	18	14	15	1	10	47	4
1	22-Aug-02	16	4	16	0	7	19	3
2	28-Jun-02	12	13	10	0	23	8	3
2	17-Jul-02	18	9	18	2	25	29	4
2	02-Aug-02	10	14	6	0	5	88	10
2	22-Aug-02	15	4	17	0	27	10	4
3	28-Jun-02	16	12	14	4	59	36	7
3	17-Jul-02	18	12	14	2	39	89	8
3	02-Aug-02	16	18	15	28	40	17	6
3	22-Aug-02	14	5	13	1	38	22	5
4	10-Jul-02	25	12	20	2	52	110	7
4	24-Jul-02	20	12	13	1	24	92	7
4	07-Aug-02	21	13	14	9	24	82	6
4	22-Aug-02	19	13	16	5	40	22	4
5	18-Jun-02	15	13	14	0	4	10	2
5	10-Jul-02	21	7	17	0	88	64	8
5	24-Jul-02	20	12	17	1	68	86	9
5	07-Aug-02	21	14	15	32	25	31	5
5	22-Aug-02	18	13	14	2	25	30	4
6	18-Jun-02	15	13	14	1	7	32	4
6	10-Jul-02	19	7	12	0	57	43	6
6	24-Jul-02	19	12	15	3	37	80	7
6	07-Aug-02	18	14	14	7	12	22	3
6	22-Aug-02	22	4	20	1	20	20	3
Totals				389	104	912	1194	

A total of 2,832 weevils of various life stages were released at two locations within Mattoon Lake between July 2 and September 24, 2002. Of these, 233 were adults taken directly from Stan Coffin Lake. The weevils were placed in the lake on milfoil they were clinging to or living in. This milfoil was wound around existing surfacing milfoil. The two release locations were at the northwest and southwest end of the lake (Figure 4). A total of 1,233 were released at the northwest end and 1,599 at the southwest end.

Weevil Monitoring

We checked for weevil presence in Mattoon Lake on June 24, 2002 before we began releasing them, and again on September 3, 2002 toward the end of the stocking period. For the qualitative inventory we conducted three 20 minute searches with experienced weevil hunting snorkelers. Two of the sites were near the weevil release sites, and one was along the northeastern shore. We did not see any signs of weevils or weevil damage during either of these inventories.

For the quantitative inventory we collected two *M. spicatum* stems of at least 1 meter length from 25 randomly selected locations. We found no evidence of an established milfoil weevil population from plants collected during either of the dates. We did find evidence of meristem damage and leaf grazing, especially on the lower branches during both surveys. Chironomid fly larvae were often seen in this area, living in silky cases. We also found another fly larvae living in mined out stems. There is a Chironomid fly (*Cricotopus myriophylli*) found associated with *M. spicatum* in the Okanogan region of British Columbia. This fly larvae lives and builds cases in the apical meristems of *M. spicatum*, and has been implicated in contributing to milfoil declines in that area (Kangasniemi et al., 1992; Macrae et al., 1990). However, the larvae in Mattoon Lake were identified as *Pseudochironomus* sp., *Psectrocladius* sp., and *Parakiefferiella* sp., none of which are known to be herbivorous on macrophytes (Lester, 2003).

Aquatic Plant Monitoring

The aquatic plants observed in Mattoon Lake are listed in Table 11. By mid-summer a mat of surfacing *M. spicatum* was present around the lake's perimeter. This is in contrast to what was found during a 1994 inventory when the plant community was dense, but dominated by a mix of *Elodea canadensis, Potamogeton foliosus, Stuckenia pectinata* and *Myriophyllum sibiricum.*

Table 11: Aquatic plant species found in Mattoon Lake, June 2002.

Scientific name	Common name	Growth Form
Ceratophyllum demersum	Coontail; hornwort	submersed
Chara sp.	muskwort	submersed
Elodea canadensis	common elodea	submersed
Elodea nuttallii	Nuttall's waterweed	submersed
Iris pseudacorus	yellow flag	emergent
Myriophyllum sibiricum	northern watermilfoil	submersed
Myriophyllum spicatum	Eurasian water-milfoil	submersed
Potamogeton crispus	curly leaf pondweed	submersed
Potamogeton sp (thin leaved)	thin leaved pondweed	submersed
Stuckenia pectinata	sago pondweed	submersed

Biomass

Five submersed species were collected as part of the 30 biomass samples. The plant with the greatest biomass was *M. spicatum* (Table 12). *Ceratophyllum demersum* also had a large biomass; however, this is a difficult plant to sample with the method used as it is not rooted. The plants tend to grow in a great tangled mass, so collecting plant matter from only a 0.1 m^2 frame is difficult. Likely this species was over-sampled relative to the other species. The remaining three species were far less prevalent in the samples.

Table 12: Mattoon Lake macrophyte mean biomass.
Standard deviation given in parenthesis.

Species	Mean Biomass (g/m^2)
C. demersum	272.6 (502.7)
E. nuttallii	19.0 (50.7)
M. spicatum	304.2 (313.2)
P. crispus	0.5 (1.4)
Potamogeton (thin leaf)	0.3 (0.7)

Frequency

Frequency data were collected at 119 points scattered throughout the lake. Of the nine species observed, *M. spicatum* was the most frequently observed (Table 13). The next most common species was *C. demersum*, and then *E. nuttallii*. These results show the extent to which *M. spicatum* dominates the submersed plant community, and corroborate the biomass data results.

Table 13: Frequency results for Mattoon Lake.

Plant species	% frequency of occurrence
C. demersum	72
Chara spp.	4
E. canadensis	4
E. nuttallii	45
M. sibiricum	1
M. spicatum	87
no plants	2
P. crispus	2
Potamogeton (thin leaf)	7
Stuckenia pectinata	1

Fish Community and Diet Analysis

The fish community in Mattoon Lake was sampled on May 28, 2002, before any milfoil weevils were released. Results from the fish community analysis will be available in 2003 (Divens, 2003). At the same time the stomach contents from six species were collected and identified: 30 from pumpkinseed (*Lepomis gibbosus*), 35 from yellow perch (*perca flavescens*), 6 from brown trout (*Salmo trutta*), 17 from large mouth bass (*Micropterus salmoides*), 13 from rainbow trout (*Salmo gairdneri*), one from channel catfish (*Ictalurus punctatus*), and one unidentified. Results showed no *E. lecontei* in the stomach contents of any of the species collected. The taxonomic break down of what invertebrate orders were found is provided in Figure 5. There was one brown trout with a weevil from the family Curculionidae (same family as *E. lecontei*) but it was from the genus *Miccotrogus. T*he most commonly consumed organisms by the warm water fish (pumpkinseed, largemouth bass and perch) were Cladocera and Copepoda. The trout seemed to focus more on Diptera and Hydrachnidae. Statistical analysis will be performed on these data when a post-stocking sample is collected.

Phylum Annelida
- Class Clitellata
  - Order Haplotaxida (Oligochaets in part)

Phylum Arthropoda
- Subphylum Crustacea
  - Class Branchiopoda
    - Order Diplostraca
      - Suborder Cladocera (water fleas)
  - Class Malacostraca
    - Order Amphipoda (amphipods)
    - Order Decapoda (crayfish)
  - Class Maxillipoda
    - Order Copepoda (copepods)
  - Class Ostracoda (seed shrimp, ostracods)
- Subphylum Chelicerata
  - Class Arachnida
    - Order Araneae (white-eyed spider)
    - Order Trombidiformes
      - Family Hydrachnidae (water mites)
- Subphylum Hexapoda
  - Class Insecta
    - Order Coleoptera (beetles)
    - Order Collembola (spring tails)
    - Order Diptera (flies)
    - Order Hemiptera (true bugs)
    - Order Homoptera
    - Order Hymenoptera (ants, bees, wasps)
    - Order Odonata (dragonflies, damselflies)
    - Order Thysanoptera
    - Order Trichoptera (caddisflies)

Phylum Chordata
- Subphylum Vertebrata
  - Class Actinopterygii
    - Order Perciformes (perch-like fish)
    - Order Salmoniformes (salmons)

Phylum Ciliophora
- Class Ciliatea
  - Order Peritrichida

Phylum Mollusca
- Class Bivalvia
  - Order Eulamellibranchia
- Class Gastropoda
  - Order Basommatophora
    - Family Planorbidae
      - Genus *Helisoma* (ram horn)
  - Order Pulmonata

Phylum Nematomorpha
- Class Gordioida
  - Order Gordea (horsehair worms)

Phylum Platyhelminthes
- Class Cestoda (tapeworms)
  - Order Pseudophyllidea

Figure 5: Results of fish stomach contents analysis

Myriophyllum aquaticum on the Yakima River

In September 2002 Yakima County Noxious Weed Coordinator Dick Jacobson found *Myriophyllum aquaticum* (parrotfeather) growing in a small pond near the Yakima River south of Union Gap (Exit 50 off of Interstate 82 (Figure 6)). This represented the first known population of this invasive species on the east side of the Cascade Mountain range. A short while later a WDFW biologist discovered another patch of it in a pond down river near exit 52.

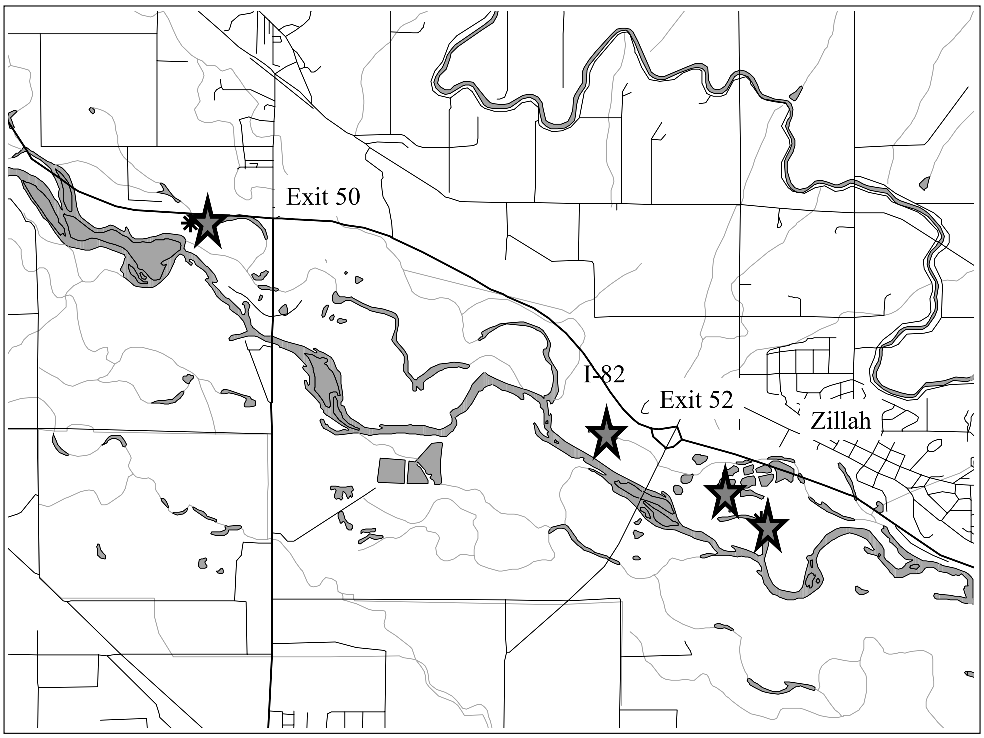

Figure 6: *Myriophyllum aquaticum* locations near the Yakima River

The meandering and braided channel morphology along this section of the Yakima River made searching for additional patches of this plant very difficult from the ground. However, we felt it was important to ascertain the extent of the population both because this is the only known site in a very wide geographical area, and because the mat forming nature of *M. aquaticum* has the potential to severely impact shallow water habitat along the river. (It will shade out more desirable native species, lower dissolved oxygen, and raise surface water temperatures).

We decided to try conducting an inventory of the ponds and side channels from the air in a helicopter. We had never used this method before, but because *M. aquaticum* grows sprawled along the water's surface with most of its vegetation above the water, and because it is a characteristic gray-green in color, we were optimistic about finding it this way. We hired a pilot with low elevation flight experience, and spent about 3 hours searching for additional patches of the plant. We covered approximately 22 river miles downstream of Union Gap to Granger. We were successful in finding additional *M. aquaticum* sites, including one site flowing directly to the river. We were also very pleased with the effectiveness and efficiency of this survey method. The helicopter allowed us to get close enough to easily identify plant species when needed, and we covered areas that would have been nearly impossible to access by foot or in a boat due to dense wetland vegetation and unknown property ownership.

Nearly all of the *M. aquaticum* found during these inventories was subsequently sprayed with herbicide. Follow-up treatments and additional surveys will be conducted in 2003.

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Herbarium

Methods Used in Aquatic Plant Identification

All plants were identified to the lowest taxonomic group possible, usually to species unless critical features of the plant were missing (such as flowers or fruits). To assure proper identification, a number of books and other sources were consulted as cross references (see Parsons (2001) for a list). In addition, several people from within and outside the agency are consulted in cases where identification is difficult. If this is not conclusive, the plant is sent to national taxonomic experts for an opinion. The Integrated Taxonomic Information System (ITIS) (http://www.itis.usda.gov), The Jepson Manual (Hickman, 1993), and the Flora of North America (Flora of North America Editorial Committee, 1993) are used to ensure the nomenclature is current.

Methods Used in Collection and Preservation

The methods used to preserve collected aquatic plants were those of Haynes (1984). First, all available plant parts (roots, stem, and flowering parts) were collected and sealed in a wet plastic bag. Within three days, but usually sooner, the plants were washed, identified, and arranged on a sheet of 100% rag herbarium paper. If the plant was too limp to maintain its shape in air, it was arranged on the paper in a tray of water. The herbarium sheets with plants and a written site description were then sandwiched between newspaper, blotter paper, and cardboard in a plant press. When the specimen dried, it was fixed to the paper with herbarium glue or binding tape (if it was not already sufficiently adhered from the wet pressing process). A label with identification and collection information was attached. These reference specimens are stored in a sealed herbarium cabinet located in the Central Regional Office laboratory in Yakima.

Currently, the herbarium collection contains 127 unique taxa from 41 families (Appendix E). There are a total of 414 specimens, and in most cases each species is represented by more than one specimen. Each time a noxious weed is found; a collection is made and kept as a record. Additional taxa will be added to the herbarium as they are collected in future years. Also, specimens from aquatic plant mapping projects funded under the Aquatic Weed Management grant program are housed in this herbarium. The collection is available to both Ecology staff and the public as a reference and permanent record.

Aquatic Weed Management Fund-Related Activities

Money was available from the Aquatic Weed Management Fund (AWMF) to fund a grant cycle in autumn 2002 for fiscal year 2003. This year we had nearly $500,000 to fund projects qualifying for assistance. Table 14 lists the 17 applicants that applied for funding in the order they were received. The projects were evaluated and prioritized by a team of Ecology employees familiar with lake issues. We had enough money this year to fund the best 10 projects in addition to providing $100,000 to King County for continuation of the *Hydrilla* eradication project in Pipe and Lucerne lakes.

In addition to the regular funding cycle, one application for early infestation funds was received and funded during 2002. It was for control of *M. spicatum* in Capitol Lake, Thurston County. For additional information on this grant program and the use of the monies contact Kathy Hamel at the Department of Ecology, Water Quality Program.

Table 14. List of applicants for AWMF grant funds in Fiscal Year 2003 and the amount awarded.

Applicant	Project Title	Amount Requested	Amount Awarded
City of Ocean Shores	Grass Carp Acquisition & Monitoring	75,000	75,000
King County	Spring Lake Aquatic Weed Control	65,037	65,037
Thurston County	Lake Lawrence IAWMP	30,000	30,000
Skagit County	Skagit Lakes Surveillance/Detection	34,125	0
University of Washington Fish and Wildlife Research Unit	Herbicides and Salmon Smoltification Study	57,627	57,627
Pend Oreille County	Milfoil Eradication in Diamond Lake	35,000	35,000
City of Federal Way	Steel Lake LMD Formation &Interim IAVMP	52,560	0
Thurston Co. Water & Wastewater Management	Long Lake IAVMP	30,000	30,000
Wahkiakum Co. Weed Board	Wahkiakum Aquatic Weed Control	75,000	0
Lake Limerick Community Club	Lake Limerick Brazilian Elodea Eradication	18,500	0
WA State Dept. of Agriculture	Weevil Augmentation	16,000	16,000
WA State Dept. of Agriculture	Mapping and Genotyping Phragmites	18,750	18,750
Mason Conservation District	Mason Lake Develop IAVMP	30,000	30,000
Mason Conservation District	Mason Lake Education/Information Plan	10,350	0
Mason Conservation District	Mason Lake Mapping and Survey	9,300	0
Lincoln County Weed Board	Weeds in Lower Spokane	25,800	0
Skagit County	Big Lake Implementation/Education	7,968	7,968

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Appendix A

Site Visit Table 2002

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	Waterbody Name	Date	WRIA	Survey Extent	Noxious Weeds
Adams	Herman Lake	7/2/02	41	selected areas	*L. salicaria*
	Hutchinson Lake	7/2/02	41	selected areas	*M. spicatum, L. salicaria, P. australis*
	Sprague Lake	7/25/02	34	selected areas	*P. arundinacea*
Benton	De Atley Pit	9/9/02	37	whole littoral	*P. australis*
Cowlitz	Kress Lake	6/11/02	27	whole littoral	*M. spicatum*
		8/27/02	27	whole littoral	*M. spicatum*
Ferry	Curlew Lake	8/6/02	60	selected areas	*P. australis (?)*
	Ferry Lake	8/6/02	52	whole littoral	none
	Swan	8/6/02	52	selected areas	*P. arundinacea*
Grant	Burke Lake	10/1/02	41	selected areas	*M. spicatum, L. salicaria, P. arundinacea*
	Park Lake	8/5/02	42	whole littoral	*P. australis*
	Red Rock Lake	7/15/02	41	whole littoral	*M. spicatum, P. australis, P. arundinacea*
	Stan Coffin Lake	6/18/02	41	selected areas	*M. spicatum, L. salicaria*
		11/1/02	41	selected areas	*M. spicatum, L. salicaria*
Jefferson	Leland Lake	8/29/02	17	whole littoral	*E. densa, I. pseudacorus, N. odorata, P. arundinacea*
King	Lucerne Lake	10/4/02	9	whole littoral	*Hydrilla verticillata*
	Neilson (Holm) Lake	6/20/02	9	whole littoral	*M. spicatum, I. pseudacorus, N. odorata, P. arundinacea, P. australis*
	Number Twelve Lake	6/20/02	9	whole littoral	*M. spicatum, I. pseudacorus, N. odorata, P. arundinacea*
	Pipe Lake	10/4/02	9	selected areas	*Hydrilla verticillata, I. pseudacorus, N. odorata*
Kitsap	Buck Lake	7/31/02	15	whole littoral	*I. pseudacorus, L. salicaria, L. vulgaris, P. arundinacea*
	Island Lake	7/31/02	15	whole littoral	*I. pseudacorus, N. odorata*
	Kitsap Lake	7/29/02	15	whole littoral	*I. pseudacorus, N. odorata, P. arundinacea*
	Mission Lake	7/30/02	15	whole littoral	*I. pseudacorus, N. odorata, P. arundinacea*
	Panther Lake	7/30/02	15	whole littoral	*I. pseudacorus*
	Wildcat Lake	8/1/02	15	whole littoral	*I. pseudacorus, N. odorata, P. arundinacea*
Kittitas	Fiorito Ponds	7/18/02	39	whole littoral	*M. spicatum, I. pseudacorus, P. arundinacea*
	Freeway Pond	9/12/02	39	whole littoral	*L. salicaria, P. arundinacea*
	Gladmar Pit	9/12/02	39	whole littoral	*P. arundinacea*
	Hanson Ponds	9/12/02	39	whole littoral	*P. arundinacea*
	Mattoon Lake	5/28/02	39	selected areas	*M. spicatum, I. pseudacorus*
		6/10/02	39	whole littoral	*M. spicatum, I. pseudacorus*
Mason	Devereaux Lake	6/22/02	14	whole littoral	none
	Haven Lake	8/14/02	15	whole littoral	*I. pseudacorus*
	Mason Lake	8/13/02	14	whole littoral	*M. spicatum, P. arundinacea*
	Simpson (Arrowhead) Lake	8/12/02	22	whole littoral	*I. pseudacorus, P. arundinacea*
	Trails End (formerly Prickett)	8/15/02	14	whole littoral	*L. salicaria, N. odorata*
	Wooten Lake	8/14/02	15	whole littoral	*I. pseudacorus, N. odorata*

Okanogan	Beaver Lake	8/7/02	60	whole littoral	none
	Beth Lake	8/7/02	60	selected areas	none
	Bonaparte Lake	8/7/02	49	whole littoral	none
	Green Lake	8/8/02	49	selected areas	none
	Lost Lake	8/7/02	60	selected areas	none
Pacific	Loomis Lake	6/24/02	24	whole littoral	*E. densa, M. spicatum, P. arundinacea*
Pend Oreille	Bead Lake	7/23/02	62	whole littoral	*P. arundinacea*
	Fan Lake	7/22/02	55	selected areas	*I. pseudacorus, M. spicatum, P. arundinacea*
	Leo Lake	7/23/02	59	whole littoral	*P. arundinacea*
	Sacheen Lake	8/3/02	55	selected areas	*M. spicatum*
Pierce	American Lake	6/18/02	12	selected areas	*I. pseudacorus, P. arundinacea*
	Bonney Lake	8/28/02	10	whole littoral	*I. pseudacorus, N. odorata, P. arundinacea*
	Florence Lake	6/19/02	15	whole littoral	*I. pseudacorus, N. odorata*
	Josephine Lake	6/19/02	15	whole littoral	*I. pseudacorus, P. arundinacea*
	Spanaway Lake	6/17/02	12	whole littoral	*I. pseudacorus, N. odorata, P. arundinacea*
Snohomish	Meadow Lake	6/6/02	7	whole littoral	*Hydrocharis morsus-ranae*
Spokane	Clear Lake	8/3/02	43	launch area	*M. spicatum*
Stevens	Loon Lake	7/24/02	59	selected areas	*I. pseudacorus, L. salicaria, P. arundinacea*
	Waitts Lake	7/24/02	59	whole littoral	*N. odorata, P. arundinacea*
Thurston	Elbow Lake	8/26/02	11	whole littoral	*L. salicaria, N. odorata, P. arundinacea*
Yakima	Buena Lake	10/3/02	37	selected areas	*M. spicatum*
	Clear Lake	8/19/02	38	whole littoral	none
	Dog Lake	8/19/02	38	whole littoral	*M. spicatum*
	East Selah Pit	9/11/02	39	whole littoral	*I. pseudacorus, L. salicaria, P. arundinacea*
	Edler Ponds	7/8/02	37	selected areas	*I. pseudacorus, L. salicaria, P. arundinacea*
		9/10/02	37	whole littoral	*I. pseudacorus, L. salicaria, P. arundinacea*
	Freeway (Rotary) Lake	10/8/02	37	selected areas	*I. pseudacorus, L. salicaria, M. spicatum, P. arundinacea*
	I-82 Pond, Ex 50	9/27/02	37	whole littoral	*M. aquaticum, L. salicaria*
		10/3/02	37	whole littoral	*M. aquaticum, L. salicaria*
	I-82 Ponds, Ex 52	10/15/02	37	selected areas	*M. aquaticum*
		10/24/02	37	selected areas	*M. aquaticum*
		10/28/02	37	selected areas	*M. aquaticum*
		12/20/02	37	selected areas	*M. aquaticum*
	Newland Pit	9/11/02	37	whole littoral	*L. salicaria*
	Parker Ponds	7/8/02	37	selected areas	*I. pseudacorus, L. salicaria, N. odorata*
		9/10/02	37	whole littoral	*I. pseudacorus, L. salicaria, N. odorata*
	Pond # 1	7/8/02	37	selected areas	none
	Pond # 2	7/8/02	37	selected areas	*M. spicatum, P. arundinacea*
	Pond 3	7/8/02	37	selected areas	*I. pseudacorus, L. salicaria, M. spicatum*
	Pond 4	7/8/02	37	selected areas	*L. salicaria, M. spicatum, P. arundinacea*
	Pond 5	7/8/02	37	selected areas	*L. salicaria, M. spicatum, P. arundinacea*
		9/10/02	37	whole littoral	*L. salicaria, M. spicatum, P. arundinacea*
	Unnamed Pond (13N-19E-07)	10/8/02	37	selected areas	*I. pseudacorus, L. salicaria, P. arundinacea*

Appendix B

Site Visit Summary Table 1994-2002

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County	Waterbody Name	WRIA	Date	Survey Extent
Adams	Herman Lake	41	7/28/98	whole lake
			9/27/2000	whole littoral
			7/10/2001	whole lake
			8/7/2001	north coves
			7/2/2002	selected areas
	Hutchinson Lake	41	8/27/2001	selected areas
			7/2/2002	selected areas
	Sprague Lake	34	9/16/1997	south half
			9/1/1999	selected areas
			7/25/2002	selected areas
Asotin	Snake River at Chief Timothy S.P.	35	8/4/1997	3 sites
Benton	De Atley Pit Pond	37	9/9/2002	whole littoral
Chelan	Antilon Lake	47	8/31/1994	from shore, N and S ends
	Chelan Lake	47	8/31/1994	from City Park shore
	Dry Lake	47	8/31/1994	from shore, east end
	Fish Lake	45	6/16/1997	west shore
			8/12/1999	west end
			9/10/2001	boat launch areas
	Roses Lake	47	8/31/1994	south shore
			6/17/1997	whole littoral
			9/11/2001	whole littoral
	Wapato Lake	47	8/31/1994	entire shoreline
			6/27/1995	whole littoral
			8/8/1995	whole littoral
			9/11/1995	whole littoral
			6/24/1996	whole littoral
			7/15/1996	milfoil sites
			9/16/1996	milfoil sites
			7/16/1997	whole littoral
			8/10/1999	whole lake
	Wenatchee Lake	45	9/1/1994	west end, east boat launch
			8/9/1999	east and west ends
			9/12/2001	east end
Clallam	Beaver Lake	20	7/9/1996	whole littoral
			8/15/2000	whole littoral
	Crescent Lake	19	7/10/1996	4 sites
			8/15/2000	boat launch areas
	Ozette Lake	20	7/9/1996	3 sites
	Pleasant Lake	20	7/11/1996	whole littoral
			8/15/2000	whole littoral
	Sutherland Lake	18	7/11/1996	whole littoral
			8/14/2000	whole littoral
			4/13/2001	selected areas
	Unnamed (30N-04W-17)	18	7/13/1995	ID from plant sample
Clark	Battleground Lake	28	4/13/1994	from dock only
			6/17/1999	whole lake
	Caterpillar Slough	28	8/15/1995	spot check from boat
	Columbia River at Ridgefield	28	8/15/1995	spot check from boat
	Lacamas Lake	28	9/3/1997	whole littoral
			6/17/1999	whole lake
Clark con’t	Vancouver Lake	28	8/15/1995	spot check from shore

County	Waterbody Name	WRIA	Date	Survey Extent
Columbia	Snake River at Little Goose Dam	35	8/5/1997	spot check, boat
	Snake River near Lyons Ferry	35	8/5/1997	spot check, boat
Cowlitz	Kress Lake	27	9/30/1999	whole shore
			6/13/2000	whole lake
			8/24/2000	whole lake
			6/21/2001	whole lake
			9/6/2001	whole lake
			8/27/2002	whole lake
	Merrill Lake	27	6/23/1999	several sites
	Sacajawea Lake	25	8/4/98	3 sites, shore
			6/23/1999	whole lake
	Silver Lake	26	9/7/1994	several locations thu' lake
			9/19/1995	several sites, from boat
			8/4/1998	south half
			9/30/1999	launch area
	Solo Slough	25	4/13/1994	spot check from shore
			7/14/1994	spot check from shore
			8/16/1995	from shore
			8/8/1996	from shore
			5/28/1997	spot check from shore
			8/4/1998	1 site, shore
	Willow Grove Slough	25	4/13/1994	spot check from shore
			7/14/1994	spot check from shore
			8/16/1995	several sites, from boat
			8/4/98	1 site, shore
Douglas	Jameson Lake	44	6/26/1996	1 site from shore
Ferry	Curlew Lake	60	8/22/1995	5 sites, whole littoral
			8/2/1996	4 sites (launches)
			8/13/1997	5 sites (launches)
			5/19/1998	2 sites, boat
			7/28/1999	10 sites, launches
			8/6/2002	selected areas
	Ellen Lake	58	8/23/1995	whole littoral
	Ferry Lake	52	8/13/1997	whole littoral
			8/6/2002	whole littoral
	Swan Lake	52	8/13/1997	whole littoral
			8/6/2002	selected areas
	Trout Lake	58	8/22/1995	whole littoral
	Twin Lakes	58	8/23/1995	4 sites, both lakes
			8/14/1997	3 sites, both lakes
Franklin	Kahlotus Lake	36	9/28/2000	one area, from shore
	Scooteney Reservoir	36	7/26/1995	spot check from shore
	Snake River - Lower Monumental Dam	33	8/20/1996	spot check, boat
	Snake River at Ice Harbor Dam	33	8/19/1996	spot check, boat
	Snake River at Levey Park	33	8/19/1996	spot check, boat
	Snake River at Windust Park	33	8/20/1996	spot check, boat
	Snake River at Lyons Ferry	34	8/5/1997	spot check, boat
Garfield	Snake River, Lower Granite Dam	35	8/4/1997	spot check, boat
Grant	Alkali Lake	42	7/16/1996	whole littoral

County	Waterbody Name	WRIA	Date	Survey Extent
Grant con't	Babcock Ridge Lake	41	7/24/1995	2 sites, whole littoral
	Banks Lake	42	6/25/1996	spot check, shore
	Billy Clapp Lake	42	8/30/1995	4 sites, whole littoral
	Blue Lake	42	7/16/1996	whole littoral
	Burke Lake	41	6/28/1994	entire shoreline
			9/19/1996	whole littoral
			9/24/1997	whole littoral
			9/9/98	whole lake
			9/29/1999	whole lake
			9/19/2001	whole littoral
			10/1/2002	selected areas
	Caliche Lake	41	9/28/2001	whole littoral
	Canal Lake	41	8/30/1995	4 sites, whole littoral
			9/27/2000	whole littoral
	Corral Lake	41	7/25/1995	whole littoral
	Crater Lake	41	7/24/1995	spot check from shore
	Deep Lake	42	6/25/1996	whole littoral
	Dry Falls Lake	42	6/25/1996	spot check, shore
	Evergreen Lake	41	6/27/1994	entire shoreline
			9/12/1995	8 transects, whole littoral
			9/18/1996	8 transects, whole littoral
			9/23/1997	8 transects, whole littoral
			9/9/98	whole lake
			9/28/1999	whole lake
			10/10/2001	east end
	Frenchman Hills	41	7/29/98	1 site, shore
	Heart Lake	41	9/26/2000	whole littoral
	Lenore Lake	42	7/17/1996	whole littoral
	Long Lake (17N-29E-32)	41	8/31/1995	2 sites, whole littoral
			9/27/2000	whole littoral
	Moses Lake	41	7/15/1998	10 sites, boat
	Park Lake	42	6/26/1996	whole littoral
			9/10/1998	whole lake
			8/5/2002	whole littoral
	Potholes Reservoir	41	8/7/1994	6 sites on N & W side
			7/16/98	10 sites, boat
	Priest Rapids Lake	36	6/27/2001	selected areas
	Quincy Lake	41	6/28/1994	entire shoreline
			9/13/1995	3 transects, whole littoral
			9/17/1996	3 transects, whole littoral
			9/22/1997	whole littoral
			9/8/98	whole lake
			9/29/1999	whole lake
	Red Rock Lake	41	5/15/2002	whole littoral
	Rocky Ford Cr	41	7/28/1997	spot check, shore
	Soda Lake	41	7/25/1995	whole littoral
			9/26/2000	whole littoral
	Stan Coffin Lake	41	6/29/1994	entire shoreline
			7/11/2001	whole littoral
			6/18/2002	selected areas

County	Waterbody Name	WRIA	Date	Survey Extent
Grant con't	Stan Coffin Lake con't		11/1/2002	selected areas
	Warden Lake	41	7/25/1995	2 sites, whole littoral
			7/28/98	whole lake
			9/26/2000	whole lake
	Winchester Wasteway	41	7/26/1995	spot check from shore
			7/28/98	1 site, shore
	Windmill Lake	41	8/30/1995	south end
			9/27/2000	whole littoral
Grays Harbor	Aberdeen Lake	22	7/22/1996	whole littoral
			8/16/2000	whole littoral
	Duck Lake	22	9/9/1995	2 sites, from shore
			8/18/98	main lake
			9/21/1999	10 sites
	Failor Lake	22	6/25/1997	whole littoral
			8/16/2000	whole littoral
	Quinault Lake	21	10/7/1996	75% of littoral
	Sylvia Lake	22	7/22/1996	whole littoral
			8/16/2000	whole littoral
Island	Cranberry Lake	6	8/24/1994	4 sites around lake
			9/5/1996	spot check, shore
			8/7/2001	selected areas
	Crockett Lake	6	9/4/1996	spot check, shore
	Deer Lake	6	9/4/1996	whole littoral
	Goss Lake	6	9/5/1996	whole littoral
			8/4/1999	whole lake
			8/8/2001	whole littoral
	Lone Lake	6	9/4/1996	whole littoral
Jefferson	Anderson Lake	17	7/8/1996	whole littoral
	Crocker Lake	17	5/24/1994	northwest half - littoral
			6/14/1995	whole littoral
			6/11/1996	whole littoral
			8/27/1997	whole littoral
			9/3/98	whole lake
			8/8/2001	selected areas
	Leland Lake	17	5/24/1994	entire shoreline
			6/14/1995	whole littoral
			10/3/1995	whole littoral
			11/8/1995	Egeria site
			6/11/1996	whole littoral
			7/2/1996	whole littoral
			10/2/1996	whole littoral
			8/27/1997	spot check
			9/3/98	whole lake
			10/7/1999	whole lake
			9/14/2000	whole lake
			8/9/2001	selected areas
			8/29/2002	whole littoral
	Tarboo Lake	17	7/2/1996	whole littoral
King	Alice Lake	7	8/12/1999	whole lake
	Desire Lake	8	9/7/1999	whole lake

County	Waterbody Name	WRIA	Date	Survey Extent
King con't			7/8/1999	whole lake
	Killarney Lake	10	9/18/2001	whole littoral
	Lucerne Lake	9	6/9/1995	outlet
			7/15/1995	spot check
			10/4/2002	whole littoral
	Meridian Lake	9	7/10/1997	whole littoral
	Morton Lake	9	8/19/1997	whole littoral
	Neilson (Holm) Lake	9	6/20/2002	whole littoral
	Number Twelve Lake	9	6/20/2002	whole littoral
	Otter (Spring) Lake	8	7/8/1999	whole lake
	Pipe Lake	9	6/1/1995	several sites, divers
			6/9/1995	near boatlaunch, outlet
			7/12/1995	from shore
			7/15/1995	6 sites, biomass samples
			8/1/1995	6 sites, biomass samples
			6/18/1996	spot check, boat
			7/21/1997	3 sites
			6/9/98	whole lake
			11/17/98	3 sites, boat
			6/10/1999	selected areas
			10/4/2002	selected areas
	Sawyer Lake	9	8/7/1997	whole littoral
			7/21/1999	whole lake
	Steel Lake	9	5/11/1994	entire shoreline, divers
	Shady Lake	9	7/8/1999	whole lake
	Washington Lake	8	8/24/98	Juanita Bay
	Wilderness Lake	9	8/19/1997	whole littoral
Kitsap	Buck Lake	15	7/22/98	whole lake
			7/31/2002	whole littoral
	Horseshoe Lake	15	8/22/1996	whole littoral
			7/20/2000	whole littoral
	Island Lake	15	7/22/98	whole lake
			7/31/2002	whole littoral
	Kitsap Lake	15	8/3/1995	2 sites, whole littoral
			8/28/1997	4 sites
			7/1/1998	south end
			7/29/2002	whole littoral
	Long Lake	15	9/12/1994	several locations
			3/17/1995	6 transects, whole littoral
			7/22/1997	2 sites
			8/28/1997	3 sites
			8/17/1999	selected areas
	Mission Lake	15	9/9/1996	whole littoral
			6/18/1998	whole lake
			7/30/2002	whole littoral
	Panther Lake	15	8/2/1995	whole littoral
			7/30/2002	whole littoral

County	Waterbody Name	WRIA	Date	Survey Extent
Kitsap con't	Square Lake	15	7/22/1997	spot check, shore
			6/2/1999	1 site, shore
	Wildcat Lake	15	10/4/1995	4 sites, whole littoral
			8/20/1998	whole lake
			8/1/2002	whole littoral
	William Symington Lake	15	9/16/98	whole lake
	Wye Lake	15	7/1/98	1 site, shore
Kitsap/Mason	Tiger Lake	15	9/9/1996	whole littoral
			6/14/1999	whole lake
Kittitas	Cle Elum Reservoir	39	7/29/98	1 site, shore
	Easton Lake	39	8/30/1994	spot check from shore
			6/18/1997	spot check, shore
	Fiorito Ponds	39	6/26/2001	selected areas
			7/18/2002	whole littoral
	Freeway Pond	39	9/12/2002	whole littoral
	Gladmar Pit Pond	39	9/12/2002	whole littoral
	Hanson Ponds	39	11/2/2001	selected areas
			9/12/2002	whole littoral
	Kiwanis Pond	39	8/30/1994	spot check from shore
		39	9/14/2001	selected areas
	Lavender Lake	39	6/18/1997	whole littoral
			7/27/98	whole lake
			9/14/2001	whole littoral
	Mattoon Lake	39	8/30/1994	most of shoreline
			8/21/2001	whole littoral
			5/28/2002	selected areas
			6/10/2002	whole littoral
	Roza Reservoir	39	6/26/2001	whole littoral
	Unnamed Ponds near Easton	39	6/18/1997	spot check, shore
	unnamed ponds	39	8/30/1994	spot checks
	Wild Duck Lake	39	7/27/98	2 sites, shore
			7/12/1999	whole lake
			8/17/2001	selected areas
Klickitat	Columbia River at Bingen	29	8/14/1995	spot check from shore
	Columbia River at Maryhill	30	8/14/1995	spot check from boat
	Horsethief Lake	30	8/14/1995	spot check from shore
			6/17/1999	1 site, shore
	Spearfish Lake	30	6/17/1999	whole shore
Lewis	Carlisle Lake	23	8/20/1997	whole littoral
	Chehalis River	23	7/27/1995	shoreline, from boat
			9/10/1996	1 site from shore
			7/23/1997	spot check, shore
			8/20/1997	1 mile of river
	Interstate Ave Slough	23	8/20/1997	spot check, shore
	Mayfield Reservoir	26	10/5/98	south half
	Plummer Lake	23	8/20/1997	whole littoral
			7/30/2001	whole littoral
	Swofford Pond	26	9/15/98	east end
			7/31/2001	whole littoral
Lincoln	Sprague Lake	34	8/6/1994	cove at NE end of lake
Mason	Benson Lake	14	7/23/1996	whole littoral

County	Waterbody Name	WRIA	Date	Survey Extent
Mason con't	Benson Lake		7/20/2000	whole littoral
	Devereaux Lake	15	8/16/1994	spot check from shore
			6/22/2002	whole littoral
	Haven Lake	15	8/16/1994	entire shoreline
			6/8/1998	whole lake
			8/14/2002	whole littoral
	Isabella Lake	14	7/19/1994	entire shoreline
			8/2/1995	checked for rare plant
			8/18/1997	whole littoral
			7/18/2000	whole littoral
	Island Lake	14	7/23/1996	whole littoral
			6/24/1997	whole littoral
			7/9/98	whole littoral
			7/13/2000	whole littoral
	Limerick Lake	14	8/15/1994	entire shoreline
			7/13/1995	spot check, boat
			7/22/1997	2 sites
			7/8/98	whole lake
			7/13/2000	whole lake
			9/13/2001	whole littoral
	Lost Lake	14	8/11/1994	entire shoreline
			6/10/1997	whole littoral
			7/18/2000	whole littoral
	Lystair (Star) Lake	22	6/12/98	whole lake
	Maggie Lake	15	8/19/98	whole lake
	Mason Lake	14	8/7/1996	whole littoral
			9/14/98	whole lake
			9/22/1999	whole shore
			9/13/2000	selected areas
			8/13/2002	whole littoral
	Nahwatzel Lake	22	6/26/1997	whole littoral
			7/14/2000	whole littoral
	Phillips Lake	14	7/20/98	whole lake
			6/8/1999	whole lake
			8/17/2000	whole lake
	Simpson (Arrowhead) Lake	22	9/17/2001	whole littoral
			8/12/2002	whole littoral
	Spencer Lake	14	8/15/1994	most of shoreline
			7/13/1995	spot check, boat
			8/22/1996	south end, boat
			7/22/1997	2 sites
			6/15/1999	whole lake
			8/17/2000	whole lake
	Tee Lake	15	8/19/98	whole lake
	Trails End (formerly Prickett)	15	6/16/98	whole lake
			8/15/2002	whole littoral
	Wooten Lake	15	8/16/1994	most of shoreline
			6/16/98	whole lake
			7/22/1999	whole lake
			8/14/2002	whole littoral
Okanogan	Aeneas Lake	49	7/25/1994	entire shoreline

County	Waterbody Name	WRIA	Date	Survey Extent
Okanogan con't			7/12/1999	south end
	Alta Lake	48	6/29/1995	whole littoral
	Beaver Lake	60	8/7/2002	whole littoral
	Beth Lake	60	8/7/2002	selected areas
	Big Twin Lake	48	8/9/1995	most of littoral
			8/11/1999	whole lake
	Blue Lake (37N-25E-22)	49	7/14/1999	whole lake
	Bonaparte Lake	49	8/27/1996	whole littoral
			8/7/2002	whole littoral
	Buffalo Lake	53	8/21/1995	3 sites, boat
	Chopaka Lake	49	7/13/1999	selected areas
	Conconully Lake	49	7/26/1994	7 sites thru' shoreline
	Conconully Reservoir	49	7/26/1994	north end
			9/18/1997	whole littoral
	Crawfish Lake	52	8/28/1996	whole littoral
	Davis Lake	48	8/9/1995	whole littoral
			8/10/1999	1 site, shore
	Duck (Bide-a-Wee) Lake	49	8/28/1996	spot check, shore
			9/18/1997	spot check
	Ell Lake	52	7/15/1999	whole lake
	Fish Lake	49	7/26/1994	entire shoreline
			7/14/1999	whole lake
	Green Lake	49	6/29/1995	2 sites, whole littoral
			8/8/2002	selected areas
	Leader Lake	49	8/29/1996	whole littoral
	Little Twin Lake	48	8/9/1995	whole littoral
			8/11/1999	whole lake
	Long Lake	52	7/15/1999	whole lake
	Lost Lake	60	8/7/2002	selected areas
	Omak Lake	49	8/28/1996	north end, boat
	Palmer Lake	49	7/27/1994	boatlaunches, from shore
			6/28/1995	whole littoral
			7/13/1999	whole lake
	Patterson Lake	48	8/10/1995	2 sites, whole littoral
			8/10/1999	whole lake
	Pearrygin Lake	48	8/10/1995	3 sites, whole littoral
			8/11/1999	whole lake
	Round Lake	52	7/15/1999	whole lake
	Sidley Lake	49	8/27/1996	spot check, shore
	Spectacle Lake	49	7/27/1994	5 sites, various locations
			8/27/1996	whole littoral
			9/17/1997	3 sites
			7/14/1999	selected areas
	Wannacut Lake	49	7/28/1994	3 sites
	Whitestone Lake	49	7/27/1994	5 sites, various locations
			6/28/1995	6 sites, whole littoral
			8/26/1996	whole littoral
			9/17/1997	whole littoral
			7/13/1999	1 site, shore
Pacific	Black Lake	24	7/12/1994	spot check, shore
			8/8/1996	most of shoreline

County	Waterbody Name	WRIA	Date	Survey Extent
Pacific con’t			8/26/1997	whole littoral
			6/22/1999	1 site, shore
			8/2/2001	selected areas
	Island Lake	24	7/14/1994	entire shoreline
			8/26/1997	whole littoral
	Loomis Lake	24	7/13/1994	most of shoreline
			8/25/1997	whole littoral
			6/22/1999	whole lake
			8/1/2001	whole littoral
			6/24/2002	whole littoral
	O'Neil Lake	24	7/12/1994	entire littoral
			8/25/1997	spot check, shore
	Surfside Lake	24	7/13/1994	5 sites from bridges
			8/25/1997	spot check, shore
Pend Oreille	Bead Lake	62	8/12/1997	coves, 5 sites
		62	7/23/2002	whole littoral
	Big Meadow	61	7/26/2000	west basin
	Browns Lake	62	7/31/1996	spot check, shore
			8/25/1999	whole lake
	Davis Lake	62	8/2/1994	most of littoral
			7/30/1996	north end, boat launch
			8/12/1997	whole littoral
	Diamond Lake	55	8/2/1994	boatlaunch, from shore
			7/31/1996	east end, boat launch
			8/11/1997	west half
	Fan Lake	55	8/3/1994	entire shoreline
			8/12/1997	whole littoral
			7/22/2002	selected areas
	Frater Lake	59	8/1/1996	spot check, shore
			8/28/2001	whole littoral
	Half Moon Lake	62	7/31/1996	north end
	Horseshoe Lake	55	7/13/98	west half
	Kent Meadows Lake	62	8/25/1999	2 sites, shore
	Leo Lake	59	7/28/1999	whole lake
			7/23/2002	whole littoral
	Little Spokane River	55	8/2/1994	at Fertile Valley Rd crossing
			8/2/1994	at Haworth Rd crossing
	Marshall Lake	62	8/1/1994	3 sites, mostly at inlets
			8/24/1999	whole lake
			8/28/2001	whole littoral
	Mill Lake	62	8/1/1996	2 sites, shore
			8/27/2001	whole littoral
	Nile Lake	62	8/1/1996	spot check, shore
			8/27/2001	whole littoral
	Parker Lake	62	8/24/1999	1 site, shore
	Pend Oreille River	62	8/1/1996	spot check, shore
	Sacheen Lake	55	8/2/1994	3 sites, covered entire shore
			8/3/2002	selected area
	Skookum Lake, North	62	7/31/1996	spot check, shore
			8/24/1999	whole lake
	Skookum Lake, South	62	7/31/1996	whole littoral

County	Waterbody Name	WRIA	Date	Survey Extent
Pend Oreille	Sullivan Lake	62	8/1/1996	north and south, boat
	Trask Pond	57	8/25/1999	shore
	Unnamed Wetland near Usk	62	8/1/1996	shore
Pierce	American Lake	12	10/4/1994	4 sites
			10/6/1998	whole lake
			6/18/2002	selected areas
	Bay Lake	15	9/28/1995	whole littoral
			9/13/2000	whole littoral
	Bonney Lake		8/28/2002	whole littoral
	Carney Lake	15	7/1/1998	1 site, shore
	Clear Lake	11	7/21/1994	entire shoreline
			6/12/1996	whole littoral
			6/23/1997	whole littoral
			7/6/1999	whole lake
	Florence Lake	15	6/19/2002	whole lake
	Harts Lake	11	6/17/1996	spot check, shore
			7/3/1996	whole littoral
			6/24/1999	whole lake
	Josephine Lake	15	6/19/2002	whole lake
	Kapowsin Lake	10	9/20/2000	northeast half
			6/15/2001	selected areas
	Ohop Lake	11	7/25/1996	whole littoral
			9/25/1997	whole littoral
			9/19/2001	whole littoral
	Rapjohn Lake	11	7/25/1996	whole littoral
			8/2/1999	whole lake
			9/19/2001	whole littoral
	Silver Lake	11	6/17/1996	spot check, shore
	Spanaway Lake	12	9/11/1996	whole littoral
			6/17/2002	whole littoral
	Steilacoom Lake	12	6/19/1996	spot check, boat
			8/26/98	whole lake
			10/21/98	1 site, boat
	Tanwax Lake	11	7/21/1994	entire shoreline
			9/12/1996	whole littoral
			7/6/1999	whole lake
	Tapps Lake	10	9/21/2000	boat launch area
	Whitman Lake	11	8/5/1999	whole lake
San Juan	Cascade Lake	2	9/9/1997	whole littoral
	Hummel Lake	2	9/8/1997	whole littoral
			8/7/2001	whole littoral
	Mountain Lake	2	9/9/1997	whole littoral
	Sportsman Lake	2	9/10/1997	whole littoral
Skagit	Beaver Lake	3	8/25/1994	entire shoreline
			9/15/1999	whole lake
	Big Lake	3	8/23/1994	3 sites, extreme ends
			8/23/1994	& launch
			9/15/1999	whole lake
	Campbell Lake	3	6/7/1994	entire shoreline
			8/13/1996	whole littoral
			7/2/1997	whole littoral

County	Waterbody Name	WRIA	Date	Survey Extent
			8/4/1999	whole lake
Skagit con't	Cavanaugh Lake	5	8/24/98	whole lake
	Clear Lake (34N-05E-07)	3	8/25/1994	boatramp only
			9/15/1999	whole lake
	Cranberry Lake	3	8/25/98	2 sites, shore
			9/11/2000	north end, from shore
	Erie Lake	3	8/24/1994	Entire shoreline
			8/13/1996	spot check, shore
			7/2/1997	whole littoral
			9/16/1999	whole lake
			9/11/2000	whole lake
			8/6/2001	whole littoral
	Everett Lake	4	8/15/1996	spot check, shore
	Heart Lake (35N-01E-36)	3	8/24/1994	most of shoreline
			8/13/1996	whole littoral
			8/25/98	whole lake
			9/11/2000	whole lake
	McMurray Lake	3	6/6/1994	entire shoreline
			8/23/1994	entire shoreline
			8/3/1999	whole lake
	Pass Lake	3	7/2/1997	spot check, shore
	Sixteen Lake	3	6/6/1994	entire shoreline
			8/3/1999	whole lake
Skamania	Coldwater Lake	26	8/27/98	80% of shore
	Drano Lake	29	6/17/1999	1 site, shore
Snohomish	Blackmans Lake	7	8/5/98	whole lake
	Flowing Lake	7	9/12/2000	whole littoral
	Goodwin Lake	7	6/20/1995	3 sites, littoral survey
	Howard Lake	5	7/20/1999	whole lake
	Ki Lake	5	7/19/1999	whole lake
	Martha Lake (31N-04E-18)	5	7/20/1999	whole lake
	Martha Lake (27N-04E-01)	8	8/5/98	whole lake
	Meadow Lake	7	6/6/2002	whole lake
	Nina Lake	7	6/20/1995	2 sites, from shore
	Riley Lake	5	7/19/1999	whole lake
	Roesiger (north arm) Lake	7	8/6/98	whole lake
	Roesiger (south arm) Lake	7	8/25/1994	east side, littoral
			6/21/1995	spot check, boat
			8/29/1995	most of shoreline
			8/6/98	whole lake
	Shoecraft Lake	7	8/15/1996	whole littoral
	Stevens Lake	7	9/10/1997	4 sites
Spokane	Amber Lake	34	8/5/1994	at boatramp, from shore
	Badger Lake	34	8/5/1994	2 sites at extreme ends
	Chapman Lake	34	8/24/1995	3 sites
	Clear Lake	43	8/4/1994	4 sites, most of shoreline
			8/3/2002	launch area
	Downs Lake	34	8/3/1994	from shore - one location
	Eloika Lake	55	8/3/1994	3 sites, missed some places
			8/29/2001	whole littoral

County	Waterbody Name	WRIA	Date	Survey Extent
Spokane con't	Fishtrap Lake	43	8/4/1994	3 sites
	Liberty Lake	57	7/13/98	whole lake
			7/27/2000	4 sites
	Long Lake (reservoir)	54	8/6/1994	2 sites near boatlaunch
			8/25/1995	1 site
			8/31/1999	selected areas
	Medical Lake	43	7/14/98	whole lake
	Medical, West Lake	43	7/14/98	whole lake
			8/30/2001	whole littoral
	Newman Lake	57	8/31/1999	south end
			7/26/2000	north end
	Silver Lake	34	8/4/1994	only at boatramp (closed)
			8/24/1995	2 sites
			7/28/2000	whole littoral
			8/30/2001	selected areas
	Williams Lake	34	8/5/1994	boatlaunch and south end
			9/16/1997	whole littoral
Stevens	Black Lake	59	7/25/2000	whole littoral
	Deep Lake	61	7/30/1997	whole littoral
			7/25/2000	all but west shore
	Deer Lake	59	7/29/1997	whole littoral
			7/27/1999	whole lake
			7/27/2000	boat launch areas
	Gillette Lake	59	7/27/1999	whole lake
	Jumpoff Joe Lake	59	7/29/1997	whole littoral
			7/27/2000	whole littoral
	Loon Lake	59	9/25/1996	whole littoral
			7/31/1997	1 site
			6/24/1998	whole lake
			8/11/1998	whole lake
			6/28/1999	whole lake
			7/24/2002	selected areas
	Starvation Lake	59	7/26/1999	whole lake
	Waitts Lake	59	7/30/1997	whole littoral
			7/24/2002	whole littoral
Thurston	Black Lake	23	7/8/1994	north end
			4/18/1995	1 site to test methods
	Black River near Gate	23	8/18/98	1 site, shore
			9/15/98	1 site, shore
			9/30/98	5 mile reach
			10/20/1999	5 mile reach
	Clear Lake	11	8/7/1995	1 site
	Elbow Lake	11	8/26/2002	whole littoral
	Hicks Lake	13	5/24/1995	3 sample sites, shoreline
	Lawrence Lake	13	11/7/1995	spot check from shore
	Lois Lake	13	8/12/2001	selected areas
	Long Lake	14	6/6/1995	spot check
			9/20/1995	milfoil site
			10/18/1995	spot check
			11/2/1995	milfoil site
	Munn Lake	13	6/3/98	1 site, shore

County	Waterbody Name	WRIA	Date	Survey Extent
Thurston con't			10/14/98	1 site, shore
	Munn Lake		5/25/1999	1 site, shore
			6/21/1999	whole lake
			9/7/2000	whole littoral
	Offutt Lake	13	7/7/98	whole lake
	Patterson Lake	13	9/18/2001	whole littoral
	Summit Lake	14	7/23/1997	west end
	Ward Lake	13	7/6/98	whole lake
Wahkiakum	Brooks Slough	25	6/22/1999	1 site, shore
	Columbia River at Cathlamet	25	8/16/1995	spot check, boat
	Columbia River at Skamokawa	25	8/8/1996	spot check, boat
	Puget Island Sloughs	25	5/16/1995	2 sloughs, from shore
Walla Walla	Snake River - Lower Monumental Dam	33	8/20/1996	spot check, boat
	Snake River at Charbonneau Park	33	8/19/1996	spot check, boat
	Snake River at Fishhook Park	33	8/19/1996	spot check, boat
	Snake River at Ice Harbor Dam	33	8/19/1996	spot check, boat
Whatcom	Cain Lake	3	8/14/1996	whole littoral
			9/13/1999	whole lake
	Samish Lake (East Arm)	3	6/30/1997	whole littoral
			9/14/1999	whole lake
	Samish Lake (West Arm)	3	6/30/1997	whole littoral
			9/14/1999	whole lake
	Silver Lake	1	7/1/1997	whole littoral
			9/12/2000	whole littoral
	Terrell Lake	1	8/14/1996	whole littoral
			9/14/1999	whole lake
	Toad (Emerald) Lake	1	7/3/1997	whole littoral
	Whatcom Lake	1	6/21/1995	3 sites, littoral, west basin
	Wiser Lake	1	8/14/1996	spot check, shore
			7/1/1997	whole littoral
Whitman	Rock Lake	34	8/5/1994	south boatramp, from shore
			9/15/1997	spot check, shore
	Snake River at Central Ferry	35	8/5/1997	spot check, shore
	Snake River at Little Goose Dam	35	8/5/1997	spot check, boat
	Snake River at Lower Granite Dam	35	8/4/1997	spot check, boat
Yakima	Byron Lake	37	7/9/2001	selected areas
	Buena Lake	37	10/3/2002	selected areas
	Clear Lake	38	8/19/2002	whole lake
	Dog Lake	38	7/30/1998	whole lake
			8/15/2001	whole littoral
			10/25/2001	selected areas
			8/19/2002	whole lake
	East Selah Pit Pond	39	9/11/2002	whole littoral
	Edler Ponds	37	9/10/2002	whole littoral
	Freeway (Rotary) Lake	37	10/8/2002	selected areas

County	Waterbody Name	WRIA	Date	Survey Extent
Yakima con't	Giffin Lake	37	7/19/1995	from shore
			8/1/2001	selected areas
	I-82 Pond, Exit 50	37	9/27/2002	whole littoral
	I-82 Ponds, Exit 52	37	10/15/2002	selected areas
	Leech Lake	39	7/30/1998	whole lake
			8/24/2001	whole littoral
	Morgan Lake	37	7/19/1995	spot check, from shore
			8/1/2001	selected areas
	Myron Lake	38	6/25/2001	selected areas
	Newland Pit Pond	37	9/11/2002	whole littoral
	Parker Ponds	37	7/18/1995	spot check, from shore
			7/29/1998	4 sites, shore
			9/10/2002	all of eastern ponds
	pond nr hwy 12	37	8/8/1994	one spot, from shore
			7/27/2001	selected areas
	Pond 1	37	7/8/2002	selected areas
	Pond 2	37	7/8/2002	selected areas
	Pond 3	37	7/8/2002	selected areas
	Pond 4	37	7/8/2002	selected areas
	Pond 5	37	9/10/2002	whole littoral
	Unnamed Pond (13N-19E-07)	37	10/8/2002	selected areas
	Unnamed pond (14N-19E-31)	39	7/18/1995	spot check, from shore
			7/29/1998	1 site, shore
	Wenas Lake	39	7/29/98	whole lake
			7/17/2001	selected areas
	Yakima River	37	8/8/1994	from Selah to Arboretum
			9/27/1994	Arboretum to Union Gap
			7/19/1995	Mabton Bridge

Appendix C

Myriophyllum spicatum, Egeria densa,
Myriophyllum aquaticum

Distribution Maps

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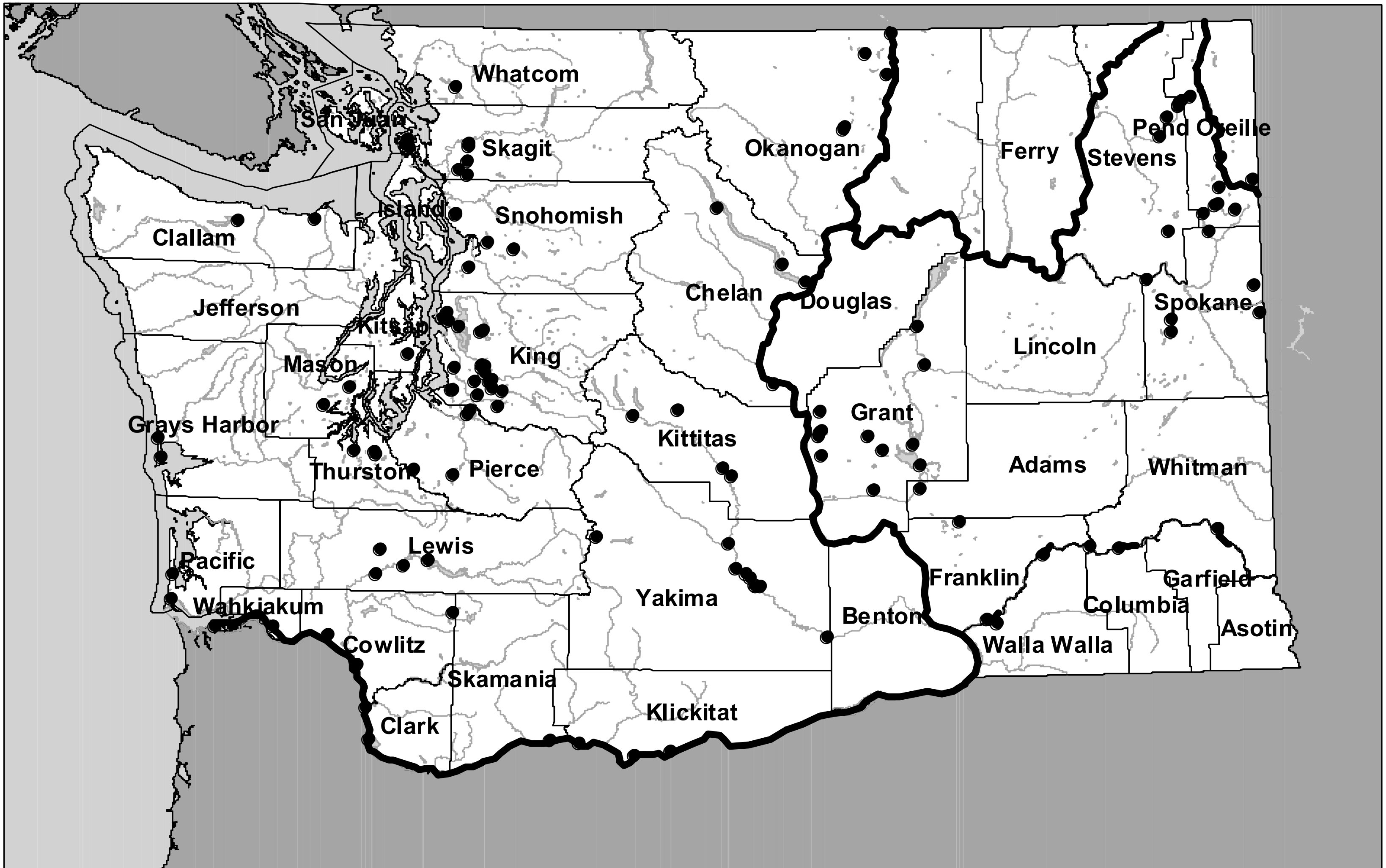
Lakes Known to Contain Eurasian milfoil (*Myriophyllum spicatum*), as of December, 2002

County	Waterbody Name	County	Waterbody Name
Adams	Hutchinson Lake	Mason	Island Lake
Chelan	Chelan Lake		Mason Lake
	Cortez (Three) Lake	Okanogan	Conconully (Salmon) Lake
	Domke Lake		Conconully Reservoir (35N-25E-18)
	Roses (Alkali) Lake		Osoyoos Lake
	Wapato Lake		Palmer Lake
Clallam	Sutherland Lake		Whitestone Lake
	Unnamed (30N-04W-17)	Pacific	Black Lake
Clark	Caterpillar Slough		Loomis Lake
	Columbia River at Ridgefield	Pend Oreille	Davis Lake
Clatsop	Columbia River at Astoria		Diamond Lake
Columbia	Snake River at Little Goose Dam		Fan Lake
	Snake River near Lyons Ferry		Horseshoe Lake
Cowlitz	Kress Lake		Little Spokane River
	Willow Grove Slough		Marshall Lake
Franklin	Scooteney Res		Nile Lake
	Snake River at Ice Harbor Dam		Pend Oreille River
	Snake River at Lower Monumental Dam		Sacheen Lake
	Snake River at Lyons Ferry	Pierce	Clear Lake
Grant	Babcock Ridge Lake		Harts Lake
	Banks Lake		Hidden Lake
	Billy Clapp Lake		Tapps Lake
	Burke Lake	Skagit	Beaver Lake
	Caliche Lake		Big Lake
	Evergreen Lake		Campbell Lake
	Moses Lake		Clear Lake (34N-05E-07)
	Potholes Reservoir		Erie Lake
	Priest Rapids Lake		Heart Lake (35N-01E-36)
	Red Rock Lake		McMurray Lake
	Stan Coffin Lake		Sixteen Lake
	Winchester Wasteway	Skamania	Drano Lake
	Winchester Wasteway Ext.	Skamania, Cowlitz	Coldwater Lake
Grays Harbor	Connor Creek	Snohomish	Goodwin Lake
	Duck Lake		Roesiger (north arm) Lake
Island	Goss Lake		Roesiger (south arm) Lake
King	Bass Lake		Shoecraft Lake
	Desire Lake		Silver Lake (28N-05E-30)
	Dolloff Lake		Stevens Lake
	Green Lake	Spokane	Eloika Lake
	Lucerne Lake		Liberty Lake
	Meridian Lake		Long Lake (Reservoir)

County	Waterbody Name	County	Waterbody Name
	Neilson (Holm) Lake		Newman Lake
	Number Twelve Lake		North Silver Lake
	Otter (Spring) Lake		Silver Lake
	Phantom Lake	Stevens	Black Lake
	Pipe Lake		Gillette Lake
	Sammamish Lake		Heritage Lake
	Sawyer Lake		Loon Lake
	Shadow Lake		McDowell Lake
	Shady Lake		Sherry Lake
	Ship Canal		Thomas Lake
	Star Lake	Thurston	Capitol Lake
	Steel Lake		Lois Lake
	Union Lake		Long Lake
	Washington Lake		Scott Lake
	Wilderness Lake		Skiview Lake
Kitsap	Long Lake	Wahkiakum	Columbia River at Cathlamet
Kittitas	Fiorito Ponds	Walla Walla	Snake River at Ice Harbor Dam
	Lavender Lake		Snake River at Lower Monumental Dam - Walla Walla
	Mattoon Lake	Whatcom	Whatcom Lake
	Private Pond (20N-16E-10)	Whitman	Snake River at Central Ferry
Klickitat	Columbia River at Bingen		Snake River at Little Goose Dam
	Columbia River at Maryhill		Snake River at Lower Granite Dam
	Horsethief Lake	Yakima	Buena Lake
Lewis	Carlisle Lake		Byron Lake
	Cowlitz River near Blue Cr		Dog Lake
	Mayfield Reservoir		Freeway (Rotary) Lake
	Riffe Lake		Parker Ponds
	South County Park Pond		Pond 2
	Swofford Pond		Pond 3
			Pond 4
			Pond 5

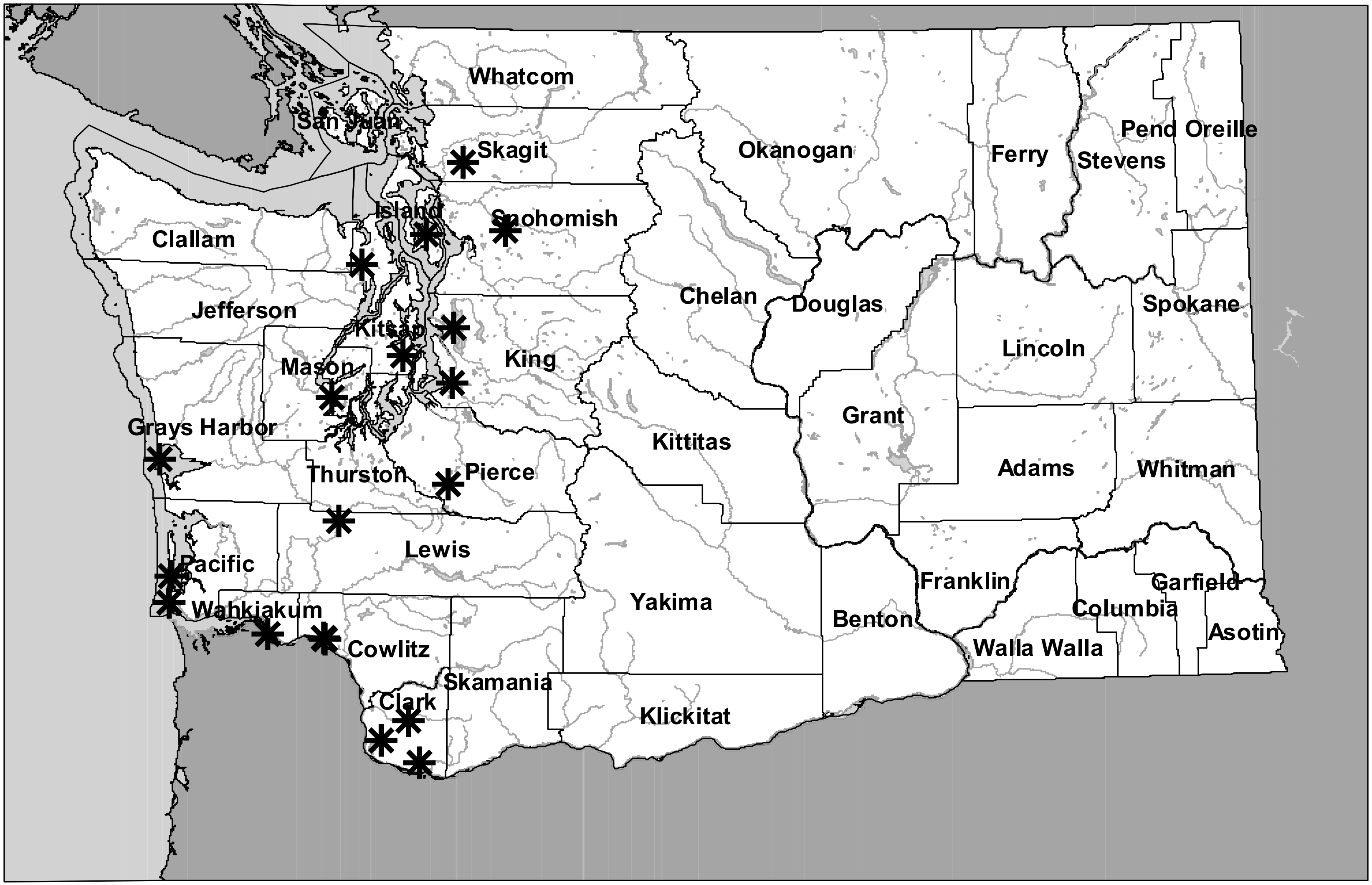
Myriophyllum spicatum distribution, 2002



Lakes Known to Contain Brazilian elodea (*Egeria densa*), as of December, 2002

County	Waterbody Name	County	Waterbody Name
Clark	Battleground Lake	Kitsap	Long Lake
	Klineline Pond	Lewis	Chehalis River
	Lacamas Lake		Plummer Lake
Cowlitz	Solo Slough	Mason	Limerick Lake
	Willow Grove Slough	Pacific	Black Lake
Grays Harbor	Duck Lake		Loomis Lake
Island	Unnamed Pond	Pierce	Ohop Lake
Jefferson	Leland Lake	Skagit	Big Lake
King	Fenwick Lake	Snohomish	Swartz Lake
	Washington Lake	Wahkiakum	Puget Island Sloughs

Egeria densa distribution, 2002



Lakes Known to Contain parrotfeather (*Myriophyllum aquaticum*), as of December, 2002

County	Waterbody Name	County	Waterbody Name
Cowlitz	Solo Slough	Pierce	Slough, Port of Tacoma
Grays Harbor	Chehalis River	Snohomish	Nina Lake
Island	Unnamed Pond (31N-02E-35)	Wahkiakum	Brooks Slough
King	Unnamed Pond, Bellevue		Columbia River at Skamokawa
Lewis	Chehalis River		Puget Island Sloughs
	Interstate Ave Slough	Yakima	I-82 Pond, Exit 50
Pacific	Sloughs near Long Beach		I-82 Ponds, Exit 52

Myriophyllum aquaticum distribution, 2002

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Appendix D

Locations of aquatic invasive non-native species (other than M. spicatum, E. densa, and M. aquaticum)

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Scientific name	Weed Class	County	Waterbody Name
Cabomba caroliniana	Class B	Clatsop	Cullaby Lake
(fanwort)		Cowlitz	Solo Slough
		Cowlitz	Willow Grove Slough
Hydrilla verticillata	Class A	King	Lucerne Lake
(hydrilla)		King	Pipe Lake
Hydrocharis morsus-ranae (European frog-bit)	Quarantine	Snohomish	Meadow Lake
Ludwigia hexapetala (water primrose)	Monitor	Cowlitz	Solo Slough
Nymphaea odorata	Class C	Chelan	Fish Lake
(fragrant waterlily)		Chelan	Roses (Alkali) Lake
		Clark	Battleground Lake
		Cowlitz	Sacajawea Lake
		Cowlitz	Silver Lake
		Grant	Canal Lake
		Grant	Heart Lake
		Grays Harbor	Aberdeen Lake
		Jefferson	Leland Lake
		King	Alice Lake
		King	Beaver Lake No. 2
		King	Burien Lake
		King	Cottage Lake
		King	Desire Lake
		King	Dolloff Lake
		King	Fivemile Lake
		King	Geneva Lake
		King	Haller Lake
		King	Joy Lake
		King	Kathleen Lake
		King	Killarney Lake
		King	Leota Lake
		King	Lucerne Lake
		King	Marcel (Loop) Lake
		King	McDonald Lake
		King	Meridian Lake
		King	Morton Lake
		King	Neilson (Holm) Lake
		King	North Lake
		King	Number Twelve Lake
		King	Panther Lake
		King	Pine Lake
		King	Pipe Lake
		King	Retreat Lake

Scientific name	Weed Class	County	Waterbody Name
		King	Sawyer Lake
		King	Shadow Lake
		King	Shady Lake
		King	Star Lake
		King	Steel Lake
		King	Trout Lake
		King	Wilderness Lake
		Kitsap	Buck Lake
		Kitsap	Horseshoe Lake
		Kitsap	Island Lake
		Kitsap	Kitsap Lake
		Kitsap	Long Lake
		Kitsap	Mission Lake
		Kitsap	Square Lake
		Kitsap	Tahuya Lake
		Kitsap	Wildcat Lake
		Kitsap/Mason	Tiger Lake
		Mason	Benson Lake
		Mason	Isabella Lake
		Mason	Island Lake
		Mason	Limerick Lake
		Mason	Lost Lake
		Mason	Lystair (Star) Lake
		Mason	Mason Lake
		Mason	Nahwatzel Lake
		Mason	Spencer Lake
		Mason	Trails End (formerly Prickett)
		Mason	Wooten Lake
		Pacific	Loomis Lake
		Pend Oreille	Diamond Lake
		Pend Oreille	Sacheen Lake
		Pierce	American Lake
		Pierce	Bay Lake
		Pierce	Bonney Lake
		Pierce	Clear Lake
		Pierce	Florence Lake
		Pierce	Harts Lake
		Pierce	Ohop Lake
		Pierce	Silver Lake
		Pierce	Spanaway Lake
		Pierce	Tanwax Lake
		Pierce	Whitman Lake
		San Juan	Hummel Lake
		Skagit	Beaver Lake

Scientific name	Weed Class	County	Waterbody Name
		Skagit	Big Lake
		Skagit	Campbell Lake
		Skagit	Cavanaugh Lake
		Skagit	Clear Lake (34N-05E-07)
		Skagit	Erie Lake
		Skagit	Heart Lake (35N-01E-36)
		Skagit	McMurray Lake
		Snohomish	Blackmans Lake
		Snohomish	Bosworth Lake
		Snohomish	Cochran Lake
		Snohomish	Devils (Lost) Lake
		Snohomish	Flowing Lake
		Snohomish	Howard Lake
		Snohomish	Ketchum Lake
		Snohomish	Ki Lake
		Snohomish	Loma Lake
		Snohomish	Martha Lake (27N-04E-01)
		Snohomish	Martha Lake (31N-04E-18)
		Snohomish	Nina Lake
		Snohomish	Panther Lake
		Snohomish	Roesiger (north arm) Lake
		Snohomish	Roesiger (south arm) Lake
		Snohomish	Serene Lake (28N-04E-34)
		Snohomish	Shoecraft Lake
		Snohomish	Stevens Lake
		Snohomish	Stickney Lake
		Snohomish	Sunday Lake
		Spokane	Long Lake (Reservoir)
		Spokane	Newman Lake
		Stevens	Deer Lake
		Stevens	Gillette Lake
		Stevens	Loon Lake
		Stevens	Waitts Lake
		Thurston	Black Lake
		Thurston	Elbow Lake
		Thurston	Hicks Lake
		Thurston	Lawrence Lake
		Thurston	Long Lake
		Thurston	Munn Lake
		Thurston	Offutt Lake
		Thurston	Patterson Lake
		Thurston	St. Clair Lake
		Thurston	Summit Lake
		Thurston	Ward Lake

Scientific name	Weed Class	County	Waterbody Name
		Whatcom	Cain Lake
		Whatcom	Samish Lake (East Arm)
		Whatcom	Toad (Emerald) Lake
		Whatcom	Wiser Lake
		Yakima	Giffin Lake
		Yakima	Morgan Lake
		Yakima	Parker Ponds
Nymphoides peltata (yellow floating heart)	Class B	Spokane	Long Lake (Reservoir)
Utricularia inflata	Monitor	Cowlitz	Silver Lake
(swollen bladderwort)		Kitsap	Horseshoe Lake
		Kitsap	Mission Lake
		Kitsap	Square Lake
		Kitsap	Tahuya Lake
		Kitsap	Wye Lake
		Mason	Limerick Lake
		Mason	Spencer Lake
		Mason	Trails End (formerly Prickett)
		Pierce	Rapjohn Lake
		Thurston	Hicks Lake
		Thurston	Munn Lake

* Weed classes as stated by the Washington State Noxious Weed Control Board.

- Class A weeds require eradication
- Class B weeds are designated for control in areas of the state where their distribution is still limited
- Class C weeds are usually widespread in Washington, control is a local option
- Monitor weeds are plants of concern for which more data are being gathered

Appendix E

Herbarium Specimens, Grouped by Family

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Herbarium Specimens - Grouped by Family

	Family	Scientific name Common name
Alismataceae		
	Alisma gramineum	narrowleaf water-plantain
	Sagittaria cuneata	Arumleaf arrowhead, wapato
	Sagittaria graminea	slender arrowhead
	Sagittaria rigida	bur arrowhead
Apiaceae		
	Cicuta douglasii	western water-hemlock
	Hydrocotyle ranunculoides	water-pennywort
	Lilaeopsis occidentalis	lilaeopsis
Asteraceae		
	Megalodonta beckii	water marigold
Azollaceae		
	Azolla mexicana	mexican water-fern
Boraginaceae		
	Myosotis laxa	small flowered forget-me-not
	Myosotis scorpioides	common forget-me-not
Brassicaceae		
	Nasturtium officinale	water-cress
	Rorippa palustris	marsh yellowcress
	Subularia aquatica	awlwort
Butomaceae		
	Butomus umbellatus	flowering rush
Cabombaceae		
	Brasenia schreberi	watershield
	Cabomba caroliniana	fanwort
Callitrichaceae		
	Callitriche hermaphroditica	northern water-starwort
	Callitriche heterophylla	different-leaved water-starwort
	Callitriche stagnalis	pond water-starwort
	Callitriche verna	spring water-starwort
Campanulaceae		
	Lobelia dortmanna	water gladiole; water lobelia
Ceratophyllaceae		
	Ceratophyllum demersum	Coontail; hornwort
Characeae		
	Nitella sp.	stonewort
	Tolypella intricata	macro algae
Crassulaceae		
	Crassula aquatica	pygmy-weed
Cyperaceae		

Family	Scientific name	Common name
	Carex unilateralis	one-sided sedge
	Cyperus bipartitus	shining flatsedge
	Cyperus erythrorhizos	red rooted cyperus
	Cyperus squarrosus	awned flat sedge
	Dulichium arundinaceum	Dulichium
	Eleocharis acicularis	needle spike-rush
	Eleocharis sp.	spike-rush
	Scirpus acutus	hardstem bulrush
	Scirpus americanus	american bulrush
	Scirpus cyperinus	wool-grass
	Scirpus fluviatilis	river bulrush
	Scirpus maritimus	seacoast bulrush
	Scirpus nevadensis	Nevada bulrush
	Scirpus subterminalis	water clubrush
Elatinaceae		
	Elatine americana	American waterwort
	Elatine sp.	waterwort
	Elatine triandra	three-stamen waterwort
Equisetaceae		
	Equisetum fluviatile	water horsetail
Fontinalaceae		
	Fontinalis antipyretica	water moss
Haloragaceae		
	.	northern watermilfoil
	Myriophyllum aquaticum	parrotfeather
	Myriophyllum hippuroides	western watermilfoil
	Myriophyllum quitense	waterwort watermilfoil
	Myriophyllum sp.	water-milfoil
	Myriophyllum spicatum	Eurasian water-milfoil
	Myriophyllum verticillatum	whorled watermilfoil
Hippuridaceae		
	Hippuris vulgaris	common marestail
Hydrocharitaceae		
	Egeria densa	Brazilian elodea
	Egeria najas	Asian anacharis
	Elodea canadensis	common elodea
	Elodea nuttallii	Nuttall's waterweed
	Hydrilla verticillata	hydrilla
	Hydrocharis morsus-ranae	European frog-bit
	Vallisneria americana	water celery
Isoetaceae		
	Isoetes sp.	quillwort

Family	Scientific name	Common name
Juncaceae		
	Juncus acuminatus	tapered rush
	Juncus bulbosus	bulbous rush
Lamiaceae		
	Lycopus asper	rough bungleweed
Lemnaceae		
	Wolffia borealis	water-meal
Lentibulariaceae		
	Utricularia inflata	big floating bladderwort
	Utricularia macrorhiza	common bladderwort
	Utricularia minor	lesser bladderwort
	Utricularia sp.	bladderwort
	Utricularia vulgaris	common bladderwort
Marsileaceae		
	Marsilea sp.	water clover
Menyanthaceae		
	Menyanthes trifoliata	buckbean
	Nymphoides peltata	water fringe
Najadaceae		
	Najas flexilis	common naiad
	Najas gradalupensis	Guadalupe water-nymph
Nymphaeaceae		
	Nuphar polysepala	spatter-dock, yellow water-lily
Onagraceae		
	Epilobium hirsutum	fiddle-grass
	Ludwigia hexapetala	water primrose
	Ludwigia palustris	water-purslane
Poaceae		
	Cinna latifolia	wood reed-grass
	Glyceria borealis	northern mannagrass
	Zizania aquatica	wild rice
Polygonaceae		
	Polygonum amphibium	water smartweed
	Polygonum hydropiper	marshpepper smartweed
	Polygonum hydropiperoides	common smartweed
Pontederiaceae		
	Heteranthera dubia	water star-grass
Potamogetonaceae		
	Potamogeton alpinus	red pondweed
	Potamogeton amplifolius	large-leaf pondweed
	Potamogeton crispus	curly leaf pondweed
	Potamogeton diversifolius	snailseed pondweed, diverse leaf

Family	Scientific name	Common name
	Potamogeton epihydrus	ribbonleaf pondweed
	Potamogeton foliosus	leafy pondweed
	Potamogeton friesii	flat-stalked pondweed
	Potamogeton gramineus	grass-leaved pondweed
	Potamogeton illinoensis	Illinois pondweed
	Potamogeton natans	floating leaf pondweed
	Potamogeton nodosus	longleaf pondweed
	Potamogeton obtusifolius	bluntleaf pondweed
	Potamogeton praelongus	whitestem pondweed
	Potamogeton pusillus	slender pondweed
	Potamogeton richardsonii	Richardson's pondweed
	Potamogeton robbinsii	fern leaf pondweed
	Potamogeton sp.	pondweed
	Potamogeton strictifolius	stiff-leaved pondweed
	Potamogeton zosteriformis	eel-grass pondweed
	Stuckenia pectinata	sago pondweed
	Stuckenia vaginata	sheathing pondweed
Primulaceae		
	Lysimachia nummularia	creeping loosestrife
	Lysimachia thyrsiflora	tufted loosestrife
	Lysimachia vulgaris	garden loosestrife
Ranunculaceae		
	.	water-buttercup
	Ranunculus flammula	creeping buttercup
	Ranunculus gmelinii	yellow water buttercup
Ruppiaceae		
	Ruppia cirrhosa	ditch-grass
Scrophulariaceae		
	Gratiola neglecta	hedge-hyssop
	Limosella acaulis	mudwort
	Limosella aquatica	mudwort
	Lindernia dubia	false-pimpernel
	Veronica anagallis-aquatica	water speedwell
Sparganiaceae		
	Sparganium angustifolium	narrowleaf bur-reed
	Sparganium eurycarpum	broadfruited bur-reed
	Sparganium natans	small bur-reed
	Sparganium sp.	bur-reed
Typhaceae		
	Typha angustifolia	lesser cat-tail
	Typha domingensis	Southern cat-tail
	Typha X glauca	hybrid cat-tail
Zannichelliaceae		
	Zannichellia palustris	horned pondweed