

University of Maine Browntail Moth Research Project, December 2018

Project Director: Dr. Eleanor Groden
Professor of Entomology
School of Biology and Ecology
University of Maine
Orono, ME
Groden@maine.edu

Co-Director: Dr. Barbara Cole
Professor of Chemistry
Department of Chemistry
University of Maine
Orono, ME
Cole@maine.edu

Background:

Browntail is an invasive moth introduced into North America in 1897. In addition to defoliating hardwood trees including oak, apple, and cherry, larvae pose serious human health concerns due to toxic urticating hairs that can cause a severe rash and/or respiratory distress. After its initial introduction into Massachusetts, the insect's range rapidly spread to six states and two Canadian provinces. By the 1930's browntails had contracted to relic populations in coastal Maine and Cape Cod, Massachusetts. These populations persisted until late 1980's-2003, when browntails went through localized epidemics. Following a brief subsidence, populations have risen to levels higher than anything seen since the early 1900's. In the spring of 2016, 24,975 acres were defoliated by browntail caterpillars. During that summer, moths were trapped in various locations from Roque Bluff to Millinocket, Maine (130 miles inland) and 64,000 acres of defoliation was mapped in September 2016. Current evidence suggests that browntail moth are continuing to expand in Maine. Fall 2018 aerial surveys by the Maine Department of Agriculture, Forestry, and Conservation (MAFC), determined that the impacted infestation area is now over 126,000 acres.

It is not clear what caused the initial collapse of the browntail's invasive range. As higher overwintering survival has been recorded in its coastal habitats compared to inland habitats, climate limitations via restrictions on natural enemies and/or interactions with host plant quality have been proposed. Hence, climate warming could be triggering a new expansion of this pest, and its initial invasive range suggests that it may have the potential to again spread further throughout the northeast.

Homeowners and town managers have requested assistance from state and university entomologists in developing management strategies. Of particular concern are heavy infestations in high risk areas surrounding schools and outdoor recreational facilities.

Current Projects:

The overall objective of the Browntail moth research at the University of Maine is to understand the underlying cause of the current outbreak, and develop environmentally sound management options for this pest in affected areas. Our work is in collaboration with entomologists at the MAFC, whose entomologists have been tracking Browntail moth in Maine for a number of years. We communicate with and collaborate with local municipalities and citizens groups working to extend education and management information about browntail moth. Our specific on-going projects include:

- 1) Assessment of severity of browntail moth outbreaks throughout Maine.
- 2) Assessment of browntail moth natural mortality throughout various parts of the outbreak area.
- 3) Management of Browntail moth.
 - a. Testing of environmentally compatible materials for browntail moth control.
 - b. **Characterization of the silk that browntail moth caterpillars produce for their overwintering webs, and assessment of potential materials to degrade the integrity of silk webs to expose the caterpillar to potentially damaging winter conditions.**

Projects 1-3a have been on-going since 2016 and have been supported by funds from the NE-IPM Center, the University of Maine Agriculture and Forestry Experiment Station, the town of Harpswell, and private donations from citizens and non-profit organizations (Abagadasset Foundation). (Brief descriptions are below.). Funding is currently being sought to continue research on the silk browntail moths produce for their winter webs and potential to target this stage for pest management.

Browntail moth silk, and assessment of potential materials to degrade the integrity of silk webs to expose the caterpillar to potentially damaging winter conditions: We are exploring a very novel approach to pest management that could be very well suited to browntail moth biology. Browntail moths lay their eggs in Maine on foliage in mid to late July through early August. When these eggs hatch in early to mid August, small caterpillars feed on the foliage of oaks and other suitable host plants for 1-3 molts. In later August and early September, caterpillars begin to make and secure silken webs, usually at the top outer branches of their host trees, in which they will spend the winter. The young caterpillars spend 8 months through the late fall, winter, and early spring in these webs before emerging as midstage caterpillars to feed in late April, early May. This later stage of spring and early summer caterpillar activity is the most hazardous to people residing in infested areas, as the larger caterpillars has sufficient concentration of the toxin in their hairs to cause severe dermatitis and respiratory reactions in those exposed.

Given the length of time that caterpillars inhabit the wintering webs and the harsh weather conditions that they must endure, we have begun explorations into potential ways to compromise the integrity of these overwintering webs, such that caterpillars will be exposed to and perhaps suffer mortality from adverse winter weather. Winter treatments that impact the integrity of the webs may also have fewer non-target impacts, as most other insects and other invertebrate species will not be active and experience exposure.

Initial research: In summer 2019, a visiting undergraduate student in Groden's lab working with Dr. Barbara Cole in Chemistry, and Dr. Cole's graduate student (Hyeweon Hwang), harvested silk from browntail moth winter webs and summer pupation nests, and

compared the amino acid composition of the browntail moth caterpillar silk with that of the *Bombyx mori*, the commercial silk moth. Some differences in silk composition were found, but another anecdotal finding was also illuminating. The first step in the process of examining the amino acids of the silk was to strip the sericin, which is the glue that holds the silk components together, from the silk strands. When the sericin was removed, considerably less “cleaned” silk (by weight) remained in the browntail moth sample than the silk moth sample. Subsequent research revealed that seracin is a very hydrophobic (water repellent) and antifreeze compound. It likely lends these properties to the overwintering browntail moth webs.

The process of removing the sericin for chemical analysis of the silk involves washing the webs with a heated alkaline detergent. In the interest of exploring a “proof of concept” and move research ahead as quickly as possible we initiated a field trial over the 2018-2019 winter. Winter webs were treated at 6 sites throughout the infested area with high concentrations of commercially available and registered insecticidal soap, detergent insecticide additives (spreader-sticker), and a liminon-based product. The survival of the caterpillars in the webs will be assessed throughout the winter. With funding, future work will include:

- Quantifying sericin levels in winter webs, and determining other web and silk components that may provide protection for webs;
- Assessing the effect of detergents and other materials on the quality and properties of browntail moth silk.
- Determine concentrations and application strategies needed to impact caterpillar overwintering survival.
- Evaluate effects of silk damaging strategies on non-target organisms.

Other On-going Browntail Moth Research in Groden Lab at UMaine

- 1) *Assessment of severity of browntail moth outbreaks throughout Maine.* Objective: Track the current spread of browntail moth throughout the state. With undergraduate and graduate students, we are monitoring relative densities of caterpillars and overwintering webs within and on the expanding edges of current outbreak areas. This project is coordinated with the MAFC Entomologists, Allison Kanoti and Thomas Schmeelk, who have been conducting light trapping for moths and aerial assessments of defoliation throughout the state.
- 2) *Assessment of browntail moth natural mortality throughout various parts of the outbreak area.* Objective: A graduate student, Karla Boyd, is working to identify and assess the impact of natural enemies and disease on the current outbreak populations of browntail moth. She is sampling caterpillars and pupae throughout the region at different stages of development, and rearing them to determine the incidence of parasitism. She is also collecting caterpillars and using molecular markers to assess the incidence of both a fungal pathogen and a virus in the populations. Tracking these natural enemies throughout the region will provide insight into the factors that can naturally manage populations and also provide us with information on their activity periods, such that we can optimize timing of management tactics to minimize interfering with their activities. Support for the graduate student stipend is provided by the University of Maine Agriculture and Forestry Experiment Station

3) *Management of Browntail moth.*

a. Testing of environmentally compatible materials for browntail moth control.

Through laboratory bioassays and field trials, we have been evaluating a number of environmentally compatible and organically certified materials that can be applied to manage browntail moth. This project is being conducted in collaboration with Maine Forest Service. Partial support for this project through 2017 was provided by the Maine Forest Service, the NE-IPM Center and the University of Maine Agricultural Center. Additional support for travel, supplies and personnel through 2018 were provided by donations from private citizens and the Town of Harpswell. The opportunity for future trials against spring and summer caterpillars in 2019 will depend on the assessment of laboratory and field studies currently underway. Finishing sample processing and data analysis is scheduled during the winter 2019.

DONATIONS TO SUPPORT THIS WORK ARE GREATLY APPRECIATED AND CAN BE DIRECTED TO THE UNIVERSITY OF MAINE FOUNDATION, TWO ALUMNI PLACE, ORONO, ME 04469-5792. PLEASE SPECIFY THAT FUNDS ARE SPECIFICALLY FOR SUPPORT OF THE UNIVERSITY OF MAINE BROWNTAIL MOTH PROJECT.