AQUATIC PLANT MANAGEMENT REPORT

February 19, 2009

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BACKGROUND

Big Sand Lake is a 1,408 acre drainage lake located in northern Vilas. Big Sand Lake exhibits good water clarity and according to the Wisconsin Trophic State Index is an oligotrophic lake. Eurasian water-milfoil (*Myriophyllum spicatum* - EWM) and aquatic invasive specie (AIS) is confirmed on Big Sand Lake. Lake residents have become concerned about the presence of EWM and other AIS in the aquatic plant community of Big Sand Lake. In 2008 EWM was actively managed on Big Sand Lake with a treatment of 127.6 acres of the total 309 acres treated.

Northern Environmental completed pre and post-treatment surveys in 2008 along with fall EWM mapping surveys in 2007 – 2008. The fall surveys are used to delineate any changes in EWM location, map new areas, and create potential treatment areas for the following year.

Aquatic Plant Management

Treatment

In June 2008, EWM totaling 127.6 acres was treated on Big Sand Lake. A fall EWM survey was completed in September, 2007 that mapped 309 acres of EWM for the following years (2008) treatment. A pre-treatment survey was completed prior to the 2008 treatments with a post-treatment and fall EWM survey completed in September, 2008.

Chemicals containing the active ingredient 2,4-Dychlorophenoxyacetic acid (2,4-D) have proven to be the effective in treating EWM. Navigate and Weedar 64 both contain 2,4-D and were used in the 2008 treatment of Big Sand Lake. Navigate, a granular herbicide, was used in areas under 200 feet wide while Weedar 64, a liquid herbicide, was used in the remainder of the treatment areas. Treatment of 127.6 of the permitted 131 acres of EWM occurred on June 3 – 5, 2008. Navigate was applied at a rate of 150lbs/acre on 21 acres while Weedar 64 was applied to 106.6 at a rate of 9.615 gallons/acre (Treatment Record).

All 309 acres of EWM existing in spring of 2008 could not be treated in one year due to cost and potential effects of applying such a large amount of chemical herbicide. On behalf of the Big Sand Lake Property Owners Association, Schmidt's Aquatic Plant Control applied for, and was approved, a Wisconsin Department of Natural Resources (WDNR) permit of aquatic plant control for treatment of 131 acres of EWM in the 2008 treatment season.

Surveys

To provide a baseline of EWM presence, location, and density for future treatments Northern Environmental collected aquatic plant data during September, 2007, following WDNR pre and post-treatment protocol. Northern Environmental sampled 221 points with all plants at each sample point recorded within the mapped 309 acres of EWM. Of the 221 sample locations from the 2007 survey, 102 were within treated areas and 119 were within untreated areas. A break down of vegetation within these areas is included with Table 1. At these points, fifteen species were sampled with EWM being the most abundant at 214 locations (Table 1). Common waterweed (*Elodea canadensis*) and fern pondweed (*Potamogeton robbinsii*) were the next two most abundant plants sampled after EWM. Densities of each plant at each sample point were recorded on a 1-3 scale along with water depth.

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Table 1: 2007 Fall Survey Results. Big Sand Lake, Phelps, Wisconsin.

Plant		Points Sampled			Frequency of Occurrence (%)	Average Density
Common Name	Scientific Name	Treated Area	Untreated Area	Total Pts.		
Eurasian watermilfoil	*Myriophyllum spicatum*	98	116	214	96.8	2
Coontail	*Ceratophyllum demersum*	19	8	27	12.2	1
Common waterweed	*Elodea Canadensis*	27	12	39	17.7	1
Northern watermilfoil	*Myriophyllum sibiricum*	0	1	1	0.45	1
Dwarf watermilfoil	*Myriophyllum tenellum*	0	1	1	0.45	1
Bushy pondweed	*Najas flexilis*	0	3	3	1.4	1
Large-leaf pondweed	*Potamogeton amplifolius*	1	0	1	0.45	1
Variable pondweed	*Potamogeton gramineus*	0	8	8	3.6	1
Illinois pondweed	*Potamogeton illinoensis*	0	1	1	0.45	1
White-stem pondweed	*Potamogeton praelongus*	9	12	21	9.5	1
Small pondweed	*Potamogeton pusillus*	9	3	12	5.4	1
Clasping-leaf pondweed	*Potamogeton richardsonii*	4	0	4	1.8	1
Fern pondweed	*Potamogeton robbinsii*	44	15	59	26.7	2
Flat-stem pondweed	*Potamogeton zosteriformis*	2	4	6	2.7	1
Wild celery	*Vallisneria americana*	6	7	13	5.9	1

Before treatment in 2008, a pre-treatment survey was required to again evaluate presence of EWM within targeted areas. However, between the 2007 fall survey and the planned 2008 pre-treatment survey WDNR changed sampling protocol, requiring more sample points (an average of four per acre). This upped the total points sampled to 1,333 points from 221 across all 309 acres of EWM. This increase equates to a total of 574 points within treated areas and 759 points within untreated areas. Following protocol, areas to be treated in 2008 were sampled and only EWM was recorded at points. The 2008 pre-treatment survey was conducted in May, 2008 with 267, or 46.5%, of the 574 points having EWM.

Following treatment, a post-treatment survey was conducted using the same points as the pre-treatment survey but all plants were sampled. Along with this a "fall survey" was conducted within untreated areas of the lake, with a total of 759 points sampled. These surveys were completed during September 12-15, 2008. Between the surveys, a total of 1,333 points were sampled with 14 species present. EWM was the second most abundant species sampled at 584 (43.8%) of the points. Fern pondweed was the most abundant being sampled at 682 (51.1%) points while white-stem pondweed (*Potamogeton praelongus*) was the third most abundant species sampled at 520 (39%) points (Table 2).

Table 2: 2008 Total Fall Survey Results. Big Sand Lake, Phelps, Wisconsin.

Plant		Points Sampled			Frequency of Occurrence (%)	Average Density
Common Name	Scientific Name	Treated Area	Untreated Area	Total Pts.		
Eurasian watermilfoil	*Myriophyllum spicatum*	192	392	584	43.8	1
Coontail	*Ceratophyllum demersum*	130	134	264	19.8	1
Common waterweed	*Elodea Canadensis*	52	78	130	9.8	1
Quillwort	*Isoetes sp.*	1	0	1	0.1	1
Water marigold	*Heternathera dubia*	2	0	2	0.2	1
Dwarf watermilfoil	*Myriophyllum tenellum*	1	0	1	0.1	1
Bushy pondweed	*Najas flexilis*	0	15	15	1.1	1
Large-leaf pondweed	*Potamogeton amplifolius*	1	1	2	0.2	1

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Variable pondweed	*Potamogeton gramineus*	11	12	23	1.7	1
White-stem pondweed	*Potamogeton praelongus*	246	274	520	39.0	1
Fern pondweed	*Potamogeton robbinsii*	297	385	682	51.2	2
Flat-stem pondweed	*Potamogeton zosteriformis*	35	16	51	3.8	1
Hardstem bulrush	*Schoenoplectus acutus*	0	2	2	0.2	1
Wild celery	*Vallisneria americana*	27	11	38	2.9	1

2007 vs. 2008

When comparing between years using percent of points with EWM in treated areas (96.08% for 2007 & 33.45% for 2008), a reduction of percentage points with EWM was noted of 65.19%. Interestingly, EWM in untreated areas was reduced 47.02% (97.48% in 2007 vs. 51.65% in 2008). Across the entire lake, percent points with EWM were down 43.81%. Tables 3-5 contain aquatic plant changes between 2007 & 2008.

When statistically comparing data between the years, the change (reduction) in EWM within the area treated in 2008 is statistically significant (using a Chi-square test with an error rate of 0.05 in). Using the Chi-square tests with an error rate of 0.05, means that there is 5% chance (0.05) that a significant change occurred due to a given factor (assumed to be treatment) even when no real change occurred. Five percent (0.05) is the standard measure of deviation around a mean value used in most ecological studies. The P-value, or chance of error, of change across treated areas between 2007 & 2008 is well below this 0.05 chance at 5.17E-32 (Table 6).

A statistically significant reduction in EWM was noted in the 2008 untreated areas (P-value of 2.77E-21). The fact that untreated areas had a reduction in EWM may mean that there are other environmental factors at play. One such factor of note is the high wind day after treatment which spread chemical to untreated areas of the lake. However, a winter more severe than what the Northwoods has been having took place between 2007 and 2008 which may have helped in controlling EWM; the sample design does not allow us to isolate these factors. Total 2007 acreage of EWM decreased by 170.77 acres from 309 acres to 138.23 acres (Figure 1).

Change, along with outcomes in statistical significance, for all observed plant species in the 2007 to 2008 Big Sand Lake post-treatment/fall surveys can be found in Table 6. During 2007 sampling ten plants species were sampled in treatment areas while twelve species were sampled in 2008. Two species, clasping-leaf pondweed (*Potamogeton richardsonii*) and small pondweed (*Potamogeton pusillus*), sampled in 2007 were not sampled during the 2008 survey while four new species, Dwarf watermilfoil (*Myriophyllum tenellum*), quillwort (*Isoetes* sp.) variable pondweed (*Potamogeton gramineus*), and water marigold (*Bidens beckii*), were sampled. Based off frequency of occurrence, common waterweed abundance dropped 65.8% while flatstem pondweed (*Potamogeton zosteriformis*) and white-stem pondweed abundance rose approximately 211% & 385%, respectively (Table 3). Both small pondweed and common waterweed abundance decreased significantly, P-values of 7.81E-13 and 0.00351 respectively, when using a Chi-square test with an error rate of 0.05. However, presence of white-stem pondweed increased significantly (P-value of 6.37E-11) between 2007 and 2008 (Table 6).

Within non-treatment areas, thirteen species were sampled in 2007 and eleven in 2008. Four species, dwarf watermilfoil, small pondweed, Illinois pondweed (*Potamogeton illinoensis*), and northern watermilfoil (*Myriophyllum sibiricum*), sampled in 2007 were not sampled during the 2008 survey while two new species, hard-stem bulrush (*Schoenoplectus acutus*) and large-leaf pondweed (*Potamogeton amplifolius*), were sampled. Based off changes in frequency of occurrence, variable pondweed and wild celery abundance

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dropped the most (76.5% & 75.4% respectively) while coontail (*Ceratophyllum demersum*), white-stem pondweed, and fern pondweed all increased dramatically in abundance (162.6%, 258%, & 302.4% respectively) between 2007 and 2008 (Table 4). Though four species were sampled in 2007 but not 2008, their absence in 2008 is not statistically significant. Both variable pondweed and wild celery decreased significantly between 2007 and 2008 with P-values of 0.0047 and 0.0015 respectively. Conversely coontail, white-stem pondweed, and fern pondweed abundances all increased significantly between 2007 and 2008 with P-values of 0.0026, 1.80E-8, and 8.28E-15, respectively (Table 6).

Across all areas sampled in Big Sand Lake, fifteen species of aquatic plants were sampled in 2007 with fourteen species sampled during the 2008 post-treatment and fall surveys within the same areas. Four species were present in 2007 but not sampled in 2008 include clasping-leaf pondweed, Illinois pondweed, northern watermilfoil, and small pondweed. However, three new species, hard-stem bulrush, quillwort, and water marigold, were sampled in 2008 that were not sampled in 2007. When comparing frequencies of occurrence common waterweed, variable pondweed, and wild celery, decreased in abundance (44.7%, 52.3%, and 98.7% respectively) while flat-stem, fern, and white-stem pondweeds all increased in abundance (40.9%, 91.6%, and 310.5% receptively) from 2007 to 2008 (Table5). Small pondweed and wild celery abundance decreased significantly (P-values of 1.33E-17 & 0.019) across all sample points while coontail, common waterweed, fern pondweed, and white-stem pondweed all increased significantly in abundance (P-values of 0.0074, 0.00048, 1.54E-11, & 1.48E-17, respectively) between the 2007 and 2008 surveys (Table 6).

Across all areas sampled (treated, untreated, & entire lake) some species were either present or absent in the surveys when they had been either absent or present the previous year. However, their change was not statistically significant because the low number of points sampled with that species were not enough to confidently make a statistical conclusion and this does not mean such plants have been extirpated. A change in sample point locations and abundance may have lead to a change in species present or absent.

Lake Monitoring

2,4-D Monitoring

Use of liquid 2,4-D (Weedar 64) in Wisconsin is in its infancy and has been touted as being a cheaper, more effective alternative than the granular products. To monitor the presence of 2,4-D within Big Sand Lake a series of water samples were collected at ten separate sites with the majority of the sites being sampled at 1/3rd and 2/3rds total water column depth. Samples were taken from treatment sites and sites that did not receive any treatment (Figure 2). Samples were taken at intervals of a week before treatment, one day after treatment, four days after treatment, eight days after treatment, and twelve days after treatment. Each sample was sent to the Wisconsin State Lab of Hygiene (SLOH) for an enzyme-linked immunoassay (ELISA) to determine if the chemical herbicide was still present in the water.

Weedar 64 is most effective at rates of 2-10 gallons per acre, depending on depth. During the 2008 treatment, 106.6 acres were treated with liquid 2,4-D at a rate of 9.615 gallons/acre and an average depth of 7.67 feet within treated areas. Weedar 64 has an average of 38.9% active ingredient (AI), or 3.8 pounds, per gallon. This equals an application rate of 36.54 pounds of AI per acre, or 1.75 mg/L (ppm).

According to the ELISA, 2,4-D was detected in all water samples collected after treatment except for the 2/3rds depth sample at point 2, twelve days after treatment (Table 7). According to the Weedar label, water treated with the product is not recommended for irrigation or use as potable water until three weeks after treatment and an approved assay shows the water contains less than 0.1 ppm of 2,4-D. Samples collected

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showed concentrations below this level at all times except for the following seven samples: two days post-treatment at site two at both sampled depths, eight days post treatment at site two deep sample and site 4 shallow sample, and twelve days post treatment at site six shallow sample and both samples at site 7.

Dissolved Oxygen Monitoring

Oxygen levels were monitored by members of the Big Sand Lake Association due to the concern of a drop in oxygen associated with plant decay from the chemical treatment of EWM beds. A drop in oxygen levels could result in condition where there was not enough oxygen to support fish or invertebrates. Dissolved oxygen (DO) levels were monitored using a Hach HQ30D, single probe monitor with a rugged dissolved oxygen probe. Water samples were taken at three different locations with DO levels recorded in and out of EWM beds and at 5 and 10 feet below the surface at each location and sampled four separate dates. All samples showed adequate oxygen levels to support aquatic life (Table 8). Dissolved oxygen monitoring took a total of nine hours of volunteer time. To serve other neighboring lakes, the Big Sand Lake Association has arranged a lending program with the Phelps Town Lake Committee, whereby they will share the Hach probe with other local lakes that need the equipment.

Other Efforts

During 2008 the Big Sand Lake Association participated in numerous AIS prevention, education, and identification efforts. Efforts included six hours of lake surveys and AIS searches, four hours of Clean Boats, Clean Waters training, and three hours of water quality testing and sampling. These are all initial steps to continue to educate users of Big Sand Lake and garner support from additional property owners for volunteer time with Clean Boats/Clean Waters. The Association hopes to gain more volunteers for Clean Boats, Clean Waters in 2009.

Recommendations

Liquid 2,4-D was used on an experimental basis. Because of its success during the 2008 treatment and low residual concentrations found in the assay tests further use of liquid 2,4-D is recommended to treat most of the EWM in Big Sand Lake. Isolated plants or small beds should still be targeted with granular 2 4-D. High use areas and areas with greater potential to spread to new areas, such as near the boat landing and resorts, should receive preference for potential 2009 treatments. At a minimum, the same amount of acreage treated in 2008 should be treated in 2009 to achieve best results.

The Clean Boats, Clean Waters campaign was not initiated effectively in 2008. An aggressive push to increase participation should be done in 2009. Almost anyone can be a volunteer and someone should be assigned sole responsibility for this campaign. The 2009 goal is 50 hours of boat landing monitoring between May – October. Three hours of volunteer time per week would accomplish this goal although a more concentrated focus in the summer months is recommended.

2009 Recommendation Summary

Treat approximate 140 acres of remaining in 2009 mostly with liquid 2, 4-D
Aggressively expand the Clean Boats, Clean Waters campaign

Summary

EWM treatment occurred in 2008 on 127.6 acres on the permitted 130.1 acres. 106.6 acres were treated with liquid 2,4-D while 21 acres were treated with the traditional, granular 2,4-D. Though not all acres of EWM

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were treated within Big Sand Lake, EWM was significantly reduced across the entire lake. Total EWM coverage dropped by 170.77 acre to 138.23 acres surveyed during the 2008 post-treatment and fall surveys with treated areas reducing the most.

The Big Sand Lake Association must remain proactive in there approach. With the Association's continued commitment to ensuring the health, aesthetic and recreational values of Big Sand Lake are preserved. Using the 2008 season as an example, with active aquatic plant management, the quantity of nuisance aquatic plant growth, and exotic species such as EWM on the Lake can be adequately controlled. The Association will continue pursuing financial assistance through various grant programs to help offset the management of AIS. WDNR AIS Control Grants will be the Association target grant program for financing management projects such as chemical herbicide control of AIS and aquatic plant survey costs. With help of a professional consulting firm such as Northern Environmental, the Association hopes to continue a cooperative relationship with the WDNR 75% of the cost of the public resource that is Big Sand Lake to be carried by the State of Wisconsin and much of the matching contributions to be in the form of in-kind donations by Association members.

Northern Environmental appreciates working for the Association this past treatment season and we look forward to working with you on future projects. Please feel free to contact Northern Environmental at (800) 498-3921 if you have any questions regarding the 2008 chemical treatment, a 2009 treatment, or if you have any other additional questions or concerns.

ATTACHMENT A

WDNR CHEMICAL AQUATIC PLANT CONTROL PERMIT

ATTACHMENT B

AQUATIC PLANT MANAGEMENT HERBICIDE TREATMENT RECORD, JUNE 9, 2006

ATTACHMENT C

AQUATIC PLANT MANAGEMENT HERBICIDE TREATMENT RECORD, JULY 27, 2006