PIPE AND LUCERNE LAKES

HYDRILLA and AQUATIC VEGETATION SURVEYS 2011: FINAL REPORT

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Introduction

Pipe and Lucerne lakes in King County, Washington experienced the only known infestation of *Hydrilla verticillata* (hydrilla) in the state between 1995 and 2006. This infestation might have caused ecological damage and reduced recreational opportunities and aesthetics, potentially costing the state millions of dollars if it were allowed to spread to other waters. Therefore, this state-listed, highly invasive noxious weed was targeted for eradication by the Washington State Department of Ecology (Ecology) and King County (County).

The aquatic herbicide fluridone (trade name: Sonar PR) was applied every summer from 1995 to 2000 and then from 2003 to 2009 to target hydrilla in the lakes in accordance with the *Pipe and Lucerne Lakes Integrated Aquatic Vegetation Management Plan* (King County 2004). From 2003 through 2007, Sonar PR was applied to both lakes three times each summer to maintain the concentration of fluridone at a level toxic to hydrilla (i.e., 5 parts per billion (ppb)) throughout the growing season. Only Pipe Lake received herbicide treatments in 2008 and 2009.

Since herbicide treatments started again in 2003, aquatic plant surveys have been conducted three times each summer by staff from Envirovision between 2003 and 2009, and Herrera Environmental Consultants (Herrera) beginning in 2010, in cooperation with the King County Lake Stewardship Program. No hydrilla has been found during these surveys in either lake since August 2006. The focus of the surveys has shifted in recent years from treatment effectiveness monitoring to plant community characterization and evaluation; however, searching for hydrilla is still the primary goal of these surveys.

Three surveys were conducted during the summer of 2011. The three surveys replicated the surveys conducted in previous summers. These were broad scans of the entire littoral zone, primarily for the purpose of looking for hydrilla. For the August survey, an additional component of native plant evaluation was added in 2010 and repeated in 2011. This more detailed aquatic plant community survey (i.e., the transect survey) was conducted along eight reference transects in August. Comparing the results of this transect survey to surveys conducted in 2003 and 2010 will help to assess the re-establishment of aquatic plant communities impacted by the fluridone treatments.

This report summarizes the aquatic plant survey activities that were undertaken in the summer of 2011. The results from these activities are discussed in the context of hydrilla eradication and plant community re-establishment.

Methods

Scuba divers from Herrera and Snorkelers from King County conducted three aquatic plant surveys in Pipe and Lucerne Lakes in 2011. All three surveys included thorough scans of the entire littoral zone, primarily for the purpose of looking for hydrilla. Additionally, detailed observations about the plant community, species composition and density were also recorded during these surveys. In addition to the

hydrilla search, the August survey included a detailed assessment of the aquatic plant community along eight reference transects originally established in 2003. The subsections below briefly summarize the techniques that were used. More detailed descriptions of the methods used for each individual survey can be found in Herrera 2011a, 2011b, and 2011c.

Hydrilla Searches

Hydrilla searches were conducted on June 16, August 10, and October 18, 2011. Since 2003, the lakes have been surveyed for hydrilla three times each summer. Fourteen sections of the lakes (initially delineated in 2003) were used as reference locations to compare hydrilla plant locations by section (Figure 1). A two-person scuba dive team from Herrera led the survey efforts, and two snorkelers from King County assisted with the shallow water examination during June and August surveys. In most sections, the observers swam in a zigzag pattern between the shoreline to the end of the littoral zone. One diver surveyed the area from a depth of approximately 4 feet to a depth of 9 feet, while the other diver surveyed from a depth of 8 feet to 15 feet. The snorkeler(s) surveyed the shallower areas (less than 4 feet) by swimming parallel to the shore. In more expansive shallow areas of the lake, the divers or snorkelers typically swam multiple transects parallel to each other through the central portions of the shallow areas to achieve greater coverage. General observations about the plant community in each section were reported by the team in the water and recorded by the technician in the boat.

Aquatic Plant Community Survey

Eight transects were established in 2003 and relocated in 2010 (Herrera 2010) to serve as reference points for the comparison of plant communities between years. In 2010, the transect start, end, and path-lines were referenced in the field in order to replicate their locations again in 2011. Surveyed transects are shown in Figure 1. The transects were surveyed on August 10, 2011. Scuba divers surveyed the littoral zone between the 4 to 15 foot depth zone, while the snorkelers surveyed the 0 to 4 foot depth. The team in the water took notes of the plant species observed, as well as their relative abundance, and the overall vegetation density along each transect. Density was estimated based on the average number of plants (independent of species) per square meter along the transect line. Low density growth was considered to be less than five plants growing per square meter. Medium density growth was identified as 6 to 10 plants per square meter, and high density growth was greater than 10 plants per square meter. The divers and snorkelers surfaced at the end of each transect and reported their observations to the surface support crew.

Results

Hydrilla Searches

No hydrilla was found in either lake during the three searches. The visibility ranged from moderate in October to good in August, and excellent in June. Good visibility generally contributed to high quality surveys and greatly reduced the potential for missing hydrilla plants.

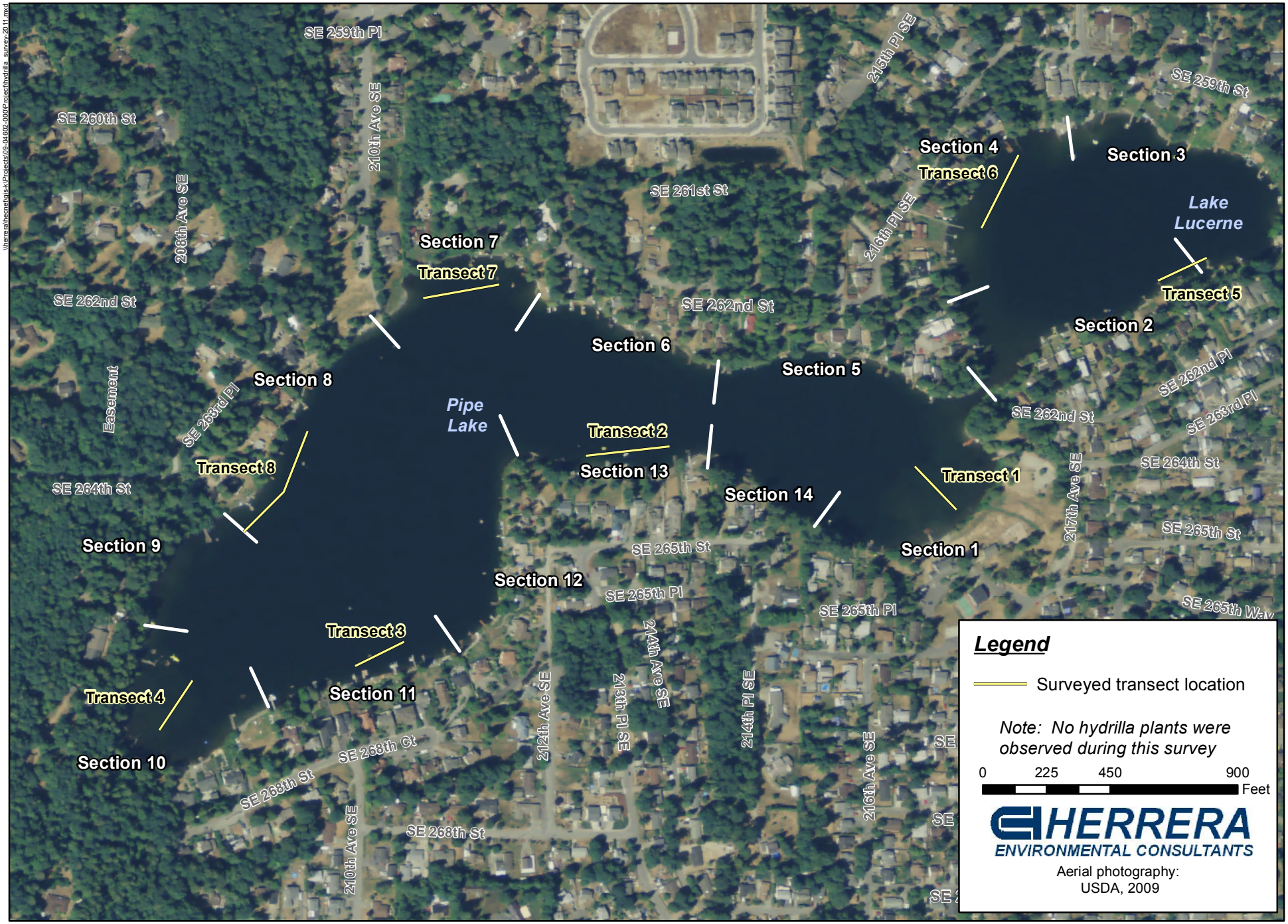

Figure 1. Pipe and Lucerne Lakes Hydrilla and Vegetation Survey, August 10, 2011.

This year marks the fifth year in a row that hydrilla was not found in either lake. This is a strong indicator that hydrilla may have been eradicated from both lakes.

Aquatic Plant Community Survey

The comprehensive survey of the aquatic plant community indicates that a healthy native plant community is steadily re-colonizing Pipe and Lucerne lakes. This was confirmed through the informal observations made by the divers during the hydrilla searches and transect surveys. Table 1 lists the aquatic plants that were observed during the survey activities during 2011. Table 2 presents the results from the formal aquatic plant community survey, and provides a comparison to plant community density observed during the 2003 Survey.

Table 1. List of aquatic plants and macroalgae observed at Pipe and Lucerne Lakes in 2011.

Scientific Name	Common Name
EMERGENT PLANTS	
Iris pseudacorus	Yellow-flag iris
Juncus sp.	Rushes
Polygonum hydropiperoides	Waterpepper
Solanum dulcamara	Bittersweet, nightshade
Typha sp.	Cattail
Veronica scutellata	Skullcap speedwell
FLOATING-LEAVED PLANTS	
Ludwigia palustris	Water purslane
Nymphaea odorata	Fragrant waterlily
Potamogeton amplifolius	Big leafed pondweed
Potamogeton gramineus	Grass-leaved pondweed
Potamogeton natans	Floating pondweed
SUBMERSED PLANTS	
Najas flexilis	Slender water-nymph, common water-nymph
Potamogeton foliosus	Leafy pondweed
Potamogeton robbinsii	Fern-leaf pondweed
Potamogeton zosteriformis	Fern, flat-stem, or eelgrass pondweed
Ruppia sp.	Widgeongrass, ditch-grass
Utricularia sp.	Bladderworts
Zannichellia palustris	Horned pondweed
ALGAE	
Chara sp.	Muskgrass, stonewort
Nitella sp.	Nitella
Periphyton	Filamentous algae

Transect Survey Results

A wide variety of plants were observed in both lakes (Table 2), although *Chara*, *Nitella*, *Potamogeton robbinsii*, and *Potamogeton foliosus* continue to be dominant in most areas of the lakes. All plants observed in the 2003 survey were observed in the 2011 survey with the exception of *Fontinalis antipyretica* ("FT" in Table 2), which was only observed in 2003. As noted previously (Herrera 2010), one species (*P. foliosus*) that was not observed during the 2003 survey was observed in 2010, and again during the 2011 survey. However, *P. foliosus* may have been mistaken as *P. zosteriformis* in the 2003

Table 2. Aquatic plants and algae found in reference transects during surveys at Pipe and Lucerne Lakes in 2003, 2010, 2011.

Transect #	Depth (ft)	2003 Survey		2010 Survey		2011 Survey		Change in Density Between 2003 and 2011	Change in Density Between 2010 and 2011
		Plant Species Observed [1]	Density [2]	Plant Species Observed [1]	Density [2]	Plant Species Observed [1]	Density [2]		
T1	0-3	FA, PZ, PR, C/N	L	PF, PR	L	PF, PR, C/N	L	Same	Same
	3-6	FA	H	PF, PR	M	PF, PR, C/N	M	Decrease	Same
	>6	FA, PZ, PR	L	PR, PF, C/N	M	PR, PF, C/N	H	Increase	Increase
T2	0-5	PZ, C/N	L	C/N	L	PR, C/N	L	Same	Same
	5-13	C/N	H	FA, C/N	L	PF, C/N	L	Decrease	Same
	13-16	PZ	L	C/N	M	C/N	L	Same	Decrease
T3	0-4	None, gravel bottom	-	C/N, PS	L	C/N	L	Increase	Same
	4-8	PZ, C/N	L	PR, PF	L	PR, C/N	L	Same	Same
	8-13	PR, C/N, (HY)	M (L)	C/N	L	C/N	L	Decrease	Same
T4	0-4	PZ, PR	L	PR, PF	L	PR, C/N	M	Increase	Increase
	4-6	PZ, PR, C/N	M	PR, PF	L	PR, PZ, C/N	H	Increase	Increase
T5	0-5	C/N	L	C/N, PF, PR	M	PF, PR, C/N	L	Same	Decrease
	5-10	PZ, C/N	L	C/N, PF	M	PF, FA, C/N	M	Increase	Same
	10-15	C/N, UT	M	C/N, PF	L	PF, C/N	L	Decrease	Same
T6	0-5	PZ, PR, PA, C/N	L	C/N, PF, UT, PR, PG	L	PA, PF, NA, PR, C/N	L	Same	Same
	5-8	PZ, C/N, FT	L	C/N, PF, UT, PR, PS	L	C/N, PF, UT	L	Same	Same
T7	0-10	PZ, PR, C/N, (HY)	M (L)	C/N, PR	L	C/N, PF, PR	L	Decrease	Same
	10-13	C/N	H	C/N, PR	H	C/N, PR	H	Same	Same
T8	0-6	PZ, PR, C/N, (HY)	L (L)	PR, C/N	L	PR, C/N	L	Same	Same
	6-12	PZ, PR, C/N, (HY)	L (L)	PR, C/N	M	NA, PF, PR, C/N	H	Increase	Increase
	12-15	C/N	M	C/N, PR	M	PF, PR, C/N	L	Decrease	Decrease

[1] FA = *filamentous algae*, NA = *Najas* spp., PR = *Potamogeton robbinsii*, PA = *Potamogeton amplifolius*, PF = *Potamogeton foliosus*, PS = *Potamogeton strictifolius*, PG = *Potamogeton gramineus*, PZ = *Potamogeton zosteriformis,* C/N = *Chara/Nitella*, UT = *Utricularia* spp., FT = *Fontinalis antipyretica*, HY = *Hydrilla verticillata* (density in parenthesis).

[2] L = 1-5 plants/m2, M = 6-10 plants/m2, H = >10 plants/m2.

survey. *Potamogeton foliosus* was positively distinguished from *P. zosteriformis* in 2010 based on the structure of the top (flowering) leaves (Ecology, 2001; Brayshaw, 1985). Although not observed along the transects, and therefore not included in Table 2, *Potamogeton gramineus* was observed in Section 2 (near Transect 5 in Lucerne Lake) during the 2011 hydrilla search, but was not observed in either lake in 2003.

Comparisons of plant density estimates indicate the community is recovering from herbicide treatments that occurred between 2003 and 2009. Estimates in 2011 indicate similar densities as in 2003, when the plant community was recovering from six years of herbicide treatments that occurred between 1995 and 2000. Of the 21 areas monitored in the 8 transects; 15 have either recovered to a similar density or have a higher density than before the recent (2003 through 2009) herbicide treatments (Table 2). Observations made during the aquatic plant community survey (i.e. the eight transects) also suggest similar densities this year as compared to 2010, with one notable increase in the density of *P. robbinsii* along transect 4; from low in 2010, to medium and high in 2011.

In terms of plant diversity, the 2011 survey results show similar plant diversity to what was observed in 2003 across all transects (Table 2). The primary difference is that *Fontinalis antipyretica* was observed only in 2003, while *P. gramineous* was observed only in 2010 (Transect 6), and again in Lucerne Lake in 2011 (although not on a transect). Plant diversity in 2011 increased in most transects since 2010, but was similar across all transects combined compared to observations in 2010. In addition, a few *P. foliosus* were observed in transect 2, where no vascular plants were observed in 2010.

General Observations

Based on observations of plant densities in the 14 sections surveyed during the hydrilla search there was an overall increase in vegetation density between 2010 and 2011. Plant density estimates were slightly higher in four of the 14 sections surveyed for hydrilla (Sections 4, 6, 8, and 10), while density was lower in only one section (Section 5). Surveyors also noted a general increase in the abundance of *P. amplifolius* in both lakes since 2010. As noted in 2010, Pipe Lake continues to exhibit lower plant species diversity and predominately lower overall plant community density compared to Lucerne Lake, where herbicide treatments concluded two years earlier than in Pipe Lake.

In 2011, plant growth was typical of what would be expected to occur over the course of the summer growing season. Observations indicated healthy growth of submersed aquatic plants between June and August. Density and coverage were similar between August and October. Variations in the size of patches, and minor variations in species diversity or relative dominance, were likely due to typical seasonal changes in lake conditions and plant growth patterns.

Conclusions

The last hydrilla plant in Lucerne Lake was found over 7 years ago (June 2004), and it has been 4 years since herbicide was applied to that lake. Hydrilla has not been found in Pipe Lake for over 5 years (August 2006). The last herbicide treatment in Pipe Lake occurred in July 2009, so eradication has not yet been declared; however, the continued absence of hydrilla is encouraging.

The overall plant community is recovering well since the second round of fluridone treatments ended. Comparison of plant communities along the eight reference transects to the 2003 survey indicates that plant re-establishment is proceeding well. Overall, plant community densities are similar to those surveyed in 2003, and a slightly greater diversity of species was identified in 2011. Plant density is medium to high along some of the transects, and throughout several other areas of the lake.

This is the second consecutive systematic survey of the aquatic plant community in these lakes, and the results indicate an overall slight increase in plant density and diversity observed between 2010 and 2011. Both lakes appear to be recovering in terms of native plant species diversity and density. The plant community density is expected to increase annually until all available aquatic habitat is fully utilized.

Future Considerations

Even though hydrilla appears to be eradicated from the lakes, continued surveys are recommended. These surveys will serve two purposes. The primary goal will continue to be to search for hydrilla, however an important secondary goal will be to search for other invasive aquatic plants. While it is true that many invasive plants do not seem to be deterred by dense native plant communities, Pipe and Lucerne Lakes are considered especially vulnerable to colonization by other invasive species until the existing plant community completely recovers. There is also an added value in the detailed observations regarding plant species presence, relative abundance, and overall community density: these continue to be useful tools in tracking community changes and long term impacts from herbicide applications.

As the native plant community increases in coverage and density, the hydrilla searches will become more challenging. Past surveys have been aided by the sparse plant growth resulting from the ongoing fluridone applications. It will be more difficult to spot hydrilla plants growing among a dense, native plant community. Fewer but longer, more methodical surveys should be considered for future efforts.

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