Browntail Moth Research at the University of Maine
2022 Update

Browntail moth (BTM; *Euproctis chrysorrhoea*) is a non-native insect native to Eurasia that was accidentally introduced into North America in the late 1800's. Known to feed on over 50 species of woody hosts, BTM quickly became a serious defoliating pest of forest and ornamental deciduous trees, and spread unabated throughout the northeastern region for the first 15 years of its invasion. After 1915, however, BTM populations declined and became restricted to a few coastal habitats in the Casco Bay area of Maine and Cape Cod area of Massachusetts. In its native range, BTM populations can reach outbreak levels every 10-30 years. BTM populations in Maine have seen population growth spurts every 10-15 years or so in coastal areas, but these were quickly controlled or naturally declined due to biological agents present in Maine (e.g., predators, fungal infection, etc.). In 2015, BTM populations exploded to 100-year highs, causing both forest and human health problems. This outbreak has caused ~250,000 acres of hardwood defoliation with tree mortality being observed in areas that have experienced repeated years of defoliation. In addition, BTM caterpillars have toxic hairs that can cause severe rashes and respiratory problems in humans. Since the hairs go airborne when they shed their exoskeletons, direct contact with the caterpillars is not a prerequisite for serious symptoms, and outbreaks can negatively impact tourism, outdoor recreation, and everyday activities such mowing the yard or raking leaves.

Browntail moth female laying an egg mass (July 2021).

The Forest Entomology lab in the School of Biology and Ecology at the University of Maine, led by Dr. Angela Mech, is conducting multiple research projects to better understand, monitor, and control BTM, with the goal of reducing the impacts of the current outbreak while better preparing for the next one.

With the assistance of the Maine Forest Service, USDA Forest Service, Trécé Inc., collaborators from UMaine and other Universities, and multiple Maine landowners, the Forest Entomology lab at UMaine is conducting research in the following areas:

1. **<u>Establish a Long-term Monitoring Program</u>.** Models that can predict insect population densities based on the number of males caught in pheromone-baited traps have been used for a number of insect pest species as an early predictor of outbreaks (to detect when populations are experiencing the onset of their building phase). Monitoring is an integral part of early-intervention strategies aimed at preventing populations from reaching outbreak levels. To reach this goal, the following research is necessary:
    a. ***Determine the most effective pheromone lure-trap type combination***. Working with Trécé Inc., we are testing different purity levels and concentrations of BTM's female sex pheromone as well as different trap styles and colors. For a successful monitoring program, it is important that the lure and trap are able to effectively capture males, especially when BTM population levels are low (i.e., during the non-outbreak phase). Preliminary 2021 trials found the synthesized pheromone to be effective at attracting male BTM, and additional trials will be conducted during the summer 2022 flight season to finalize the lure-trap combination that will be used moving forward.

Hanging a pheromone-baited trap to capture browntail moth males.

    b. ***Develop a BTM population density predictive model***. Starting in summer 2022, and continuing through at least 2026, pheromone traps will be set up across Maine in different population densities (no BTM to High population levels). Male BTM catch data will be collected yearly and correlated to the number of winter webs in each trap area. The predictive model will help answer the question "how many males in a trap equates to a damaging population level?" and can be used to develop risk assessments.

2. **<u>Test Mating Disruption</u>**. This method is based on the concept that insect sex pheromones can be used to suppress pest populations by releasing high enough concentrations that the males become confused and can no longer find females. This method can be used over large areas, does not directly affect natural enemies, is cheaper than using chemicals, has minimal non-target effects, is environmentally friendly, and can be highly effective. Species-specific behavior modifying semiochemicals (i.e., pheromones) can therefore result in a longer-term reduction of pest populations compared to conventional pesticides, which may need to be reapplied yearly. Mating disruption is

not effective for all insect species, but BTM has many traits that indicate mating disruption could successfully work at suppressing populations – there is only one generation per year, adult flight seasons are short and highly synchronized, and the heavy females only lay a single egg mass and do not appear to be efficient fliers. The following research is necessary to test this control method:

a. ***Determine if the synthesized pheromone successfully confuses male BTM.*** Starting in summer 2022, different concentrations of the female sex pheromone will be used to determine at which rate the males are unable to find a virgin female.

b. ***Determine the synthesized pheromone plume distance.*** Starting summer 2022, tests will be conducted to determine the plume size of the pheromone lures. This will help us determine the number of lures and/or loading rate that would need to be used per unit area in larger field trials (2023 start).

3. **<u>Determine attractiveness of light</u>.** It is well known that moths are typically attracted to lights, but different species of moths can be attracted to different parts of the solar spectrum. For example, some species are strongly drawn to the blue or UV parts of the spectrum. The reason for this attractiveness is still being studied, but one of the hypotheses is that males use light as a cue to find females, particularly if their wings reflect that light. Being that BTM females are white and that BTM nests can be found in higher numbers near lights, this may be the case. It is currently unknown which part of the light spectrum attracts browntail moth, but if their vision is restricted to particular wavelengths, then lights that emit *other* wavelengths may not be as attractive. Using light bulbs that are not visible to BTM could potentially result in fewer BTM nests near houses. To determine if this is the case, the following research is necessary:

Browntail moth adults on lamppost.

a. ***Determine the attractiveness of commercially available light bulbs.*** During the summer 2022 BTM flight season, we will test the attractiveness of different light bulbs in a choice lab experiment, as well as observation studies quantifying the BTM moth populations at different types of outdoor lights.

b. ***Determine if outdoor lights increase the number of BTM nests.*** During the winter of 2022, winter webs were counted per tree and will be correlated to the distance to the nearest light source. The type of bulb for each light source will be determined and then correlated to the number of nests to determine whether certain outdoor bulb types result in an increase in BTM populations. Results will assist in recommendations regarding the use of outdoor lights.

4. **<u>Test the efficacy of more-targeted biopesticides.</u>** Currently, homeowners are responsible for any browntail moth management on their property. Although clipping reachable winter webs is a cost effective way to reduce the population in your area, BTM webs are often found at the tips of branches on trees too tall to reach. For these trees, chemical control is one of the options, but most commercially available products labeled for use against BTM are considered broad-spectrum (i.e., they can negatively impact other insects, including beneficial insects). To determine whether more-targeted products, including organic biopesticides that only affect species in the order Lepidoptera (moths & butterflies), are effective against browntail moth, the following research is necessary:
    a. ***Test products in a controlled lab environment.*** Larvae are fed treated plant material in a controlled lab experiment to determine whether it causes significant mortality. In 2021, lab trials tested seven different commercially available biopesticide products and found promising results. However, lab bioassay results don't always directly translate to outdoor efficacy, so field trials must be conducted before recommendations can be made.

Browntail moth caterpillar lab experiment testing different biopesticide products.

    b. ***Test products in field trials.*** In 2022, the most successful products from the 2021 lab experiments will be tested on BTM-infected trees. Trials will be conducted in the spring, to test their efficacy on caterpillars that emerge from winter webs, and in the fall on recently-hatched (pre-winter web) caterpillars. Products found to be effective can be added to the list of products available for BTM management.

Donations to support the University of Maine browntail moth research may be sent to:

The University of Maine Fountain
2 Alumni Place
Orono, ME 04469

***Please indicate that funds are specifically for the Browntail Moth Project**