Big Lake
2013 Aquatic Plant Control Program

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Project Overview

This was Northwest Aquatic Eco-Systems (NWAE) second year of providing aquatic weed control services for the Big Lake LMD #1 district. Much of the past historical data included in the 2012 report has been incorporated into the 2013 report. This approach has been taken so that anyone reading the report will have a full understanding of past and present control efforts. Past yearly reports provided the baseline for our 2013 Big Lake weed control operations. Big Lake has been actively involved for at least ten years with an intense program to eradicate noxious aquatic macrophytes from the system. Targeted species include Eurasian watermilfoil, Egeria densa (Brazilian elodea), Nymphaea odorata and yellow flag iris. Densities of both Eurasian watermilfoil and Egeria densa have been reduced considerably. No Brazilian elodea plants were identified during 2013 and milfoil infestations were limited to single plants within a few small locations located along the far southern and southwest shoreline lake regions. These lake regions have maintained very light density single plant populations for a number of years. As noxious weed species declined native species increased their range lake wide, extending outward to the 15 foot contour line. Such vegetation had become so dense in areas that shoreline use was being severely restricted and native species now pose the same recreational problems often associated with noxious species. Management practices of the lake now also incorporates control efforts necessary to maintain native species at an acceptable level. Such efforts were utilized during the 2012 and continued into the 2013 treatment season. This report reviews all activities undertaken at Big Lake during the year 2013.

2010 -2012 Data Review

Section S8 of the NPDES permit requires each permit holder submit a pesticide/product application report to the Washington State Department of Ecology at the close of each treatment season. These reports must identify the dates treatments occurred, products/amounts used and the acreage treated. Data associated with the 2010, 2011 and 2012 application efforts were reviewed for Big Lake.

In conjunction with the application records, NWAE also reviewed the year end reports submitted to Skagit County by the consultant for the years 2010, 2011 and 2012. Surveys for 2010, 2011 & 2013 identify Myriophyllum spicatum as the only submersed noxious species present in the system. Egeria densa was not identified during any of the surveys. Dominant native species consisted of Elodea canadensis, Potamogeton species, Najas and Chara. Najas and Chara are macro algae.

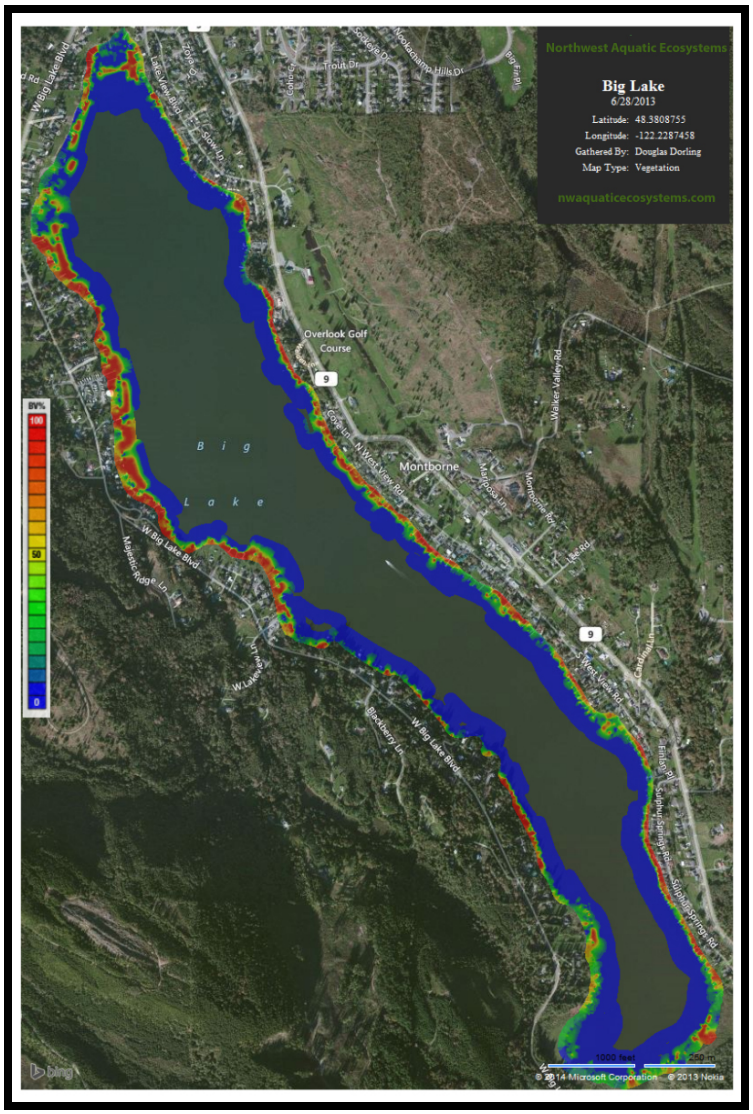
Survey Protocol

Survey techniques for 2013 differed slightly from past efforts in that new technology was incorporated into survey protocol. During 2013 sonar data was collected utilizing specific transducers and bottom scanning equipment. Once collected the SD card was uploaded via. cloud based technology and the processing of the data was finalized. The resulting product is a color coded map of the lake bottom identifying weed growth areas and plant densities. Not only is a well-defined map produced but a sonar log of the survey is saved allowing a complete review and evaluation of the survey to occur in house. The sonar log allows you the ability to view all plant growth along the boats survey track. Past Big Lake surveys consisted of manually retrieving weed samples from numerous locations lake-wide while observing growth through the water column. Although effective, individual bottom sampling can only identify plants within the immediate area sampled. This new protocol avoids the possibility of missing plants between bottom surveying data points. This updated protocol encompasses a surface vehicle transecting the lake along the littoral zone.. Boat tracks are designed to be approximately 50 feet apart. To ensure the efficacy of the survey, a bottom sampling rake was thrown from the boat at various locations lake-wide. The rake was then drawn across the lake bottom, brought to the surface and into the boat. Plants attached to the rake were identified and confirmed as being the same species as noted through the structure scan or visually through the water column. The system automatically calculates and stores the position of every transect data point enabling the mapping of thousands of data points on a daily basis.

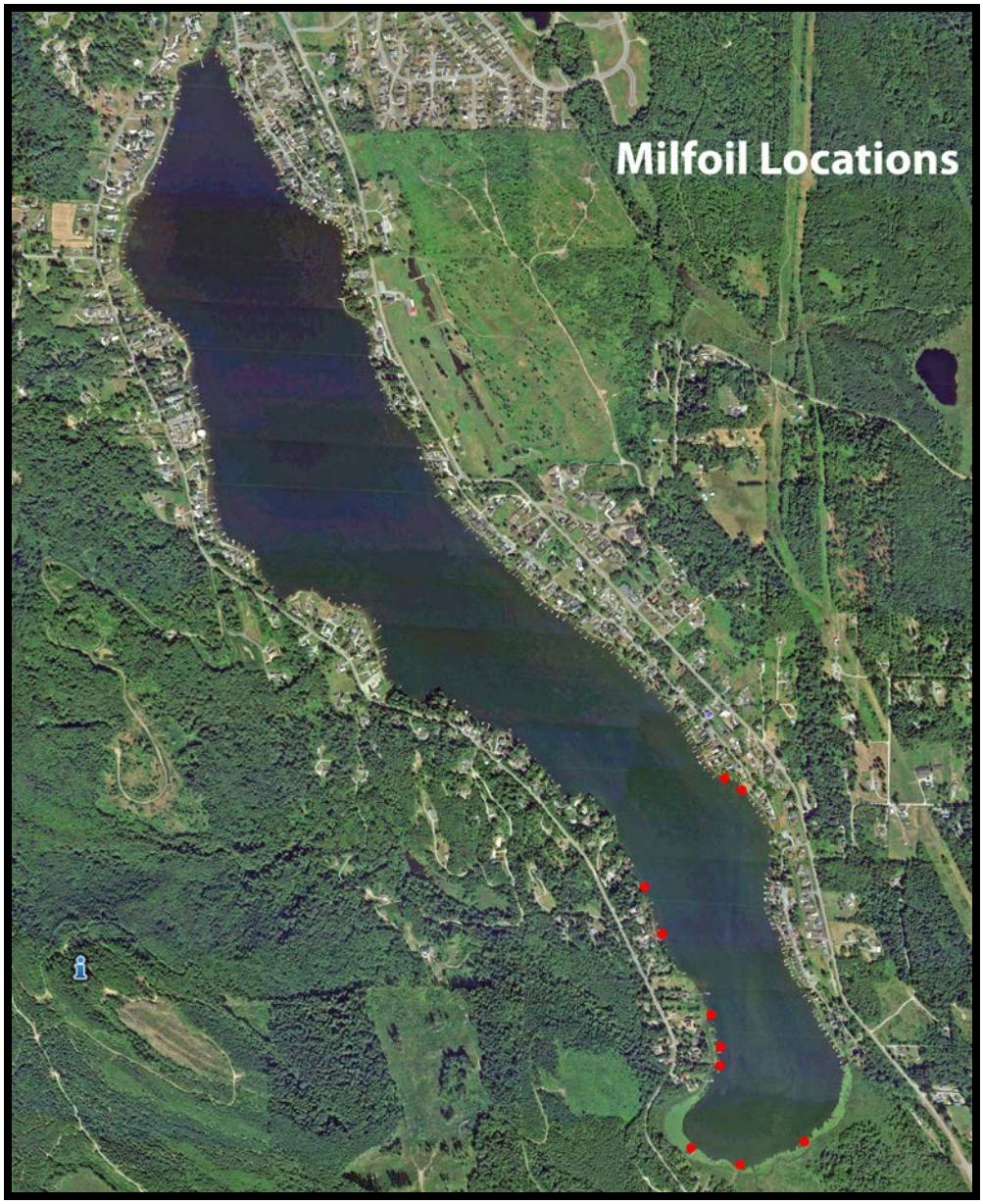
When individual milfoil plants were identified from the surface way points were added to the transect line.

Big Lake Pre Treatment Survey Results

Big Lake was surveyed on June 28. At the time of the survey water clarity exceeded ten feet. The relative shallow slope of the immediate shoreline lakebed was already experiencing visible weed growth with some species breaking the water's surface. As the survey progressed it became obvious that there were no "extended" shoreline "weed free" zones. There were only a few parcels that were not experiencing some degree of plant growth. Milfoil locations were similar to those reported over the last five years. The 2013 NWAE survey identified only minor occurrences of P. amplifolius while most of the entire shoreline was occupied by a number of pondweeds including P. richardsonii, P. robbinsii, P. praelongus, P. foliosus and P. epihydrus. Problematic non pondweed species included Elodea canadensis, Vallisineria americana. Different shoreline sections of the lake were dominated by the dissimilar pondweed species.



Blue map areas indicate the absence of vegetation.
Red areas identify 100 percent plant coverage.



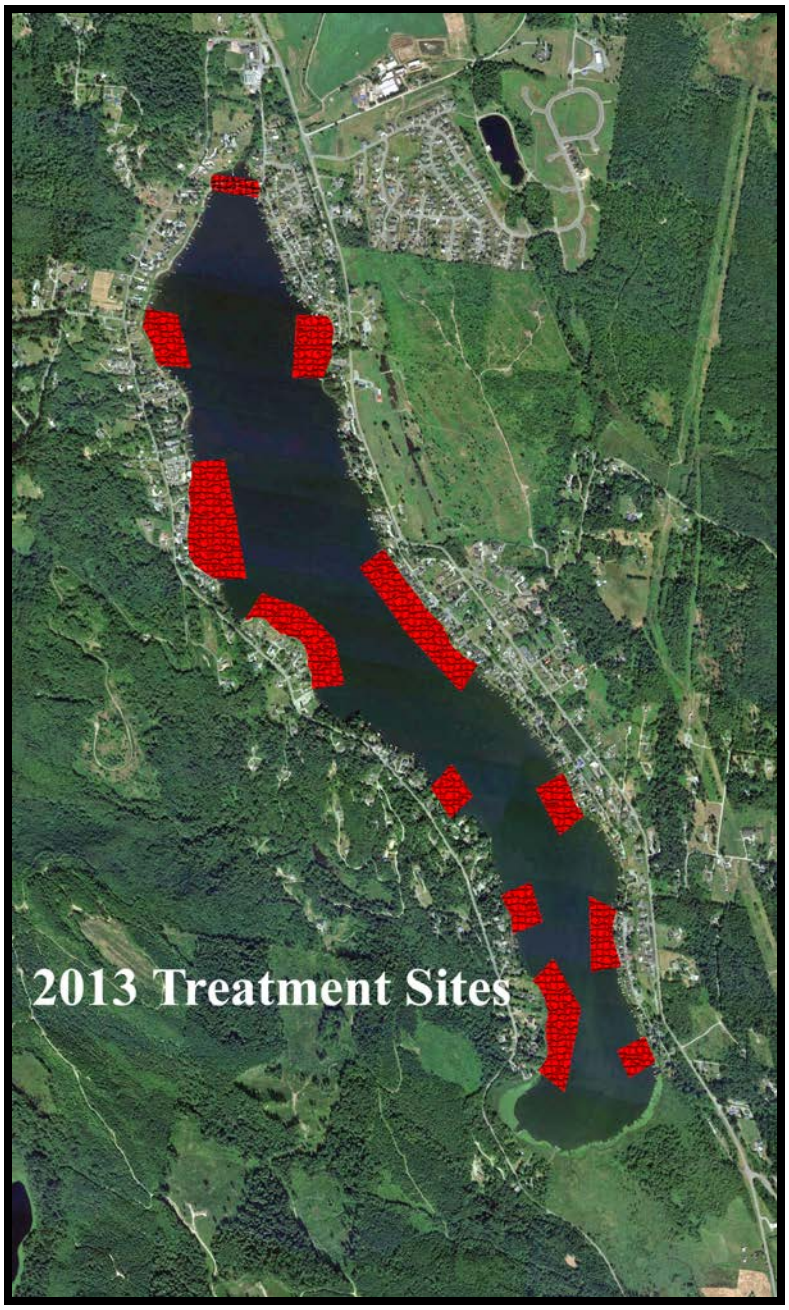
July 22 Treatment

Big Lake is 520 acres with a shoreline length of 6.2 miles. Under current NPDES guidelines, native macrophytes control is limited to no more than 30% of the shoreline or approximately 9,820 feet. “In water bodies over 500 acres in size the Permittee may intentionally apply herbicides to no more than 30 percent of the littoral zone”).

Our approach during 2013 was to continue to provide maximum coverage under the current NPDES guidelines. During our June 28 survey of the lake the total acreage of the lake was determined to be 555.6 acres. NWAE was hoping that this survey would define

the lake under 500 acres enabling a larger permitted area to treat. Lakes less than 500 acres are allowed treatment up to 50% of the shoreline. The 2013 treatment model was designed to adhere to the 30% rule and also expand treatment outward into the main water-body. This approach is commonly referred to as the "block treatment" scenario. During 2013 Aquathol K was incorporated into the spray mixture at one of the treatment sites in an effort to enhance control. As noted in the NPDES permit requirements the same areas treated during 2012 were again treated during 2013.

Shoreline posting was conducted the day prior to treatment. A two person crew initiated posting on July 21. Prior to posting a newspaper article appeared in the local paper outlining the projects purpose and the requested restricted lake use on the day of treatment. Information about the treatment was also broadcast over the local radio station. The public boat launch was posted with a large sign requesting that no boating occur during the treatment. All posting was completed by 6:00 PM. On the day of treatment material was offloaded from a locked truck container and transferred into two 25 gallon spray tanks mounted on the application boat. Containers were triple rinsed on site and returned empty back into the truck. Herbicides diquat and Aquathol K were applied utilizing an 18 foot airgator airboat. Lake water was drawn into the boat through intake ports located in the hull of the boat. Herbicide was then metered into the lake water via an injection manifold. Once the herbicide was injected, the water was then discharged back into the lake. Weighted hoses were then used to place the material at the appropriate depth in the water column. Prior to treatment a lake treatment map, identifying treatment plots, was downloaded into the onboard GPS system. The boat utilized the onboard GPS to identify treatment site boundaries. All of the targeted submersed sites were treated on July 22. Floating plants received treatment a few weeks later. Submersed weeds were treated with Diquat at a rate of one to two gallons per surface acre. Aquathol K was applied at a five gallon per acre rate in a tank mix with diquat.

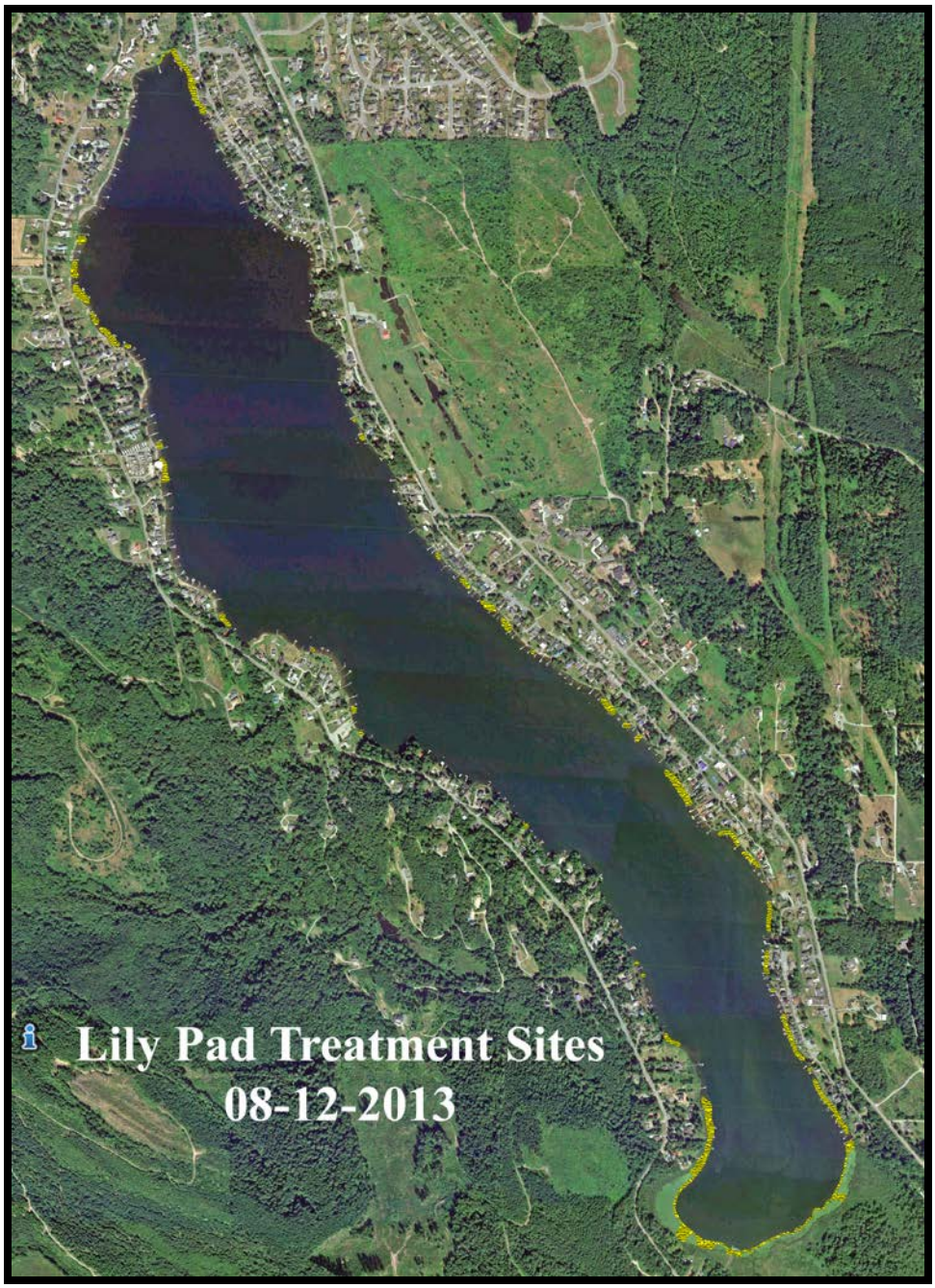

2013 Treatment Sites


Additional Milfoil
Treatment Sites

August 12 Treatment

Lily pads along the entire shoreline were treated. During 2012 windy conditions permitted only sections of the shoreline to be treated during the morning hours, once wind conditions exceeded label requirements spraying operations were halted. During our August 12 visit to the lake previous experienced wind conditions did not develop and treatment of all shoreline lily pad infestations occurred. Treatment initiated along the mid-western shoreline area and continued clockwise until the entire perimeter of the lake was travelled. An 18 foot aluminum boat equipped with one 25 gallon spray tank was incorporated into this spray event. The 25 gallon tank was filled with lake water, herbicide and surfactant was then added directly into the tank. Once mixed the application boat drove along the shoreline identifying targeted floating plants and the spray mixture was then discharged using a spray gun. When emptied the tank was refilled and dispensed as needed. Lily pads received a 1.5% solution of glyphosate sprayed directly onto the floating leaves.

During the spraying event a general inspection of the July 22, 2013 treatment sites were conducted. It appeared that all targeted sites had responded better to the 2013 application then the prior 2012 treatment. It is likely that this increased control rate was attributed to the fact that boating on the lake was restricted during the day of treatment. In the past wave action increased the dilution rate of the material and also increased the suspended sediment along those shallow shoreline treatment zones. During 2013 the amount of re-suspended sediment created by boat wakes in the water column was nearly nonexistent. Lake use was limited to only one or two boats. The increased effort to inform residents of the treatment and problems associated with high speed recreational boat use during treatment resulted in a more favorable environment for treatment.

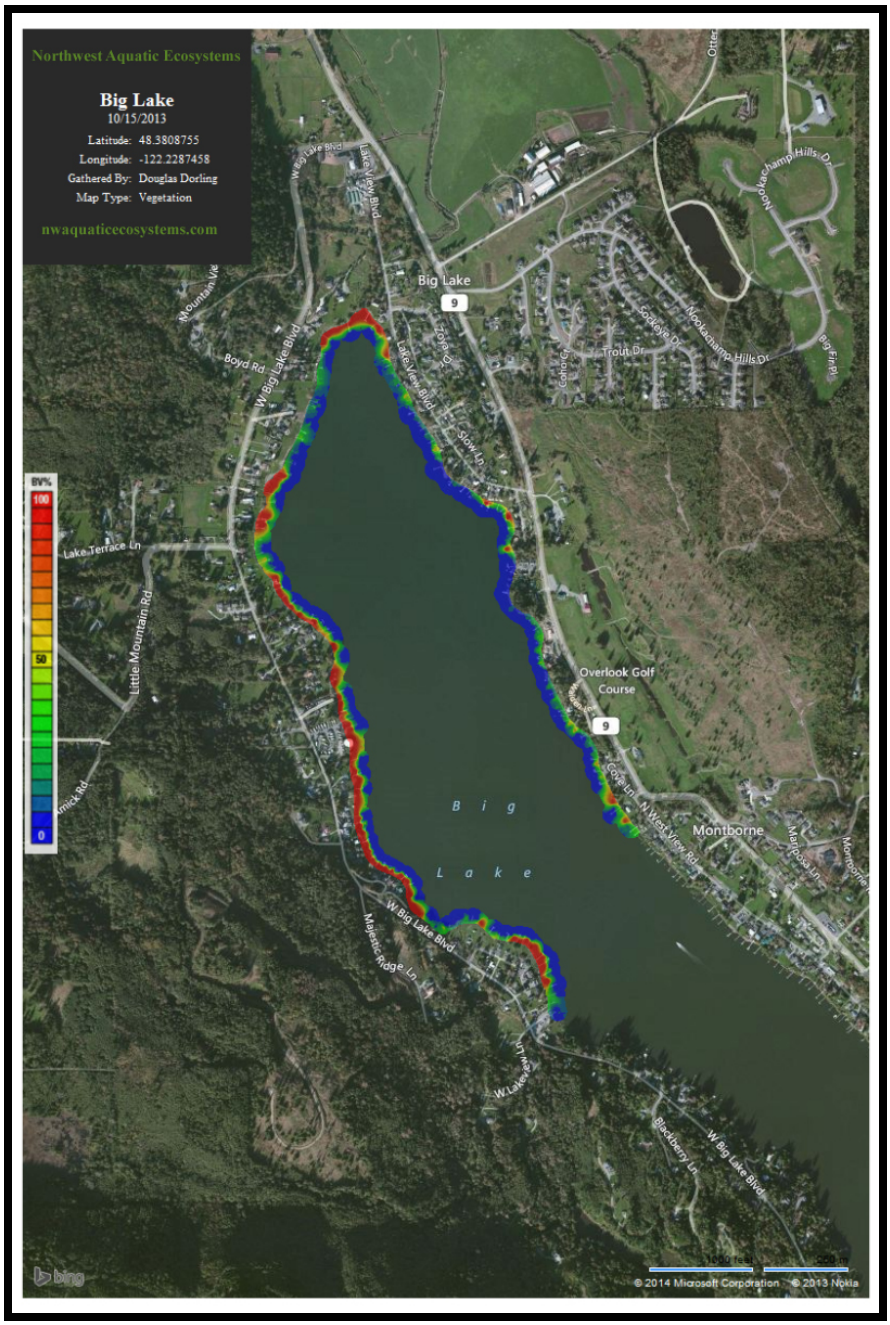


Fall Survey

The fall survey was performed on October 15, 2013. During the time of the survey a sever algae bloom was occurring. The bloom had been in progress for a number of weeks prior to the survey. Skagit County was monitoring the bloom. Bloom conditions created extremely poor water clarity with some areas of the lake supporting visibility issues of

less than one foot. The bloom appeared to be wind driven with the heaviest concentrations noted along the western and entire far southern area of the lake. As a follow up to our visual survey performed on August 12, 2013 the fall survey identified reduced plant growth lake wide. Control obtained during 2013 was far superior to what we observed during our 2012 campaign. There were no plants noted on the surface and many species were still decomposing from the summer application. Since the extreme southern portion of the lake was not treated this area can be utilized as a control for project evaluation. When evaluating weed growth in this lake section it became apparent that there was considerably more weed growth in the untreated portion of the lake. Not only were these macrophytes denser but they were also growing up to the waters surface. The survey also acknowledged that no seed heads were present. This is an important component in treatment of those weed species that reproduce from seed production. Since no seeds were produced this year the total seed bed available for germination next year was reduced. This reduction may not bring about a noticeable change in plant densities next year since aquatic seeds can stay viable in the bottom sediments exceeding five years. The 2013 effort did reduce the number of seeds that could potentially germinate during 2014.

Our fall survey was recorded on two different memory cards. Corruption of the card containing the data from the eastern half of the lake was not available for downloading and processing. Several attempts were made to recover the data, all efforts failed.



There were still some areas treated were the rich organic matter still created problems during treatment. This response was noted along the far southeast shoreline areas where soft rich black organic sediments were easily displaced by the treatment boat passing close to the shoreline area. A different approach in treating this area will need to be researched and incorporated into the 2014 program.

Increased lily pad control was also noted this year. Areas in the past where wind and wave action resulted in poor control exhibited extremely successful results. Many of these sites exhibited no less than a 50% reduction in the floating pads. A secondary

treatment was discussed and a decision to not treat was based on the algae bloom that was in progress.

The poor water quality during the fall survey restricted our efforts at possibly identifying all of the remaining milfoil plants. Although we were able to inspect those areas that had documented milfoil prior to treatment the effort to locate new plants may have resulted in inaccurate results. Limited milfoil regrowth had occurred. This is not an unusual occurrence when contact herbicides are used, expansion of the plant was not noted. Plants were individual in nature and very sporadic.

2013 Algae Bloom

Like many lakes throughout Washington State Big Lake experienced a late summer algae bloom. Historically lakes state wide that had never experienced a bloom noted bloom conditions during 2013. Typically blooms are created when an influx of nutrients are introduced into a system. These increased nutrients when provided adequate sunlight have the ability to stimulate a normal algae lake environment into one that is excessively productive. This productivity increases the algae populations to a point where the lake turns green. If the bloom continues lake conditions will degrade where thick green scums are noted on the lakes surface. These green scums are then windblown and accumulate along shoreline areas. Although a bloom may be lake wide noted thick green scums may be particular to only certain lake areas. As wind directions change the scum has a tendency to move from one lake area to another.

The 2013 summer produced a long dry spell and an early downpour of record rains. These rains flushed nutrients into many lake systems via inlets, storm drains and typical surface water runoff. The first rain after any long dry spell typically flushes all surface nutrients that have been collecting on the soils surface into the system. Late seasonal nutrient rich rains followed by sunny conditions has the ability to produce long lasting algae blooms. As the bloom continues algae cells die and decompose, upon decomposition nutrients are again released back into the water column. If the outflow waters are not great enough and the lake is not receiving nutrient free water the bloom will continue until water temperatures decline. All of the required elements necessary to produce and sustain a bloom during 2013 were present.

Typical severe algae bloom, Ocean Shores WA.

Recommendations

1. Continue the expanded notification to the property owners and local residents through newspaper articles, radio and LMD notifications. Emphasis again needs to be directed at no lake use during the treatment. This approach resulted in increased control efficacy.

2. Lily pad control operations should only be conducted during the morning hours and be completed by noon unless weather conditions are favorable and support later spraying. During 2013 the entire lily pad population was sprayed during one event.

3. Residents need to continue to be informed of the current weed growth conditions and what species are native and noxious species, what plants are targeted for control and what plants cannot be controlled.

4. Noxious species appear to no longer represent the problematic species lake-wide. The range and location of milfoil plants have stabilized and not much expansion has been detected. All of the milfoil is localized within two small areas of the lake and is now classified as subdominant. Plants currently coexist in mixed stands of native species. Milfoil can now seasonally be controlled with either contact herbicides or specifically targeted with systemic materials. How these plants are controlled and what materials should be applied requires evaluation preceding the spring survey.

What actions may or may not be implemented will probably change on a year to year basis.

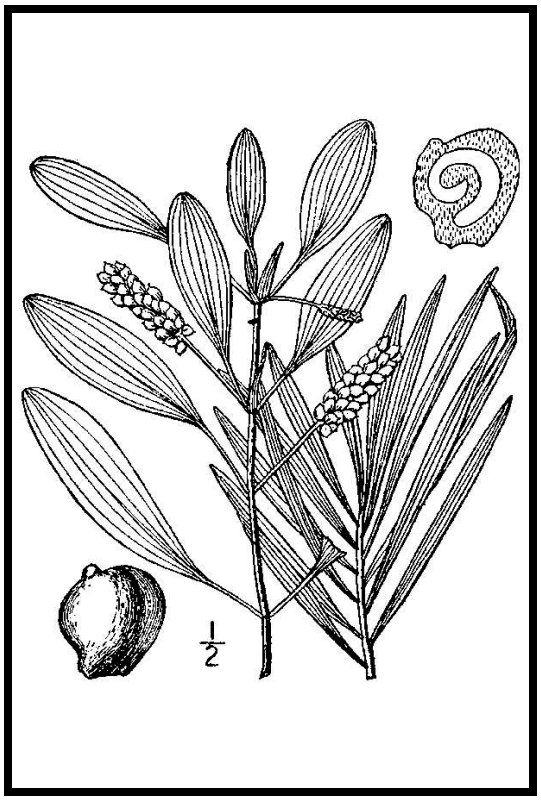
5. The spring survey should be considered the more important of the two scheduled surveys. This survey will determine what plants are targeted and what materials will be used during any treatment year. The late summer survey is performed too late in the season to direct any further native weed control operations. In general this survey will identify where successful control operations occurred and the need for any additional late season milfoil treatment.

6. Continued expand use of the contact herbicide Aquathol K. Use of the material during 2013 proved to be successful in controlling some pondweeds not susceptible to diquat. Use should also include tank mixes of both diquat and Aquathol K.

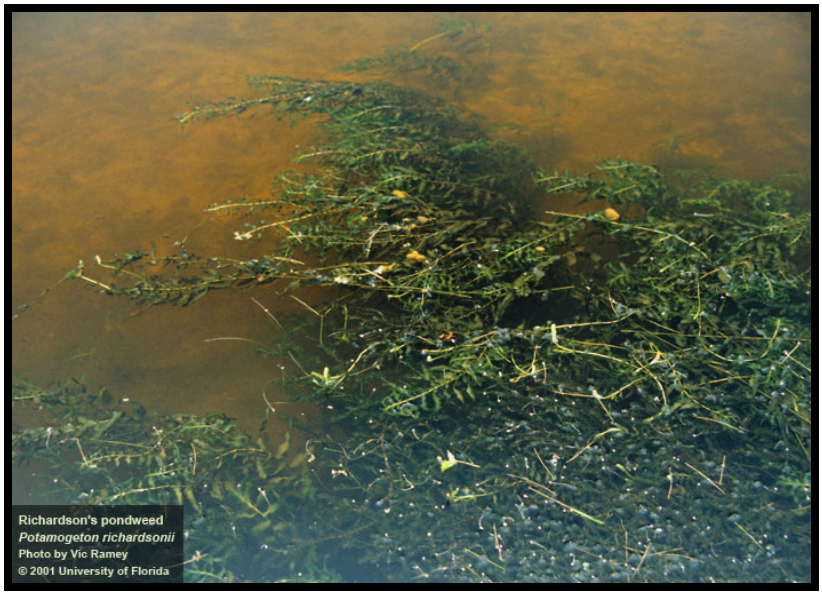
7. Continued use of the new mapping technology. This technology provides an excellent visual evaluation of weed conditions lake wide. The resulting map can be understood by all users of the lake and requires no in-depth technical background for review. The technology also provides an excellent reference to visually show a property owner if problematic weeds are present at their parcel.

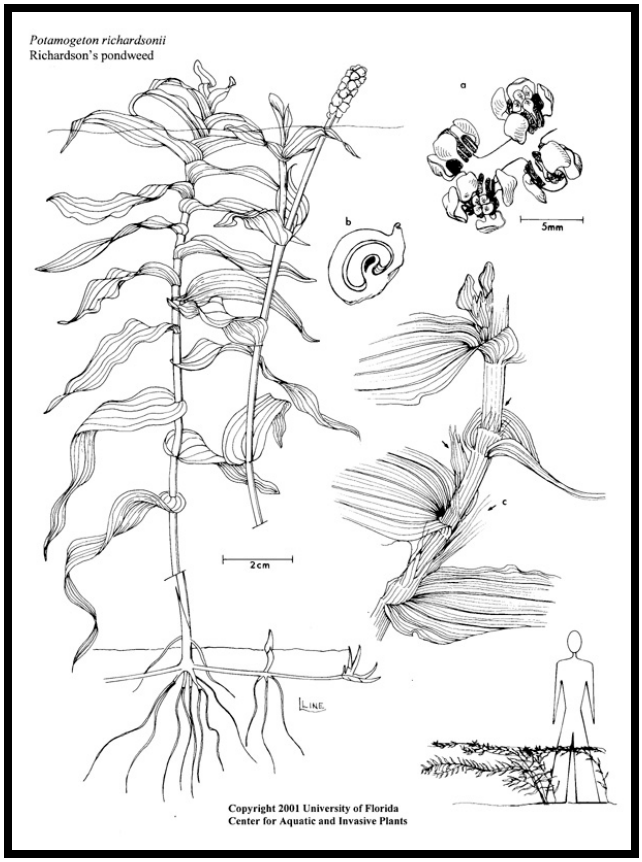
Dominant Submersed Macrophyte Species

Potamogeton epihydrus

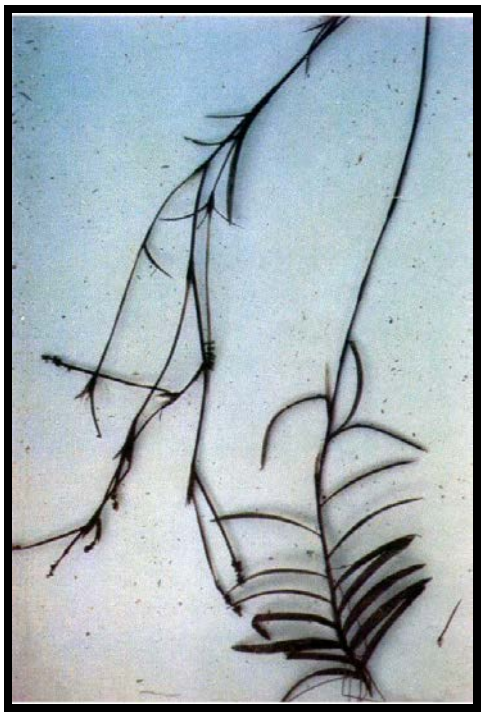


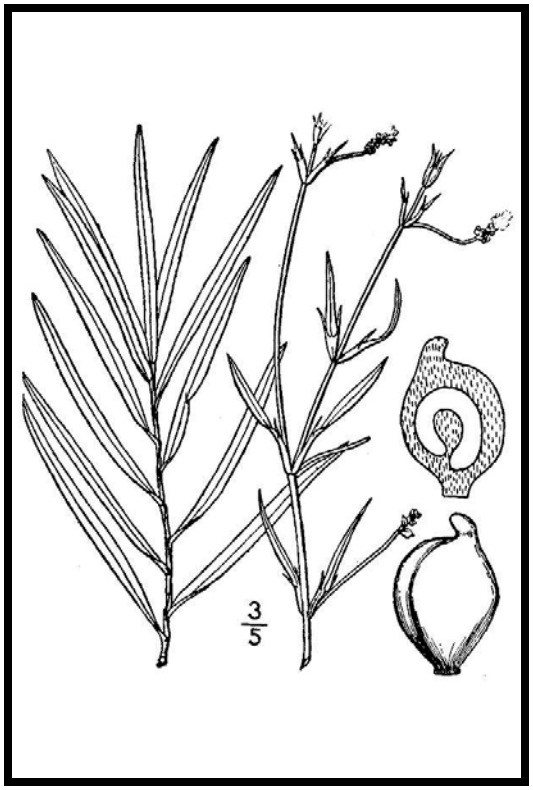
Potamogeton richardonsii





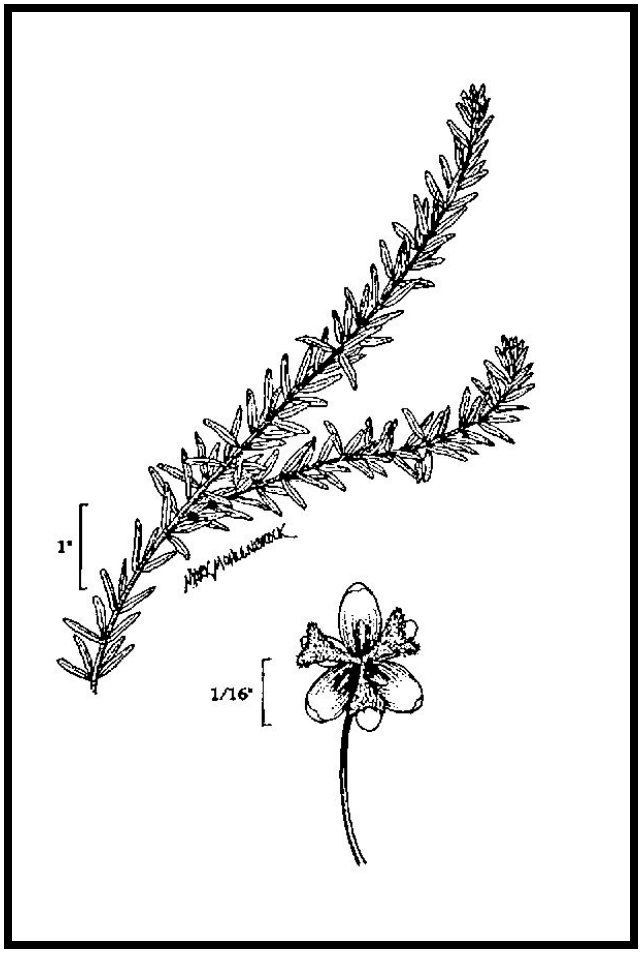
Potamogeton robbinsii





Potamogeton foliosus

Elodea canadensis



Vallisneria americana