Figure 7. Known infestations of Eurasian water milfoil in Little Lake Wissota and Stillson Creek totaling 2.58 acres, 2009.

Plant Community

A healthy aquatic plant community in Lake Wissota is essential because aquatic plants (1) **improve water quality,** (2) provide wildlife habitat, (3) provide necessary habitat for fish, (4) can limit nuisance aquatic plant growth, (5) stabilize sediments, and (6) provide oxygen to aquatic organisms.

History. Whole lake plant surveys were conducted in 1989, 2005, and 2009 using the same sampling techniques for each study to allow for comparison between studies. A list of the plant species found during those studies is found in Appendix D. The species found at each transect were documented in map format as well and are included in the plant study reports from 2005 and 2009. An example of a map from the 2009 study is included in Appendix E. The first aquatic plant survey was conducted from 1989-1990 in preparation for the Wissota dam re-licensing project in 2000. The survey was designed to determine baseline data about the aquatic plant community that could be replicated in the future to determine any changes in the plant community. The species present, their distribution, and their frequency and abundance were recorded. In 1998, the Wisconsin Department of Natural Resources conducted a study of the impact of late-winter drawdowns on the aquatic plant community. In 2005, the aquatic plant survey from 1989 was repeated and the data from the 1989 and 2005 studies were compared. In 2009, the aquatic plant study was repeated again and the data compared to 2005 and 1989.

Thirty-one plant species were documented during the 1989 plant study. The 1989 study showed that aquatic plants were primarily found in areas with silty or mucky sediment and that the composition of the plant community slightly favored plants that were drawdown tolerant. The species list indicates that there was only one aquatic invasive plant species in Lake Wissota at that time, curly-leaf pondweed (*Potamogeton crispus*).

A study in 1998 (Konkel 1998) provided anecdotal evidence about how the Lake Wissota plant community differed from other impoundment lakes in the West Central region of the state that do not experience late-winter drawdowns. It was suggested that the reduction of the late-winter drawdowns might lead to an expansion of littoral zone vegetation into deeper water of the lake, which might enlarge the plant community and might potentially lead to increased plant diversity.

A healthy aquatic plant community in Lake Wissota is essential because aquatic plants (1) provide necessary spawning habitat for fish, (2) provide shelter for animals such as ducks and otters, (3) improve water quality, (4) can limit aquatic plant growth, (5) stabilize sediments, (6) provide oxygen to aquatic organisms, and much more.

Figure 8. Water lily on Lake Wissota. *Photo courtesy of Jessica Soine.*

In 2005, the 1989 aquatic plant survey was repeated. Thirty-three plant species were present in 2005. The results of the two studies were compared and showed that following the reduction of the late-winter drawdowns, although not necessarily as a direct result of the reduction, there was an increase in silt and muck sediment areas, a slight shift in the aquatic plant community that allowed some species that are sensitive to water level fluctuations (ie. drawdowns), such as white water-lily (*Nymphaea odorata*, Figure 7) and yellow pond lily (*Nuphar variegata*), to survive, although in low frequencies. The presence of two aquatic invasive plant species, curly-leaf pondweed and Eurasian water milfoil (*Myriophyllum spicatum*) were also documented.

In 2009, the aquatic plant survey was repeated again and results compared to 2005 and 1989. Thirty two plant species were present in 2009, compared to 33 in 2005 and 31 in 2009.

Dominance. The 2009 study included a comparison of the dominance of species between 1989, 2005, and 2009 (Figure 7). Dominant species are those that are found most frequently and have the highest densities. In all years, the dominant species in Lake Wissota was *Elodea canadensis*, also know as common waterweed or elodea. The second most dominant species in 1989 was *Ceratophyllum demersum* (coontail), followed by *Najas flexilis* (Slender naiad). In 2005, the second most dominant species changed to *Vallisneria americana* (water celery), followed by *C. demersum* and this remained the same in 2009.

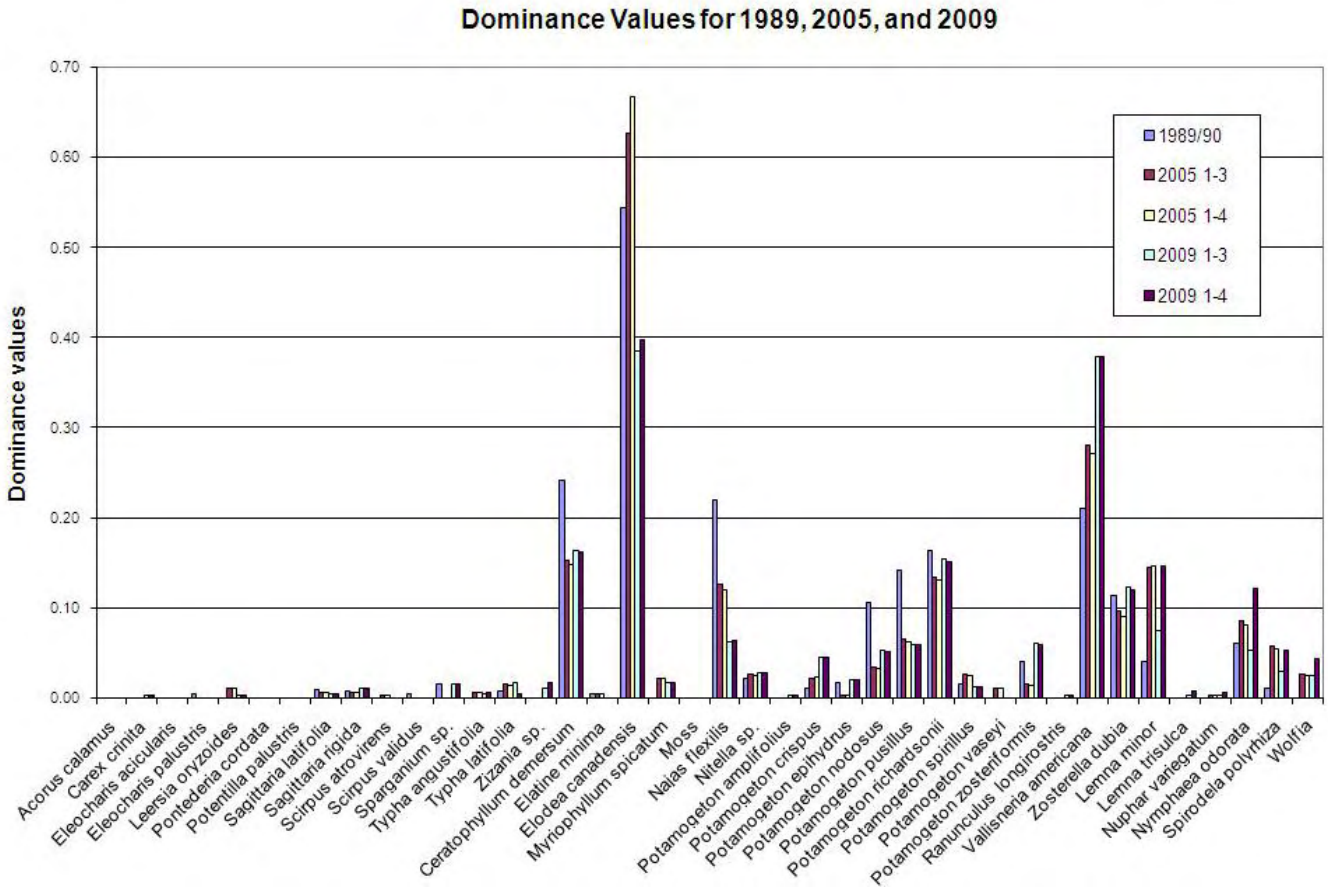

Figure 9. Plant species percent (%) dominance for 1989, 2005, and 2009 (Data from Swanson 2009)

Frequency. The frequencies of the most prevalent aquatic plant species in Lake Wissota for 1989, 2005, and 2009 are included in Table 2. The most frequent species in all years was *Elodea canadensis* (common waterweed) although in 2009, *Vallisneria americana* was a close second (24.96% *E. canadensis*; 24.63%, *V. americana*). Both *E. canadensis* and *V. americana* are considered resilient to water level disturbances (Swanson 2009). The least frequent species in 1989 was *Zosterella dubia* (water stargrass), and in 2005 was *Potamogeton pusillus* (small pondweed). In 2009, four species tied for least frequent: *Leersia oryzoides* (rice cut-grass), *Pontederia cordata* (pickerelweed), *Potamogeton amplifolius* (large-leaf pondweed), and *Ranunculus longirostris* (stiff water crowfoot). *P. cordata, P. amplifolius*, and *R. longirostris* are species that thrive in areas with more stable water levels. It will be important to monitor these species to see if their frequencies increase as time since drawdown reduction increases. *Nuphar variegata* and *Nymphaea odorata* frequencies both increased in the 2009 study.

Depths of Aquatic Plants. The results of the 2009 plant study indicated that aquatic plants were found most frequently at the 1.5-5ft zone (consistent with the 2005 study), followed by the 0-1.5ft zone (Swanson 2009). In 2005 and 1989, the 5-10ft zone was the second most frequently dominated zone (Heuschele 2005). The fact that the 0-1.5ft zone has an increasing frequency of aquatic plants indicates that this area is recovering as a result of the reduction of the

late-winter drawdowns. These areas may become valuable spawning areas for fish and provide habitat for aquatic invertebrates, which is good news for Lake Wissota anglers. In all years, plants were found least frequently in the 10-20ft zone. It is important to note that in 1989, no plants were found growing in the 10-20ft zone.

Table 2. Percent frequencies of prevalent aquatic plant species in Lake Wissota.

Species	1989/90	2005	2009
Elodea canadensis	28%	30%	25%
Ceratophyllum demersum	14%	7%	11%
Najas flexilis	13%	6%	5%
Vallisneria americana	12%	11%	25%
Potamogeton richardsonii	10%	7%	12%
Potamogeton pusillus	10%	3%	5%
Zosterella dubia	8%	5%	9%
Nymphaea odorata	4%	4%	10%
Lemna minor	3%	6%	10%

Lake Bottom Sediment Types. Just as soil type is important for terrestrial plants, lake bottom sediment types are important for aquatic plants. Silty or mucky sediment is the most favorable for aquatic plant growth (Boreman 1991).

The lake bottom sediment types in Lake Wissota were recorded during all of the plant studies. "There is some subjectivity to the assessment of substrates, however, as guidelines as to particle size per category were not established, for example, there was not a clear cut off point between rock and gravel" (Swanson, 2009).

In 1989, the sediment type was predominantly sand or sand/gravel (62%) and only 7.8% of the sampled points had silt or muck sediment. However, the silt or muck points had the highest frequency of plant occurrence (86.5% of silt/muck sample points had plants) and the highest plant densities (Boreman 1991). In 2005 and 2009, muck and silt points still had the highest frequency of plant occurrence, with 100% of points containing vegetation. 56% and 53% of sample points contained sand or sand/gravel sediment in 2005 and 2009, respectively, while 13% contained muck or silt sediment in both years (Swanson 2009). Figure 11 provides an example of the distribution of the

Figure 10. Beaver Creek Reserve researchers conducting Eurasian watermilfoil survey prior to herbicide treatment, 2009. *Photo courtesy of Sarah Braun.*

sediment types for the northern shoreline of the main lake as they were mapped during the 2009 aquatic plant study (Swanson 2005). Additional substrate maps can be found in the aquatic plant study reports (Heuschele 2005, Swanson 2009).

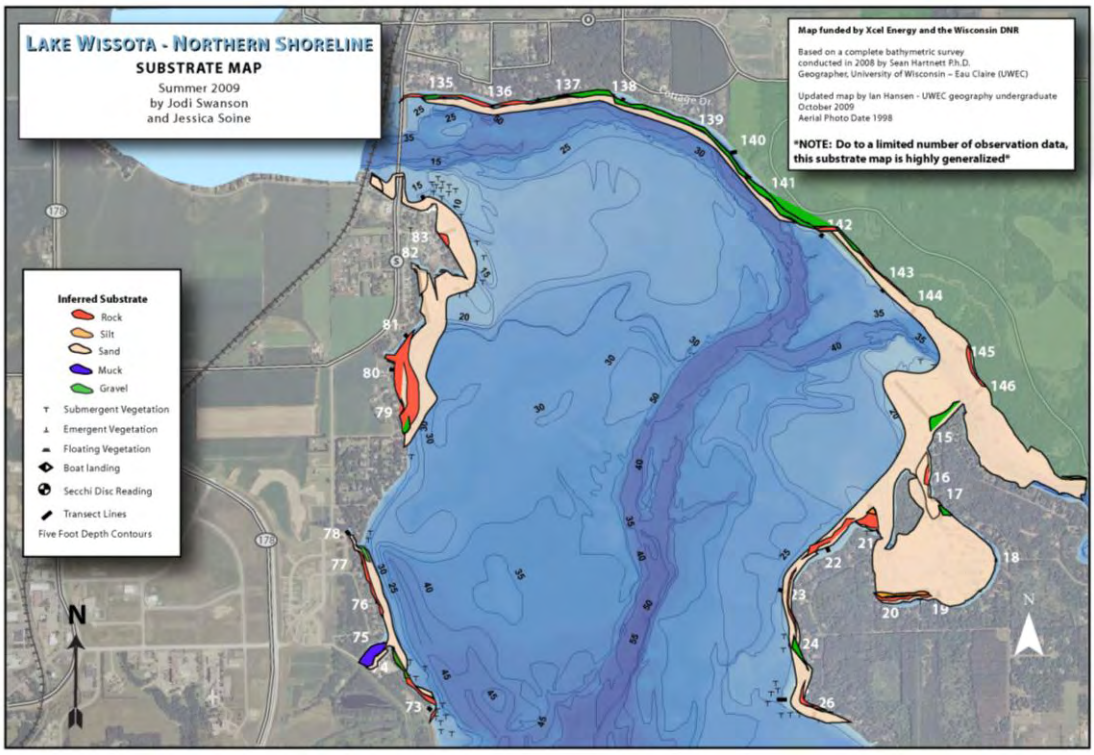

Figure 11. Substrate map for Lake Wissota northern shoreline from summer 2009. (Swanson and Soine 2009).

Near Shore Vegetation. Near shore vegetation is the area along the shore and in the water (not the shoreline) that contains submerged and emergent vegetation. This area often provides important breeding and nesting habitat for fish and other wildlife, acts as a sediment trap, and buffers the shoreline from wave action, thereby reducing erosion of the shore (Dudiak 2000). Over the course of 20 years from the first study in 1989, to the most recent study in 2009, the percentage of the vegetated points in the zone from 0-1.5ft from shore increased from 29% (1989) to 37% (2005) to 57% (2009). The 1.5-5ft zone also saw an increase in the percentage of vegetated points, from 52% (1989) to 55% (2005) to 62% (2009). This indicates a slight increase in the overall frequency of plants in the near shore depth zones (Swanson, 2009).

Floristic Quality Index. The Floristic Quality Index utilizes the number of aquatic plant species and the identity of aquatic plant species in a lake to determine lake quality. The FQI was developed in Wisconsin for Wisconsin lakes. The range for FQI is 3.0-44.6, the median is 22.2, and the higher the number, the better the lake quality (Aron et al. 2006). In 1989 and 2005, the FQI value for Lake Wissota was calculated at 28.24 and 28.00, respectively.

In 2009, the FQI value increased to 29.3. The values for all years are higher than the state and regional averages (Swanson 2009).

Aquatic Invasive Plants. Two aquatic invasive plants are found in Lake Wissota, curly-leaf pondweed (*Potamogeton crispus*) and Eurasian water milfoil (EWM, *Myriophyllum spicatum*). Both species have increased in frequency over the 20-year course of the three plant studies. *P. crispus* increased from 0.63% in 1989 to 3.45% in 2009. *M. spicatum* increased from 0% in 1989 to 0.98% in 2005 to 1.48% in 2009. These frequencies are low compared to other species in the lake (ie. *Elodea canadensis* had a 25% frequency in 2009). However, in areas like Moon Bay where there are several beds of EWM, the EWM may begin to crowd out native plants, if it hasn't begun to do so already. It is also disconcerting that the frequency of EWM is increasing at all, given that it has been treated each year since it was first documented in the lake. It would seem that the frequency of this plant should have decreased with the 2009 survey rather than increased, since it had been treated by herbicides for several seasons prior to the survey. It also is cause for concern that new areas of infestation appear each year. The increase in frequency of *P. crispus* should be monitored carefully to determine if it is displacing native plants.

Total Acreage Vegetated. Visual estimations of plant bed sizes totaled 495.5 (7.9%) acres over the entire water system, 162.9 (45.7%) acres in Moon Bay, 47.8 (11.9%) acres in Little Lake and 152.5 (13.2%) acres in the Chippewa River north of the main basin (Table 6). Shoreline vegetation occurred on 39.3 miles (70.1%) of the entire shoreline (Swanson 2009; Figure 12).

The Wisconsin Department of Natural Resources fisheries has recorded 47 species of fish from 11 families in Lake Wissota between 1976 and 2008.

Fisheries

The Wisconsin Department of Natural Resources has recorded 47 species of fish from 11 families in Lake Wissota between 1976 and 2008, (Appendix F). A state endangered species, the slender madtom (*Noturus exilis*) was reported in the lake, but there is dispute about its identification, and it may have been a misidentified stonecat. The greater redhorse (*Moxostoma valenciennesi*) is a state, threatened species that was found in the lake in 1994. The lake sturgeon (*Acipenser fulvescens*), common in the lake, is considered a species of special concern in Wisconsin. Species of special concern are species about which some problem of abundance or distribution is suspected but not proven. The main purpose of this category is to focus attention on these species before they become threatened or endangered. Common carp (*Cyprinus carpio*) was the only species in Lake Wissota not native to Wisconsin.

Twelve species were captured only one time in Lake Wissota: bigmouth buffalo (1975), greater redhorse (1994), warmouth (2006), blacknose shiner (*Notropis heterolepis*, 2005), bluntnose minnow (*Pimephales notatus*, 1994), hornyhead chub (*Nocomis biguttatus*, 1994), largescale stoneroller (*Campostoma oligolepis*, 1994), longnose dace (*Rhinichthys cataractae*, 1994), river shiner (*Notropis blennius*, 1976), blackside darter (*Percina maculata*, 2005), Iowa darter (*Etheostoma exile*, 1994), and central mudminnow (*Umbra lima*, 1994).

No efforts were made to document all fish species present in Lake Wissota prior to or after the elimination of the drawdowns on the lake. However, fish surveys conducted after the major late-winter drawdowns were eliminated have shown improvements in fish populations that are dependent on aquatic