Aquatic Plants Technical Assistance Program

1997 Activity Report

April 1998
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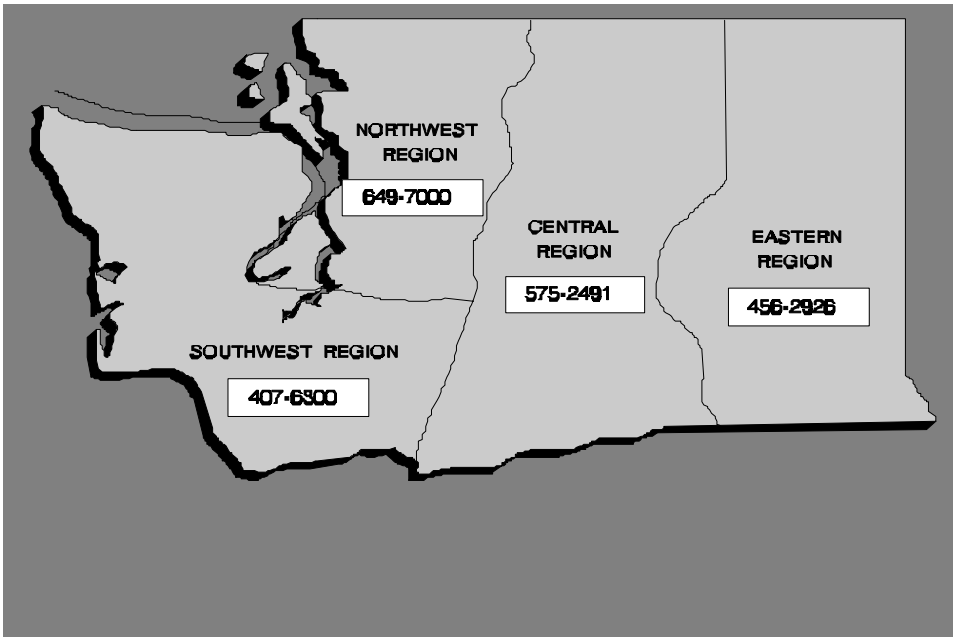

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Aquatic Plants Technical Assistance Program

1997 Activity Report

by
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Environmental Investigations and Laboratory Services Program
Ambient Monitoring Section
Post Office Box 47600
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Abstract

The objectives of the Aquatic Plant Technical Assistance Program are to provide advice on aquatic plant identification, biology, and management to government agencies and the public, to document aquatic plant distribution and habitat through site visits, and to assist with evaluating projects supported by Freshwater Aquatic Weed Program grant money.

During the 1997 field season, aquatic plant data were gathered during 84 site visits to waterbodies located throughout the state. Several previously unknown populations of non-native invasive aquatic plants were recorded. These included six previously unknown populations of *Myriophyllum spicatum,* one population of *Egeria densa,* and one population of *Myriophyllum aquaticum.* Two new plants were recorded for the state, *Typha angustifolia*, which has the potential to become a noxious weed of wetland habitats, and *Sagittaria rigida*, a plant that is not known to become invasive. Other accomplishments during 1997 included gathering additional plants for the herbarium collection, providing educational and technical outreach, assisting with projects funded by Freshwater Aquatic Weed Program grant money, and providing assistance and editorial comments for the "Aquatic Plant Field Identification Guide" project.

Introduction

Legislative action in 1991 (RCW 43-21A.660) established the Freshwater Aquatic Weed Account to provide additional 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 agency officials to adequately address them. To provide the technical expertise for aquatic plants, one full-time position was created within the Environmental Investigations and Laboratory Services Program of the Department of Ecology. This position was filled in February 1994. The objectives for this position are as follows:

- to provide technical assistance on aquatic plant identification and management to government agencies and the public;
- to 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; and
- to 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 1997. Reports on the program's results from 1994, 1995 and 1996 are also available (Parsons 1995a; Parsons 1996a, Parsons 1997a).

To simplify reporting, all plants 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
Ludwigia hexapetala	water primrose
Lysimachia vulgaris	garden or yellow loosestrife
Lythrum salicaria	purple loosestrife
Myriophyllum aquaticum	parrot feather milfoil
Myriophyllum spicatum	Eurasian milfoil
Nymphaea odorata	fragrant waterlily

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. Toward this aim, I participated in several workshops, meetings, and conferences and wrote articles for various publications between January 1 and December 31, 1997 (Table 2). I 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. Much of this information, as well as other publications the Department of Ecology has produced on aquatic plants in Washington, are available on Ecology's web pages (http://www.wa.gov/ecology).

Table 2. Aquatic plant technical outreach activities - 1997.

Function	Date	Location	Role
Washington Lakes Protection Association newsletter	01/97		Article on *Nymphaea odorata* biology and ecology
Washington State Weed Coordinators Assoc. meeting	03/20/97	Coupeville, WA	Presentation on aquatic weed inventory techniques and distribution in Washington
Western Aquatic Plant Management Society board meeting	03/26/97	Seattle, WA	Attended meeting as a board member, elected to the newsletter editor position for 2 year term
Western Aquatic Plant Management Society Annual Conference	03/27-03/28/97	Seattle, WA	Presented paper titled 'Egeria densa - an emerging problem', attended sessions
Washington Lakes Protection Association newsletter	04/97		Article on *Ceratophyllum demersum* (coontail), a native submersed plant
Western Aquatic Plant Mgmt Society newsletter	05/97		Wrote articles, edited and produced newsletter
University of Washington Herbarium	06/97	Seattle, WA	Donated extra aquatic plant herbarium specimens
Royal British Columbia Museum Herbarium	06/04/97	Victoria, B.C.	Information and herbarium specimen exchange with Canadian aquatic plant experts
Function	Date	Location	Role

Met with citizens, Skagit County personnel	07/02/97	Campbell Lake, Skagit County	Discussed aquatic plant mapping and management techniques
Aquatic Plant Management Society National Conference	07/13-07/16/97	Ft. Myers, Florida	Presented paper on getting invasive species off the market, attended sessions
Met with University of Florida faculty	07/17/97	Gainesville, Florida	Toured aquatic plant research facilities
Met with visiting aquatic plant specialist from New Zealand	07/96	Olympia, WA	Information exchange, toured locations with aquatic weeds in Washington
Met with citizens and Pend Oreille County personnel	08/12/97	Bead Lake, Pend Oreille County	Surveyed lake, discussed aquatic plant issues in relation to proposed launch site
Met with Pend Oreille County Noxious Weed Control personnel	08/12/97	Fan Lake and Davis Lake, Pend Oreille County	Surveyed lakes to determine extent of weed populations
Met with Ferry County Conservation Dist. personnel	08/13-08/14/97	Several Ferry County lakes	Assisted with aquatic plant mapping and identification
Met with Lewis County Noxious Weed Control personnel	8/20/97	Chehalis River, Plummer Lake, Lewis County	Observed *Egeria densa* spread, discussed options for control
Met with citizens and Jefferson County personnel	08/27/97	Leland Lake	Assisted with plant identification and sorting of biomass samples
Met with Kitsap/Bremerton Health District personnel	08/28/97	Long Lake, Kitsap Lake, Kitsap County	Provided training on aquatic plant identification and monitoring techniques
Met with Clark County Noxious Weed Board personnel	09/03/97	Lacamas Lake, Clark County	Surveyed and mapped aquatic plant community
Met with citizens and San Juan County personnel	09/08/97	Hummel Lake, San Juan County	Discussed aquatic plant management techniques
Met with Pierce County Noxious Weed Board personnel	09/25/97	Ohop Lake, Pierce County	Mapped extent of *Egeria densa* population
Western Aquatic Plant Management Society newsletter	09/97		Edited and produced newsletter
Washington Lakes Protection Association newsletter	10/97		Article on *Lythrum salicaria* by Maggie Bell-McKinnon
Met with Portland State University personnel	11/05/97	Columbia River Estuary	Surveyed Lois Island for *Murdannia keisak*, a potentially invasive plant
Met with Shelton High School Environmental Education class	11/13/97	Shelton, WA	Discussed aquatic plants found in Island Lake
Western Aquatic Plant Management Society newsletter	12/97		Edited and produced newsletter

Site Visits

Introduction

This section documents aquatic plant surveys conducted during the 1997 field season. The general purpose of site visits was to identify aquatic plants (targeting exotic invasive species), evaluate plant community structures, estimate the extent of, or potential for, aquatic plant problems, and suggest possible management options. Another important aspect of the site visits was to expand the aquatic plant database and herbarium collection.

Site Visit Objectives

The objectives for the 1997 site visits were as follows:

- to revisit selected lakes with exotic invasive plants in order to assess plant population changes since earlier surveys;
- to revisit other selected lakes considered to be at high risk for a non-native plant invasion;
- to conduct field surveys in selected lakes that had not been surveyed by this program during previous field seasons;
- to confirm rare plant sightings from past field seasons; and
- to continue plant community monitoring projects on selected lakes.

The 1997 Aquatic Plant Technical Assistance Implementation Plan (Parsons, 1997b) contains a more complete discussion of these objectives.

During site visits, meetings with concerned citizens or local government representatives were arranged if appropriate. If new populations of exotic species were found, the local weed board representative or county extension agent was contacted.

Field Methods

For a detailed discussion of field methods and data quality control, refer to the Aquatic Plant Technical Assistance Final Quality Assurance Project Plan in Parsons (1995b). 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 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 growth depth are made. This method was recommended by other aquatic plant researchers (Sytsma, 1994; Warrington, 1994) and was used successfully during the past three years. However, it should be noted that because the surveys are conducted from the surface, small populations of any plant species may be overlooked.

Some water quality data were collected on selected lakes (Table 3). This was ancillary to the plant data, so frequency of sample collection was limited by time and logistical constraints. These parameters were chosen because they have been shown to influence plant community type (Srivastava *et al.*, 1995; Smart, 1990; Kadono, 1982; Hellquist, 1980) and because they are relatively easy to obtain. The alkalinity samples were collected in open water to minimize the diel influence of macrophytes. Alkalinity was measured using a Hach® field test kit model AL-DT with a digital titrator to determine phenolphthalein and total alkalinity as $CaCO_3$. Secchi depth was also measured in deep, open water.

Table 3. Summary of water quality and sediment analyses.

Parameter	Method	Method Precision
Alkalinity	Hach field test kit using phenolphthalein and a digital titrator	± 10 mg/L
Secchi depth	visual observation	± 0.1 m

Field visits occurred between late spring and early fall to correspond with the time of maximal growth and flowering. Sampling locations were recorded with a written description, visual placement on a map, and with a Global Positioning System (GPS) unit.

Collections were made of any unusual plant species and of 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 (see Parsons 1995a for a database design description).

Aquatic Plant Survey Results

During the 1997 field season 84 site visits were made to different waterbodies. Highlights of results from these surveys are provided in the following section. In addition, several special projects will be discussed in subsequent sections. These include:

- an update on the *Hydrilla verticillata* eradication project in Pipe and Lucerne Lakes;
- the status of selected weed eradication projects;
- a report on non-native plants which currently have a limited distribution in Washington but that should be monitored for invasive tendencies;
- the expansion of *Egeria densa* in Leland Lake;

- results from plant mapping / monitoring projects.

General Results

Table 4 lists the lakes where aquatic plant data were gathered during the 1997 field season, the extent of the survey, and any aquatic plants listed with the Washington State Noxious Weed Control Board that were found. A similar table with data summarizing all four years of this program is contained in Appendix A. Additional information on any of the listed waterbodies can be provided by the author upon request.

Table 4. Site visit and results summary table

County	Waterbody Name	WRIA	Date	Survey Extent	Plants of Concern
Adams	Sprague Lake	34	9/16/97	south half	none
Asotin	Snake River, Chief Timothy S.P.	35	8/4/97	3 sites	none
Chelan	Fish Lake	45	6/16/97	west shore	none
	Roses (Alkali) Lake	40	6/17/97	whole littoral	none
	Wapato Lake	47	6/17/97	whole littoral	*Myriophyllum spicatum*
Clark	Lacamas Lake	28	9/3/97	whole littoral	*Egeria densa*
Clatsop	Columbia River, Astoria, OR		11/5/97	Lois Island	*Myriophyllum spicatum* *Lythrum salicaria*
Columbia	Snake River, Little Goose Dam	35	8/5/97	spot check, boat	*Myriophyllum spicatum*
	Snake River near Lyons Ferry	35	8/5/97	spot check, boat	*Myriophyllum spicatum*
Cowlitz	Solo Slough	25	5/28/97	spot check, shore	*Egeria densa* *Ludwigia hexapetala* *Myriophyllum aquaticum*
	Willow Grove Slough	25	5/28/97	spot check, shore	*Cabomba caroliniana*
Ferry	Curlew Lake	60	8/13/97	5 sites (launches)	none
	Ferry Lake	52	8/13/97	whole littoral	none
	Swan	52	8/13/97	whole littoral	none
	Twin Lakes	58	8/14/97	3 sites	none
Franklin	Snake River at Lyons Ferry	34	8/5/97	spot check, boat	*Myriophyllum spicatum*
Garfield	Snake River, Lower Granite Dam	35	8/4/97	spot check, boat	none
Grant	Burke Lake	41	9/24/97	whole littoral	*Lythrum salicaria* *Myriophyllum spicatum*
	Evergreen Lake	41	9/23/97	whole littoral	*Lythrum salicaria* *Myriophyllum spicatum*
	Quincy Lake	41	9/22/97	whole littoral	*Lythrum salicaria*
	Rocky Ford Cr.	41	7/28/97	spot check, shore	*Lythrum salicaria*
Grays Harbor	Failor Lake	22	6/25/97	whole littoral	none
Jefferson	Crocker Lake	17	8/27/97	whole littoral	none
	Leland Lake	17	8/27/97	spot check	*Egeria densa*
County	**Waterbody Name**	**WRIA**	**Date**	**Survey Extent**	**Plants of Concern**
King	Meridian Lake	9	7/10/97	whole littoral	*Lythrum salicaria* *Myriophyllum spicatum*
	Morton Lake	9	8/19/97	whole littoral	none
	Pipe Lake	9	7/21/97	3 sites	*Hydrilla verticillata*

	Sawyer Lake	9	8/7/97	whole littoral	*Myriophyllum spicatum*
	Wilderness Lake	9	8/19/97	whole littoral	*Lythrum salicaria* *Myriophyllum spicatum*
Kitsap	Kitsap Lake	15	8/28/97	4 sites	none
	Long Lake	15	7/22/97 8/28/97	2 sites 3 sites	*Egeria densa* *Lythrum salicaria* *Myriophyllum spicatum*
	Square Lake	15	7/22/97	spot check, shore	none
Kittitas	Easton Lake	39	6/18/97	spot check, shore	none
	Lavender Lake	39	6/18/97	whole littoral	*Myriophyllum spicatum*
	Unnamed Ponds near Easton	39	6/18/97	spot check, shore	none
Lewis	Carlisle Lake	23	8/20/97	whole littoral	none
	Chehalis River	23	7/23/97	spot check, shore	*Myriophyllum aquaticum*
			8/20/97	1 mile of river	*Egeria densa*
	Interstate Ave Slough	23	8/20/97	spot check, shore	*Myriophyllum aquaticum*
	Plummer Lake	23	8/20/97	whole littoral	*Egeria densa*
Mason	Isabella Lake	14	8/18/97	whole littoral	*Lythrum salicaria*
	Island Lake	14	6/24/97	whole littoral	*Myriophyllum spicatum*
	Limerick Lake	14	7/22/97	2 sites	*Egeria densa*
	Lost Lake	14	6/10/97	whole littoral	none
	Nahwatzel Lake	22	6/26/97	whole littoral	none
	Spencer Lake	14	7/22/97	2 sites	none
Okanogan	Conconully Reservoir	49	9/18/97	whole littoral	*Myriophyllum spicatum*
	Duck (Bide-a-Wee) Lake	49	9/18/97	spot check	none
	Spectacle Lake	49	9/17/97	3 sites	none
	Whitestone Lake	49	9/17/97	whole littoral	*Myriophyllum spicatum*
Pacific	Black Lake	24	8/26/97	whole littoral	*Egeria densa*
	Island Lake	24	8/26/97	whole littoral	none
	Loomis Lake	24	8/25/97	whole littoral	*Myriophyllum spicatum*
	O'Neil Lake	24	8/25/97	spot check, shore	none
	Surfside Lake	24	8/25/97	spot check, shore	none
Pend Oreille	Bead Lake	62	8/12/97	coves, 5 sites	none
	Davis Lake	62	8/12/97	whole littoral	*Myriophyllum spicatum*
	Diamond Lake	55	8/11/97	west half	none
	Fan Lake	55	8/12/97	whole littoral	*Lythrum salicaria*
Pierce	Clear Lake	11	6/23/97	whole littoral	*Myriophyllum spicatum*
	Ohop Lake	11	9/25/97	whole littoral	*Egeria densa*
San Juan	Cascade Lake	2	9/9/97	whole littoral	none
	Hummel Lake	2	9/8/97	whole littoral	none
	Mountain Lake	2	9/9/97	whole littoral	none
	Sportsman Lake	2	9/10/97	whole littoral	none
Skagit	Campbell Lake	3	7/2/97	whole littoral	*Myriophyllum spicatum*
	Erie Lake	3	7/2/97	whole littoral	none
	Pass Lake	3	7/2/97	spot check, shore	none
Snohomish	Stevens Lake	7	9/10/97	4 sites	none
County	**Waterbody Name**	**WRIA**	**Date**	**Survey Extent**	**Plants of Concern**
Spokane	Williams Lake	34	9/16/97	whole littoral	none
Stevens	Deep Lake	61	7/30/97	whole littoral	none
	Deer Lake	59	7/29/97	whole littoral	none
	Jumpoff Joe Lake	59	7/29/97	whole littoral	none
	Loon Lake	59	7/31/97	1 site	*Lysimachia vulgaris* *Lythrum salicaria*

					Myriophyllum spicatum
	Waitts Lake	59	7/30/97	whole littoral	*Lythrum salicaria*
Thurston	Summit Lake	14	7/23/97	west end	none
Whatcom	Samish Lake (East Arm)	3	6/30/97	whole littoral	none
	Samish Lake (West Arm)	3	6/30/97	whole littoral	none
	Silver Lake	1	7/1/97	whole littoral	none
	Toad (Emerald) Lake	1	7/3/97	whole littoral	none
	Wiser Lake	1	7/1/97	whole littoral	none
Whitman	Rock Lake	34	9/15/97	spot check, shore	none
	Snake River, Central Ferry	35	8/5/97	spot check, shore	*Myriophyllum spicatum*
	Snake River, Little Goose Dam	35	8/5/97	spot check, boat	*Myriophyllum spicatum*
	Snake River, Lower Granite Dam	35	8/4/97	spot check, boat	*Myriophyllum spicatum*

The results of these surveys include the discovery of five previously unknown populations of *Myriophyllum spicatum* (the two reservoirs on the upper Snake River; Lavender Lake, Kittitas County; Conconully Reservoir, Okanogan County; and in the lowest reach of the Columbia River) and one population of *Lysimachia vulgaris* (Loon Lake, Stevens County) by Ecology personnel. In addition, one population of *Myriophyllum spicatum* (Cowlitz River, Lewis County) one population of *Egeria densa* (Chehalis River, Lewis County) and one population of *Myriophyllum aquaticum* (Interstate Ave Slough, Lewis County) were brought to my attention by Lewis County Noxious Weed Board personnel (Wamsley 1997).

Figures 1, 2, and 3 illustrate where known populations of the noxious invasive aquatic plants *Myriophyllum spicatum*, *Egeria densa*, and *Myriophyllum aquaticum* occur in Washington. These 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 lake or pond will be removed from this list.

Figure 1. Known locations of *Myriophyllum spicatum* in Washington, 1997

County	No.	Waterbody Name	County	No.	Waterbody Name
Chelan	1	Chelan Lake	Klickitat	48	Columbia River, Bingen
	2	Cortez (Three) Lake		49	Columbia River, Maryhill
	3	Domke Lake		50	Horsethief Lake
	4	Wapato Lake	Lewis	51	Carlisle Lake
Clallam	5	unnamed pond		52	Cowlitz River
Clark	6	Caterpillar Slough		53	Riffe Lake
	7	Columbia River at Ridgefield		54	Swofford Pond
Clatsop, OR	8	Columbia River at Astoria	Mason	55	Island Lake
Columbia	9	Snake River, Little Goose Dam	Okanogan	56	Conconully (Salmon) Lake
Cowlitz	10	Kress Lake		57	Conconully Reservoir
	11	Willow Grove Slough		58	Okanogan River
Franklin	12	Scooteney Reservoir		59	Osoyoos Lake
	13	Snake River, Ice Harbor Dam		60	Whitestone Lake
	14	Snake River, Lower Mon. Dam	Pacific	61	Loomis Lake
	15	Snake River at Lyons Ferry	Pend Oreille	62	Davis Lake
Grant	16	Babcock Ridge Lake		63	Little Spokane River
	17	Banks Lake		64	Nile Lake
	18	Billy Clapp Lake		65	Pend Oreille River
	19	Burke Lake		66	Sacheen Lake
	20	Evergreen Lake		67	Trask Pond
	21	Moses Lake	Pierce	68	Clear Lake
	22	Potholes Reservoir		69	Harts Lake
	23	Stan Coffin Lake		70	Hidden Lake
	24	Winchester Wasteway	Skagit	71	Big Lake
	25	Winchester Wasteway Ext.		72	Campbell Lake
Island	26	Goss Lake		73	Clear Lake (34N-05E-07)
King	27	Angle Lake		74	McMurray
	28	Bass Lake		75	Sixteen Lake
	29	Desire Lake	Snohomish	76	Goodwin Lake
	30	Green Lake		77	Shoecraft Lake
	31	Lucerne Lake		78	Silver Lake (28N-05E-30)
	32	Meridian Lake		79	Stevens Lake
	33	Number Twelve Lake	Spokane	80	Eloika Lake
	34	Otter (Spring) Lake		81	Liberty Lake
	35	Phantom Lake	Stevens	82	Gillette Lake
	36	Pipe Lake		83	Heritage Lake
	37	Sammamish Lake		84	Loon Lake
	38	Sawyer Lake		85	Sherry Lake
	39	Shadow Lake		86	Thomas Lake
	40	Shady Lake	Thurston	87	Long Lake
	41	Ship Canal		88	Scott Lake
	42	Steel Lake	Wahkiakum	89	Columbia River, Cathlamet
	43	Union Lake	Walla Walla	90	Snake River, Ice Harbor Dam
	44	Washington Lake		91	Snake River, Lower Mon. Dam
	45	Wilderness Lake	Whatcom	92	Whatcom Lake
Kitsap	46	Long Lake	Whitman	93	Snake River at Lower Granite Dam
Kittitas	47	Lavender Lake	Yakima	94	Byron Lake

Figure 1. Continued, Known locations of *Myriophyllum spicatum* in Washington, 1997.

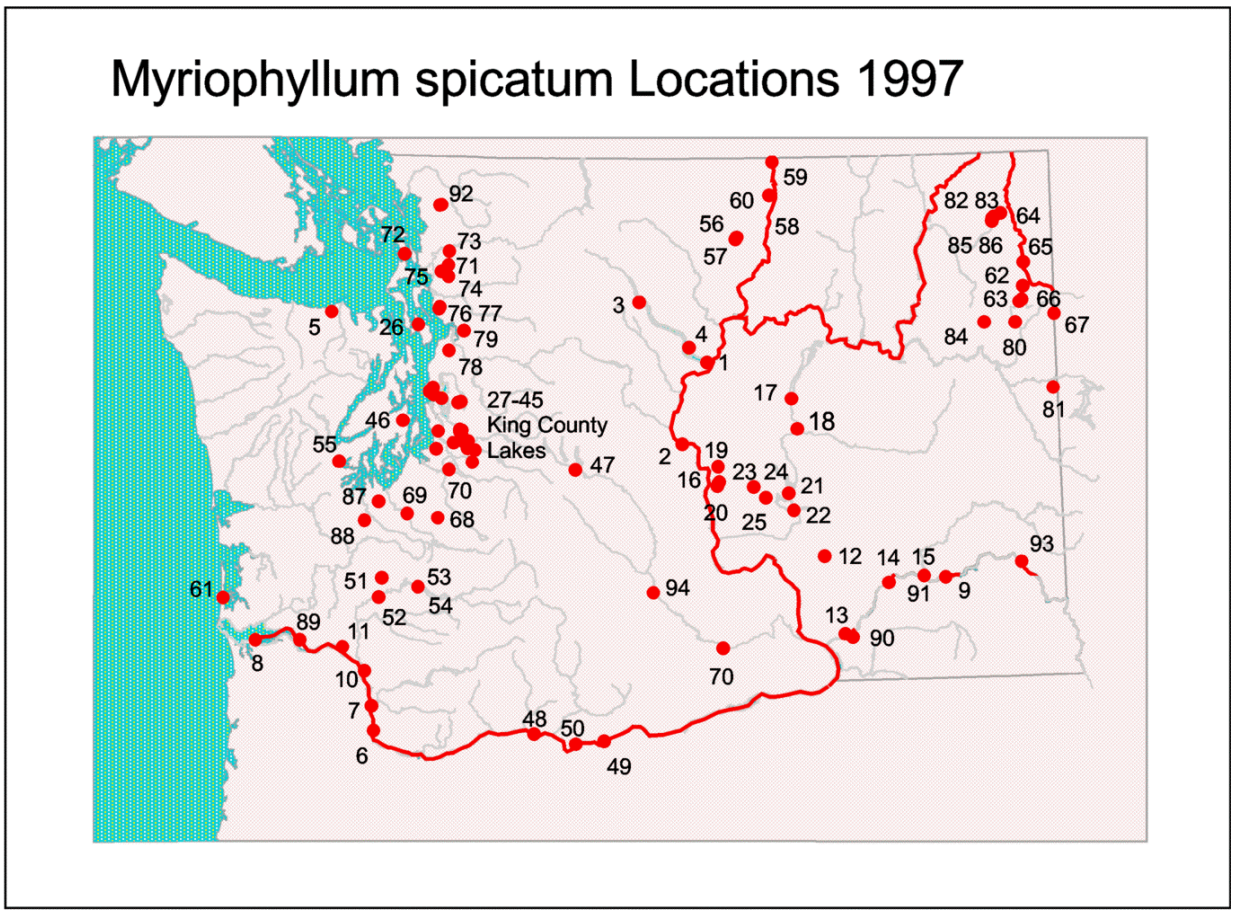


Figure 2. Known locations of *Egeria densa* in Washington, 1997.

County	No.	Waterbody Name
Clark	1	Battleground Lake
	2	Lacamas Lake
Cowlitz	3	Solo Slough
	4	Willow Grove Slough
Grays Harbor	5	Duck Lake
Jefferson	6	Leland Lake
King	7	Fenwick Lake
Kitsap	8	Long Lake
Lewis	9	Chehalis River
	10	Plummer Lake
Mason	11	Limerick Lake
Pacific	12	Black Lake
Pierce	13	Ohop Lake
Skagit	14	Big Lake
Snohomish	15	Swartz Lake
Thurston	16	Nisqually River
Wahkiakum	17	Puget Island Sloughs

Figure 2. Continued, Known locations of *Egeria densa* in Washington, 1997.

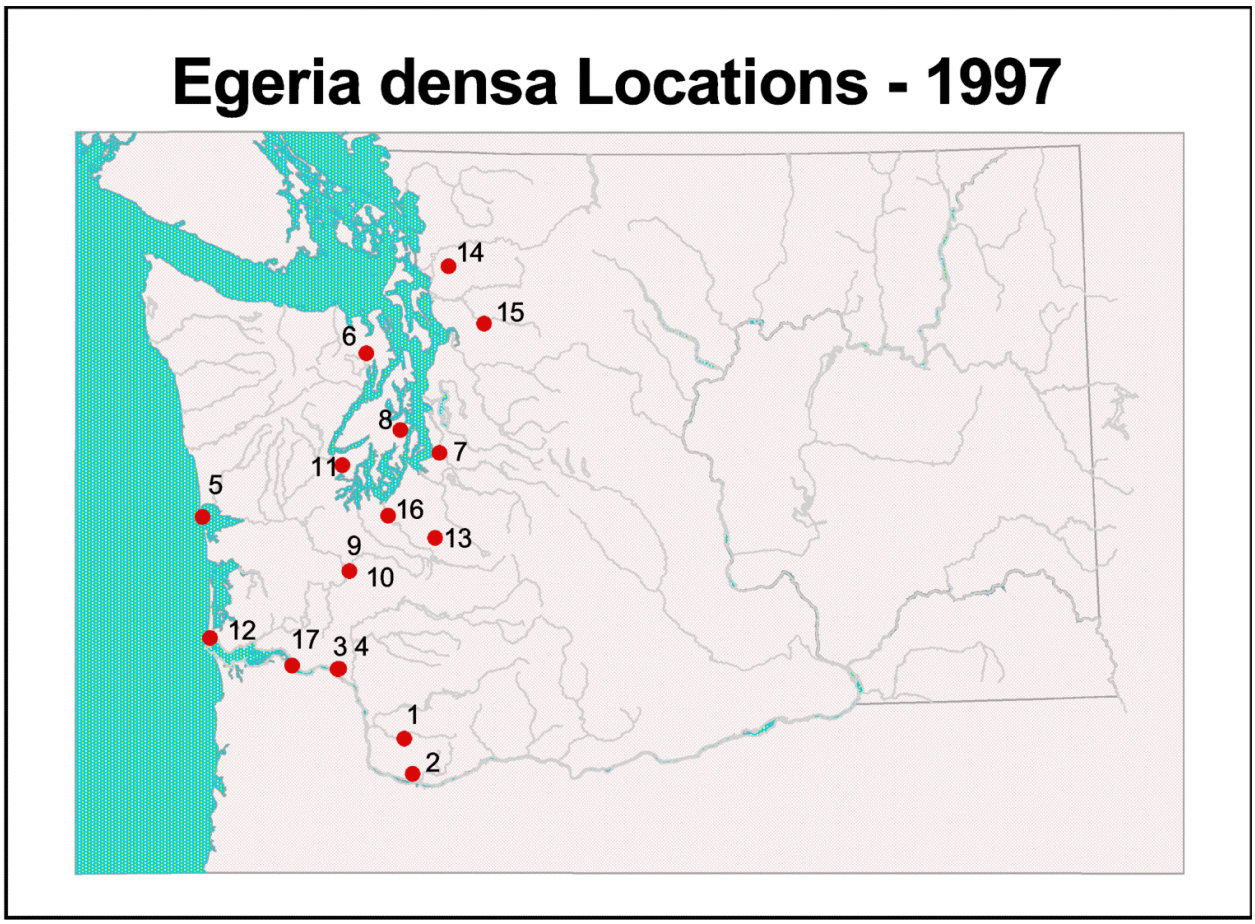
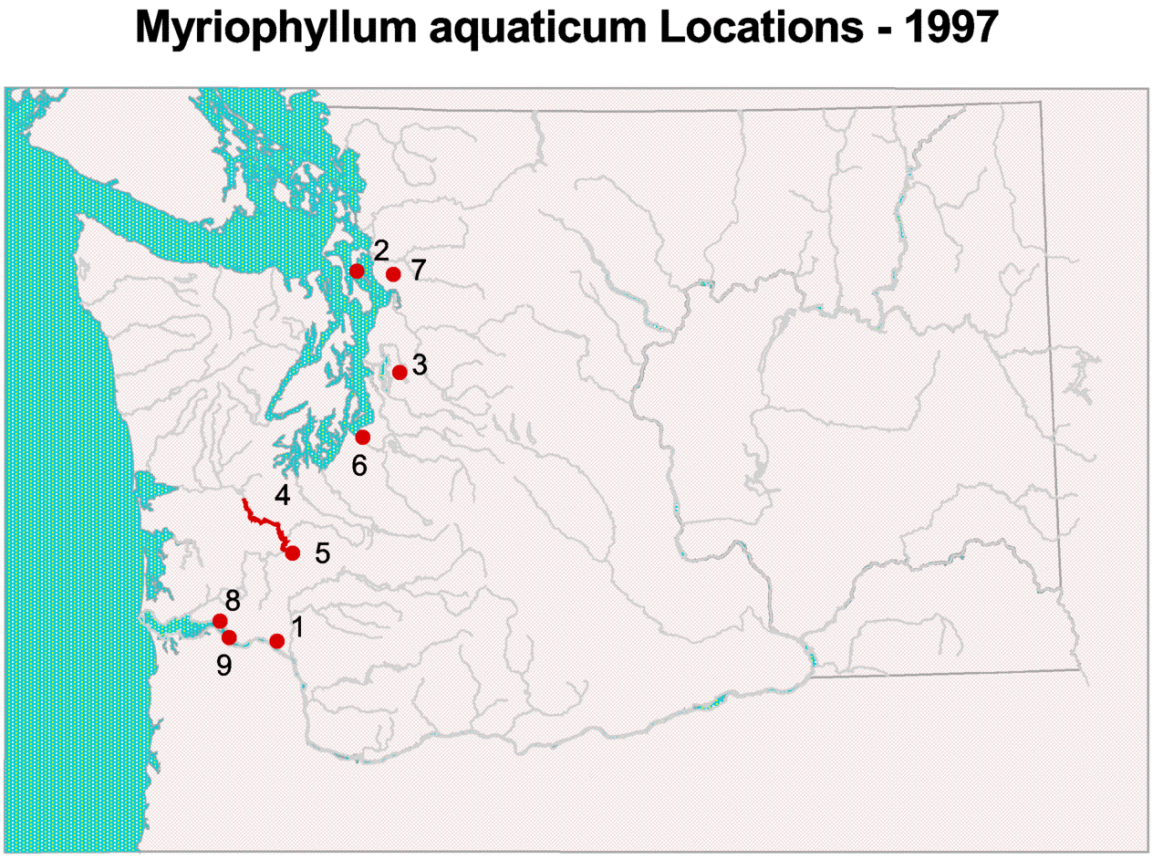


Figure 3. Known locations of *Myriophyllum aquaticum* in Washington.

County	No.	Waterbody Name
Cowlitz	1	Solo Slough
Island	2	Unnamed Pond (31N-02E-35)
King	3	Private Pond (24N-05E-11)
Lewis	4	Chehalis River
	5	Interstate Ave Slough
Pierce	6	Slough, Port of Tacoma
Snohomish	7	Nina Lake
Wahkiakum	8	Columbia River at Skamokawa
	9	Puget Island Sloughs

Figure 3. Continued, Known locations of *Myriophyllum aquaticum* in Washington, 1997.



Hydrilla Verticillata - An Update

The presence of *Hydrilla verticillata* was confirmed in Pipe and Lucerne Lakes (King County) on June 1, 1995. *Hydrilla* is an aggressive, non-native aquatic plant which will out-compete native vegetation if given the opportunity. Where it has become established (in the southern United States as far north as Connecticut and west to California), its rapid growth has radically changed aquatic environments. It is particularly difficult to control due to its many propagation strategies which include tubers, turions, plant fragments, and seeds. Federal and State agencies spend millions of dollars each year attempting to control its growth (Langeland, 1990; Anderson, 1987).

Because this is the first known population of *Hydrilla* in the northwest, aggressive action has been taken to attempt its eradication. During the summers of 1995, 1996 and 1997, the 73 acre Pipe/Lucerne Lake system was treated with the systemic aquatic herbicide fluridone (brand name Sonar®). A complete discussion of the events leading to these treatments during the first two years is provided in Parsons (1997a).

During the summer of 1997, *Hydrilla* could still be found growing at a density of up to six plants per square meter. At this time it was also noted that the submersed macroalgae *Tolypella* was covering most of the littoral zone with a low growing mat. (*Tolypella* is considered a beneficial plant. Because it is not affected by the herbicide, it has expanded to fill locations formerly occupied by vascular plants). The herbicide application, which was ongoing during the survey, would have killed all sprouted plants and prevented new tuber formation. However, any remaining unsprouted tubers would not have been killed. In fact, monoecious *Hydrilla* tubers will remain viable in the lab up to four years (Van and Steward, 1990). They may last much longer in cool water environments (Clayton, 1997).

We plan to conduct additional diver surveys in the spring of 1998 to quantify sprouting dormant tubers in the Pipe/Lucerne Lake system.. This information will be used to help determine if additional herbicide applications will be recommended.

Aquatic Weed Eradication Efforts

Several Washington lakes have undergone treatment efforts aimed at eradicating noxious aquatic weeds. Below is a discussion of those lakes where the targeted weed has not been observed for at least two years post-treatment. Some of these lakes are still included on the aquatic weed distribution maps (Figures 1, 2, and 3), because it is generally felt by aquatic plant experts that the plant should be absent for five years before the lake is declared weed-free.

Surfside Lake, Pacific County. Surfside Lake is a small lake and canal system (37 acres) located on the Long Beach Peninsula. It had a well developed population of *Myriophyllum spicatum.* In 1992 the lake homeowner's association gained approval to stock sterile grass carp.

The year after treatment no submersed aquatic plants could be found. Subsequent visits in 1994 and 1997 also showed a lack of submersed vegetation. It appears that *M. spicatum* has been eradicated from this system.

Goss Lake, Island County. Goss Lake is a deep 47 acre lake with high water clarity. It had a limited, though expanding population of *Myriophyllum spicatum.* In the summer of 1994, a whole lake treatment with an approved systemic herbicide was completed. Post treatment control included using bottom barrier on shoreline areas where the terrestrial form of *M. spicatum* was growing in response to drought-induced low water levels. Surveys of the lake's littoral zone during 1995 and 1996 showed no evidence of *M. spicatum* regrowth. Monitoring should continue to ensure early detection of any surviving milfoil.

Silver Lake, Cowlitz County. Silver Lake is a large (approximately 2,300 acre), shallow, eutrophic lake. It had a widely distributed and dense population of *Egeria densa*, as well as a more limited distribution of *Myriophyllum spicatum.* In 1992, 83,000 grass carp were planted in the lake (Scherer *et al*., 1995). By the summer of 1994 almost no submersed vegetation could be found in the lake. In the summer of 1996 this condition continued, with a marked decrease in water clarity as well. The only surviving aquatic vegetation consists of the large floating-leaved plant *Nuphar lutea* (yellow waterlily) and the emergent *Menyanthes trifoliata* (bog buckbean). Even these robust species have been impacted and currently form less vigorous stands than in the past. Because grass carp are extremely difficult to remove from lakes, it is assumed that the submersed aquatic vegetation will continue to be consumed by the fish, and that the targeted weeds will not reestablish.

Killarney Lake, King County. Lake Killarney is a 31 acre shallow productive lake that had a well established *Myriophyllum spicatum* population. However, for many years the lake was chemically treated to control both aquatic plant and algal growth. During the summers of 1995 and 1996 no *M. spicatum* was observed in the lake (Storer, 1996). Most likely it succumbed to the successive herbicide treatments. The lake should continue to be monitored for any recurring patches of this plant, or for a reintroduction from nearby lakes.

Steel Lake, King County. Steel Lake is 40 acres and of moderate depth. Until 1994 it had a well established population of *Myriophyllum spicatum*. During the spring of that year the *M. spicatum* population apparently crashed. The reason for the population crash is unclear; an illegal herbicide application was postulated. However, an unusually large number of the caddisfly larvae *Triaenodes injecta* were also noted. These insects have been attributed to *M. spicatum* declines in British Columbia (Winchester, 1994) and may have contributed to the apparent decline of this plant in Steel Lake. The lake home owners association decided to continue with their plans to treat the lake with a systemic herbicide that summer. In the summer of 1996 divers surveyed the lake, and no *M. spicatum* was observed (Renstrom, 1997).

Carlisle Lake, Lewis County. Carlisle Lake is a small (29 acre), shallow abandoned mill pond. It had a dense population of *Myriophyllum spicatum* which was treated with a systemic herbicide in early summer, 1994. Divers surveyed the lake during 1995, and by June of 1996 no *M. spicatum*

was observed (Wamsley, 1997). A surface survey of the lake was conducted in 1997. Few submersed plants were found, and no *M. spicatum* was observed.

Note on Long Lake, Thurston County. Long Lake, which had a dense population *of Myriophyllum spicatum*, was treated with the systemic herbicide Sonar® during 1991. Each subsequent year it was surveyed by a team of divers to look for surviving plants. In the two years after herbicide treatment, hand pulling and bottom barriers were used to control the surviving *M. spicatum*. In 1994 no *M. spicatum* was found in the lake. However, in 1995 a patch of milfoil with characteristics resembling both *M. spicatum* and *M. sibiricum* was found (Thurston County, 1995). Since that time its identity as *M. spicatum* was confirmed. Diver hand-pulling of individual plants and bottom barrier installation over larger patches has continued in 1996 and 1997. It is possible that this population of *M. spicatum* represents a reintroduction rather than surviving plants from the original population. Control efforts will continue.

Note on Stevens Lake, Snohomish County. During the summer of 1994 *M. spicatum* was observed growing in several locations in Lake Stevens. At that time the lake managers were concentrating on nutrient loading to the lake, so no action was taken against the milfoil. In 1997 this lake was visited during our routine plant surveys, and also by Snohomish County personnel. Neither of us could find any *M. spicatum*, even though the same person from Snohomish County surveyed the lake both times (Williams, 1997). In fact, all the submersed plants appeared to be unhealthy. The lake should continue to be watched to see if the *M. spicatum* returns, and to check for possible diseases or herbivorous insects that could have caused the plant die-back.

Non-native Plants of Concern

The aquatic plant technical assistance program concentrates efforts on the several aquatic plants listed as noxious weeds by the State Noxious Weed Control Board (WAC 16-750). These include *Hydrilla verticillata, Myriophyllum aquaticum, Myriophyllum spicatum, Egeria densa, Cabomba caroliniana*, and *Lythrum salicaria*. Since the inception of this program, two additional plants have been added to the Monitor List, which means more data are needed to determine if the plants are invasive. These are *Ludwigia hexapetala* (water primrose) and *Nymphoides peltata* (floating heart).

However, many other adventive plants can be found growing in state waters. Some of these are widespread and apparently fit into the native plant communities without dominating them (including *Vallisneria americana* and *Potamogeton crispus*). Others appear to have a limited distribution, but where they are located they seem to thrive. Most of these have been introduced by people who purchased the plant as an ornamental. Because many plants that become problem weeds experience a lag time during which the population builds and adapts to the environment (Tasker, 1996), these species should be monitored for expansion and invasive tendencies. Aquatic plants that have been encountered during the lake surveys and which fit into this category are discussed in this section.

Utricularia inflata, or floating bladderwort, is native to the Eastern United States. This plant has been observed in several Western Washington lakes. It is a free-floating plant with many

branched underwater stems. The yellow flowers float above the surface supported by a spoke-like float. Its habit of growing near the surface makes it a cause for concern in lakes where it proliferates. In one lake, Lake Limerick in Mason County, students are hired during the summer months to hand rake the floating vegetation from the lake surface.

Sagittaria graminea (grass-leaved arrowhead) is native to the Eastern United States. It forms a dense meadow of submersed vegetation in Lake Roesiger, Snohomish County. In shallow water it will grow above the surface, and sends out flower stalks with three-petaled white flowers. This plant dominates much of the littoral zone throughout this lake; however, so far it has not been found in any other lake in Washington.

Sagittaria rigida (bur arrowhead) is also native to the Eastern United States. It was first identified this year in Crocker Lake, Jefferson County. This lake has been surveyed every year since 1994, and this is the first time this plant has been observed flowering. It was common near the boatlaunch area and on the east shore. *Sagittaria rigida* is not known to be weedy in other areas of the country, but it should continue to be monitored.

Butomus umbellatus (flowering rush) is originally from Eurasia, but has been introduced to several areas in North America. It has been observed in one lake in Washington (Silver Lake, Whatcom County), though it is likely found in others. It grows in profusion on the shoreline and in the shallow water of Silver Lake. It appears to be crowding out other vegetation.

Epilobium hirsutum (fiddle-grass) has been growing in wet areas in Whatcom County for many years (Baldwin, 1997). We observed it as a dense stand along the shores of Wiser Lake. This plant is apparently spreading to new locations, and should be considered for inclusion in some category of the noxious weed list.

Typha angustifolia (narrow cattail) was observed in two locations, Sawyer Lake, King County and Clear Lake, Pierce County. This plant and its hybrids with *T. latifolia* (called T. Xglauca) are causing many noxious weed problems in the Midwest. It crowds out other shoreline vegetation and encroaches on the open water of shallow ponds (Smith, 1997). Due to its reputation in other parts of the country, this plant should be included in some category of the noxious weed list.

Egeria densa in Lake Leland

Lake Leland is a 110 acre shallow lake in rural eastern Jefferson County. Historically it has supported a diverse community of native vegetation that appears to host much wildlife. Casual observation disclosed newts laying eggs on native pondweeds, large duck flocks, and many wintering trumpeter swans. The fish biologist for this area stated that Lake Leland supports the best warm water fishery in the region (Collins, 1995).

During the 1994 field season an isolated though well developed population of *Egeria densa* was discovered in the western end of the lake. Additional site visits were made in 1995 and 1996,

and the *Egeria* population boundaries were recorded with a GPS unit and by visual placement on a map (see Parsons 1997a for detailed maps of the *Egeria* expansion). During 1995 the population expanded throughout most of the isolated western end of the lake. By the fall of 1996 small pioneering clumps of *E. densa* were present in much of the lake's main body, and the western end contained a dense ring of this species between depths of one to three meters.

The people living in the community are concerned about the impacts this plant will have on the lake. In the summer of 1997 they used grant money from the Aquatic Weed Management Fund to conduct an aquatic plant mapping project that included biomass measurements. They found *E. densa* present in 85% of the 27 transects made on the lake, indicating that the plant has successfully colonized most of the littoral zone. The greatest density of *E. densa* was in the western end, where the plant was apparently introduced. Most of the remainder of the lake is not yet dominated by the *E. densa*, and hosts a mix of native species as well. The shoreline is dominated by the common exotic grass *Phalaris arundinacia* (reed canarygrass) (Gately, 1997).

Plant Monitoring Project

A more in-depth macrophyte study has been conducted during September of 1995, 1996 and 1997 on two isolated Grant County lakes: Evergreen Lake and Quincy Lake. These lakes were chosen to track plant community changes over time. They are close geographically, and Evergreen Lake has a widely distributed population of *Myriophyllum spicatum,* while Quincy Lake does not appear to support any *M. spicatum*. On each lake, several transects were established running perpendicular to shore. Transect locations were recorded with a GPS unit and a written description. Plant species and cover data were collected with a weighted rake and by visual inspection at one-meter depth intervals until the maximum depth of plant growth was reached (or the other side of the lake). The data were used to update bathymetric plant community maps. These transects will be revisited in future years to continue monitoring plant community changes.

Evergreen Lake

Evergreen Lake is the larger and deeper of the two lakes (250 acres, 55 feet deep) (Figure 4). It receives direct irrigation runoff as its main water supply (Haltrap, 1995), and could have originally been colonized by *Myriophyllum spicatum* through fragments floating in from infested waterbodies upstream. Much of the shoreline is steep and rocky, providing inhospitable aquatic plant habitat. However, in the coves and in deeper water a dense aquatic plant community thrives.

In 1995 *M. spicatum* dominated the plant community between depths of three to five meters throughout much of the lake (the exception being the far east end). There was, however, a diverse group of other species found as well. In the 1996 survey the *M. spicatum* population level had decreased throughout the lake, except the far east end where it had increased. In most areas it was not the dominant plant, but shared that distinction with a mix of several native or naturalized plants (*Chara sp., Potamogeton crispus, Elodea canadensis, Ceratophyllum demersum*).

In 1997 the aquatic plant community again resembled that found in 1995. *Myriophyllum spicatum* was again dominant at moderate depths, though this time the depth interval was from 2.5 to 3.5 meters. During all years the maximum depth of macrophyte growth was approximately seven meters and the deeper water was almost exclusively colonized by *E. canadensis* and *C. demersum*. In general, the plant community appeared less vibrant in 1996 than it had in 1995 or 1997, as was true for many lakes that year. This could be why the *M. spicatum* did not appear dominant.

Quincy Lake

Quincy Lake is a long narrow 51 acre lake with a maximum depth of 23 feet (Figure 5). This lake has no direct water supply, instead being fed by ground water (the water table is elevated due to irrigation in the Columbia Basin). It is much more alkaline than Evergreen Lake (Quincy total alkalinity around 300 mg/L $CaCO_3$, Evergreen around 70 mg/L $CaCO_3$). Therefore, Quincy Lake has a more limited plant community, consisting of plants tolerant of alkaline conditions. This could be the reason *Myriophyllum spicatum* is not found in this lake (see discussion under Alkalinity results). Over the three year study period, the population of *Lythrum salicaria* on the shores of Quincy Lake has increased in spite of control efforts. In deeper water throughout most of the lake (to six meters deep), *Chara* has been the dominant macrophyte in all study years. The more shallow zones were populated by a mixture of species including *Myriophyllum sibiricum, Potamogeton pectinatus* and *Ceratophyllum demersum*. In 1997 the *M. sibiricum* appeared more plentiful than in the past.

Rare Plants

In addition to the weedy plants, populations of plants listed as rare by the Washington Natural Heritage Program (WNHP) (Washington Natural Heritage Program, 1994) were observed during the field surveys. *Limosella acaulis* (mudwort), was again observed in Grant County, and several lakes with populations of *Lobelia dortmanna* in San Juan and Mason Counties were visited. In addition, sightings of *Heteranthera dubia, Utricularia minor, Hydrocotyle ranunculoides,* and *Sparganium fluctuans* were reported to the WNHP database manager. It was hoped that the suspected population of *Potamogeton obtusifolius* in Mason County could be confirmed, however plant specimens collected could not be positively identified.

Figure 4. Evergreen Lake aquatic plant communities.

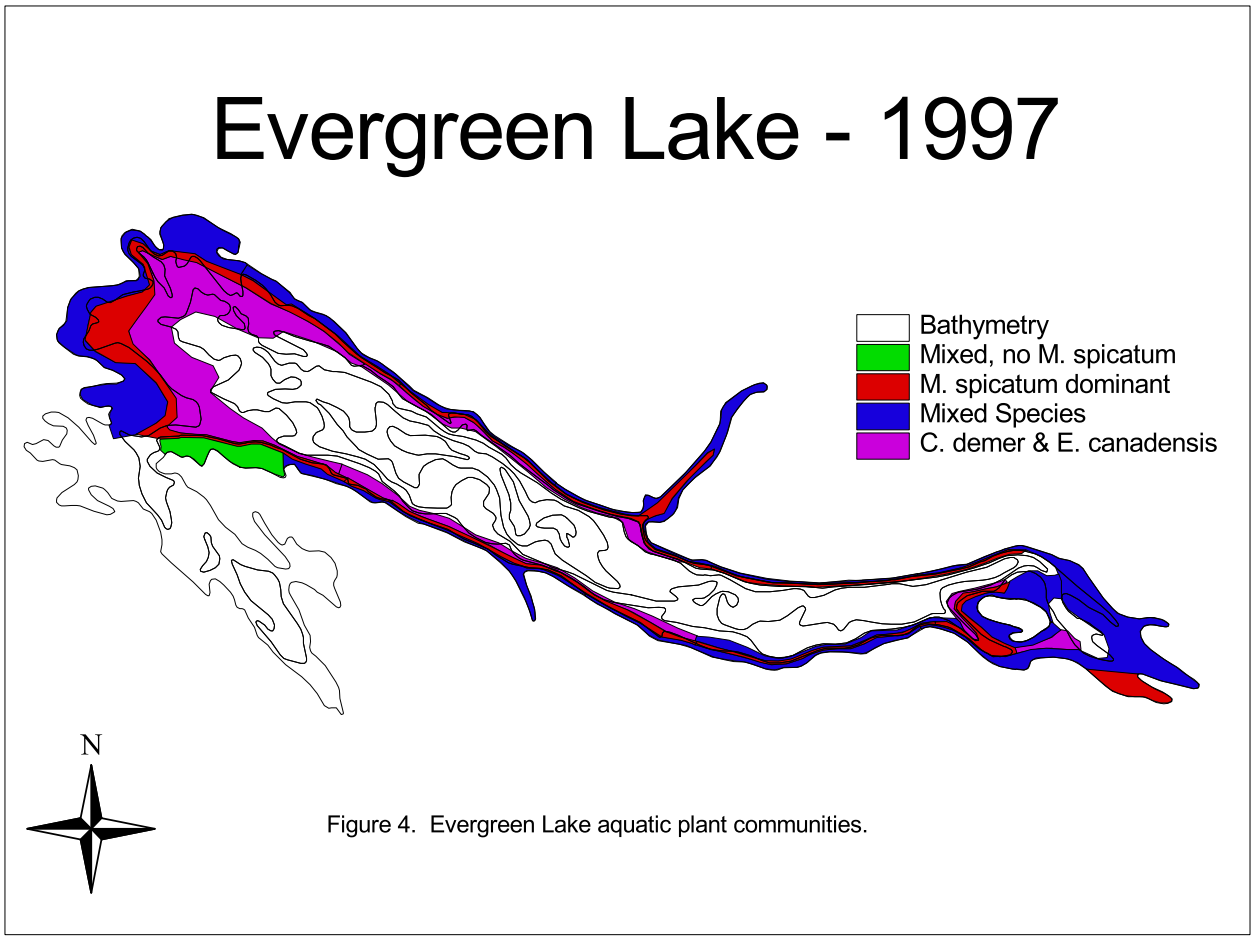
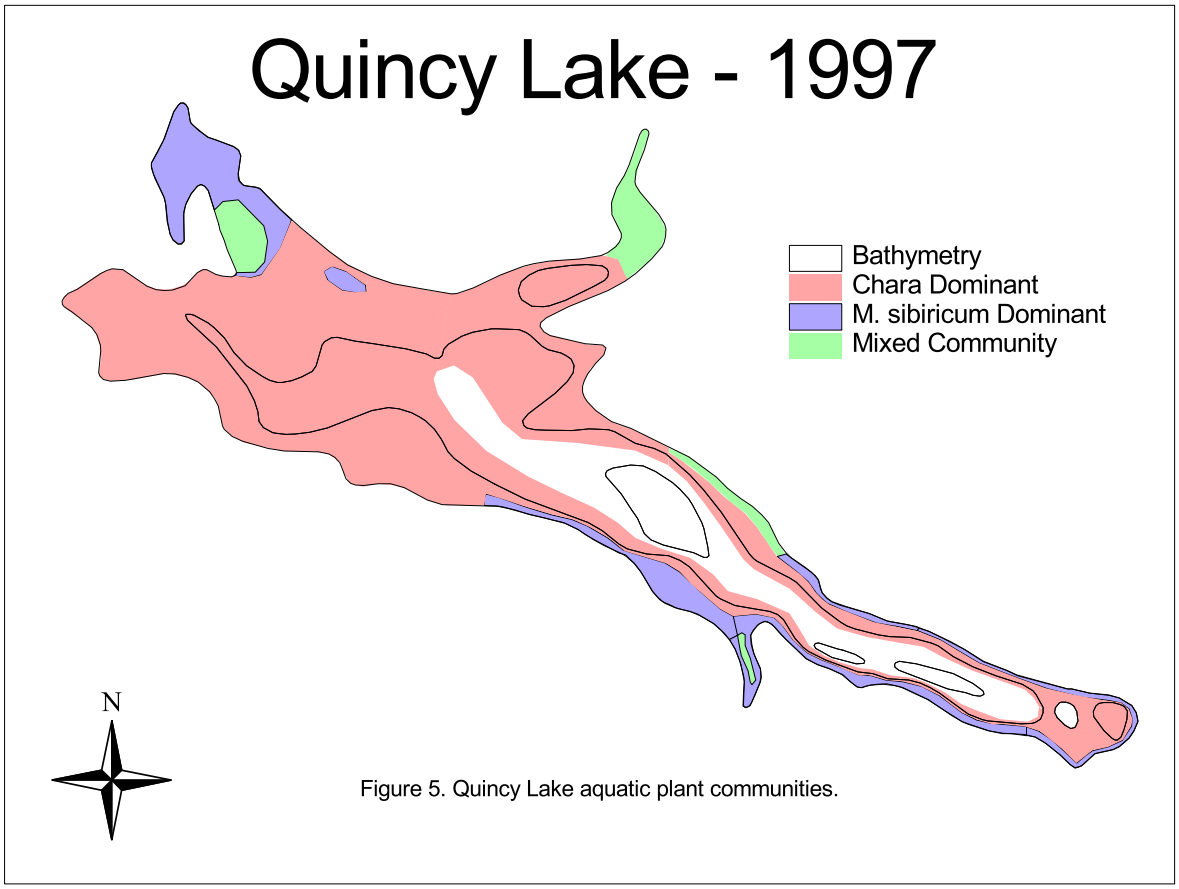


Figure 5. Quincy Lake aquatic plant communities.



Alkalinity Results

There is a wide range of alkalinity values reported for Washington lakes, with the general trend of lower values in the Western and Northeast portions of the state, and higher values in the Columbia Basin. Table 5 lists the alkalinity results for 1995, 1996 and 1997 using a Hach® field test kit. Confidence in these values should be limited to the ±10 mg/l limit reported by the Hach® Company.

Table 5. Alkalinity data results.

County	Waterbody Name	Date	Alkalinity* (mg/l $CaCO_3$)
Chelan	Roses (Alkali) Lake	6/17/97	254
	Wapato Lake	6/27/95	180
		8/8/95	172
		6/24/96	200
		6/17/97	175
Clallam	Beaver Lake	7/9/96	30
	Crescent Lake	7/10/96	49
	Ozette Lake	7/9/96	8
	Pleasant Lake	7/11/96	14
	Sutherland Lake	7/11/96	65
Columbia	Snake River at Little Goose Dam	8/5/97	43
Ferry	Curlew Lake	8/22/95	99
	Ellen Lake	8/23/95	70
	Swan	8/13/97	60
	Trout Lake	8/22/95	82
	Twin Lakes	8/23/95	33
Grant	Alkali Lake	7/16/96	229
	Babcock Ridge Lake	7/24/95	130
	Billy Clapp Lake	8/30/95	51
	Blue Lake	7/16/96	207
	Burke Lake	9/19/96	172
		9/24/97	134
	Canal Lake	8/30/95	154
	Corral Lake	7/25/95	230
	Deep Lake	6/25/96	147
	Evergreen Lake	9/12/95	57
		9/18/96	70
		9/23/97	63
	Lenore Lake	7/17/96	931
	Long Lake (17N-29E-32)	8/31/95	118
	Park Lake	6/26/96	190
	Quincy Lake	9/13/95	233
		9/17/96	386
		9/22/97	301
	Soda Lake	7/25/95	97

County	Waterbody Name	Date	Alkalinity* (mg/l $CaCO_3$)
Grays Harbor	Aberdeen Lake	7/22/96	28
	Failor Lake	6/25/97	11
	Quinault Lake	10/7/96	24
	Sylvia Lake	7/22/96	16
Island	Deer Lake	9/4/96	20
	Goss Lake	9/5/96	26
	Lone Lake	9/4/96	74
Jefferson	Anderson Lake	7/8/96	58
	Crocker Lake	8/27/97	20
	Leland Lake	6/14/95	22
		10/3/95	30
		6/11/96	26
	Tarboo Lake	7/2/96	9
King	Meridian Lake	7/10/97	28
	Pipe Lake	6/18/96	31
	Sawyer Lake	8/7/97	48
Kitsap	Horseshoe Lake	8/22/96	5
	Kitsap Lake	8/3/95	36
	Mission Lake	9/9/96	35
	Panther Lake	8/2/95	6
	Wildcat Lake	10/4/95	18
Kitsap/Mason	Tiger Lake	9/9/96	5
Kittitas	Lavender Lake	6/18/97	24
Mason	Benson Lake	7/23/96	6
	Isabella Lake	8/18/97	32
	Island Lake	6/24/97	16
	Nahwatzel Lake	6/26/97	5
Okanogan	Alta Lake	6/29/95	91
	Conconully Reservoir	9/18/97	56
	Crawfish Lake	8/28/96	21
	Davis Lake	8/9/95	162
	Green Lake	6/29/95	225
	Leader Lake	8/29/96	102
	Little Twin Lake	8/9/95	163
	Omak Lake	8/28/96	2986
	Patterson Lake	8/10/95	79
	Pearrygin Lake	8/10/95	114
	Spectacle Lake	8/27/96	77
		9/17/97	70
	Whitestone Lake	6/28/95	110
		9/17/97	114
Pacific	Black Lake	8/26/97	10
	Loomis Lake	8/25/97	23

County	Waterbody Name	Date	Alkalinity* (mg/l $CaCO_3$)
Pend Oreille	Davis Lake	7/30/96	46
	Diamond Lake	7/31/96	35
	Skookum Lake, South	7/31/96	9
	Sullivan Lake	8/1/96	52
Pierce	Clear Lake	6/12/96	20
		6/23/97	18
	Harts Lake	7/3/96	67
	Ohop Lake	7/25/96	28
	Rapjohn Lake	7/25/96	28
	Spanaway Lake	9/11/96	48
	Tanwax Lake	9/12/96	29
San Juan	Cascade Lake	9/9/97	54
	Mountain Lake	9/9/97	22
	Sportsman Lake	9/10/97	44
Skagit	Campbell Lake	8/13/96	85
	Campbell Lake	7/2/97	54
	Erie Lake	7/2/97	52
	Heart Lake (35N-01E-36)	8/13/96	82
Snohomish	Goodwin Lake	6/20/95	25
Spokane	Williams Lake	9/16/97	112
Stevens	Deep Lake	7/30/97	165
	Deer Lake	7/29/97	32
	Jumpoff Joe Lake	7/29/97	109
	Loon Lake	9/25/96	85
	Waitts Lake	7/30/97	132
Whatcom	Cain Lake	8/14/96	18
	Samish Lake (East Arm)	6/30/97	16
	Silver Lake	7/1/97	25
	Terrell Lake	8/14/96	38
	Toad (Emerald) Lake	7/3/97	29
	Whatcom Lake	6/21/95	19
	Wiser Lake	7/1/97	53
Whitman	Snake River at Little Goose Dam	8/5/97	43

- In 1996 a known standard addition was used to test the accuracy of the field test kit. An average correction value was calculated from the test results and applied to the 1996 values as recommended by the manufacturer (Hach, 1994). In 1997 a different method of measuring the known addition was followed, and the results were highly variable. Therefore no correction value was calculated for that year. However, because the uncorrected values from 1997 were similar to values from previous years in lakes that were duplicated, I felt the uncorrected values could be reported. Additional confidence in these data was gained last year when results nearly exactly matched the results from laboratory analyses (Parsons, 1997a).

Figure 6 presents the alkalinity ranges of plant species observed in at least five different lakes. Many species appear to have a broad range of tolerance. However, there are several that have only been observed in lakes within a limited alkalinity range. For example, *Potamogeton epihydrus, Dulichium arundinacia, Lobelia dortmanna* and *Ludwigia palustris* all were found in lakes with relatively low alkalinity (less than 50 mg/L $CaCO_3$). On the other end of the scale, *Ruppia cirrhosa* was not found in any lake with less than about 150 mg/L $CaCO_3$. *Zannichellia palustris* appears to have the most distinctive mid-range of tolerance, with all occurrences in lakes between 100 - 200 mg/L $CaCO_3$.

In comparing these data with similar studies, both similarities and differences are seen (Table 6 and Table 7). In a study of Japanese lakes, Kadono (1982) found *Myriophyllum spicatum,* and *Ceratophyllum demersum* in lakes with moderate alkalinity (Table 6), akin to what was found in Washington lakes. Kadono (1982) also observed *Brasenia schreberi* in lakes with relatively low alkalinity, a pattern which the Washington data also follow. Table 6 also provides median alkalinity values for plants found in Florida lakes (Hoyer et al., 1996). Most of these plants were found in less alkaline waters than those from Washington, especially in the case of *P. pectinatus*. In another study, Hellquist (1980) studied the correlation between *Potamogeton* species distribution and alkalinity in New England lakes (Table 7). Overall, the ranges and median alkalinity values for species found in the two regions are very similar. There are, however, a few differences that can be noted. The upper limit for *P. pectinatus* in New England was far less than that for Washington, but this is probably due to the absence of highly alkaline lakes in New England. Hellquist found *P. epihydrus* in lakes with up to 161 mg/L $CaCO_3$, whereas in the Washington lakes studied this plant appears restricted to less alkaline waters. Two other plants appear to tolerate higher alkalinity in New England; *P. praelongus* and *P. nodosus*. Three species seem to tolerate higher alkalinity in Washington; *P. friesii, P. illinoensis* and *P. richardsonii*. However, for all except *P. richardsonii* the median values are still fairly close.

The differences in observed values from these studies could be due to different physiological characteristics of the plants from different regions (different ecotypes), to differences in plant community composition, or to other factors influencing the plants such as other water quality or sediment variables, or climatic differences. Also, the data from Washington lakes are more limited, so additional observations may affect the results. However, it is interesting to note that the addition of 1997 data to the array brought few changes to the ranges, and altered the median values very little (compare to Parsons, 1997a).

Figure 6. Box plot of alkalinity ranges for selected macrophytes.

Plant Name Codes (from bottom to top of plot):

Brasenia schreberi
Ceratophyllum demersum
Chara sp.
Dulichium arundinacea
Elodea canadensis
Fontinalis antipyretica
Iris pseudacorus
Isoetes spp.
Lemna minor
Lobelia dortmanna
Ludwigia palustris
Lythrum salicaria
Megalodonta beckii
Myriophyllum sibiricum
Myriophyllum spicatum
Najas flexilis
Nitella
Nuphar polysepala
Nymphaea odorata
Phalaris arundinacea
Polygonum amphibium
Potamogeton amplifolius
Potamogeton crispus
Potamogeton epihydrus
Potamogeton foliosus
Potamogeton friesii
Potamogeton gramineus
Potamogeton illinoensis
Potamogeton natans
Potamogeton nodosus
Potentilla palustris
Potamogeton pectinatus
Potamogeton praelongus
Potamogeton pusillus
Potamogeton richardsonii
Potamogeton robbinsii
Potamogeton zosteriformis
Ranunculus aquatilus
Ruppia cirrhosa
Scirpus americanus
Sparganium angustifolium
Spirodela polyrrhiza
Vallisneria americana
Zannichellia palustris

Legend:

bar within the box - median
hinges (box edges) - within which 25% to 75% of the values lie
whiskers - include values within 1.5 Hspreads of the hinges (Hspread is the absolute value of the difference between the values of the two hinges).
asterisk - values within 3 Hspreads of the hinges
open circle - values outside 3 Hspreads of the hinges

Figure 6 continued

Alkalinity Range by Macrophyte Species

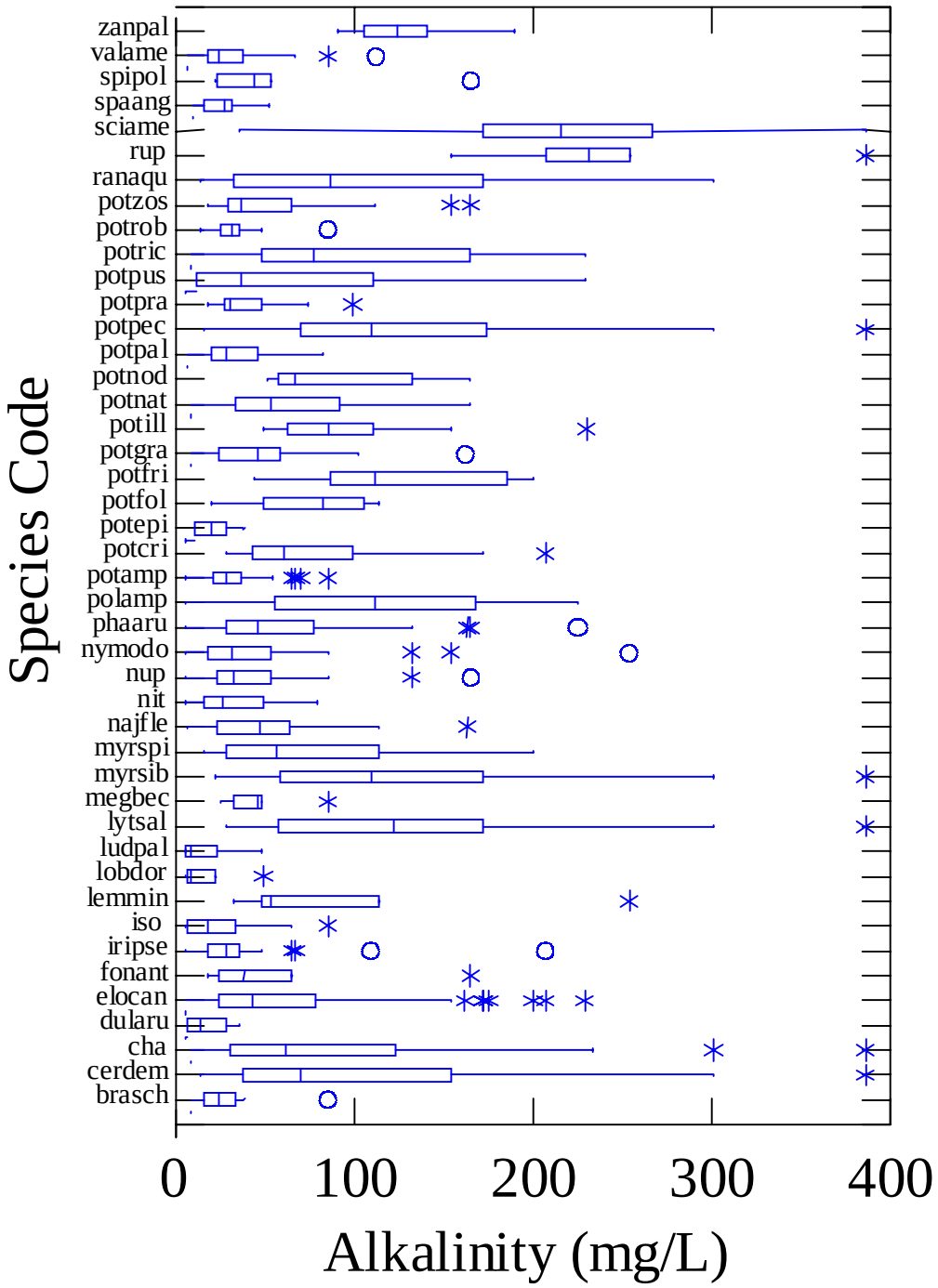


Table 6: Alkalinity values for plant species from other studies

Species	Alkalinity Range mg/l CaCO3	Median mg/l CaCO3
Lakes from Japan		
Brasenia schreberi	3 to 47	16
Ceratophyllum demersum	9 to 451	35
Myriophyllum spicatum	13 to 145	35
Spirodela polyrrhiza	18 to 103	51
Florida Lakes		
Brasenia schreberi		3
Ceratophyllum demersum		24
Chara spp.		22
Fontinalis spp.		2
Lemna minor		24
Nitella spp.		14
Nymphaea odorata		9
Potamogeton illinoensis		40
Potamogeton pectinatus		15
Vallisneria americana		27

Table 7: Comparison of Alkalinity Ranges

	New England Lakes			**Washington Lakes**		
Species	Alkalinity Range mg/l CaCO3	median mg/l CaCO3	n	Alkalinity Range mg/l CaCO3	median mg/l CaCO3	n
Potamogeton amplifolius	4 to 151	28	78	5 to 85	28	35
P. crispus	15 to 208	93	31	28 to 207	60	18
P. epihydrus	2 to 161	*	169	5 to 38	20	17
P. foliosus	17 to 168	73	62	20 to 114	82	8
P. friesii	43 to 151	85	11	44 to 200	112	7
P. gramineus	3 to 151	*	117	8 to 162	46	17
P. illinoensis	24 to 151	80	24	49 to 230	85	13
P. natans	3 to 162	21	152	8 to 165	53	16
P. nodosus	6 to 283	76	20	51 to 165	67	6
P. pectinatus	37 to 283	113	26	33 to 931	110	49
P. praelongus	10 to 151	44	39	18 to 99	30	15
P. pusillus	3 to 206	*	172	5 to 229	36	12
P. richardsonii	17 to 131	44	27	8 to 229	77	28
P. robbinsii	4 to 122	26	49	14 to 85	31	16
P. zosteriformis	6 to 151	49	74	18 to 165	36	21

* values for more than one variety combined, original values not available to calculate a median

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 have been consulted as cross references (Appendix B). 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. Kartesz (1994), The Jepson Manual (Hickman, 1993), and personal consultation with authors of the Flora of North America (Flora of North America Editorial Committee, 1993) are used to ensure the nomenclature is current. In the case of questionable *Myriophyllum* species, samples were sent to Oluna Ceska for identification by analysis of the plant's flavonoid chemistry (Ceska, 1977).

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 finished reference specimens are stored in a sealed herbarium cabinet located in the Ecology headquarters building benthic laboratory.

Currently, the herbarium collection contains 99 unique taxa from 37 families (Table 8). There is a total of 284 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 to be 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.

Table 8: 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
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		
	Rorippa nasturtium-aquaticum	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 gladiola; water lobelia
Ceratophyllaceae		
	Ceratophyllum demersum	Coontail; hornwort
Characeae		
	Nitella sp.	stonewort
	Tolypella intricata	macro algae
Crassulaceae		
	Crassula aquatica	pygmy-weed

Family	Scientific name	Common name
Cyperaceae		
	Carex unilateralis	one-sided sedge
	Cyperus erythrorhizos	red rooted Cyperus
	Dulichium arundinaceum	Dulichium
	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 sp.	waterwort
	Elatine triandra	three-stamen waterwort
Fontinalaceae		
	Fontinalis antipyretica	water moss
Haloragaceae		
	Myriophyllum aquaticum	parrotfeather
	Myriophyllum hippuroides	western watermilfoil
	Myriophyllum quitense	waterwort watermilfoil
	Myriophyllum sibiricum	northern 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
	Vallisneria americana	water celery
Isoetaceae		
	Isoetes lacustris	lake quillwort
Juncaceae		
	Juncus acuminatus	tapered rush
	Juncus bulbosus	bulbous rush
Lamiaceae		
	Lycopus asper	rough bungleweed
Family	**Scientific name**	**Common name**

Lemnaceae		
	Wolffia sp.	water-meal
Lentibulariaceae		
	Utricularia inflata	big floating bladderwort
	Utricularia macrorhiza	common bladderwort
	Utricularia minor	lesser bladderwort
	Utricularia sp.	bladderwort
	Utricularia vulgaris	common bladderwort
Menyanthaceae		
	Menyanthes trifoliata	buckbean
	Nymphoides peltata	water fringe
Najadaceae		
	Najas flexilis	common naiad
	Najas gradalupensis	Guadeloupe water-nymph
Nymphaeaceae		
	Nuphar polysepala	spatter-dock, yellow water-lily
Onagraceae		
	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 hydropiperoides	common smartweed
Pontederiaceae		
	Heteranthera dubia	water star-grass
Potamogetonaceae		
	Potamogeton amplifolius	large-leaf pondweed
	Potamogeton crispus	curly leaf pondweed
	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 pectinatus	sago pondweed
	Potamogeton praelongus	whitestem pondweed
	Potamogeton pusillus	slender pondweed
Family	**Scientific name**	**Common name**

Potamogetonaceae con't		
	Potamogeton richardsonii	Richardson's pondweed
	Potamogeton robbinsii	fern leaf pondweed
	Potamogeton vaginatus	sheathing pondweed
	Potamogeton zosteriformis	eel-grass pondweed
Primulaceae		
	Lysimachia nummularia	creeping loosestrife
	Lysimachia thyrsiflora	tufted loosestrife
	Lysimachia vulgaris	garden loosestrife
Ranunculaceae		
	Ranunculus aquatilis	water-buttercup
	Ranunculus flammula	creeping buttercup
Ruppiaceae		
	Ruppia maritima	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 nutans	small bur-reed
	Sparganium sp.	bur-reed
Zannichelliaceae		
	Zannichellia palustris	horned pondweed

Aquatic Weed Management Fund Related Activities

The regular 1997 funding cycle for the Aquatic Weed Management Fund (AWMF) was canceled due to a shortage of available funds for distribution. For information on this grant program and the use of the monies contact the AWMF administrator at the Department of Ecology, Water Quality Program. Grants were still made available for projects to control early infestations of noxious aquatic weeds. One such grant was awarded to the Stevens County Noxious Weed Board for mapping and control of *Myriophyllum spicatum* in Loon Lake.

Aquatic Plant Field Guide

During 1994, money from the AWMF was targeted for the development and production of an Aquatic Plant Field Guide. The guide will include 110 aquatic plants with photographs, line drawings, written descriptions, and notes on the values and natural history of the plants. We selected a consultant team headed by Shapiro and Associates to develop the guide. Since then this team has compiled photographs and drawings of the plants, and composed written descriptions. All pages required extensive review by aquatic plant technical assistance personnel for accuracy and readability. This process is nearing completion, and an outside reviewer will be contracted early in 1998 to conduct a final technical review. It is hoped that this project will be completed in time for the 1998 field season.

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Appendix A

Site Visit Summary Table 1994-1997

County	Waterbody Name	WRIA	Date	Survey Extent	Noxious Aquatic Weeds
Adams	Sprague Lake	34	9/16/97	south half	none
Asotin	Snake River at Chief Timothy S.P.	35	8/4/97	3 sites	none
Chelan	Antilon Lake	47	8/31/94	from shore, N and S ends	none
	Chelan Lake	47	8/31/94	from City Park shore	*Myriophyllum spicatum*
	Dry Lake	47	8/31/94	from shore, east end	none
	Fish Lake	45	6/16/97	west shore	none
	Roses Lake	47	8/31/94	south shore	none
			6/17/97	whole littoral	none
	Wapato Lake	47	8/31/94	entire shoreline	*Myriophyllum spicatum*
			6/27/95	whole littoral	
			8/8/95	whole littoral	
			9/11/95	whole littoral	
			6/24/96	whole littoral	
			7/15/96	milfoil sites	
			9/16/96	milfoil sites	
			7/16/97	whole littoral	
	Wenatchee Lake	45	9/1/94	west end, east boat launch	none
Clallam	Beaver Lake	20	7/9/96	whole littoral	none
	Crescent Lake	19	7/10/96	4 sites	none
	Ozette Lake	20	7/9/96	3 sites	none
	Pleasant Lake	20	7/11/96	whole littoral	none
	Sutherland Lake	18	7/11/96	whole littoral	none
	Unnamed (30N-04W-17)	18	7/13/95	ID from plant sample	*Myriophyllum spicatum*
Clark	Battleground Lake	28	4/13/94	from dock only	*Egeria densa*
	Caterpillar Slough	28	8/15/95	spot check from boat	*Myriophyllum spicatum*
	Columbia River at Ridgefield	28	8/15/95	spot check from boat	*Myriophyllum spicatum* *Lythrum salicaria*
	Lacamas Lake	28	9/3/97	whole littoral	*Egeria densa*
	Vancouver Lake	28	8/15/95	spot check from shore	none
Columbia	Snake River at Little Goose Dam	35	8/5/97	spot check, boat	*Myriophyllum spicatum*
	Snake River near Lyons Ferry	35	8/5/97	spot check, boat	*Myriophyllum spicatum*
Cowlitz	Silver Lake	26	9/7/94	several locations thu' lake	*Myriophyllum spicatum*
			9/19/95	several sites, from boat	none
	Solo Slough	25	4/13/94	spot check from shore	*Myriophyllum aquaticum*
			7/14/94	spot check from shore	*Cabomba caroliniana*
			8/16/95	from shore	*Egeria densa*
			8/8/96	from shore	*Ludwigia hexapetala*
			5/28/97	spot check from shore	*Myriophyllum spicatum*
	Willow Grove Slough	25	4/13/94	spot check from shore	*Cabomba caroliniana*
			7/14/94	spot check from shore	*Myriophyllum spicatum*
			8/16/95	several sites, from boat	*Egeria densa* *Lythrum salicaria* *Myriophyllum spicatum*
Douglas	Jameson Lake	44	6/26/96	1 site from shore	none
Ferry	Curlew Lake	60	8/22/95	5 sites, whole littoral	none
			8/2/96	4 sites (luanches)	none
			8/13/97	5 sites (launches)	none
	Ellen Lake	58	8/23/95	whole littoral	none
	Ferry Lake	52	8/13/97	whole littoral	none
	Swan Lake	52	8/13/97	whole littoral	none
	Trout Lake	58	8/22/95	whole littoral	none
	Twin Lakes	58	8/23/95	4 sites, both lakes	none
			8/14/97	3 sites, both lakes	none
Franklin	Scooteney Reservoir	36	7/26/95	spot check from shore	*Myriophyllum spicatum*
	Snake River - Lower Monumental	33	8/20/96	spot check, boat	*Myriophyllum spicatum*
	Snake River at Ice Harbor Dam	33	8/19/96	spot check, boat	*Myriophyllum spicatum*
	Snake River at Levey Park	33	8/19/96	spot check, boat	none
	Snake River at Windust Park	33	8/20/96	spot check, boat	none
	Snake River at Lyons Ferry	34	8/5/97	spot check, boat	*Myriophyllum spicatum*
Garfield	Snake River at Lower Granite Dam	35	8/4/97	spot check, boat	none

County	Waterbody Name	WRIA	Date	Survey Extent	Noxious Aquatic Weeds
Grant	Alkali Lake	42	7/16/96	whole littoral	none
	Babcock Ridge Lake	41	7/24/95	2 sites, whole littoral	*Myriophyllum spicatum* *Lythrum salicaria*
	Banks Lake	42	6/25/96	spot check, shore	none
	Billy Clapp Lake	42	8/30/95	4 sites, whole littoral	*Myriophyllum spicatum*
	Blue Lake	42	7/16/96	whole littoral	none
	Burke Lake	41	6/28/94	entire shoreline	*Lythrum salicaria* *Myriophyllum spicatum*
			9/19/96	whole littoral	
			9/24/97	whole littoral	
	Canal Lake	41	8/30/95	4 sites, whole littoral	*Lythrum salicaria*
	Corral Lake	41	7/25/95	whole littoral	*Lythrum salicaria*
	Crater Lake	41	7/24/95	spot check from shore	none
	Deep Lake	42	6/25/96	whole littoral	none
	Dry Falls Lake	42	6/25/96	spot check, shore	none
	Evergreen Lake	41	6/27/94	entire shoreline	*Lythrum salicaria* *Myriophyllum spicatum*
			9/12/95	8 transects, whole littoral	
			9/18/96	8 transects, whole littoral	
			9/23/97	8 transects, whole littoral	
	Lenore Lake	42	7/17/96	whole littoral	none
	Long Lake (17N-29E-32)	41	8/31/95	2 sites, whole littoral	none
	Park Lake	42	6/26/96	whole littoral	none
	Potholes Reservoir	41	8/7/94	6 sites on N & W side	*Myriophyllum spicatum*
	Quincy Lake	41	6/28/94	entire shoreline	*Lythrum salicaria*
			9/13/95	3 transects, whole littoral	
			9/17/96	3 transects, whole littoral	
			9/22/97	whole littoral	
	Rocky Ford Cr	41	7/28/97	spot check, shore	*Lythrum salicaria*
	Soda Lake	41	7/25/95	whole littoral	none
	Stan Coffin Lake	41	6/29/94	entire shoreline	*Myriophyllum spicatum* *Lythrum salicaria*
	Warden Lake	41	7/25/95	2 sites, whole littoral	*Lythrum salicaria*
	Winchester Wasteway	41	7/26/95	spot check from shore	*Lythrum salicaria*
	Windmill Lake	41	8/30/95	south end	none
Grays Harbor	Aberdeen Lake	22	7/22/96	whole littoral	none
	Duck Lake	22	9/9/95	2 sites, from shore	*Egeria densa*
	Failor Lake	22	6/25/97	whole littoral	none
	Quinault Lake	21	10/7/96	75% of littoral	none
	Sylvia Lake	22	7/22/96	whole littoral	none
Island	Cranberry Lake	6	8/24/94	4 sites around lake	none
			9/5/96	spot check, shore	none
	Crockett Lake	6	9/4/96	spot check, shore	none
	Deer Lake	6	9/4/96	whole littoral	none
	Goss Lake	6	9/5/96	whole littoral	none
	Lone Lake	6	9/4/96	whole littoral	*Lythrum salicaria*
Jefferson	Anderson Lake	17	7/8/96	whole littoral	none
	Crocker Lake	17	5/24/94	northwest half - littoral	none
			6/14/95	whole littoral	
			6/11/96	whole littoral	
			8/27/97	whole littoral	
	Leland Lake	17	5/24/94	entire shoreline	*Egeria densa*
			6/14/95	whole littoral	
			10/3/95	whole littoral	
			11/8/95	Egeria site	
			6/11/96	whole littoral	
			7/2/96	whole littoral	
			10/2/96	whole littoral	
			8/27/97	spot check	
	Tarboo Lake	17	7/2/96	whole littoral	none

County	Waterbody Name	WRIA	Date	Survey Extent	Noxious Aquatic Weeds
King	Lucerne Lake	9	6/9/95	outlet	*Hydrilla verticillata*
			7/15/95	spot check	*Myriophyllum spicatum*
	Meridian Lake	9	7/10/97	whole littoral	*Lythrum salicaria* *Myriophyllum spicatum*
	Morton Lake	9	8/19/97	whole littoral	none
	Pipe Lake	9	6/1/95	several sites, divers	*Hydrilla verticillata*
			6/9/95	near boatlaunch, outlet	*Myriophyllum spicatum*
			7/12/95	from shore	
			7/15/95	6 sites, biomass samples	
			8/1/95	6 sites, biomass samples	
			6/18/96	spot check, boat	
			7/21/97	3 sites	*Hydrilla verticillata*
	Sawyer Lake	9	8/7/97	whole littoral	*Myriophyllum spicatum*
	Steel Lake	9	5/11/94	entire shoreline, divers	*Myriophyllum spicatum*
	Wilderness Lake	9	8/19/97	whole littoral	*Lythrum salicaria* *Myriophyllum spicatum*
Kitsap	Horseshoe Lake	15	8/22/96	whole littoral	none
	Kitsap Lake	15	8/3/95	2 sites, whole littoral	none
			8/28/97	4 sites	none
	Long Lake	15	9/12/94	several locations	*Egeria densa*
			3/17/95	6 transects, whole littoral	*Myriophyllum spicatum*
			7/22/97	2 sites	*Lythrum salicaria*
			8/28/97	3 sites	
	Mission Lake	15	9/9/96	whole littoral	none
	Panther Lake	15	8/2/95	whole littoral	none
	Square Lake	15	7/22/97	spot check, shore	none
	Wildcat Lake	15	10/4/95	4 sites, whole littoral	none
Kitsap/Mason	Tiger Lake	15	9/9/96	whole littoral	none
Kittitas	Easton Lake	39	8/30/94	spot check from shore	none
			6/18/97	spot check, shore	none
	Kiwanis Pond	39	8/30/94	spot check from shore	none
	Lavender Lake	39	6/18/97	whole littoral	*Myriophyllum spicatum*
	unnamed fishing pond	39	8/30/94	most of shoreline	none
	Unnamed Ponds near Easton	39	6/18/97	spot check, shore	none
	unnamed ponds	39	8/30/94	spot checks	Lythrum salicaria at one
Klickitat	Columbia River at Bingen	29	8/14/95	spot check from shore	*Myriophyllum spicatum*
	Columbia River at Maryhill	30	8/14/95	spot check from boat	*Myriophyllum spicatum*
	Horsethief Lake	30	8/14/95	spot check from shore	*Myriophyllum spicatum*
Lewis	Carlisle Lake	23	8/20/97	whole littoral	none
	Chehalis River	23	7/27/95	shoreline, from boat	*Myriophyllum aquaticum*
			9/10/96	1 site from shore	
			7/23/97	spot check, shore	*Egeria densa*
			8/20/97	1 mile of river	
	Interstate Ave Slough	23	8/20/97	spot check, shore	*Myriophyllum aquaticum*
	Plummer Lake	23	8/20/97	whole littoral	*Egeria densa*
Lincoln	Sprague Lake	34	8/6/94	cove at NE end of lake	none
Mason	Benson Lake	14	7/23/96	whole littoral	none
	Devereaux Lake	15	8/16/94	spot check from shore	none
	Haven Lake	15	8/16/94	entire shoreline	none
	Isabella Lake	14	7/19/94	entire shoreline	none
			8/2/95	checked for rare plant	none
			8/18/97	whole littoral	*Lythrum salicaria*
	Island Lake	14	7/23/96	whole littoral	*Myriophyllum spicatum*
			6/24/97	whole littoral	*Myriophyllum spicatum*
	Limerick Lake	14	8/15/94	entire shoreline	*Egeria densa*
			7/13/95	spot check, boat	
			7/22/97	2 sites	
	Lost Lake	14	8/11/94	entire shoreline	none
			6/10/97	whole littoral	none
	Mason Lake	14	8/7/96	whole littoral	none
	Nahwatzel Lake	22	6/26/97	whole littoral	none

County	Waterbody Name	WRIA	Date	Survey Extent	Noxious Aquatic Weeds
	Spencer Lake	14	8/15/94	most of shoreline	*Lythrum salicaria*
			7/13/95	spot check, boat	*Lythrum salicaria*
			8/22/96	south end, boat	none
			7/22/97	2 sites	none
	Wooten Lake	15	8/16/94	most of shoreline	none
Okanogan	Aeneas Lake	49	7/25/94	entire shoreline	none
	Alta Lake	48	6/29/95	whole littoral	none
	Big Twin Lake	48	8/9/95	most of littoral	none
	Bonaparte Lake	49	8/27/96	whole littoral	none
	Buffalo Lake	53	8/21/95	3 sites, boat	none
	Conconully Lake	49	7/26/94	7 sites thru' shoreline	*Myriophyllum spicatum*
	Conconully Reservoir	49	7/26/94	north end	none
			9/18/97	whole littoral	*Myriophyllum spicatum*
	Crawfish Lake	52	8/28/96	whole littoral	none
	Davis Lake	48	8/9/95	whole littoral	none
	Duck (Bide-a-Wee) Lake	49	8/28/96	spot check, shore	none
			9/18/97	spot check	none
	Fish Lake	49	7/26/94	entire shoreline	none
	Green Lake	49	6/29/95	2 sites, whole littoral	none
	Leader Lake	49	8/29/96	whole littoral	none
	Little Twin Lake	48	8/9/95	whole littoral	none
	Omak Lake	49	8/28/96	north end, boat	none
	Palmer Lake	49	7/27/94	boatlaunches, from shore	none
			6/28/95	whole littoral	none
	Patterson Lake	48	8/10/95	2 sites, whole littoral	none
	Pearrygin Lake	48	8/10/95	3 sites, whole littoral	*Lythrum salicaria*
	Sidley Lake	49	8/27/96	spot check, shore	none
	Spectacle Lake	49	7/27/94	5 sites, various locations	none
			8/27/96	whole littoral	none
			9/17/97	3 sites	none
	Wannacut Lake	49	7/28/94	3 sites	none
	Whitestone Lake	49	7/27/94	5 sites, various locations	*Myriophyllum spicatum*
			6/28/95	6 sites, whole littoral	*Lythrum salicaria*
			8/26/96	whole littoral	
			9/17/97	whole littoral	
Pacific	Black Lake	24	7/12/94	spot check, shore	*Egeria densa*
			8/8/96	most of shoreline	
			8/26/97	whole littoral	
	Island Lake	24	7/14/94	entire shoreline	none
			8/26/97	whole littoral	none
	Loomis Lake	24	7/13/94	most of shoreline	none
			8/25/97	whole littoral	*Myriophyllum spicatum*
	O'Neil Lake	24	7/12/94	entire littoral	none
			8/25/97	spot check, shore	none
	Surfside Lake	24	7/13/94	5 sites from bridges	none
			8/25/97	spot check, shore	none
Pend Oreille	Bead Lake	62	8/12/97	coves, 5 sites	none
	Browns Lake	62	7/31/96	spot check, shore	none
	Davis Lake	62	8/2/94	most of littoral	none
			7/30/96	north end, boat launch	*Myriophyllum spicatum*
			8/12/97	whole littoral	
	Diamond Lake	55	8/2/94	boatlaunch, from shore	none
			7/31/96	east end, boat launch	none
			8/11/97	west half	none
	Fan Lake	55	8/3/94	entire shoreline	*Lythrum salicaria*
			8/12/97	whole littoral	
	Frater Lake	59	8/1/96	spot check, shore	none
	Half Moon Lake	62	7/31/96	north end	none
	Little Spokane River	55	8/2/94	at Fertile Valley Rd crossing	M. spicatum
			8/2/94	at Haworth Rd crossing	none
	Marshall Lake	62	8/1/94	3 sites, mostly at inlets	none

	Mill Lake	62	8/1/96	2 sites, shore	none
County	**Waterbody Name**	**WRIA**	**Date**	**Survey Extent**	**Noxious Aquatic Weeds**
	Nile Lake	62	8/1/96	spot check, shore	*Myriophyllum spicatum*
	Pend Oreille River	62	8/1/96	spot check, shore	*Myriophyllum spicatum*
	Sacheen Lake	55	8/2/94	3 sites, covered entire shore	*Myriophyllum spicatum* *Lythrum salicaria*
	Skookum Lake, North	62	7/31/96	spot check, shore	none
	Skookum Lake, South	62	7/31/96	whole littoral	none
	Sullivan Lake	62	8/1/96	north and south, boat	none
	Unnamed Wetland near Usk	62	8/1/96	shore	none
Pierce	American Lake	12	10/4/94	4 sites	none
	Bay Lake	15	9/28/95	whole littoral	*Lythrum salicaria*
	Clear Lake	11	7/21/94	entire shoreline	*Myriophyllum spicatum*
			6/12/96	whole littoral	
			6/23/97	whole littoral	
	Harts Lake	11	6/17/96	spot check, shore	*Myriophyllum spicatum*
			7/3/96	whole littoral	
	Ohop Lake	11	7/25/96	whole littoral	*Egeria densa*
			9/25/97	whole littoral	
	Rapjohn Lake	11	7/25/96	whole littoral	none
	Silver Lake	11	6/17/96	spot check, shore	none
	Spanaway Lake	12	9/11/96	whole littoral	*Lythrum salicaria*
	Steilacoom Lake	12	6/19/96	spot check, boat	none
	Tanwax Lake	11	7/21/94	entire shoreline	none
			9/12/96	whole littoral	none
San Juan	Cascade Lake	2	9/9/97	whole littoral	none
	Hummel Lake	2	9/8/97	whole littoral	none
	Mountain Lake	2	9/9/97	whole littoral	none
	Sportsman Lake	2	9/10/97	whole littoral	none
Skagit	Beaver Lake	3	8/25/94	entire shoreline	none
	Big Lake	3	8/23/94	3 sites, extreme ends	*Egeria densa*
			8/23/94	& launch	*Myriophyllum spicatum*
	Campbell Lake	3	6/7/94	entire shoreline	none
			8/13/96	whole littoral	*Myriophyllum spicatum*
			7/2/97	whole littoral	
	Clear Lake	3	8/25/94	boatramp only	*Myriophyllum spicatum*
	Erie Lake	3	8/24/94	Entire shoreline	none
			8/13/96	spot check, shore	none
			7/2/97	whole littoral	none
	Everett Lake	4	8/15/96	spot check, shore	none
	Heart Lake (35N-01E-36)	3	8/13/96	whole littoral	none
	Heart Lake (Fidalgo)	3	8/24/94	most of shoreline	none
	McMurray Lake	3	6/6/94	entire shoreline	*Myriophyllum spicatum*
			8/23/94	entire shoreline	
	Pass Lake	3	7/2/97	spot check, shore	none
	Sixteen Lake	3	6/6/94	entire shoreline	*Myriophyllum spicatum*
Snohomish	Goodwin Lake	7	6/20/95	3 sites, littoral survey	*Myriophyllum spicatum*
	Nina Lake	7	6/20/95	2 sites, from shore	*Myriophyllum aquaticum*
	Roesiger (south arm) Lake	7	8/25/94	east side, littoral	none
			6/21/95	spot check, boat	none
			8/29/95	most of shoreline	none
	Shoecraft Lake	7	8/15/96	whole littoral	*Myriophyllum spicatum*
	Stevens Lake	7	9/10/97	4 sites	none
Spokane	Amber Lake	34	8/5/94	at boatramp, from shore	none
	Badger Lake	34	8/5/94	2 sites at extreme ends	none
	Chapman Lake	34	8/24/95	3 sites	none
	Clear Lake	43	8/4/94	4 sites, most of shoreline	none
	Downs Lake	34	8/3/94	from shore - one location	none
	Eloika Lake	55	8/3/94	3 sites, missed some places	M. spicatum
	Fishtrap Lake	43	8/4/94	3 sites	none
	Long Lake (reservoir)	54	8/6/94	2 sites near boatlaunch	*Lythrum salicaria*
			8/25/95	1 site	

	Silver Lake	34	8/4/94	only at boatramp (closed)	none
			8/24/95	2 sites	none
County	**Waterbody Name**	**WRIA**	**Date**	**Survey Extent**	**Noxious Aquatic Weeds**
	Williams Lake	34	8/5/94	boatlaunch and south end	none
			9/16/97	whole littoral	none
Stevens	Deep Lake	61	7/30/97	whole littoral	none
	Deer Lake	59	7/29/97	whole littoral	none
	Jumpoff Joe Lake	59	7/29/97	whole littoral	none
	Loon Lake	59	9/25/96	whole littoral	*Myriophyllum spicatum*
			7/31/97	1 site	*Lysimachia vulgaris*
					Lythrum salicaria
	Waitts Lake	59	7/30/97	whole littoral	*Lythrum salicaria*
Thurston	Black Lake	23	7/8/94	north end	none
			4/18/95	1 site to test methods	none
	Clear Lake	11	8/7/95	1 site	
	Hicks Lake	13	5/24/95	3 sample sites, shoreline	none
	Lawrence Lake	13	11/7/95	spot check from shore	none
	Long Lake	14	6/6/95	spot check	*Myriophyllum spicatum*
			9/20/95	milfoil site	
			10/18/95	spot check	
			11/2/95	milfoil site	
	Summit Lake	14	7/23/97	west end	none
Wahkiakum	Columbia River at Cathlamet	25	8/16/95	spot check, boat	*Lythrum salicaria*
					Myriophyllum spicatum
	Columbia River at Skamokawa	25	8/8/96	spot check, boat	*Lythrum salicaria*
	Puget Island Sloughs	25	5/16/95	2 sloughs, from shore	*Egeria densa*
					Myriophyllum aquaticum
Walla Walla	Snake River - Lower Monumental Dam	33	8/20/96	spot check, boat	*Lythrum salicaria*
					Myriophyllum spicatum
	Snake River at Charbonneau Park	33	8/19/96	spot check, boat	none
	Snake River at Fishhook Park	33	8/19/96	spot check, boat	none
	Snake River at Ice Harbor Dam	33	8/19/96	spot check, boat	*Myriophyllum spicatum*
Whatcom	Cain Lake	3	8/14/96	whole littoral	none
	Samish Lake (East Arm)	3	6/30/97	whole littoral	none
	Samish Lake (West Arm)	3	6/30/97	whole littoral	none
	Silver Lake	1	7/1/97	whole littoral	none
	Terrell Lake	1	8/14/96	whole littoral	*Lythrum salicaria*
	Toad (Emerald) Lake	1	7/3/97	whole littoral	none
	Whatcom Lake	1	6/21/95	3 sites, littoral, west basin	*Myriophyllum spicatum*
	Wiser Lake	1	8/14/96	spot check, shore	none
			7/1/97	whole littoral	none
Whitman	Rock Lake	34	8/5/94	south boatramp, from shore	none
			9/15/97	spot check, shore	none
	Snake River at Central Ferry	35	8/5/97	spot check, shore	*Myriophyllum spicatum*
	Snake River at Little Goose Dam	35	8/5/97	spot check, boat	*Myriophyllum spicatum*
	Snake River at Lower Granite Dam	35	8/4/97	spot check, boat	*Myriophyllum spicatum*
Yakima	Giffin Lake	37	7/19/95	from shore	none
	Morgan Lake	37	7/19/95	spot check, from shore	none
	pond nr hwy 12	37	8/8/94	one spot, from shore	none
	Unnamed pond (14N-19E-31)	39	7/18/95	spot check, from shore	none
	Unnamed Ponds (12N-19E-20)	37	7/18/95	spot check, from shore	*Myriophyllum spicatum*
	Yakima River	37	8/8/94	from Selah to Arboretum	*Lythrum salicaria*
			9/27/94	Arboretum to Union Gap	*Lythrum salicaria*
			7/19/95	Mabton Bridge	none

Appendix B

Plant Identification References

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