Tracking Lily Leaf Beetle (*Lilioceris lilii*) in St. Lawrence County

Paul Siskind, Master Naturalist

Photo by Paul Siskind

Acknowledgement:

This project has been supported by a grant from the Research Trust Fund of the North American Lily Society.

Leaf Beetles
(Family: *Chrysomelidae)*

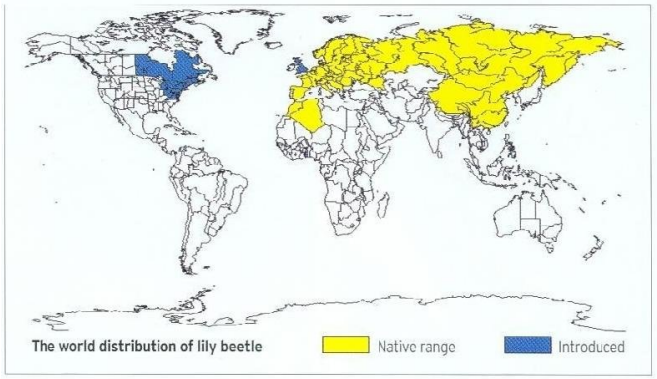
- 2,500+ genera
- 35,000+ species
- World-wide distribution
- Many feed on just a narrow range of plants.
- Many are serious agricultural pests:
    - “Potato Bug” (also eats tomatoes, eggplants)
    - Cereal Leaf Beetle: wheat, oats, barley, rye

https://en.wikipedia.org/wiki/Colorado_potato_beetle

https://commons.wikimedia.org/wiki/File:Cereal_Leaf_Beetle_-_Oulema_melanopus,_Smithsonian_Environmental_Resource_Center,_Edgewater,_Maryland.jpg

Lily Leaf Beetle
(*Lilioceris lilii*)

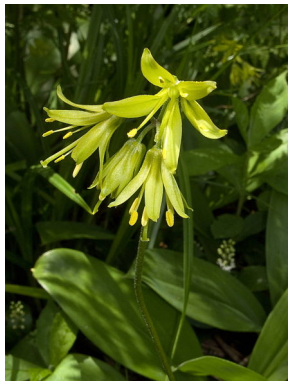
- Originally native to Europe and Asia
- Temperate climate (same as Lilies)



- Feeds almost exclusively on species in the family *Liliaceae:*
  - Can subsist only on "true" bulbous Lilies (genus *Lilium).*
  - Will feed on closely-related *Fritillaria* in early Spring.
  - In it will occasionally feed and lay eggs on other genera, but larvae don't survive on them:
    Streptopus (Twisted Stalk)
    Polygonatum (Solomon's Seal) - ?

Map: Salisbury, A. 2008. Lily beetles and prospects for control. *The Plantsman* 7:230-234
Photo by Rick Parent. https://lilybeetletracker.weebly.com/news-updated-2-june-2021

The Genus *Lilium* - 1


Clade
Monocots
Family
Liliaceae

Subfamilies
Lilioideae
Calochortoideae (ex. Mariposa Lilies *Calochortus*; Toad Lilies *Trycirtis*)
Streptopoideae (ex. Twisted Stalk *Streptopus*)

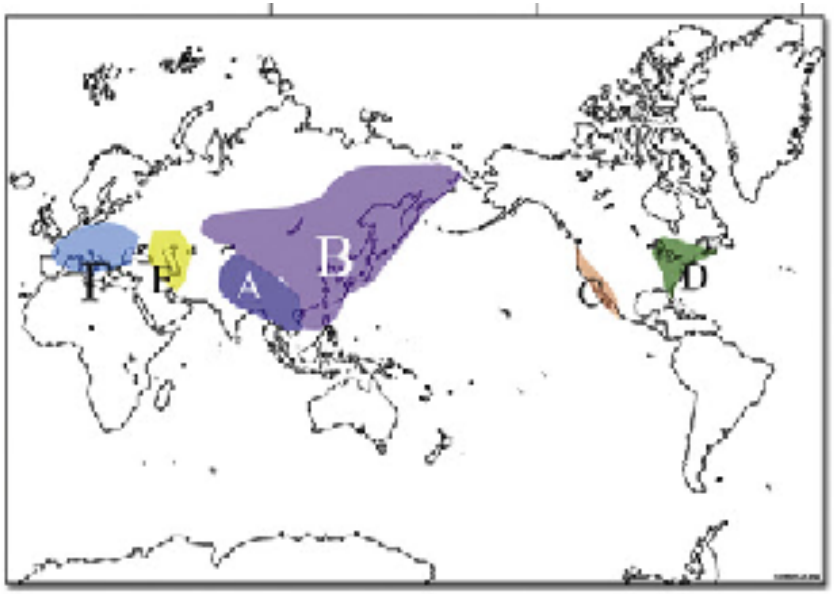
Tribes
Lilieae
Medeoleae (ex. Indian Cucumber-Root *Medeola;* Blue Bead Lily *Clintonia*)

Genera
Lilium
Fritillaria
Tulipa
Erythronium (Trout Lilies)
Others...


Doesn't include Daylilies (*Hemerocallis*) or other "lilies,"
or other common garden bulbs (order *Asparagales*)

Photos from Wikipedia: Twisted Stalk *Streptopus;* Blue Bead Lily *Clintonia*; Trout Lily *Erythronium*; *Fritillaria imperialis*
http://www.illinoiswildflowers.info/weeds/plants/or_daylily.htm

The Genus *Lilium* - 2



- About 100 species.
  - Native across the northern hemisphere
  - Temperate and subtropical
  - Highest density of species in Asia

- Some species naturally hybridize.
  - This makes classification difficult.
  - Many small pockets of subspecies and varieties
  - Fairly easy to create artificial hybrids;
    sometimes between 3 or 4 species.

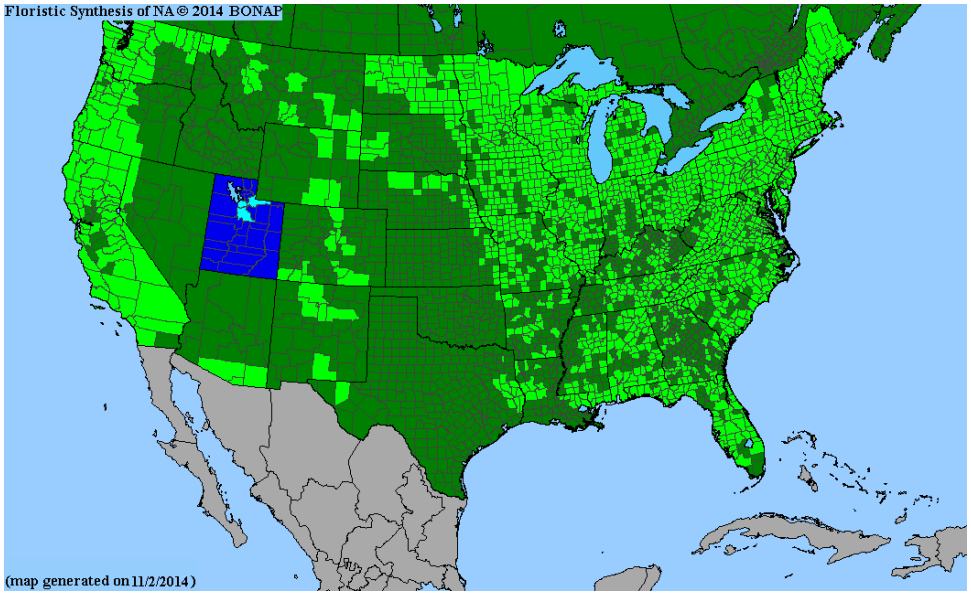
Small populations, widely scattered; sparse, rarely dense.

This makes conservation difficult and critical.

Gao, Yundong & Harris, Aj & Zhou, Songdong & He, Xing-Jin. (2013). Evolutionary events in Lilium (including Nomocharis, Liliaceae) are temporally correlated with orogenies of the Q-T plateau and the Hengduan Mountains. Molecular phylogenetics and evolution. 68. 10.1016/j.ympev.2013.04.026.

Distribution of American *Lilium* Species

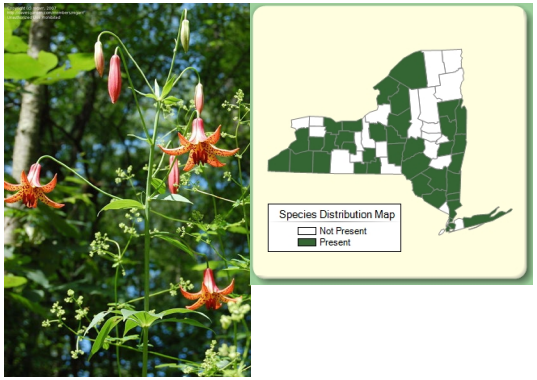
- Widespread across temperate North America
- Northeast = ca. 4 species
    - Fairly wide ranges, often overlap
    - One naturalized species
- West coast = ca. 15 species
    - narrow ranges, niche environments
- A few southern species (rare).

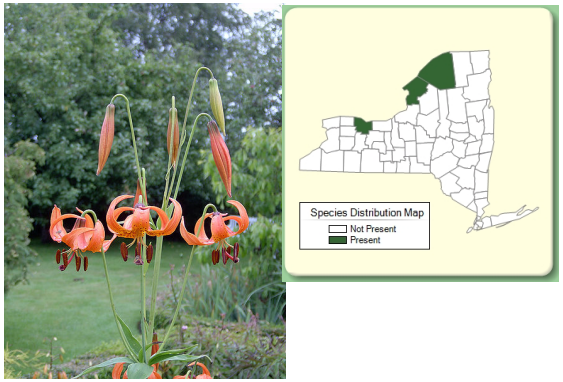


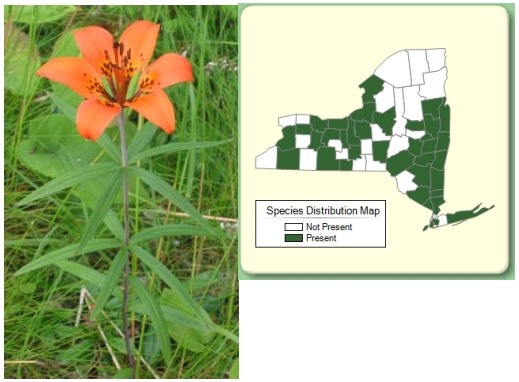
http://bonap.net/Napa/TaxonMaps/Genus/County/Lilium

Lilium Species in SLELO

- *Lilium canadense* (Canada Lily; orange and yellow forms)
- *Lilium michiganense* (Michigan Lily)
- *Lilium philadelphicum* (Wood Lily; Prairie Lily)

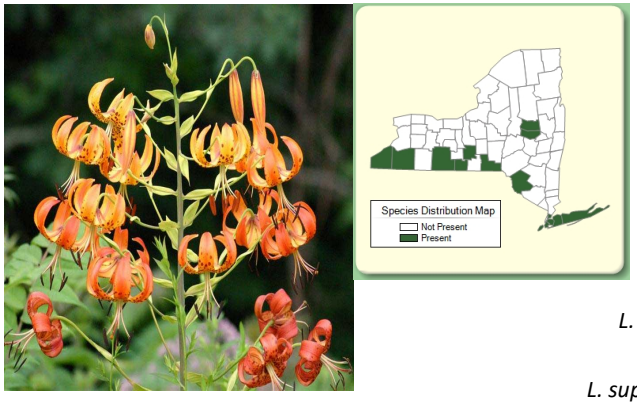






- Naturalized: *Lilium lancifolium,* syn. *tigrinum* (Tiger Lily)
- Downstate NY: *Lilium superbum* (Turk's-Cap Lily)

Common names are often used regionally, conflated, etc.



Maps: https://newyork.plantatlas.usf.edu/Results.aspx

L. canadensis: http://davesgarden.com/guides/pf/showimage/161967/

L. michiganense: https://commons.wikimedia.org/wiki/File:Lilium_michiganense_(1).jpg

L. philadelphicum: http://www.npsnj.org/photo_galleries/photo_pages_irmi/lilium_philadelphicum_irmi.htm

L. lancifolium: https://shop.romencegardens.com/lilium-lancifolium-splendens-p1996.aspx

L. superbum: http://www.buyrareseeds.com/fresh-seeds/index.php?main_page=product_info&products_id=373

Life-Cycle of Northeast Lilies

- Habitats: Moist meadows, edge of wetlands, edge of woods
    - Roadside ditches (but salt?)
- Reproduces by seeds and rhizomes.
- First year from seed (or bulb scale): Sends up only 1 leaf.
    - Browns out by mid-summer.
- That year's bulb sends out a rhizome for next year's bulb, then dies.
- Next year: Produces just one whorl of 3-5 leaves.
    - Browns out by mid-summer.
- Next year(s): 2-3 whorls. (Only 1 stem per bulb.)
- Takes 5-7 years (of good conditions) to flower.

Hard to find; scattered and sparse populations.

Photos by Paul Siskind

Threats

- Deer (eating, trampling)
- Wind
- Trampling (e.g. ATVs, dogs)
- Snails
- Beavers
- Drought
- Mowing
- Gravel, paving over
- *Lily Leaf Beetle!*

Photos by
Paul Siskind and
Kathy MacKay

Lily Leaf Beetle Life Cycle - 1

- Adults over-winter (diapause) in leaf litter.
- In Spring, when lilies sprout, the adults emerge, and locate lilies (by odor?).
- Adults do moderate damage to plants.
- Within a week, adults mate and lay eggs. (up to 400 eggs/female)
- Conflicting reports about whether these adults die versus live a second year
  (and/or if they fly away to other stands of lilies).

In North America, adults usually stop laying eggs by July,
but occasionally will lay new eggs in August

http://awaytogarden.com/fighting-lily-leaf-beetles-organically/
Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

Lily Leaf Beetle Life Cycle - 2

- Eggs hatch (7-10 days) into larvae.
- The larvae eat more voraciously than the adults;

  one clutch can strip a lily of all its leaves and flowers.
- After about 10-14 days, the larvae climb to the ground,

  and burrow in to pupate.
- The next generation of adults emerges in 10-14 days.
- Unconfirmed: A small percentage of pupae enter extended diapause, and don't emerge until the following summer.

Photo by Paul Siskind

Lily Leaf Beetle Life Cycle - 3

- It appears that many of these new adults fly off to find new stands of lilies.
- Most sources say that these new adults don't mate until the next year.
- But some sources report that in North America:
  - Late-season mating (but no late-season eggs).
  - Late-season new eggs/pupae/new adults:
    - Second round of breeding versus second generation versus late breeding?

Photos by Paul Siskind

Evasive Maneuvers

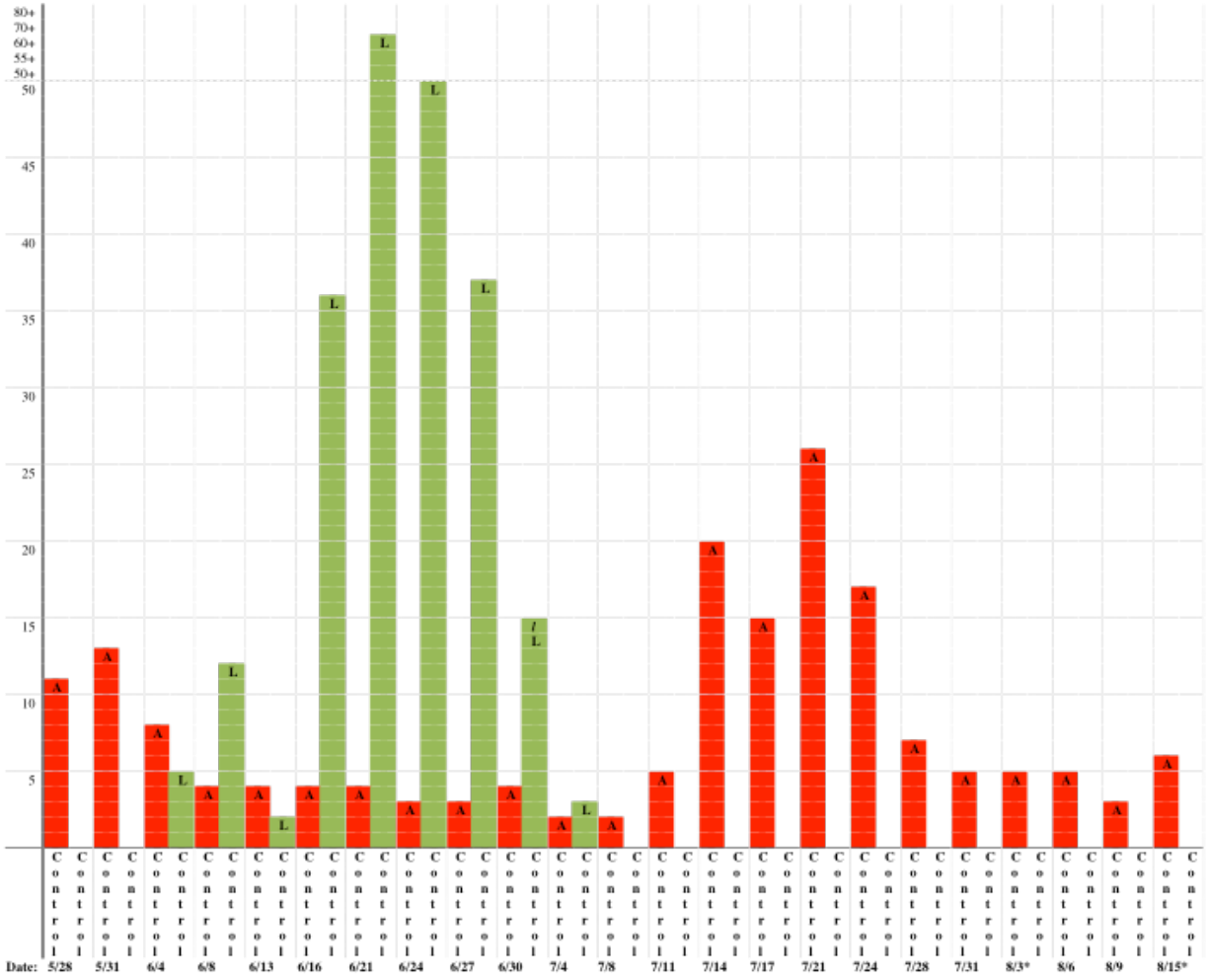
- Adult beetles fall to the ground, land on its back;
  hard to see the black belly against the soil.
- The larvae cover themselves with their own excrement.
  This deters most predators.
- Many species of Chrosomelids protect themselves with fecal shields.
- Fecal shield also protects from insecticides; can be shed if necessary.
  When they're "naked," they're easy prey for birds, spiders, etc.

There are no known natural predators in North America!

http://bugguide.net/node/view/655776

Three “Waves” of Infestation per season

Red = Adults Green = Larvae



Why it matters...

- A (cultivated) lily can survive defoliation for a year or two,
  but after 2-3 years of defoliation, the bulb dies.

- Unknown how resilient native lilies are.

- Because wild lilies occur in only sparse populations, extirpation of individual populations is a concern.

- Controlling the beetle in home gardens is critical for conserving wild populations, because the concentrated feeding/breeding resources of home gardens sustains/magnifies the threat of infestation of native lilies.

(This is especially true because the beetle isn't as fecund on native lilies.)

Biological Control Methods - 1

- In Europe-Asia, the beetle is kept under control by 6 species of parasitoid wasps.
- Lay their eggs inside the beetle larvae;
  the wasp larvae eat the beetle pupae from the inside.
- Like the beetles, these wasps have very narrow range of host species.
  (Relatively safe to import.)
- Since 1999, three species of parasitioids have been imported.
  - Lisa Tewkesbury, University of Rhode Island.
    - *Tetrastichus setifer*
    - *Lemophagus errabundus*
    - *Diaparsis jucunda*

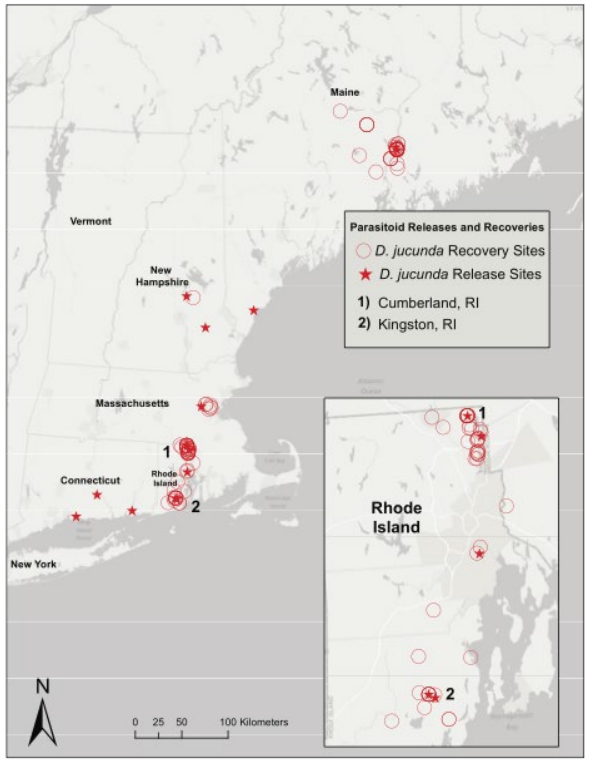
Coincidentally:
Tetrastichus planipennisi has been imported into North America to combat the Emerald Ash Borer.

Biological Control Methods - 2

- In test plots and in gardens, parasitoids lower the beetle population by 70-95% .

- The parasitoids have been released in ME, NH, MA, RI, CT, NY (Ithaca), and Ottawa.

- However, the parasitoids spread at a rate of only 2-5 km/year.



- The parasitoids will eventually be the primary protection for wild native lilies, but until then, controlling the beetle in gardens is the best way to protect native lilies.

If you would like to collect beetle larvae from your garden and send them to be tested to see if the parasitoids have arrived in your area, the info is in the Links document in the Resources folder.

Lisa Tewksbury, Richard A. Casagrande, Naomi Cappuccino, Marc Kenis, Establishment of Parasitoids of the Lily Leaf Beetle (Coleoptera: Chrysomelidae) in North America,

Environmental Entomology, Volume 46, Issue 2, April 2017, Pages 226–236, https://doi.org/10.1093/ee/nvx049

My projects

1) Developed an IPM method for home gardeners.

(Info in Resources folder)

2) Tried to ascertain:

- Do beetles live for more than one year?
- Can new adults breed before hibernation?
- Do some pupae enter extended diapause?

(No meaningful results)

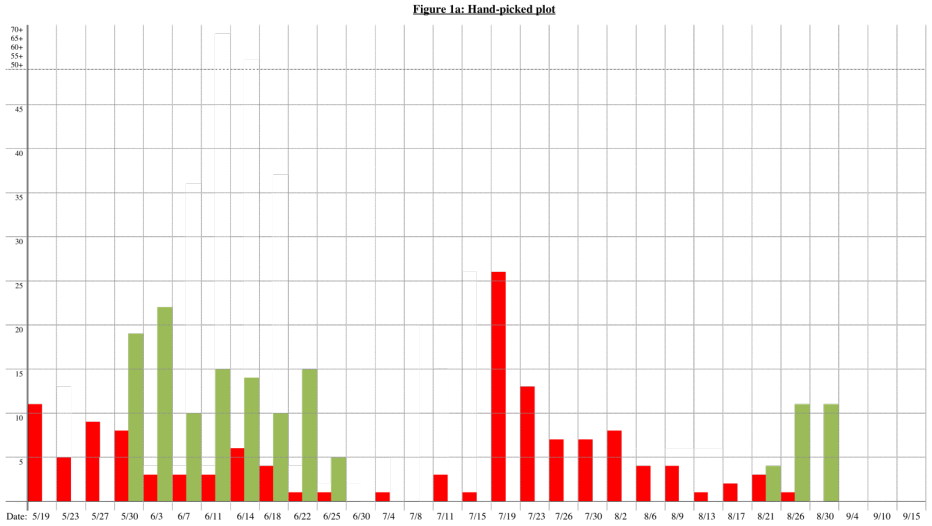
3) 4-5 year survey of infestations of populations of wild lilies.

(and replanting threatened bulbs)

Results from 2017 - 1

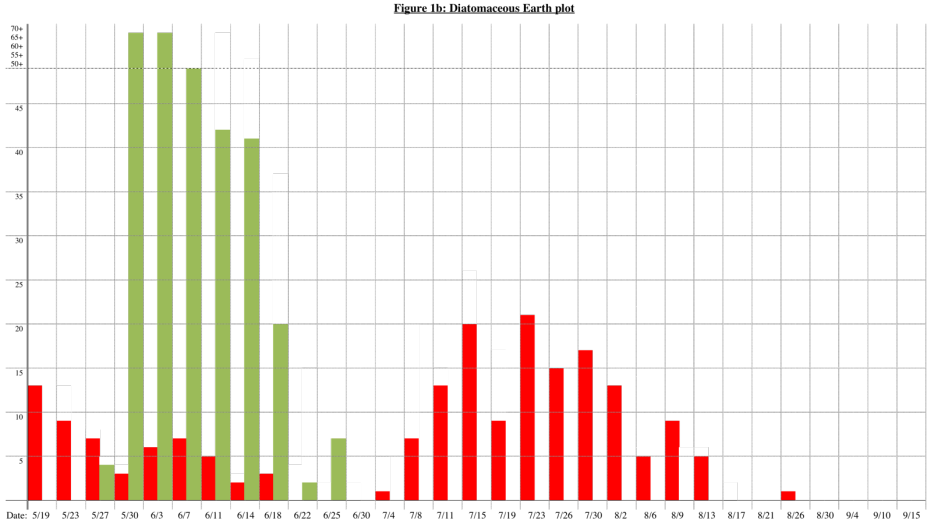
Hand-Picking only

- *New Larvae?!?!*



Diatomaceous Earth only

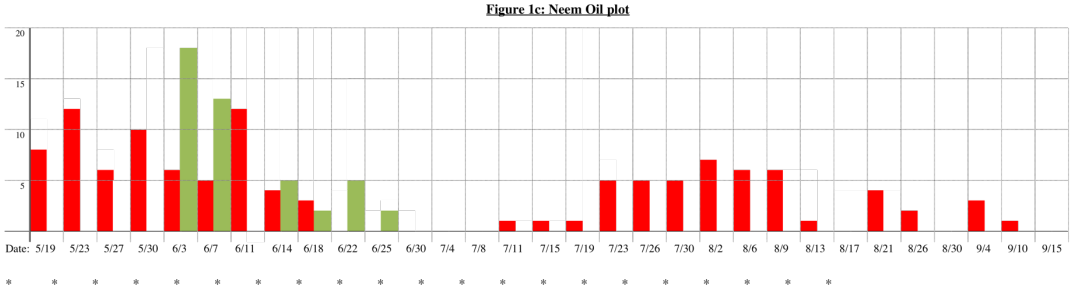
- Not effective



Results from 2017 - 2

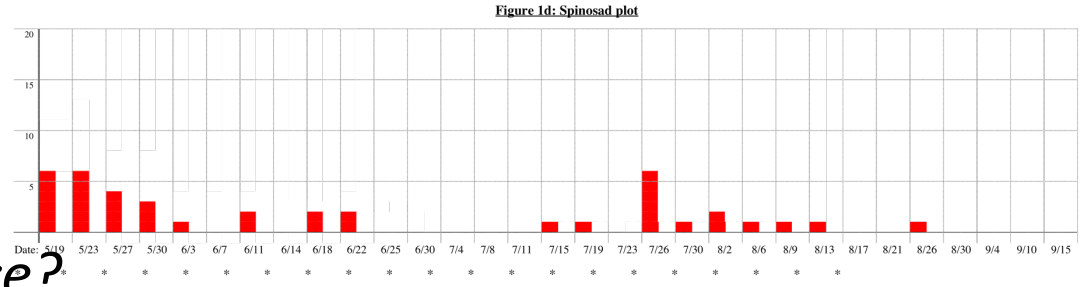
Neem Oil only

- Doesn't kill eggs.
- Kills larvae as they develop.



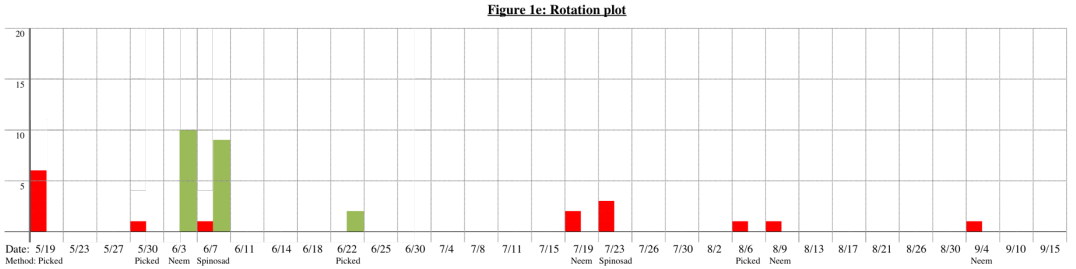
Spinosad only

- No larvae at all.
- *Danger of resistance?*



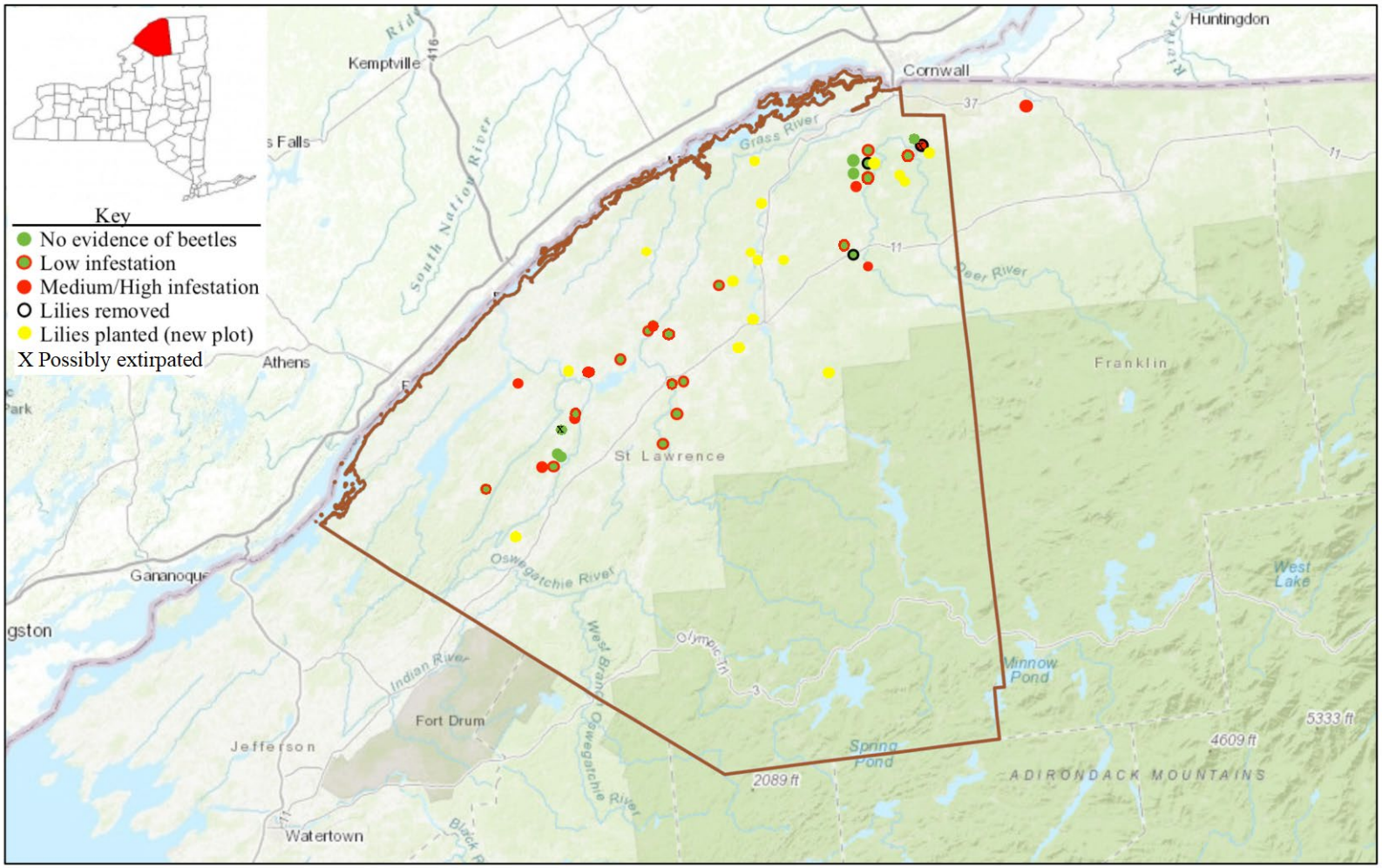
Rotation

- Spinosad 1x/week
- *Less resistance?*



Infestations of populations of *L. canadense* in St. Lawrence County, NY 2018-2021 (generalized data)

Please send me more locations!



Preliminary Observations in the Wild

Compared to infestations in gardens:

- Fewer "explosion" infestations; range from light to heavy

  (Reduced fecundity on American species? Sparsity of plants?)

- Usually, some plants in a population not infested.

  (Hidden among other plants?)

- Nearby populations aren't always infested (even just 30' away).

- Some infestations appear to be established but remain consistently low-moderate.

Paradoxes:

- Mowing (usually in June-July, and again in August) seems to sometimes prevent infestations from becoming established (or at least lessen them).

  (Dense patches of small lilies; resilience?)

- Drought in summer 2020 caused lilies to brown out in July;

  fewer beetles appeared in early spring of 2021.

- In 2021, early spring thaw followed by return to freezing (followed by lack of rain) threw off the coordination of beetle with lily cycles.

Bad news: Since 2018, 8 (out of 32) sites became newly infested.

Good news: Potential to rebound after the parasitoid wasps arrive?

What the heck is it?

Lilium canadense (yellow form, flat); Northeast, Canada

Lilium canadense (orange form, recurved); Northeast, Canada

Lilium michiganense; Midwest, only 2 counties in NY (Monroe, ?Jefferson?)

Debated for decades:

- Expanded range? (NYFA)
- Intermediate forms?
- Subspecies?
- Natural hybrid? (NYFA)

https://www.friendsofeloisebutler.org/pages/plants/canadalily.html
Photo by Paul Siskind
http://www.srgc.net/forum/index.php?topic=12987.15
Photo by Paul Siskind

Citizen Science

- Please send me locations of native (or naturalized) lilies.

  paul@paulsiskind.com

- IPM protocol for home gardeners.

  (in Resources folder)

- Collect larvae (gardens, wild) and send for testing for parasitoids.

  (in Resources folder)

Questions?