Response of *Myriophyllum heterophyllum* and non-target plants in Lake Winnisquam to three different herbicides

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Introduction:

Variable milfoil (*Myriophyllum heterophyllum* Michx) is the most widespread invasive aquatic plant in freshwater lakes and ponds in New Hampshire. Recent herbicide evaluations completed by the US Army Engineer Research Development Center (ERDC) determined that 2,4-D BEE (granular formulation) was the most effective herbicide for control of New Hampshire strains of variable milfoil (Netherland and Glomski, 2007). Two other auxin-mimic herbicides, 2,4-D amine and triclopyr amine, did yield effective control of variable milfoil at higher use rates in this same experiment. Results of field applications can vary from the laboratory results due to dissipating herbicide concentrations over time from water exchange, diffusion, plant uptake and adsorption and herbicide breakdown (Green and Westerdahl, 1990).

Objective:

The current study was performed to evaluate the difference in field treatment efficacy of Navigate (2,4-D BEE granular), Renovate Max-G (triclopyr amine and 2,4-D amine granular) and Sculpin G (2,4-D amine granular) for variable milfoil control in Lake Winnisquam in 2010.

Methods:

- In 2010, three experimental sites and one control site were established on Lake Winnisquam, located in Laconia New Hampshire.

Table 1: Selected sites, basic parameters and treatment protocol:

	Area (acres)	Depth Range (feet)	Average Depth (feet)	Bottom Type	Herbicide	lbs/ac	ppm a.e.	Total lbs
North End	9.2	1 to 9	5	silt/organic and sand	Navigate	125	1.75	1150
Sunray Shores	7.2	1 to 12	5	organic and sand	Renovate Max G	150	1.6	1080
Ephraim's Cove	9.1	1 to 8	4	silt/organic and sand	Sculpin G	120	1.82	1092
Control Site	1	1 to 8	3	silt/organic and sand	Control	--	--	--

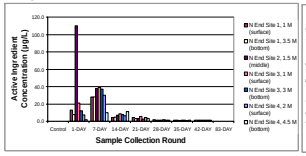
Lake Winnisquam - Study Site Locations

- Point intercept surveys utilizing a standardized 27.4 meter grid were performed approximately two weeks pre-treatment and twelve weeks post-treatment.
- During the surveys the following information was recorded at each data point location: water depth, aquatic plant species present, milfoil relative abundance for each of three throw rake tosses and total fresh weight of variable milfoil stems for three throw rake tosses.
- The proportion of sites where variable milfoil was still present post-treatment for each experimental group and the control were compared utilizing a Chi Square test followed by the Marascuilo Procedure post-hoc testing (0.05)
- Average relative abundance and fresh weight measures were compared utilizing an unmatched Analysis of Variance followed by Tukey-Kramer post-hoc testing. (0.05)
- Species richness was compared utilizing a Kruskal-Wallis followed by LSD post hoc testing for comparison of all sites and Mann-Whitney testing to compare pre-treatment and post-treatment conditions in individual sites.

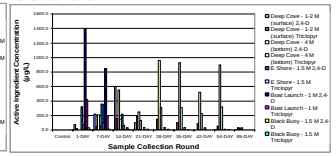
Results:

Herbicide Residue Testing Showed Variation in Concentration-Exposure Time (CET) Relationships Among Treatments

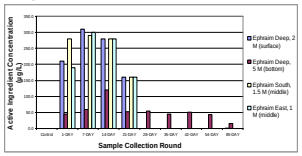
Navigate



Renovate Max G



Sculpin G



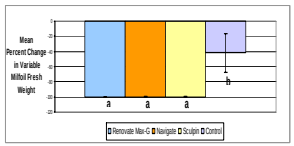
- Similar acid equivalents of active ingredient for all three herbicides were utilized in the treatments (Table 1) and yet the concentrations just one day after treatment differed considerably between treatment groups.
- Throughout the treatment period in the Navigate treatment site, notably lower concentrations of 2,4-D were observed. These low concentrations could be the result of several factors including but not limited to higher flow through the Navigate treatment site, differences in the inert carriers (granules) of the herbicides and water chemistry interactions with the ester (Navigate) verses the amine formulations (Renovate Max G and Sculpin G).

Applied Herbicide Did Not Affect Variable Milfoil Control

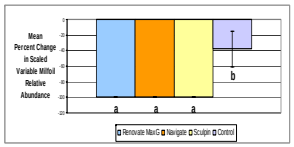
Table 2: Variable Milfoil Frequency of Occurrence:

Study Site	Pre-treatment	Post-treatment
Renovate Max G	43%	3%
Navigate	50%	3%
Sculpin G	56%	2%
Control	100%	100%

Variable Milfoil Fresh Weight



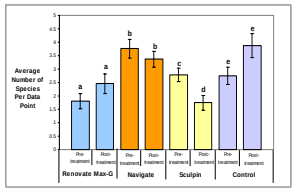
Variable Milfoil Relative Abundance



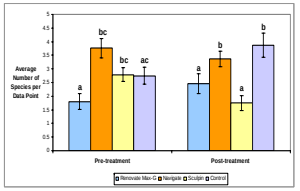
- In the above parameter comparisons significant differences were observed between the control site and all treatment sites and no significant differences were observed in any of the pair-wise comparisons between the treatment sites.

Species Richness Measurements Varied Among Study Sites

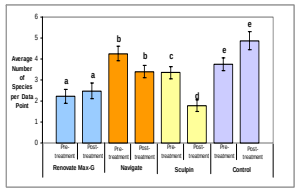
Native Species Richness Change in Individual Sites



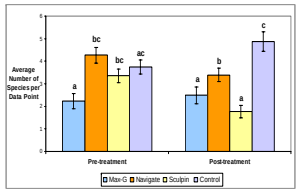
Native Species Richness Site Differences Pre-treatment and Post-treatment



All Species Richness Change in Individual Sites



All Species Richness Site Differences Pre-treatment and Post-treatment



- The above graphs depict the results of the statistical comparisons of species richness. Within a grouping no statistically significant difference was observed between sites sharing at least one letter.
- Among the comparisons of individual study sites, a statistically significant decrease in species richness was only observed in the comparison of the pre-treatment and post-treatment conditions at the Sculpin G study site. This decrease may have been amplified by the blue-green algae bloom conditions observed during the post-treatment survey, which resulted in a reduction in light penetration to macrophytes.

Conclusions:

At this level of scrutiny no significant difference of control of variable milfoil in lake Winnisquam was observed in 2010. For the three products tested this experiment provides some empirical field-based evidence for the argument that rather than product efficacy being the deciding factor for which product to use for variable milfoil control, the particular attributes of the treatment area (i.e. flow, water chemistry, non-target species assemblage and selectivity requirements, etc.) and the corresponding characteristics of the different chemicals (i.e. water use restrictions) should be considered.

Literature Cited:

Green, W. R. and H. E. Westerdahl. 1990. Response of Eurasian watermilfoil to 2,4-D concentrations and exposure times. *J. Aquat. Plant Manage*. 28: 27-32.

Netherland, M. D. and L. M. Glomski. 2007. Evaluation of aquatic herbicides for selective control of variable milfoil (*Myriophyllum heterophyllum* Michx). Final Report to the New Hampshire Dept. of Environ. Services. 96 pp.

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