Southeast Wisconsin's
Pewaukee Lake
Aquatic Plant Survey 2010

Wisconsin Lutheran College, Biology Dept.

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Introduction

This report is a further contribution to the ongoing aquatic plant monitoring effort on Pewaukee Lake and is a key component of the lake management plan (SEWRPC 2003). The plant survey, which is the basis for the report, is also in line with recommendations made by Eco-Resource Consulting (2007).

In a lake that contains an aggressive invasive species such as Eurasian watermilfoil annual control and monitoring of the plant community is essential to developing and maintaining aquatic plant diversity. Plant diversity in turn is a critical base for a healthy lake community (Engel 1985, Carpenter and Lodge 1986, Petr 2000, Hoyer and Canfield 2001, UWEX 2007). Every lake is unique in its morphometry, adjacent watershed and history. Plant management strategies need to be tailored to the specific attributes of the lake (Madsen 2000). In order to effectively tailor a plant management approach it is important to evaluate the lake's response to existing management approaches as well as monitor responses to lake use and changes in weather patterns. This study provides an additional year of plant distribution data to the existing base of information on aquatic plant density and relative abundance in Pewaukee Lake and thus informs management decisions.

Methods

The survey was conducted on Pewaukee Lake, Waukesha County during the summer of 2010 to determine the frequency of occurrence and density of aquatic macrophyte species. Fourteen new transect points were chosen for 2010 to broaden the sampling scope of the annual monitoring program. These fourteen transects are evenly distributed along the shoreline of the lake and were selected from the full set of lake transects established by the Wisconsin DNR (Figure 1).

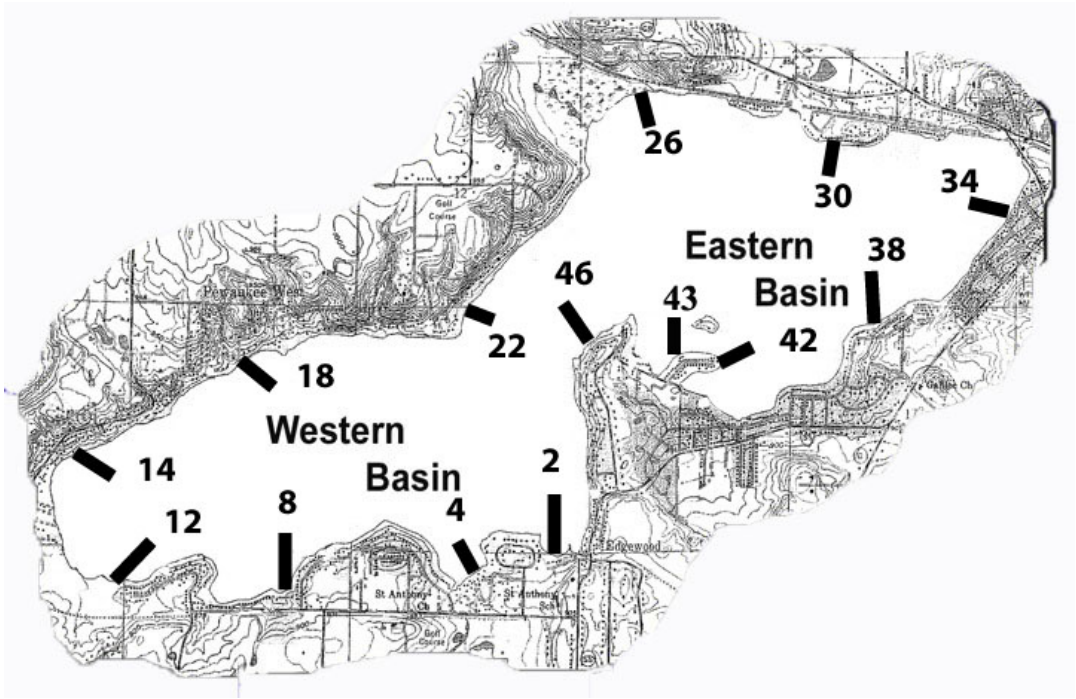


Figure 1: Fourteen transects sampled on Pewaukee Lake on July 28and August 3, 2010.

A Trimble GeoXM Global Positioning System field unit was used to locate each transect site. Samples were collected at each transect point in accordance with the line intercept method (Deppe and Lathrop 1992, Jessen and Lound 1962, Madsen 1999). Four rake pulls were cast at each depth (1.5 ft., 5 ft., 9 ft., and 11 ft.) off the front of the boat in a semi-circular pattern (Figure 2).

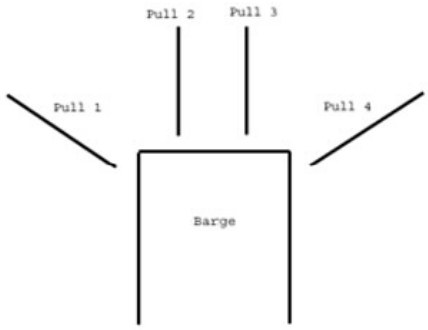


Figure 2: Sampling pattern for each depth.

A garden rake head attached to a 16-foot collapsible pole was used for macrophyte sample retrieval. The combined length of the rake head and the pole was used to determine water depth and substrate type at each sample site. The rake head is composed of a 1/2-inch butt plate with

fourteen 2½-inch long teeth (Figure 3). The density of vegetation for each retrieval was determined based on the fullness of the rake head (Table 1).

Figure 3: Rake head used to recover submerged vegetation attached to a 16-foot pole.

Table 1: Criteria used to assign density ratings for a plant species collected during a rake haul (Jessen and Lound 1962).

Rake frequency (Presence of a species on a rake head)	Density rating	Descriptive term
Present in all 4 casts (rake teeth full all casts)	5	Dense
Present in all 4 rake casts (rake teeth less than full)	4	Heavy
Present in 3 rake casts	3	Moderate
Present in 2 rake casts	2	Scattered
Present in 1 rake cast	1	Sparse
Present in 0 rake casts	0	Absent

Emergent plants along the perimeter of the lake were identified by visual surveys and the results were incorporated into a digitized lake map. Macrophyte samples were identified according to identification keys (Crow and Hellquist 2000, Borman et al 1997). Samples which could not be accurately identified in the field were taken to the lab for detailed analysis. Reference samples of each species were dried and mounted on herbarium paper.

Secchi disk readings were taken by Lake Pewaukee Sanitary District personnel on a monthly basis in the center of the west basin of the lake.

Results

A total of twenty-three aquatic plants were identified during the 2010 survey. Twenty-one species are native to the lake while Eurasian watermilfoil and curlyleaf pondweed are exotic invasive species. Eurasian watermilfoil was the most frequently occurring macrophyte in Pewaukee Lake. The predominant native species were northern watermilfoil and coontail with elodea, water stargrass and muskgrass occurring quite frequently as well (Figure 4).

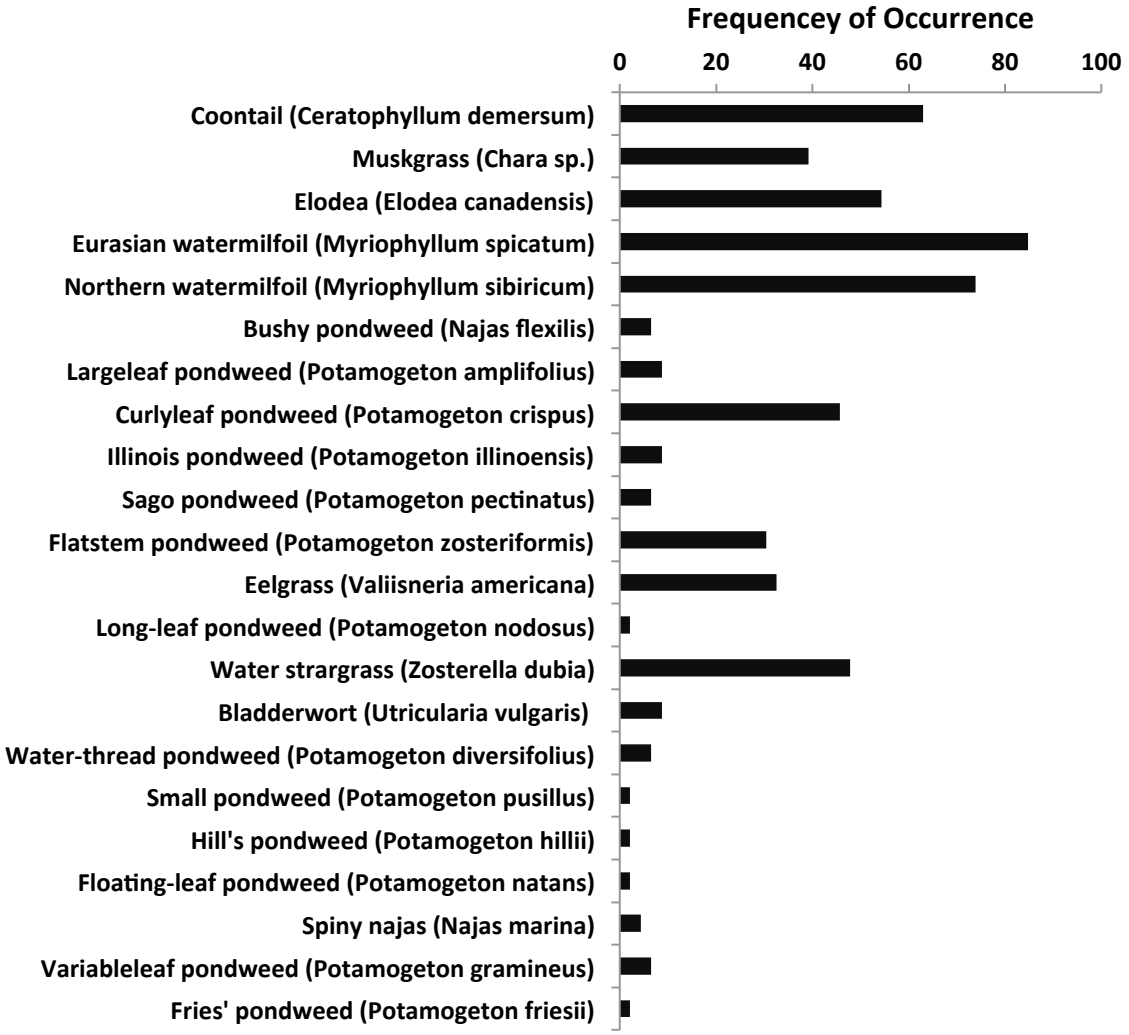


Figure 4: Frequency of occurrence of aquatic plants in Pewaukee Lake, Waukesha County, Wisconsin during the summer of 2010.

Most plant species occurred more frequently in the east basin than the west basin of Pewaukee Lake. In particular coontail, elodea, and curlyleaf pondweed occurred nearly twice as often in the east basin (Figure 5). In addition, eight native plant species occurred in the east basin that did not occur in the west basin. Eurasian watermilfoil, coontail, Elodea, and northern milfoil occurred in over 80% of the sampling points.

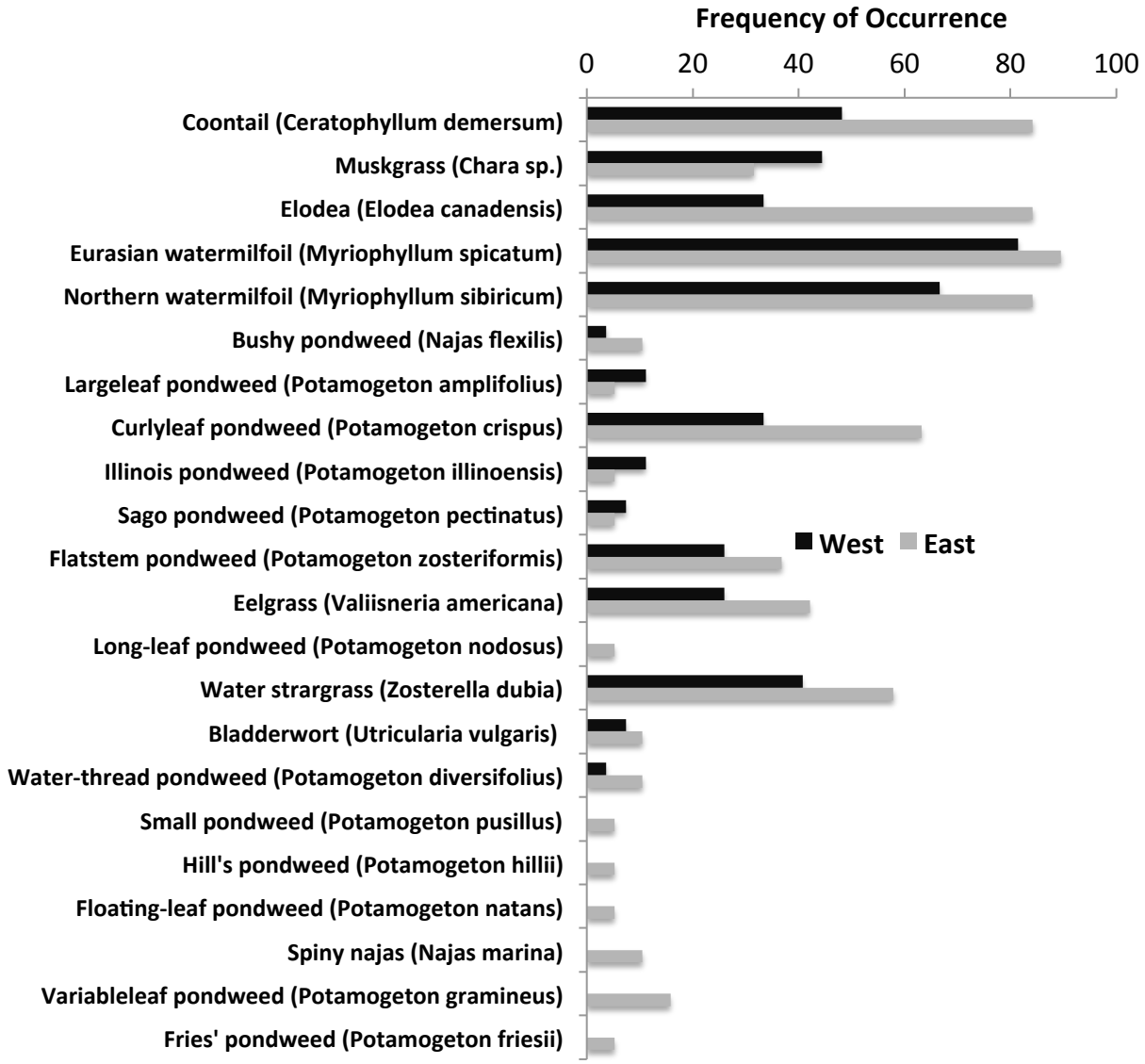


Figure 5: Frequency of occurrence of aquatic plants in the west and east basins of Pewaukee Lake, Waukesha County, Wisconsin during the summer of 2010.

Another way to evaluate plant abundance in the lake is to compare the density of each species at the sampling locations. From this perspective Eurasian watermilfoil has an even greater presence in the lake. Coontail and northern watermilfoil followed with equal density levels that were approximately 60% of Eurasian watermilfoil density (Figure 6).

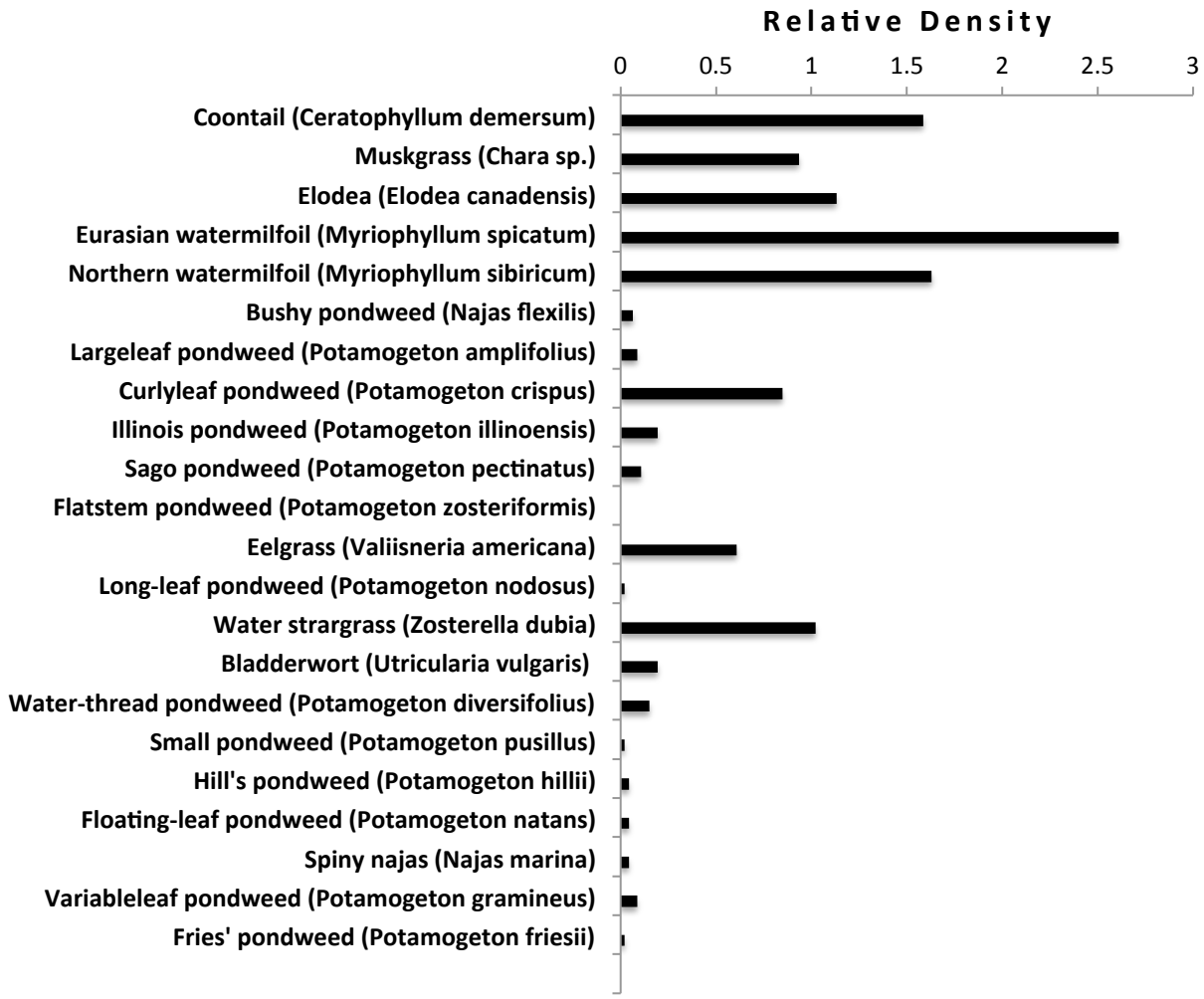


Figure 6: Relative density of plants in Pewaukee Lake, Waukesha County, Wisconsin during the summer of 2010.

The density of plants was generally greater in the east basin with the exception of muskgrass, largeleaf pondweed and sago pondweed. The density of Elodea in the east basin was just over twice what it was in the west basin while Eurasian watermilfoil was only 14% greater in the east basin (Figure 7).

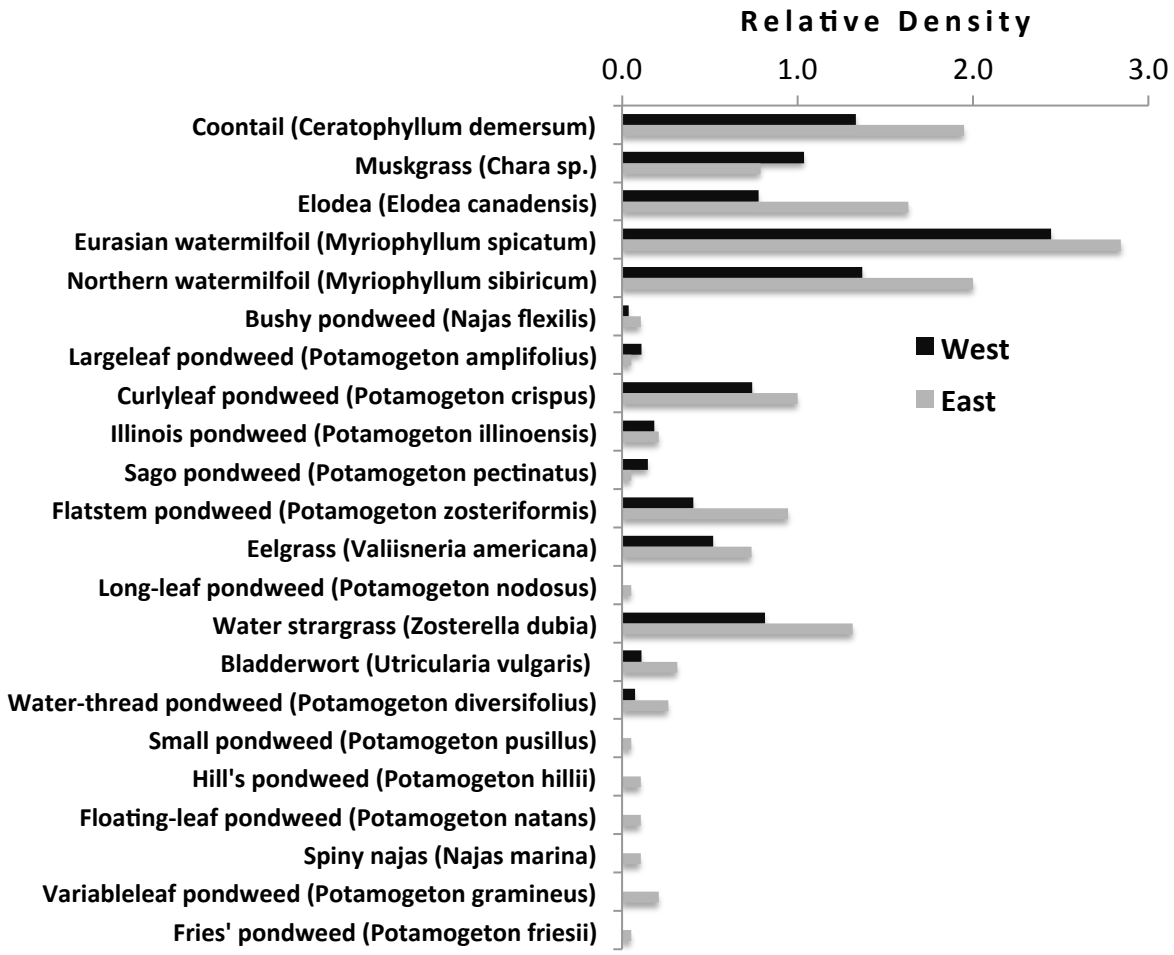


Figure 7: Relative density of plants in the west and east basins of Pewaukee Lake, Waukesha County, Wisconsin during the summer of 2010.

The distribution of aquatic plants by depth in the west basin of Pewaukee Lake (Figure 8) showed that coontail, Eurasian watermilfoil and curlyleaf pondweed increased in occurrence from the 1.5 foot depth to the 11 foot depth. Muskgrass and eelgrass occurred most frequently at the 5 foot depth. Flatstem pondweed and water star grass generally declined in abundance with depth. Elodea occurred much more frequently at the 9 foot depth and northern watermilfoil occurred most frequently at both the 5 and 9 foot depths.

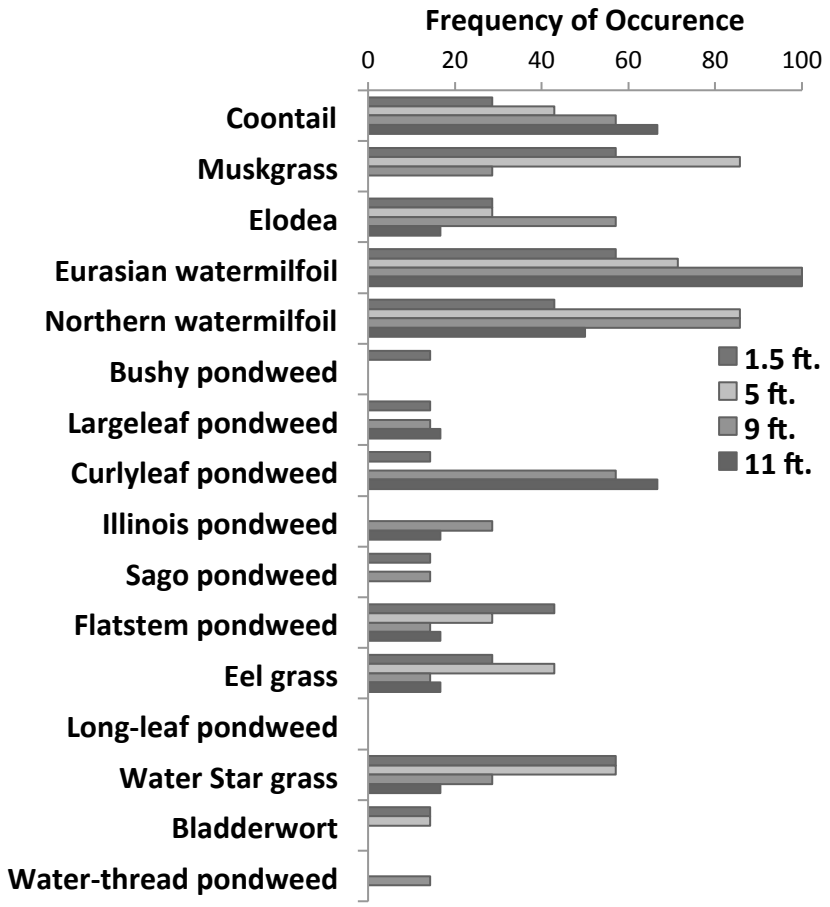


Figure 8: Frequency of occurrence of plants by depth in the west basin of Pewaukee Lake, Waukesha County, Wisconsin during the summer of 2010.

In the east basin of the lake frequency of occurrence of aquatic plants by depth revealed different patterns than those seen in the west basin for some species (Figure 9). Coontail, Elodea, eelgrass and northern watermilfoil occurred most frequently at the shallowest depth rather than in deeper water. Eurasian water milfoil had its lowest occurrence at the 5 foot depth in the east basin rather than the 1.5 foot depth in the west basin. Water star grass however followed the same pattern of decreasing occurrence with depth in both basins.

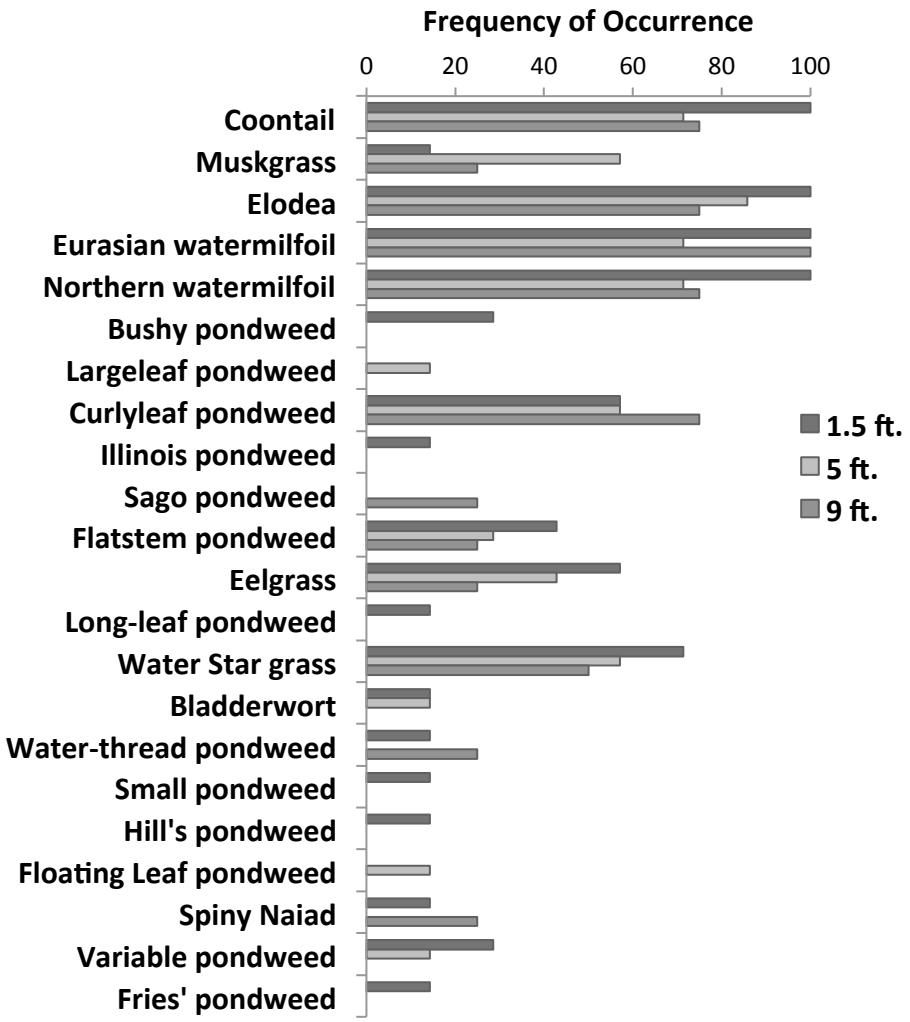


Figure 9: Frequency of occurrence of plants by depth in the east basin of Pewaukee Lake, Waukesha County, Wisconsin during the summer of 2010.

Emergent plants along the Pewaukee Lake shoreline (Figure 10) is not extensive due to a variety of artificial shore stabilization techniques used by land owners. Nevertheless, there are two natural areas, one on the west shoreline and one on the northeastern shore that have a good variety and density of emergent vegetation. There are various areas along the shore where landowners have developed a natural shoreline protected by emergent plants.

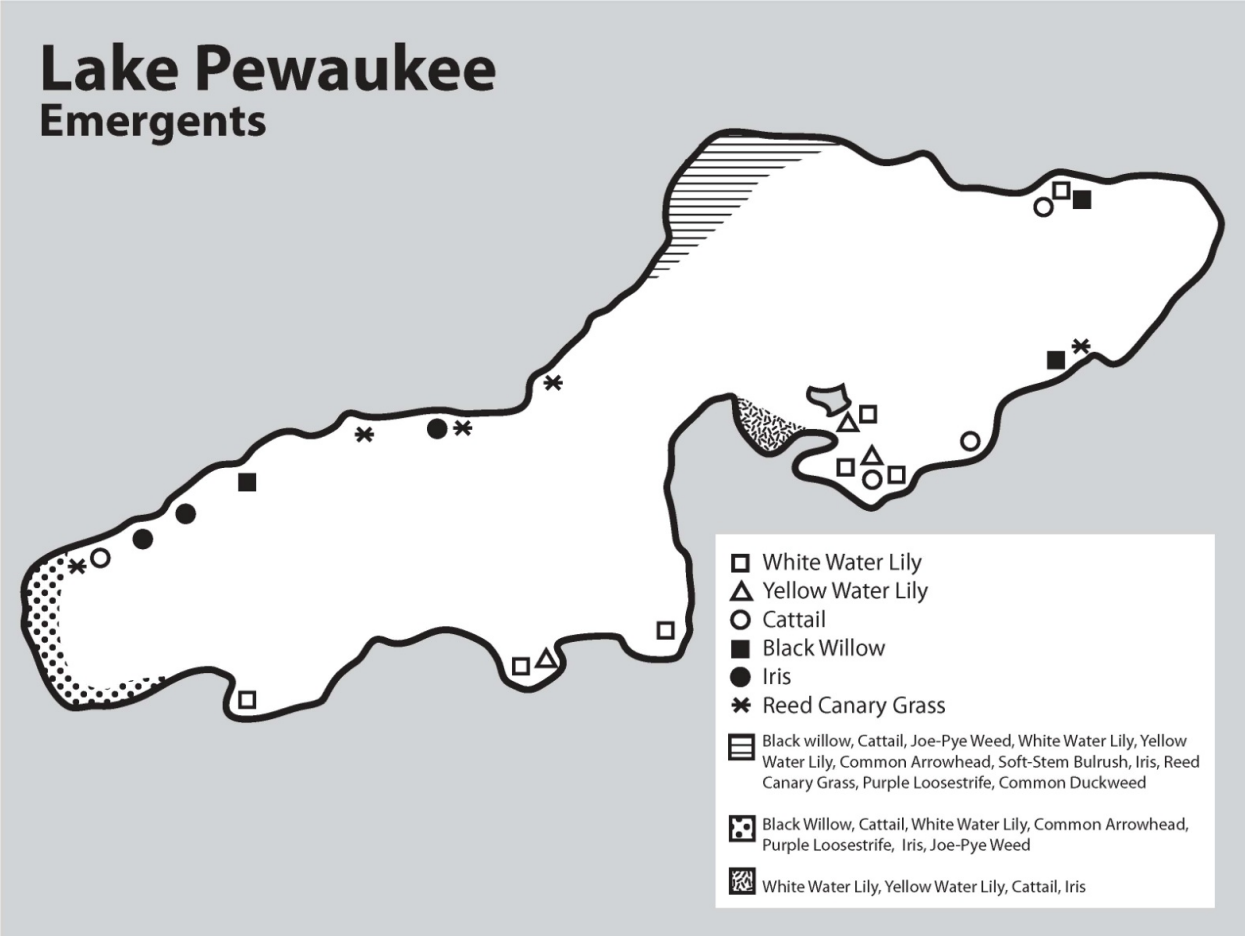
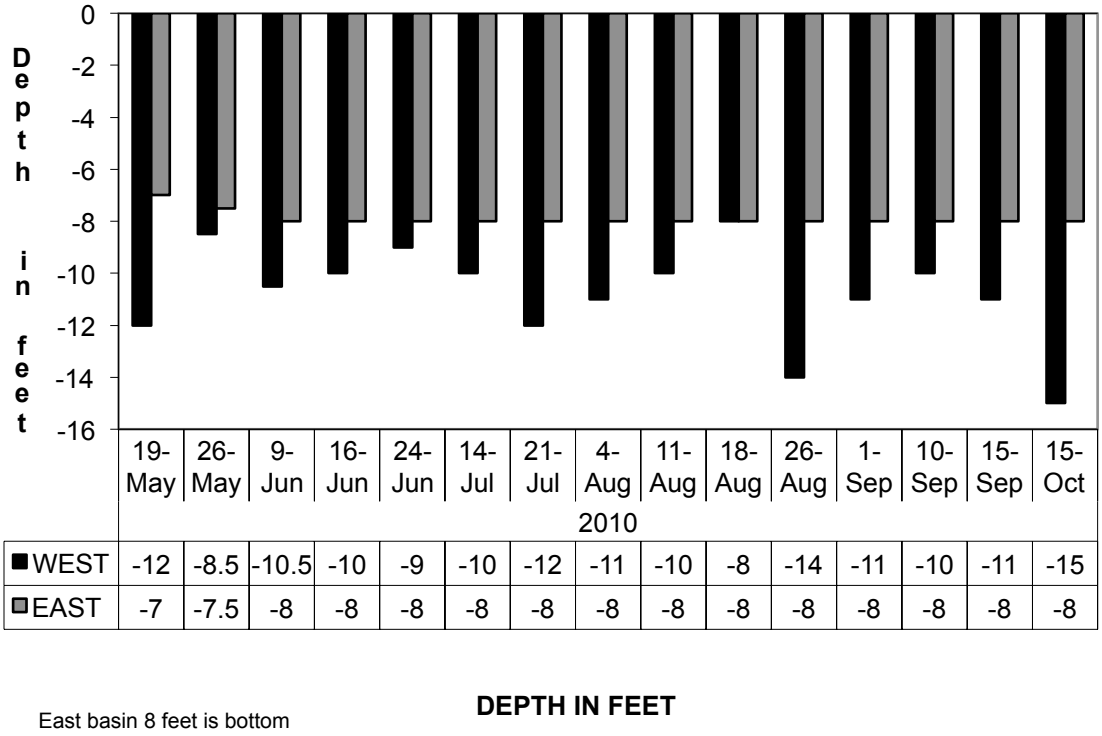


Figure 10. Distribution of emergent plants in Pewaukee Lake, Waukesha County, Wisconsin during the summer of 2010.

Water clarity, as measured by secchi disc, showed somewhat greater clarity in early summer and fall with light penetrating to 14 feet in mid October and 12 feet in mid May (Figure 11). An unusually clear period did occur in late August. Water clarity was sufficient to provide light throughout the whole water column in the east basin for most of the plant-growing season.



	19-May	26-May	9-Jun	16-Jun	24-Jun	14-Jul	21-Jul	4-Aug	11-Aug	18-Aug	26-Aug	1-Sep	10-Sep	15-Sep	15-Oct
	2010														
WEST	-12	-8.5	-10.5	-10	-9	-10	-12	-11	-10	-8	-14	-11	-10	-11	-15
EAST	-7	-7.5	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8

Figure 11: Water clarity measured by secchi disc in Pewaukee Lake, Waukesha County, Wisconsin during the summer of 2010. (Lake Pewaukee Sanitary District 2010)

Discussion

For the past four years, plant surveys on Pewaukee Lake have been based on the same 14 transects distributed evenly around the lake. This year the transects were shifted in order to sample different sections of the lake. With this change nine species of plants were collected that were not part of collections during the previous three years. This provides a strong argument for varying transects each year in order to obtain a better representation of the plant community in Pewaukee Lake.

Comparisons across the past four years of collections (Figure 12) indicate that coontail, muskgrass, Elodea, curlyleaf pondweed, and flatstem pondweed all show an increasing trend. Eurasian watermilfoil, northern milfoil, bushy pondweed, Illinois pondweed, sago pondweed, eel grass and white-stem pondweed show variation between years with no clear trend. It is interesting to note that even though Eurasian watermilfoil is the most frequently occurring species it has not increased above its 2007 level. It is also encouraging to see the dramatic increases in many of the native species that occurred in 2010. Coontail, muskgrass, Elodea, northern milfoil, flatsem pondweed and eelgrass all more than doubled their previous year occurrence. Unfortunately curlyleaf pondweed, a nonnative invasive species, also more than doubled its occurrence in 2010. Relative density of plants for the lake showed similar trends although the differences were less dramatic (Figure 13).

A comparison of frequency of occurrence in the east and west basin over the last four years (Figure 14) shows similar patterns of increasing occurrence in both basins for coontail, musk grass, Elodea, and northern watermilfoil. Eurasian watermilfoil reached its lowest occurrence during 2009 in both basins and increased to 2007 levels in 2010.

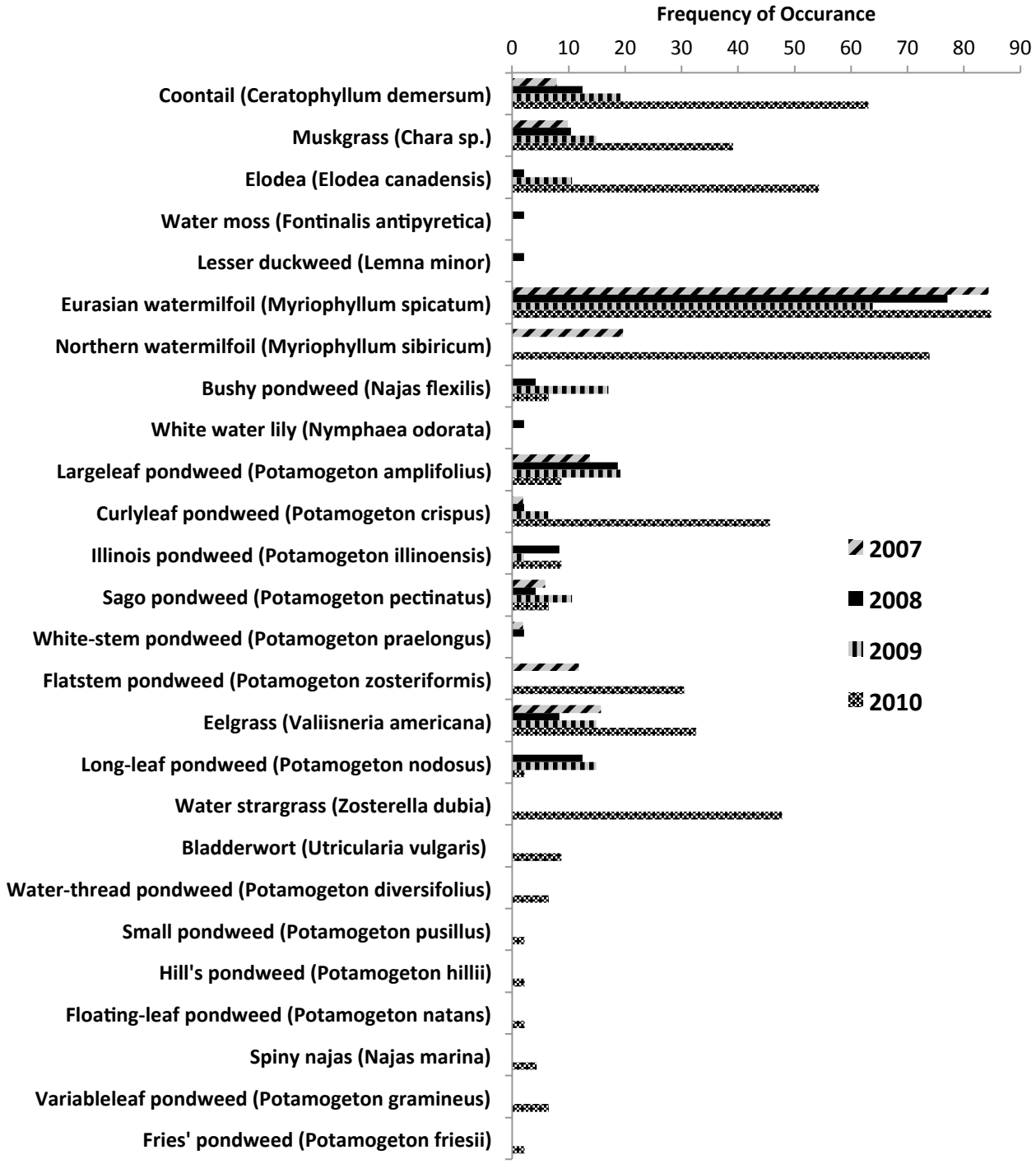


Figure 12. Frequency of occurrence of aquatic plants in Pewaukee Lake, Waukesha County, Wisconsin during the summers of 2007 – 2010 (Zhang and Anderson 2009).

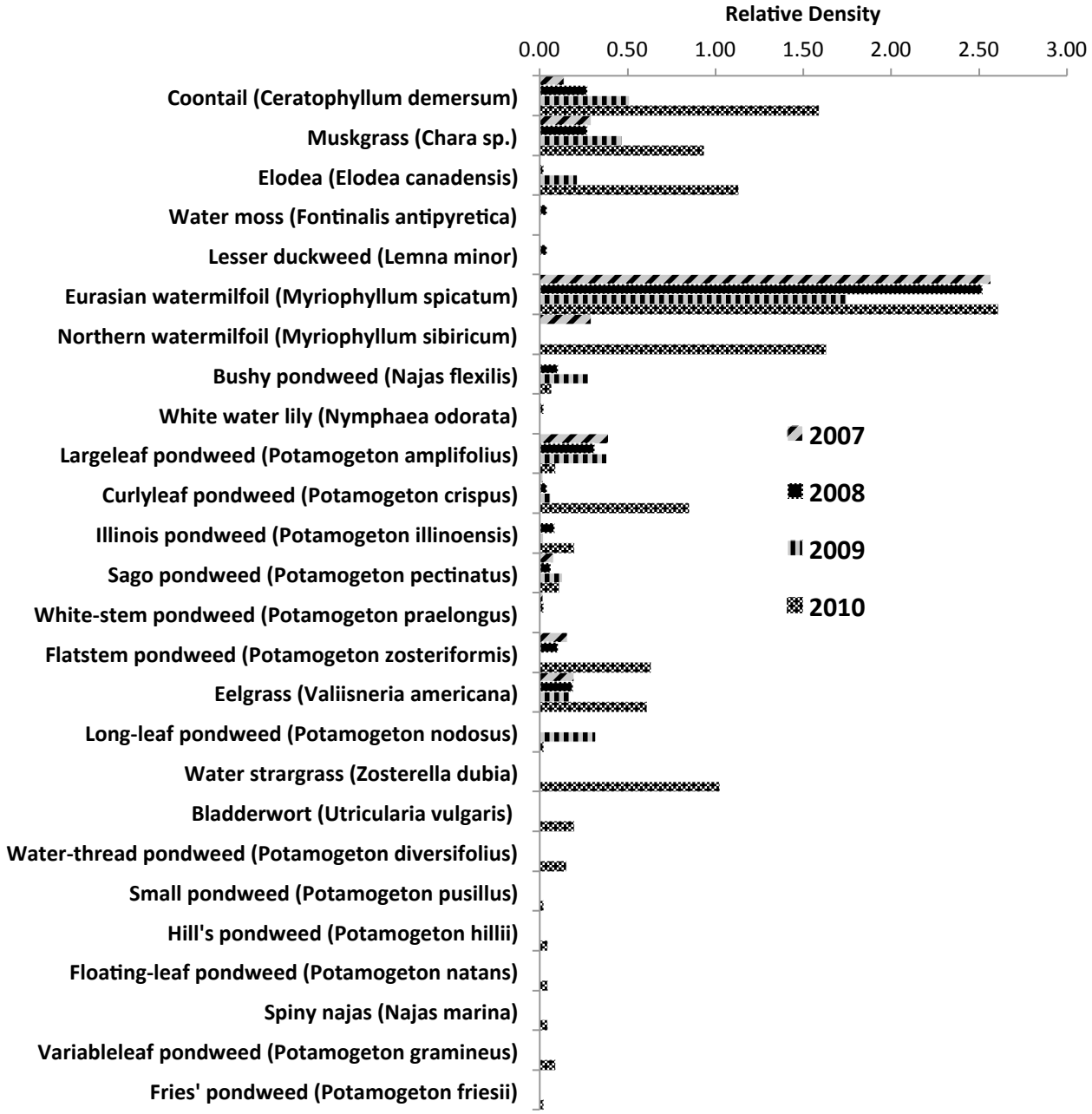


Figure 13. Relative density of aquatic plants in Pewaukee Lake, Waukesha County, Wisconsin during the summers of 2007 – 2010 (Zhang and Anderson 2009).

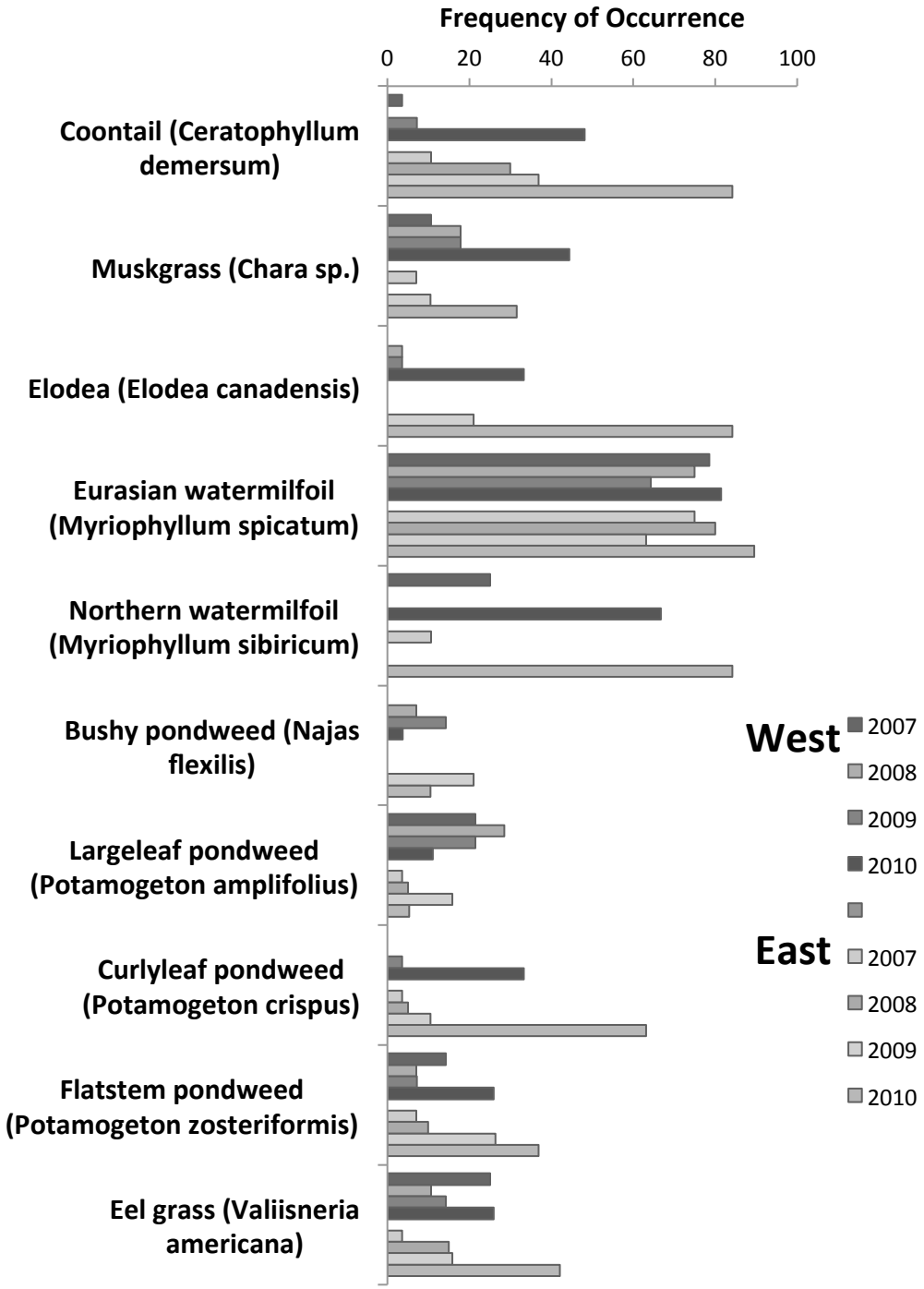


Figure 14: Frequency of occurrence of major aquatic plants in the east and west basins of Pewaukee Lake, Waukesha County, Wisconsin during the summers of 2007 – 2010. (Lake Pewaukee Sanitary District 2010)

Relative frequency analysis of Pewaukee Lake aquatic plants showed a continuation of the trend reported in Zhang and Anderson (2009) with a decline in the relative frequency of Eurasian watermilfoil and increases in several of the major native species (Table 2 and Figure 15). Of particular note are the dramatic increases in common or northern watermilfoil and Elodea. In addition, five native pondweed species were identified in 2010 that may have previously been listed under the generic category pondweeds (Potamogeton sp.) but have not specifically been recorded in the lake. The existing lake management program and the continual spread of zebra mussels (personal observation) seems to be resulting in increased water clarity (Figure 16). This increase in water clarity in turn may be generating an environment conducive to an increasing native plant population. As is evident from the long term plant monitoring on Pewaukee Lake (Table 2) annual variations are expected but general trends seem to be showing encouraging results. With the reduced dominance of Eurasian watermilfoil there is the possibility of increased habitat diversity for macroinvertebrates and fish thus increasing the health of these populations. (Hoyer 2001, Petr 2000, Engle 1985).

Table 2: Frequency of occurrence and relative frequency of aquatic plants in Pewaukee Lake, Waukesha County, Wisconsin 1988 – 2010.

	1988(1)			1991(1)			1994(1)			1997(1)			2000(4)			2002(4)		
Species Name	Occur.	Freq.	Rel. Freq.	Occur.	Freq.	Rel. Freq.	Occur.	Freq.	Rel. Freq.	Occur.	Freq.	Rel. Freq.	Occur.	Freq.	Rel. Freq.	Occur.	Freq.	Rel. Freq.
Coontail *Ceratophyllum demersum*	33	37.9%	11.1%	57	65.5%	23.8%	45	51.7%	16.7%	55	64.0%	20.1%	82	49.4%	16.7%	26	54.2%	15.5%
Muskgrass *Chara sp.*	26	29.9%	8.8%	9	10.3%	3.8%	26	29.9%	9.6%	18	20.9%	6.6%	39	23.5%	7.9%	11	22.9%	6.5%
Waterweed *Elodea canadensis*	6	6.9%	2.0%	6	6.9%	2.5%	7	8.0%	2.6%	9	10.5%	3.3%	22	13.3%	4.5%	9	18.8%	5.4%
Lesser duckweed *Lemna minor*		0.0%	0.0%		0.0%	0.0%	1	1.1%	0.4%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%
Common water-milfoil *Myriophyllum sibiricum*		0.0%	0.0%		0.0%	0.0%	7	8.0%	2.6%	37	43.0%	13.5%	1	0.6%	0.2%		0.0%	0.0%
Eurasian water-milfoil *Myriophyllum spicatum* (2)	86	98.9%	29.0%	66	75.9%	27.5%	58	66.7%	21.5%	41	47.7%	15.0%	137	82.5%	27.9%	44	91.7%	26.2%
Bushy pondweed *Najas flexilis*	40	46.0%	13.5%	28	32.2%	11.7%	41	47.1%	15.2%	8	9.3%	2.9%	72	43.4%	14.7%	24	50.0%	14.3%
Spiny najas *Najas marina* (2)		0.0%	0.0%		0.0%	0.0%	1	1.1%	0.4%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%
Southern naiad *Najas quadalupensis*		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	40	46.5%	14.6%		0.0%	0.0%		0.0%	0.0%
White water lily *Nymphaea odorata*		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	0	0.0%	0.0%		0.0%	0.0%		0.0%	0.0%
Large-leaf pondweed *Potamogeton amplifolius* (3)	3	3.4%	1.0%	2	2.3%	0.8%	5	5.7%	1.9%	6	7.0%	2.2%	8	4.8%	1.6%	4	8.3%	2.4%
Curly-leaf pondweed *Potamogeton crispus* (2)	21	24.1%	7.1%	6	6.9%	2.5%	5	5.7%	1.9%		0.0%	0.0%	4	2.4%	0.8%	3	6.3%	1.8%
Thread-leaf pondweed *Potamogeton filiformis*		0.0%	0.0%	4	4.6%	1.7%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%
Leafy pondweed *Potamogeton foliosus*(3)		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	3	3.5%	1.1%		0.0%	0.0%		0.0%	0.0%
Variableleaf pondweed *Potamogeton gramineus*(3)	0	0.0%	0.0%	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0	0.0%	0.0%	5	10.4%	3.0%
Illinois pondweed *Potamogeton illinoensis*(3)		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	1	0.6%	0.2%		0.0%	0.0%
Floating-leaf pondweed *Potamogeton natans*		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	1	0.6%	0.2%		0.0%	0.0%
Sago pondweed *Potamogeton pectinatus*	9	10.3%	3.0%	22	25.3%	9.2%	24	27.6%	8.9%	20	23.3%	7.3%	34	20.5%	6.9%	11	22.9%	6.5%
White-stem pondweed *Potamogeton praelongus*		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	5	3.0%	1.0%		0.0%	0.0%
Clasping-leaf pondweed *Potamogeton richardsonni*		0.0%	0.0%	3	3.4%	1.3%	1	1.1%	0.4%		0.0%	0.0%	1	0.6%	0.2%	1	2.1%	0.6%
Flat-stemmed pondweed *Potamogeton zosteriformis*(3)	2	2.3%	0.7%	10	11.5%	4.2%	9	10.3%	3.3%	8	9.3%	2.9%	15	9.0%	3.1%	8	16.7%	4.8%
Pondweeds *Potamogeton sp.*	30	34.5%	10.1%	1	1.1%	0.4%	1	1.1%	0.4%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%
Bladderwort *Utricularia vulgaris* or sp.(3)	2	2.3%	0.7%		0.0%	0.0%	3	3.4%	1.1%	1	1.2%	0.4%	2	1.2%	0.4%		0.0%	0.0%
Eel grass *Vallisneria americana*	12	13.8%	4.0%	8	9.2%	3.3%	16	18.4%	5.9%	17	19.8%	6.2%	43	25.9%	8.8%	16	33.3%	9.5%
Horned pondweed *Zannichellia palustris*		0.0%	0.0%	2	2.3%	0.8%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%
Water strargrass *Zosterella dubia*	7	8.0%	2.4%	8	9.2%	3.3%	6	6.9%	2.2%	9	10.5%	3.3%	24	14.5%	4.9%	6	12.5%	3.6%
Long-leaf pondweed *Potamogeton nodosus*																		
Water-thread pondweed *Potamogeton diversifolius*																		
Small pondweed *Potamogeton pusillus*																		
Hill's pondweed *Potamogeton hillii*																		
Fries' pondweed *Potamogeton friesii*																		
Other	19	21.8%	6.4%	1	1.1%	0.4%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%
None	1	1.1%	0.3%	7	8.0%	2.9%	14	16.1%	5.2%	2	2.3%	0.7%		0.0%	0.0%		0.0%	0.0%
Occurance Total	297			240			270			274			491			168		
Total quads	87			87			87			86			166			48		
Total frquency		340.2%	100.0%		267.8%	100.0%		294.3%	100.0%		316.3%	100.0%		295.8%	100.0%		350.0%	100.0%

Table 2: Frequency of occurrence and relative frequency of aquatic plants in Pewaukee Lake, Waukesha County, Wisconsin 1988 – 2010 (continued).

	2004(4)			2006(4)			2007(5)			2008(5)			2009(5)			2010		
Species Name	Occur.	Freq.	Rel. Freq.	Occur.	Freq.	Rel. Freq.	Occur.	Freq.	Rel. Freq.	Occur.	Freq.	Rel. Freq.	Occur.	Freq.	Rel. Freq.	Occur.	Freq.	Rel. Freq.
Coontail *Ceratophyllum demersum*	28	17.4%	14.1%	7	13.7%	6.9%	4	7.8%	4.5%	7	13.7%	7.6%	10	21.7%	9.9%	29	63%	12%
Muskgrass *Chara sp.*	7	4.3%	3.5%	11	21.6%	10.9%	5	9.8%	5.7%	6	11.8%	6.5%	6	13.0%	5.9%	18	39%	7%
Waterweed *Elodea canadensis*	3	1.9%	1.5%	1	2.0%	1.0%	0	0.0%	0.0%	1	2.0%	1.1%	5	10.9%	5.0%	25	54%	10%
Lesser duckweed *Lemna minor*		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	1	2.0%	1.1%	0	0.0%	0.0%	0	0%	0%
Common water-milfoil *Myriophyllum sibiricum*		0.0%	0.0%	11	21.6%	10.9%	10	19.6%	11.4%	2	3.9%	2.2%	0	0.0%	0.0%	34	74%	14%
Eurasian water-milfoil *Myriophyllum spicatum* (2)	86	53.4%	43.2%	41	80.4%	40.6%	43	84.3%	48.9%	40	78.4%	43.5%	34	73.9%	33.7%	39	85%	16%
Bushy pondweed *Najas flexilis*	7	4.3%	3.5%	5	9.8%	5.0%		0.0%	0.0%	2	3.9%	2.2%	11	23.9%	10.9%	3	7%	1%
Spiny najas *Najas marina* (2)		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	2	4%	1%
Southern naiad *Najas quadalupensis*		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	0	0%	0%
White water lily *Nymphaea odorata*	1	0.6%	0.5%		0.0%	0.0%		0.0%	0.0%	1	2.0%	1.1%	0	0.0%	0.0%	0	0%	0%
Large-leaf pondweed *Potamogeton amplifolius* (3)	3	1.9%	1.5%	4	7.8%	4.0%	7	13.7%	8.0%	9	17.6%	9.8%	8	17.4%	7.9%	4	9%	2%
Curly-leaf pondweed *Potamogeton crispus* (2)	3	1.9%	1.5%	3	5.9%	3.0%	1	2.0%	1.1%	1	2.0%	1.1%	3	6.5%	3.0%	21	46%	8%
Thread-leaf pondweed *Potamogeton filiformis*		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	0	0%	0%
Leafy pondweed *Potamogeton foliosus*(3)		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	0	0%	0%
Variableleaf pondweed *Potamogeton gramineus*(3)	10	6.2%	5.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	3	7%	1%
Illinois pondweed *Potamogeton illinoensis*(3)		0.0%	0.0%	1	2.0%	1.0%		0.0%	0.0%	4	7.8%	4.3%	0	0.0%	0.0%	4	9%	2%
Floating-leaf pondweed *Potamogeton natans*		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	1	2%	0%
Sago pondweed *Potamogeton pectinatus*	25	15.5%	12.6%	7	13.7%	6.9%	3	5.9%	3.4%	4	7.8%	4.3%	9	19.6%	8.9%	3	7%	1%
White-stem pondweed *Potamogeton praelongus*		0.0%	0.0%		0.0%	0.0%	1	2.0%	1.1%	1	2.0%	1.1%	0	0.0%	0.0%	0	0%	0%
Clasping-leaf pondweed *Potamogeton richardsonni*		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	0	0%	0%
Flat-stemmed pondweed *Potamogeton zosteriformis*(3)	4	2.5%	2.0%	2	3.9%	2.0%	6	11.8%	6.8%	5	9.8%	5.4%	6	13.0%	5.9%	14	30%	6%
Pondweeds *Potamogeton sp.*		0.0%	0.0%	1	2.0%	1.0%		0.0%	0.0%		0.0%	0.0%	0	0.0%	0.0%	0	0%	0%
Bladderwort *Utricularia vulgaris* or sp.(3)		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	4	9%	2%
Eel grass *Vallisneria americana*	13	0.0%	6.5%	7	13.7%	6.9%	8	15.7%	9.1%	7	13.7%	7.6%	9	19.6%	8.9%	15	33%	6%
Horned pondweed *Zannichellia palustris*		8.1%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	0	0.0%	0.0%	0	0%	0%
Water stargrass *Zosterella dubia*	9	5.6%	4.5%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	22	48%	9%
Long-leaf pondweed *Potamogeton nodosus*																1	2%	0%
Water-thread pondweed *Potamogeton diversifolius*																3	7%	1%
Small pondweed *Potamogeton pusillus*																1	2%	0%
Hill's pondweed *Potamogeton hillii*																1	2%	0%
Fries' pondweed *Potamogeton friesii*																1	2%	0%
Other		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%	1	2.0%	1.1%		0.0%	0.0%		0%	0%
None		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0.0%	0.0%		0%	0%
Occurance Total	199			101	198.0%		88			92			101			248		
Total quads	161			51			51			51			46			46		
Total frquency		123.6%	100.0%		396.1%	100.0%		172.5%	100.0%		180.4%	100.0%		219.6%			539%	100%

1. 1988-1997 data from DNR Long-term trends (SEWRPC 2003).
2. Exotic species
3. Sensitive species
4. 2000-2006 (Zappa, A. and R. C. Anderson. 2006)
5. 2007-2009 (Zhang, H. and R.C. Anderson 2009)

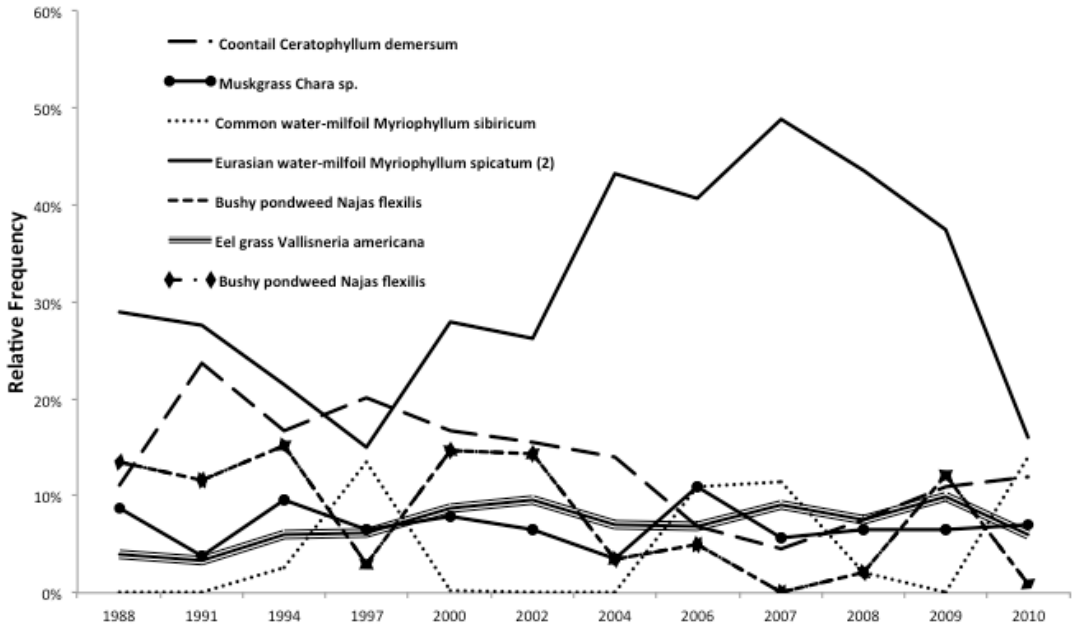
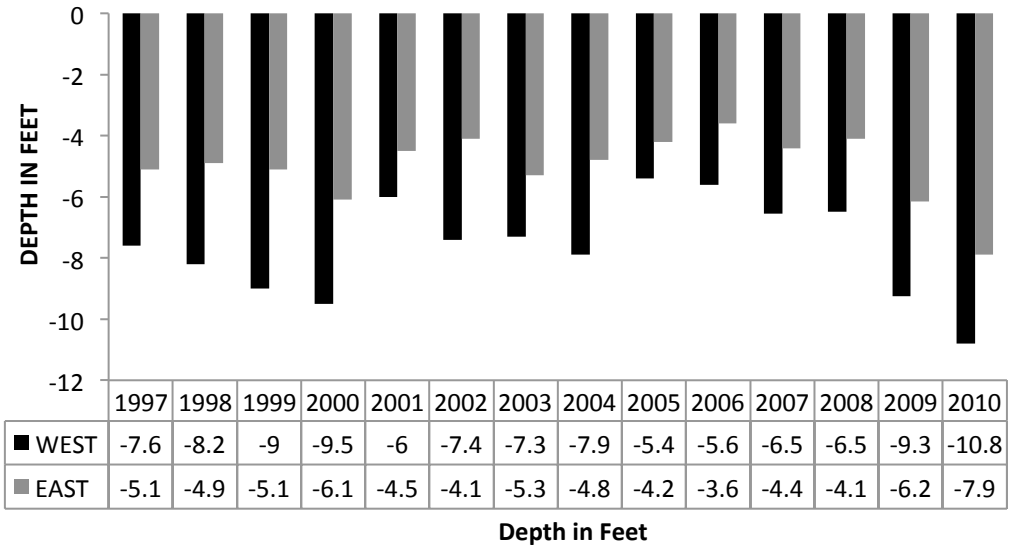


Figure 15: Relative frequency of Eurasian watermilfoil and major native plant species collected in Pewaukee Lake, Waukesha County, Wisconsin during 1988 – 2010 (Table 2).



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
WEST	-7.6	-8.2	-9	-9.5	-6	-7.4	-7.3	-7.9	-5.4	-5.6	-6.5	-6.5	-9.3	-10.8
EAST	-5.1	-4.9	-5.1	-6.1	-4.5	-4.1	-5.3	-4.8	-4.2	-3.6	-4.4	-4.1	-6.2	-7.9

Figure 16: Annual average of Secchi disc readings taken in the center of the east and west basins of Pewaukee Lake, Waukesha County, Wisconsin during 1997 – 2010.

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