8.9 LAUREL LAKE

8.9.1 An Introduction to Laurel Lake

Laurel Lake, Oneida County, is a drainage lake with a maximum depth of 27 feet and a surface area of 232 acres. This eutrophic lake has a relatively large watershed when compared to the size of the lake. Laurel Lake contains 33 native plant species, of which wild celery was the most common. Purple loosestrife, an exotic emergent wetland plant, was found along Laurel Lake.

Field Survey Notes

Many emergent and floating-leaf plants as well as islands located in north-eastern section of lake – very diverse habitat, great for wildlife!

Photo 8.9.1-1 Laurel Lake, Oneida County

Lake at a Glance – Laurel Lake

Morphology	
Acreage	232
Maximum Depth (ft)	27
Mean Depth (ft)	*Not available*
Volume (acre-feet)	*Not available*
Shoreline Complexity	7.4
Vegetation	
Curly-leaf Survey Date	June 22, 2011
Comprehensive Survey Date	August 10, 2011
Number of Native Species	33
Threatened/Special Concern Species	-
Exotic Plant Species	Purple loosestrife
Simpson's Diversity	0.77
Average Conservatism	6.9
Water Quality	
Wisconsin Lake Classification	Deep, Lowland Drainage Lake
Trophic State	Eutrophic
Limiting Nutrient	Phosphorus
Watershed to Lake Area Ratio	242:1

8.9.2 Laurel Lake Watershed Assessment

Laurel Lake's watershed is 56,382 acres in size. Compared to Laurel Lake's size of 232 acres, this makes for an incredibly large watershed to lake area ratio of 242:1.

Exact land cover calculation and modeling of nutrient input to Laurel Lake will be completed towards the end of this project (in 2015-2016). By this time, the latest satellite imagery (and thus the most accurate land cover delineation) will be available. Additionally, when water quality sampling of the upper reaches of the chain is completed, these results will be input to predictive models and thus make the modeling of nutrient input to the entire chain more accurate.

As mentioned previously in the Chain-wide Watershed Section, one of the most sensitive areas of the watershed is the immediate shoreland area. This area of land is the last source of protection for a lake against surface water runoff, and is also a critical area for wildlife habitat. In late summer of 2011, Laurel Lake's immediate shoreline was assessed in terms of its development. Laurel Lake has stretches of shoreland that fit all of the five shoreland assessment categories. In all, 3.2 miles of natural/undeveloped and developed-natural shoreline (55% of the entire shoreline) were observed during the survey (Figure 8.9.2-1). These shoreland types provide the most benefit to the lake and should be left in their natural state if at all possible. During the survey, 1.0 mile of urbanized and developed–unnatural shoreline (16% of the total shoreline) was observed. If restoration of the Laurel Lake shoreline is to occur, primary focus should be placed on these shoreland areas as they currently provide little benefit to, and actually may harm, the lake ecosystem. The Laurel Lake Map 1 displays the location of these shoreline lengths around the entire lake.

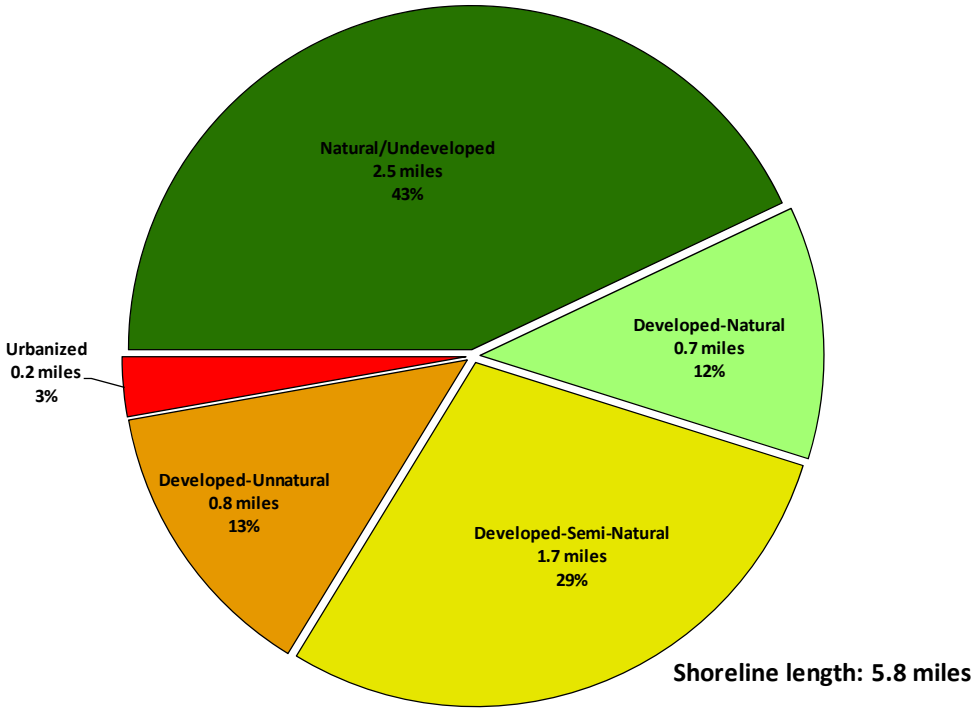


Figure 8.9.2-2. Laurel Lake shoreland categories and total lengths. Based upon a late summer 2011 survey. Locations of these categorized shorelands can be found on the Laurel Lake Map 1.

8.9.3 Laurel Lake Water Quality

During 2011/2012, water quality data was collected from Laurel Lake on six occasions. Onterra staff sampled the lake for a variety of water quality parameters including total phosphorus, chlorophyll-*a*, Secchi disk clarity, temperature, and dissolved oxygen.

Citizens Lake Monitoring Network (CLMN) volunteers have monitored water clarity since 2006. These efforts provide a database of historical clarity data which may be compared against recent data in an effort to detect any trends that may be occurring in the water quality of the lake. These efforts should be continued in order to understand trends in the water quality of Laurel Lake. Unfortunately, only Secchi disk clarity has been monitored in the past, as monitoring for total phosphorus and chlorophyll-*a* requires additional sampling and funding.

In 2011, summer total phosphorus concentrations averaged 29.3 µg/L, which is slightly higher than the median value for other deep, lowland drainage lakes in the state of Wisconsin (23.0 µg/L). As with the total phosphorus values, 2011 average summer chlorophyll-*a* concentrations are also somewhat higher than the average for other deep, lowland drainage lakes statewide (median = 7.0 µg/L). Both the total phosphorus and chlorophyll-*a* values rank as *Good* in the Trophic State Index.

Measurements of Secchi disk clarity span a longer timeframe than the other two primary water quality parameters (Figure 8.9.3-1). All summer averages range between categories of *Fair* and *Good*; but a weighted average across all years is less than the median for other deep, lowland drainage lakes statewide. Secchi disk clarity is often tied to algal abundance – the more algae in the water column, the less clear the water will be. However Secchi disk clarity is influenced by many other factors which themselves vary due to several environmental conditions such as precipitation, sunlight, and nutrient availability. In Laurel Lake and the rest of the Three Lakes Chain of lakes, a natural staining of the water plays a role in light penetration, and thus water clarity, as well. The darker waters of Laurel Lake contain many organic acids that are washed into the lake from nearby wetlands. The acids are not harmful to humans or aquatic species; they are by-products of decomposing wetland plant species. This natural staining reduces light penetration into the water column, which reduces visibility but also reduces the growing depth of aquatic vegetation within the lake.

Laurel Lake Trophic State

The TSI values calculated with Secchi disk, chlorophyll-*a*, and total phosphorus values range in values spanning from lower mesotrophic to eutrophic (Figure 8.9.3-4). In general, the best values to use in judging a lake's trophic state are the biological parameters; therefore, relying primarily on total phosphorus and chlorophyll-*a* TSI values, it can be concluded that Laurel Lake is in a eutrophic state.

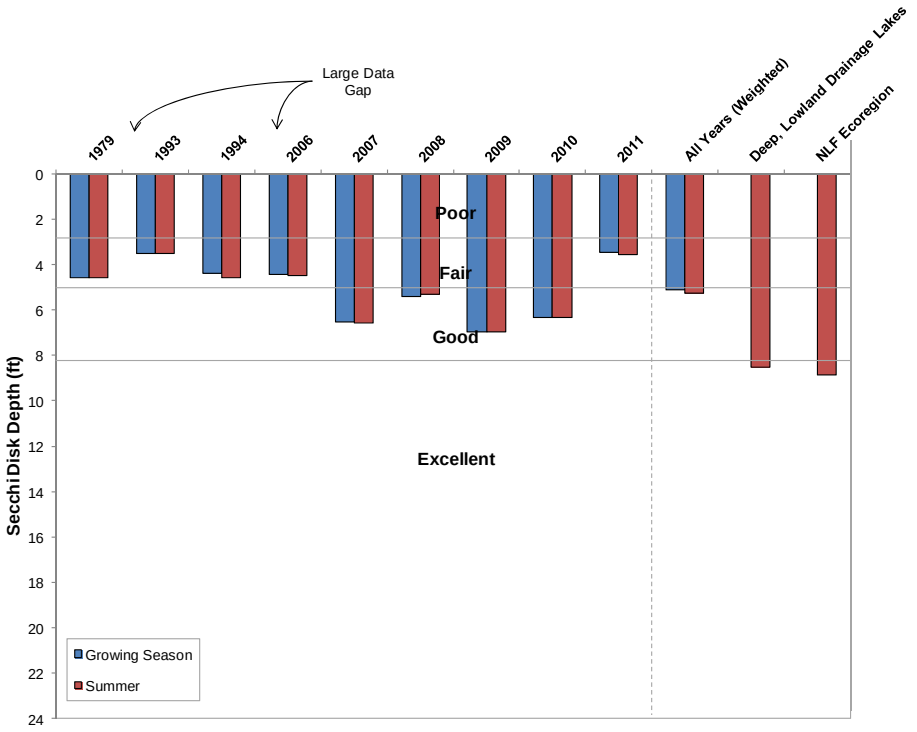


Figure 8.9.3-1. Laurel Lake, state-wide deep, lowland drainage lakes, and regional Secchi disk clarity values. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

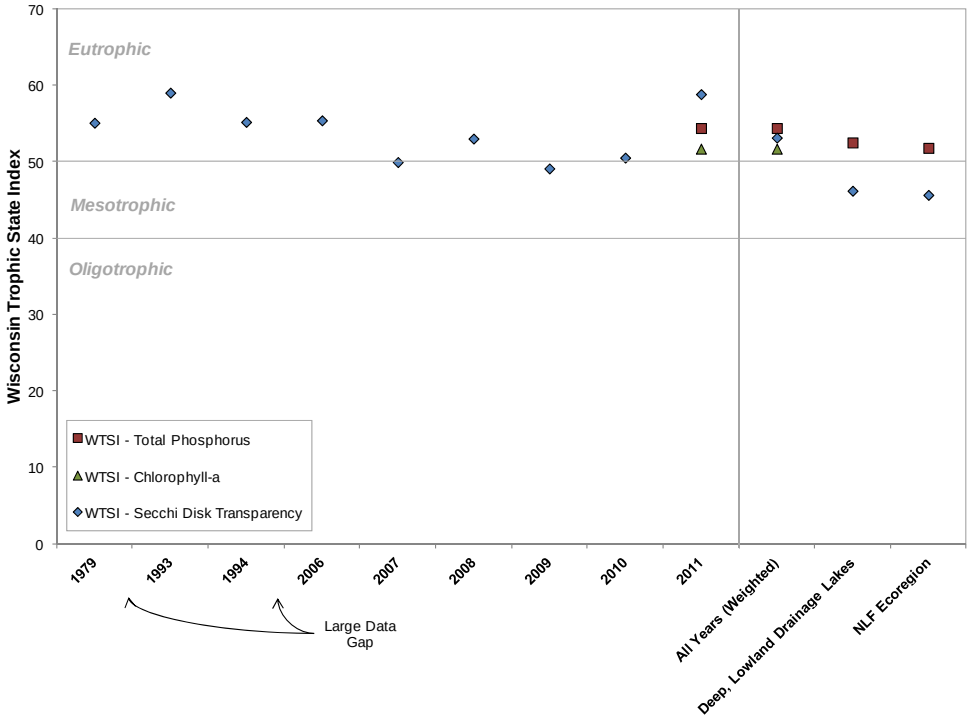


Figure 8.9.3-2. Laurel Lake, state-wide deep, lowland drainage lakes, and regional Wisconsin Trophic State Index values. Values calculated with summer month surface sample data using WDNR PUB-WT-193.

Dissolved Oxygen and Temperature in Laurel Lake

Dissolved oxygen and temperature profiles were created during each water quality sampling trip made to Laurel Lake by Onterra staff. Graphs of those data are displayed in Figure 8.9.3-5 for all sampling events.

Laurel Lake mixed thoroughly during the spring (May) and fall (October) of 2011. This is the case in many Wisconsin lakes, as high winds and changing air temperatures during this time mix the water column up and distribute temperatures and oxygen throughout the lake. In the early summer months, the lake begins to stratify as temperatures increase in the top of the water column and remain constant towards the bottom. Dissolved oxygen is used by bacteria near the bottom of the lake to breakdown organic matter. As the decomposition occurs, oxygen is depleted and not replenished from the overlying water, which has been fully stratified by August. Once the October winds begin, the lake mixes completely and oxygen is restored to the bottom of Laurel Lake.

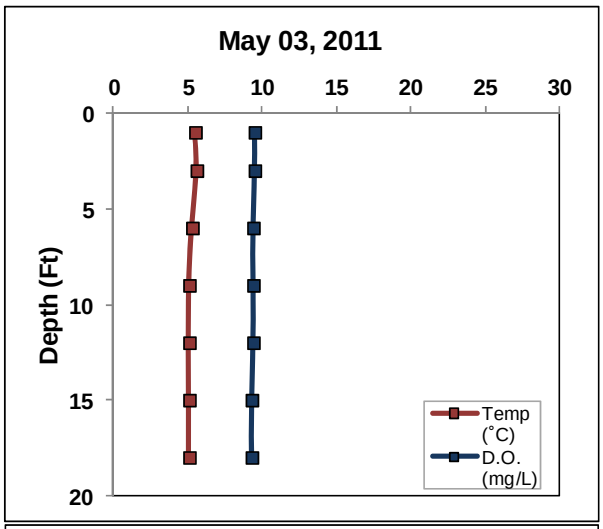
Additional Water Quality Data Collected at Laurel Lake

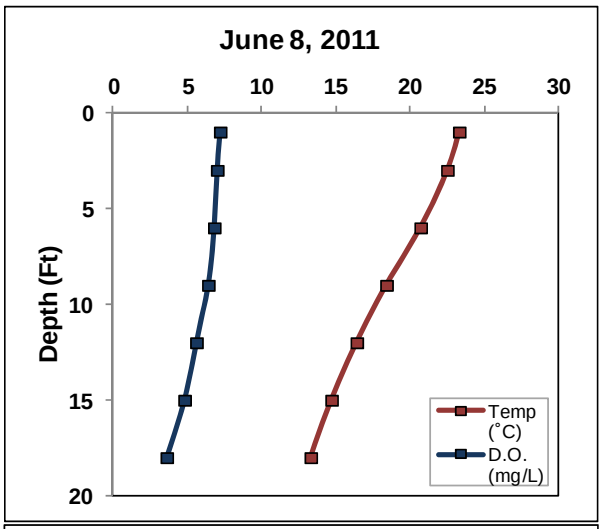
The water quality section is centered on lake eutrophication. However, parameters other than water clarity, nutrients, and chlorophyll-*a* were collected as part of the project. These other parameters were collected to increase the understanding of Laurel Lake's water quality and are recommended as a part of the WDNR long-term lake trends monitoring protocol. These parameters include; pH, alkalinity, and calcium.

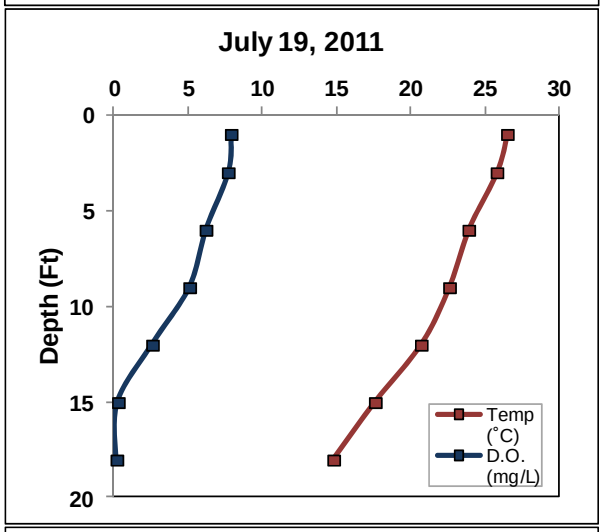
As the Chainwide Water Quality Section explains, the pH scale ranges from 0 to 14 and indicates the concentration of hydrogen ions (H^+) within the lake's water and is thus an index of the lake's acidity. Laurel Lake's pH was measured at about 7.3 during summer 2011 surveys. This value is near neutral and falls within the normal range for Wisconsin lakes.

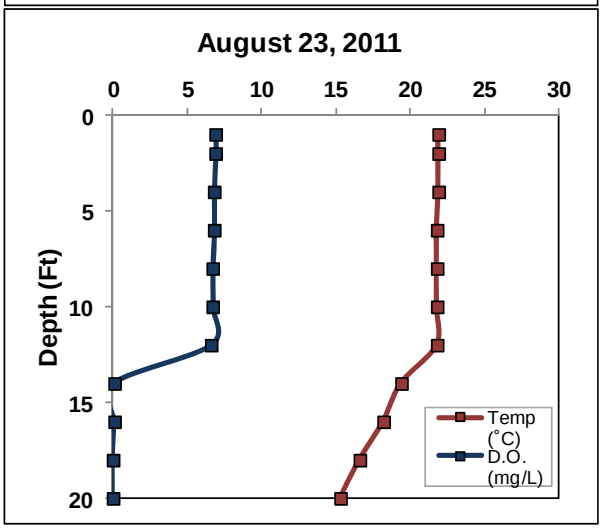
A lake's pH is primarily determined by the amount of alkalinity that is held within the water. Alkalinity is a lake's capacity to resist fluctuations in pH by neutralizing or buffering against inputs such as acid rain. Lakes with low alkalinity have higher amounts of the bicarbonate compound (HCO_3^-) while lakes with a higher alkalinity have more of the carbonate compound of alkalinity ($CO_3^=$). The bicarbonate form is better at buffering acidity, so lakes with higher alkalinity are less resistant to acid rain than those with lower alkalinity. The alkalinity in Laurel Lake was measured at 22.1 (mg/L as $CaCO_3$), indicating that the lake has a substantial capacity to resist fluctuations in pH and has a low sensitivity to acid rain.

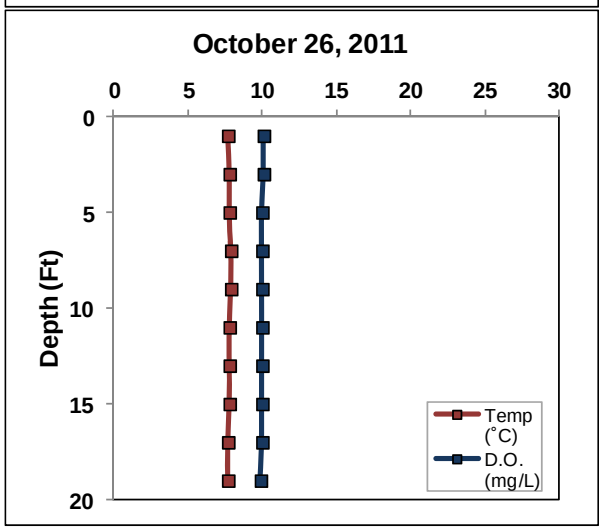
Samples of calcium were also collected from Laurel Lake during the summer of 2011. Calcium is commonly examined because invasive and native mussels use the element to build shells and in reproduction. Invasive mussels typically require higher calcium concentrations than native mussels. The commonly accepted pH range for zebra mussels is 7.0 to 9.0, so Laurel Lake's pH of 7.3 falls within this range. Lakes with calcium concentrations of less than 12 mg/L are considered to have very low susceptibility to zebra mussel establishment. The calcium concentration of Laurel Lake was found to be 7.5 mg/L, falling below the optimal range for zebra mussels. Plankton tows were completed by Onterra staff during the summer of 2011 and these samples were processed by the WDNR for larval zebra mussels. No veligers (larval zebra mussels) were found within these samples.











No profile was taken during the winter WQ sampling due to equipment failure.

Figure 8.9.3-3. Laurel Lake dissolved oxygen and temperature profiles.

8.9.4 Laurel Lake Aquatic Vegetation

The curly-leaf pondweed survey was conducted on Laurel Lake on June 22, 2011. This meander-based survey did not locate any occurrences of this exotic plant, and it is believed that this species either does not currently exist in Laurel Lake or is present at an undetectable level.

The aquatic plant point-intercept survey was conducted on Laurel Lake on August 10, 2011 by Onterra. The floating-leaf and emergent plant community mapping survey was completed on August 10 & 11 to create the aquatic plant community map (Laurel Lake Map 2). During all surveys, 33 species of native aquatic plants were located in Laurel Lake (Table 8.9.4-1). 24 of these species were sampled directly during the point-intercept survey and are used in the analysis that follows. An additional exotic plant, purple loosestrife, was found along the shoreline of Laurel Lake. Submergent aquatic plants were found growing to a depth of eight feet, which is comparable to the maximum depth of plants in the other lakes within the Three Lakes Chain of lakes. As discussed later on within this section, many of the plants found in this survey indicate that the overall community is healthy and fairly diverse.

Of the 158 point-intercept locations sampled within the littoral zone, approximately 71% contained aquatic vegetation. Approximately 36% of the point-intercept sampling locations where sediment data was collected at were sand, 63% consisted of a fine, organic substrate (muck) and 1% were determined to be rocky (Chain-wide Fisheries Section, Figure 3.4-5).

Table 8.9.4-1. Aquatic plant species located in the Laurel Lake during the 2011 aquatic plant surveys.

Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)	2011 (Onterra)
Emergent	Dulichium arundinaceum	Three-way sedge	9	I
	Decodon verticillatus	Water-willow	7	I
	Eleocharis palustris	Creeping spikerush	6	I
	Iris versicolor	Northern blue flag	5	I
	Lythrum salicaria	Purple loosestrife	Exotic	I
	Pontederia cordata	Pickerelweed	9	X
	Sagittaria latifolia	Common arrowhead	3	I
	Scirpus cyperinus	Wool grass	4	I
	Typha spp.	Cattail spp.	1	I
	Zizania palustris	Northern wild rice	8	I
FL	Brasenia schreberi	Watershield	7	X
	Nuphar variegata	Spatterdock	6	X
	Nymphaea odorata	White water lily	6	X
FL/E	Sparganium eurycarpum	Common bur-reed	5	I
	Sparganium fluctuans	Floating-leaf bur-reed	10	X
Submergent	Chara spp.	Muskgrasses	7	X
	Ceratophyllum demersum	Coontail	3	X
	Elodea nuttallii	Slender waterweed	7	X
	Isoetes sp.	Quillwort species	N/A	X
	Megalodonta beckii	Water marigold	8	X
	Myriophyllum sibiricum	Northern water milfoil	7	X
	Najas flexilis	Slender naiad	6	X
	Potamogeton epihydrus	Ribbon-leaf pondweed	8	X
	Potamogeton zosteriformis	Flat-stem pondweed	6	X
	Potamogeton spirillus	Spiral-fruited pondweed	8	X
	Potamogeton vaseyi	Vasey's pondweed	10	X
	Potamogeton pusillus	Small pondweed	7	X
	Potamogeton robbinsii	Fern pondweed	8	X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	X
	Potamogeton gramineus	Variable pondweed	7	X
	Utricularia vulgaris	Common bladderwort	7	X
	Vallisneria americana	Wild celery	6	X
SE	Eleocharis acicularis	Needle spikerush	5	X
FF	Spirodela polyrhiza	Greater duckweed	5	X

FL = Floating Leaf; FL/E = Floating Leaf and Emergent; S/E = Submergent and Emergent; FF = Free Floating
X = Located on rake during point-intercept survey; I = Incidental Species

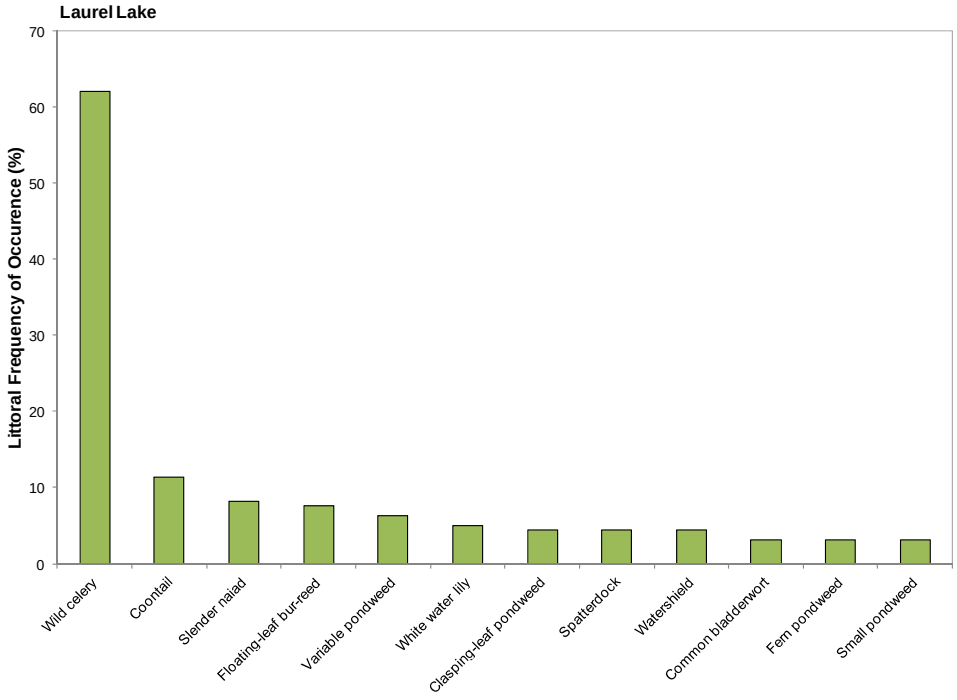


Figure 8.9.4-1 Laurel Lake aquatic plant littoral frequency of occurrence analysis.
Chart includes species with a frequency occurrence greater than 2.0% only. Created using data from a 2011 point-intercept survey.

Figure 8.9.4-1 (above) shows that wild celery, coontail and slender naiad were the most frequently encountered plants within Laurel Lake. Wild celery is a long, limp, ribbon-leaved turbidity-tolerant species that is a premiere food source for ducks, marsh birds, shore birds and muskrats. Animals may eat the entire plant, including the tubers that reside within the sediment. Able to obtain the majority of its essential nutrients directly from the water, coontail does not produce extensive root systems, making the plant susceptible to uprooting by water-action and water movement. When this occurs, uprooted plants float and aggregate on the water's surface where they can continue to grow and form dense mats. Further, coontail is able to tolerate low-light conditions; this in addition to its ability to obtain nutrients directly from the water allow this species to thrive in productive systems. Slender naiad, as its name implies, is a slender, low-growing species with narrow, short pale green leaves. This submerged plant provides habitat for small aquatic organisms and is a food source of waterfowl.

Of the seven milfoil species (genus *Myriophyllum*) found in Wisconsin, only northern water milfoil was located within Laurel Lake. Northern water milfoil, arguably the most common milfoil species in Wisconsin lakes, is frequently found growing in soft sediments and higher water clarity. Northern water milfoil is often falsely identified as Eurasian water milfoil, especially since it is known to take on the reddish appearance of Eurasian water milfoil as the plant reacts to sun exposure as the growing season progresses. The feathery foliage of northern water milfoil traps filamentous algae and detritus, providing valuable invertebrate habitat. Because northern water milfoil prefers high water clarity, its populations are declining state-wide as lakes are becoming more eutrophic.

33 species of aquatic plants (including incidentals) were found in Laurel Lake and because of this, one may assume that the system would also have a high diversity. As discussed earlier, how evenly the species are distributed throughout the system also influence the diversity. The diversity index for Laurel Lake's plant community (0.77) lies below the Northern Lakes and Forests Lakes ecoregion value (0.86), indicating the lake only moderate diversity.

As explained earlier in the Primer on Data Analysis and Data Interpretation Section, the littoral frequency of occurrence analysis allows for an understanding of how often each of the plants is located during the point-intercept survey. Because each sampling location may contain numerous plant species, relative frequency of occurrence is one tool to evaluate how often each plant species is found in relation to all other species found (composition of population). For instance, while wild celery was found at 62% of the sampling locations, its relative frequency of occurrence is 46%. Explained another way, if 100 plants were randomly sampled from Laurel Lake, 46 of them would be wild celery. This distribution can be observed in Figure 8.9.4-2, where together 12 species account for 90% of the population of plants within Laurel Lake, while the other 12 species account for the remaining 20%. However, wild celery clearly dominates the plan community. Nine additional species were located from the lake but not from of the point-intercept survey, and are indicated in Table 8.9.4-1 as incidentals.

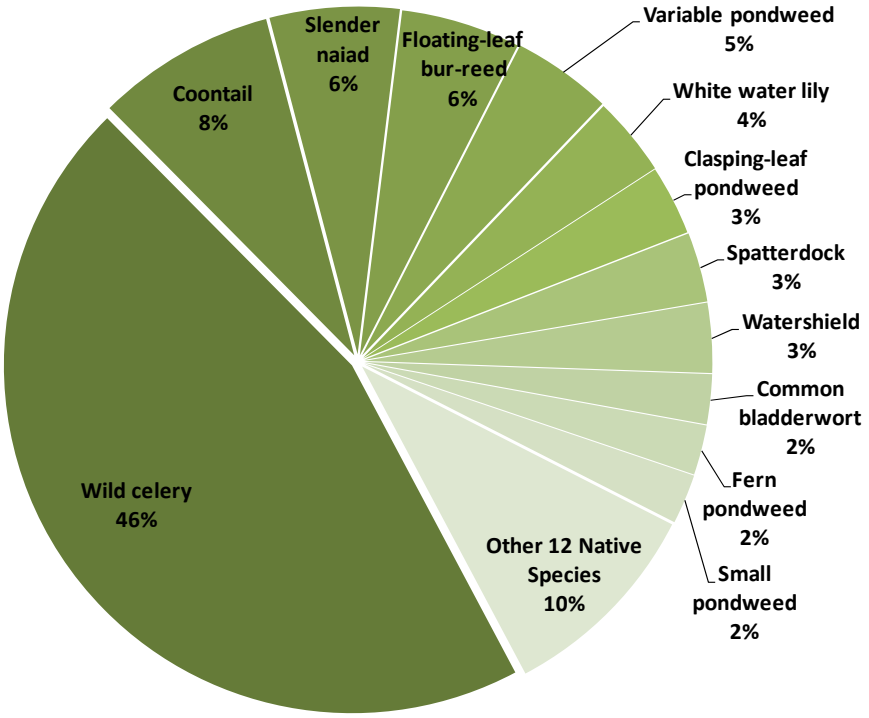


Figure 8.9.4-2 Laurel Lake aquatic plant relative frequency of occurrence analysis.
Created using data from 2011 point-intercept survey.

Laurel Lake's average conservatism value (6.9) is higher than both the state and ecoregion median. This indicates that the plant community of Laurel Lake is indicative of a moderately undisturbed system. This is not surprising considering Laurel Lake's plant community has great diversity and high species richness. Combining Laurel Lake's species richness and average

conservatism values to produce its Floristic Quality Index (FQI) results in a value of 33.7 which is above the median values of the ecoregion and state.

The quality of Laurel Lake is also indicated by the high incidence of emergent and floating-leaf plant communities that occur in many areas. The 2011 community map indicates that approximately 79.1 acres of the lake contains these types of plant communities (Laurel Lake Map 2, Table 8.9.4-2). Fourteen floating-leaf and emergent species were located on Laurel Lake (Table 8.2.4-1), all of which provide valuable wildlife habitat.

Table 8.9.4-2. Laurel Lake acres of emergent and floating-leaf plant communities from the 2011 community mapping survey.

Plant Community	Acres
Emergent	17.1
Floating-leaf	31.7
Mixed Floating-leaf and Emergent	30.3
Total	79.1

The community map represents a 'snapshot' of the emergent and floating-leaf plant communities, replications of this survey through time will provide a valuable understanding of the dynamics of these communities within Laurel Lake. This is important, because these communities are often negatively affected by recreational use and shoreland development. Radomski and Goeman (2001) found a 66% reduction in vegetation coverage on developed shorelines when compared to undeveloped shorelines in Minnesota Lakes. Furthermore, they also lost a significant reduction in abundance and size of northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*) associated with these developed shorelines.

Aquatic Invasive Species in Laurel Lake

During the 2011 community mapping survey, a single occurrence of purple loosestrife was located along the shorelines of Laurel Lake (Laurel Lake Map 2, Table 8.X.4-2). Purple loosestrife (*Lythrum salicaria*) is a perennial herbaceous plant native to Europe and was likely brought over to North America as a garden ornamental. This plant escaped from its garden landscape into wetland environments where it is able to out-compete our native plants for space and resources. First detected in Wisconsin in the 1930's, it has now spread to 70 of the state's 72 counties. Purple loosestrife largely spreads by seed, but also can vegetatively spread from root or stem fragments.

There are a number of effective control strategies for combating this aggressive plant, including herbicide application, biological control by native beetles, and manual hand removal – all of which have proven to be successful with continued and aggressive effort. Additional purple loosestrife monitoring during periods of control efforts would be required to ensure the eradication of the plant from the shorelines of Laurel Lake. Detailed discussion regarding this control effort will be discussed in the Implementation Plan.

.