Gilbert Lake
WIBIC # 186400
Aquatic Plant Survey

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Introduction:
An aquatic plant survey was conducted on Gilbert Lake during the summer of 2004. Data was gathered primarily for a Sensitive Area Designation, but can be used for other purposes. Fisheries, wildlife, water regulation and water quality biologist staff in their daily management activities can use these data. Consultants, the Gilbert Lake Advancement Association and the public can, and are encouraged to, use these data for information and educational purposes.

When this survey was designed, it was done so using a holistic approach so it can be used to manage the lake on broad scale that encompasses the entire ecosystem. This will allow the benefits to be realized for fish, wildlife, water quality, lake users and future generations more so than if a single objective was the goal. Holistic management may not be appropriate for single objective management such as intense Eurasian Watermilfoil mapping, but it can be used to provide background data in those cases. Using this data to support single objective goals will help people obtain their goals more efficiently and ensure adequate protection to the lake and the resource.

General Lake Information:
Gilbert Lake is a 140-acre, glacial kettle lake located in north central Waushara County. The maximum depth is 69 feet and the lake has a relatively small littoral zone. Observed *Maximum Colonization Depth* (MCD) of aquatic plants is 26 feet according to data gathered from the survey. The lake is similar of other glacial lakes in Waushara County, which are typically hardwater seepage lakes with good water clarity. *Trophic state* of these lakes are usually late *oligotrophic* to *mesotrophic*.

Water levels fluctuate naturally on these types of lakes provided no water level control device is constructed. From 1962 to 1993, water levels have ranged more than 5.5 feet on Gilbert Lake (WDNR files). The natural water level fluctuation is absolutely critical to the lake. Near shore vegetation such as bulrushes have evolved around this phenomenon and actually require periodic lows to spread. As water levels increase, near shore vegetation is inundated and becomes habitat for fish and wildlife. These near shore plants also help filter nutrients out of the water that would otherwise produce algae.

It appears Gilbert Lake, like others, responded to the low levels caused by the drought of 2002-2003. Lake levels dropped across the region and in many cases Three-square bulrush expanded to this stimulus. Water levels rose slightly in 2004 inundating some of these plants. The flooded stands of emergent plants will be used by fish and wildlife and help protect water quality. Previous data of emergent species such as bulrushes are lacking to quantify this on Gilbert Lake thus this is more of a qualitative measure.

Low-lying areas that may be dry one year can be flooded the next in these types of lakes. An example of this is the small bay along the south central shoreline (see SAD #2 in the Sensitive Area Designation Report). This bay seems to be isolated from the lake but as water levels rise it can become connected. During times of high water species of fish like northern pike and perch will use these areas intensively to spawn. During drier years when fish can not migrate to these isolated bays, other animals such as herps will use these areas.

The lake fishery is chiefly composed of largemouth bass, northern pike and panfish. Walleyes are present but are sustained through stocking. Due to the depth of the lake a two-story fishery is supported through stocking. Realizing this, the WDNR stocked trout historically until the late 60's. However due to low survival from one year to the next stocking ceased. The We Really Kare Fishing Club stocked trout again in 2004.

Wildlife consists of waterfowl, furbearers, herps, reptiles and raptors. Some areas of the lake are more conducive to certain species of wildlife than others. Development pressure and habitat types play an important role in what kind of wildlife can be expected to utilize an area. For instance, some high value upland areas that are connected to the lake are just as important to wildlife as the lake is. Keeping upland habitat connected to the lake allows corridors for wildlife to travel from land to water and in some cases, complete their life cycles. Having a diverse shoreline provides important habitat and a connection from the water to the land. The occasional sightings of eagles and ospreys are a testament to this.

There are several public access points dedicated as walk-in areas and one public boat access on the east end. The lake has varying degrees of development along the lake and a wide array of uses ranging from canoeing, fishing and swimming to motor boating. The lake is typical of developed lakes. Near shore vegetation has been sharply reduced from the historic distribution, according to residents. Propwash scars and areas void of plants are common along the shoreline. Woody debris is sparse along developed shorelines with some increases in occurrence on undeveloped shorelines.

Along with use of the lake from the public and riparian owners comes the risk of exotic species introduction. In 1994 Eurasian Watermilfoil (*Myriophyllum spicatum*) was found. Since then, milfoil densities have increased until herbicide treatments began in 2001. Eurasian Watermilfoil (EWM) appears to be decreasing however eradication has not been achieved. This is not unusual as very few lakes, if any, can claim 100% eradication once this plant has been established. The current treatment regimen is having an impact on EWM. However locating isolated stands seems to be a challenge facing managers to date. This survey may be able to assist in some degree, however a single objective goal such as intensively mapping all EWM stands is needed, which this survey cannot supply. Data in this survey should be used in collaboration with other such management plans/surveys.

Survey Methods:
The point intercept method was used for this survey. Wisconsin Department of Natural Resources protocol, **Recommended Baseline Monitoring of Aquatic Macrophytes** (Hauxwell, rev. 2004) was used for sampling. Basically this entails using a grid system to define sampling locations on a random basis.

Wisconsin Department of Natural Resources calculated the littoral zone to be less than 100 acres. Therefore, according to protocol, the distance between sampling points was 50 meters (50-m grid spacing). A total of 224 points were placed over the entire lake (see figure 1 for a map of the sampling points). Coordinates for each point were assigned based on the North American Datum 1983 (NAD 83); these coordinates can be found in Appendix I. A sonic depth gauge (Humminbird 100SX fish locator) was used to determined depth at all points. At all points depth was recorded and plants were sampled until enough data was produced to show where the maximum colonization depth (MCD) of the plants were. On Gilbert Lake the MCD was determined to be 26 feet.

A hand held Garmin 12 GPS was used to locate each sampling point. Upon arrival at a point, the boat was anchored and depth was recorded. A two headed rake constructed from a standard garden rake (14 teeth) with another rake head welded to the top was used to obtain plant material. The rake was tethered by a chord to the sampler and was thrown sufficient distance to rake the lakebed at least 2.5 feet. All plants found on the rake were recorded. This was repeated in all four cardinal directions around the boat.

Presence of a species was recorded by how many times it was found on a rake per sampling point. For example, if Chara spp. (muskgrass) was found three of four tosses it was recorded as a three. If the plant was totally dominant on all throws it was assigned a rating of five. This was done for all submergent and floating leaf species found at each site.

Roles of Aquatic Plants:
Aquatic plants in a lake are equivalent to trees in a forest. They provide the same roles to different animals that live in a lake. Like a forest, if the trees are removed there is no longer a functioning forest ecosystem; if the aquatic plants are removed, there is no longer a functioning lake ecosystem. Aquatic plants are simply that important. In this section the roles plants play in a lake are discussed as well as specific information for each species found in the lake.

Aquatic plants affect water quality. They absorb nutrients such as, phosphorus and nitrogen. These nutrients can cause large algae blooms that cause water clarity to be reduced and degrade the water chemistry. If aquatic plants were not in the lake, algae would use the nutrients, which would soon dominate the system. This has occurred in other lakes, which caused a species shift in the fish assemblage from gamefish to roughfish. Many of our prized gamefish are sight feeders and depend on water clarity to find their prey. When a lake becomes very turbid from too much algae, species that rely on scent such as bullheads, carp and catfish do well. Years of an algae dominated system can cause this shift to occur.

Aquatic plants can also impact water chemistry. Not only do aquatic plants absorb nutrients that can cause algae blooms, some can actually break down pollutants (Borman et al., 1997). Aquatic plants influence the pH in a lake and dissolved oxygen levels. During the day, aquatic plants absorb carbon dioxide (CO_2) and then convert it to oxygen during photosynthesis. This causes the pH to swing more to the alkaline (basic) side and oxygen levels to go up. At night as bacteria respire they give off CO_2 and consume oxygen, which causes the pH to swing back towards the acidic side of the scale. Too many plants or algae can exacerbate these swings and actually become detrimental to the lake. Not enough plants can cause overall productivity of the lake to decrease and fish production to decline. It's a fine balancing act.

Aquatic plants can be very different in shape and size. This all adds to their uniqueness. Some plants have a great amount of surface area and some have very little. Surface area is important to invertebrates for places to hide and feed. These invertebrates feed the fish and wildlife. The surface area a plant provides also traps fine particulate matter that decreases water clarity.

Combining all of this, plants act as a sponge to absorb unwanted chemicals and nutrients; trapping fine particles that decrease water clarity. They are the pH and dissolved oxygen (DO) regulators of the living lake. They provide shelter and shade to invertebrates, fish and animals. They are the hardest working organisms in a lake, trying to keep a balanced ecosystem. Disrupting this balance by unneeded removal of native vegetation and introduction of exotic species can damage a lake beyond repair.

Every species that was encountered during the survey is described below with some points that contribute to their uniqueness.

Chara spp. (muskgrass). This plant is actually considered a higher algae lacking conductive tissue. Each segment or node is actually a single cell. It has a very strong odor that smells skunky, hence the common name MUSKgrass. Once you smell it, you won't forget it. Chara has many benefits. It has plenty of surface area to filter particulate matter and offer shelter to small invertebrates. Part of the reproductive organs (oogoniums) is a favorite food for waterfowl. Young trout and bass utilize this plant to feed on the invertebrates and find shelter. This plant can become established rather quickly on disturbed sites and provides a protective bed that helps prevent EWM from becoming rooted.

Najas flexilis (Slender naiad, bushy pondweed). Slender naiad is a thin-stemmed plant with leaves of variable size attaching to the stem. The leaves of the plant vary in size and are affected by water quality conditions. This is the second most frequent plant found in

Gilbert Lake. Slender naiad is considered an annual plant that reproduces by seeds every year. This trait can be a benefit and actually a tool to employ when fighting EWM. Slender naiad has a tendency to invade disturbed areas such as an EWM area treated with a selective herbicide, thus adding competition to a treated target species will only make regeneration of that target species more difficult.

Potamogeton illinoensis (Illinois Pondweed): A plant that shares its genus with many other plants – the pondweeds. However, their namesake minimizes their importance to the lake ecosystem. Illinois Pondweed is often confused with large-leaf pondweed and Variable Pondweed. Major distinguishing features are two ridges along the keel of the larger stipules. Their leaves usually have 9-19 veins and often tipped with needle-like tip. The fruit of this plant is an important food source for waterfowl and furbearers and even deer graze the plant. Fish find this plant attractive for the shelter it provides for defensive hiding to concealment for ambushing smaller prey.

Potamogeton natans (Floating-leaf Pondweed): It would appear that this plant is more common because of the presence and easily seen floating leaves. However it is actually the fourth most frequent plant found on the lake. Like its cousins in the pondweed family it is a valuable species to wildlife, fish and water quality protection. A special trait of this species is that it retains its fruit late in the season, which is a good food source for waterfowl.

Potamogeton gramineus (Variable Pondweed): Fairly frequent occurring plant in Waushara County, as it is in Gilbert Lake. Sometimes can be difficult to distinguish from Illionois Pondweed, even hybridizing with it at times. The most distinguishing features are that the leaf lack stalks and has 3-7 veins. The leaves vary in size, but in Gilbert Lake they were generally small and numerous. This plant has a good deal of surface area due to its many leaves. Invertebrates often colonize these plants, which in turn make these stands a good place for larger fish to feed. The leaves may have material deposited, which is a testament to its ability to filter lake water. The plant usually dies back in late fall but the rich rhizomes and winter buds provide food for furbearers and waterfowl.

Myriophyllum spicatum (Eurasian Watermilfoil): Probably the most infamous aquatic plant in Wisconsin. This plant produces long stems with leaves whorled around the stem in a feather like fashion. It is very invasive and can grow much earlier in the season giving it an unfair advantage over native species. These plants reproduce mainly by fragmentation, thus spreading of the plant can be intensified by physical disturbances. All fragments found floating should be removed from the water. Recently research is pointing to the direction the reproduction from seed may be more significant than once thought. A few lakes in Waushara County actually have a hybrid of native milfoil and EWM. Care should be taken to clean all watercraft and equipment before launching into the lake to prevent further infestations. Likewise it is absolutely imperative to clean all watercraft and equipment coming from Gilbert Lake before being launched in another lake.

Stuckenia pectinatus (Sago Pondweed): Sago is an important plant species in a lake ecosystem for many reasons. It is starchy tubers that are sought by waterfowl, the plant provides shelter to young fish and a mature plant has a lot of surface area. It can look like a cylindrical, finely leafed plant when in the water, but upon removal falls limp and appears to look like flatten pine boughs. Up until recently, this plant was considered to be in the genus Potamogeton (pondweeds).

Potamogeton zosteriformis (Flat-stem Pondweed): Flat-stem is a plant easily distinguished from other pondweeds. As the name suggests, the plant has flat stems and leaves. A species it is sometimes confused with is Water Stargrass but we did not find that species in the lake during the survey. This plant provides excellent cover for fish and invertebrates.

Nymphaea odorata (White water lily): An easily recognized floating leaf plant when flowering. It is also aesthetically pleasing and is sold in the aquascape business. Before the plant flowers, it can be distinguished from spatterdock by the nearly perfect, circular leaf. The leaf has a narrow sinus or a slit from the edge of the leaf to the stem. This plant offers shade and shelter to fish, shades out other plants like EWM and absorbs wave energy. This is also an important species to fish and wildlife as nursing, spawning and prey areas.

Elodea canadensis (Common waterweed): Is a plant that has a long stem with short leaves attached around the main stem in a whorled fashion. In some cases it can form very dense beds that can become a nuisance. The plant is similar to an evergreen that can photosynthesize year round even under the ice. This allows the plant to provide dissolved oxygen year round also. Elodea can grow on soft mucky substrates that some other species can’t, this helps keep the sediment from being disturbed and re-suspended. Fish will uses elodea beds to graze and seeks shelter. Furbearers also graze directly on the plant eating stems and leaves.

Myriophyllum sibiricum (Northern Watermilfoil): This is one of the native species of milfoil and should not be seen as a threat in Waushara County lakes. It is a beneficial plant that resembles it’s cousin EWM but has less leaflets (<12) per leaf than EWM (>12 leaflets/leaf). Anyone removing milfoil should first learn to distinguish the two apart so the native species are not accidentally removed. Northern Watermilfoil is somewhat sensitive to changes in water clarity and can be used as an indicator of water clarity conditions. The fine leaflets per leaf provide ample surface area where particulate matter can be trapped, aiding in increase water clarity.

Potamogeton amplifolius (Large-leaf pondweed, bass weed, musky weed): The common names give this plant away almost instantly. This pondweed has a large leaf with usually 25-37 veins. The leaf appears to be sometimes folded along the midvein. Sometimes the leaves are broad enough they resemble cabbage leaves and hence another common name, water cabbage or just plain cabbage. This is one of the premier aquatic plants for fish habitat. Anglers often search for beds of large-leaf to fish for many species of fish.

Potamogeton praelongus (White-stem pondweed): A high value species, this plant is an indicator of good water clarity. It is intolerant to turbid water and usually found on or near soft sediment. The stem has a zigzag appearance, with leaves connected to the stem directly. The submerged leaves have 3-5 prominent veins tapering to a boat shaped tip that will split when trying to flatten. The seeds are grazed on by waterfowl and furbearers.

Nuphar variegata (spatterdock): This plant is often called yellow pond lily by mistake. The flower is the easiest way to distinguish it from other lilies. Look for an orange or red patch at the base of the flower sepals (pedals). The leaves differ significantly from white-eater lily. The leaves tend to be oblong in shape and have a winged margin on the leaf stalk. They have many of the same benefits as other floating leaf plant in Gilbert Lake – White-water lily.

Results:

The aquatic plant community in Gilbert Lake is very similar to other lakes in the area. Generally speaking, there tends to be a lack of emergent and floating leaf plants near the shore due to shoreline disturbances. There were 13 species of native submergent and floating leaf aquatic plants and one exotic species - Eurasian Watermilfoil. The most dominant species on the lake was muskgrass or Chara. Chara is not a true plant but an algae. Chara is readily seen growing along the bottom like a carpet. It is not unusual for the plant to come up with anchors and has a distinct odor, hence the common name muskgrass. The exotic species Eurasian Watermilfoil was the sixth most frequent plant found. Table 1 lists the plants found in Gilbert Lake in order of their frequency.

Table 1. Submergent plants species found in Gilbert Lake 2004.

Species	Scientific name	% frequency	Rel. frequency	ave. Density	***C***
Muskgrass	*Chara spp.*	98.8	36	3.25	7
Slender Naiad	*Najas flexilis*	48.8	18	0.99	6
Illinois Pondweed	*Potamogeton illinoensis*	39.3	14	0.67	6
Floating-leaf Pondweed	*Potamogeton natans*	21.4	8	0.36	5
Variable-leaf Pondweed	*Potamogeton amplifolius*	19.1	7	0.21	7
Eurasian Milfoil	*Myriophyllum spicatum*	11.9	4	0.19	
Sago Pondweed	*Stuckenia pectinatus*	11.9	4	0.25	3
Flat-stem Pondweed	*Potamogeton zosteriformis*	7.14	3	0.15	6
White Water Lily	*Nymphaea odorata*	7.14	3	0.18	6
Waterweed	*Elodea canadensis*	3.57	1	0.11	3
Northern Milfoil	*Myriophyllum sibiricum*	2.38	1	0.04	7
Large-leaf Pondweed	*Potamogeton amplifolius*	1.19	0	0.01	7
White-stem Pondweed	*Potamogeton praelongus*	1.19	0	0.04	8
Spatterdock	*Nuphar variegata*	1.19	0	0.05	6
FQI = 21.3 not including EWM				*All plant mean*	5.5

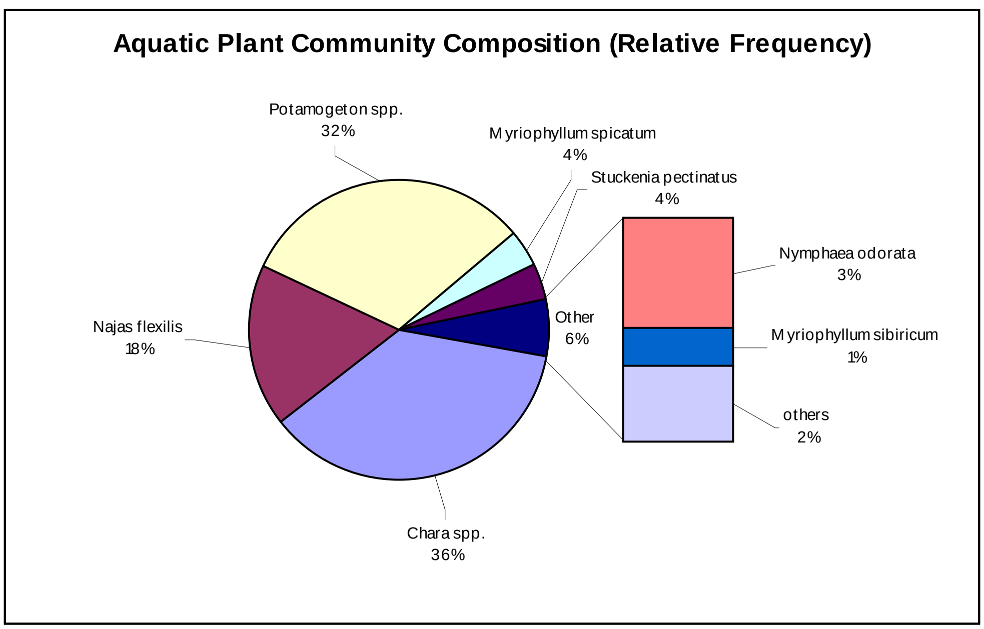
FQI = 20.6 including EWM

When analyzing the data there are several terms used to describe distribution and abundance of aquatic plants. It is important to understand what these terms mean to understand the data. The terms used in this survey are defined below:

Percent Frequency: The number of times a plant is found in all sampling sites, expressed as a percent. This number is often used because it can be used to show how much a specie(s) was encountered throughout the littoral zone. In this case, Chara has a percent frequency of 98.8%. This means that 98.8% of the sampling points in the littoral zone had Chara present. This is usually interpreted as 98.8% of the littoral zone has Chara. However, just because a species is found throughout a lake does not mean it is the dominant species. It just means that it is found at 98.8% of the lake in any density (thick or thin).

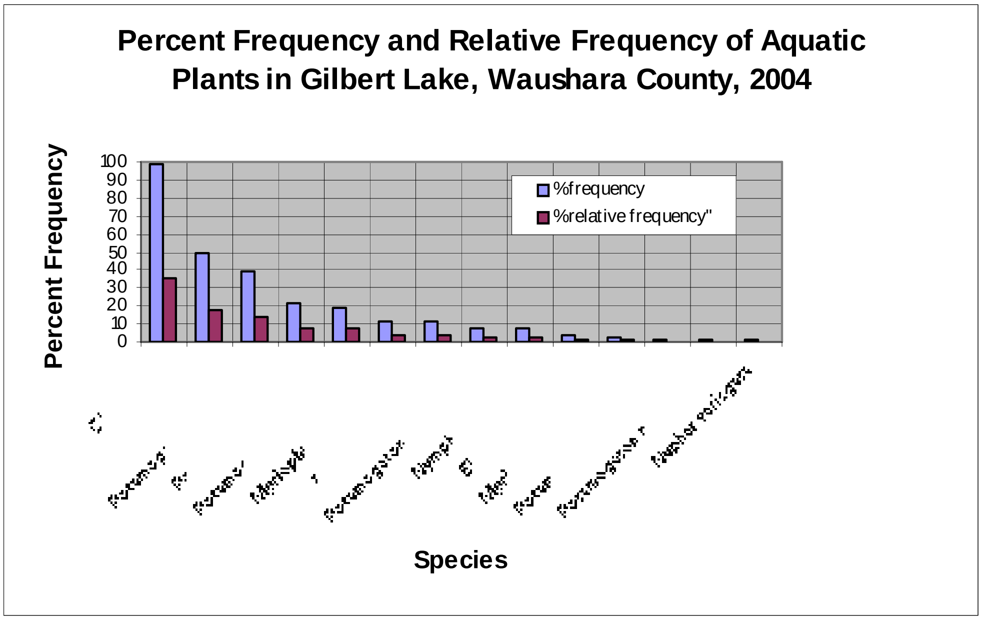
Relative Frequency: The number of times a species was found among the total number of all plants found. This is a ratio, often expressed as a percentage to demonstrate a single species' abundance in the whole plant community. Using Chara as an example again, the relative frequency is 0.36 or 36%. This shows that of all the plant species in the lake, Chara comprises 36% of the community. This can be interpreted as 36% (slightly more than a third) of all plants in the lake are Chara. Figure 2 illustrates the relative frequency of the plant community.

Figure 2. Relative frequency of the Aquatic Plant Community for Gilbert Lake, 2004.



Comparing frequency with relative frequency: In Gilbert Lake, the likelihood of seeing a plant (frequency) is proportional to the portion that particular plant comprises of the entire aquatic plant community (relative frequency). The graph in figure 1 illustrates how frequency and relative frequency are related in the littoral zone of the lake.

Figure 3. Percent Frequency and Relative Frequency of plants found in the submergent aquatic plant community.



The frequency and relative frequency is usually, but not always, the same in other lakes. This tells us a certain species of plant that is commonly found, is in fact the most common plant in the entire community. This becomes important when gauging aquatic plant management activities such as herbicide treatments. With Naiad being an important component to the aquatic plant community, any treatment that may compromise the plant's distribution or density should be discouraged. These native plants are absolutely necessary to help prevent re-infestations and help control the spread of EWM.

Average Density: Average density is used to show how much of a plant is found at the sampling points. You can interpolate this to indicate how much (how thick) a species is in the lake. The numbers are based on a scale of zero through five. Zero is equivalent to absent and 5 would be very dense (thick) coverage of a plant. Rarely would average densities exceed four even though the possibility exists. Chara had an average density of 3.25. This means across all the sampling points, Chara density (on the 0 to 5 scale), averaged 3.25.

*Coefficient of Conservatism (**C**):* This is a number, based on a scale of 0 through 10 that is assigned to a species. This number reflects the probability a plant would be found in a disturbed or undisturbed system. A ***C*** of 0 indicates very low probability the community is undisturbed. A ***C*** of 10 indicates a very high probability a certain species is of an undisturbed community, which would indicate a high quality natural area indicative to pre-settlement conditions.

Floristic Quality Index (FQI): is a product of the mean ***C*** multiplied by the square root of the number of species found. This number can be used to compare a plant community to statewide or regional trends. The FQI for the lake will be used to compare it to other lakes as an overall aquatic plant community assessment.

The FQI uses the ***C*** for only native species. Exotic species are not included in the calculation. However, by including exotic species in the calculation it is possible to compare the FQI with and without exotic species.

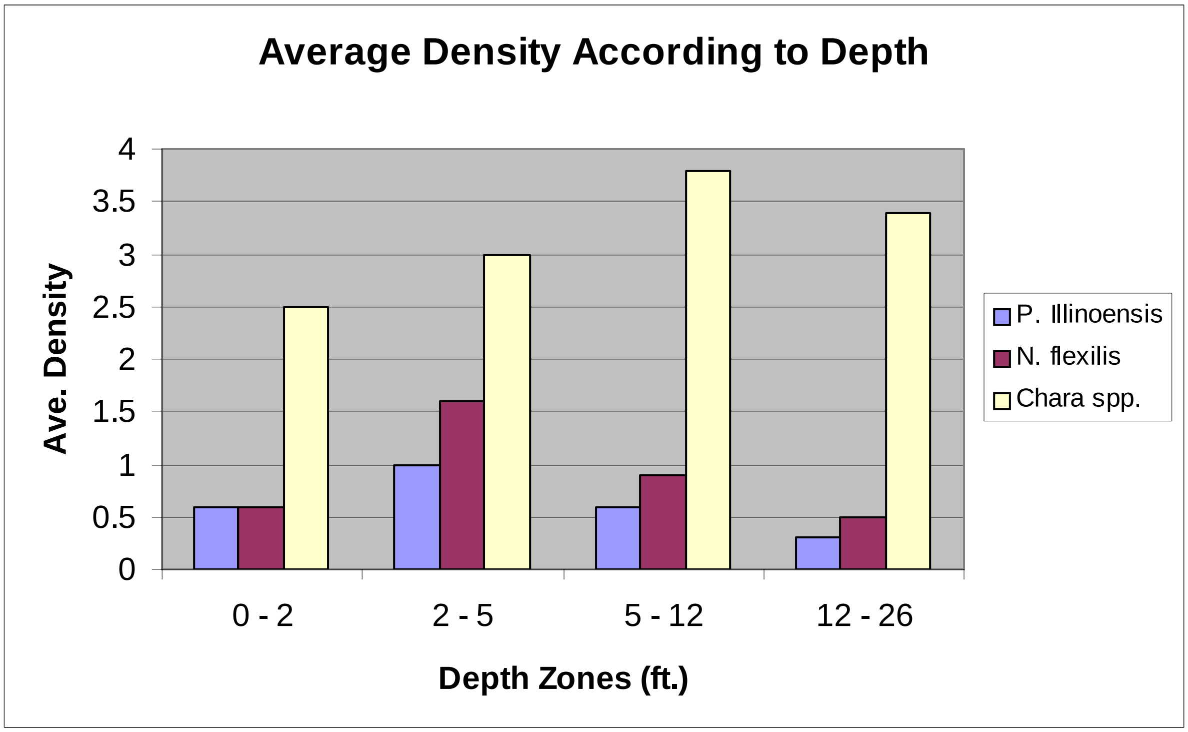
If an exotic such as EWM is encountered the ***C*** is in essence zero. Thus when calculating the mean (average) it will cause the FQI to be lower than if the exotic species was not found. A FQI of 20.6 is calculated when EWM is included in the formula. When EWM is excluded, the FQI yields 21.3. The difference seems minor but when it is compared to the regional North Central Hardwood Forest and Southeastern Wisconsin Till Plains (NCSE) of 20.9 the difference becomes obvious. With EWM presence in Gilbert Lake the FQI is below the regional value and above the regional value if EWM was not present.

Summarizing Data: When combining all these terms, a manager or lake resident can gain a better understanding of the distribution (frequency), the portion of the plant makes up of the entire community (relative frequency) and thickness (density) the plant is found in the lake. As an example, summarizing the data for Chara we can see it the most commonly found plant, covering most of the littoral zone of the lake and exhibits fairly vigorous growth compared to all other species. This is all becomes important to a fish biologist who is interested in evaluating how much cover there is for young of the year fish. A wildlife biologist may be interested in food supply for waterfowl. The aquatic plant management coordinator realizes the benefit chara has to controlling the spread of EWM and will use this information when reviewing permit applications.
Muskgrass (*Chara Spp*.), Slender Naiad (*Najas flexilis*), and Illionois Pondweed (*Potamogeton Illoensis*) were the three most commonly occurring plants found in Gilbert Lake. All three of these species are important to fish and wildlife (see Roles of Aquatic Plant section).

Aquatic Plant Distribution and Discussion:
The most diverse aquatic plant areas were found near the east end of the lake in the no-wake area. Emergent, floating leaf and submergent species were common with moderate density. Other areas that seem to be protected from wave energy such as the small bay on the southwest area of the lake, exhibit similar characteristics as the east bay. Two other areas where floating leaf plants were found were also near smaller bays that offered some protection and similar substrate. Map 1 shows the overall vegetation distribution for Gilbert Lake. This map only shows the presence or absence of submergent or floating leaf species and does not show density of plants.

The vegetative cover map shows that plants are found throughout most of the littoral zone. This can be deceiving when densities are not factored in. The mere presence indicates distribution or location. It does not indicate density, which determines if there are enough plants in sufficient amount, to provide their benefits. Figure 4 shows how densities of plants change with depth. For the three most frequent species found, the shallow water (0-2 feet) and the deepest water (12-26 feet) had the lowest densities. The highest densities of plants were found in the 2 – 5 and 5-12 foot depths.

Figure 4. Average density of P. Illinoensis, N. Flexilis and Chara spp. relative to depth zones.



It is basic reasoning to suggest that the deeper water would have fewer plants than shallower areas due to the lower intensity of light. Other factors must be contributing to the low density in shallow water. Substrate types appeared to be similar and plant frequency didn't seem to change much suggesting that some other factor is responsible for lower densities in shallow water. Besides natural conditions such as wind-derived waves and ice scouring, what is common in this area is generally a lack of plants in the shallow near shore area due to human impacts. Raking the shore to remove aquatic plants or leaves, making wakes in shallow water, and shoreline alterations are common causes of lower densities and frequencies of plants species. This has a direct impact on fish and wildlife also.

The three most frequently occurring plant species have also been mapped. There abundance or density has been mapped also to show where the plant(s) and how much of the plant(s) was found. The areas that are shaded and/or color-coded are general mapping units. There are small areas that are totally void of plants within the mapping units. It would be nearly impossible to show at this scale every area that was void of plants. Most of the areas void of plants can be attributed to high use areas from such activities as boating.

Chara spp. Distribution: Chara was found throughout most of the sampling points (98.8%) in the littoral zone and comprises 36% of the total plant community. Chara was also the most abundant (highest density) of all other plants in the survey. Map 2 shows this relative to the lake. Chara can help reduce the spread of EWM by competing against it due to its nature of growth. Chara has a tendency to grow along the bottom like a carpet. This helps prevent fragments of EWM from rooting into the sediment. It is not totally effective as it is not unusual to see EWM associated with it, but it does help slow the spread by competing against it. Due to the other benefits it has, this is a good species to have in the lake. Very rarely does it ever become a nuisance.

Najas flexilis Distribution: Slender naiad is also called bushy pondweed by some was the second most frequent plant found in the lake. It comprises 18% of the total aquatic plant species found and can be found in almost half (48.8%) of all the sampling points. Map 3 shows the frequency of occurrence and density throughout the lake. Slender naiad is species of plant that can spread relatively quickly. It often responds to EWM treatment by vigorous growth due to the decline of competition from the treated EWM. This is only the case when a herbicide is applied that will not kill naiad along with the EWM. Herbicide selectivity is important if they are considered. On Map 3 stands of EWM that were found during the survey are also plotted. The occurrences of EWM were always associated with naiad. This may not be the case all of the time, but it nevertheless are found consistently with EWM during the point-intercept survey of 2004.

Potamogeton illionensis Distribution: Illionois Pondweed was the third most frequent plant found in Gilbert Lake. It was found in 39.3% of the sampling points and comprised 14% of the aquatic plant community. Having a mix of species such as pondweeds, which are considered monocots and other plants like native water milfoil and lilies, which are dicots is a good mix. This becomes important when applications for chemical treatment are reviewed.

Pondweeds are also very diverse amongst their genus. Many pondweeds have no resemblance toward each other, but are very similar in their morphology. Different pondweeds provide different food sources and cover to a wide variety of fish and wildlife. When we combine the genus of *Potamogetons* (pondweeds), it represents almost a third (32%) of the aquatic plant community. Other pondweeds in Gilbert Lake may make up a small percentage of the plant assemblage but they are good indicators of environmental conditions. Potamogeton praelongus (white-stem pondweed) is found in a small amount but this particular species can not tolerate turbidity (unclear water). It is usually used as indicator of good water quality and of all the plants in Gilbert Lake that were found, Potamogeton praelongus has the highest ***C*** rating.

Floating Leaf Vegetation: This is a categorical term given to plants that are mostly floating. White-water Lily (*Nymphaea odorata*) and Spatterdock (*Nuphar variegata*) were the floating leaf species found during the survey. Map 5 shows the distribution and density throughout the lake. It should be noted that Nymphaea odorata was the most dominant species of floating leaf vegetation found on the sampling points. Spatterdock (sometimes called yellow pond lily) only was found in appreciable amounts near the west end of the lake. It could very possibly be found elsewhere in smaller bays. A few plants of Nuphar spp. was found near the east end but was not within the range of a sampling point.

They have the ability to shade out other species. Species such as EWM can be associated with lilies but are usually at lower densities than EWM plants growing in the same conditions without lilies. Protecting the floating leaf vegetation should be a high priority.

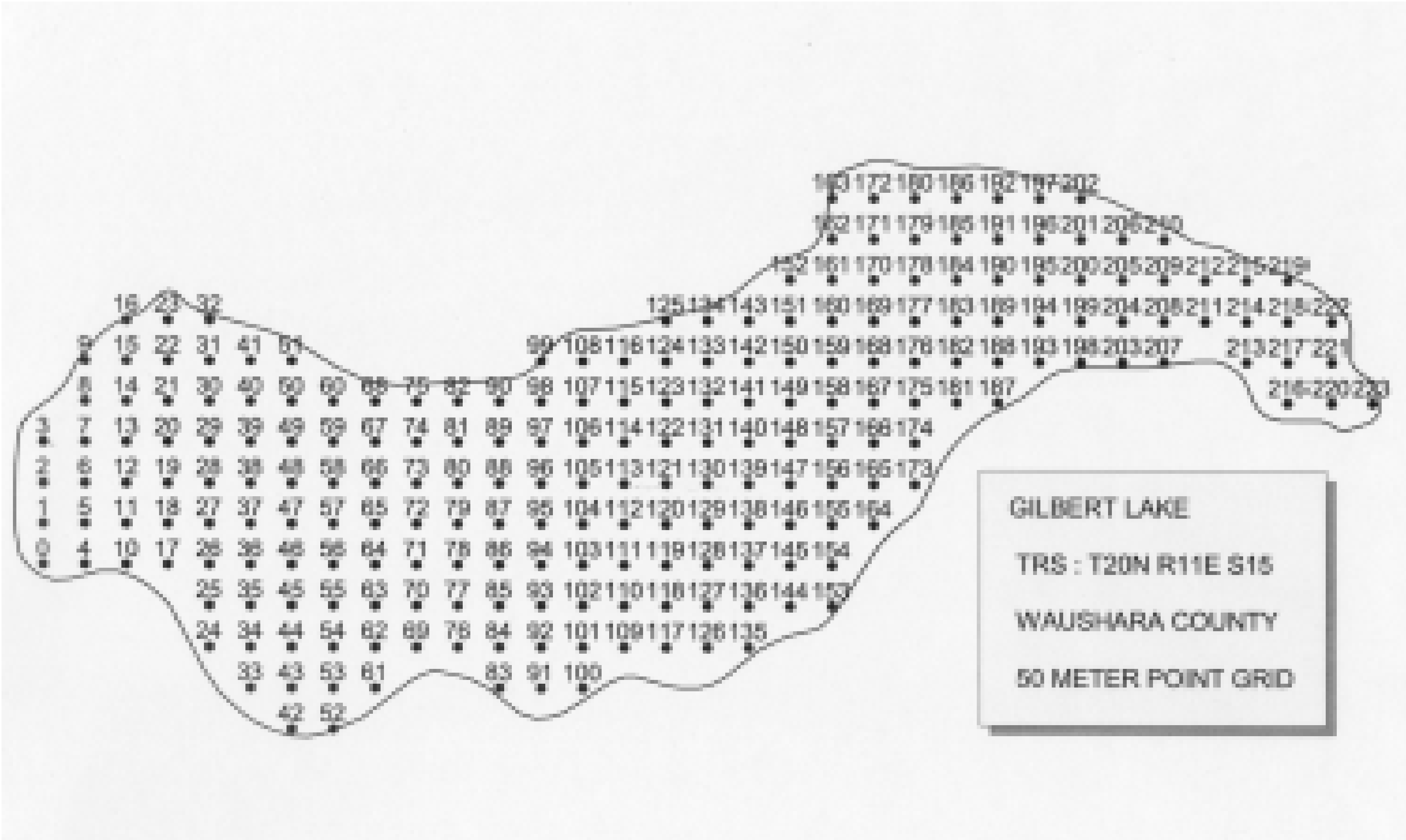
Like the milfoils, these plants are dicots and are sensitive to some of the same herbicides. However, higher rates of a herbicide such as 2,4-D (Navigate) are needed to kill the lilies than what is needed for EWM. Timing can play an important role as well. In many cases EWM is actively growing early in the spring when lilies have not yet begun to start growing after the winter. If possible, any treatments should utilize this window of opportunity. Thus it is important when treating EWM in areas with dicots that rates of application and timing of the application are closely monitored to minimize or eliminate the risk of damage to these plants.

Woody debris: Woody debris is often excluded from discussion when dealing with aquatic plants because it is not considered a benefit. In fact, woody debris is very important to most of the living things in a lake. Most aquatic life either directly or indirectly benefits from woody debris. Many species of organisms that feed fish and other wildlife depend on woody debris for food, nesting areas, shelter and basking. Without fallen trees and other woody debris these organisms would be reduce affecting the overall population of fish and wildlife in the lake. A fallen tree can absorb wave energy that would otherwise pummel the shore and scour the bottom. Plants can colonize these areas to provide essential habitat and contribute to increase water quality by filtering water and stabilizing sediments.

Gilbert Lake has a very noticeable lack of woody debris along the shoreline. Attempts have been made to mitigate the loss of woody debris by adding offshore cribs but that falls short of the near shore habitat needs. Woody debris along the shore is essential for a diverse aquatic plant community that benefits everyone from the angler to the boater.

Like all lakes in Waushara County, much of the woody debris has been removed, which has had a negative impact to the aquatic plant community and ultimately the lake as a whole. It is important to remember than trees have been falling into the lake for thousands of years. Fish, wildlife and aquatic plants have evolved around these natural conditions. Removing this material removes a needed component to the lake's ecosystem.

Figure 1. Sampling points for the Point Intercept Survey on Gilbert Lake, Waushara County, Wisconsin.



Conclusion:
Gilbert Lake has a moderately healthy aquatic plant community. Thirteen native species of submergent vegetation were recorded and one exotic species – Eurasian Watermilfoil. The most frequent and dominant species was Chara spp., followed by Najas flexilis (slender naiad), and Potamogeton illinoensis (Illionois Pondweed). Although the point intercept method showed that plant coverage was very extensive throughout the littoral zone, the density of these plants are low in the shallow areas (0-5 feet) when compared to the deeper depths (>5 feet) of the littoral zone. The Floristic Quality Index (FQI) was calculated using only the native species. A FQI of 21.3 was calculated. As a comparison, this is slightly above the average FQI for the North Central Hardwood Forest/Southeastern Wisconsin Till Plain (NCSE) of 20.9.

Gilbert Lake could substantially increase the density of native species by protecting sensitive areas, avoiding herbicide applications that would jeopardize native species, and restoring woody debris along the shoreline. Increasing the native species density, would enhance fishery and wildlife opportunities near the shore, increase water clarity and quality, and help slow or control the spread of Eurasian Watermilfoil.

Gilbert Lake residents should utilize opportunities from the State to participate in a Clean Boats – Clean Waters Workshop to develop a watercraft inspection team that can be used to prevent further reintroductions of Aquatic Invasive Species (AIS). This team can also be used in an information and education campaign to educate users about other AIS's, and prevention methods.

Recommended Readings:
Through the Looking Glass, A Field Guide to Aquatic Plants. Susan Borman, Robert Korth, Jo Temte. 1999. University of Wisconsin – Extension, University of Wisconsin – Stevens Point. College of Natural Resources. Phone: 715.346.2116

Glossary:
Maximum Colonization Depth (MCD): Depth in the lake to which aquatic plants can grow. This is often times the depth of the littoral zone.

Trophic State: Measure of the lakes fertility or an expression of "age". This can be expressed as a numerical figure such as a trophic state index or as a descriptor such as oligotrophic.

Oligotrophic: A lake with low fertility often characterized by clear water and low to moderate plant growth. Nutrient levels tend to be low in these lakes.

Mesotrophic: A lake in with mid level fertility characterized by moderately clear water and moderate plant growth. Algae blooms can occur when nutrient levels may spike.

Eutrophic: A high level of fertility, sometimes with low water clarity. Algae blooms may be more frequent and plant growth is generally abundant.

Refernces:

Broman, S.; Korth, R.; Temte, J. 1999. Through the Looking Glass, A Field Guide to Aquatic Plants, PUB# FH –207-97. University of Wisconsin – Extension. University of Wisconsin – Stevens Point.

Hauxwell, J. 2004. Recommended Basline Monitoring of Aquatic Macrophytes. Integrated Science Services – Wisconsin Department of Natural Resources.

Nichols, S.A. 1998. Floristic quality assessment of Wisconsin lake plant communities with example applications. Lake and Reserv. Manage. 15(2):133-141.

Nichols, S.A. 1999. Distribution and habitat descriptions of Wisconsin lake plants. Wisconsin Geological and Natural History Survey, Bulletin 96. Madison, WI.

Appendix I

Id	Latitude	Longitude	Id	Latitude	Longitude	Id	Latitude	Longitude
0	44.21146142	-89.1780595	50	44.21323	-89.1743	100	44.21005	-89.1699
1	44.21191153	-89.1780533	51	44.21368	-89.1743	101	44.2105	-89.1699
2	44.21236164	-89.178047	52	44.20963	-89.1737	102	44.21095	-89.1699
3	44.21281176	-89.1780408	53	44.21008	-89.1737	103	44.2114	-89.1699
4	44.21145691	-89.1774337	54	44.21053	-89.1737	104	44.21185	-89.1699
5	44.21190703	-89.1774275	55	44.21098	-89.1737	105	44.2123	-89.1699
6	44.21235714	-89.1774212	56	44.21143	-89.1737	106	44.21275	-89.1699
7	44.21280725	-89.1774149	57	44.21188	-89.1737	107	44.2132	-89.1699
8	44.21325736	-89.1774087	58	44.21233	-89.1737	108	44.21365	-89.1699
9	44.21370747	-89.1774024	59	44.21278	-89.1737	109	44.2105	-89.1693
10	44.21145241	-89.1768079	60	44.21323	-89.1737	110	44.21095	-89.1693
11	44.21190252	-89.1768017	61	44.21007	-89.1731	111	44.2114	-89.1693
12	44.21235263	-89.1767954	62	44.21053	-89.1731	112	44.21185	-89.1693
13	44.21280274	-89.1767891	63	44.21098	-89.1731	113	44.2123	-89.1693
14	44.21325285	-89.1767829	64	44.21143	-89.1731	114	44.21275	-89.1693
15	44.21370297	-89.1767766	65	44.21188	-89.173	115	44.2132	-89.1693
16	44.21415308	-89.1767703	66	44.21233	-89.173	116	44.21365	-89.1693
17	44.21144789	-89.1761821	67	44.21278	-89.173	117	44.21049	-89.1687
18	44.21189801	-89.1761759	68	44.21323	-89.173	118	44.21094	-89.1687
19	44.21234812	-89.1761696	69	44.21052	-89.1724	119	44.21139	-89.1687
20	44.21279823	-89.1761633	70	44.21097	-89.1724	120	44.21184	-89.1687
21	44.21324834	-89.176157	71	44.21142	-89.1724	121	44.21229	-89.1687
22	44.21369845	-89.1761508	72	44.21187	-89.1724	122	44.21274	-89.1687
23	44.21414857	-89.1761445	73	44.21232	-89.1724	123	44.21319	-89.1686
24	44.21054316	-89.1755689	74	44.21277	-89.1724	124	44.21364	-89.1686
25	44.21099327	-89.1755626	75	44.21322	-89.1724	125	44.21409	-89.1686
26	44.21144338	-89.1755563	76	44.21052	-89.1718	126	44.21049	-89.1681
27	44.21189349	-89.17555	77	44.21097	-89.1718	127	44.21094	-89.1681
28	44.2123436	-89.1755438	78	44.21142	-89.1718	128	44.21139	-89.168
29	44.21279372	-89.1755375	79	44.21187	-89.1718	129	44.21184	-89.168
30	44.21324383	-89.1755312	80	44.21232	-89.1718	130	44.21229	-89.168
31	44.21369394	-89.1755249	81	44.21277	-89.1718	131	44.21274	-89.168
32	44.21414405	-89.1755186	82	44.21322	-89.1718	132	44.21319	-89.168
33	44.21008852	-89.1749494	83	44.21006	-89.1712	133	44.21364	-89.168
34	44.21053864	-89.1749431	84	44.21051	-89.1712	134	44.21409	-89.168
35	44.21098875	-89.1749368	85	44.21096	-89.1712	135	44.21048	-89.1674
36	44.21143886	-89.1749305	86	44.21141	-89.1712	136	44.21093	-89.1674
37	44.21188897	-89.1749242	87	44.21186	-89.1712	137	44.21138	-89.1674
38	44.21233909	-89.174918	88	44.21231	-89.1712	138	44.21183	-89.1674
39	44.2127892	-89.1749117	89	44.21276	-89.1712	139	44.21228	-89.1674
40	44.21323931	-89.1749054	90	44.21321	-89.1712	140	44.21273	-89.1674
41	44.21368942	-89.1748991	91	44.21006	-89.1706	141	44.21318	-89.1674
42	44.20963389	-89.1743299	92	44.21051	-89.1706	142	44.21363	-89.1674
43	44.210084	-89.1743236	93	44.21096	-89.1706	143	44.21409	-89.1674
44	44.21053412	-89.1743173	94	44.21141	-89.1705	144	44.21093	-89.1668
45	44.21098423	-89.174311	95	44.21186	-89.1705	145	44.21138	-89.1668
46	44.21143434	-89.1743047	96	44.21231	-89.1705	146	44.21183	-89.1668
47	44.21188445	-89.1742984	97	44.21276	-89.1705	147	44.21228	-89.1668
48	44.21233456	-89.1742921	98	44.21321	-89.1705	148	44.21273	-89.1668
49	44.21278468	-89.1742859	99	44.21366	-89.1705	149	44.21318	-89.1668

Id	Latitude	Longitude	Id	Latitude	Longitude
150	44.21363037	-89.1667633	196	44.21495	-89.163
151	44.21408048	-89.166757	197	44.2154	-89.163
152	44.21453059	-89.1667506	198	44.2136	-89.1624
153	44.21092513	-89.1661756	199	44.21405	-89.1624
154	44.21137524	-89.1661693	200	44.2145	-89.1624
155	44.21182536	-89.1661629	201	44.21495	-89.1624
156	44.21227547	-89.1661566	202	44.2154	-89.1624
157	44.21272558	-89.1661502	203	44.21359	-89.1618
158	44.21317569	-89.1661439	204	44.21404	-89.1618
159	44.2136258	-89.1661375	205	44.21449	-89.1617
160	44.21407591	-89.1661312	206	44.21494	-89.1617
161	44.21452602	-89.1661248	207	44.21359	-89.1611
162	44.21497613	-89.1661185	208	44.21404	-89.1611
163	44.21542624	-89.1661121	209	44.21449	-89.1611
164	44.21182079	-89.1655371	210	44.21494	-89.1611
165	44.2122709	-89.1655308	211	44.21403	-89.1605
166	44.21272101	-89.1655244	212	44.21448	-89.1605
167	44.21317112	-89.165518	213	44.21358	-89.1599
168	44.21362123	-89.1655117	214	44.21403	-89.1599
169	44.21407134	-89.1655053	215	44.21448	-89.1599
170	44.21452145	-89.165499	216	44.21313	-89.1593
171	44.21497156	-89.1654926	217	44.21358	-89.1593
172	44.21542167	-89.1654863	218	44.21403	-89.1592
173	44.21226632	-89.1649049	219	44.21448	-89.1592
174	44.21271643	-89.1648986	220	44.21312	-89.1586
175	44.21316654	-89.1648922	221	44.21357	-89.1586
176	44.21361666	-89.1648859	222	44.21402	-89.1586
177	44.21406677	-89.1648795	223	44.21312	-89.158
178	44.21451688	-89.1648731			
179	44.21496699	-89.1648668			
180	44.2154171	-89.1648604			
181	44.21316197	-89.1642664			
182	44.21361208	-89.16426			
183	44.21406219	-89.1642537			
184	44.2145123	-89.1642473			
185	44.21496241	-89.1642409			
186	44.21541252	-89.1642346			
187	44.21315739	-89.1636406			
188	44.2136075	-89.1636342			
189	44.21405761	-89.1636278			
190	44.21450772	-89.1636215			
191	44.21495783	-89.1636151			
192	44.21540794	-89.1636087			
193	44.21360291	-89.1630084			
194	44.21405302	-89.163002			
195	44.21450314	-89.1629956			