

A Longitudinal Survey of Infestations of Lily Leaf Beetle on Populations of Wild Lilies in St. Lawrence County, NY, 2018-2022

Paul Siskind, Master Naturalist; paul@paulsiskind.com

Lilium canadense

- The most widespread native lily in northeastern North America. (Fig. 1)
- The only species common in St. Lawrence County, NY.
- Less-common native species are *L. michiganense*, *L. philadelphicum*, and *L. superbum*. Non-native *L. lancifolium* is naturalized.
- The lilies are generally not rare in their main ranges, but they usually occur in scattered, sparse populations.
- It takes 5-10 years for these lilies to grow from seed to flowering size. (Fig. 2)
- Their bulbs are much smaller than bulbs of Eurasian lilies, with many small, brittle scales.
- Depletes the bulb each year, and grows a new bulb from a short rhizome. (Fig. 3)
- Each bulb sends up only one stem per year. If the stem gets defoliated or broken, the bulb doesn't regrow a new stem, and it senesces early; this creates a smaller bulb for next year. (Fig. 3)
- The stem is easily broken by wind, trampling, etc. Also a favored food for deer and rabbits.

These factors might make individual populations susceptible to local extirpations.

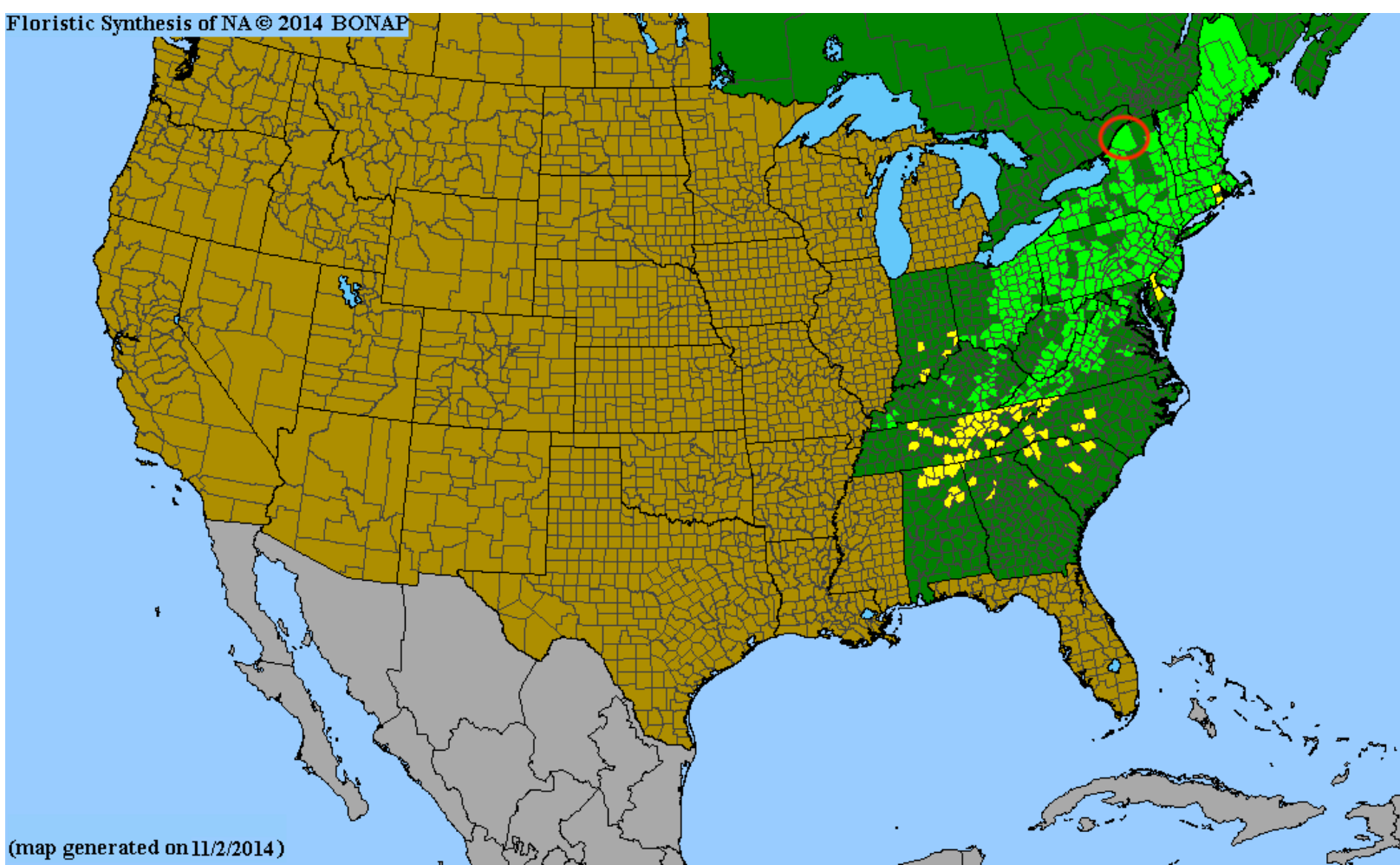


Figure 1 - Distribution of *L. canadense*
<https://bonap.net/MapGallery/County/Lilium%20canadense.png>



Figure 2



Figure 3



Figure 4



Figure 5

Lily Leaf Beetle (*Lilioceris lili*)

- An invasive Chrysomelid, native to Eurasia.
- First reported in North America in the 1940s in Montreal; didn't spread. Second introduction in the 1990s near Boston; this spread and merged with the early one. Now has spread across northern US and southern Canada to West Coast.
- Feeds almost exclusively on *Lilium* and *Fritillaria*; *Lilium* is the only host for reproduction.

- No known predators in North America.

- Reported to be strictly univoltine (one egg cycle per year) in Eurasia, but contradictory reports in North America. It's unknown whether adults live for more than one year, and whether/when they migrate away from their birth plots. (Figs. 6, 7)

- The larvae cause a lot more leaf damage than the adults. However, leaf damage from adults early in the season can significantly contribute to desiccation and early senescence. (Figs. 4, 5)

- In Eurasia, LLB infestation is mitigated by six species of parasitoid wasps and flies which lay eggs in the beetle larvae; the wasp/fly larvae then kill the beetle pupae. Three of these have been released as biological controls in North America since 1996: *Tetrastichus setifer* (Fig. 8), *Lemophagus errabundus*, and *Diaparsis jucunda*. They have successfully controlled the beetle in parts of New England and Ontario.

- However, the parasitoids establish and spread only about half as quickly as the beetle.
- The parasitoids have not yet been detected in St. Lawrence County.

Research Objective

Even though native lilies will eventually be protected by the imported parasitoids, there's potential for local extirpations before the biocontrols become widely established. This study examined the level of infestation and its impact on populations of native lilies in St. Lawrence County over a five-year period.

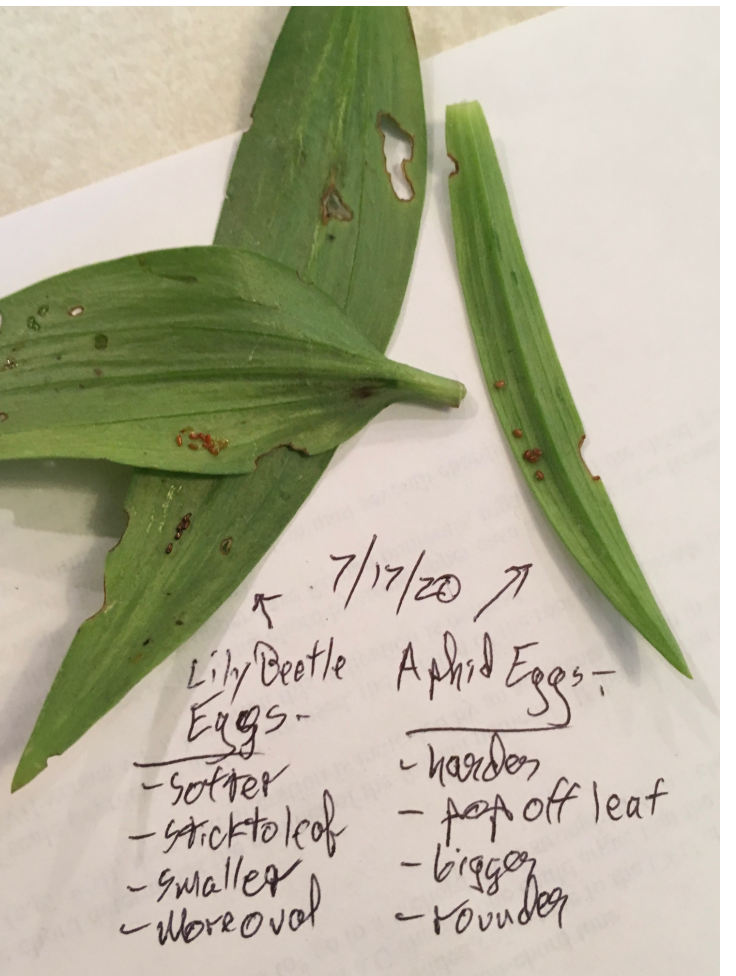


Figure 7



Figure 8 - *Tetrastichus setifer*, Photo by Andrea Brauner,
<https://web.uri.edu/biocontrol/files/2022/08/successful-biological-control-of-the-lily-leaf-beetle.pdf>

Methodology

- Surveys were conducted during May-August/September of 2018-2022, in St. Lawrence County, NY.
- Populations of lilies were located by:
 - Listings in Eldblom and Johnson's *Plants of St. Lawrence County*
 - Communications with park rangers, agricultural extension offices, science professors, bird watchers, hiking clubs, word of mouth, etc.
 - Driving around areas with suitable habitats.
- Because the number and size of the lilies that grow in a single area varies over the course of a season and from year to year, plot size was generalized:
1-10 plants = small 11- 30 plants = medium 31+ plants = large
- Plants within 50' of each other were considered to be in the same plot, unless they were separated by a road.
- Plots were demarcated with bamboo stakes (plus flagging tape, if mowing seemed likely). (Fig. 10)
- Plots were visited on a rotating but variable basis every 2-4 weeks during the growing season, depending on the growing conditions, weather, distance, etc.
- During each visit, the number of plants was counted (with their species and general size noted). Plants were searched for signs of LLB presence (e.g. leaf damage, scat deposits), and the approximate numbers of beetles, eggs, and larvae were noted, along with the general level of damage to the plants.
- Confounding factors made consistent quantification difficult:
 - Difficulty locating plants except when flowering; difficulty finding/identifying/counting young plants.
 - Difficulty surveying the interior of large grassy plots without trampling the lilies.
 - When danger approaches, the beetles drop off of the plants, hiding dark belly up on the ground.
 - Difficulty distinguishing leaf damage from beetles versus snails. (Fig. 11)
 - Difficulty discerning when early senescence is caused by LLB damage versus other factors.
- The data were later generalized into broad levels of infestation:
0 = No clear evidence of presence of LLB.
1 = LLB present, but sparse damage.
2 = Medium infestation.
3 = High infestation.
- Additional notes were added:

- If the owner of the plot had picked off beetles or sprayed with insecticide.
- If the area had been mowed, foraged by deer, trampled, graveled over, etc. (Fig. 12)
- If the lilies were hard to find because they'd become overgrown by surrounding vegetation.
- When the lilies browned out and senesced for the season.

Results

Levels of infestations of LLB in populations of L. canadense St. Lawrence County, NY, 2018-2022 (generalized data)

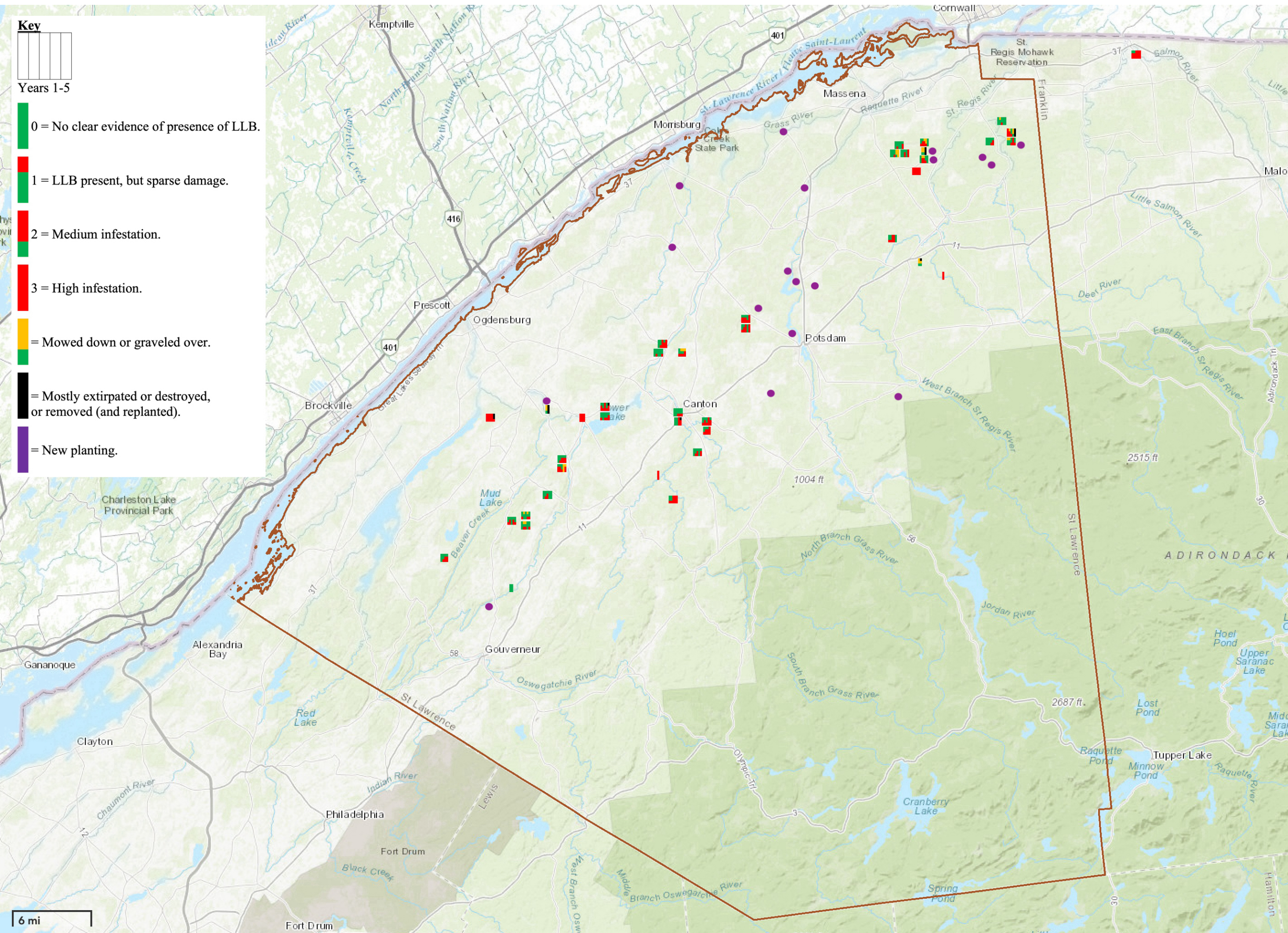


Figure 9

Additional Activities

- In situations where the lilies got mowed down every year, or when I heard they were going to be graveled or paved over, I dug out as many bulbs as I could. I replanted half of them in a nearby but safer area, and replanted the others in new suitable locations around the county. (Fig. 9)
- I collected the first vouchered record of *L. canadense* in Franklin County, NY. (Fig. 9)
- I helped document first records of *L. michiganense* (or *L. michiganense* x *canadense*) in St. Lawrence County.



Figure 10



Figure 11



Figure 12

Discussion

- The levels of infestation of a population are impacted by the complex interactions of a combination of factors:
 - The slow and seasonal lifecycle of the lilies.
 - The ability of the lilies to persist as small bulbs/plants.
 - The compressed univoltine lifecycle of the LLB.
 - Migration of LLB away from birth plots (not yet studied).
 - LLB's preference for tall plants for feeding and breeding.
 - Impacts of dry conditions on the senescence of the lilies (i.e. whether they're green long enough to support the LLB).
 - Impacts of other types of perturbances, including mowing, trampling, deer/rabbit browsing, etc.

The interactions of these factors creates interesting paradoxes:

- Factors which appear to reduce the general health of a population of lilies also help to reduce the levels of infestation by LLB. (Similar to classic predator-prey cycles.) For example:
 - A heavy infestation creates fewer tall plants for feeding/breeding, leading to reduction of infestation in future years.
 - Drought conditions, trampling, and deer/rabbit browsing also cause similar setbacks for lily healthy; but these setbacks also help reduce infestation by the LLB.
 - Mowing (e.g. farm fields, roadside ditches) presents an extreme example of the paradoxes. On the one hand, mowing prevents the plants from ever growing taller than 1-2 whorls and they'll never flower, creating a colony of stunted plants growing from small bulbs (possibly clonal). (Fig. 15) Conversely, mowing probably kills most of the beetles/larvae in a plot, and the stunted plants can't support infestation by LLB.

Conclusion

The paradoxical interactions of these factors will likely allow wild populations of L. canadense to survive infestation by the LLB as colonies of small plants, long enough for the eventual spread and establishment of the imported parasitoid biocontrols.

Observations

- LLB doesn't infest wild populations of native lilies as completely, nor as heavily, as it does Eurasian-derived hybrid lilies in garden settings. (This corroborates previous ex-situ host suitability and preference studies.)
- Even within a heavily infested population, some plants will sustain little damage. (Fig. 13) Similarly, nearby plots might not be infested, or only lightly infested.
- The level of infestation doesn't necessarily increase in a consistent fashion; it may wax and wane within a season and/or between seasons.
- Adult beetles rarely feed on small plants, and don't lay eggs on them (presumably because there's not enough foliage to support a brood of larvae). Small plants are spared infestation.
- Weather conditions appear to impact levels of infestation in both short and long term. For example, late spring cold/snow delays emergence of the beetle; this allows the plants to grow more before the season's cycle of infestation begins.
- Dry conditions appear to have a significant impact. A dry season, especially an early drought, causes the plants to desiccate and senesce earlier, providing less food to support new broods of larvae, and less food for new adults to eat before overwintering. (Fig. 14) This appears to lessen levels of infestation at the start of the next season.
- Mowing, trampling, and browsing by deer/rabbits appear to impact levels of infestation similarly to drought, decreasing the foliage available for the beetles/larvae, and causing early senescence.



Figure 13

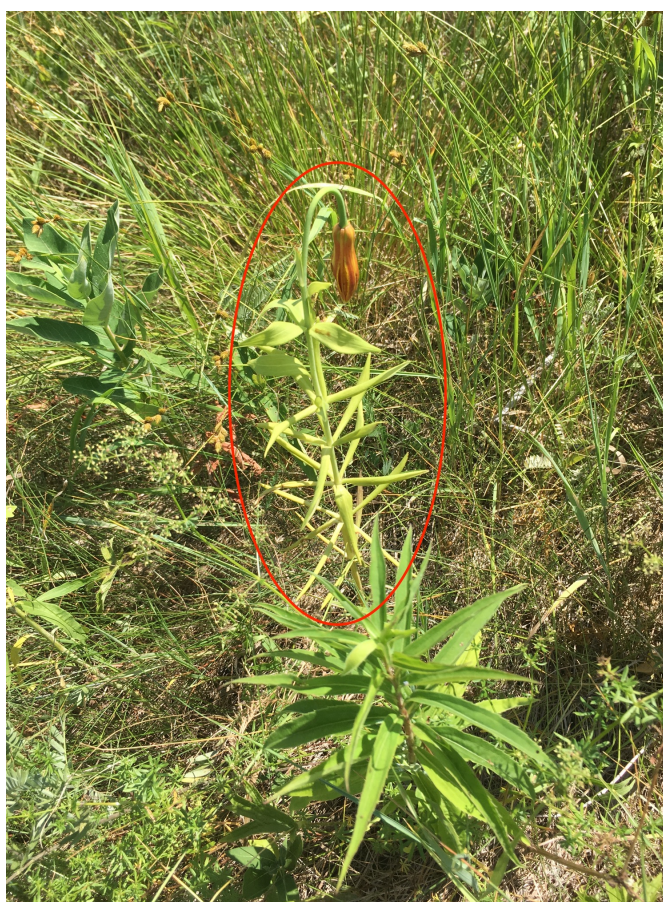


Figure 14



Figure 15

Principle References

- All photos and figures by Paul Siskind, except where noted.*
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- Haye T, Kenis M, 2004. Biology of *Lilioceris* spp. (Coleoptera: Chrysomelidae) and their parasitoids in Europe. *Biological Control*, 29:399-408.
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