THE AQUATIC PLANT COMMUNITY OF LOWER CAMELOT LAKE, ADAMS COUNTY

2000-2013

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EXECUTIVE SUMMARY

An updated aquatic macrophytes (plants) field study of Lower Camelot Lake was conducted during July 2013 by staff from the Adams County Land and Water Conservatism Department and the Tri-Lakes Management District. Prior quantitative vegetation studies using the transect method were performed by Wisconsin Department of Natural Resources staff in 2000 and staff of Adams County Land & Water Conservation Department in 2006. Two methods were used in 2009: the transect method (t) and the point intercept method (pi). The 2013 survey used the PI method.

Lower Camelot Lake is located in the Town of Rome, Adams County, Wisconsin. The impoundment is slightly over 200 surface acres in size. Maximum depth is 24 feet, with an average depth of 8 feet. The dam impounds Fourteen-Mile Creek downstream upstream from Arrowhead Lake and Sherwood Lake, on its way to the Wisconsin River. There is a public boat ramp located on southwest side of the lake owned by the Adams County Parks Department. The park includes a small swimming beach.

Lower Camelot Lake scores as "mesotrophic" in water clarity and total phosphorus (two parameters used to gauge lake water health) and "eutrophic" in chlorophyll-a readings (third parameter used). With its cholorophyll-a readings, more than occasional algal blooms would be expected.

62 aquatic species were found during the survey in 2013 of Lower Camelot Lake. Of these, 56 were native. Of the native plants category, 34 were emergent, 3 species were free-floating, 3 were rooted floating-leaf species and 16 were

submergent species. Six exotic invasives were found: *Lythrum salicaria* (Purple Loosestrife); *Myriophyllum spicatum* (Eurasian Watermilfoil); *Nasturtium officinale* (Watercress); *Phalaris arundinacea* (Reed Canarygrass); *Potamogeton crispus* (Curly-Leaf Pondweed); and *Rumex crispus* (Curly Dock).

Ceratophyllum demersum (Coontail) and *Potamogeton pusillus* (Small Pondweed) were almost tied for the most frequently-occurring aquatic species in the 2013 survey. Also frequently occurring were *Myriophyllum spicatum* (the invasive Eurasian Watermilfoil), *Vallisneria americana* (Water Celery, *Potamogeton zosteriformis* (Flat-Stemmed Pondweed), and *Stuckenia pectinata* (Sago Pondweed). No aquatic plant in the survey exhibited a more than average density of growth. Based on dominance value, Coontail and Small Pondweed were the dominant aquatic plant species in the survey of Lower Camelot Lake in 2013. Sub-dominant was Water Celery.

The Simpson's Diversity Index for Lower Camelot Lake in 2013 was .93 This is very good species diversity. This places this lake in the upper quartile for Simpson's Diversity Index readings for both North Central Hardwood Forest Region and all Wisconsin lakes.

The 2013 AMCI for Lower Camelot Lake was 58, placing the lake's AMCI in the average range for North Central Wisconsin Lakes and just above average for all Wisconsin Lakes.

MANAGEMENT RECOMMENDATIONS

1) The few sites where there is undisturbed shore should be maintained and left undisturbed. In other spots, natural shoreline restoration and erosion control in many areas is needed, especially on some bare steep banks. If trees fall at the eroded sites due to continued erosion, large portions of the banks will fall with them. The large amount of disturbed shores currently covering the area around Lower Camelot Lake will not help improve water health.

2) To protect banks and water quality and to comply with the Adams County Shoreland Zoning Ordinance, a buffer area of native plants needs to be restored on those many sites that now have seawalls or have traditional lawns mowed to the water's edge. Large areas of the lake shoreline are unnatural and prone to erosion & runoff of nutrients & toxics. Unmowed native vegetation reduces runoff into the lake and filters runoff that enters the lake.

3) Machine harvesting can continue for aquatic plant management, but should concentrate on providing edge for fish habitat and navigational lanes.

4) Invasives in areas shallower than 5 feet in depth can be hand-pulled, making sure that entire plants are removed, and minimizing the amount of disturbance to the sediment.

5) Impervious surface around the lake should be identified and mapped. Mitigation plans for runoff control should then be developed to deal with the

large amounts of impervious surfaces around the lake. Not only is this good management, it will help maintain water quality.

6) Stormwater management of the many impervious surfaces around the lake is essential to maintain the current quality of the lake water and prevent further degradation. This is especially important since studies show that nutrients in the Tri-Lakes system are coming from the shores within the lakes.

7) No chemicals should be used on properties around the lake. If they must be used, they should be used no closer than 50 feet to the shore.

8) The aquatic plant management plan should continue be reviewed annually. Mechanical harvesting plans should not continue target harvesting for Eurasian Watermilfoil (EWM), since it doesn't appear to be succeeding. Alternate methods of reducing EWM presence need to be explored and implemented.

9) Hand-harvesting invasive species in the nearshore areas around docks might help reduce the spread of invasives like Eurasian Watermilfoil, since if these plants have been removed from that area, they are unlikely to be spread by fragmentation caused by boats going through them to reach the deeper areas of the lake.

10) The management plan needs to be revised to add management of Curly—Pondweed to prevent further spread of this invasive and to provide for monitoring for the other invasive plants.

11) Stepped up beetle-rearing to attack the more numerous Purple Loosestrife plants needs to be implemented.

12) Now that zebra mussels have been confirmed in the Camelot Lakes, the management plan needs to be revised to include increased monitoring and management of this new invasive.

13) The Tri-Lakes Management District may want to continue to apply for grants from the Wisconsin Department of Natural Resources to help defray the cost of aquatic plant management.

14) No broad-scale chemical treatments of aquatic plant growth are recommended due to the undesirable side-effects of such treatments, including increased nutrients from decaying plant material and decreased dissolved oxygen and opening up more areas to the invasion of EWM.

15) Continued involvement in the Citizen Lake Monitoring Program should continue on the lake. This will include regular water quality sampling during the growing season, regular visual inspections of the lake for aquatic invasives, and continued involvement in the Clean Boats, Clean Waters Program.

16) Lower Camelot Lake residents should identify, cooperate with and participate in watershed programs that will reduce nutrient and sediment inputs.

17) Inventory of the streams in the 14-Mile Creek Watershed should be completed and actions taken to address any problems. This inventory should look at eroding banks, gully erosion, invasives, and stormwater runoff, among other things.

18) No drawdowns of water level except for DNR-approved purposes should occur. Several of the plants found in Lower Camelot Lake in the past few surveys are those encouraged by drawdowns.

19) The Tri-Lakes Management District should make sure that its lake management plan takes into account all inputs from the surface and ground watersheds for Lower Camelot Lake.

20) Cooperating with the Adams County Parks Department in keeping the boat ramp and swimming beach area in safe condition should help reduce any negative impacts caused by the heavy use of this public area.

21) Installation of a portable boat washing station at the public landing should be considered. Allowing people to wash off their boats should assist in reducing both input and output of invasive aquatic species.

22) Although there is currently a sanitary district, consideration of the installation of a sewage system around the Tri-Lakes Management District area should be explored. Many Tri-Lakes District residents blame the upstream agricultural producers for the nutrient input of the lake, but fail to take full responsibility for reducing their own inputs into the lake.

Reducing nutrient inputs by lake area residents needs to occur before asking watershed residents to reduce theirs.

THE AQUATIC PLANT COMMUNITY FOR LOWER CAMELOT LAKE ADAMS COUNTY 2000-2013

INTRODUCTION

An updated aquatic plants (macrophytes) field study of Lower Camelot Lake was conducted during July 2013 by staff of the Adams County Land and Water Conservatism Department and the Tri-Lakes Management District. Prior quantitative vegetation studies were performed by Wisconsin Department of Natural Resources in 2000 and by the Adams County Land & Water Conservation Department and Tri-Lakes Management in 2006 and 2009. The 2013 survey was done using the Point Intercept (PI) method.

Information about the diversity, density and distribution of aquatic plants is an essential component in understanding the lake ecosystem due to the integral ecological role of aquatic vegetation in the lake and the ability of vegetation to impact water quality (Dennison et al, 1993). This study will provide continued information for continued management of Lower Camelot Lake, including fish habitat improvement, protection of sensitive areas, aquatic plant management, and water resource regulation. This data will be compared to the past and future studies and offer insight into changes in the lake.

Ecological Role: Lake plant life is the beginning of the lake's food chain, the foundation for all other lake life. Aquatic plants and algae provide food and oxygen for fish and wildlife, as well as cover and food for the invertebrates that many aquatic organisms depend on. Plants provide habitat and protective cover for aquatic animals. They also improve water quality, protect shorelines and lake bottoms, add to the aesthetic quality of the lake, and impact recreation.

Characterization of Water Quality: Aquatic plants can serve as indicators of water quality because of their sensitivity to water quality parameters such as clarity and nutrient levels (Dennison et al, 1993).

Testing has shown that Lower Camelot Lake has very hard water, with an average of 184 milligrams/liter of Calcium Carbonate. Lake water pH has ranged from 6.3 to 8.21, with an overall average of 7.8 (alkaline). Alkaline hard water lakes tend to produce more fish and aquatic plants than soft water lakes (Shaw, 1993).

The average summer water clarity 1986-2013 was 5.9 feet. Total phosphorus average was 36.1 micrograms/liter, while the average chlorophyll-a pigment score was 15.4 micrograms/liter.

Background and History: Lower Camelot Lake is located in the Town of Rome, Adams County, Wisconsin. The impoundment is slightly over 200 surface acres in size. Maximum depth is 24 feet, with an average depth of 8 feet. The dam impounds Fourteen-Mile Creek downstream upstream from Arrowhead Lake and Sherwood Lake, on its way to the Wisconsin River. There is a public boat ramp located on southwest side of the lake owned by The Adams County Parks Department. The park includes a small swimming beach.

Lower Camelot Lake is accessible off of State Highway 13 by turning east onto either Apache Avenue, then north on 10th Avenue to the County Park entrance.

Heavy residential development around the lake is found along most of the lakeshore. The large surface watershed (extending into the next county east) is 39.88% residential; 30.06% woodlands; 11.66% outdoor recreation (mostly golf courses); 9.82% water; 4.9% industrial/commercial/ governmental; and 3.68% open grassland. The ground watershed, which also extends into Waushara County, has much irrigated and non-irrigated agricultures. There are endangered or threatened resources in the watershed including the Karner Blue Butterfly, the Greater Prairie Chicken; the Long-Leaf Aster; and the natural communities of northern dry-mesic forest and alder thicket. Archeological sites reported in the Lower Camelot Lake surface watershed include an unnamed burial site in Adams County, as well as the Millard Smith Mound Group, Lake Huron Group, Krushki Group, Town House Mounds, and Weymouth Group, all located in Waushara County.

A fishery inventory in October 2004 revealed that bluegills and largemouth bass are abundant in Lower Camelot Lake, although bluegills had a poor size (stunted growth) structure; all other fish found, including black crappie, northern pike, pumpkinseed, yellow perch, and walleye, were scarce. In the 1970s, the lake was stocked with largemouth bass, walleye, northern pike and bluegills. Perch were stocked in the mid-2000s. Using a grant, the Tri-Lakes Management District installed several fish cribs and stalked Camelot Lake with walleye fingerlings in late summer and fall 2013.

Soils in the Lower Camelot Lake surface watershed are sands of various slopes. Such soils tend to be excessively-drained, with infiltration of water being rapid to very rapid, and permeability also high. Such soils also usually have low water-holding and low organic matter content, thus making them vegetation establishment difficult. These soils tend to be easily eroded by both water and wind.

Efforts at controlling aquatic plant growth have included both chemical treatments and mechanical harvesting.

Figure 1: Chemical Treatment History

Year	Copper	Cutrine+	Aquathol	Hydrothol	Diquat	Rodeo	2,4-D	Silvex	AV-70
-	(lbs)	(gal)	(gal)	(gal)	(gal)	(gal)	(lbs)	-	-
1970	400		5		10			2	
1971	85		5		29.5			13	
1972	105				8				
1973	985				29.5				
1974	380				23				
1975	374		16.5		13				14
1976	130		70	100	16				17
1977	520		25	400	10		14		10.5
1978									
1979	400								
1980	250								
1984				30					
1985	75		26		5				
1986	265		24		4				
1987	210								
1988	1085				20				
1989	1000		15		10				
1990	270		15		21	6	10		
1991	375		12.5		4		10		
1992	350		20		12				
1993	200				15		10		
1994	150		38.25		22.75		10		
1995	355		52		21.75		10		
1996		32	15		15		10		
1997		46.5	3		3				
1999			5		5				
2000					30				
total	**7967**	**78.5**	**362.25**	**530**	**327.5**	**6**	**74**	**19**	**41.5**

Copper entered the lake from both the application of copper in pounds and from the use of cutrine in gallons. Copper is an element and does not degrade any further. Copper is known to harm native mollusks (clams, mussels, snails) and invertebrates that serve as food for the fish.

Mechanical harvesting of aquatic plants in Lower Camelot Lake started in 1995 and has continued through 2013. The chart below shows the pounds of aquatic plant removed through mechanical harvesting through 2009. Every year, plant samples are taken to estimate how much phosphorus the mechanical harvesting is removing.

Figure 2: Mechanical Harvesting History for Lower Camelot Lake

Year	Pounds Harvested
1995	37,000
1996	98,000
1997	85,000
1998	214,000
1999	221,100
2000	274,000
2001	328,000
2002	54,600
2003	313,000
2004	296,000
2005	911,400
2006	607,000
2007	456,900
2008	669,000
2009	883,300
2010	509,200
2011	581,300
2012	1,276,700
2013	678,100
total	8,493,600

The Tri-Lakes Management District also submits samples of the aquatic plants harvested to a lab for testing of total phosphorus removal. According to the testing done in 2013, mechanical harvesting in Lower Camelot Lake removed 125.5 pounds of phosphorus from the lake.

METHODS

Field Methods

The 2013 aquatic plant survey used the Point Intercept (PI) method, with some added nearshore sites, an aquatic plant survey using the PI method was also done on Lower Camelot Lake in 2009. This method involves calculating the surface area of a lake and dividing it (using a formula developed by the WDNR) into a grid of several points, always placed at the same interval from the next one(s). These points are related to a particular latitude and longitude reading. At each geographic point, the depth is noted and one rake is taken, with a score given between 1 and 3 to each species on the rake.

A rating of 1 = a small amount present on the rake;
A rating of 2 = moderate amount present on the rake;
A rating of 3 = large amount present on the rake.

A visual inspection was done between points to record the presence of any species that didn't occur at the raking sites. Gleason and Cronquist (1991) nomenclature was used in recording plants found.

Data Analysis:

The percent frequency (number of sampling sites at which it occurred/total number of sampling sites) of each species was calculated. "Relative frequency" (number of species occurrences/total of all species occurrences) was also calculated. The "mean density" (sum of species' density rating/number of sampling sites) was calculated for each species. "Relative density" (sum of species' density/total plant density) was also calculated. "Mean density where present "(sum of species' density rating/number of sampling sites at which species occurred) was calculated. Relative frequency and relative density results were summed to obtain a dominance value. Species diversity was measured by Simpson's Diversity Index.

The Average Coefficient of Conservatism and Floristic Quality Index were calculated as outlined by Nichols (1998) to measure plant community disturbance. A coefficient of Conservatism is an assigned value between 0 and 10 that measures the probability that the species will occur in an undisturbed habitat. The Average Coefficient of Conservatism is the mean of the coefficients for the species found in the lake. The coefficient of conservatism is used to calculate the Floristic Quality Index, a measure of a plant community's closeness to an undisturbed condition.

To measure the quality of the aquatic plant community, an Aquatic Macrophyte Community Index (AMCI) was determined using the method developed by Nichols et al (2000). This measurement looks at the following seven parameters and assigns each of them a number on a scale of 1-10: maximum depth of plant growth; percentage of littoral zone vegetated; Simpson's diversity index; relative frequency of submersed species; relative frequency of sensitive species; taxa number; and relative frequency of exotic species. The average total for the North

Central Hardwoods lakes and impoundments is between 48 and 57. The average for all Wisconsin lakes ranges from 45 to 57.

RESULTS

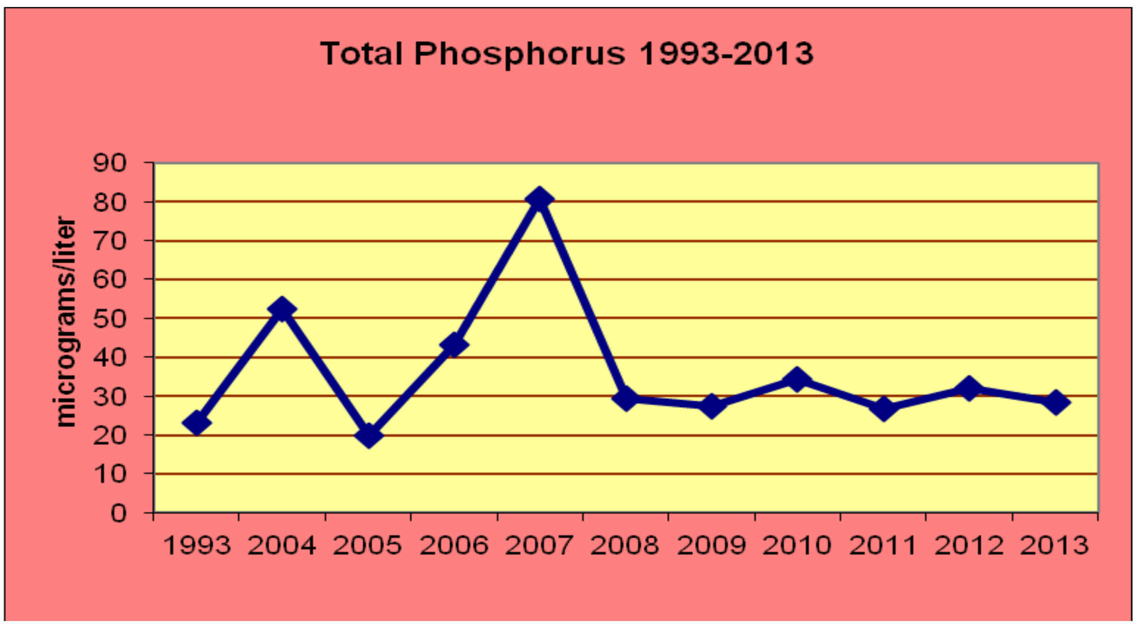
Physical Data

The aquatic plant community can be impacted by several physical parameters. Water quality, including nutrients, algae and clarity, influence the plant community; the plant community in turn can modify these boundaries. Lake morphology, sediment composition and shoreline use also affect the plant community.

The trophic state of a lake is a classification of water quality. Phosphorus concentration, chlorophyll a concentration and water clarity data are collected and combined to determine a trophic state. Eutrophic lakes are very productive, with high nutrient levels and large biomass presence. Oligotrophic lakes are those low in nutrients with limited plant growth and small fisheries. Mesotrophic lakes are those in between, i.e., those which have increased production over oligotrophic lakes, but less than eutrophic lakes; those with more biomass than oligotrophic lakes, but less than eutrophic lakes. These lakes tend to have a good and more varied fishery than either the eutrophic or oligotrophic lakes.

The limiting nutrient for plant growth in most Wisconsin lakes, including Lower Camelot Lake, is phosphorus. Measuring the phosphorus in a lake system thus provides an indication of the nutrient level in a lake. Increased phosphorus in a lake will feed algal blooms and also may cause excess plant growth. Records for total phosphorus readings for Lower Camelot Lake go back to 1993. The summer average phosphorus concentration in Lower Camelot Lake for 1993 to 2013 was 36.1 micrograms/liter. This is low for impoundments (average in Wisconsin for impoundments: 65.0 micrograms/liter), but above the 30 micrograms/liter recommended for impoundments to keep algae blooms unlikely. This concentration suggests that Lower Camelot Lake is likely to have some nuisance algal blooms, but not as frequently as many impoundments. This places Lower Camelot Lake in the "good" water quality section for impoundments, and in the "mesotrophic" level for total phosphorus.

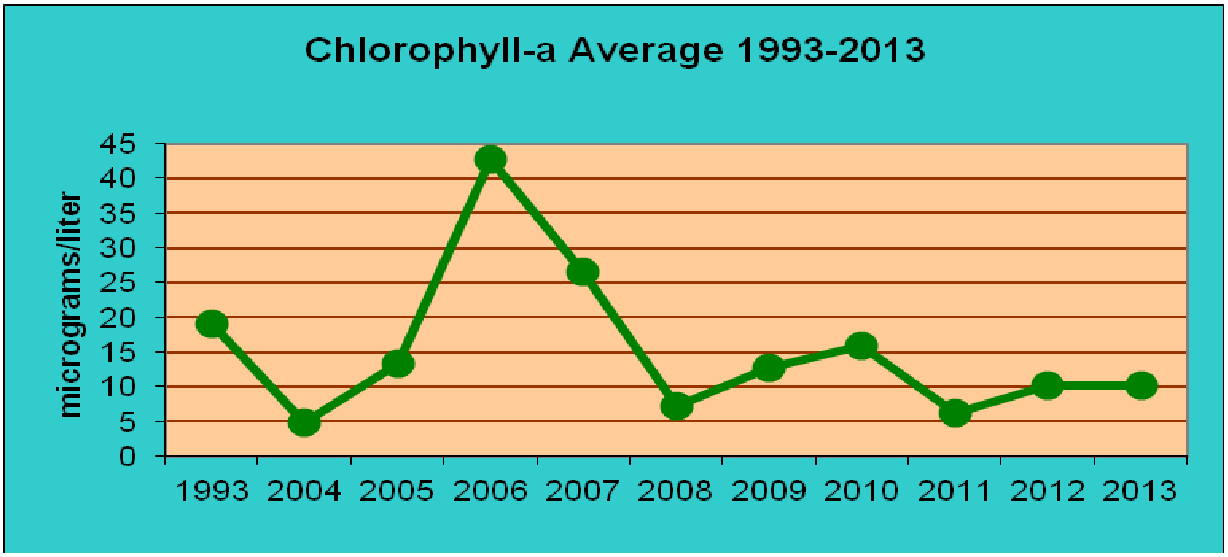
Figure 3: Average Total Phosphorus Readings



Chlorophyll-a concentrations provide a measurement of the amount of algae in a lake's water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth. The 1993-2013 summer average chlorophyll-a concentration in Lower Camelot Lake was

15.4 micrograms/liter. These chlorophyll-a results place Lower Camelot Lake at the "eutrophic" level with "poor" water quality.

Figure 4: Average Chlorophyll-a Levels



Water clarity is a critical factor for plants. If aquatic plants receive less than 2% of the surface illumination, they won't survive. Water clarity can be reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color or cloud the water. Water clarity is measured with a Secchi disk. For Lower Camelot Lake, water clarity records go back to 1986. Average summer Secchi disk clarity in Lower Camelot Lake in 1986-2013 was 5.9 feet. This indicates fair water clarity, putting Lower Camelot Lake into the "mesotrophic" category for water clarity.

It is normal for all of these values to fluctuate during a growing season. They can be affected by human use of the lake, by summer temperature variations, by algae growth & turbidity, and by rain or wind events. Phosphorus tends to rise in early summer, than decline as late summer and fall progress. Chlorophyll a tends to rise in level as the water warms, then decline as autumn cools the water. Water clarity also tends to decrease as summer progresses, probably due to algae growth, then improve as fall approaches.

Figure 5: Average Water Clarity for Lower Camelot Lake

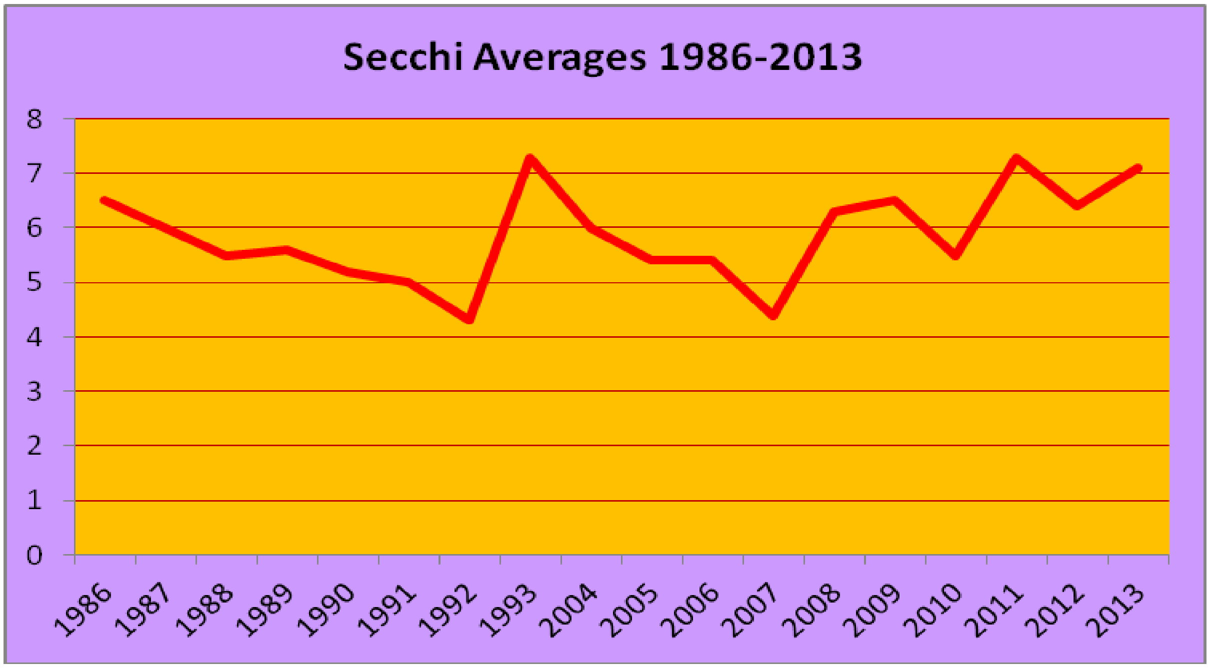


Figure 6: Trophic State

Trophic State	Quality Index	Phosphorus (ugm/l)	Chlorophyll a (ug/l)	Sechhi Disk (ft)
Oligotrophic	Excellent	<1	<1	>19
	Very Good	1 to 10	1 to 5	8 to 19
Mesotrophic	Good	10 to 30	5 to 10	6 to 8
	Fair	**30 to 50**	10 to 15	**5 to 6**
Eutrophic	Poor	50 to 150	**15 to 30**	3 to 4
Lower Camelot Lake		**36.1**	**15.4**	**5.9**

According to these results, Lower Camelot Lake scores as "mesotrophic" in two of the three general parameters often used to gauge lake water health and "eutrophic" in chlorophyll-a readings.

A groundwater study done in 2000 by UW-Stevens Point found that the groundwater coming into Lower Camelot Lake showed elevated chloride & reactive phosphorus levels, along with elevated nitrate or ammonium, suggesting nutrient inputs from septic systems. A limnological investigation performed by the U.S. Army Corps of Engineers in 2000 indicated that Lower Camelot Lake had a significant increase of phosphorus from sediments under anoxic conditions. These studies indicated that internal phosphorus loading is probably occurring in Lower Camelot Lake, which increases the likelihood of aquatic plant growth and algae occurrence.

Lake morphology is an important factor in distribution of lake plants. Duarte & Kalff (1986) determined that the slope of a littoral zone could explain 72% of the observed variability in the growth of submerged plants. Gentle slopes support higher plant growth than steep slopes (Engel 1985).

Lower Camelot Lake is a narrow lake that lies at the beginning of a series of lakes that are originally fed by a very large, multi-county stream system. Much of the lake is shallow, although there are some areas of steeper drop-offs within the lake near the dam. With fair water clarity and shallow depths, plant growth is favored in much of Lower Camelot Lake, since the sun reaches much of the sediment to stimulate plant growth.

Sediment composition can also affect plant growth, especially those that are rooted. The richness or sterility and texture of the sediment will determine the type and abundance of macrophyte species that can survive in a particular location.

Figure 7: Sediment Composition—Lower Camelot Lake

Sediment	Type	Zone 1 (0-1.5)	Zone 2 (1.5-5)	Zone 3 (5-10)	Zone 4 (10-20)	Overall
Hard	Sand	60.00%	75.00%	80.00%	100.00%	78.08%
	Sand/Rock	5.00%				1.37%
	Rock	15.00%				4.11%
Mixed	Sand/Muck	10.00%				2.74%
Soft	Muck	10.00%	15.00%			6.85%
	Peat		10.00%	20.00%		6.85%

Most of the sediment in Lower Camelot Lake is hard, with little natural fertility and low available water holding capacity. Although such sediment may limit growth, most hard sediment sites in Lower Camelot Lake were vegetated. 81% sample sites were vegetated in Lower Camelot Lake in 2013, regardless of sediment type. Most unvegetated sites appeared to have had vegetation cleared by hand harvesting.

Shoreline land use often strongly impacts the aquatic plant community and thus the entire aquatic community. Impacts can be caused by increased erosion and sedimentation and higher run-off of nutrients, fertilizers and toxins applied to the land. Such impacts occur in both rural and residential settings.

Since the PI survey protocol doesn't provide for shoreline evaluations, results from prior years were examined. In 2009, natural vegetation covered only 23.9% of the lake shoreline, a slight increase from the 2006 coverage of 23.0%. Disturbed shorelines—including bare sand, traditional cultivated lawn, hard structure (piers, decks, seawalls, etc.) and rock riprap-- covered 76.1% of the shores of Lower Camelot Lake in 2009. In other words, over ¾ of the shores are impacted by human disturbance.

Figure 8: Shoreland Coverage—Lower Camelot Lake—2000 -2009

Shore Type	2000	2006	2009
Wooded	0.50%	4.00%	12.05%
Herbaceous	11.50%	16.50%	9.15%
Shrub	6.75%	2.50%	2.65%
Rock	0.00%	2.25%	0.25%
Bare sand	25.75%	14.50%	17.90%
Eroded	0.00%	0.00%	0.00%
Landscape rock	0.00%	0.00%	1.95%
Wood chips	0.00%	0.25%	0.50%
Cultivated Lawn	47.75%	35.25%	39.00%
Hard Structure	1.50%	13.50%	9.15%
Pavement	2.25%	0.00%	0.00%
Rip-rap	4.00%	11.25%	7.40%

Adams County revised its Shoreland Zoning Ordinance considerably, including that all waterfront property be in compliance with the state buffer rules unless granted an exception or mitigation by July 1, 2015. There are many properties on Lower Camelot Lake that will need to be addressed to avoid violating the ordinance.

Macrophyte Data

SPECIES PRESENT

62 aquatic species were found during the transect survey in 2009 of Lower Camelot Lake. Of these, 56 were native. Of the native plants category, 34 were

emergent, 3 species were free-floating, 3 were rooted floating-leaf species and 16 were submergent species. Six invasives were found: *Lythrum salicaria* (Purple Loosestrife); *Myriophyllum spicatum* (Eurasian Watermilfoil); *Nasturtium officinale* (Watercress); *Phalaris arundinacea* (Reed Canarygrass); *Potamogeton crispus* (Curly-Leaf Pondweed); and *Rumex crispus* (Curly Dock).

Figure 9: Aquatic Plants Found in Lower Camelot Lake 2013

Scientific Name	Common Name	Type
Alisma trivale	Northern Water Plantain	Emergent
Alnus incana	Tag Alder	Emergent
Asclepias incarnata	Swamp Milkweed	Emergent
Carex bebbii	Bebb's Sedge	Emergent
Carex crawfordii	Crawford's Sedge	Emergent
Carex hystericinia	Porcupine Sedge	Emergent
Carex lacustris	Common Lake Sedge	Emergent
Carex scoparia	Broom Sedge	Emergent
Carex stricta	Common Tussock Sedge	Emergent
Carex vulpinoidea	Fox Sedge	Emergent
Ceratophyllum demersum	Coontail	Submergent
Chara sp	Muskgrass species	Submergent
Cicuta bulbifera	Bulb-Bearing Water Hemlock	Emergent
Cornus spp	Dogwood species	Emergent
Eleocharis palustris	Common Spikerush	Emergent
Elodea canadensis	Common Waterweed	Emergent
Euthamia graminifolia	Grass-Leaved Goldenrod	Emergent
Glyceria striata	Fowl Manna Grass	Emergent
Impatiens capensis	Jewelweed	Emergent
Iris versicolor	Blue-Flat Iris	Emergent
Juncus effusus	Common Rush	Emergent
Leersia oryzoides	Rice Cut Grass	Emergent
Lemna minor	Lesser Duckweed	Free-Floating
Lycopus americanus	American Bugleweed	Emergent
Lycopus uniflorus	Northern Bugleweed	Emergent
Lysimachia terrestris	Swamp Candle	Emergent
*Lythrum salicaria**	Purple Loosestrife	Emergent
Myriophyllum heterophyllum	Various-Leaved Milfoil	Submergent

Myriophyllum sibiricum	Northern Milfoil	Submergent
*Myriophyllum spicatum**	Eurasian Watermilfoil	Submergent
Najas flexlis	Bushy Pondweed	Submergent
*Nasturtium officinale**	Watercress	Floating-Leaf
Onoclea sensibilis	Sensitive Fern	Emergent
*Phalaris arundinacea**	Reed Canarygrass	Submergent
Polygonum amphibium	Water Smartweed	Floating-Leaf
*Potamogeton crispus**	Curly-Leaf Pondweed	Submergent
Potamogeton epihydrus	Ribbon-Leaf Pondweed	Submergent
Potamogeton gramineus	Variable Pondweed	Submergent
Potamogeton illinoensis	Illinois Pondweed	Submergent
Potamogeton natans	Floating-Leaf Pondweed	Floating-Leaf
Potamogeton nodosus	Long-Leaf Pondweed	Floating-Leaf
Potamogeton pusillus	Small Pondweed	Submergent
Potamogeton zosteriformis	Flat-Stemmed Pondweed	Submergent
Ranunculus aquatilis	White Water Crowfoot	Submergent
*Rumex crispus**	Curly Dock	Emergent
Sagittaria latifolia	Common Arrowhead	Emergent
Salix spp	Willow species	Emergent
Schoenoplectus tabernaemontani	Soft-Stemmed Bulrush	Emergent
Scirpus cyperinus	Woolgrass	Emergent
Scuterllaria laterifolia	Mad Dog Skullcap	Emergent
Sparganium americanum	American Bur-Reed	Emergent
Sparganium eurycarpum	Common Bur-Reed	Emergent
Spirodela polyrhiza	Greater Duckweed	Free-Floating
Stuckenia pectinata	Sago Pondweed	Submergent
Triadenum fraseri	Bog St John's Wort	Emergent
Tradescantis ohioensis	Common Spiderwort	Emergent
Typha	Cattail species	Emergent
Vallisnera americana	Water Celery	Submergent
Virburnum spp	Arrowwood species	Emergent
Wolffia columbiana	Common Watermeal	Free-Floating
Zosterella dubia	Water Stargrass	Submergent

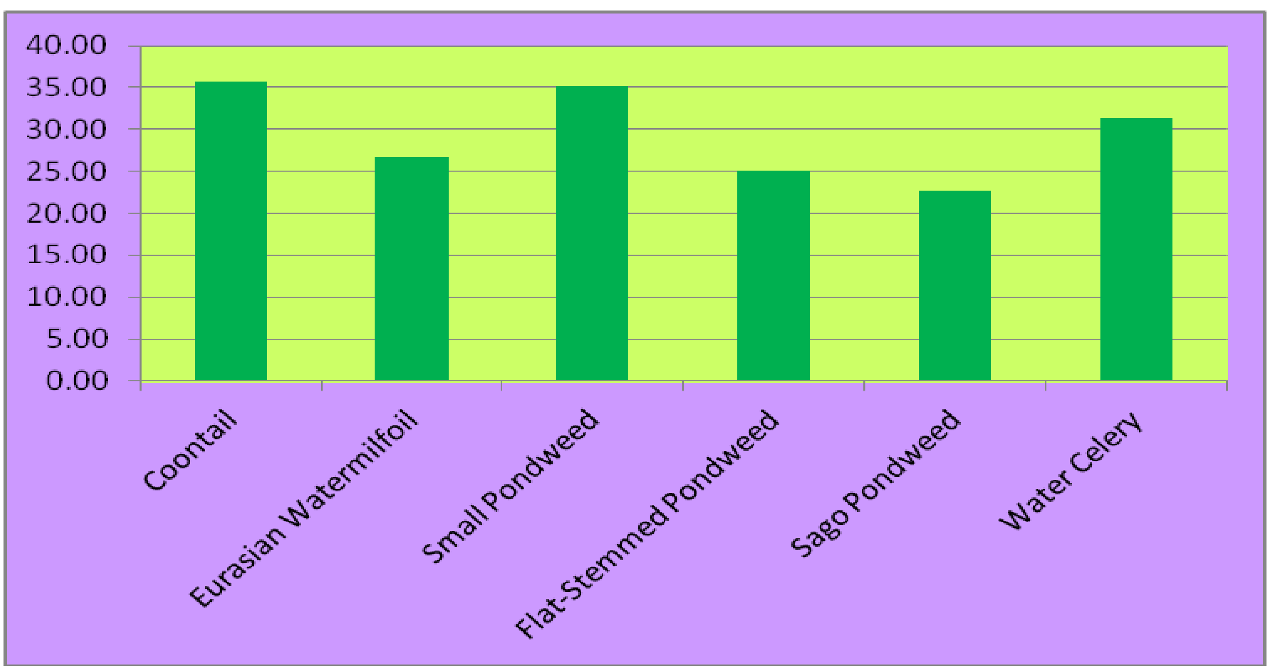
* invasive species

FREQUENCY AND DENSITY OF OCCURRENCE

Coontail and Small Pondweed were nearly tied for the most frequently-occurring aquatic species in the 2013 transect survey. They were followed closely by Water Celery. Other common species included Flat-Stemmed Pondweed, Sago Pondweed, and the invasive Eurasian Watermilfoil.

The high frequency of occurrence for Coontail and Small Pondweed is a change from the prior aquatic plant survey results. In the 2000 survey, the plant-like algae Muskgrass (*Chara spp*) was by far the most frequently-occurring species. It remained frequently-occurring in 2006, although was matched by Bushy Pondweed (*Najas flexilis)* and Water Celery (*Vallisneria americana).* In 2009, when two different aquatic plant surveys were done, Sago Pondweed and Water Celery were the most frequently-occurring species in both surveys.

Figure 10: Graph of Most Frequently-Occurring Species 2013

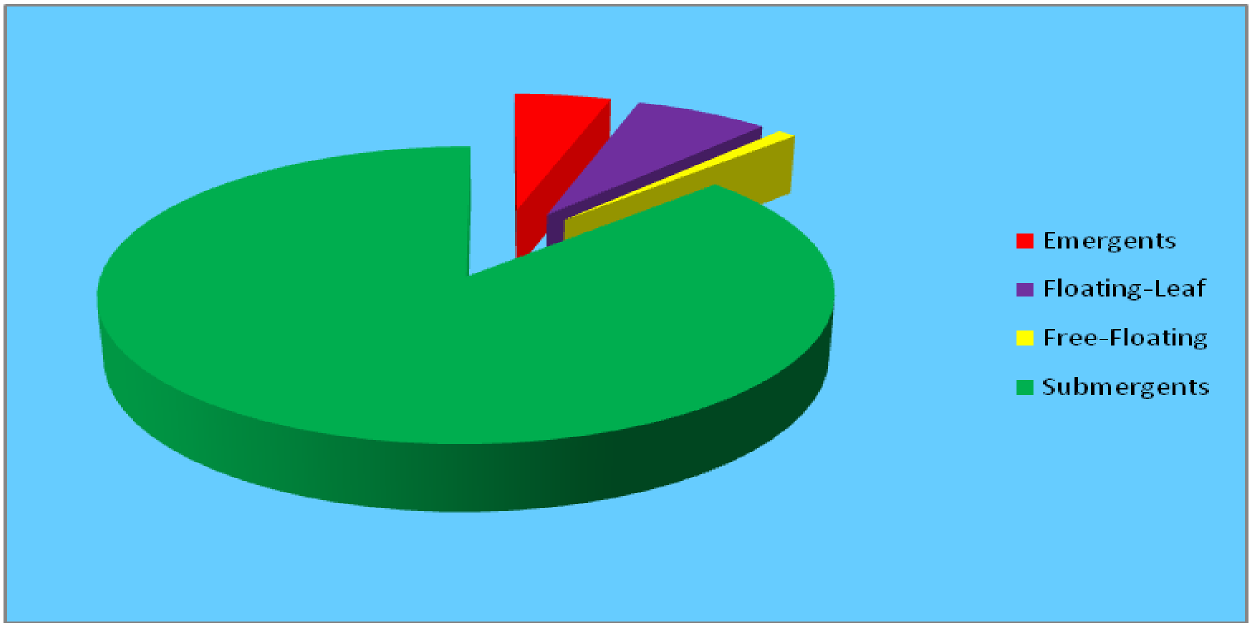


In terms of relative frequency, aquatic invasive plants comprised 16% of the 2013 plant community. This percentage is above the previously-stable invasive part of the community at around 10% (in 2000, 2006 and 2009). Eurasian Watermilfoil has continued to be the most frequently-occurring aquatic invasive, followed by Curly-Leaf Pondweed and Reed Canarygrass. New in 2009 were Purple Loosestrife and Curly Dock. New in 2013 was Watercress.

A long-time problem at Lower Camelot Lake is the low frequency of emergent plants. Emergents provide important fish habitat and spawning areas, as well as food and cover for wildlife. While only 19 species were found in 2000, 11% of that community was emergent plants. By 2006, emergent species were down to 4% of the aquatic plant community. Emergent species have hovered around 13% of the aquatic plant community in 2009 and 2013; most of these, however, were found in the far east end of the lake that is totally undeveloped and little disturbed. On the main body of the lake, emergent plants are extremely scarce.

Although most of Lower Camelot Lake has always had aquatic vegetation over much of its bed, the plants do not generally occur in high density. This has been true in all the aquatic plant surveys done on this lake, even if one examined the figures for density where present.

Figure 11: Occurrence Frequency in 2013 by Plant Type



DENSITY

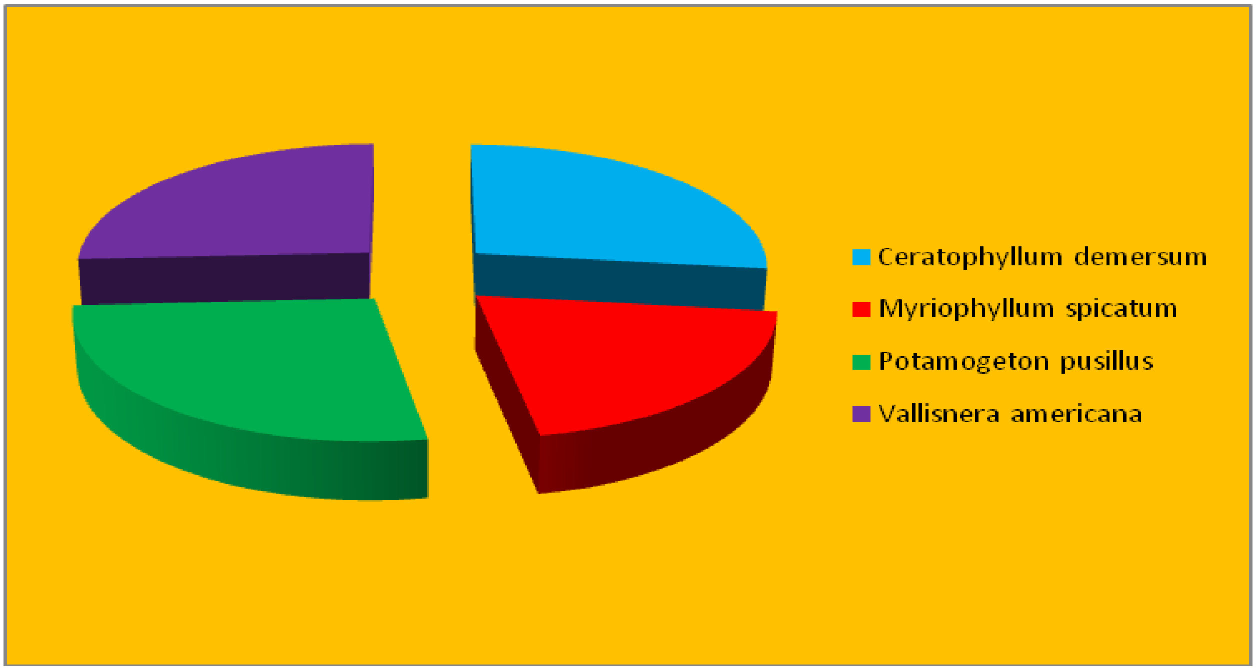
Not only is the frequency of occurrence and relative frequency examined after the field work for an aquatic plant study, the results are also examined in terms of growth density and relative density of growth. In 2013, three species were tied for highest density of growth: Coontail, Small Pondweed and Water Celery. Eurasian Watermilfoil was not far below. However, none of the species in the 2013 survey exhibited more than average growth density.

DOMINANCE

Relative frequency and relative density are combined into a dominance value that demonstrates how dominant a species is within its aquatic plant community. Based on dominance value, four species dominated the lake in 2013, comprising 44.5% of the entire aquatic plant community. Coontail and Small Pondweed tied at 12%

each. Close behind was Water Celery at 11.5% of the community. Eurasian Watermilfoil made up 9% of the community.

Figure 12: Dominance in Lower Camelot Lake in 2013



DISTRIBUTION

Aquatic plants occurred at 81% of the sample sites in Lower Camelot Lake to a maximum rooting depth of 19.5 feet, where both Eurasian Watermilfoil and Small Pondweed were found. Flat-Stemmed Pondweed was found at 18 feet.

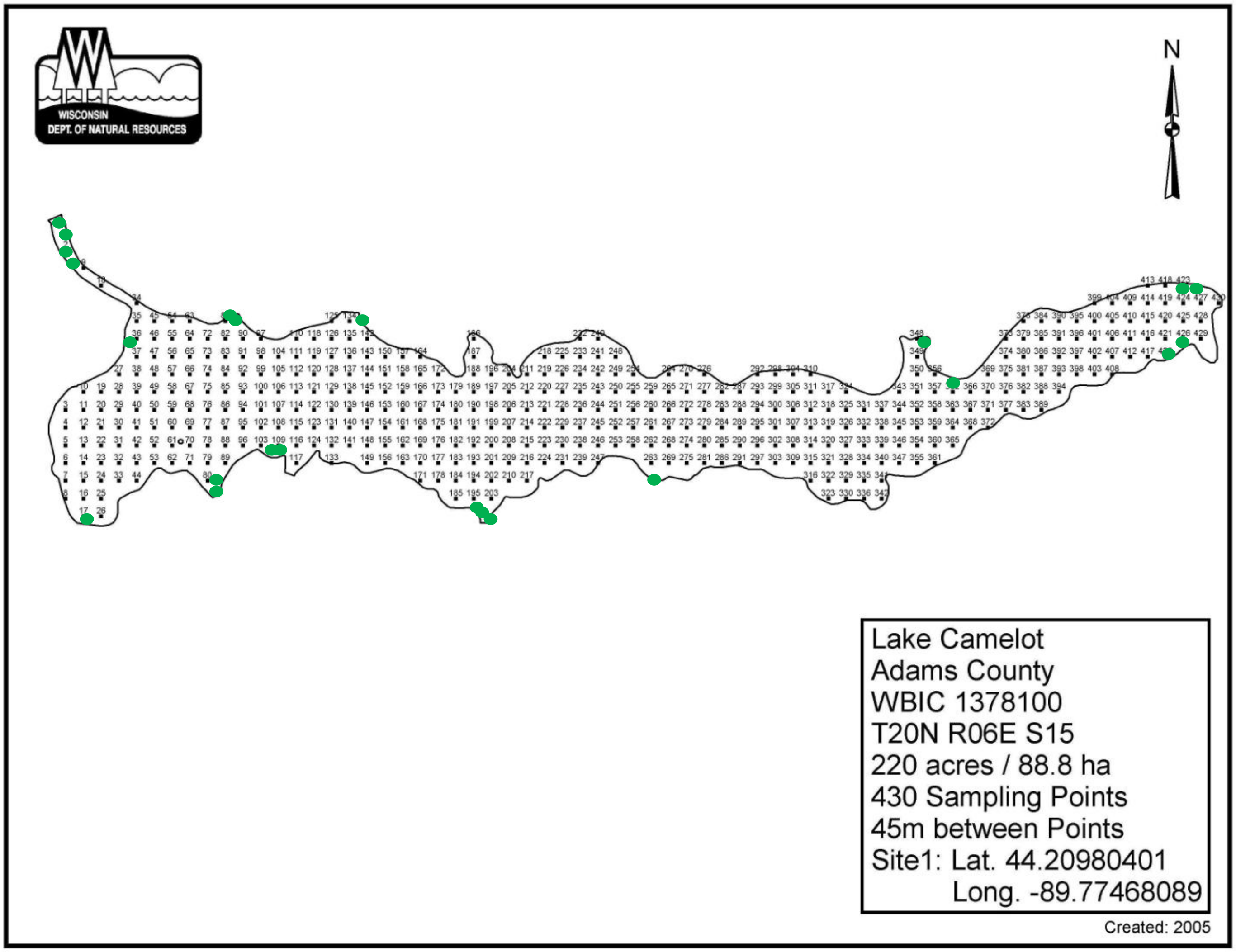


Figure 13a: Distribution of Emergents in Western 2/3 of Lower Camelot Lake

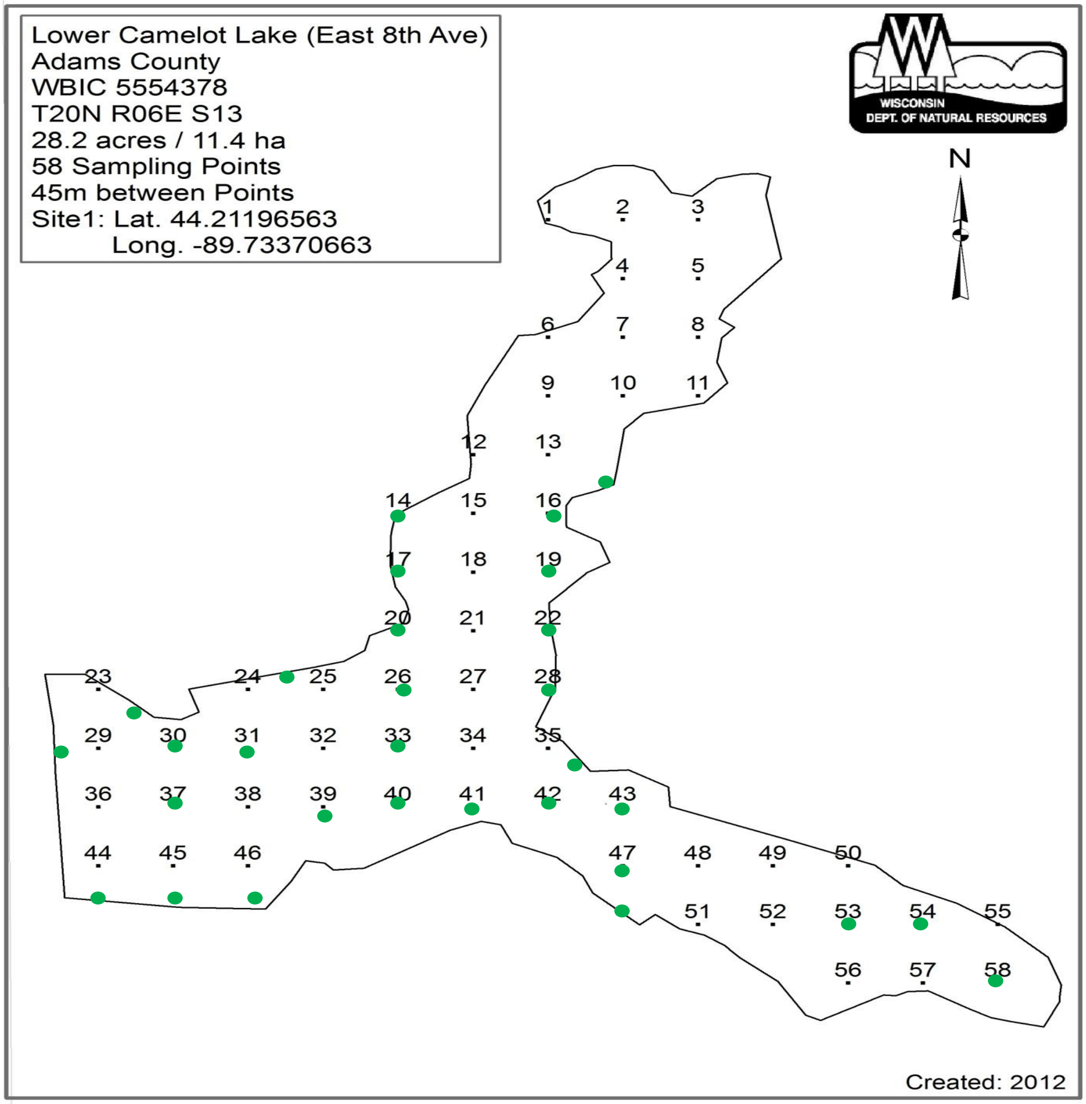


Figure 13b: Emergents in Far East End of Lower Camelot Lake

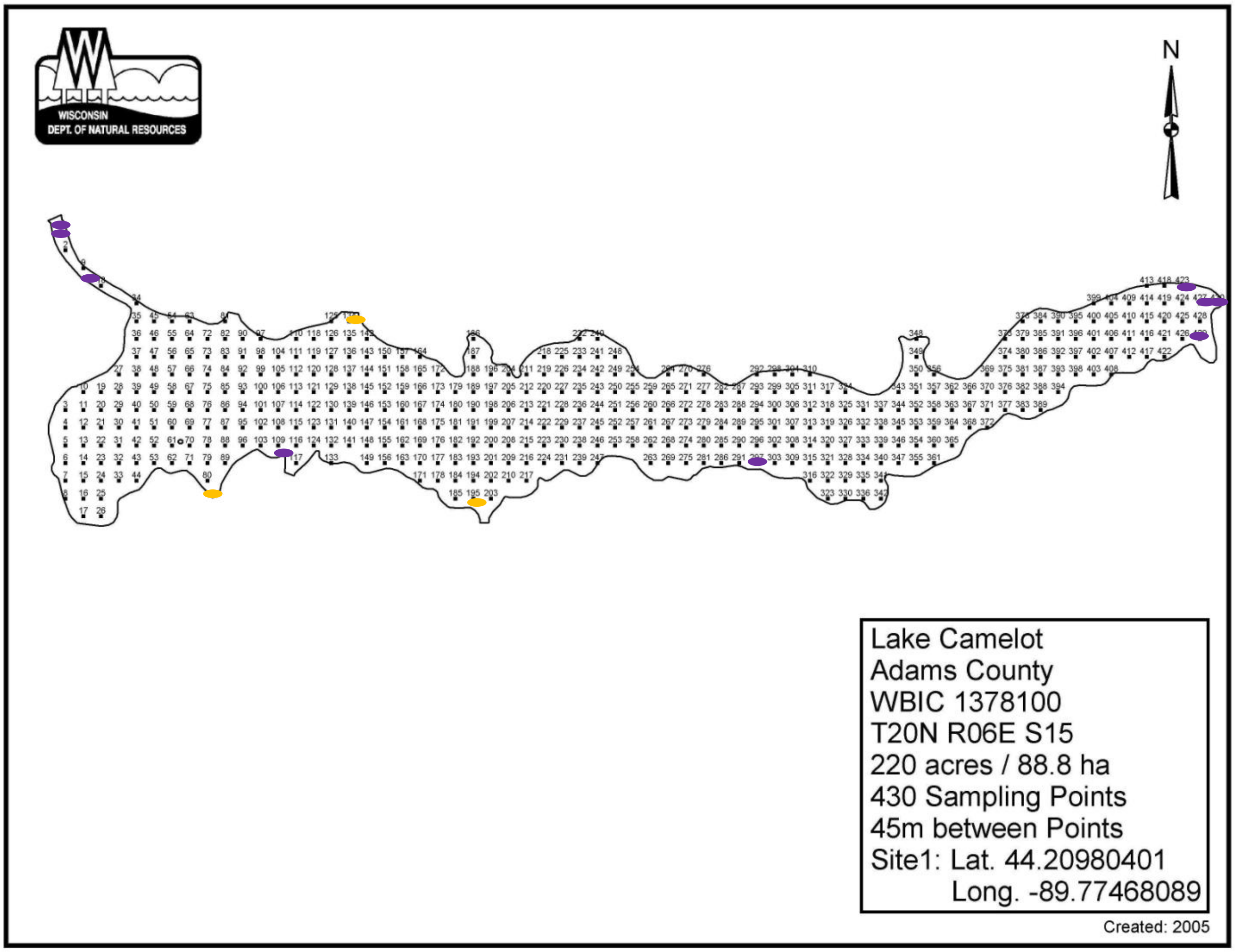


Figure 14a:Distribution of Floating-Leaf and Free-Floating Plants in West 2/3

Free-Floating Plants
Rooted Floating-Leaf Plants

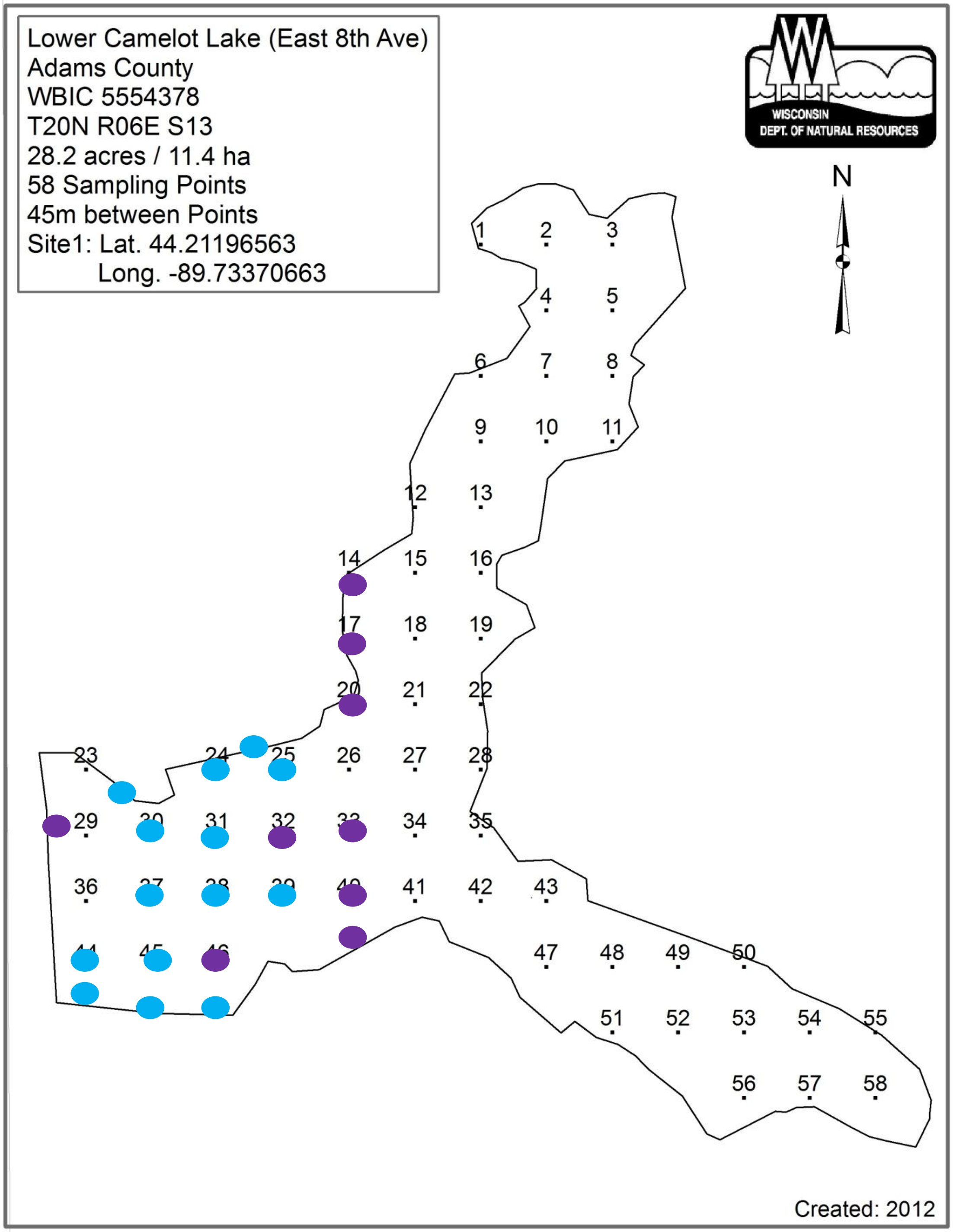


Figure 14b: Free-Floating and Rooted Floating-Leaf Plants in Far East

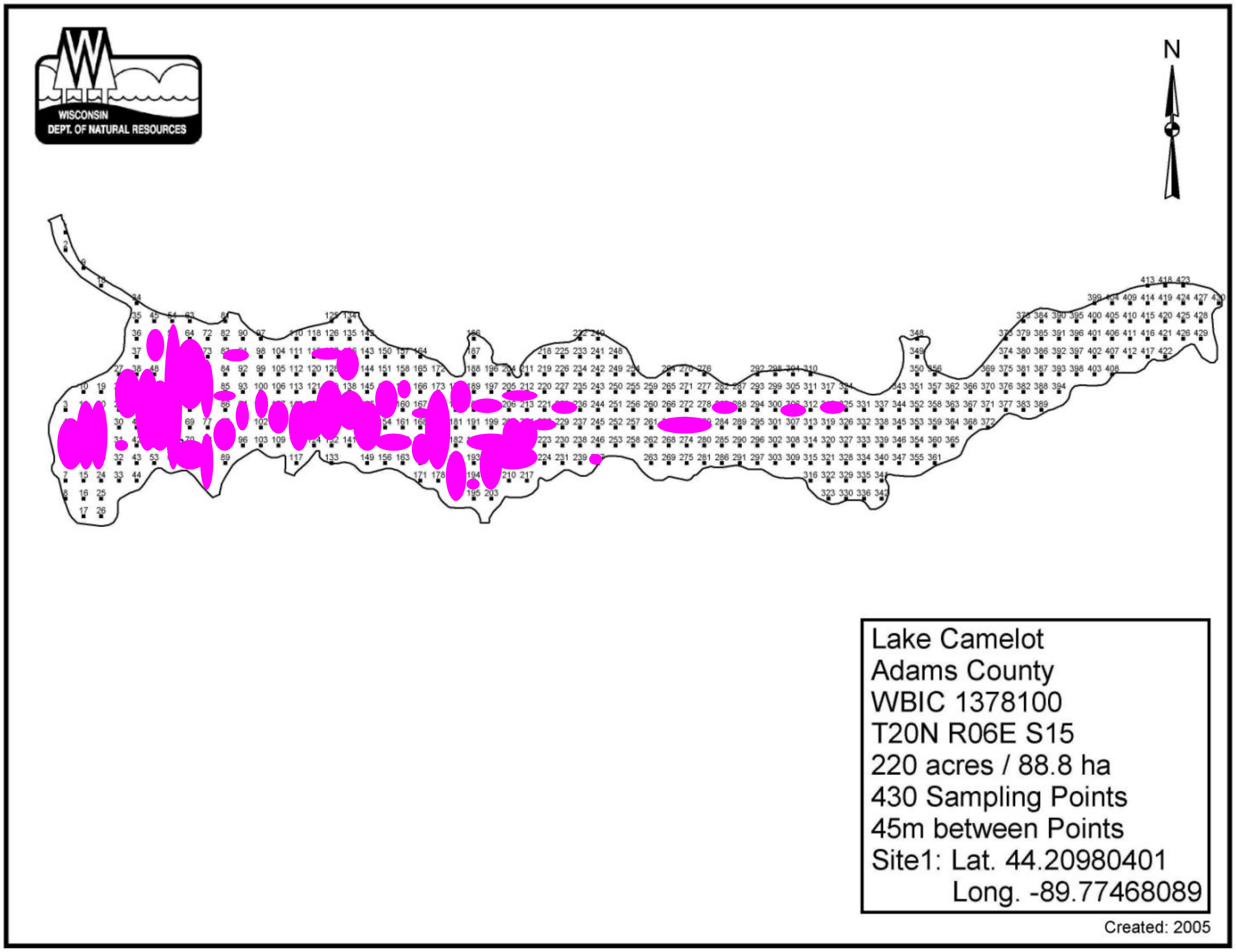
Free-Floating Plants

Rooted Floating-Leaf Plants

Both

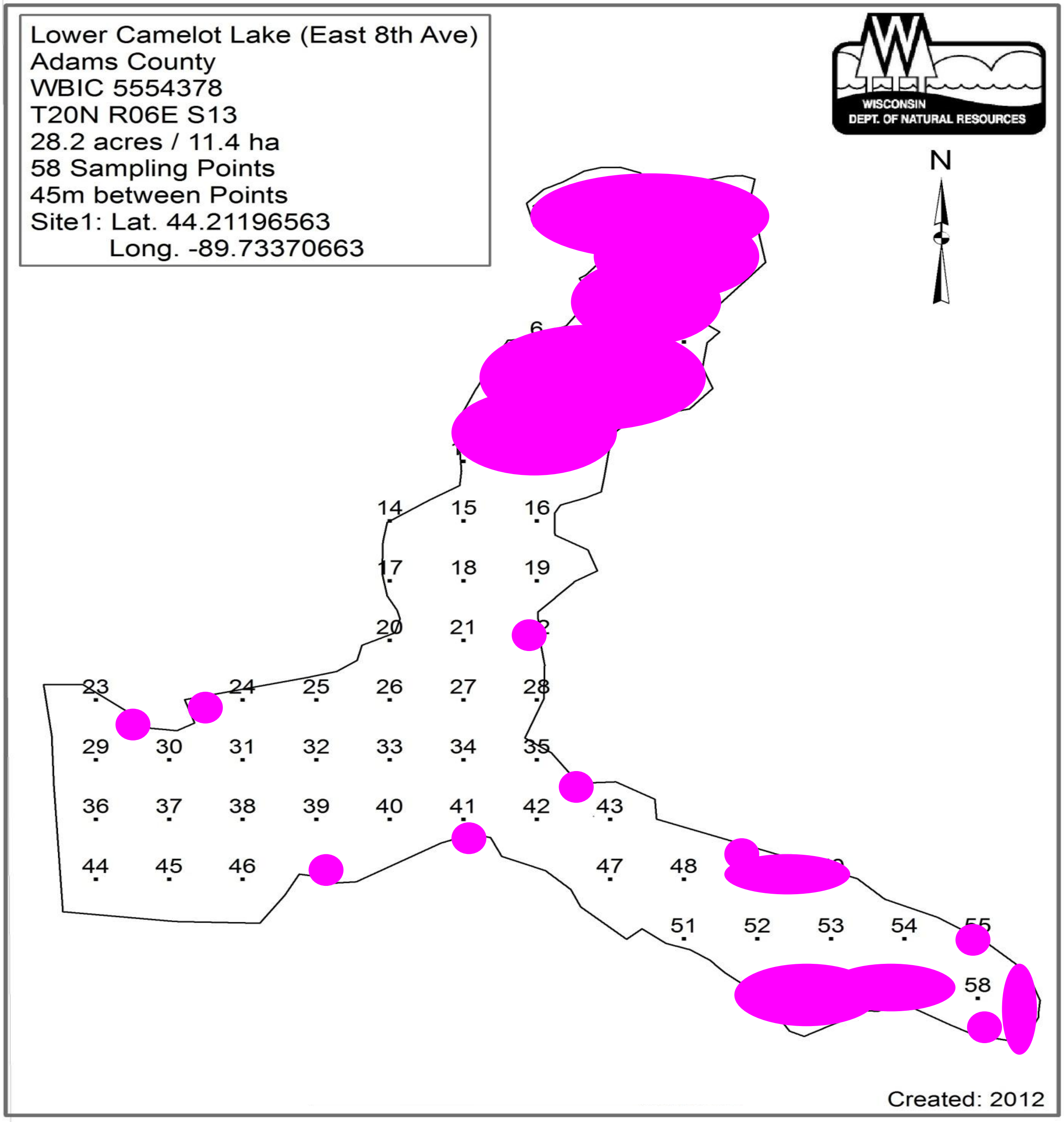
Like many impoundments, Lower Camelot Lake is dominated by submergent plants. When mapping the distribution of submergent plants, it is clearer to map areas where there are no submergent plants than to try to map where they are.

Figure 15a: Distribution of Submergent Plants in Western 2/3 of Lake



Area Where No Submergents Occurred

Figure 15b: Distribution of Submergents in Far East End 2013

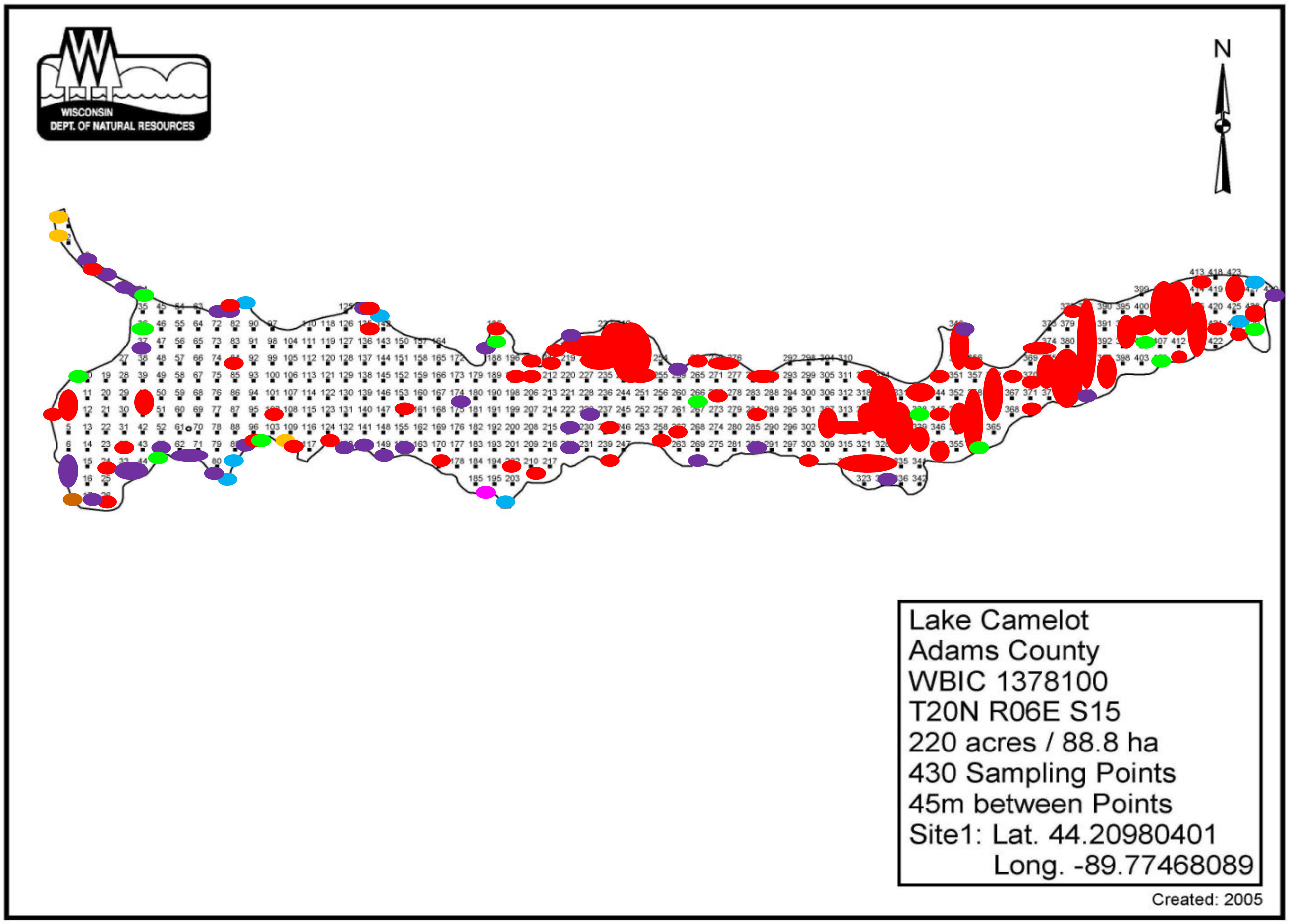


The presence of several invasive species could be a significant factor in the future. This includes both plant and animal invasives. Currently, none of the exotic plant species appear to be taking over the aquatic plant community. Eurasian Watermilfoil comprised 9% of the aquatic plant community in Lower Camelot Lake in 2013. In the 2009 survey, it was 6.5% of the plant community, slighter lower than the 2006 level of 8.5% and the same as the 2000 percentage of 6.5%. Curly-Leaf Pondweed was found in Lower Camelot Lake in the 2000 survey and again in the 2009 and 2013 surveys. In 2013, it comprised 5% of the aquatic plant community. Both these submergent plants must continue to be monitored, since their tenacity and ability to spread to large areas fairly quickly could make them a danger to the diversity of Lower Camelot Lake's current aquatic plant community.

Reed Canarygrass, although it has been found in every survey since 2000, continues to remain a small part of the Lower Camelot aquatic plant community. In 2013, it was at its highest level in the overall plant community, making up only 2.5% of the community (up slightly from the prior years of about 1%). This plant is generally found in Lower Camelot Lake mixed with native emergents; the large monocultred areas often seen with extensive Reed Canarygrass presence are not seen about the lake.

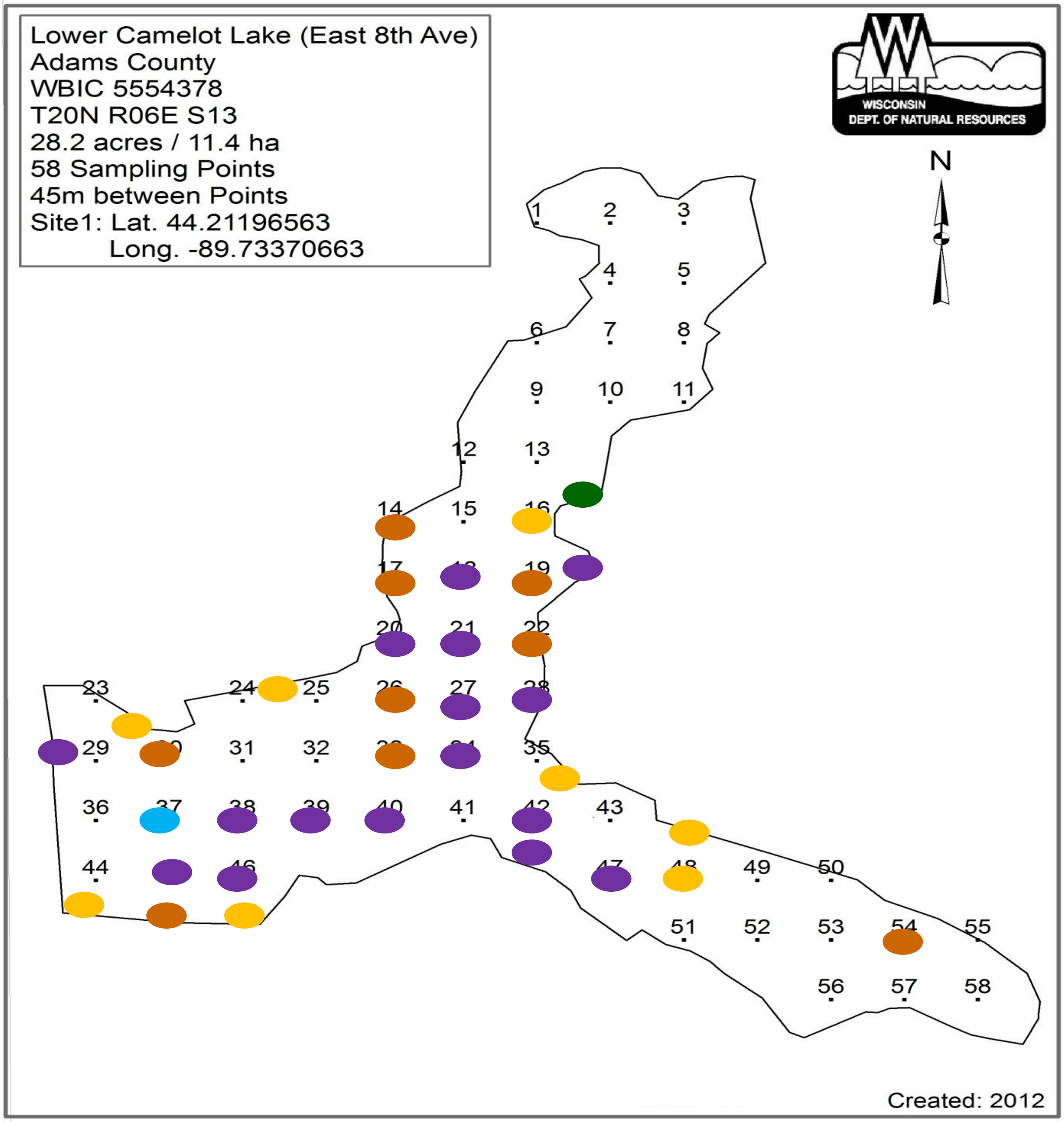
Purple Loosestrife was previously found on the shores of Lower Camelot Lake in the early 2000s. Tri-Lakes volunteers have participated in the WDNR's beetle-rearing program to attack Purple Loosestrife by releasing beetles from the *Galerucella* genus for several years. However, despite these efforts, more Purple Loosestrife was found on Lower Camelot Lake in 2013 than in the prior surveys. Flowering heads were removed and bagged in 2013. The remaining plants were marked with landscape tape for easy discovery. At present, Purple Loosestrife is still confined to smalll patches, but the beetle-rearing program should be increased to account for the new patches.

Figure 16a: Distribution of Invasive Plant Species Western 2/3 of Lake



- Eurasian Watermilfoil
- Curly-Leaf Pondweed
- Reed Canarygrass
- Reed Canarygrass/Curly-Leaf Pondweed
- Reed Canarygrass/Eurasian Watermilfoil
- Eurasian Watermilfoil/Reed Canarygrass, Purple Loosestrife, Watercress

Figure 16b: Invasive Species Distribution in Eastern 1/3 of Lake



Curly-Leaf Pondweed
Reed Canarygrass
Reed Canarygrass/Eurasian Watermilfoil
Reed Canarygrass/Curly-Leaf Pondweed
Curly Dock

Two invasives were only found at one place each in 2013: Watercress and Curly Dock. Although they are currently extremely limited, obviously they will have to be monitored due to their ability to spread quickly. The Curly Dock is at the far east end of the lake where there is little to no boat traffic, so it is unlikely to be spread by humans. The Watercress is in an area of the lake where there is more human use, but it since it prefers cold alkaline waters, often around springs, rather than the warmer water likely to be found through most of Lower Camelot Lake, it may stay in the general area where it is now found (U.S. Forest Service).

In addition to the invasive plants, the invasive zebra mussel was found in Lower Camelot Lake in 2009-2010. Many of the plants raked up during the 2013 survey had a number of zebra mussels attached. As yet, there is no known treatment to reduce or exterminate zebra mussels in a lake without also harming the native snails and mussels. The Tri-Lakes Management District does have an active Clean Boats, Clean Waters program to educate lake users about the invasives in Lower Camelot Lake and inspect boats as they enter and leave the launch area.

Species richness is the number of aquatic plants found per sample site. Species richness has varied slightly, but it remained fairly low.

Figure 17: Average Species Richness 2000 to 2013

2000 (transect)	2.4
2006 (transect)	2.5
2009 (transect)	3.7
2009 (Point Intercept)	2.1
2013 (Point Intercept)	2.9

THE COMMUNITY

The Simpson's Diversity Index for Lower Camelot Lake in 2013 was .93 for the PI survey. This is a very good score for diversity. This is up from the SI in 2006 of .87. A rating of 1.0 would mean that each plant in the lake was a different species (the most diversity achievable). This places it in the upper quartile for SI readings for both North Central Hardwood Forest Region and all Wisconsin lakes.

The Aquatic Macrophyte Community Index (AMCI) was developed to help assess the biological quality of aquatic plant communities in lakes as a way of determining overall lake quality. There are seven components: maximum depth of plant growth; percentage of littoral zone vegetated; Simpson's Diversity Index; relative frequency of submergent plants; relative frequency of invasive plants; relative frequency of sensitive species; and number of species. The average AMCI for all Wisconsin lakes ranges from 45 to 57. The average range for the North Central Hardwood Forest Region (which includes Adams County) is 48 to 57. Most of the scores for Lower Camelot Lake have been in the average range for both the entire state and the region. The scores for the 2009 and 2013 PI surveys are just above average at 59 and 58.

Figure 18: AMCI Scores 2000-2013 for Lower Camelot Lake

	2000(t)	score	2006(t)	score	2009(t)	score	2009 (pi)	score	2013 (pi)	score
rooting depth	15	9	15.5	9	11	6	15	9	19.5	10
% littoral veg.	86.3	10	85.3	10	77.5	10	54.4	10	81	10
% submergents	95	7	96	6	86	9	80	10	87	9
% invasives	7	5	10	5	5	5	13	6	16	4
% sensitives	8	5	9	5	5	6	6	5	9	5
# of species	20	9	24	9	42	10	45	10	62	10
Simpson Index	0.87	7	0.87	7	0.85	6	0.91	9	0.93	10
		52		51		52		59		58

These AMCI values place Lower Camelot Lake in the upper half of AMCI scores for all Wisconsin Lakes and for the North Central Hardwood Region.

An Average Coefficient of Conservatism and a Floristic Quality Index calculation were performed on the field results. Technically, the Average Coefficient of Conservatism measures the community's sensitivity to disturbance, while the Floristic Quality Index measures the community's closeness to an undisturbed condition. Indirectly, they measure past and/or current disturbance to the particular community.

Previously, a value was assigned to all plants known in Wisconsin to categorize their probability of occurring in an undisturbed habitat. This value is called the plant's Coefficient of Conservatism. A score of 0 indicates a native or alien opportunistic or invasive plant. Plants with a value of 1 to 3 are widespread native plants. Values of 4 to 6 describe native plants found most commonly in early successional ecosystem. Plants scoring 6 to 8 are native plants found in stable climax conditions. Finally, plants with a value of 9 or 10 are native plants found in areas of high quality and are often rare, endangered or threatened. In other words, the lower the numerical value a plant has, the more likely it is to be found in disturbed areas.

The Average Coefficient of Conservatism in Lower Camelot Lake in 2013 was 4.4. This score puts this lake in the lowest quartile for Wisconsin Lakes (average 6.0) and for lakes in the North Central Hardwood Region (average 5.6). The aquatic plant community in Lower Camelot Lake is thus in the category of those lakes most tolerant of disturbance, probably due to selection by a series of past and ongoing disturbances.

The Floristic Quality Index is a tool that can be used to identify areas of high conservation value, monitor sites over time, assess the anthropogenic (human-caused) impacts affecting an area and measure the ecological condition of an area (M. Bourdaghs, 2006). The Floristic Quality Index of the aquatic plant community in 2013 was 34.1, up from the 2009 PI figure of 25.3. Where the Coefficient of Conservatism score put Lowers Camelot Lake below average for both all Wisconsin Lakes (average 22.2) and the North Central Hardwood Region (average 20.9), the 2013 FQI figure is above average. However, it is clear from other measures that Lower Camelot Lake has been subject to significant disturbance.

Figure 19: Floristic Quality Index/Average Coefficient of Conservatism

	Average Coefficient of Conservatism †	Floristic Quality ‡
Wisconsin Lakes	5.5, 6.0, 6.9 *	16.9, 22.2, 27.5
NCHR	5.2, 5.6, 5.8 *	17.0, 20.9, 24.4
Lower Camelot Lake	4.4	34.11

* - Values indicate the highest value of the lowest quartile, the mean and the lowest value of the upper quartile.

† - Average Coefficient of Conservatism for all Wisconsin lakes ranged from a low of 2.0 (the most disturbance tolerant) to a high of 9.5 (least disturbance tolerant).

‡ - lowest Floristic Quality was 3.0 (farthest from an undisturbed condition) and the high was 44.6 (closest to an undisturbed condition).

"Disturbance" is a term that covers many disruptions to a natural community. It includes physical disturbances to plant beds such as boat traffic, plant harvesting, chemical treatments, dock and other structure placements, shoreline development and fluctuating water levels. Indirect disturbances like sedimentation, erosion, increased algal growth, and other water quality impacts will also negatively affect an aquatic plant community. Biological disturbances such as the introduction of non-native and/or invasive species (such as the Eurasian Watermilfoil, Reed Canarygrass, Curly-Leaf Pondweed and others found here), destruction of plant beds, or changes in aquatic wildlife can also negatively impact an aquatic plant community. Shore development and sediment deposition can also reduce the quality of the aquatic plant community.

Surveys done in 2000 and 2006 were conducted using the transect method, which is considerably different than the current PI method. To help in the crossover, both types were conducted in 2009. However, because different methods are used, a comparison of the Average Coefficient of Conservatism and the FQI in the different years can't be mechanically performed. But looking at the information can provide some idea of whether the aquatic plant community is stable or not. A review of the numbers show that the type of aquatic plant in the Lower Camelot Lake aquatic plant community (scores around 4, suggesting subject to disturbance) has stayed stable, although the number has changed (resulting in the FQI score).

Figure 20: Average Coefficient of Conservatism & Floristic Quality Index

	2000(t)	2006(t)	2009(t)	2009(pi)	2013(pi)
Average Coefficient of Conservatism	3.9	4.4	4.1	4.7	4.4
Floristic Quality Index	19.6	19.7	25.3	29.7	34.1

DISCUSSION

Based on water clarity, chlorophyll-a and phosphorus data, Lower Camelot Lake is a eutrophic/mesotrophic impoundment with fair water clarity and poor to fair water quality. This trophic state should support substantial plant growth and some algal blooms. Although aquatic plant populations have varied somewhat, the parameters for the trophic state of Lower Camelot Lake have remained substantially the same over the years.

Sufficient nutrients (trophic state), fair water clarity, hard water, shallow lake, and heavy shore development at Lower Camelot Lake favor plant growth. Despite the sometime limiting effect of sand sediments on aquatic plant growth, most of the lake with depths under 20 feet is vegetated, suggesting that even the very sandy sediments in Lower Camelot Lake hold sufficient nutrients to maintain aquatic plant growth.

Historically, many aquatic plant treatments in Lower Camelot Lake were chemical. There has been mechanical harvesting to try to reduce plant growth in the last 15 years or so. A continued regular schedule and pattern of machine harvesting will help in removing vegetation from the lake and may help with nutrient reduction. Hand-harvesting in shallow areas of invasives could help reduce the spread of these plants by reducing the fragmentation produced by boats leaving docks and traveling through invasive patches. It might also help to skim off the filamentous algae.

The lake has some mixture of plant structure that includes emergent, floating-leaf and submerged plants. In 2013, 21 species were found that hadn't been found in the 2009 PI survey. 13 of them are emergent plants. Because of the late thaw in 2013 and later spring rains, Lower Camelot Lake was slightly higher in 2013 than it was in either 2006 or 2009. This may be why so many more emergent plants were found. However, although there were more species found, their occurrence frequency and density remained low, as was that of floating-leaf plants, both of which are important components of habitat. Both types continue to be scarce in this lake and have actually gone down in presence since the 2009 survey. In the 2009 PI survey, rooted floating-leaf plants (such as White Water Lily and Water Smartweed) plus emergent plants made up about 15% of the aquatic plant community, that number dropped to only 5% in 2013.

IV. COMPARISON TO PRIOR YEARS

Because the PI survey uses a different method to gather and evaluate data than the transect method, comparison of the two PI survey results to prior transect results is not appropriate. However, comparisons were made between the results of the 2009 PI survey for Lower Lake Camelot and the one done in 2013.

Figure 21: Changes in the Macrophyte Community 2009-2013

Lower Camelot	2009	2013	Change
Number of Species	44	59	41
Maximum Rooting Depth	15.0	17.0	2.0
% of Littoral Zone Vegetated	54	81	26.6
%/Emergents	13.0	5.0	-8%
%Free-floating	2.0	7.0	5%
%Submergents	83.0	87.0	4%
%Floating-leaf	2.0	1.0	-1%
Simpson's Diversity Index	0.91	0.93	0.02
Species Richness	2.1	1.9	-0.2

The aquatic plant communities of 2009 and 2013 were also compared in regards to the specific plants present, as well as their actual occurrence frequency and relative frequency of occurrence. The coefficient of similarity is an index, first developed by Jaccard in 1901, which compares the similarity and diversity of sample sets. In this instance, the figure considers the frequency of occurrence and relative frequency of all species found, then determines how similar the overall aquatic plant communities are. Similarity percentages of 75% or more are considered statistically similar (Dennison et al, 1993).

When these calculations were done for the 2009 and 2013 PI aquatic plant surveys, the Coefficient of Similarity for actual frequency was 87.1% and for relative frequency, 89.2%. Both of these figures are above the 75% needed to be statistically similar, suggesting that, overall, the aquatic plant communities in 2013 and 2009 in Lower Camelot Lake were substantially the same.

Figure 22: Comparison of Plant Community 2000-2013

		2000(t)	2006(t)	2009(t)	2009(pi)	2013(pi)
Alisma trivale	Northern Water Plantain				x	x
Alnus incana	Tag Alder					x
Amaranthus tuberculata	Rough-Fruited Water Hemp				x	
Asclepias incarnata	Swamp Milkweed			x	x	x
Carex spp	Sedges		x	x	x	
Carex bebbii	Bebb's Sedge			x		x
Carex crawfordii	Crawford's Sedge			x		x
Carex foenea	Bronze-Headed Noble Sedge			x		
Carex gracillima	Graceful Sedge			x		
Carex hystericinia	Porcupine Sedge					x
Carex lacustris	Common Lake Sedge			x		x
Carex scoparia	Broom Sedge					x
Carex stricta	Common Tussock Sedge					x
Carex trichocarpa	Hairy Fruit Lake Sedge			x		
Carex vulpinoidea	Fox Sedge			x		x
Ceratophyllum demersum	Coontail	x	x	x	x	x
Chara contraria	Muskgrass	x	x	x	x	x
Cicuta bulbifera	Bulb-Bearing Water Hemlock				x	x
Cornus spp	Dogwood				x	x

Eleocharis acicularis	Needle Spikerush	x				
Eleocharis palustris	Common Spikerush				x	x
Elodea canadensis	Common Waterweed	x	x	x	x	x
Elymus canadensis	Canade Wild Rye				x	
Equisetum fluviatile	River Horsetail			x		
Euthamia graminifolia	Grass-Leaved Goldenrod					x
Glyceria striata	Fowl Manna Grass					x
Hypericum kalmianum	Kalm's St John's Wort			x		
Impatiens capensis	Jewelweed		x		x	x
Iris versicolor	Blue-Flag Iris					x
Juncus spp	Rush				x	
Juncus effusus	Common Rush			x		x
Leersia oryzoides	Rice-Cut Grass		x	x	x	x
Lemna minor	Lesser Duckweed	x		x	x	x
Lycopus americanus	American Bugleweed			x	x	x
Lycopous uniflorus	Northern Bugleweed					x
Lysimachia terrestris	Swamp Candle					x
Lythrum salicaria	Purple Loosestrife					x
Myriophyllum heterophyllum	Various-Leaved Milfoil			x	x	x
Myriophyllum sibiricum	Northern Milfoil		x	x	x	x
Myriophyllum spicatum	Eurasian Watermilfoil	x	x	x	x	x
Najas flexlis	Bushy Pondweed	x	x	x	x	x
Nasturtium officinale	Watercress					x
Onoclea sensibilis	Sensitive Fern				x	x
Physotegia virginiana	False Dragonhead				x	
Phalaris arundinacea	Reed Canarygrass		x	x	x	x
Polygonum amphibium	Water Smartweed		x			x
Potamogeton crispus	Curly-Leaf Pondweed	x		x	x	x
Potamogeton epihydrus	Ribbon-Leaf Pondweed					x
Potamogeton foliosus	Leafy Pondweed	x	x			
Potamogeton gramineus	Variable-Leaf Pondweed				x	x
Potamogeton illinoensis	Illinois Pondweed		x			x
Potamogeton natans	Floating-Leaf Pondweed					x
Potamogeton nodosus	Long-Leaf Pondweed		x		x	x
Potamogeton pusillus	Small Pondweed	x	x	x	x	x
Potamogeton zosteriformis	Flat-Stemmed Pondweed		x	x	x	x
Prunella vulgaris	Heal-All				x	
Ranunculus spp	Crowfoot				x	
Ranunculus aquatilis	White Water Crowfoot			x		x
Rumex crispus	Curly Dock				x	x
Sagittaria latifolia	Common Arrowhead	x	x		x	x
Salix spp	Willow		x	x	x	x
Schoenoplectus acutus	Hard-Stemmed Bulrush			x		
Schoenoplectus tabernaemontani	Soft-Stemmed Bulrush	x	x	x	x	x
Scirpus cyperinus	Wooldgrass					x
Scutellaria galericulata	Marsh Skullcap			x		

Scuterllaria laterifolia	Mad Dog Skullcap					x
Sparganium americanum	American Bur-Reed					x
Sparganium eurycarpum	Common Bur-Reed					x
Spirodela polyrhiza	Great Duckweed			x	x	x
Stuckenia pectinata	Sago Pondweed			x		x
Tradescantis ohioensis	Common Spiderwort					x
Traidenum fraserii	Bog St John's Wort					x
Typha spp	Cattails	x	x	x	x	x
Vallisnera americana	Water Celery	x	x	x	x	x
Viburnum spp	Arrowwood					x
Wolffia columbiana	Common Watermeal	x		x	x	x
Zizia aurea	Golden Alexander				x	
Zosterella dubia	Water Stargrass	x	x	x	x	x

CONCLUSION

62 aquatic species were found during the transect survey in 2009 of Lower Camelot Lake. Of these, 56 were native. Of the native plants category, 34 were emergent, 3 species were free-floating, 3 were rooted floating-leaf species and 16 were submergent species. Six exotic invasives were found: *Lythrum salicaria* (Purple Loosestrife); *Myriophyllum spicatum* (Eurasian Watermilfoil); *Nasturtium officinale* (Watercress); *Phalaris arundinacea* (Reed Canarygrass); *Potamogeton crispus* (Curly-Leaf Pondweed); and *Rumex crispus* (Curly Dock).

Ceratophyllum demersum (Coontail) and *Potamogeton pusillus* (Small Pondweed) were almost tied for the most frequently-occurring aquatic species in the 2013 survey. Also frequently occurring were *Myriophyllum spicatum* (the invasive Eurasian Watermilfoil), *Vallisneria americana* (Water Celery, *Potamogeton zosteriformis* (Flat-Stemmed Pondweed), and *Stuckenia pectinata* (Sago Pondweed). No aquatic plant in either survey exhibited a more than average density of growth.

Based on dominance value, Coontail and Small Pondweed were the dominant aquatic plant species in the transect survey of Lower Camelot Lake in 2013. Sub-dominant was Water Celery.

The Simpson's Diversity Index for Lower Camelot Lake in 2013 was .93. This suggests very good to excellent scores for diversity. This places this lake in the upper quartile for Simpson's Diversity Index readings for both North Central Hardwood Forest and all Wisconsin lakes.

The very few shoreline areas of native vegetation and wetlands on the lake should be preserved as they are to maintain habitat and to serve as a buffer for that area. Studies have suggested that runoff from natural shores is substantially less than that of developed areas. Shoreline restoration of native vegetation continues to be badly needed on Lower Camelot Lake.

Some type of native vegetated shoreline covered only 24.0% of the lake shoreline. Disturbed shorelines---including bare sand, traditional cultivated lawn, hard structure (piers, decks, seawalls, etc.) and rock riprap---were the most frequently-occurring shore, and covered 76% of Lower Lake Camelot's shores. These conditions offer little protection for water quality and have significant potential to negatively impact Lower Camelot Lake's water by increased runoff (including lawn fertilizers, pet waste, pesticides) and shore erosion.

Lower Camelot Lake is a eutrophic to mesotrophic impoundment with fair to poor water quality and water clarity. The Average Coefficient of Conservatism average of the aquatic plant community in Lower Camelot Lake is below average for Wisconsin lakes and for lakes in the North Central Hardwood region, although the Floristic Quality Index is higher than average. The AMCI is in the average/slightly above average range for both North Central Hardwood Region and all Wisconsin lakes. Filamentous algae are present. Structurally, the aquatic plant community contains very few emergent plants and sparse floating-leaf rooted plants. Submergent plants continue dominate the aquatic plant community in this lake.

A healthy and diverse aquatic plant community plays a vital role within the lake ecosystem. Plants help improve water quality by trapping nutrients, debris and pollutants in the water body; by absorbing and/or breaking down some pollutants; by reducing shore erosion by decreasing wave action and stabilizing shorelines and lake bottoms; and by tying-up nutrients that would otherwise be available for algae blooms. Aquatic plants provide valuable habitat resources for fish and wildlife, often being the base level for the multi-level food chain in the lake ecosystem, and also produce oxygen needed by animals.

Figure 23: Use Table for Some Aquatic Macrophytes

	Fish	Water Fowl	Shore Birds	Muskrat	Beaver	Deer
Ceratophyllum demersum	F,I,C,S	F,I,C		F		
Chara	F,S	F,I,C				
Elodea canadensis	F,I,C	F,I,C		F		
Phalaris arundinacea	C	C				
Potamogeton amplifolius	F,I,C,S	F,I	F	F	F	F
Stucenia pectinata	F,I,C,S	F,I	F	F	F	F
Potamogeton pusillus	F,I,C,S	F,I		F		
Potamogeton zosteriformis	F,I,C,S	F,I	F	F	F	F

F = used as food I = used by invertebrates C = used as cover S = used for spawning

Further, a healthy and diverse aquatic plant community can better resist the invasion of species (native and non-native) that might otherwise "take over" and create a lower quality aquatic plant community. A well-established and diverse plant community of natives can help check the growth of more tolerant (and less desirable) plants that would otherwise crowd out some of the more sensitive species, thus reducing diversity.

Vegetated lake bottoms support larger and more diverse invertebrate populations that in turn support larger and more diverse fish and wildlife populations (Engel, 1985). Also, a mixed stand of aquatic macrophytes (plants) supports 3 to 8 times more invertebrates and fish than do monocultural stands (Engel, 1990). A diverse plant community creates more microhabitats for the preferences of more species.

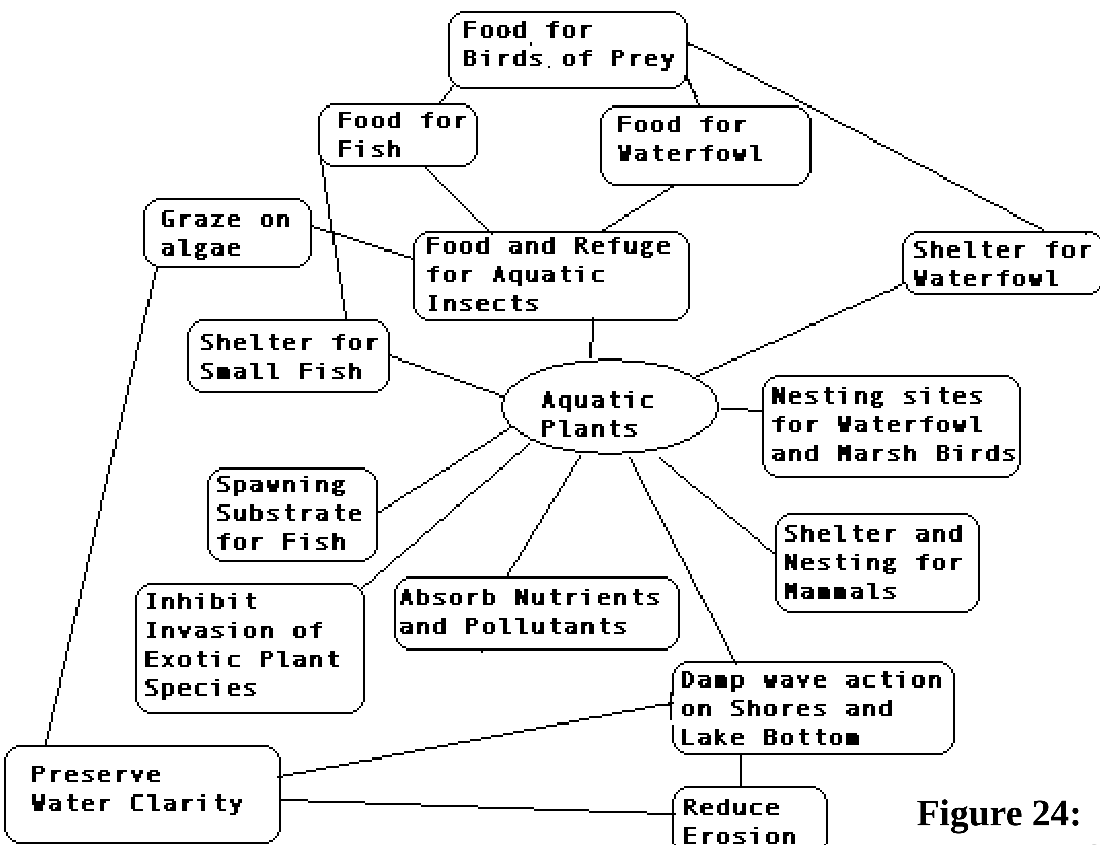


Figure 24: Aquatic Ecosytem Chart

MANAGEMENT RECOMMENDATIONS

1) The few sites where there is undisturbed shore should be maintained and left undisturbed. In other spots, natural shoreline restoration and erosion control in many areas is needed, especially on some bare steep banks. If trees fall at the eroded sites due to continued erosion, large portions of the banks will fall with them. The large amount of disturbed shores currently covering the area around Lower Camelot Lake will not help improve water health.

2) To protect banks and water quality and to comply with the Adams County Shoreland Zoning Ordinance, a buffer area of native plants needs to be restored on those many sites that now have seawalls or have traditional lawns mowed to the water's edge. Large areas of the lake shoreline are unnatural and prone to erosion & runoff of nutrients & toxics. Unmowed native vegetation reduces runoff into the lake and filters runoff that enters the lake.

3) Machine harvesting can continue for aquatic plant management, but should concentrate on providing edge for fish habitat and navigational lanes.

4) Invasives in areas shallower than 5 feet in depth can be hand-pulled, making sure that entire plants are removed, and minimizing the amount of disturbance to the sediment.

5) Impervious surface around the lake should be identified and mapped. Mitigation plans for runoff control should then be developed to deal with the large amounts of impervious surfaces around the lake. Not only is this good management, it will help maintain water quality

6) Stormwater management of the many impervious surfaces around the lake is essential to maintain the current quality of the lake water and prevent further degradation. This is especially important since studies show that nutrients in the Tri-Lakes system are coming from the shores within the lakes.

7) No chemicals should be used on properties around the lake. If they must be used, they should be used no closer than 50 feet to the shore.

8) The aquatic plant management plan should continue be reviewed annually. Mechanical harvesting plans should not continue target harvesting for Eurasian Watermilfoil (EWM), since it doesn't appear to be succeeding. Alternate methods of reducing EWM presence need to be explored and implemented.

9) The management plan needs to be revised to add management of Curly-Leaf Pondweed to prevent further spread of this invasive and to provide for monitoring for the other invasive plants.

10) Stepped up beetle-rearing to attack the more numerous Purple Loosestrife plants needs to be implemented.

11) Now that zebra mussels have been confirmed in the Camelot Lakes, the management plan needs to be revised to include increased monitoring and management of this new invasive.

12) The Tri-Lakes Management District may want to continue to apply for grants from the Wisconsin Department of Natural Resources to help defray the cost of aquatic plant management.

13) No broad-scale chemical treatments of aquatic plant growth are recommended due to the undesirable side-effects of such treatments, including increased nutrients from decaying plant material and decreased dissolved oxygen and opening up more areas to the invasion of EWM.

14) Continued involvement in the Citizen Lake Monitoring Program should continue on the lake. This will include regular water quality sampling during the growing season, regular visual inspections of the lake for aquatic invasives, and continued involvement in the Clean Boats, Clean Waters Program.

15) Lower Camelot Lake residents should identify, cooperate with and participate in watershed programs that will reduce nutrient and sediment inputs.

16) Inventory of the streams in the 14-Mile Creek Watershed should be completed and actions taken to address any problems. This inventory should look at eroding banks, gully erosion, invasives, and stormwater runoff, among other things.

17) No drawdowns of water level except for DNR-approved purposes should occur. Several of the plants found in Lower Camelot Lake in the past surveys are those encouraged by drawdowns.

18) The Tri-Lakes Management District should make sure that its lake management plan takes into account all inputs from the surface and ground watersheds for Lower Camelot Lake.

19) Cooperating with the Adams County Parks Department in keeping the boat ramp and swimming beach area in safe condition should help reduce any negative impacts caused by the heavy use of this public area.

20) Installation of a portable boat washing station at the public landing should be considered. Allowing people to wash off their boats should assist in reducing both input and output of invasive aquatic species.

21) Although there is currently a sanitary district, consideration of the installation of a sewage system around the Tri-Lakes Management District area should be explored. Many Tri-Lakes District residents blame the up stream agricultural producers for the nutrient in put of the lake, but fail to take responsibility for reducing their own inputs into the lake. Reducing nutrient inputs by lake area residents needs to occur before asking watershed residents to reduce theirs.

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