Monitoring the dynamics of *Galerucella* spp. and purple loosestrife (*Lythrum salicaria*) in the Goodyear Swamp Sanctuary, summer 2010

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**INTRODUCTION**

The distribution and effectiveness of *Galerucella* spp. populations as a biocontrol agent of purple loosestrife (*Lythrum salicaria*) were monitored within Goodyear Swamp Sanctuary as part of an ongoing monitoring regime that began in 1997. Annual spring and fall monitoring of the impact of *Galerucella* spp. on purple loosestrife is updated in this report. Details of the history of this study can be found in Albright et al. (2004).

*Lythrum salicaria* is an emergent aquatic plant that was introduced into the United States from Eurasia in the early 19th century (Thomson 1987). Purple loosestrife is an aggressive and highly adaptive invasive species which inhabits wetlands, flood plains, estuaries and irrigation systems. Once established, purple loosestrife often creates monospecific stands, displacing native species including cattails (*Typha* spp.), sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), willows (*Salix* spp.) and horsetails (*Equisetum* spp.). Recent efforts, which include both chemical application and the use of biocontrol methods, have focused on controlling *L. salicaria* where stands impede well-diversified wetland communities (Thomson 1987).

In June 1997, 50 adults each of *Galerucella calmariensis* and *G. pusilla* were introduced into Goodyear Swamp Sanctuary (N42°48.6’ W74°53.9), located at the northeastern end of Otsego Lake (Austin 1998). The beetles were initially released in cages from sites 1 and 2 (Figure 1). In 1998, sites 3-5 were introduced into the study in order to monitor the distribution of *Galerucella* over time to other stands of purple loosestrife (Austin 1999). Sampling sites were established 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 1998). It was expected that these beetles would lessen the competitive ability of purple loosestrife by feeding upon their meristematic regions, resulting in defoliation, impaired growth, decreased seed production, and increased mortality (Blossey et al. 1994).
METHODS

Spring and fall monitoring were performed according to protocols established by Blossey et al. (1997). Observations of the insects and plants were made within the five 1m² quadrats, marked by four visible stakes (Figure 1).

Spring monitoring was completed on 27 May 2010. This first assessment is typically completed within 2-3 weeks after overwintering adults appear (Blossey 1997). *Galerucella* spp. abundance was estimated in each life stage (egg, larva, adult) according to the established abundance categories (Table 1). The number of stems of *L. salicaria* within each quadrat were counted, and the five tallest were measured. The percent cover of *L. salicaria* and the percent damage attributable to *Galerucella* spp. were both estimated according to established frequency categories. Fall monitoring, which was completed on 15 September 2010, consisted of the same metrics measured in the spring monitoring along with measurements to gauge the vigor of *L. salicaria* plants, including the number of inflorescences per plant and per quadrat, as well as the number of flowers per inflorescence.
Table 1. Categories prescribed by Blossey’s (1997) protocol for reporting abundance and frequency categories.

<table>
<thead>
<tr>
<th>Abundance Categories</th>
<th>Frequency Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>range</td>
</tr>
<tr>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>1-9</td>
<td>1-5%</td>
</tr>
<tr>
<td>10-49</td>
<td>5-25%</td>
</tr>
<tr>
<td>50-99</td>
<td>25-50%</td>
</tr>
<tr>
<td>100-499</td>
<td>50-75%</td>
</tr>
<tr>
<td>500-1000</td>
<td>75-100%</td>
</tr>
<tr>
<td>&gt;1000</td>
<td>100%</td>
</tr>
</tbody>
</table>

RESULTS & DISCUSSION

All monitoring data are represented by abundance and frequency categories defined in Table 1. Changes between these frequency categories from year-to-year or plot-to-plot can represent a substantial change in abundance (Albright 2004) due to the broad ranges covered by each category. It should be noted that the actual number of *L. salicaria* stems are presented in the following results, while all other metrics are categorical. Variation in the number of stems between years or plots may not correspond with a shift in percent cover category, due to the above-stated lack of sensitivity that is inherent in a categorical classification scheme.

Spring Monitoring (27 May 2010)

Eggs of the *Galerucella* beetle were present in quadrats 2, 4 and 5 at densities of 10 to 49 eggs each (Figure 2). No larvae were found in any quadrat, as is consistent with past observations (Figure 3); spring sampling generally takes place prior to or during the laying of eggs. Quadrats 3, 4 and 5 had adults at the Category 3 level (range = 10 to 49 eggs) (Figure 4).

![Figure 2. Comparison of *Galerucella* spp. egg abundance from yearly spring samplings. Abundance categories taken from Table 1.](image-url)
Lythrum salicaria had a relatively low abundance of stems at the time of the 2010 spring monitoring, similar to that seen in 2008 and 2009 (Figure 5). Estimated percent cover also similar to the estimates made from 2002 through 2007, with L. salicaria attaining Frequency Category 2 (5-25% cover) in only two of the five quadrats (Figure 6). However, that loosestrife which was in the quadrats was virtually undamaged by herbivory (Figure 7).
Figure 5. Comparison of the number of purple loosestrife stems from yearly spring sampling observations.

Figure 6. Comparison of percent cover estimates by purple loosestrife from yearly spring samplings. Frequency category mid points derived from Table 1.

Figure 7. Comparison of percent damage estimates to purple loosestrife leaves from yearly spring samplings. Frequency category mid points derived from Table 1.
The number of *L. salicaria* stems and estimated percent cover was higher than that estimated on 2008 and 2009 (Figures 8 and 9, respectively). However, the purple loosestrife present within the quadrats in 2010 had more numerous inflorescences than in any year since 2000.

*Galerucella* are host-specific and as such feed exclusively on purple loosestrife. This characteristic results in a beetle population that is directly dependent upon loosestrife densities within the swamp. Abundance patterns observed within the swamp since 1998 illustrate the population dynamics of host-specific organisms and their dependency upon host populations (Fagan et al. 2002). It appears that once *Galerucella* spp. became established in the Sanctuary in about 2001, control of purple loosestrife has been effective, with abundance at a fraction of what it had been prior to the onset of biocontrol efforts.
CONCLUSIONS

The dispersal of *Galerucella* spp. is expanding from the original site release at Goodyear Swamp and has indicated its potential effectiveness as a biological agent against the invasive *L. salicaria*. Research and monitoring of *Galerucella* spp. and *L. salicaria* populations and dynamics should be continued in the future in order to 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 invasive species.

REFERENCES


