

Aton Forest Fellow's Annual Report and Prospectus

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The general focus of my research, both at Aton Forest and elsewhere, is documenting the host plants and natural history of understudied herbivorous insects. This month I completed the second edition of my self-published e-book *Leafminers of North America*, and I am in the process of compiling a similar guide to North American sawfly larvae. I am continually updating both guides with information gleaned from newly published literature, photographs posted online (iNaturalist.org and BugGuide.net), and my own observations. When my own observations represent significant new information (e.g., new species or previously unknown host associations), I am documenting them thoroughly in peer-reviewed publications.

Research at Aton Forest

This year I spent five days at Aton Forest and Spaulding Pond, each time accompanied and assisted by my wife, Julia Blyth. I photographed at least one example of each type of leaf mine and sawfly larva we encountered, along with miscellaneous other insects and signs thereof (e.g., galls and folded or tied leaves). Herbivorous insect larvae that I could not identify to species in the field were collected in an attempt to rear them to adults. The dates of each visit are listed below, along with the general area explored, a link to view photos from that day, and a list of some highlights (new discoveries or mysteries to follow up on in the future).

June 18 – Bull Pasture; stream near Aton Forest headquarters

https://www.inaturalist.org/observations?on=2022-06-18&subview=table&user_id=ceiseman&verifiable=any

- Leaf mines of a possibly undescribed species of fly (Anthomyiidae: *Chirosia* sp.) on silvery spleenwort (*Deparia acrostichoides*)
- Leaf mines of an unknown species of fly (Agromyzidae: *Phytomyza* sp.) on white wood aster (*Eurybia divaricata*)
- Distinctive feeding sign of an unknown insect on interrupted fern (*Osmunda claytoniana*), consisting of narrow channels on the lower leaf surface
- Southernmost record of the birch leaf-mining moth *Stigmella lapponica* (Nepticulidae); the only previous US record was a leaf mine I found in southern Vermont
- Reared adults of the leaf-mining fly *Phytomyza spinaciae* (Agromyzidae) and the leaf-mining moth *Scrobipalpa acuminatella* (Gelechiidae) from Canada thistle (*Cirsium arvense*); first Connecticut record for both species
- Reared the first Connecticut specimens of *Phytomyza loewii* (Agromyzidae), a leafminer of *Clematis*
- Reared the leaf-mining moth *Caloptilia canadensisella* (Gracillariidae) from silky dogwood (*Cornus amomum*); first Connecticut record and a new host species
- Reared adults of an as yet undetermined species of *Agromyza* (Agromyzidae) from leaf mines on orchard grass (*Dactylis glomerata*); this genus has not been reared from *Dactylis* in North America before

June 19 – along Doolittle Brook

https://www.inaturalist.org/observations?on=2022-06-19&subview=table&user_id=ceiseman&verifiable=any

- Reared adults of the leaf-mining moth *Neurobathra strigifinitella* (Gracillariidae) from sweetgale (*Myrica gale*). This species normally feeds on oaks and related trees.
- A previously unreported leaf spot gall on sweetgale, caused by a midge (Cecidomyiidae)
- A globular, axillary bud gall on meadowsweet (*Spiraea alba*) caused by an unknown midge. A gall matching this description has been reported from *Spiraea* sp. (geographic location not specified), but apparently no specimens exist of the insect that causes it.
- A gall on highbush blueberry (*Vaccinium corymbosum*) consisting of a curled leaf margin, caused by an unknown species of midge (I once preserved a larva from a similar gall on lowbush blueberry, *V. angustifolium*, but it was not identifiable to genus)
- Leaf mines of an unknown species of fly (Agromyzidae: *Liriomyza* sp.) on false hellebore (*Veratrum viride*)
- Leaf-rolling moth larvae on wild sarsaparilla (*Aralia nudicaulis*); chloropid flies were reared as secondary inhabitants in the rolls. No caterpillars have been reported to feed on this plant.
- First Connecticut record of the fly *Neochirosia atrifrons* (Scathophagidae), a leafminer of false hellebore
- Collected many larvae of the potentially undescribed fly species on silvery spleenwort in an attempt to rear adults; these will not emerge until spring 2023 (so far 27 parasitoid braconid wasps have emerged)
- Reared adult flies (Agromyzidae: *Liriomyza* sp.) from white snakeroot (*Ageratina altissima*); these belong to a confusing complex of species that Owen Lonsdale and I are working on resolving

July 26 – hill south of Doolittle Brook; along N Colebrook Rd.

https://www.inaturalist.org/observations?on=2022-07-26&subview=table&user_id=ceiseman&verifiable=any

- An unknown stem-mining agromyzid fly larva on sweet-scented bedstraw (*Galium triflorum*), unfortunately not noticed until recently when I was reviewing photos I took to document the leafminer *Liriomyza galiivora*
- First Connecticut record of *Dibolia melampyri* (Chrysomelidae), a leaf-mining beetle on cow-wheat (*Melampyrum lineare*)
- Reared an as yet unidentified tortricid moth from larvae rolling leaves of wild sarsaparilla
- Reared adults of the leaf-mining moth *Stigmella castaneaefoliella* (Nepticulidae) from American chestnut (*Castanea dentata*); first Connecticut record (also reared some braconid parasitoids)

August 12 – State Line Hill Rd.; beaver pond by S Sandisfield Rd.

https://www.inaturalist.org/observations?on=2022-08-12&subview=table&user_id=ceiseman&verifiable=any

- Leaf mines of *Euleia fratria* (Tephritidae) on water parsnip (*Sium suave*); a new host genus for this fly
- Leaf mines of an unknown species of fly (Agromyzidae: *Agromyza* sp.) on avens (*Geum* sp.)
- More leaf mines of the unknown leaf-mining fly on white wood aster (see above)
- First Connecticut specimens of *Liriomyza galiivora* (Agromyzidae), reared from leaf mines on rough bedstraw (*Galium asprellum*)

- Reared a *Liriomyza* species from leaf mines on spotted Joe-pye weed (*Eutrochium maculatum*), part of the same complex noted above on white snakeroot
- Reared numerous specimens of the leaf-mining fly *Liriomyza asclepiadis* (Agromyzidae) from milkweed (*Asclepias syriaca*) for a genetic study being conducted by the Wiegmann lab at North Carolina State University; also reared many braconid and eulophid wasp parasitoids

September 10 – Near Aton Forest headquarters; Spaulding Pond

https://www.inaturalist.org/observations?on=2022-09-10&subview=table&user_id=ceiseman&verifiable=any

- Reared two as yet undetermined species of tortricid moths from larvae folding/crumpling leaves of glossy buckthorn (*Frangula alnus*). There are no North American records of tortricids using this host.
- Leaf and stem mines of an unknown moth in the genus *Pseudopostega* (Opostegidae) on bugleweed (*Lycopus*)

Field Research at Other Sites

I conducted investigations of herbivorous insects in my own yard (Northfield, MA) and surrounding areas throughout the growing season. Explorations farther afield included:

- April 29 to May 4 – With Julia Blyth, I explored the Ozarks (Missouri and Arkansas) in search of leafminers and sawfly larvae. We found numerous new state records as well as a few species (or at least immature stages) that are new to science.
- May 19 to 31 (3 days total) – I conducted rare plant surveys for Kestrel Land Trust on Mt. Toby and in the Mt. Holyoke Range (western MA). I observed and collected herbivorous insects opportunistically during these surveys as well as while conducting the fieldwork listed below.
- May 25 to October 4 (2–6 days per month) – I continued the botanical inventory and natural community mapping study of 24 summits in Mount Washington, MA and surrounding areas, sponsored by Green Berkshires, that I began in 2021.
- June 10 to September 16 (4 days total) – With Adam Kohl, I conducted a rapid ecological assessment of the Norcross Wildlife Sanctuary in Wales, MA.
- September 6 to 7 – I assisted Bill Buck and Beth Herr with their all taxa biodiversity inventory of Kent (Carmel), NY, documenting numerous species of leafminers and gall inducers.

Beyond leafminers and sawflies, a few specific areas of interest that arose this year included:

- Moth larvae feeding on wild sarsaparilla leaves. I succeeded in rearing several species (including one from Aton Forest) and have larvae of another species overwintering currently; when I have identified them all I will put together a short paper about them.
- Tortricid moth larvae that form what I call “pseudomines” (the larva lives under a sheet of silk on the lower leaf surface, which causes the leaf to crumple somewhat; these feeding shelters are often mistaken for leaf mines). These larvae take many weeks to reach maturity and are therefore difficult to rear to adults, but I managed to rear some from basswood and oak in addition to the ones from glossy buckthorn at Spaulding Pond;

I collected some on black birch and red and white oaks at Aton Forest but failed to rear adults.

- Single-celled rosette galls on rough-stemmed goldenrod. These relate to a mystery gall discussed in my recently published paper on Nantucket Diptera (see below); I succeeded in rearing tephritid and cecidomyiid flies from these galls in my yard this year, and plan to write a short paper about them this winter.

Other Activities

- January 8 – I was the invited afternoon speaker at the annual meeting of The Ohio Lepidopterists in Columbus, OH; my presentation was an overview of the many groups of leaf-mining moths, using species from my own yard as examples.
- In February I began learning to dissect and slide-mount genitalia of microlepidoptera; this is an essential step toward being able to identify and describe new species of moths without relying on overcommitted taxonomist collaborators. I continued developing this skill into early spring, and have resumed this winter now that the field season is over.
- February 16 and March 2 – I participated in a DNA barcoding training session at UMass Amherst, to explore the possibility of conducting DNA analysis on insect specimens at home. I have decided not to pursue this further, but now have a clearer understanding of what the process entails.
- April 11 – I visited Harvard University’s Museum of Comparative Zoology (Cambridge, MA) to study specimens of leaf-mining moths, as part of a project in which I am attempting to resolve a taxonomic mess involving species in the genus *Antispila* (Heliozelidae).
- April 16 and 23 – I co-led a vernal pool certification training for Hilltown Land Trust in Chesterfield and Cummington, MA.
- May 30 to November 23 – I served as a consultant for the Greentree Foundation’s survey of moths on their property in Manhasset, NY. I prepared a document indicating which leafminers might be found on each of the plants known to occur on the property, and when these species should be looked for. Throughout the season I reviewed their photographs of leaf mines and advised them on rearing, photographing, and preserving specimens.
- July 31 to August 6 – I taught a field and lab seminar, “Tracks and Sign of Insects and Other Invertebrates,” at the Eagle Hill Institute in Steuben, ME.
- August 13 – I led a plant / insect walk for Berkshire Natural Resources Council in Great Barrington, MA.
- September 4 – I led an insect / leafminer walk at Distant Hill Gardens in Walpole, NH.
- September 17 – I led an insect walk at the Mt. Wachusett Bioblitz in Princeton, MA.
- October 23 – I led an invertebrate tracking workshop in New Salem, MA as part of the Northeast Wildlife Trackers conference.
- Throughout the year, as part of my leafminer and sawfly research, I have reviewed and identified photos of these insects submitted to iNaturalist (including those added to the “Leafminers of North America” project I created). According to the website’s calculations as of December 13 (<https://www.inaturalist.org/stats/2022/ceiseman>), in 2022 I have helped 2,477 people with 23,733 identifications.

Peer-reviewed Articles Published in 2022

- Chen, Taibin, Xiaohua Dai, and Charles Eiseman. 2022. A checklist of gymnosperm-feeding leafminers (Arthropoda, Insecta) in North America and Europe. *Biodiversity Data Journal* 10: e91313. https://bdj.pensoft.net/articles.php?id=91313&journal_name=bdj
- Eiseman, Charles S. 2022. New rearing records and observations of weevils with folivorous larvae (Coleoptera: Curculionidae). *Proceedings of the Entomological Society of Washington* 123(4): 727–740.
- Eiseman, Charles S. 2022. New rearing records reveal *Phytosciara greylockensis* Eiseman, Heller, and Rulik (Diptera: Sciaridae) is a polyphagous leafminer of herbaceous plants. *Proceedings of the Entomological Society of Washington* 124(1): 174–176.
- Eiseman, Charles S. and Julia A. Blyth. 2022. Nantucket’s neglected herbivores I: Coleoptera. *Proceedings of the Entomological Society of Washington* 124(2): 202–224.
- Eiseman, Charles S. and Julia A. Blyth. 2022. Nantucket’s neglected herbivores II: Diptera. *Proceedings of the Entomological Society of Washington* 124(3): 564–605.
- Eiseman, Charles S. and Owen Lonsdale. 2022. First North American record of *Phytomyza origani* Hering (Diptera: Agromyzidae), a leafminer of cultivated herbs in the mint family (Lamiaceae). *Proceedings of the Entomological Society of Washington* 124(1): 177–183.
- Eiseman, Charles S. and David R. Smith. 2022. A review of the Nearctic fern-feeding sawflies (Hymenoptera: Tenthredinidoidea), with new host records and larval descriptions. *Proceedings of the Entomological Society of Washington* 124(1): 18–38.
- Eiseman, Charles S., David R. Smith, Bill Sheehan, and Tracy S. Feldman. 2022. *Macrophya Dahlbom* spp. (Hymenoptera: Tenthredinidae) feeding on Asteraceae. *Proceedings of the Entomological Society of Washington* 124(1): 39–45.
- Eiseman, Charles S., David R. Smith, and Peter Woods. 2022. Nearctic “slug” sawfly larvae of the genus *Caliroa* Costa (Hymenoptera: Tenthredinidae): new rearing records and a summary of hosts, descriptions, and distribution records. *Proceedings of the Entomological Society of Washington* 124(2): 225–244.
- Xuan, Jing-Li, Sonja J. Scheffer, Owen Lonsdale, Brian K. Cassel, Matthew L. Lewis, Charles S. Eiseman, Wan-Xue Liu, and Brian M. Wiegmann. 2022. A genome-wide phylogeny and the diversification of genus *Liriomyza* (Diptera: Agromyzidae) inferred from anchored phylogenomics. *Systematic Entomology* 2022: 1–20. <https://resjournals.onlinelibrary.wiley.com/doi/10.1111/syen.12569>

Other 2022 Publications and Reports

- Eiseman, Charley. 2022. BugTracks. <https://bugtracks.wordpress.com/> [11 blog posts in 2022]
- Eiseman, Charley. 2022. The daylily leafminer. *The Daylily Journal* 76(4): 18–19.
- Eiseman, Charley. 2022. Herbivorous insects of Fitzgerald Lake Conservation Area. 10 pp. https://www.broadbrookcoalition.org/wp_site/wp-content/uploads/Eiseman-Fitzgerald-Lake-insects.pdf
- Eiseman, Charley. 2022. *Leafminers of North America, Second Edition*. Privately published e-book, clxvii+2213 pp. Available from: <http://charleyeiseman.com/leafminers/>
- Eiseman, Charley. 2022. Notes on some Rhode Island leafminers. *Rhode Island Naturalist* 17(2): 1–2, 4–5. <https://rinhs.org/wp-content/uploads/2022/10/RINat-17-2-final.pdf>

Roach, Margaret. 2022. Those weird marks on your leaves? Here's how to decipher them. The New York Times. Sept. 28. <https://www.nytimes.com/2022/09/28/realestate/leaf-miners-galls-gardens.html> [article about my work]

Plans for 2023

This winter, my projects include working on the guide to sawfly larvae (and writing papers to document my own novel sawfly observations), preparing a report on my botanical / natural community surveys for Green Berkshires, and continuing to develop my skills in dissecting, identifying, and possibly describing new species of micro-moths. Other writing projects include ongoing collaborations on the taxonomy and natural history of leaf-mining flies in the families Agromyzidae, Chironomidae, Chloropidae, and Tephritidae; beetles in the families Buprestidae and Chrysomelidae; and moths in the families Bucculatricidae, Cosmopterigidae, Gracillariidae, Heliozelidae, Nepticulidae, and Tortricidae. Once my dissection skills are sufficiently developed, I hope to describe new species of moths in the families Elachistidae and Tischeriidae. I also intend to write a paper about moth larvae feeding on wild sarsaparilla, and other papers about assorted gall midges.

During the field season, in addition to continuing to add to the overall list of herbivorous insects documented at Aton Forest, I will have a list of specific targets in mind each time I visit, with the goal of collecting larvae and rearing them to adults so that the species in question can be identified (and described, if they turn out to be new). These include:

- May / early June: *Chirosia* on silvery spleenwort (if last June's collections don't end up yielding a sufficient number of specimens), *Liriomyza* on false hellebore, *Phytomyza* on white wood aster, mystery feeding channels on interrupted fern; check thallose liverworts in stream near headquarters for mining fly larvae
- Mid- to late June: *Agromyza* on avens, *Pseudopostega* on bugleweed, leaf spot gall midge on sweetgale, bud gall midge on meadowsweet, leaf curl gall midge on highbush blueberry
- Mid- to late summer: stem-mining agromyzid on sweet-scented bedstraw
- Autumn: check American fly honeysuckle (*Lonicera canadensis*) along Doolittle Brook for *Phytomyza* leaf mines

Other fieldwork will include further surveys sponsored by Green Berkshires in the vicinity of Mount Washington, MA, and probably further ecological assessments for the Norcross Wildlife Foundation.

I am one of the invited plenary speakers at the 10th International Congress of Dipterology in Reno, NV (July 16–21), where I will be giving a presentation about leaf-mining flies. With Julia Blyth, I am planning a collecting road trip in the western US before and after this conference, possibly stopping at the Southwestern Research Station in Portal, AZ to give a lecture or two at the Lepidoptera Course that is taking place there in the second week of August.