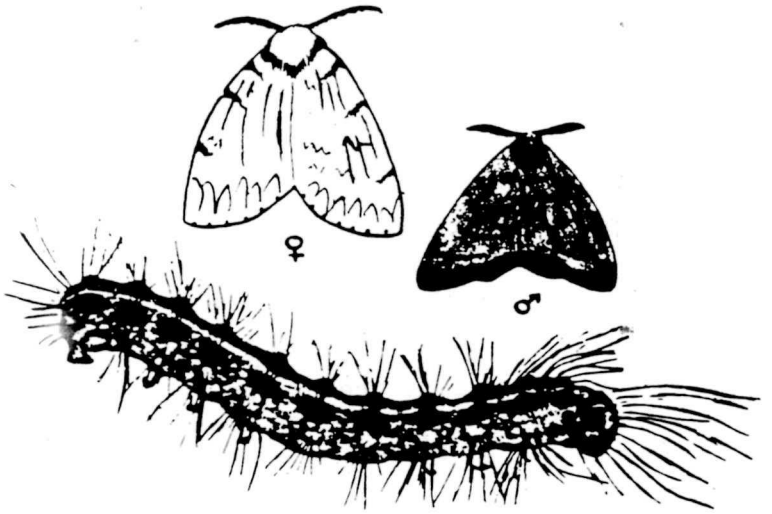

INFORMATION BULLETIN

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Management of the Gypsy Moth in the National Park Service

GYPSY MOTH INTRODUCTION AND SPREAD IN THE UNITED STATES:

...The gypsy moth (Lymantria dispar L.) was introduced into the United States (Massachusetts) from Europe in 1869 by a scientist who hoped his experiments of crossing it with silkworms would produce a new, heartier silk-producing insect. The experiments were unsuccessful, and some of the moth larvae (caterpillars) escaped. Within a few years this insect was well established in nearby woods.

...The gypsy moth spread, slowly at first. By 1988 it had moved northward into the New England states and Quebec, Canada; southward into Delaware, Maryland, and Virginia; and westward into New York, Ohio, Pennsylvania, and West Virginia...as well as sections of central Michigan, Colorado, and Oregon. Isolated infestations also had occurred in other states, such as North Carolina, Arkansas, and California.

...As the insect has moved, it also has infested National Park System parks along with other treed areas. To date, the gypsy moth has reached populations of tree-defoliation potential at Delaware Water Gap National Recreation Area (Pennsylvania), Catoctin Mountain Park (Maryland), Rock Creek Park (Washington, D.C.) and other parks in the National Capital Region, Shenandoah National Park (Virginia), and the Blueridge Parkway (Virginia and North Carolina).

...Unintentionally, humans have been aiding the gypsy moth's dispersal in their use of vehicles to visit forested areas that, unknown to them, are infested with the insect. When the people return home, they take with them gypsy moth larvae or egg masses that have attached themselves to some part of their cars, campers, trailers, or other equipment.

THE PROBLEM:

...In the areas where the gypsy moth is indigenous--Asia, Europe, and North Africa--it has more than a hundred natural enemies that usually sustain natural control. However, the gypsy moth was introduced into this country unaccompanied by these natural enemies.

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Therefore, between 1905 and 1934, more than 40 species of parasites and predators were imported into New England. Nine of these now are established as important natural enemies of the moth. Four of the 9--all parasites of gypsy moth larvae--are gypsy moth-specific and have no other hosts. Still they are not present in sufficient numbers to keep populations in check. Without these natural controls, gypsy moth populations are largely a consequence of the availability of host species. As the gypsy moths spread and defoliate trees, they weaken them so that they eventually are vulnerable to disease and other insect pests.

...Since its introduction into the United States, the moth has defoliated forest and ornamental trees on many millions of acres. Although its preferred hosts are species of oak, it can feed on more than 500 other plant species. Actually, during heavy outbreaks, older gypsy moth larvae ignore very few species.

...Additionally, the gypsy moth may be an indirect threat to some endangered animal species through potential adverse effects on these animals' food supply and alterations of habitat, and a direct threat to the endangered plant species it may defoliate.

...When gypsy moth populations have built up to high levels, and the larvae are causing moderate to heavy defoliation of susceptible hosts over wide areas, it is said that the infestations are in an outbreak mode. These outbreaks are cyclic--building periodically to epidemic levels, then collapsing.

THE GYPSY MOTH'S LIFE CYCLE:

...The gypsy moth's life cycle has four major stages: eggs, larva, pupa, moth. The insect produces one generation per year, and like many other tree-defoliating insects, is most destructive during its larval developmental stages (called instars) when it feeds on leaves. (No other life stage is known to cause damage.)

...Buff-colored egg masses are laid most commonly in clusters of 400 to 500 eggs per mass during July on the bark of host trees, where they overwinter. Their hatching usually coincides with budbreak of hardwood trees, especially oaks, the following spring.

...When weather conditions are favorable, the newly hatched larvae climb to the tops of trees or other objects. Before their first feeding, they suspend themselves on silken threads that are easily picked up by the wind and dispersed to adjacent forests or communities. This wind transport system is the primary method used by the moth to spread naturally to new areas.

...The larvae pass through several instars as they feed, shedding their skin (molting) as they grow. The caterpillars eat ravenously during the last two instars, each larva capable of consuming several leaves per day. Between mid-

June and mid-July--usually the period of the last instar--the larvae eat about 3/4 of the total foliage they will consume.

...After feeding stages are over, the larvae undergo pupation in reddish brown cocoons in protected sites on trees or other objects. In the pupal cases they are defenseless as well as immobile for about 2 weeks. Then the adult moths emerge, the males a few days before the females. Unlike the females, the males are strong flyers. On emerging from the pupal case the females are so heavily laden with eggs that they cannot fly. Therefore, they crawl to sites suitable for their eggs and there release a strong sexual attractant that the males will seek. After mating, the females deposit their eggs in masses. Soon after, they die. The males usually live for another few weeks.

TECHNIQUES FOR MANAGING THE GYPSY MOTH:

...The National Park Service (NPS) is committed to implementing the Integrated Pest Management Program (IPM) whenever possible. This strategy employs a systems approach that utilizes mechanical, biological, chemical, and cultural techniques to keep pest populations below unacceptable levels. It seeks to maximize the use of natural controls while minimizing chemical treatments.

...NPS policy indicates that determinations concerning the application of the IPM approach to gypsy moth management are to be based primarily on the management objectives for the various management zones found within a park. No decisions are to be made prior to a survey of the park area and a period of monitoring to gather information regarding locations, numbers, and viability of moth populations.

...In Congressionally mandated wilderness areas and natural zones, gypsy moth populations generally are not to be actively managed unless it is likely that unique or significant park resources will be lost if management is not implemented. Weather, predators, parasites, pathogens, and other factors causing moth mortality are relied upon to suppress populations.

...In historic, special use, and park development zones, where management objectives may require preservation of specific trees as historic objects and/or the protection of foliage in high-use public areas, more aggressive actions may be taken to control the insect's populations.

...Should the park manager make a decision that the moth is a significant problem, he/she receives technical assistance from NPS regional and Washington Office staffs and the U.S. Forest Service as needed. However, the use of pesticides is not permitted without prior review by regional office personnel and the approval of the Director or his staff.

...Many State, Federal, and private organizations have been involved in the research and development of gypsy moth control measures over the past 100 years. The most successful methods can be divided into 3 categories: mechanical control, biological control, and insecticidal control.

‹ Mechanical controls

Scraping egg masses: This method is useful in reducing the number of caterpillars that could hatch the following spring. It is practical for low level infestations in small areas. Scraped egg masses should be collected and destroyed by placing them in alcohol, bleach, or motor oil.

Burlap banding: This is a means of collecting and destroying larvae and pupae to reduce population numbers. -- Folded burlap bands are placed around trunks of host trees. As larvae move down from a tree's crown they usually will seek protection under the folded burlap. Here they can be seen quite readily. -- This is useful only for very small areas or small numbers of trees.

Male Moth Trapout: Although trapping generally is used as a population monitoring method or an early detection method for areas without an already established population, this technique also can be considered a mechanical control method because it does kill male moths. -- Milk carton-type traps are baited with the synthetic pheromone disparlure and an insecticidal strip, then placed on the trunks of primary host trees. -- It may be effective in reducing small populations where access to humans is good, such as in campgrounds and other developed areas.

‹ Biological controls.

Predators and parasites: These can be introduced into an area or, where they are already present, be augmented by the introduction of more. Over a dozen different species are being raised commercially. -- The release of alien insect predators or parasites alone can serve to keep low populations stable.

Mating disruption: The female produces a strong pheromone that attracts the male moth. It can be applied to traps or tape strips. Placing the tape strips in an area confuses the male moths and often prevents them from finding a female in time to mate successfully. -- This technique is useful in small to moderate size areas.

Sterile male moth introduction: Irradiated egg masses can be broadcast throughout the infested area. The eggs hatch and the larvae feed along with the resident population. However, these caterpillars pupate into sterile adults. Only sterile eggs are produced when these sterile adults mate with the resident adults. -- Still in the experimental stage, this technique will perhaps only be practical for small, low-level populations.

‹ Insecticidal controls.

Bacillus thuringiensis (Bt): Bt is selectively pathogenic to caterpillars of moths, skippers, and butterflies. It acts as a stomach poison, causing the larvae to cease feeding and die of starvation. Bt affects those Lepidopterans that are feeding at or near the site of application. Although Bt will not immediately reduce larval populations, it has proven to be an effective agent for foliage protection, particularly at low to moderate pest population levels.

Nucleopolyhedrosis virus (NPV): This virus is a naturally occurring, species-specific disease of gypsy moth larvae. It can be artificially introduced into populations by aerial or ground spraying of the laboratory-prepared product called Gypchek, a stomach insecticide. When it is ingested along with tree foliage, it attacks the internal organs and tissues, causing death within 10 to 14 days. NPV has no known effects on other forms of life.

Diflubenzuron: This non-specific chemical growth regulator is manufactured and sold under the trade name Dimilin. When ingested, it prevents the synthesis of chitin, an essential component of the insect exoskeleton (the outer covering). It is not known what effect this pesticide might have on other arthropod, bird, or small mammal species dependent upon the insects killed, nor upon the forest ecosystem as a whole. Recently reported scientific research indicates that repeated applications may deplete populations of other chitin-producing organisms, such as crustaceans and myriapods--non-target groups.

...IPM does not rule out the use of chemical pesticides, for there are cases where their use may be the preferred approach. In those cases where a chemical is to be used on NPS lands, it must be one that is registered by the U.S. Environmental Protection Agency, has proven effective, and has little potential for harming human health or the resources of a park. Also, chemical controls are to be used only if (1) there is a clear and present danger to the health and safety of humans; and/or (2) there is a real danger of destruction of significant property or resources; and (3) a determination has been made that other control methods are unavailable or unacceptable.

...The NPS thinks that, in the long run, it probably will be more cost effective, as well as more environmentally sound, to allow the gypsy moth to defoliate natural zone forest areas, to accept the tree mortality that may result, and to expect trees that are more resistant or less palatable to the gypsy moth to replace dead trees. This strategy will also permit gypsy moth parasite and pathogen populations to build up and remain active in the area, thereby decreasing the size of future gypsy moth outbreaks by providing some continuous level of natural control of the populations.

...As part of the NPS' continuing search for IPM approaches to pest management, it is participating in the five-year Appalachian Integrated Pest Management Gypsy Moth Demonstration Project (AIPM), along with the U.S. Forest Service, and the States of Virginia and West Virginia. The purpose of the project is to demonstrate the valid applicability of IPM techniques to gypsy moth management.

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