Aquatic Plant Treatment Evaluation

Purpose and Applicability
This protocol is used to evaluate the results of herbicide application or any other manipulation (but from here on called a chemical application or treatment) to reduce aquatic invasive plant species. The following protocol is applicable for introducing new treatments to lakes where the treatment size is greater than 10 acres or greater than 10% of the lake littoral area and more than 150 feet from shore*. It is designed to satisfy AIS grant-funded treatment conditions where restoration is a goal or where performance results are needed (i.e. for scientific or financial accountability). This protocol is written for Eurasian water-milfoil (EWM) but can be adapted for Curly-leaf pondweed and other aquatic invasive plants. This protocol may be adapted to evaluate non-herbicide controls.

This protocol assumes that the lake group has an Aquatic Plant Management (APM) Plan in place with specific goals for the native and invasive species in the lake. For example, the group should choose a percent decrease in the target plant area coverage or frequency of occurrence for an annual goal of at least 50% for restoration projects. For an overall long term goal, a reduction to less than large scale treatment (less than 10 acres or 10% of lake littoral area) where annual spot treatments can sustain low level occurrences is reasonable. Additionally, a goal of reducing the density of EWM beds by one category (for example, from high density to medium density, or from an average rake fullness of 2.5 to 1.5) might be appropriate. An acceptable native response is no significant net loss over the course of the project, and ideally some gain.

We are aware that this approach necessitates several visits to the lake per year. This work is necessary to assess the overall success of chemical treatments at reducing invasive species and at enhancing native species. After we learn how each lake responds to the treatment, we hope and expect that we will be able to cut back on the annual evaluations. For now, we need rigorous data collection that will help deal with invasive aquatic plants.

Reporting requirements are provided at the end of each step in the protocol. These are provided as a basis for improving consistency in analysis and reporting and can be used to interpret and discuss pre- and post-treatment results and in making next season's management recommendations. Please refer to this description as a guide on how to fulfill the requirements of the grant.

*Note that whole-lake scale treatment projects (those involving ≥160 acres or ≥50% of the lake littoral area) may follow a slightly different protocol, as described in the text. For newly discovered or pioneer populations of EWM (defined as a localized bed that has been present less than 5 years and is less than 5 acres in size or less than 5% of lake area whichever is greater), consult *Response for Early Detection of Eurasian Water Milfoil Field Protocol* available from the WDNR web site.

Section I. Protocol

Year 1 Season before treatment

1. *Establish baseline information about plant community*.
    a. In the season prior to a chemical treatment, perform a whole-lake summer point/intercept (P/I) survey to characterize the entire plant community if it has not been done within 5 years.
    b. Details on the protocol for conducting plant surveys can be found in *Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications*.
    c. Report Requirements: Baseline Lake Point Intercept Survey
        i. Table: Frequency of Occurrence for all species (this is calculated automatically in the "Stats" worksheet of the Aquatic Plant Survey Data Workbook.
        ii. Table: Species list
        iii. Map: Rake fullness (1, 2, 3) for all aquatic invasive plants (see example, Figure 1.)
        iv. Maps: In order to assess species interactions and chemical impacts on non-target plants, map other plants as appropriate (such as wild rice, other common plants, other common dicots, species of concern, other water-milfoils – consult APM plan or local DNR lake manager) similar to Figure 1. You may need a separate map for each species or group of species.
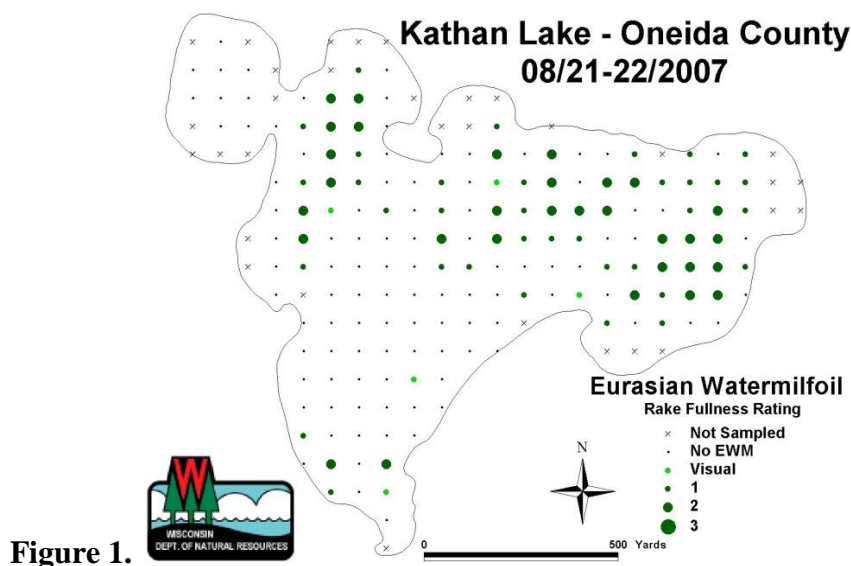

Figure 1.

2. *Identify and map plant beds proposed for treatment*
    a. During the summer or early fall growing season prior to the chemical treatment, map the proposed treatment areas of EWM and identify these polygons using GPS

to outline the beds. As explained below (<u>Year 1 Season before treatment</u> 4.), all species within the proposed treatment polygons must be assessed, and native should be assessed before Sept 1 in northern WI and late September in the south.

    i. The initial P/I survey is unlikely to identify every stand of EWM. Map the invasive beds using a number of strategies such as:

        1. Use a meander search (boat out from shore to the maximum rooting zone and then head back to shore, a short ways down the shore from where you started) to find beds.

        2. If clarity is good (to the depth of rooted plants) and the EWM bed is topped out, identification can be visual but must be augmented with rake tosses to verify species identification and find the edges of the bed. Under glare conditions, brown polarized sunglasses are helpful.

        3. If visibility is limited, SCUBA, underwater video and an Aqua-View Scope are all highly recommended to make a complete assessment of the beds.

        4. Look for plant fragments wind-rowed on shore as an indication that plants may be growing off shore from this point.

    ii. Note that in order to secure a chemical treatment permit, the applicant must know the acreage and location of the treatment areas.

b. Report Requirements: Polygons of EWM for treatment

    i. Maps: Map beds of EWM treatment areas

        1. Identify beds using numbers or letters (see example, Figure 2.)

Figure 2.
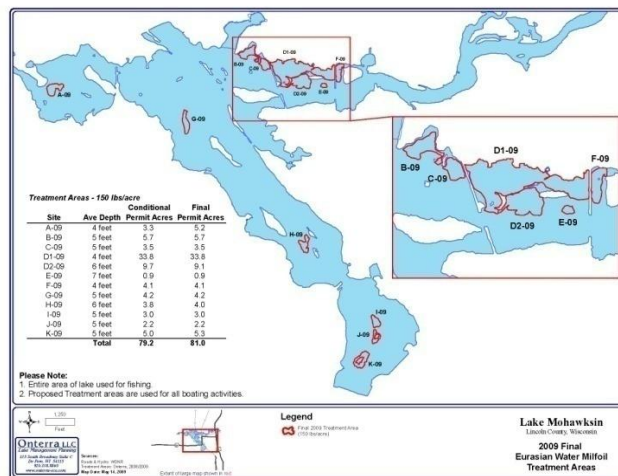
ii. Table: Report information about polygons to be treated, including acreage, depth, substrate, number of sampling points and treatment dose and density* (see example, Table 1.).

        1. *Density: To characterize density of individual polygons and help guide treatment decisions, estimate the coverage of EWM within individual polygons. Use this qualitative metric in conjunction with the quantitative metric of rake fullness. Examples of categories could

be low, medium, high or single plants, clumps, scattered, dominant, highly dominant, surface matting).

Table 1. Polygon Treatment Data (example data)

EWM Beds	Acreage	Mean depth	Substrate	PI points	Treatment rate (lbs/acre)	Density
a	1.2	4	Sand	5	100	low
b	0.8	8	Muck	5	150	medium
c	5.6	5	sand/muck	25	100	medium
d	12.3	6	Muck	50	150	high
e	2.4	7	Muck	15	150	low

3. *Confirm EWM identification.*
    a. Collect one EWM plant from each large (> 5 acres) treatment polygon where these exist, but collect at least 3 plants per lake.
    b. These EWM plants may be collected in the summer/fall before the treatment year or spring just before treatment, but the identification must be confirmed by the DNR or appropriate university personnel before treatment takes place. The DNR may ask to see a specimen from either the fall or the spring survey.
    c. Report Requirement:
        i. Document EWM identification by the DNR or appropriate university personnel.
4. *Conduct PI Survey in Proposed Treatment Polygons.*
    a. In order to assess the effect of chemical treatment on natives, there must be a survey of <u>all</u> plant species in the treatment polygons before treatment. However, since natives will be largely absent at the time of the spring pre-treatment survey, the natives must be assessed the summer before treatment (before September 1 in northern WI and by mid-late September in the south). Therefore, after defining the proposed treatment polygons (2a above), perform a presence/absence, rake fullness, and depth assessment of all plants at a sub-sample of points within and near the polygons as follows (Table 2.):
        i. Sample at least 100 points per lake among the beds
        ii. Sample a minimum of 4 points (to ensure enough detail of the plant beds) but a maximum of 10 points (the maximum resolution of many GPS units) per treated acre.
        iii. The points needn't be spread evenly across all treatment polygons, but it will be most informative to distribute the points among the largest polygons.
        iv. Record the point locations as they will be used again the following year. (It is not necessary to report these locations, but they will be needed for report maps eventually)
        v. By sampling 100 points for the pre- and post-treatment survey, you will be able to detect a 20% or larger change in species frequency (of both natives and the target species).
            1. You would have to sample many more points (approximately 350 points) to see a 10% change in a species frequency.

Table 2. Number of points to sample in proposed treatment polygons (polygon subsample points), based on total acreage of treatments to be evaluated.

Area to be treated (acres)	# of Points to sample
10	100
20	100
30	120
40	160
50	200
100	400

    b. If the proposed treatment area consists of more than 50% of the lake littoral area, or whole-lake scale treatment methods are being used (i.e. liquid applications), then this step (identification of and sampling polygons) is omitted.

        i. Instead, whole-lake P/I surveys should be conducted each year following treatment for the purposes of post-treatment evaluation.

        ii. More intensive monitoring in some polygons may be warranted for evaluating treatment effectiveness or fine-tuning treatment regimes.

    c. Report Requirements:

        i. Map: Map polygons to be treated and locations of all the points to be sampled within the polygon (polygon subsample points) (see examples Figures 3. and 4.).

        ii. Map: Rake fullness (1,2,3) for all aquatic invasive plants within polygon subsample points. This map will look like Figure 1, but for each polygon.

        iii. Map: In order to assess species interactions and chemical impacts on non-target plants map other plants in polygon subsamples as appropriate (such as wild rice, other common plants, other common dicots, species of concern, other water-milfoils). This map will look like Figure 1, but for each polygon. Consult DNR lake manager or APM plan.

        iv. Table: Frequency of occurrence for all species for all polygon subsample points (use the "Stats" worksheet of the Aquatic Plant Survey Data Workbook).

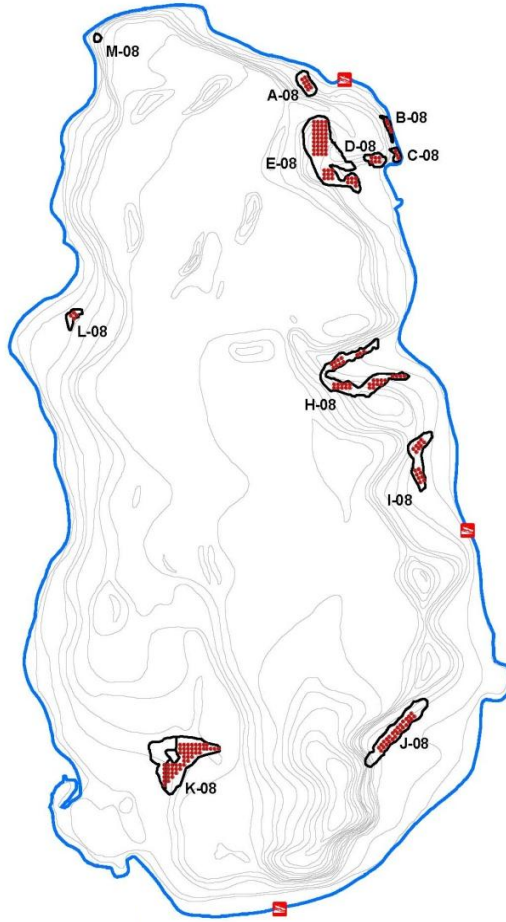   v. These report requirements should be coupled with post-treatment results and available after evaluation.

Figure 3.

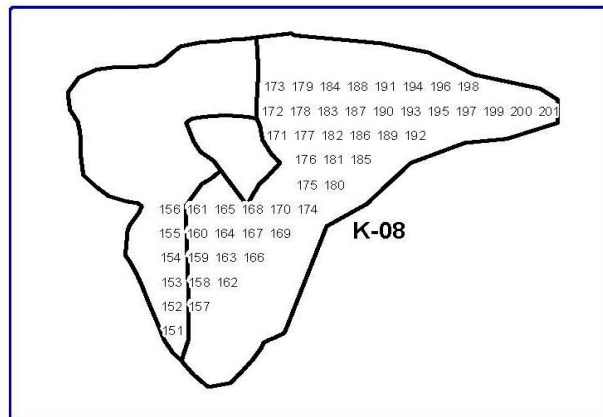**Figure 4.**

Year 2 First treatment

1. *Pre-treatment Survey - Spring just before treatment*
   a. Verify EWM is growing and finalize treatment areas. Plants may be small, and may be sparse this time of year. Underwater visual/video of the middle and edges of the proposed polygon is highly recommended. Adjust the delineation of the treatment area, if necessary.
   b. Report Requirements:
      i. Map and Table: Updated map and table as in Year 1 Season before treatment (see 2.b.i and 2.b.ii. above).
         1. Optional: Repeat the P/I survey in the proposed treatment survey polygons sampling only for EWM (e.g. this may be warranted if the lake is part of a research project).
         2. Map: Map presence/absence of EWM in polygon sites. This map will look like Figure 1, but for each polygon.
      ii. This step may be omitted for whole-lake scale treatments (where it is not necessary to define individual treatment polygons, e.g. when liquid herbicide is applied over large areas).

2. *Conduct Treatment.*
   a. It is best to conduct the treatment as close to ice-out as possible for several reasons.
      i. Many studies have shown that the chemical herbicides are effective at temperatures normally found in lakes just after ice-off.
         1. One exception is endothall products, which are not as effective at temperatures below 50° F, but should still be applied early in the season to avoid impacts to natives.
      ii. The best results are obtained when the biomass of the invasive is still low, so that there is less decomposing plant material and consequently less demand for oxygen that could rob other living organisms of oxygen.
      iii. It is best to treat before the natives are growing fast, so that they are minimally affected by the chemical.
   b. Therefore, treatment should occur in early spring (after ice-out), when EWM is actively growing throughout the proposed treatment areas (optimally around 6 inches tall).
   c. If optimal conditions for treatment have not occurred prior to May 31, consult with the DNR to confirm if treatments may go forward. It is possible that treatments are unnecessary or would be detrimental to the native plant community if conducted too late in the season.
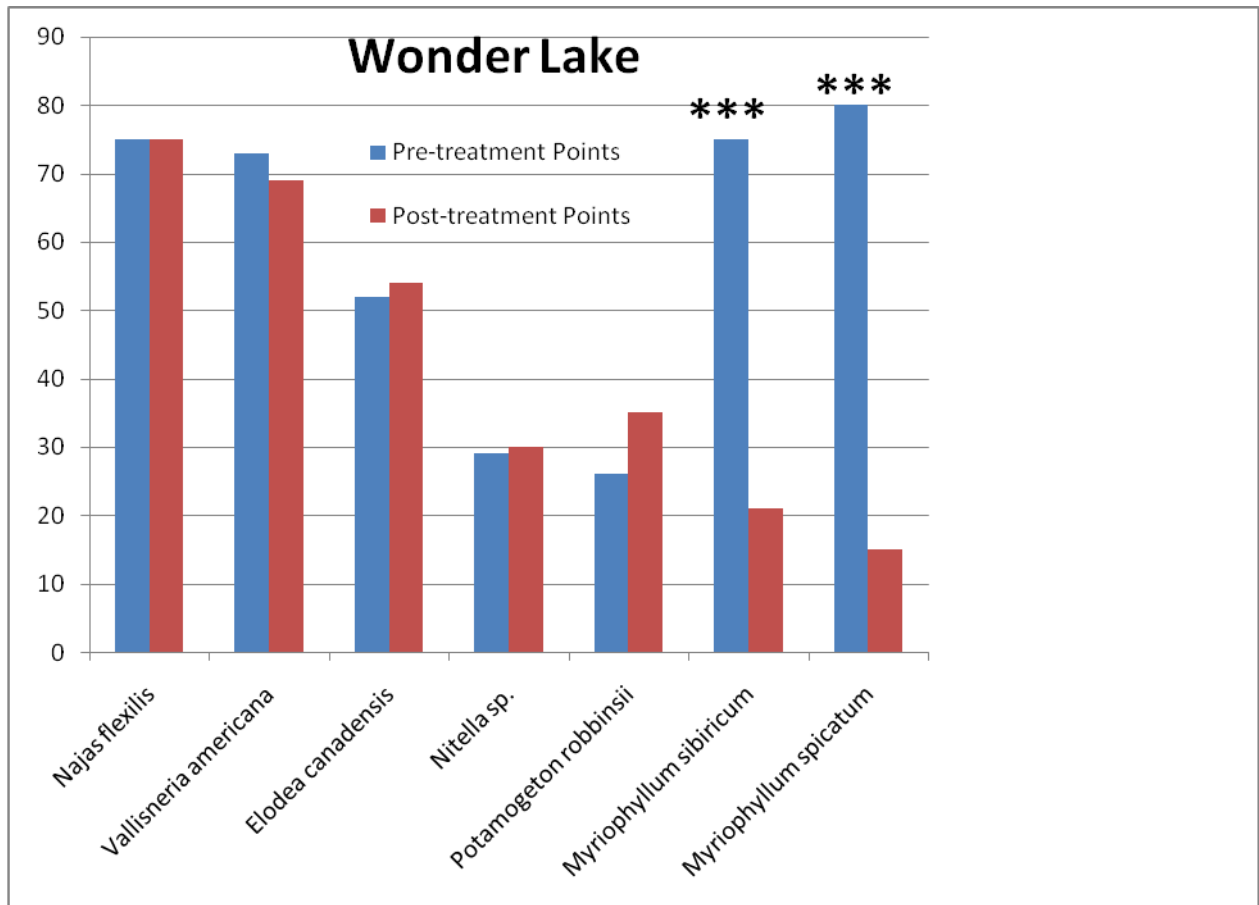
3. *Post-treatment Survey*
    a. A post-treatment survey should be scheduled when native plants are well established, generally mid-July through mid-August.
    b. If treating curly-leaf pondweed (CLP), a post treatment survey needs to be completed before CLP seasonal growth ends, possibly before many natives are easily visible (i.e. mid-June). Consult with the DNR to determine the optimal time to do a post-treatment survey for CLP.
    c. For the post-treatment survey, repeat the P/I for all species in the treatment polygons, as was done the previous summer
        i. For whole-lake scale treatments, a full lake-wide P/I survey should be conducted.
    d. To compute the significance of results from the pre- and post-treatment surveys (pre-treatment survey in summer of Year 1 and post-treatment survey in summer of Year 2) see the *Compute Pre & Post Data sheet*.
    e. Report requirements:
        i. Map: Rake fullness (1,2,3) for all aquatic invasive plants within polygon subsample points. This map will look like Figure 1, but for each polygon.
            1. For whole-lake scale treatments, map results from full lake-wide P/I survey.
        ii. Map other plants in polygon subsamples as appropriate (such as wild rice, other common plants, other common dicots, species of concern, other water-milfoils). This map will look like Figure 1, but for each polygon. You may need a separate map for each species or group of species.
        vi. Table: Frequency of occurrence for all species, including EWM, for all polygon subsample points (use the "Stats" worksheet of the Aquatic Plant Survey Data Workbook).
        iii. Optional Maps: In order to assess species interactions and chemical impacts on non-target plants, map other plants in polygon subsamples as appropriate (such as wild rice, other common plants, other common dicots, species of concern, other water-milfoils). This map will look like Figure 1, but for each polygon. Consult DNR lake manager or APM plan.
        iv. Table: Report the number of sites where each species was found pre- and post-treatment and how the frequency changed with treatment using the pre/post Chi Square evaluation (see example, Table 3.) Please see the *Compute Pre & Post Data sheet*).
        v. Graph: Create bar graph of pre- and post-treatment results for all species, noting significant changes (see example, Figure 5).
        vi. Graph: Report rake fullness for pre- and post-treatment (see example Figure 6.)
        vii. Text: Summarize results from this survey and compare them with the results from the pre-treatment survey in order to
            1. evaluate the effectiveness on target plants,
            2. evaluate any harm or benefit to native plants
            3. revisit goals and recommend a plan for the future
        viii. Identify next year's potential treatment areas for target plants.

Table 3. Wonder Lake

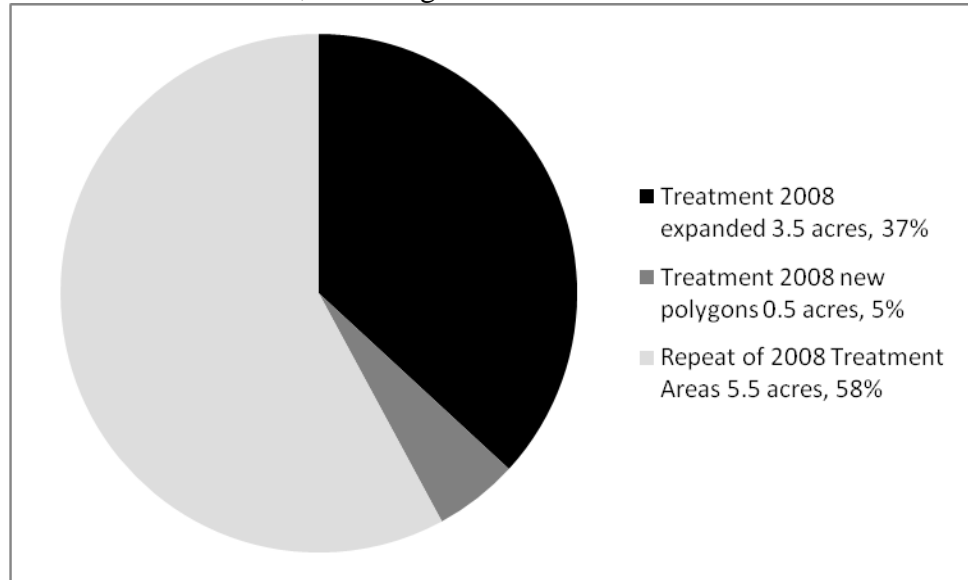|	PRE present	POST present	p	Significant change	Increase/ Decrease (proportional to # sampling points)
pre-treatment survey total points	85				
post-treatment survey total points	75				
Myriophyllum spicatum	55	0	0.00000	***	-
Ceratophyllum demersum	21	30	0.03829	*	+
Elodea canadensis	52	31	0.01218	*	-
Potamogeton robbinsii	38	60	0.00000	***	+
Potamogeton pusillus	2	15	0.00030	***	+
Potamogeton amplifolius	19	35	0.00117	**	+
Vallisneria americana		18	0.00000	***	+
Chara	15	8	0.20915	n.s.	-

Figure 5.
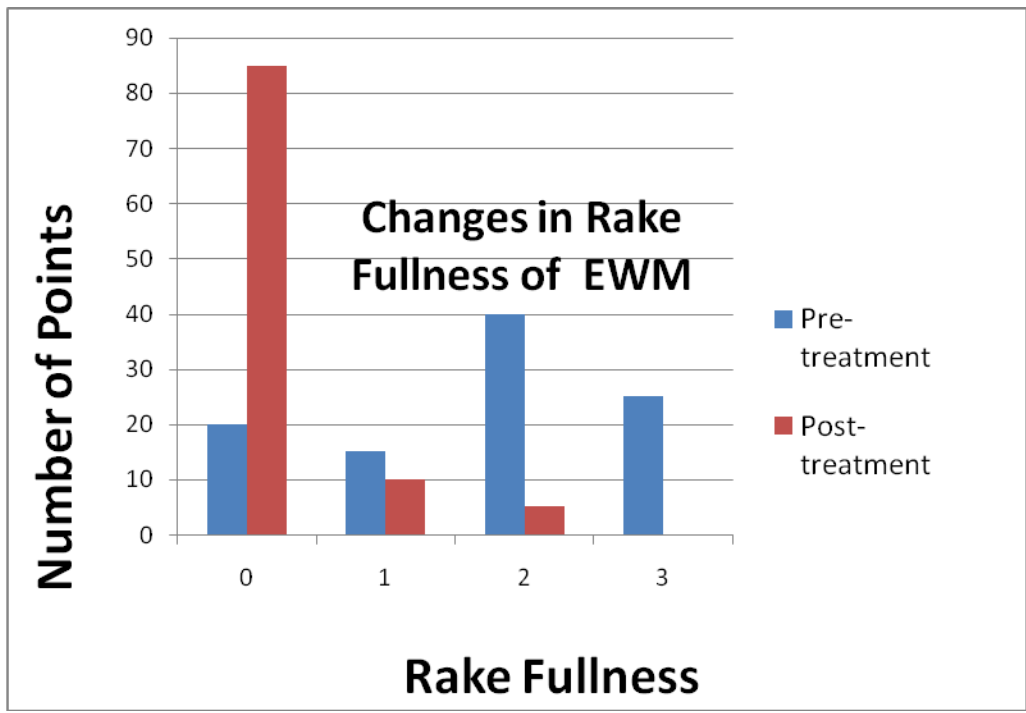
Figure 6.

4. *Get ready for Years 3 and 4*
    a. If further treatments are needed in subsequent years, go back to Year 1, step 2 and repeat all steps.
    b. If one or more polygons treated in Year 2 will be treated again in Year 3 the post-treatment survey results for those polygons in Year 2 can serve as the proposed treatment survey for the treatment to be done on them in Year 3.
    c. If any proposed treatment polygons are different in any way from polygons already treated, the new polygons must be sampled as if they are brand new.
    d. If a whole-lake P/I survey is conducted as part of a whole-lake scale treatment evaluation, this serves as the pre-treatment survey for Year 3.
    e. Report Requirements
        i. Graph or Table: (Optional) In addition to the reporting requirements from all the steps that will be repeated (starting at Year 1, step 2) present a summary of acreages to be treated in the subsequent year(s), partitioned into repeated versus expanded versus new areas (see example, Figure 7.).

Figure 7. Proposed treatment for 2009, including treatment areas in 2008.

- ■ Treatment 2008 expanded 3.5 acres, 37%
- ■ Treatment 2008 new polygons 0.5 acres, 5%
- ■ Repeat of 2008 Treatment Areas 5.5 acres, 58%

5. *Get ready for Year 5*
   a. Follow the protocol for "Get ready for Years 3 and 4" above.
   b. Conduct a lake wide P/I survey (repeat base year) to gauge overall lake community response.
   c. Use the P/I results to update the management plan.
   d. Consult with a DNR lake coordinator to adjust your APM plan goals.