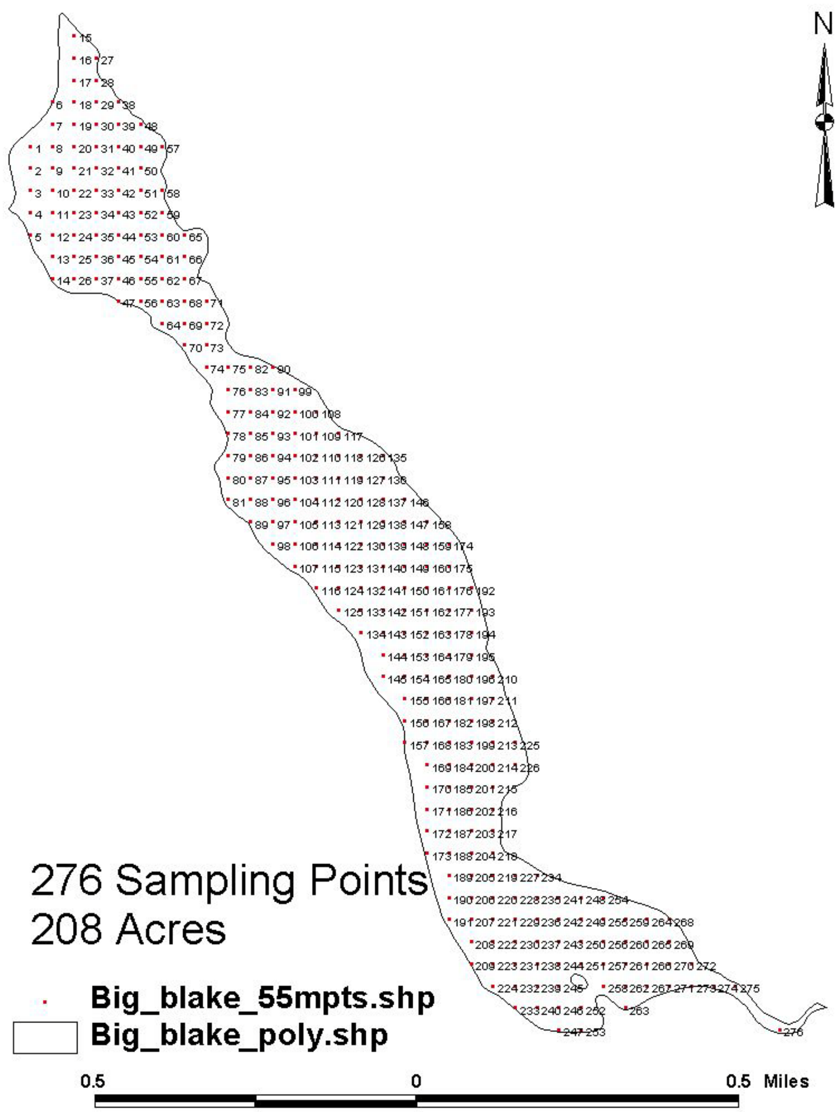
Polk County Land & Water Resources Department

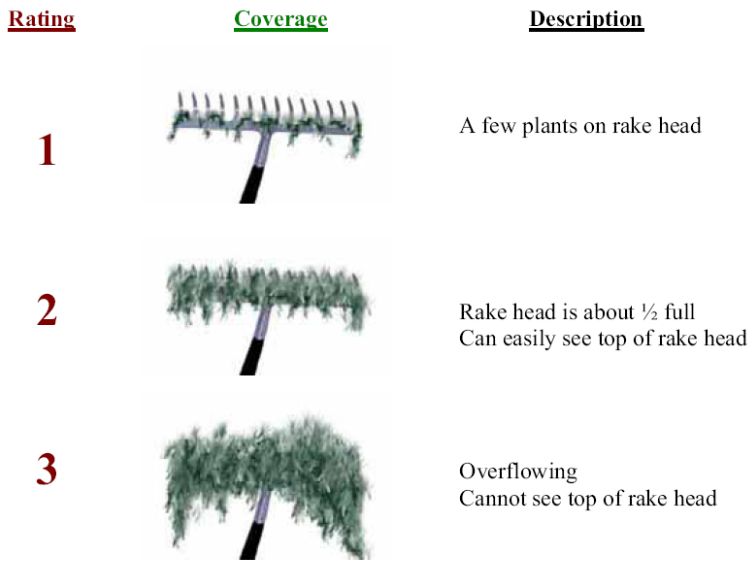
Big Blake Lake Aquatic Macrophyte Monitoring 2006-2011

Two aquatic macrophyte surveys have been carried out on Blake Lake in spring and late summer since 2006 and intensively since 2007, to assess the success of harvesting within the lake. 276 sampling points were established in the lake. A point intercept method was used to establish sampling points. A grid of points was generated in ArcView (a GIS program) and downloaded to a GPS unit. Points were then sampled in field.



Macrophyte collection sites on Blake Lake

The Jessen and Lound rake method was used to sample the macrophytes. This method involves using a rake with a handle and making a figure eight in an area that is approximately 1 m^2. The rake is then inverted and brought to the surface to assess the sample. Each species on the rake head was identified to species, and the approximate density of each species was determined on a scale of 1 to 3 (see figure below). This can be used to determine species composition or dominance of a species at a site or certain water depth. Visual sightings of plants within six feet of the sample point were also recorded. Substrate (lake-bottom) type was assigned at each site where the bottom was visible or it could be reliably determined using the rake.



Rake fullness rating (UW Extension 2007)

The results were then evaluated using three different indices or metrics. The Floristic Quality and Simpson's Diversity Index were calculated as well as the Frequency of Occurrence for each species.

<u>Frequency of occurrence for each species</u>- Frequency of occurrence is expressed as a percentage and there are two values for this. The first is the percentage of all sample points that this plant was sampled. The second is the percentage of littoral sample points that the plant was sampled. The first value shows how often the plant would be encountered everywhere in the lake, while the second value shows if only within the depths plants potentially grow. In either case, the greater this value, the more frequent the plant is in the lake. If one wants to compare to the whole lake, we look at the frequency of all points and if one wants to focus only where plants are more probable, then one would look at frequency in the littoral zone.

Frequency of occurrence example:
Plant A sampled at 35 of 150 total points = 35/150 = 0.23 = 23%
Plant A's frequency of occurrence = 23% considering whole lake sample.
This frequency can tell us how common the plant was sampled in the entire lake.

The FO in 2007 shows that *Potamogeton crispus* (curly-leaf pondweed) was present at 96.54% of the sites shallow enough to support vegetation, while in 2011 the FO was 66.91%, an almost 30% reduction. The rake density of curly-leaf pondweed went from an average of 2 in 2007 to 1.19 in 2011.

<u>Simpson's diversity index</u>- Simpson's Index **(**D**)** measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species).

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

Where D = Simpson's Diversity, n= the total number of organisms of a particular species, N=the total number of organisms of all species.
To measure how diverse the plant community is, Simpson's index is calculated. This value can range from 0 to 1.0. The greater the value, the more diverse the plant community is in a particular lake. In theory, the value is the chance that two species sampled are different. An index of "1" means that the two will always be different (very diverse) and a "0" would indicate that they will never be different (only one species found). The more diverse the plant community, the better the lake ecosystem.

Simpson's diversity example:
If one went into a lake and found just one plant, the Simpson's diversity would be "0." This is because if we went and sampled randomly two plants, there would be a 0% chance of them being different, since there is only one plant.
If every plant sampled were different, then the Simpson's diversity would be "1." This is because if two plants were sampled randomly, there would be a 100% chance they would be different since every plant is different.
These are extreme and theoretical scenarios, but they do make the point. The greater the Simpson's index is for a lake, the greater the diversity since it represents a greater chance of two randomly sampled plants being different.

In late summer 2007 the Simpson's Diversity Index was calculated to be 0.63, in 2011 it was calculated to be 0.77. This suggests that the native plant community is starting to recover as CLP density and coverage is reduced.

SUMMARY STATS May 2007:	
Total number of points sampled	261
Total number of sites with vegetation	251
Total number of sites shallower than maximum depth of plants	260
Frequency of occurrence at sites shallower than maximum depth of plants	96.54
Simpson Diversity Index	0.41
Maximum depth of plants (ft)	15.00
Number of sites sampled using rake on Rope (R)	0
Number of sites sampled using rake on Pole (P)	0
Average number of all species per site (shallower than max depth)	1.29
Average number of all species per site (veg. sites only)	1.33
Average number of native species per site (shallower than max depth)	0.24
Average number of native species per site (veg. sites only)	1.11
Species Richness	6
Species Richness (including visuals)	6

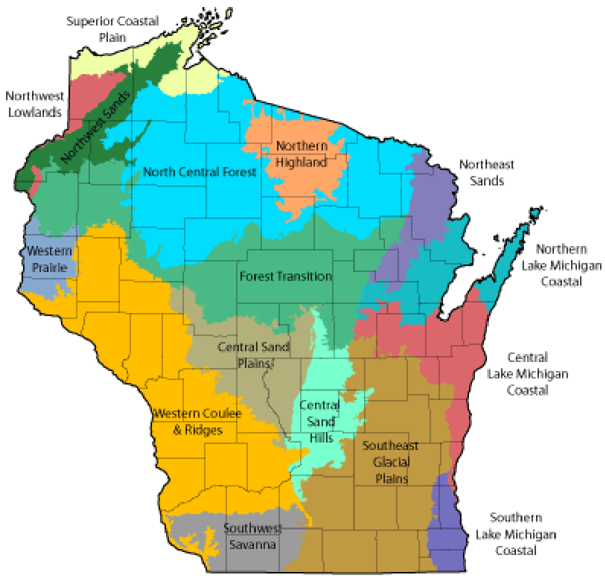
SUMMARY STATS May 2011:	
Total number of sites visited	273
Total number of sites with vegetation	195
Total number of sites shallower than maximum depth of plants	272
Frequency of occurrence at sites shallower than maximum depth of plants	71.69
Simpson Diversity Index	0.59
Maximum depth of plants (ft)**	14.50
Number of sites sampled using rake on Rope (R)	114
Number of sites sampled using rake on Pole (P)	159
Average number of all species per site (shallower than max depth)	1.10
Average number of all species per site (veg. sites only)	1.54
Average number of native species per site (shallower than max depth)	0.43
Average number of native species per site (veg. sites only)	1.62
Species Richness	10
Species Richness (including visuals)	10

SUMMARY STATS August 2007:	
Total number of points sampled	268
Total number of sites with vegetation	92
Total number of sites shallower than maximum depth of plants	254
Frequency of occurrence at sites shallower than maximum depth of plants	36.22
Simpson Diversity Index	0.63
Maximum depth of plants (ft)	12.00
Number of sites sampled using rake on Rope (R)	0
Number of sites sampled using rake on Pole (P)	268
Average number of all species per site (shallower than max depth)	
Average number of all species per site (veg. sites only)	1.47
Average number of native species per site (shallower than max depth)	0.50
Average number of native species per site (veg. sites only)	1.47
Species Richness	17
Species Richness (including visuals)	22

SUMMARY STATS August 2011:	
Total number of sites visited	269
Total number of sites with vegetation	74
Total number of sites shallower than maximum depth of plants	130
Frequency of occurrence at sites shallower than maximum depth of plants	56.92
Simpson Diversity Index	0.77
Maximum depth of plants (ft)**	10.00
Number of sites sampled using rake on Rope (R)	4
Number of sites sampled using rake on Pole (P)	130
Average number of all species per site (shallower than max depth)	1.25
Average number of all species per site (veg. sites only)	2.20
Average number of native species per site (shallower than max depth)	1.25
Average number of native species per site (veg. sites only)	2.19
Species Richness	18
Species Richness (including visuals)	19

Floristic Quality Index- The Floristic Quality Index is designed to evaluate the closeness of the flora in an area to that of an undisturbed condition. It can be used to identify natural areas, compare the quality of different sites or locations within a single lake, monitor long-term floristic trends, and monitor habitat restoration efforts. This is an important assessment in Wisconsin because of the demand by the Department of Natural Resources (DNR), local governments, and riparian landowners to consider the integrity of lake plant communities for planning, zoning, sensitive area designation, and aquatic plant management decisions.
It takes into account the species of aquatic plants found and their tolerance for changing water quality and habitat modification using the equation $I = \overline{C}\sqrt{N}$ (where *I* is the floristic quality, $\overline{C}$ is the average coefficient of conservation (obtainable from http://www.botany.wisc.edu/wisflora/FloristicR.asp) and $\sqrt{N}$ is the square root of the

number of species). The index uses a conservatism value assigned to various plants ranging from 1 to 10. A high conservatism value indicates that a plant is intolerant of change while a lower value indicates tolerance. Those plants with higher values are more apt to respond adversely to water quality and habitat changes. The FQI is calculated using the number of species and the average conservatism value of all species used in the index. Therefore, a higher FQI, indicates a healthier lake plant community. It should be noted that invasive species of a value of 0.

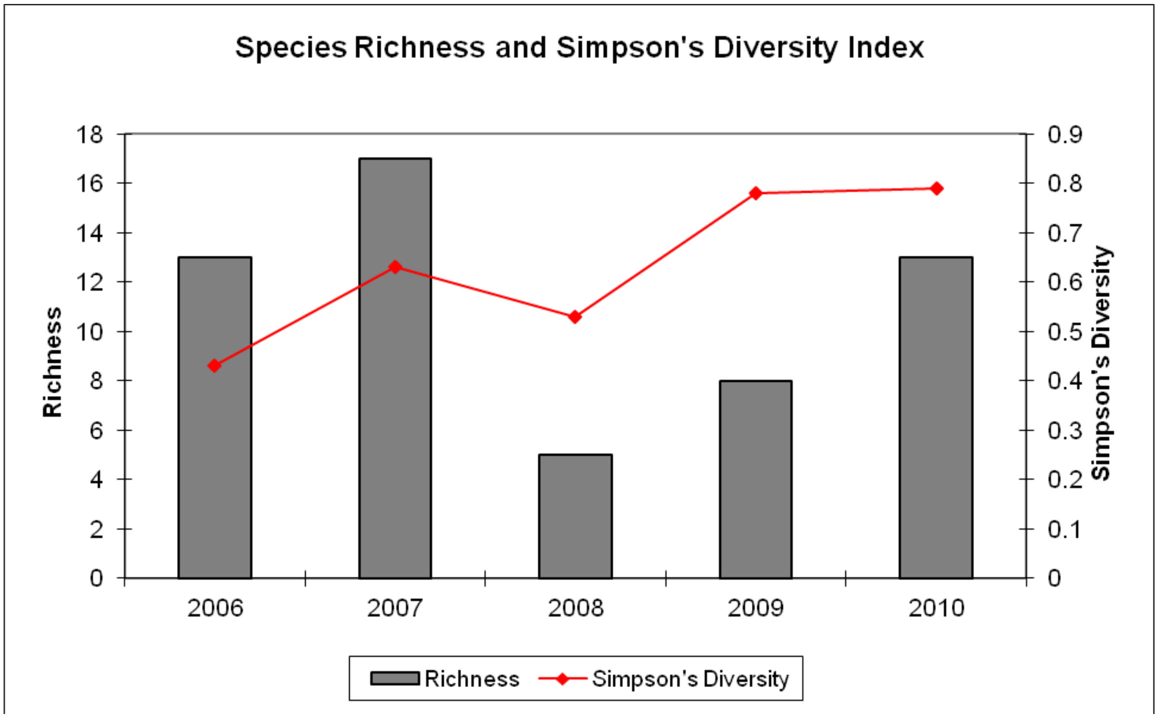


Wisconsin Eco-region Map (WDNR)

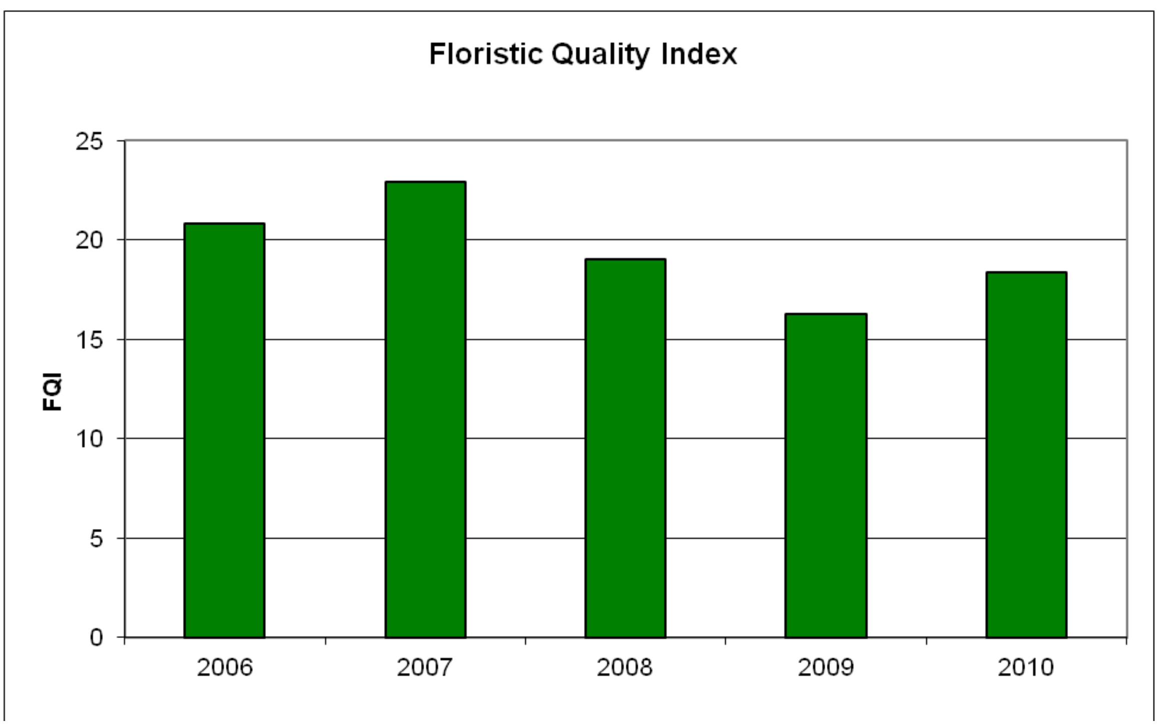
Summary of North Central Harwood Forest Values for Floristic Quality Index:
Mean species richness = 14
Mean average conservatism = 5.6
Mean Floristic Quality = 20.9*
*Floristic Quality has a significant correlation with area of lake (+), alkalinity(-), conductivity(-), pH(-) and Secchi depth (+). In a positive correlation, as that value rises so will FQI, while with a negative correlation, as a value rises, the FQI will decrease and vice versa.

In 2007 the summer FQI was determined to be 22.94; in 2011 it was determined to be 24.49. This again suggests that the native macrophyte community is beginning to recover in Big Blake Lake.

Two intensive areas were also monitored (on the Northwest and Southeast ends of the lake) using the Jessen and Lound method. And many of the same parameters were calculated just for the intensive management areas.



Initially the species richness decreased in the intesive management areas. This, however has seemed to have bounced back. Incontrast the Simpson's Diversity Index just has a small dip in 2008 and seems now to be higher than when the harvesting of CLP was initiated, indicating that the native macrophyte community may be recovering.



The Floristic Quality Index was calculated to be the highest in 2007 within the intesive management areas, with successive dips and then a slight rebound in 2010. While the Floristic Quality Index may be usful on a whole lake basis it may not be a good parameter to use in small areas such as the intensive management areas as one sensitive species can give you an artificially high score. Simpson's diversity is probably a better indicator of the aquatic macropyte community's health.

It would appear as though the aquatic macrophyte harversting targeting CLP is having a positive affect on Big Blake Lake. The Simpson's Diversity Index is up and the CLP acrage and density is down.

Moving forward whole lake point intercept surveys would be more informative of the health of Big Blake Lake's aquatic macrophyte community, you should get a more indicative number for both Simpson's Diversity and a Floristic Quality Index should that metric be chosen as a measure of lake health. CLP turion desnity within the lake sediment would be a nice piece of data to collect and monitor over time as well.

Additionally, inorganic water chemistry along with secchi disc depths data should be collected to measure the in-lake water quality as management conitues to occur. This data should demonstrate to the stakeholders the value of the recovering aquatic macrophyte community. Algae and zooplankton sampling could be informative, but does add additional cost to the monitoring.

GPS cooridnates and depth of cutting should also be recorded. This will help with the most effective cutting depths and frequency moving forward.