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# Darrin Fresh Water Institute

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A Research Center of Rensselaer Polytechnic Institute

*A Hydroacoustic Survey of the Bolton Bay area of  
Lake George, New York  
for the Presence of Eurasian Watermilfoil*

prepared for  
The Fund for Lake George

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## EXECUTIVE SUMMARY

Within the framework of the NYS Milfoil Eradication Grant, the Darrin Fresh Water Institute (DFWI) completed a detailed accounting of the aquatic plant resources found in Bolton Bay, a major embayment to Lake George. Surveys were performed with hydroacoustics equipment, analyzed with mathematical algorithms developed at the DFWI and ground-truthed to ensure accuracy. The surveys identified two previously unknown Eurasian watermilfoil locations and confirmed one existing location of known and managed milfoil growth. In addition, the surveys provided aquatic plant distribution and 1 meter resolution bathymetric (depth) maps of the Bolton Bay area of Lake George.

## INTRODUCTION

The Darrin Fresh Water Institute (DFWI) has conducted aquatic plant (macrophyte) assessments of Lake George since the early 1970s. With the discovery of Eurasian watermilfoil (*Myriophyllum spicatum* L.) in 1985, aquatic plant assessments took on an added role of plant management. Eurasian watermilfoil (EWM) management activities based on physical control techniques (hand and suction harvesting and benthic barrier) were initiated in 1989. Management activities have been supported by state, federal and local sources. Federal financial support for EWM management in Lake George ended in 1993. In 1995, a multi-year program incorporating hand harvesting, suction harvesting and benthic barrier was initiated and continued through 2001 (Boylen et al. 1997; Eichler et al. 1993: 1995). In 2002, the aquatic plant management program was awarded to Lycott Environmental Services as a consultant to the Lake George Park Commission (LGPC). The DFWI continued to provide a limited EWM monitoring effort with support from the LGPC and the FUND for Lake George. EWM clearly remains one of the most visible threats to the Lake George ecosystem. A serious and systematic effort to monitor this invasive species is of utmost importance for its management and control.

Within the framework of a NYS Milfoil Eradication Grant awarded to the FUND for Lake George, the DFWI completed a detailed accounting of the aquatic plant resources found in Bolton Bay, a major embayment to Lake George. This was accomplished by utilizing hydroacoustic technology to ascertain the extent of plant growth, to accurately delineate percent plant cover and to identify the presence, location and size of invasive EWM beds. In addition, the work refined established protocols for the identification of native aquatic macrophyte communities using hydroacoustically generated algorithms. Surveys were completed in Bolton Bay during the Fall of 2008.

## METHODS

Management of EWM is a labor-intensive pursuit. Previous management programs on Lake George have been slowed by limited survey information and inadequate determination of existing EWM populations. It is impossible to effectively manage something for which you lack adequate distribution information. Hydroacoustic technology offers an opportunity for a more rapid, thorough, and cost-effective EWM surveillance program.

Traditionally, hydroacoustic technology has been employed mainly for fisheries and bathymetry (depth mapping). However, recent developments in equipment and software have expanded its capability to include delineation of aquatic plant communities. Since 2005, the Darrin Fresh Water Institute has invested more than \$200,000 in hydroacoustic instrumentation and personnel training in order to refine this technology to maximize its utility. In 2006 and 2007, we successfully applied this technology for aquatic plant mapping with a focus on EWM in Lake George.

Of the more than 160 locations around the lake where EWM has been reported, the greater Bolton area possesses several of the largest EWM sites, including dense beds in Northwest Bay and Sawmill Bay. Given the large number of known EWM sites in this region and the limited ongoing survey efforts, this area was chosen as the focus of the 2008 efforts (Figure 1). The study area encompasses approximately 1.5 shoreline miles.

The DFWI has devoted more than three years of methodological development to adapt hydroacoustic analysis to EWM bed identification. Capabilities of this technology include mapping of seasonal plant growth and height, identification of EWM populations, determination of plant coverage and typing (species groups) and high resolution bathymetric mapping.

The hydroacoustic system used by DFWI includes both a 70 kHz and a 420 kHz split beam transducer attached to a DT-X surface unit. The transducer is deployed via a towed body from a research vessel. This system is augmented with several software packages capable of discerning bathymetry, plant height, plant percent cover, and potential plant typing. The system produces a continuous real time data stream, which enables a simultaneous integration and depiction within a geo-referenced three-dimensional space.

## RESULTS

The Bolton Bay region of Lake George (Figure 1) has been extensively invaded by Eurasian watermilfoil (*Myriophyllum spicatum* L.). Since its introduction in the Huddle Bay area at the southern margin of Bolton Bay (first discovered in Huddle Bay in 1985), EWM has been recorded at five individual locations in the greater Bolton Bay area. Through extensive management efforts, most of the known locations have been eliminated or seriously curtailed. However the greatest threat or limitation to lake management efforts is the lack of survey efforts to map all locations of EWM. Currently, intensive diving efforts are required to provide conventional distribution maps of EWM and native plant species. Diving is labor and time intensive for doing assessments of large underwater areas for EWM. A quicker and easier alternative has been developed that utilizes hydroacoustics to map the existence of EWM, providing both new discoveries and verification of known sites.

In September of 2008, DFWI researchers began a hydroacoustic investigation of Bolton Bay on Lake George to identify all locations supporting EWM growth within the limits of the bay. The work was performed with BioSonics hydroacoustic DTX equipment with two distinct transducers (70Khz, 430KHz). Data were analyzed using EcoSAV software and processed with an algorithm developed by researchers at DFWI that identifies discrete locations of EWM. Surveys conducted in Bolton Bay were arranged parallel, perpendicular and zig-zag relative to the shore line to ensure maximum coverage.

The surveys identified two previously unknown locations and confirmed one location of known and managed milfoil growth (Table 1, Figure 2.). The locations were identified by tripping (exceeding a Milfoil Index Value of 45) the hydroacoustic algorithm with a

score that indicates probable EWM growth. The sites were then revisited to confirm growth.

Locations within the survey area supporting EWM growth included:

**Site 1-** Corresponds to site M-43 in Lycott Environmental’s Lake George Integrated Aquatic Plant Management Program reports (King and Lyman 2006). The site was first discovered and managed in 1989 and has required intermittent management efforts since that time.

**Site 2-** A previously unknown bed where EWM was identified with hydroacoustics and confirmed in the field, it covers approximately 0.5 acres. The site is 300 meters northeast of Leontine Island on a rocky shoal in depths of 4 to 5 meters.

**Site 3-** A previously unknown location where scattered EWM plants were identified with hydroacoustics and confirmed in the field. The plants are at approximately 5 meters depth on the rocky shoal between Recluse Island and Dome Island.

Table 1. Physical properties of hydroacoustically identified Eurasian watermilfoil sites from Bolton Bay.

	<b>Growth Type</b>	<b>New Discovery</b>	<b>Depth (meters) Where Plants Grow</b>	<b>Latitude</b>	<b>Longitude</b>
<b>Site 1</b>	scattered	No	3	43.5493	-73.6558
<b>Site 2</b>	bed	Yes	5	43.5462	-73.6538
<b>Site 3</b>	scattered	Yes	5	43.5448	-73.6432

In total, approximately 325 acres were surveyed with the hydroacoustics equipment, including all of Bolton Bay. The survey area included 178 acres within the littoral or zone of rooted plant growth, defined as waters with depths less than 10 meters. As an ancillary to EWM identification, the method also determines and records depth. Almost five thousand discrete points were recorded with exact GPS position and depth. This data was used to provide a highly accurate and precise bathymetric map of the bay (Figure 3).

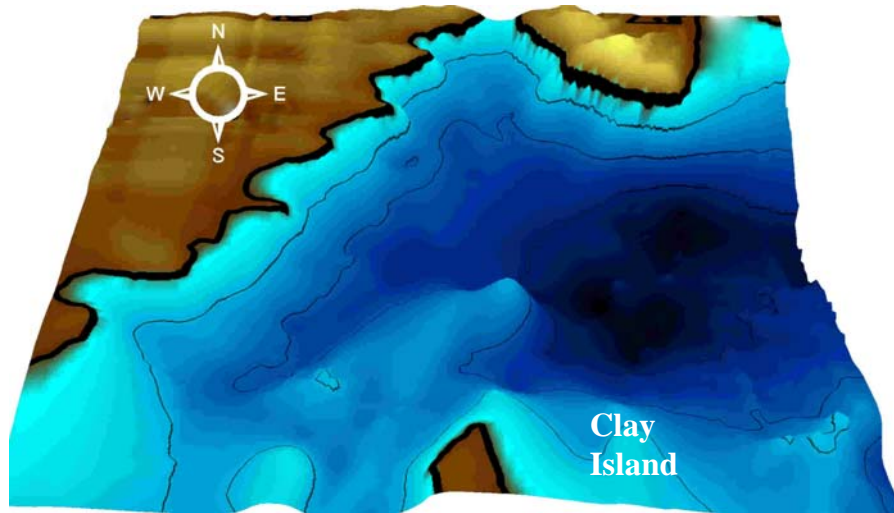
**Figure 1.** Site Location map of the 2008 Hydroacoustic survey of Bolton Bay. Red outline is the boundary line for the survey.



**Figure 2.** Site Location map showing areas where milfoil was identified with hydroacoustics in Bolton Bay of Lake George. Aerial photos provided by NYSGIS Clearinghouse.



**Figure 3.** Bathymetric map of Bolton Bay developed by extracting coordinates and depths from hydroacoustic data and krigging (extrapolating data across three dimensional space) to develop 1 m contours.



## CONCLUSIONS

Data collected during prior hydroacoustic surveys in 2007 (Harrison and Farrell 2007) can be merged with current results to provide a projection of the lake wide number of unknown EWM sites should the entire littoral zone be surveyed. This projection does not take into account many factors that determine the likelihood of EWM invasions, but only extrapolates the amount of littoral zone surveyed to date and scales up to the total littoral zone area (Table 2). This simple projection estimates that an additional 36 EWM sites would be expected in the unsurveyed portion of the Lake George littoral zone.

**Table 2.** Projection of total new milfoil sites in the littoral zone of Lake George based on hydroacoustic surveys.

Survey Site & Year	Littoral Area Surveyed (ac)
Sandy Bay - 2007	50
Huddle Bay - 2007	225
Basin Bay - 2007	240
Harris Bay - 2007	575
Warner Bay - 2007	150
Bolton Bay - 2008	178
New Beds Discovered	6
New Beds per Acre	0.004
Total Littoral Zone Surveyed (acres)	1418
Lake George Littoral Zone (acres)	8570
Percent of Littoral Zone Completed	17%
<b>Projection of Unknown Beds</b>	<b>36</b>

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