Monitoring the dynamics of *Galerucella* spp. and purple loosestrife (*Lythrum salicaria*) in the Goodyear Swamp Sanctuary and along the Otsego Lake shoreline, summer 2005

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INTRODUCTION

Monitoring continues in Goodyear Swamp Sanctuary in order to gauge the effectiveness of *Galerucella* spp. as a biocontrol agent of the exotic purple loosestrife (*Lythrum salicaria*) in 2005. This report provides an update to the annual spring and fall monitoring of *Galerucella* spp., purple loosestrife, and native plant species at Goodyear Swamp Sanctuary, and also provides an assessment of the current distribution of *Galerucella* spp. along the shoreline of Otsego Lake. Details of this study's history can be found in Albright et al. (2004).

In June, 1997, 50 adults of each *Galerucella calmariensis* and *G. pusilla*, leaf-eating beetles, were introduced to the Goodyear Swamp Sanctuary (N42^{o}48.6'W74^{o}53.9'). Beetles were released into cages at sites 1 and 2 (Figure 1), with the intent being to monitor the qualitative and quantitative effects of the beetles on purple loosestrife and also to examine the extent of any recovery by the native flora (Austin 1997). Sites 3-5 were added to the study in 1998 to monitor the spread of *Galerucella* spp. over time (Austin 1998). It was expected that these beetles would lessen the competitive ability of purple loosestrife by feeding upon their meristematic regions, resulting in defoliation, impairment of growth, decreased seed production, and increased mortality (Blossey et al. 1994).

In addition to the annual spring and fall monitoring of *Galerucella* spp, *L. salicaria*, and native plants (Blossey, et al. 1997), observations were made along the shoreline of Otsego Lake to assess the current distribution of the *Galerucella* spp. from their original point of release in Goodyear Swamp Sanctuary.

METHODS

Goodyear Swamp Sanctuary Monitoring

Spring and fall monitoring were performed according to protocols established by Blossey et al. (1997) within the five 1m^2 quadrats that were installed at the conception of the study (Austin 1997) (Figure 1).

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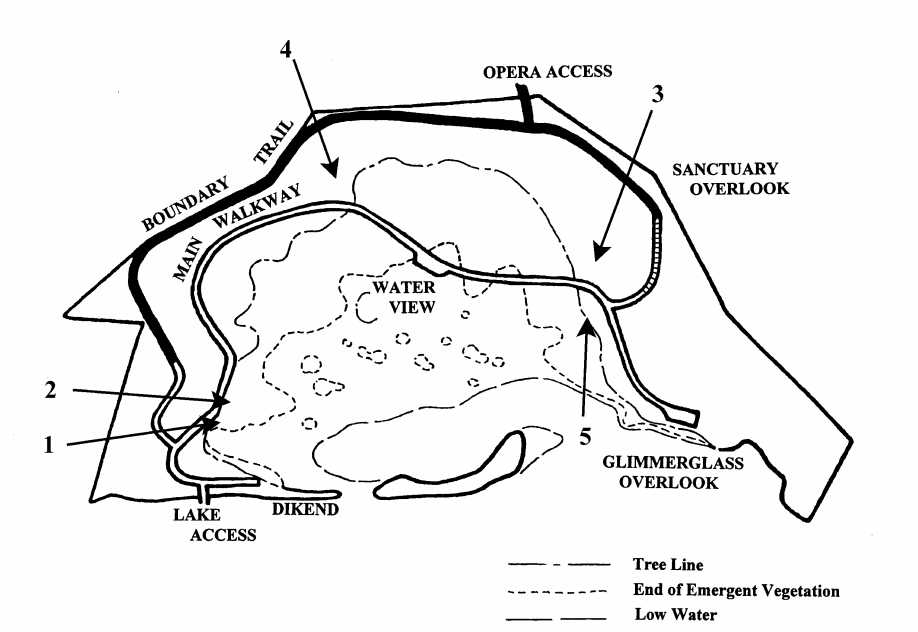

Figure 1. Map of Goodyear Swamp Sanctuary showing sampling sites. Sites 1 and 2 are 1997 *Galerucella* spp. stocking sites; sites 3-5 were established to evaluate the spread of *Galerucella* spp. within the Sanctuary over time.

Spring monitoring (8 June 2005) consisted of 5 components. *Galerucella* spp. abundance in each life stage (eggs, larva, adult) was estimated according to established abundance categories (Table 1). The number of stems of *L. salicaria* within each quadrat was counted and the five tallest were measure. The percent cover of *L. salicaria* was estimated, as well as the percent damage attributable to *Galerucella* spp. Fall monitoring (18 August 2005) consisted of the same metrics measured in the spring monitoring along with the identification of native plant species and estimation of their percent cover within each quadrat.

Table 1. Categories prescribed by Blossey's (1997) protocol for abundance and frequency.

Abundance Catagories		Frequency Catagories		
Number	category	range	category	mid point
0	1	0%	A	0%
1-9	2	1-5%	B	2.50%
10-49	3	5-25%	C	15%
50-99	4	25-50%	D	37.50%
100-499	5	50-75%	E	62.50%
500-1000	6	75-100%	F	87.50%
>1000	7	100%	G	100%

Lake-Shore Assessment

This year, six loosestrife stands around the shoreline of Otsego lake were checked for the presence of *Galerucella* beetles and signs of the beetles' herbivory to gauge the establishment and dispersion of their population since their release in Goodyear swamp sanctuary in 1997 (Figure 2). The beetles have been observed searching for new stands of loosestrife when they have decimated a stand (Albright 2004).

Assessment of beetle dispersion around the immediate proximity of the Otsego Lake shoreline was completed on 18 August. Shoreline stands of *L. salicaria* were accessed via boat, with the exception of stands at Sam Smith's boatyard and the Otesaga Country Club, which were accessed via land vehicle. Where conspicuous populations were not found, loosestrife stands were searched for about 5 minutes in order standardize the search effort.

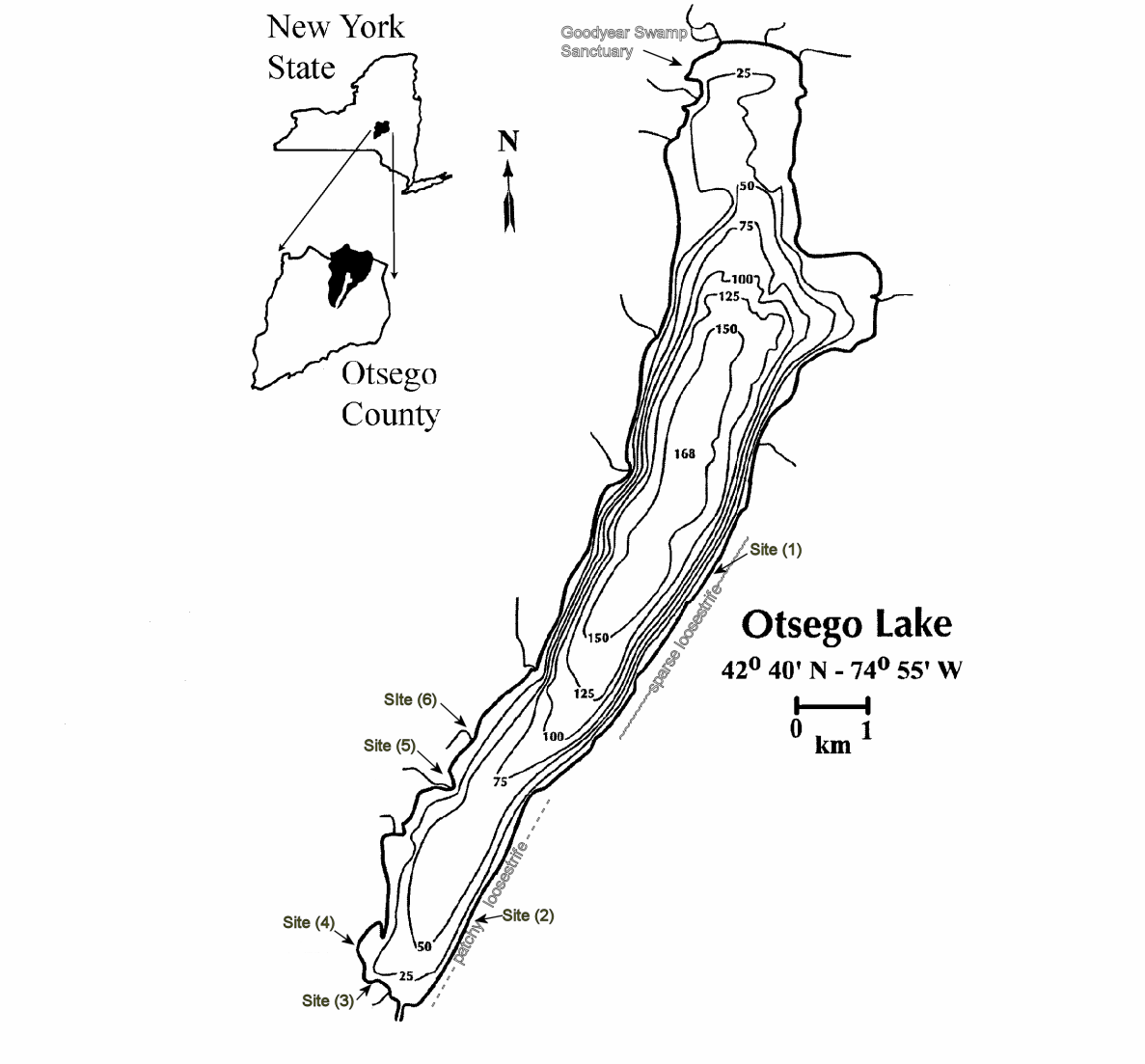

Figure 2. Shoreline sites for 18 August assessment. Otsego Lake, NY.

RESULTS AND DISCUSSION

Blossey Monitoring Protocol

Spring Monitoring (8 June 2005)

Galerucella egg abundance showed a decrease from 2004 (Albright 2005) monitoring (Figure 3), though the fact that eggs in general were laid at this point suggests that the timing of the survey overlapped with the period of egg laying for the beetles. This is not always the case, as temperature, along with other factors, determines the emergence of the beetles from their winter aestivation period and their ensuing deposition of eggs. As is typically observed, there were no larvae found during the spring monitoring. The spring sampling generally takes places prior to the laying and/or hatching of eggs (Figure 4). For the first time since 1998, adults were found only in two of the five quadrats (Figure 5). The resulting herbivory-related damage to loosestrife stems showed a decrease from 2004 (Albright 2005) (Figure 6), though this could also be related to the timing of the monitoring effort in relation to the beetle's emergence. Low abundance of the beetles during the spring monitoring may be related to a number of factors. The majority of adults may not have emerged or migrated from their state of over-wintering or perhaps there are fewer adults surviving within the swamp from 2004. This would make sense because the loosestrife densities were greatly reduced by herbivory due to high abundances of *Galerucella* the previous year. Without an abundant supply of purple loosestrife (the beetle's only source of food), it follows that the population within the swamp would decrease. Populations dynamics of host-specific organisms demonstrate dependence on the population of their host (Fagan et al. 2002), and so this pattern will likely emerge as the cycling predator-prey relationship continues, resulting in alternating periods of loosestrife success with low *Galerucella* spp. abundance and high *Galerucella* spp. abundance with effective loosestrife control. Reproductive vigor is undoubtedly related to food supply prior to over-wintering or at the time of emergence from over-wintering. Reduced egg abundance coupled with reduced adult abundance would suggest that fall conditions prior to over-wintering did not foster vigorous over-wintering populations of *Galerucella* spp. Stem counts within the quadrats this spring (Figure 7) and the estimated percent cover (Figure 8) were similar to those of recent years, being low compared to pre-control conditions. Though it seemed more widespread, and had more vigor, throughout the Sanctuary this year compared to the last several, the ability of *Galerucella* spp. density to increase when resources allow will likely keep loosestrife from returning to dominance.

Fall Monitoring (17 August 2005)

The number of stems of purple loosestrife per quadrat in the fall from 1997-2005, where available, are given in Figure 9. Counts have remained low since the establishment of *Gallerucella* spp. It is noteworthy that, though anecdotal in nature, the abundance of stems throughout the Sanctuary is substantially higher than it has been over the past few years, with some areas exhibiting greater than 75% percent cover of *L. salicaria*. Within the quadrats, the greatest estimated percent cover category by *L. salicaria* had a midpoint of 17.5% (Figure 10).

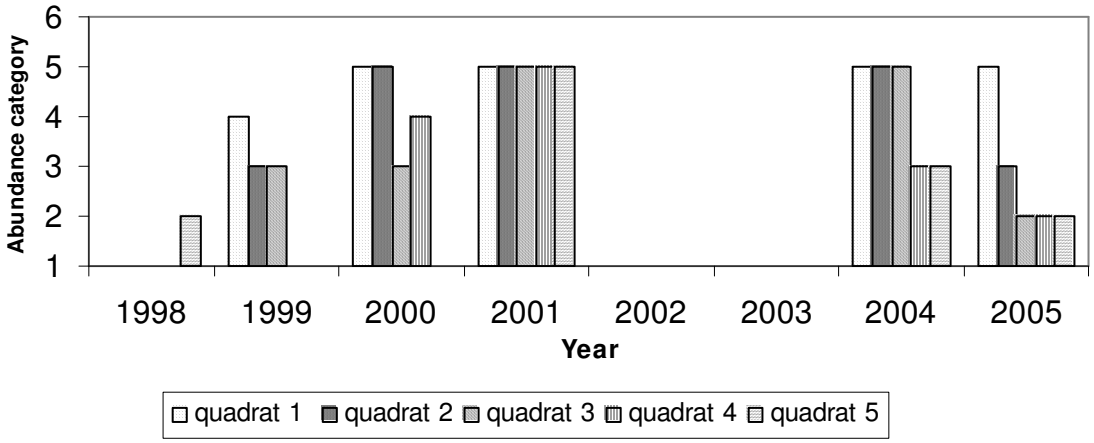

Figure 3. Comparison of *Gallerucella* spp. egg abundance from yearly spring samplings. Abundance categories taken from Table .

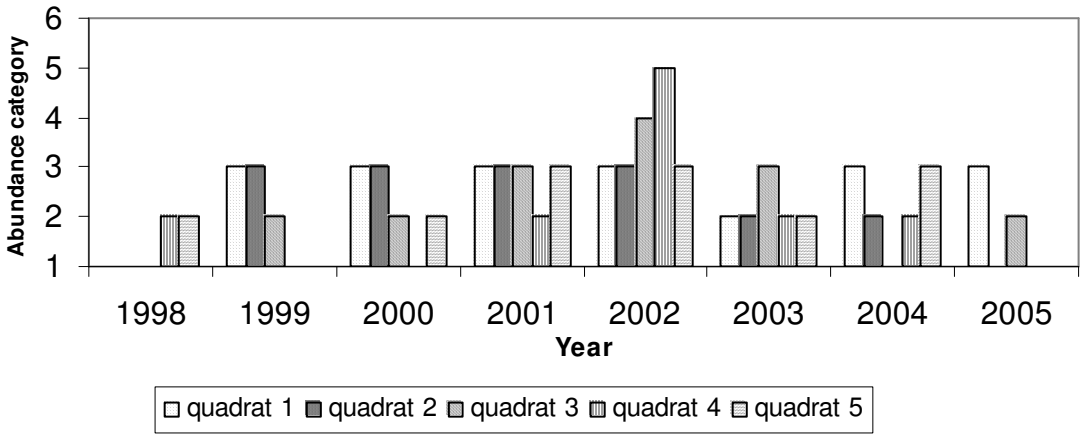

Figure 4. Comparison of *Gallerucella* spp. larval abundance from yearly spring samplings. Abundance categories taken from Table 1.

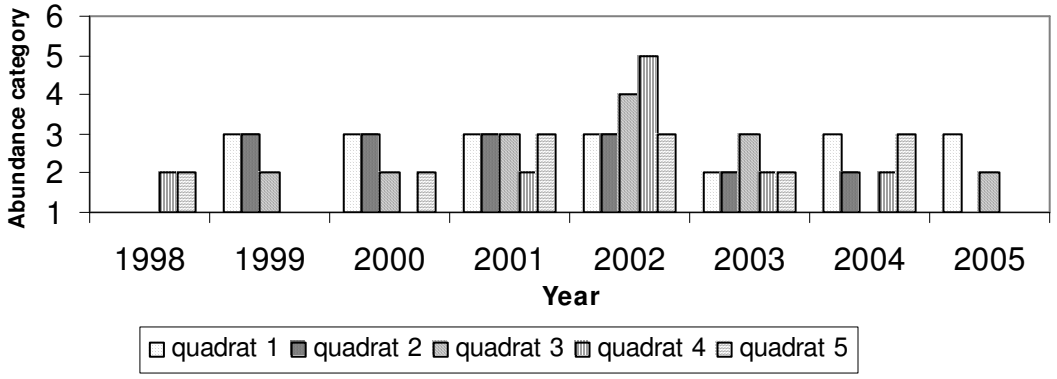

Figure 5. Comparison of *Gallerucella* spp. adult abundance from yearly spring samplings. Abundance categories taken from Table 1.

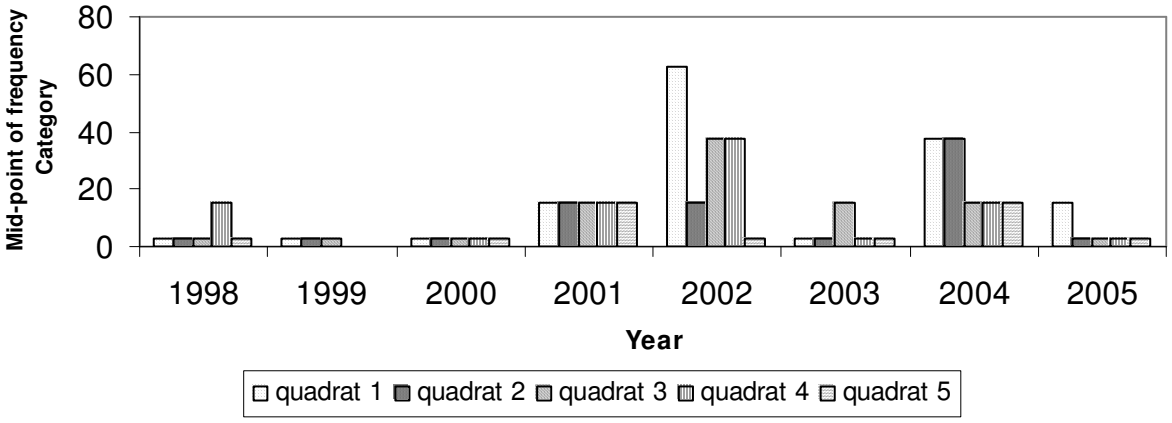

Figure 6. Comparison of percent damage estimates to purple loosestrife leaves from yearly spring samplings. Frequency taken from Table 1.

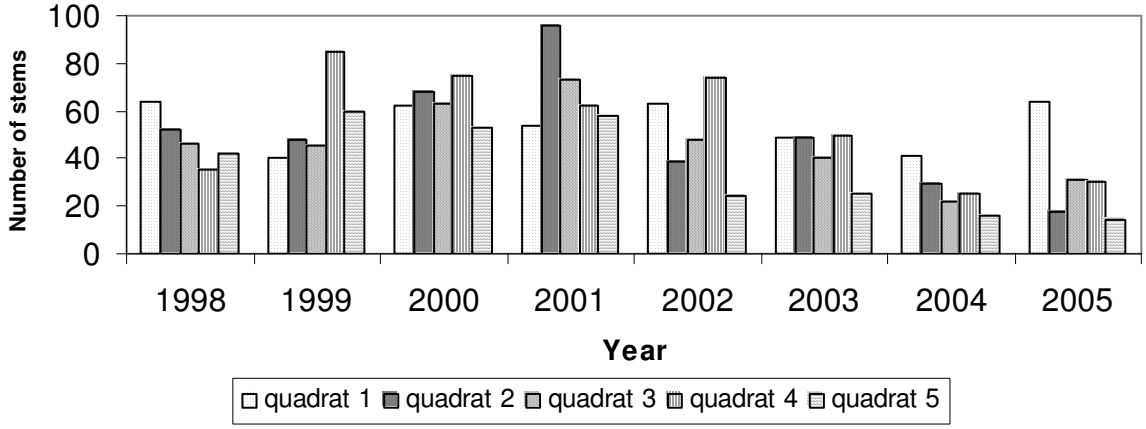

Figure 7. Comparison of the number of purple loosestrife stems from yearly spring sampling observations.

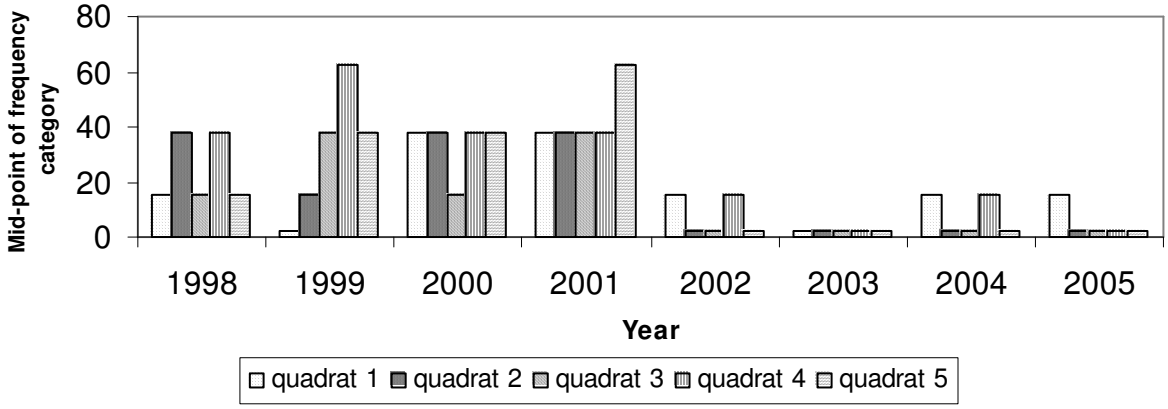

Figure 8. Comparison of percent cover estimates by purple loosestrife from yearly spring samplings. Frequency mid-points taken from Table 1.

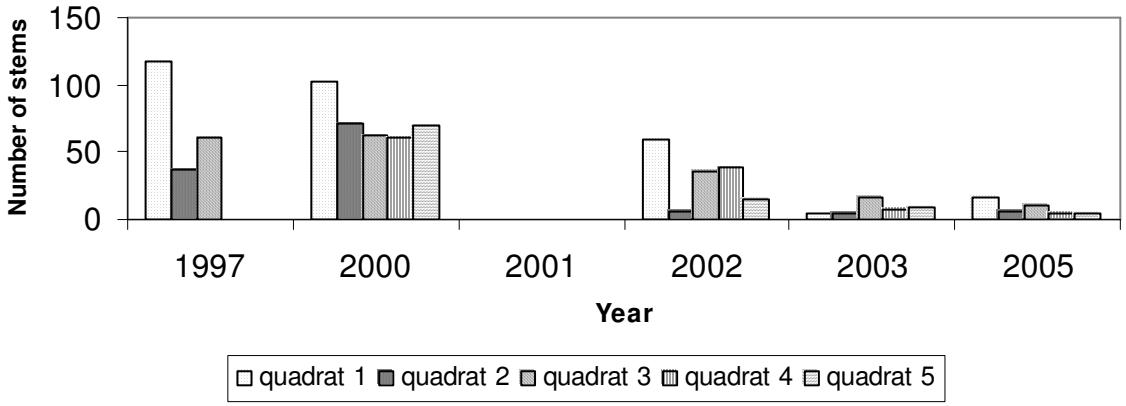

Figure 9. Number of purple loosestrife stems per quadrat during fall monitoring, 1997 and 2000-2005.

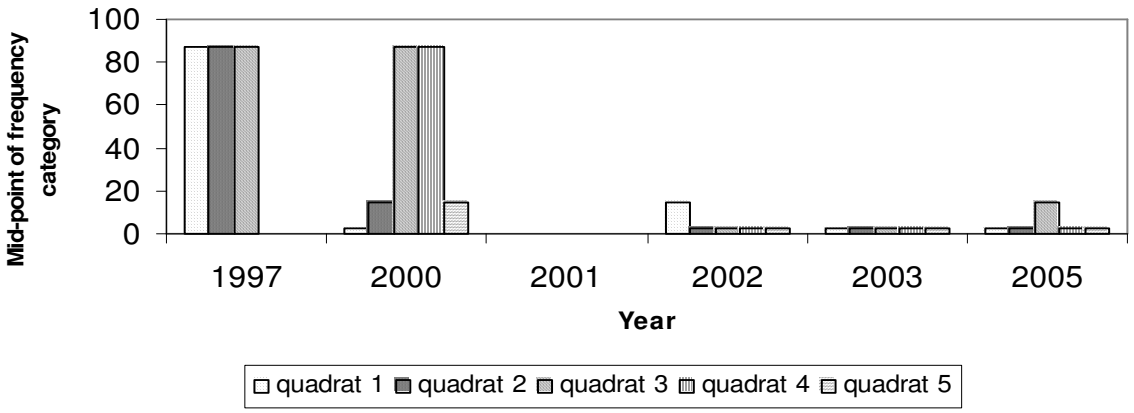

Figure 10. Mean estimated percent cover by purple loosestrife during fall monitoring, 1997 and 2000-2005.

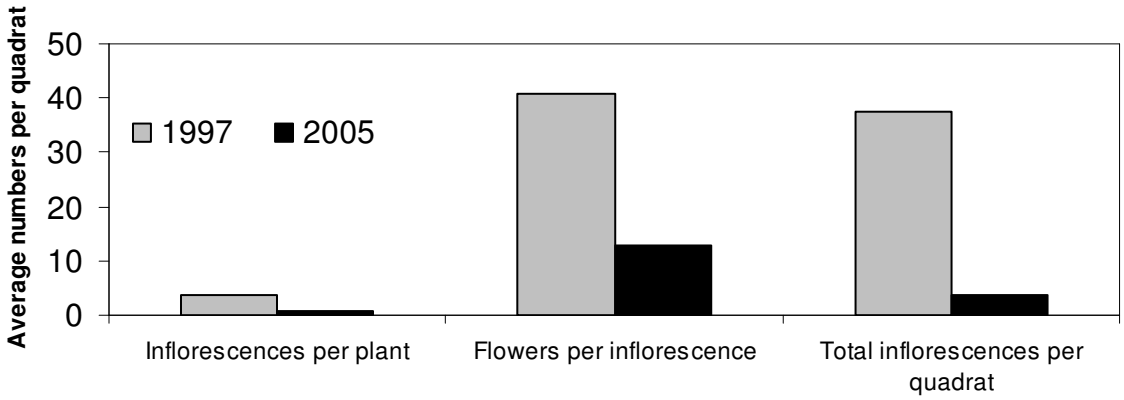

Figure 11. Data related to purple loosestrife vigor; average numbers per quadrat of inflorescences per plant, flowers per inflorescence, and total inflorescences per quadrat under pre control (1997) and post control (2005) conditions.

For the first time since 2000, purple loosestrife inflorescences were recorded in the study quadrats (three of five of them); the flowers were fairly widespread throughout the Sanctuary. In 2003, several inflorescences were noted in the Sanctuary, though none were in the quadrats (MacNamara 2004). That was the only other year since 2000 that any flowers were evident anywhere in the Sanctuary. However, the numbers of inflorescences and their sizes are substantially lower than they had been prior to *Gallerucella* spp. establishment (Figure 11).

Shoreline Assessment (18 August 2005)

Wetland habitats, those ideal for purple loosestrife's establishment, around the perimeter of Otsego Lake are sparse, as the transition to upland sites generally occurs within a few meters of the lake's shoreline. However, small dense stands of loosestrife were generally found in locations with open, non-forested shoreline (i.e. golf course, shoreline yards, stream mouths); these stands generally occupy a fraction of an acre. More scattered stands were found along forested portions, which is the dominant condition for the length of the lake's shoreline (Figure 2). Overall, very few beetles were observed, presumably due to the timing during the life cycle. The larvae in many sites may still have been pupating in the leaf litter surrounding the *L. salicaria*, and therefore were not observed at the time of the assessment. Signs indicating the presence of *Galerucella* spp. were seen at each site assessed, though often to minimal degrees, indicating that the beetles have established themselves around the entire shoreline of Otsego Lake, wherever *L. salicaria* is present.

Minimal damage and apparently low *Galerucella* populations at the shoreline sites that were assessed may be related to the difficulty of movement and establishment from one patch to another along the shoreline. This may be especially true along the eastern shore, where stands are generally more scattered and decrease in density and connectivity with northward travel from the Village of Cooperstown.

Site 1: Sparse stands on eastern shore; moderate damage to *L. salicaria*; no adults or larvae observed, but eggs were found.

Site 2: Relatively thick stand on eastern shore; minimal damage was seen; 1 adult was found, few larvae were present.

Site 3: Very dense stand at a private residence east of the Otesaga; Appeared to be undamaged, very healthy *L. salicaria*, though we were unable to closely inspect, as it was private property.

Site 4: Cooperstown Country Club golf course, thick stand along shoreline; damage characteristic of *Galerucella* spp. herbivory was evident, though no beetles were found in any life stage. Apparent larval excrement was present on damaged leaves.

Site 5: Brookwood Point, dense stand around the point; (*Galerucella* spp. had been documented here in previous years); adults and eggs were pesent in low densities; damage was minimal, though widespread. An unidentified beetle was seen on a few (~6) stems, causing heavy damage.

Site 6: Dense stand at Sam Smith's Boatyard; light damage throughout the stand; a single adult was found and a relatively small number of eggs were seen. (~6-10 per 8 stems). About 30 larvae were observed, all on a single, small plant. The plant was decimated, having no undamaged leaves; it was isolated, not being in contact with any other loosestrife stems.

Research and monitoring of *Galerucella* spp. and *L. salicaria* populations and dynamics should be continued in the future in order to better understand the proceedings of such a control measure. Knowledge of the dynamics of this system would be valuable to land and resource managers who are working on control measures for unmanaged loosestrife stands.

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