

January 2021

Slowing the Spread of Gypsy Moth in Indiana



Photos: USDA APHIS PPQ



Welcome to this introduction to gypsy moth in Indiana and the Gypsy Moth Slow the Spread program. This presentation is brought to you by the Indiana Department of Natural Resources Division of Entomology and Plant Pathology. Before we begin, we would like to acknowledge our partners who make this program possible - the Indiana DNR Division of Forestry, USDA APHIS, US Forest Service, Purdue University and Purdue Extension.

Agenda

- What is Gypsy Moth?
- Biology
- Damage
- Survey
- Treatment Options



In this presentation we will introduce you to gypsy moth, talk about its life stages, and outline what makes it such a destructive forest pest. Then we will discuss how we survey for this insect and what options we have to manage their populations when we find them.

What is gypsy moth?

- Lepidoptera
(Moth/Butterfly Order)
- Native to Europe
- Introduced near Boston
in the late 1860s
- One of North America's
most devastating forest
pests

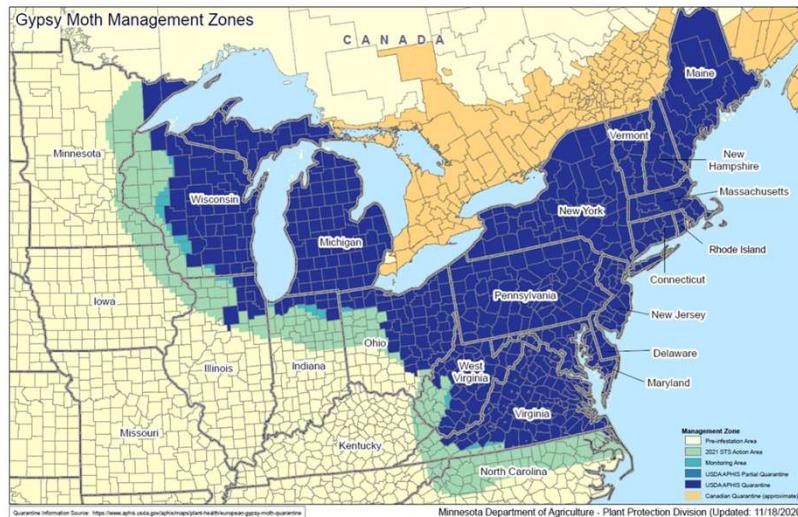


Workers wrapping trees with burlap bands circa 1893 from *The Gypsy Moth*.

So, what is gypsy moth?

European gypsy moth scientific name *Lymantria dispar dispar* is an insect in the Lepidoptera order; that is - the moths and butterflies. It is originally from Europe and was accidentally introduced near Boston in the late 1860s. By 1890, gypsy moth was causing widespread defoliation in that area and has gone on to become one of North America's most devastating forest pests.

Current Gypsy Moth Distribution in North America

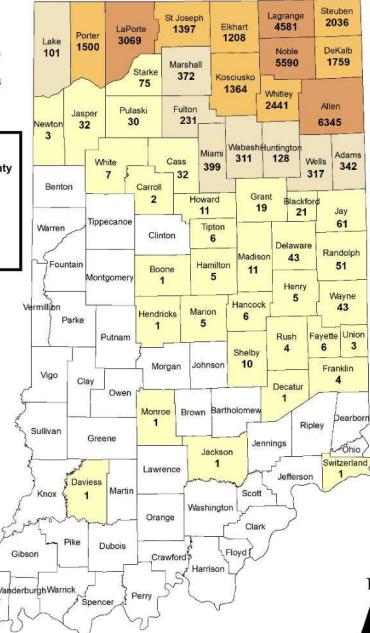
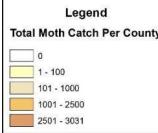


Today, gypsy moth can be found across the Northeast and Midwest states and in several Canadian provinces. The dark blue and dark orange areas are generally infested with gypsy moth. The light green areas are “action zones” where gypsy moths are actively managed by the Slow the Spread program. Occasionally, gypsy moth is found in the tan areas. These sites become a high priority for eradication in order to slow the progression of this insect across the country.

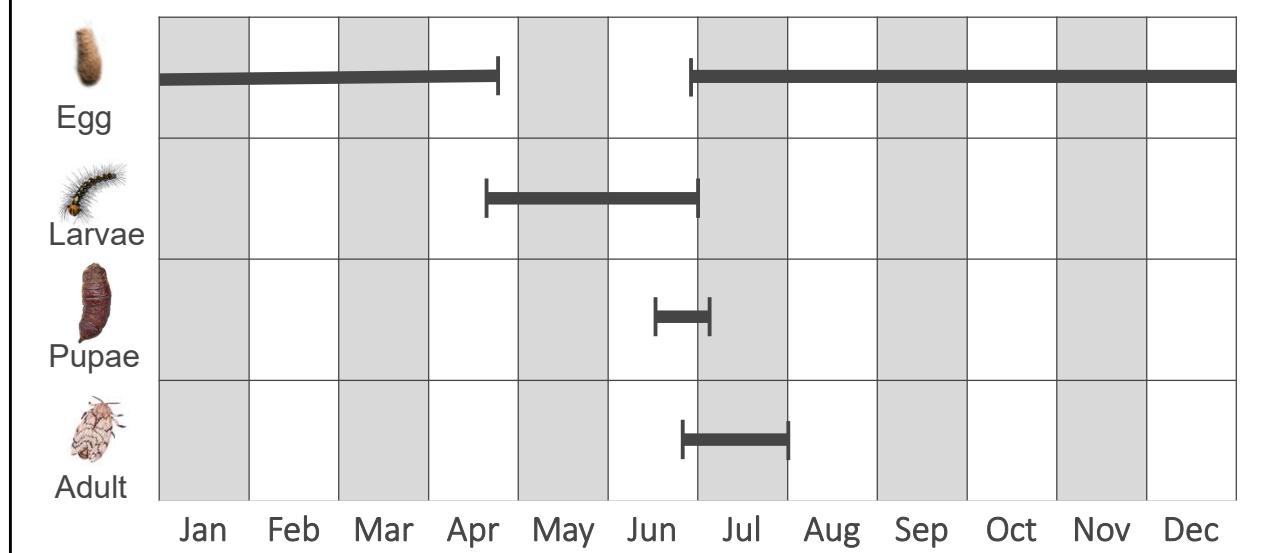
Indiana 2020 Gypsy Moth Catch per County



Indiana Department of Natural Resources

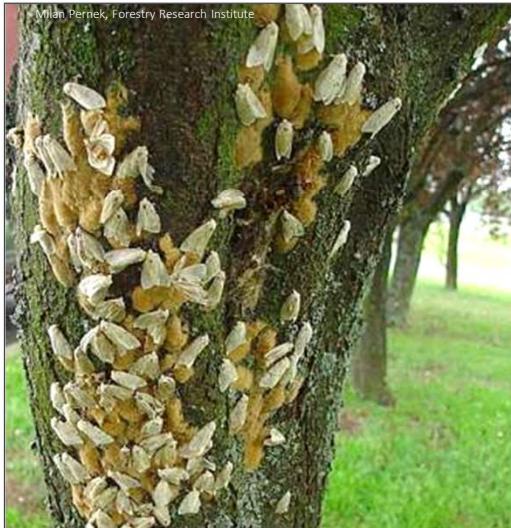


Biology: Gypsy Moth Life Cycle



Now that we know a little bit about where gypsy moth came from, let's talk about its biology.

Gypsy moth has a typical moth life cycle with four distinct stages: Eggs, larva or caterpillar, pupa, and adult. Let's look at each stage a little closer.



Egg Masses (July-April)

- Overwinters as eggs
- Each egg mass contains 500 to 1,000 eggs



Uncovered egg mass



Of the year-long life cycle, 8-9 months is spent as an egg within the protection of the egg mass. Egg masses are laid in late summer and are present through the winter and into the early spring. Each female can lay only one egg mass, but each egg mass can contain 500 to 1,000 individual eggs. Egg masses are about 1-2 inches in length and vary from dark rust to light tan in color. The velvet appearance comes from a top covering of the female's body hairs. Females seek out protected areas to lay egg masses. They can be laid on any available surface, including trees, vehicles, furniture and other outdoor items.

Caterpillars (late April-June)

- $\frac{1}{4}$ " caterpillars hatch in late April
- They move into the canopy to feed on leaves



Emergence will vary depending on how warm or cold the spring is, but sometime around April 25, quarter-inch long caterpillars will hatch out of the eggs. These caterpillars will soon move into the tree canopy to feed.

Caterpillars (late April-June)

When crowded, newly hatched caterpillars colonize other trees by producing silken threads that they ride on the breeze.



Karla Salp, Washington State Department of Ag, bugwood.org

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This is called ballooning.

Gypsy moth caterpillars do not
make webbed nests.

When the caterpillars are in crowded conditions, they will go through a process called “ballooning”. Caterpillars spin a silken thread that they then ride in the wind in order to spread to less crowded areas to colonize new trees. In these pictures, the gypsy moth caterpillar is hanging from a single thread hoping to catch a ride to a new area. Gypsy moth caterpillars do not make webbed nests.

Caterpillars (late April-June)

- Older caterpillars are hairy and have 5 pairs of blue dots and 6 pairs of red dots
- Mature caterpillars can reach 3 inches in length



The caterpillars are covered with coarse hairs. As they mature, gypsy moth caterpillars develop a characteristic marking - 5 pairs of blue dots and 6 pairs of red dots along their back. They can reach up to 3 inches in length.



Pupae (June-July)

In late June, the larva stop feeding and go into a resting stage where they will develop into adults.

In June, after about two months of feeding, the caterpillars will go into a resting or “pupal” stage where they will develop into adults. They are in this stage for about 14 to 17 days.

Adults (June-August)

Males emerge in mid to late June; flightless females emerge a few days later.



Adult males will begin to emerge from their pupal casing in late June with the females emerging a few days later. Females are flightless, so to attract a mate, they release a scent or pheromone for the males to follow. {HIT SLIDE ADVANCE TO START ANIMATION} The males have feathery antennae that allow them to sense or “smell” the scent of the female. {HIT SLIDE ADVANCE TO START ANIMATION} Both sexes have a characteristic chevron pattern or an “arrow pointing to a dot” on their wings. This marking is much less obvious on the darker colored males than on the white females.

Ecological Damage: Spreads Easily

- Natural spread by ballooning
- Artificial spread by movement of egg masses



Let's look at some of the qualities of gypsy moth that make it so devastating.

We have already talked about how caterpillars can ride on wind currents to find new feeding grounds. While natural ballooning may move caterpillars a few miles, artificial spread can take this insect across states, countries, or even across continents. This is due to the propensity for egg masses to be laid on objects moved by people, enabling spread into new areas – often undetected.

Ecological Damage: Spreads Easily



As you can see in these pictures, egg masses can hide almost anywhere – under picnic tables, in pipes, or on anything left outdoors. This habit of laying egg masses anywhere makes it very important for those living in gypsy moth areas to inspect anything left outdoors prior to moving it.

Ecological Damage: Spreads Easily



Vehicles, trailers, and campers also provide plenty of sheltered places for an egg mass to hide. Plus, their mobility provides an easy means for gypsy moth to find its way into new habitats and regions.

Ecological Damage: Wide Host Range

Gypsy moth feeds on over 500 types of plants

Most Preferred	Moderately Preferred	Less Preferred
Oak	Black Walnut	Arborvitae
Apple/Crabapple	Cherry	Catalpa
Poplar	Hickory	Dogwood
Birch	Elm	Honey Locust
Blue Spruce	Maple	Rhododendron
American Beech	Paw Paw	Tulip Tree/Yellow Poplar
Hawthorn	Sassafras	Viburnum
White Pine	White/Norway Spruce	Ash

Another reason why gypsy moth is so devastating is because it will feed on over 500 different species of plants. While it strongly prefers oaks, it is a generalist and will feed on a wide range of plants found throughout Indiana. If it can't find an oak or other preferred host, it will find something to feed on. Just because it's not a favorite food, doesn't mean it won't be consumed.

Ecological Damage: Big Appetite

Full size caterpillars
consume up to a
square foot of
foliage a day.



It's hard to imagine that a caterpillar can cause so much damage, but they are voracious feeders. At maturity, a single caterpillar can eat 1 square foot of foliage every 24 hours and can consume up to 11 square feet of leaf tissue in its lifetime.

Ecological Damage: Rapid Increase in Population

In just a few years, small populations can grow to defoliate hundreds of acres of forest.



With over 500 eggs laid by each female, gypsy moth populations can grow quickly. And when populations are large, defoliation can happen rapidly. This picture is from Snow Shoe, Pennsylvania in July 2007. The tan areas are large swaths where gypsy moth has stripped the tree canopy of leaves.

Given their potential to spread, ability to exponentially increase in numbers, a wide host range, and amount of foliage consumed, it is no wonder that gypsy moth is a threat to defoliate thousands of acres of rural and urban forests across the U.S. every year.

Ecological Damage

A defoliated tree is unable to store food and becomes susceptible to drought, diseases, and other pests.

2-3 years of defoliation in a row can kill a tree.



But what does that defoliation do to the trees? Losing leaves takes away a tree's ability to store food and puts it under stress. Because this defoliation happens early in the year, most trees can put on a second flush of leaves. But doing so uses up reserve energy and makes the tree susceptible to environmental stress like droughts, diseases and other pests. Two to three years of defoliation in a row can kill a mature tree.



Economic Damage

Property values are reduced

- Aesthetic damage
- Reduced shade
- Increase in noise

Property owners are liable for:

- Tree removal costs
- Replacement costs
- Damage from fallen limbs/trees

Gypsy moth also has economic impacts. Trees play a critical role in our communities. When gypsy moth kill trees, it changes how our neighborhoods look, feel, and sound. Additionally, property owners are responsible for the costs associated with tree removal and replacement, as well as the liability associated with falling limbs and trees.

Health and Wellness

Caterpillar hairs break off and become airborne.

These hairs can cause allergic reactions in some individuals.

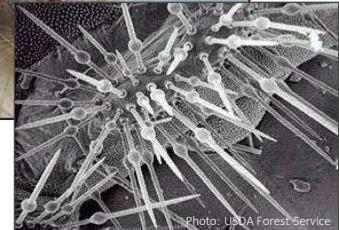
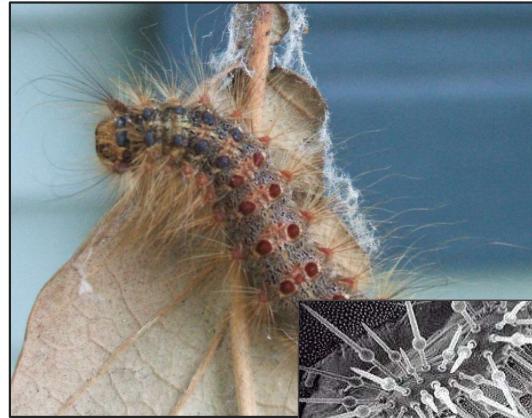


Photo: USDA Forest Service

Gypsy moth also has the potential to affect the health and wellness of a community. A very small percentage of people are sensitive to the hairs of the gypsy moth caterpillar. When people come into contact with these hairs, either when the hairs break off and become airborne or by touching or being touched by the caterpillar, a rash similar to that caused by poison ivy can develop.

Health and Wellness

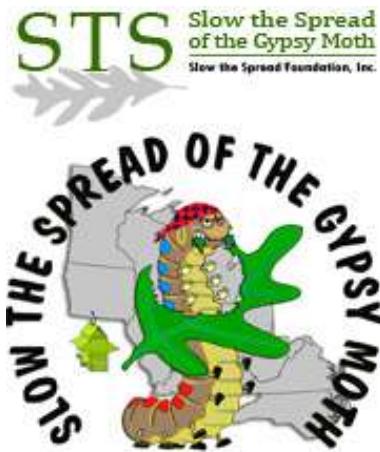


Caterpillars and excrement fall from trees, creating unpleasant messes that can reduce the allure of outdoor activities

In very high populations, gypsy moth can make outdoor activities unpleasant as well. Caterpillars and their excrement may be falling from trees and covering sidewalks, picnic tables, and other surfaces reducing the allure of backyards, parks, pools and other outdoor recreational facilities.

Survey

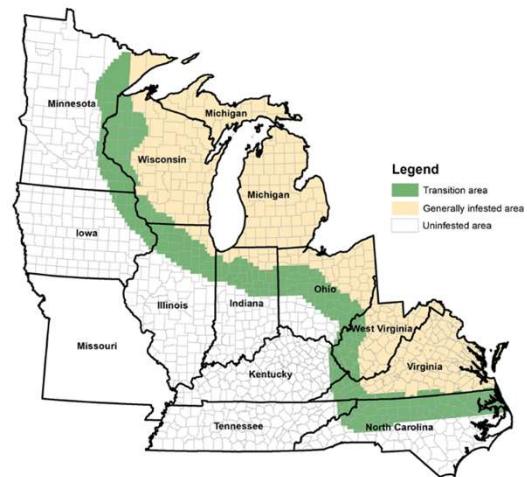
The Slow the Spread (STS) Project is a cooperative project managed by the US Forest Service.



To figure out how to manage gypsy moth, we have to know where it is. And that means conducting a survey.

The Slow the Spread or STS project is a cooperative program managed by the US Forest Service.

STS includes state agencies from Indiana, Illinois, Iowa, Kentucky, North Carolina, Ohio, Tennessee, Virginia, West Virginia, Minnesota and Wisconsin.



The STS program is conducted in cooperation with the states along the leading edge of gypsy moth infestation. Much of the survey work for gypsy moth is conducted in this area.

Gypsy moth traps are placed throughout the STS area to evaluate:

- where gypsy moth is and where treatments may be needed
- the effectiveness of previous treatments



To monitor gypsy moth populations, pheromone traps are placed in grids throughout the STS area. Remember, females don't fly. The pheromone in the trap mimics the female to attract and capture male moths and show us where populations are, where populations are increasing, and how effective previous treatments have been.

The Goal: Limit the spread of gypsy moth so natural enemies can bring populations into balance.

Predators



Pathogens



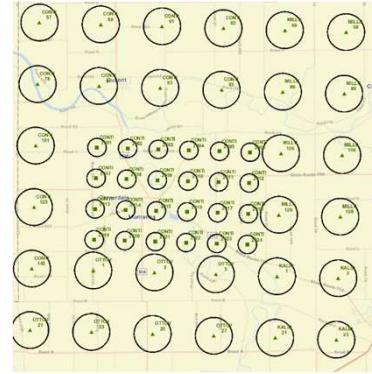
Parasitoids



The overall goal of the Slow the Spread project is to limit the spread of this pest so natural enemies can catch up with the leading edge of the infestation and help keep populations from becoming damaging. Mammals, such as this squirrel take time to adapt to potential new food sources. Meanwhile, pathogens and parasitoids take time to move into new areas and become effective controls of gypsy moth populations.

Treatment Options

- Do nothing
- Conduct additional surveys
- Ground Treatments
- Aerial Treatments
 - Mating Disruption
 - *Bacillus thuringiensis* (Btk)



Gypsy moth will never be eradicated from Indiana but we can and do manage the rate at which it moves through the state. One of the ways we manage for gypsy moth is through various treatment options.

{HIT SLIDE ADVANCE TO START ANIMATION} If a population is too far behind the STS zone or is already showing strong pressure from natural enemies, doing nothing may be an appropriate action. {HIT SLIDE ADVANCE TO START ANIMATION} In some cases we might have trap catches but are unable to locate the gypsy moth populations. A heavier grid of traps may be placed in these areas to help provide more information. {HIT SLIDE ADVANCE TO START ANIMATION} When gypsy moth populations are found in very limited areas, a ground treatment might be used. This can consist of spraying egg masses with oil or treating single trees on a site. {HIT SLIDE ADVANCE TO START ANIMATION} Finally, we can use aircraft to put applications over larger areas.

There are two different options for aerial treatments, and we'll look at each in turn.

Mating Disruption (MD)

- Effective on very low GM populations
- Applied aerially over tree canopies
- One application
(typically done in June)

Mating disruption or MD as we often call it is used in very low gypsy moth populations. It is applied over tree canopies in a single application, typically in June.

Mating Disruption (MD)



Mating disruption does not actually kill living organisms. It reduces future GM populations by decreasing the chance of mating.

- The female gypsy moth cannot fly.
- {HIT SLIDE ADVANCE TO START ANIMATION} She releases pheromones to attract a male to her.
- {HIT SLIDE ADVANCE TO START ANIMATION} {HIT SLIDE ADVANCE TO START ANIMATION} The large amount of female pheromone spread by aircraft overwhelms the males' sensory equipment, making them have great difficulty finding the females. Many males die of exhaustion before they encounter a living female moth. Unmated females do not lay viable egg masses, thus reducing future populations.

SPLAT® GM Organic

- Waxy droplets infused with pheromone
- Applied at about 1.6 ounces per acre
- Organic certified product



Photo: USDA Forest Service

The product SPLAT GM Organic is used for mating disruption. The female pheromone is infused into a waxy, biodegradable carrier made from food-grade materials. This formulation specifically affects gypsy moth and has no effect on other insects or wildlife. The application rate is about 1.6 ounces per acre. That's equivalent to about three tablespoons spread over a football field. If noticed on cars or other outdoor furniture, it can easily be washed off with a mild soap and water as recommended by the manufacturer.

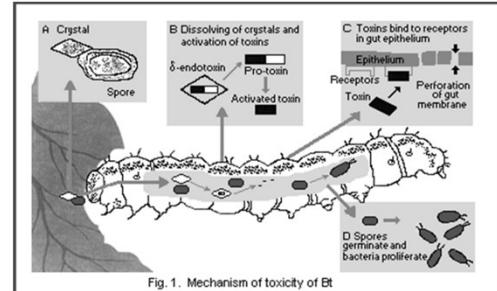
Bacillus thuringiensis subsp. *kurstaki* (Btk)

- Effective on low GM populations
- Applied aerially over tree canopies
- One or two applications
(typically done in early May: 4 to 10 days apart)

The second type of aerial application product is *Bacillus thuringiensis* subspecies *kurstaki* or Btk for short. This product is usually selected when populations are a little higher or are in an outlier population. It is usually applied in early May with a second treatment 4 to 10 days later. Occasionally Btk is applied as a single treatment when used in conjunction with an MD treatment.

Bacillus thuringiensis subsp. *kurstaki* (Btk)

- Soil-borne bacterium
- Used commercially since 1958
- Specific to caterpillars – targets their alkaline digestive system
- People, other mammals, birds, reptiles and fish have acidic guts, which are not affected by Btk



Btk is a naturally occurring soil-borne bacterium. It only affects caterpillars in the moth and butterfly family, and it must be ingested to kill the caterpillars. It is harmless to non-target species like people, other mammals, birds, reptiles, and fish. Having been in commercial use since 1958, Btk has an extensive and long-term safety record.

Foray 76B

- Applied as a liquid at about 42 ounces per acre
- Dries on the foliage within 20 to 60 minutes



The Btk product we use is called Foray 76B. It is applied at a rate of about 42 ounces per acre, which is a bit less than a 2-liter bottle of product over a football field. Foray settles on the foliage and dries within 20 to 60 minutes after application. Btk is also sensitive to sunlight and heat and will only persist in the environment for 3-7 days.

What to Expect the Day of Treatments:



- Treatments are weather dependent.
- Crop dusters will fly overhead usually in the early morning.
- The aircraft is loud and flies low over the tree canopy.
- Pilots can turn sprayers off over non-target areas.

Aerial applications are highly weather dependent. Rain, wind, or low clouds may result in a treatment being delayed. The day of treatments, a crop duster will fly over the treatment area. These planes fly low and are loud. Treatment usually occurs in the early morning but can occur any time during the day when weather is suitable. Even though pilots may fly over open fields and lakes, they have the ability to turn sprayers off so that product is only applied where it will be effective.

Security Precautions for Aerial Treatments



- Material is secured before, during, and after the operation.
- The aircraft itself is secured.
- DNR personnel monitor flights from the ground and at the airport.

The Indiana DNR and the US Forest Service take the safety of aerial applications very seriously. Material is secured before, during, and after the operation. Access to facilities and aircraft are restricted and monitored. DNR staff monitor operations at the sites, at the airport, and through GPS tracking of the aircraft.

More information can be
found at gypsymoth.IN.gov

- Proposed Treatments
- Interactive Maps
- Product Labels
- Site Maps
- Fact Sheets
- Contact Information

More information about our proposed treatments, including interactive and static maps, product labels, fact sheets and contact information can be found on our website at gypsymoth.IN.gov.



DIVISION OF
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Questions or Comments

Gypsy Moth

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If you have *any* questions or comments about our gypsy moth program and proposed treatment sites, we would love to hear from you. Please feel free to write, call, fax, or email. Again, you can find much more information about our treatment projects on the web at gypsymoth (one word) dot IN dot GOV.

The Indiana DNR thanks you very much for your time today.