

Devil's Lake Aquatic Plant Management Plan



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In cooperation with
The Friends of Devil's Lake State Park
And
Devil's Lake State Park

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Introduction

Devil's Lake is considered the most geologically unique lake in Wisconsin. The lake partly fills a gorge located in the 1.7 billion year old Baraboo Range. The gorge was also a former Wisconsin River channel that was dammed by glacial moraines at the north and south ends of the lake about 16,000 years ago. The unusual lake morphology greatly influences the distribution of aquatic plants and littoral zone communities are limited to the north, southeast and southwest shores. The stunning 500 foot purple quartzite bluffs plunge deep into the lake along the east, west and south shores and the steep rocky substrate prevents growth of most aquatic plants. Despite the physical limitations for rooted plant growth along the bluffs, the plant communities elsewhere in the lake sustain a productive fishery.

The first survey of submersed aquatic plants in Devil's Lake was conducted off the southeast shore (Baker 1975). At that time the dominant aquatic plant species were common waterweed (*Elodea canadensis*), large-leaf pondweed (*Potamogeton amplifolius*) and fern pondweed (*P. robbinsii*). A total of seven species were identified at that time, including (*Myriophyllum verticillatum*) that was perhaps misidentified and actually Eurasian watermilfoil - EWM (*Myriophyllum spicatum*) (Lillie 1989). Wisconsin Department of Natural Resources (WDNR) staff began lake-wide aquatic plant surveys in 1978, followed by more systematic quantitative surveys in 1984 and 1987 (Lillie 1989). The detailed lake-wide surveys revealed additional plant species as well as the extent of the EWM invasion. While Lillie (1989) suggested that the original introduction of EWM occurred during the 1960's, the ecological significance of the invasion did not become apparent until the 1980's after it had displaced mostly fern pondweed and common waterweed in three large beds encompassing 7.7 acres. EWM had formed dense canopies nearly 1000 feet long and up to 165 feet wide. The EWM beds functioned as barrier reefs and ultimately altered macroinvertebrates and fish populations. The decline of cool water fisheries and expansion of the bluegill and largemouth bass populations was attributed to the EWM invasion (WDNR 1988). EWM had become the third most common plant in the lake behind fern pondweed and common waterweed.

By the late 1980's, aerial photography demonstrated that the EWM beds were declining (Lillie 1989). By the early 1990's, WDNR SCUBA diver (Marshall) provided anecdotal photographic evidence of significant EWM bed decline and decay. While the State Park staff and Three Little Devil's Dive Shop had coordinated volunteer SCUBA uprooting and harvesting events, the primary reasons for the decline were natural ecological factors that had accompanied EWM declines in other lakes (Smith and Barko 1990). The extent of the EWM decline in Devil's Lake is noteworthy since it was more extensive than had occurred in most other lakes in Wisconsin. In Devil's Lake, the large reef forming canopies had declined to just low numbers of isolated plants.

The potential for future EWM re-expansion in the lake may be low given the lack of disturbances in the lake and watershed and ongoing efforts to reduce historical phosphorus levels by hypolimnetic pumping (Lathrop et al. 2005). Reduced nutrient

levels in the lake would likely favor high value environmentally sensitive plant species such as large-leaf pondweed (*P. amplifolius*) and Illinois pondweed (*P. illinoensis*) in the lake over invasive species such as EWM that thrive with ecological disturbances.

2007 Point Intercept Baseline Aquatic Plant Survey

On June 19 and 20, 2007, WDNR Bureau of Integrated Science Services (ISS) staff conducted a point intercept survey on Devil's Lake. The sampling protocol was developed by Jen Hauxwell, a research scientist with WDNR ISS. The point intercept method is based on establishing a large number of sampling sites distributed equidistantly across a lake. GPS units were used to locate the sites and double-headed rakes for sampling. The rakes are constructed in two forms. The pole rake was used for sampling macrophytes up to 15 ft (4.6 m) and rope rake was used to sample deeper areas. Density ratings of individual macrophyte species are estimated from 1 (lowest) to 3 (highest). Plants that were observed near the boat but not collected in the rake were also noted recorded. Samples of each species found in a lake were collected and pressed as voucher specimens. Figure 2 displays the point intercept sampling grid across Devil's Lake. Due to the limited littoral zones in the lake, many of the points were beyond the maximum rooting depth (17 feet) and therefore were not sampled.

The point intercept sampling methodology differs from the previous surveys that involved quantitative quadrat sampling along transects. However, the data from both surveys are comparable with respect to relative frequency. A comparison of the quadrat survey with the point intercept survey demonstrated that EWM had declined from the third most abundant plant in the lake in 1987 to one of the least common species sampled in 2007. It was found at only a single site in 2007! Fern pondweed and common water weed remained the most abundant species. For some reason, the deep water Charophyte *Nitella* was relatively abundant in 1987 but was not collected twenty years later. Figure 1 presents the relative frequency data for the four most common rooted vascular plant species in 1987 and/or 2007. More detailed aquatic plant data appear in Tables 1-3.

Figure 1: Relative frequency of major aquatic plants in Devil's Lake

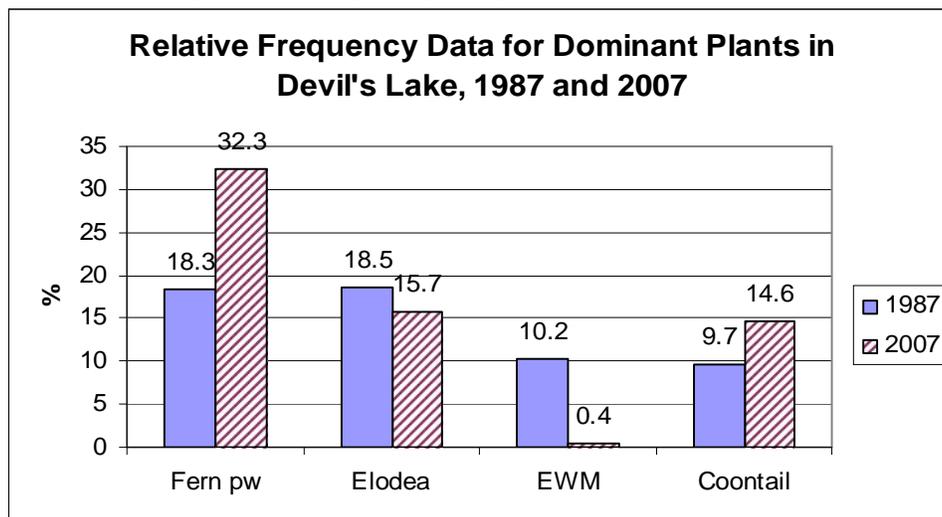
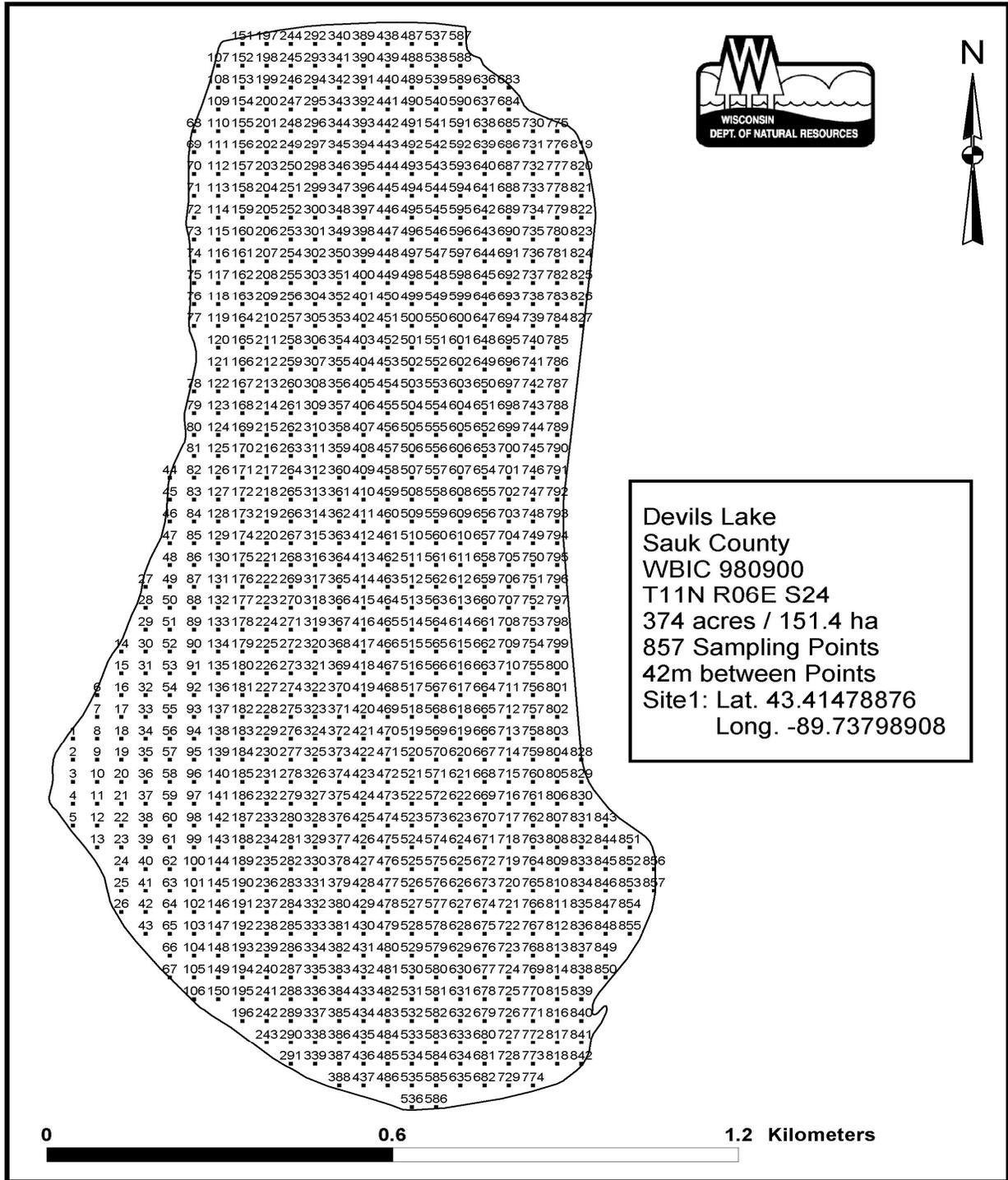


Figure 2: Map of Devil's Lake with point intercept grid



2008-09 Small Scale Lake Planning Grant Surveys

In 2008 The Friends of Devil's Lake State Park was awarded a small-scale lake planning grant to conduct qualitative EWM surveys within the three littoral zones of Devil's Lake and prepare this planning document. The more recent qualitative surveys were used to compliment the 2007 point intercept survey and were designed to determine if additional EWM beds had been missed during the point intercept survey. Only one EWM bed was found during the 2007 point intercept survey. At Blackhawk Lake in Iowa County, a few scattered EWM beds were detected visually from the surface and were not sampled as part of the point intercept survey. Furthermore, locating remnant EWM beds is useful for conducting small-scale eradication efforts and for tracking future trends of the invasive plant.

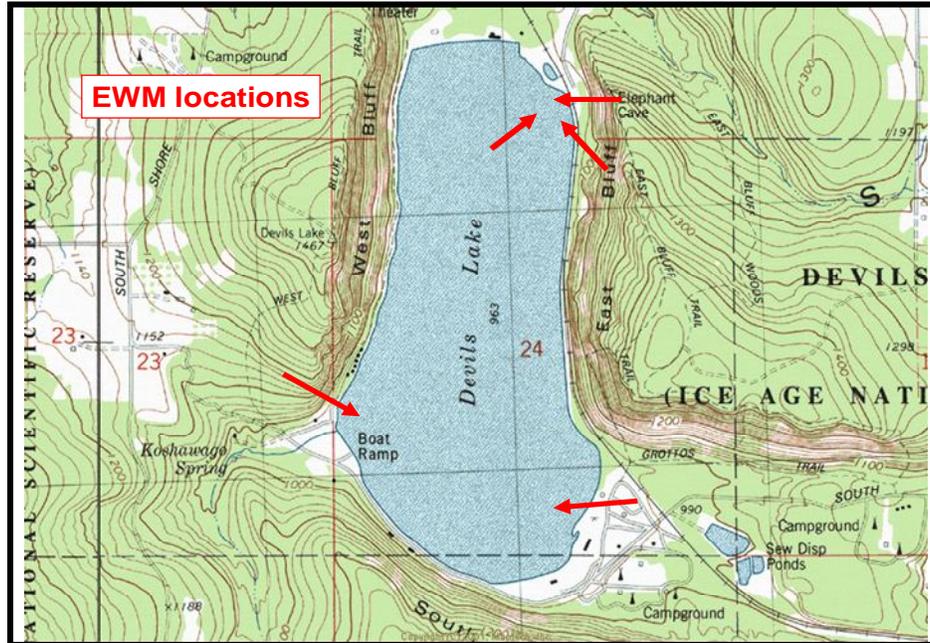
Two qualitative transect surveys were conducted in 2008 and two more in 2009. Transects were established parallel to shore. The original project goal was to complete the surveys and project in 2008 but flooding had delayed and undermined the effort. The lake was inaccessible until late in the growing season. Once water levels declined enough for lake access, the water clarity was much lower than is typical for this relatively pristine lake. Given that good water clarity is needed to observe EWM, the decision was made to continue the surveys in 2009.

The surveys included SCUBA, submersible video camera operated from a boat and visual observations from a boat using polarized glasses. The results of the surveys demonstrated that EWM was located at three locations; small colonies within each major littoral zone. In the north littoral zone, EWM was found in scattered clumps near the boat landing ($43^{\circ} 25.560'$ – $89^{\circ} 43.674'$). These were manually removed in 2008. In the southwest part of the lake, EWM was found in a small bed near the inlet creek ($43^{\circ} 24.814'$ – $89^{\circ} 44.252'$). The EWM bed identified during the 2007 point intercept survey could not be located in 2009 but was located at $43^{\circ} 24.636'$ – $89^{\circ} 43.658'$). Figure 3 reveals the locations of the three known EWM beds in Devil's Lake.

Two independent surveys using different methodologies and goals demonstrated that the EWM decline in Devil's Lake is probably more extensive than any other lake in Wisconsin and perhaps the mid-west. The decline had occurred with minimal management and largely reflects that natural ecological factors can prevail if disturbances do not support the EWM niche. These findings suggest that the best approach for managing Devil's Lake macrophytes is a passive approach. Periodically monitoring the littoral zone communities should continue with the option of rapid response eradication efforts if EWM or other invasives expand in the lake.

As part of the public outreach effort, a public presentation is recommended. A fact sheet and press release documenting the project findings were prepared as well.

Figure 3: 2007-2009 EWM locations in Devil's Lake



Recommendations

1. Volunteer boat operators and SCUBA divers should revisit the EWM sites in June 2010 to determine the status of the beds and conduct a small-scale harvesting effort. Wet weight measurements should be made to establish a biomass baseline for future assessments.
2. The Friends of Devil's Lake State Park and Park staff should encourage volunteer boat inspectors who can also share information why it is important to prevent new invasive plants or animals from entering Devil's Lake. An Aquatic Invasive Species grant may be an option for this effort - <http://www.dnr.state.wi.us/lakes/grants/>.
3. Encourage local SCUBA divers to become familiar with EWM and other potential invasives. Informed SCUBA divers could alert Park staff if exotic species are observed or photographed.
4. Littoral zones in Devil's Lake appear to have rejuvenated following the EWM decline. A passive approach to managing aquatic plant communities in the lake is recommended and aggressive management techniques such as chemical applications or large-scale mechanical harvesting are not warranted.
5. A presentation of the ecological services that native aquatic plants provide the Devil's Lake ecosystem should be part of the 2010 Nature Center program.

Table 1: Devil's Lake Aquatic Plant Relative Frequency Data from 1987 and 2007

Species	1987	2007
<i>Potamogeton robbinsii</i>	18.3	32.3
<i>Elodea canadensis</i>	18.5	15.7
<i>Myriophyllum spicatum</i> - EWM	10.2	0.4
<i>Nitella</i>	17.2	0
<i>Ceratophyllum demersum</i>	9.7	14.6
<i>Vallisneria americana</i>	4.8	3.5
<i>Potamogeton diversifolius</i>	4.4	0
<i>Potamogeton pusillus</i>	0	3.9
<i>Potamogeton amplifolius/illinoensis</i>	3.1	7.9
<i>Eleocharis acicularis</i>	2.1	6.7
<i>Najas flexilis</i>	3.0	0
<i>Isoetes echinospora</i>	2.1	2.0
<i>Chara</i>	1.1	0.4
<i>Potamogeton crispus</i> -CLP	1.1	0
<i>Megalodonta beckii</i>	1.1	1.6

Table 2: 2007 Point Intercept Summary Statistics

Total number of points sampled	249
Total number of sites with vegetation	127
Total number of sites shallower than maximum depth of plants	148
Frequency of occurrence at sites shallower than maximum depth of plants	85.81
Simpson Diversity Index	0.82
Maximum depth of plants (ft)	17.00
Number of sites sampled using rake on Rope (R)	10
Number of sites sampled using rake on Pole (P)	142
Average number of all species per site (shallower than max depth)	1.72
Average number of all species per site (veg. sites only)	2.00
Average number of native species per site (shallower than max depth)	1.26
Average number of native species per site (veg. sites only)	1.59
Species Richness	13
Species Richness (including visuals)	13

Table 3: 2007 Point Intercept Species Statistics

Species	Freq Occurrence	Number Sites Found	Ave. Rake Fullness
<i>M. spicatum</i> - EWM	0.79	1	2
Filamentous algae	22.05	28	1
<i>C. demersum</i>	29.13	37	2
<i>Chara</i>	0.79	1	1
<i>Eleocharis acicularis</i>	13.39	17	1
<i>E. canadensis</i>	31.5	40	2
<i>Megalodonta</i>	3.15	4	1
<i>P. amplifolius</i>	14.96	19	1
<i>P. illinoensis</i>	0.79	1	1
<i>P. pusillus</i>	7.87	10	1
<i>P. robbinsii</i>	64.57	82	2
<i>Vallisneria</i>	7.09	9	1
<i>Isoetes</i>	3.94	5	1

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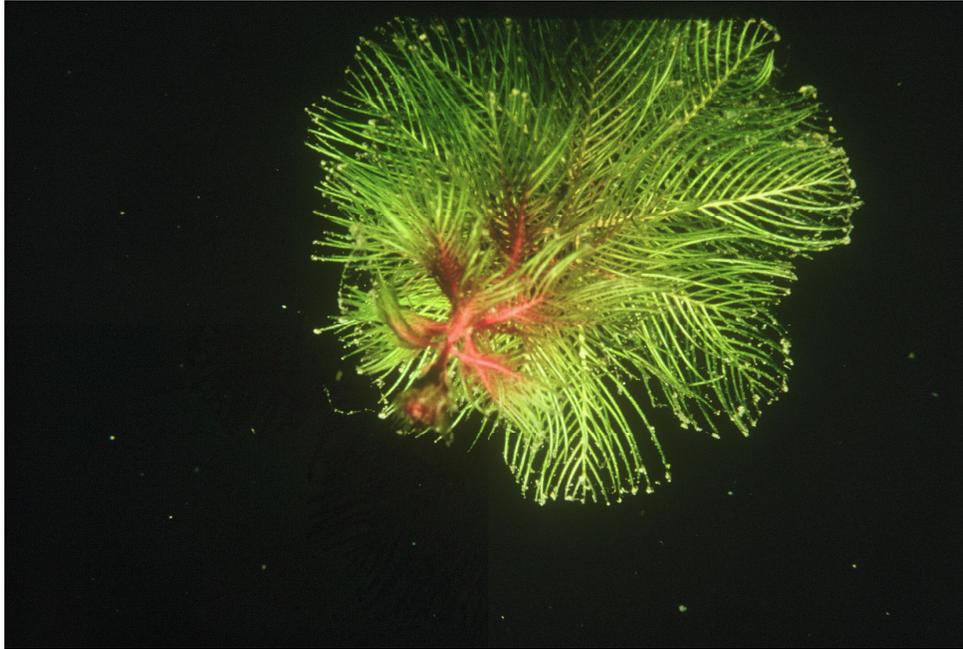
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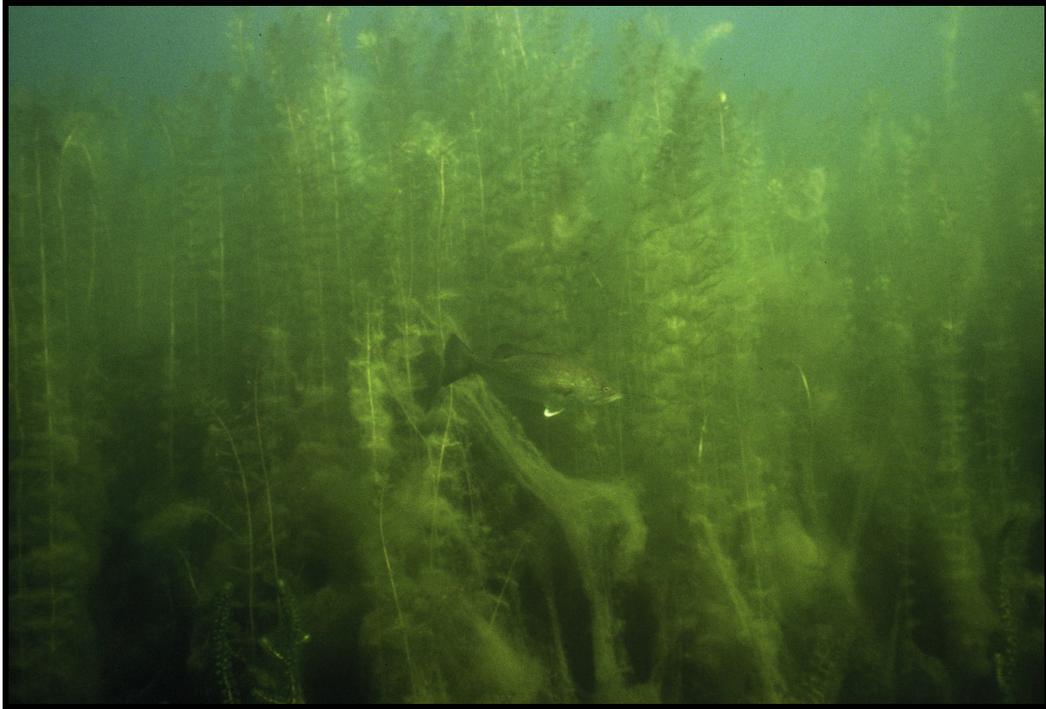
Some submersed views of Devil's Lake macrophytes
Photos by Dave Marshall



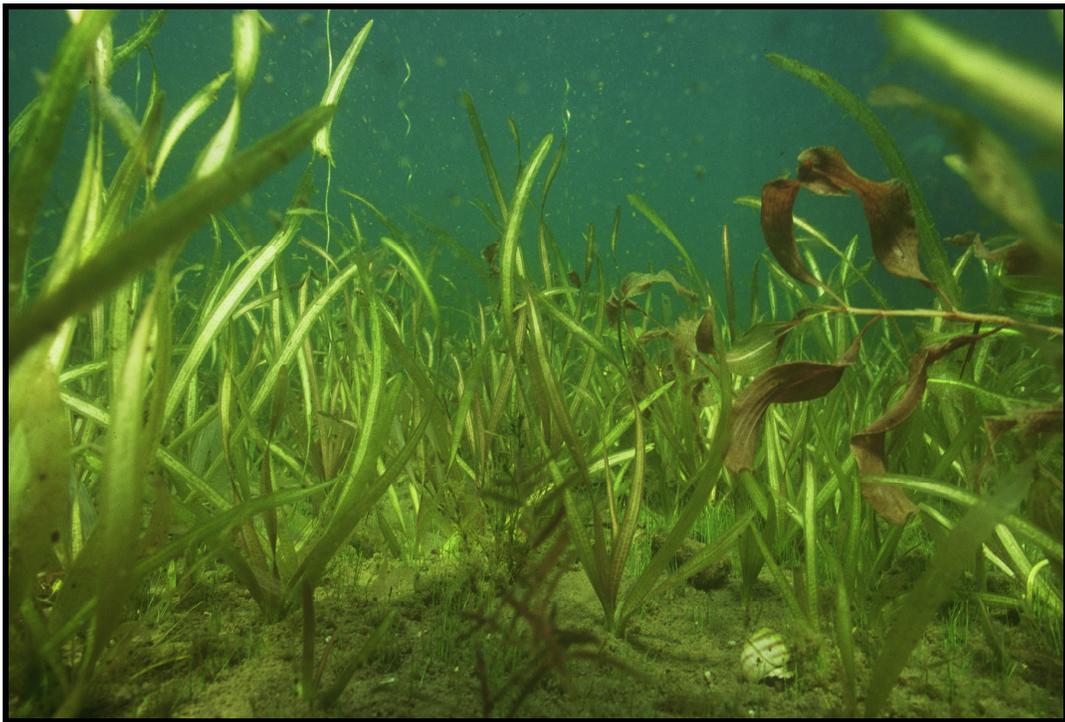
EWM close-up of leaflet structure



Walleye hiding in Elodea and Fern pondweed – southwest littoral zone



1986 EWM barrier reef in southeast littoral area



Wild celery and large-leaf pondweed in 1994 after EWM decline



Northern pike hiding in southwest littoral area Elodea bed



Large-leaf pondweed in north littoral area

Appendix A

Fish and Waterfowl Values of Desirable Native Plants in Devil's Lake

Scientific Name	Common Name	Fish	Wildlife
<i>P. robbinsii</i>	Fern pondweed	Food and cover	Food
<i>Elodea canadensis</i>	Elodea	Food and cover	Food
<i>Nitella</i>	Stonewort or Muskgrass	Food and cover	Food
<i>Ceratophyllum demersum</i>	Coontail	Food and cover	Food
<i>Vallisneria</i>	Wild celery	Food and cover	Food
<i>Potamogeton pusillus</i>	Small pondweed	Food and cover	Food
<i>Potamogetan amplifolius</i>	Large-leaf Pondweed	Food and cover	Food
<i>Potamogeton illinoensis</i>	Illinois pondweed	Food and cover	Food
<i>Eleocharis acicularis</i>	Spike Rush	Cover	Food
<i>Isoetes echinospora</i>	Quillwort	Cover	Food
<i>Chara</i>	Stonewort or Muskgrass	Food and cover	Food
<i>Megalodonta beckii</i>	Water marigold	Food and cover	Food

Fish and Wildlife Values based on Borman et al. 1997, Nichols and Vennie 1991 and Janecek 1988.