Gypsy Moth Management in the United States: *a cooperative approach*

Draft
Supplemental Environmental Impact Statement

Summary
Volume I of IV

United States Department of Agriculture

Forest Service

Animal and Plant Health Inspection Service

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Gypsy Moth Management in the United States: *a cooperative approach*

Draft Supplemental Environmental Impact Statement

Volume I of IV Summary

This volume summarizes the draft supplemental environmental impact statement (SEIS) for the gypsy moth. The complete draft SEIS is available on the Web at http://na.fs.fed.us/wv/eis. Print and CD copies are available from the United States Department of Agriculture (USDA) Forest Service, Northeastern Area State and Private Forestry, 180 Canfield Street, Morgantown, WV 26505-3101, phone 304-285-1523.

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Figure 1. Caterpillar (UGA1929085) USDA Forest Service Archives, www.forestryimages.org; pupa (UGA2652066) USDA Animal and Plant Health Inspection Service, Plant Protection and Quarantine Archives; www.forestryimages.org; moths (UGA2652079) USDA Animal and Plant Health Inspection Service, Plant Protection and Quarantine Archives, www.forestryimages.org; egg mass (UGA3948096) William M. Ciesla, Forest Health Management International, www.forestryimages.org

Figure 2. USDA Agricultural Research Service, www.ars.usda.gov/is/kids/suburb/story2/microscope.htm

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1 Gypsy Moth in the United States.

The gypsy moth is a significant nonnative forest pest in the United States (*Figure 1)*. At least 587 million acres (238 million hectares) of trees are susceptible to gypsy moth feeding and defoliation. Also at risk are countless urban and rural forested areas throughout the country where susceptible plants grow naturally or are planted.

Although both European and Asian strains exist, only the European strain is currently present in the United States. The European gypsy moth was brought to the United States and accidentally released in eastern Massachusetts around 1869. Since then, it has continued to spread into uninfested areas naturally and by artificial movement by people. The Asian strain occasionally has been found in the United States, and has been eliminated whenever it has been found. Unlike European female gypsy moths, which cannot fly, the Asian moth poses a greater risk of spread because females can fly and deposit egg masses miles from where they fed as caterpillars.

The gypsy moth continues to be a problem as it spreads: over the last 100 years history shows that gypsy moth outbreaks cause widespread defoliation, tree mortality, environmental and public health risks, and public outcry to control the outbreaks.

2 Proposed Action, Purpose, and Need.

The Forest Service and the Animal and Plant Health Inspection Service (APHIS), as co-lead agencies, propose to supplement the 1996 Record of Decision (ROD) for the 1995 Environmental Impact Statement (EIS): *Gypsy Moth Management in the United States: a cooperative approach*. The Forest Service and APHIS are proposing to add new treatment options, which are described in Section 4 on the Alternatives Considered. New treatments that were not available when the 1995 EIS was written would provide gypsy moth managers with more flexibility in conducting suppression, eradication, and slow-the-spread projects. Making new treatments available is also expected to improve the gypsy moth management program, because each new treatment developed over the last 30 years has proven to be safer, more cost-efficient, easier to use, and often more effective than older treatments. The supplement also provides new information on the gypsy moth and treatments since the 1995 EIS.

Under the 1996 decision, the three strategies of suppression, eradication, and slow the spread established a management program to address the full spectrum of gypsy moth populations found in the United States. The three strategies complement one another, although they differ in objectives and geographic locations:

Suppression reduces damage caused by outbreak populations of gypsy moth caterpillars in the *generally infested area.*

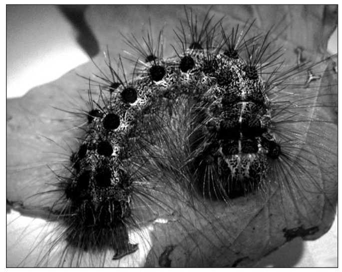
Eradication prevents establishment of the gypsy moth in *uninfested areas* by eliminating isolated infestations that occur as a result of human movement of this pest.

Slow the Spread (STS) slows the rate of spread of the gypsy moth from the generally infested area and prevents infestation of 8 million acres per year in the *transition area,* thus delaying the impacts and costs that occur as the gypsy moth infests new areas.

Gypsy Moth Life Cycle

Caterpillar

8 weeks during
spring and early summer



Young caterpillars are black, developing double rows of red and blue spots as they mature. Insecticide application usually occurs when both the caterpillars and foliage are in the early stages of development.

Pupa

2 weeks during
spring-summer

The female pupa is larger than the male; both are a dark reddish-brown. Caterpillars pupate in protected areas, increasing the chance of accidental movement of pupae by humans.

Adult

Several days
during summer

Male adults are brown or gray. Feather-like antennae detect the pheromone emitted by the female, which is white with small, black markings.

Egg Mass

9 months
summer-spring

Females lay buff-colored egg masses almost anywhere; because the egg life stage is the longest lasting, this stage is most frequently accidentally moved by humans.

Figure 1. The gypsy moth life cycle has four stages.

Treatments approved for use in the strategies are *Bacillus thuringiensis* var. *kurstaki* (*B.t.k.*), Gypchek, diflubenzuron, mating disruption (using disparlure), mass trapping (using disparlure alone or with dichlorvos), and the sterile insect technique.

The current overall USDA gypsy moth management program supports an integrated pest management approach that includes planning, detection, evaluation, monitoring, defining acceptable damage, and using appropriate management practices to prevent or control gypsy moth-caused damage and losses in the United States.

3 Programmatic Nature of the Proposed Action.

Like the 1996 ROD, the decision to be made as a result of this SEIS will be programmatic. It will apply to the overall gypsy moth management program of suppression, eradication, and slow-the-spread projects. Specific decisions to undertake any treatment projects will be made following site-specific environmental analyses conducted and documented in accordance with agency implementing procedures for the National Environmental Policy Act. Project proposals will also be analyzed for compliance with Federal laws, such as the Endangered Species Act and National Historic Preservation Act, as well as any applicable State laws.

4 Alternatives Considered.

To learn the concerns of interested and affected people the preparers of the draft SEIS invited public comments for 45 days via a notice in the Federal Register (69 Fed. Reg. 23492, April 29, 2004) soliciting feedback. The result of the public involvement process and internal scoping within the agencies was the identification of three alternatives.

Alternative 1—No Action.

Alternative 1 would maintain the 1996 decision and the current gypsy moth management program; no new treatments would be added to the approved treatments.

Alternative 2—Add Tebufenozide.

Alternative 2 would add the insecticide tebufenozide to currently approved treatments.

Alternative 3—Add Tebufenozide, and Add Other New Treatments Through the Application of the Protocol (Preferred Alternative).

Alternative 3 would add the insecticide tebufenozide and add other treatment(s) that may become available in the future for managing gypsy moths, to currently approved treatments. A new treatment would be available for use upon the agencies' finding that the treatment poses no greater risks to human health and nontarget organisms than are disclosed in this draft SEIS for the currently approved treatments and tebufenozide.

The protocol for making the necessary finding that a treatment is authorized by this Alternative is as follows:

1. Conduct a human health and ecological risk assessment (HHERA). In this risk assessment review all scientific studies available for toxicological and environmental fate information relevant to effects on human health and nontarget organisms. Use this information to estimate risk to human health and nontarget organisms. Include these four elements in the HHERA: (a) hazard evaluation, (b) exposure assessment, (c) dose-response assessment, and (d) risk characterization. The HHERA will do the following:

- Identify potential use patterns, including formulation, application methods, application rate, and anticipated frequency of application.
- Review chemical hazards relevant to the human health risk assessment, including systemic and reproductive effects, skin and eye irritation, dermal absorption, allergic hypersensitivity, carcinogenicity, neurotoxicity, immunotoxicity, and endocrine disruption.
- Estimate exposure of workers applying the chemical.
- Estimate exposure of members of the public.
- Characterize environmental fate and transport, including drift, leaching to groundwater, and runoff to surface streams and ponds.
- Review available ecotoxicity data including hazards to mammals, birds, reptiles, amphibians, fish, and aquatic invertebrates.
- Estimate exposure of terrestrial and aquatic wildlife species.
- Characterize risk to human health and wildlife.

2. Conduct a risk comparison of the human health and ecological risks of a new treatment with the risks identified for the currently authorized treatments and tebufenozide. This risk comparison will evaluate quantitative expressions of risk (such as hazard quotients) and qualitative expressions of risk that put the overall risk characterizations into perspective. Qualitative factors include scope, severity, and intensity of potential effects, as well as temporal relationships such as reversibility and recovery.

3. If the risks posed by a new treatment fall within or below the range of risks posed by the currently approved treatments and tebufenozide, publish a notice in the Federal Register of the agencies' preliminary findings that the treatment meets the requirements of Alternative 3. The notice must provide a 30-day review and comment period and must advise the public that the HHERA and the risk comparison are available upon request.

4. If consideration of public comment leads to the conclusion that the preliminary finding is correct, publish a notice in the Federal Register that the treatment meets the requirements of Alternative 3 and, therefore, is authorized by that Alternative for use in the USDA gypsy moth management program. The Forest Service and APHIS will make available to anyone, upon request, a copy of the comments received and the agencies' responses.

Like the 1996 Record of Decision, the decision to be made as a result of this draft SEIS will be programmatic. Decisions to use specific treatments in projects, including new treatments authorized under the protocol in Alternative 3, will be made after site-specific environmental analyses are conducted and documented in accordance with agency NEPA implementing procedures.

5 Issues Identified.

Two issues were derived from public involvement for this draft SEIS:

Issue 1—Risk to human health
Issue 2—Risk to nontarget organisms

The effects of each of the treatments on the identified issues are summarized in Section 8.

6 Risk Assessments and Risk Characterization.

Overview.

The consequences of the treatments in each alternative were determined by risk assessment for each treatment as well as for gypsy moth (no treatment) and by a risk comparison among the treatments and gypsy moth.

A risk assessment provides a logical process for evaluating data and analyzing potential effects of the gypsy moth and treatments. Risk assessments take into account the manner in which treatments are used in gypsy moth projects, including how treatment agents are applied, the amount applied, and the types of areas that receive treatment.

Standard steps in the risk assessment process were followed:

- **Hazard identification**--gathers known information from laboratory and field studies on toxicity of the gypsy moth and treatment agents.
- **Exposure assessment**--describes the nature and magnitude of contact with the gypsy moth and with treatment agents as they are used in gypsy moth treatment projects.
- **Dose-response assessment**--determines how much exposure to the gypsy moth and to treatment agents is needed to produce the response (effect) described in the hazard identification.
- **Risk characterization**--combines information from previous steps to describe the plausibility of observing certain effects of the gypsy moth and of treatments.

Each step in a risk assessment is accompanied by uncertainties, caused by limitations either in the available data or in the ability to relate the data to scenarios of concern. To compensate for uncertainties, risk assessment results tend to be conservative, meaning they are more likely to overestimate risks than to underestimate them.

Human Health and Ecological Risk Assessments (HHERA) were prepared by risk assessment experts (Syracuse Environmental Research Associates, Inc. [SERA]), using the best available data. The HHERAs also underwent independent technical review by other recognized experts in risk assessment methods, toxicology, and other applicable fields (consultants retained by SERA, and toxicologists and program specialists from APHIS and the Forest Service). The HHERAs cover the issues raised in scoping for this SEIS for both human health (human health assessment portion of HHERA) and nontarget organisms (ecological risk assessment portion of HHERA).

Many uncertainties are inherent in conducting and interpreting risk assessments; however, the data available on the agents covered by the risk assessments, modeling, equations and statistics all taken together with the understanding of uncertainties provide adequate information to characterize the relative hazards associated with the agents evaluated. To compensate for missing data and any uncertainties in the data, numerical uncertainty factors are used in the dose-response assessments for potential human health effects, and conservative assumptions are used in both human health and ecological risk assessments. In addition, it is virtually impossible to precisely calculate an exposure value for every situation that may arise. Therefore, models, equations, and statistical techniques were used to quantify both plausible and extreme exposures and to use ranges of toxicity values to reflect ranges of sensitivity. These ranges for exposure and toxicity are then used to numerically characterize risk with hazard quotients that are typically expressed as central estimates with upper and lower bounds.

HHERAs were prepared for each of the treatments in the alternatives and for the gypsy moth itself. The relative risks of the insecticides and treatments were illustrated in a risk comparison evaluation.

Hazard Quotients.

Risks to human health and to nontarget organisms can be estimated numerically using hazard quotients (HQs). HQs can be calculated only for effects on populations of biotic (living) organisms. The HQ is a screening tool commonly used in risk assessments. The HQ is a ratio of the exposure estimate for a particular and defined situation (labeled or prescribed conditions) for a representative population (human or nontarget species), divided by an effect level (dose or concentration level). The HQ takes into account the inherent toxicity of a substance, as well as its ability to produce specific effects on an organism (or population of organisms), and the degree of exposure. *Table 1* provides the HQs for all of the treatments and for the gypsy moth.

As an example, refer to the upper bound of the HQ for *B.t.k.* for nontarget aquatic species--0.5, in *Table 1*. This HQ was derived from an exposure estimate of 0.24 mg/L, which is calculated as the peak concentration of the *B.t.k.* formulation in water after a direct spray. This exposure estimate serves as the numerator for the HQ. The toxicity value of 0.45 mg/L is the NOEC (no observed effect concentration) from a reproduction study in *Daphnia magna,* an aquatic invertebrate. This toxicity value serves as the denominator for the HQ. Thus, the HQ is calculated as follows:

HQ = exposure estimate/toxicity value
= 0.24 mg/L / 0.45 mg/L
= 0.533… ≈ 0.5.

Note that the HQ in the above example is rounded to one significant place. This is a common practice in presenting HQ values except for those in which the level of concern is marginally exceeded, i.e., an HQ of 1.45 would be rounded to 1.4 but not to 1.0.

In risk management, the HQ must be used in conjunction with other factors and characteristics of a substance, such as the quality and quantity of substantiating evidence (published scientific literature, data, models, and risk assessments done by others such as industry and universities), the severity of potential adverse effects, and the nature of the affected species and populations.

In some cases numerical expressions of risk (HQs) do not adequately convey the potential for hazard. For example, a high HQ for a mild effect, such as skin rash, is probably more acceptable than a much lower HQ for a more serious effect like neurotoxicity. Therefore, the use of HQ as an expression of risk and "acceptability" requires that a qualitative perspective also be injected into the analysis. Ecological risk assessments often involve considerations of many different species of plants and animals, and abiotic factors, and their interrelationships and interactions. Invariably, few data sets are available, and field studies provide only an overview of the complex interrelationships and secondary effects among species. Human health risk assessments and ecological risk assessments cannot offer a guarantee of safety. Both risk assessments offer a way to estimate the adverse effects and the severity of those adverse effects.

7 Effects of the Gypsy Moth.

Risk to Human Health.

Following exposure to gypsy moth caterpillar hairs *(Figure 2)* during gypsy moth outbreaks, children and others who spend time outside may develop rashes or irritation of the eyes or respiratory tract. Some individuals may develop an allergy to the gypsy moth following repeated exposures over 1 or more years.

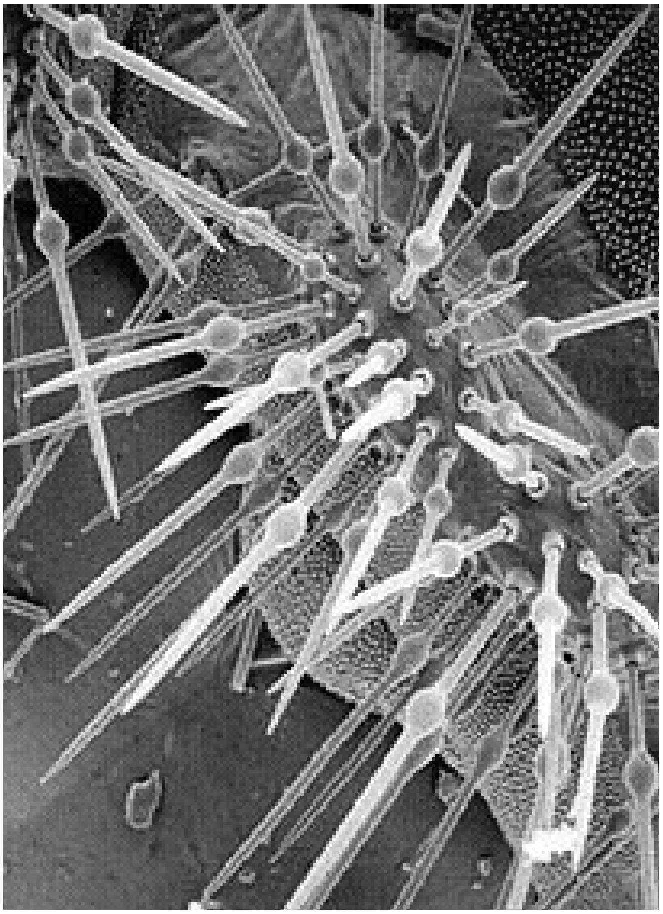


Figure 2. Gypsy moth hairs can cause irritation.

Risk to Nontarget Organisms.

Environmental effects due to the gypsy moth vary, depending on population levels, the amount of defoliation, and the duration of an outbreak. The most pronounced effects occur when the gypsy moth causes heavy defoliation.. After a single year of heavy defoliation, tree condition suffers and mortality increases. Production of both wood and hard mast (nuts) temporarily declines, and the growth rate of many shrubs and herbaceous plants may increase.

Two years of heavy defoliation greatly reduce the production of wood, hard mast (nuts), and soft mast (berries). Shoestring fungus and two-lined chestnut borer, which attack and kill trees weakened by defoliation, become more abundant. Mortality is likely within 5 years, both among oaks and among species less favored by the gypsy moth.

Three years of heavy defoliation cause high mortality in oaks and less-favored hosts; wood growth is drastically reduced, and production of hard mast will likely cease for at least 5 years. Regeneration of young forest to a mature forest requires decades, and in areas where trees less-favored by the gypsy moth remain, stands are dominated by species such as red maple, yellow poplar, black cherry, and yellow or black birch.

Decomposition of leaf fragments and caterpillar droppings reduce oxygen levels in water and result in dramatic increases in algae, reducing acid-neutralizing capacity and increasing watershed yields.

Increased exposure to sunlight caused by defoliation results in seasonal elevations in the temperature of soil and leaf litter, which may temporarily reduce soil moisture content. These factors can lead to short-lived increases in the rates of soil decomposition, mineralization, and plant productivity.

Heavy defoliation can affect animals, fish, and birds. Populations of small mammals (such as the gray squirrel) decline as do some bird species, although woodpecker populations may increase. Trout may decrease in number or disappear from small streams, along with small crayfish and snails. Forest-feeding moths and butterflies, particularly those that feed on oak also are likely to decline, as may other forest-dwelling invertebrates.

8 Effects of Treatments.

All of the treatments described in this SEIS may indirectly help to maintain existing forest conditions and environmental quality by delaying increases in gypsy moth populations, thereby protecting tree foliage.

Currently Approved Treatments.

Bacillus thuringiensis var. *kurstaki* (*B.t.k.*) (Alternatives 1, 2, 3).

Risk to Human Health.

Direct exposure to *B.t.k.* applications may cause some individuals (most likely project workers) to develop minor and transient irritation of the skin, eyes, or respiratory tract. Mating disruption with disparlure will most likely be the only treatment used in the same project area as *B.t.k.* These treatments have different modes of action and are applied weeks apart; therefore, no cumulative effects are expected between *B.t.k.* and disparlure treatments.

Risk to Nontarget Organisms.

Permanent changes in non-target caterpillar populations are not likely following treatment projects that use *B.t.k.* An exception might occur in certain habitat types that support small, isolated populations of moths and butterflies that are highly susceptible to *B.t.k.* Repeated treatment of areas with *B.t.k.* could potentially affect some species of spring-feeding butterfly and moth caterpillars. Since *B.t.k.* is not used in the same locations as other treatments that could affect non-targets, there is no cumulative effect of different treatments with *B.t.k.* on spring-feeding caterpillars

Diflubenzuron (Alternatives 1, 2, 3).

Risk to Human Health.

No human health effects are likely from exposure to diflubenzuron as used in the USDA gypsy moth management program. Exposure to very high levels of diflubenzuron may produce a detectable increase in methemoglobin, an abnormal blood pigment that reduces the oxygen-carrying capacity of blood. Exposure to other methemoglobinemia-inducing compounds in the environment may contribute to a cumulative effect. Individuals exposed to combustion smoke or carbon monoxide (agents that also cause oxidative damage to blood) may be at increased risk of developing methemoglobinemia. Individuals exposed to high levels of nitrates, either in air or in water, demonstrate increased levels of methemoglobin and may be at increased risk with exposure to compounds such as diflubenzuron. Some individuals have congenital methemoglobinemia and may be at increased risk of adverse effects from compounds that induce methemoglobinemia. Diflubenzuron rapidly dissipates from vegetation and is broken down by sunlight; in the environment the compound degrades to 4-chloroaniline, which the EPA considers a potential carcinogen. This is the only identified potential carcinogen associated with any of the agents to control gypsy moth. The compound is not expected to be present in significant amounts during application since 4-chloroaniline does not form during application. The scenario of greatest concern involving 4-chloroaniline is a cancer risk from drinking contaminated water.

Risk to Nontarget Organisms.

Moth and butterfly caterpillars, grasshoppers, parasitic wasps, some beetles, spiders, sawflies, aquatic insects, and bottom-dwelling and immature free-floating crustaceans may be affected by application of diflubenzuron. Diflubenzuron treatments are applied to the top of the tree canopy and the amount of diflubenzuron residue begins to diminish soon after the application. The population reduction is greater for those species that feed in the upper canopy as compared with those in the mid and lower canopy. Diflubenzuron may cause a reduction in some aquatic invertebrate populations. Diflubenzuron reduces numbers of stream invertebrates that process detritus; however, field studies have shown no decline in detrital decomposition rates. The populations of some invertebrates that feed on algae are reduced by diflubenzuron. An increase in algae could occur after the loss of algal herbivores, however, this has not been observed in field studies.

Birds are not directly affected by exposure to diflubenzuron. Some insectivorous species may show subtle changes, such as a switch in diet, reduced fat loads, and expanded foraging territories. Similar changes may occur in bats that feed primarily on moths and butterflies.

Diflubenzuron is generally not used in conjunction with other treatments; however, diflubenzuron might be applied to the same area in multiple years for eradication projects. In that case, diflubenzuron might have a cumulative effect on nontarget invertebrates, such as caterpillars of moths and butterflies, grasshoppers, parasitic wasps, aquatic insects, bottom dwelling crustaceans, and immature free-floating crustaceans. Diflubenzuron applications as used in USDA treatment projects will otherwise have no cumulative effects.

Disparlure (as Used in Mating Disruption and Mass Trapping) (Alternatives 1, 2, 3).

Mating disruption entails the aerial application of tiny plastic flakes containing disparlure, the synthetic version of the gypsy moth sex attractant. This treatment confuses male moths and prevents them from locating and mating with females.

Risk to Human Health.

After direct contact with disparlure, a person (most commonly, a project worker) may attract male gypsy moths. Although this attraction could last for years, and could be annoying, there are no data to show it poses any health risk. The general public is not likely to be exposed to sufficient amounts of disparlure to experience this effect. Since disparlure seems to persist in humans, repeated exposures of disparlure will attract the gypsy moth. No information is available on the interaction of disparlure with other control agents or other chemicals usually found in the environment.

Risk to Nontarget Organisms.

Disparlure has low toxicity to vertebrates and is specific to the gypsy moth in North America. As used in mating disruption (and as an attractant in mass trapping), disparlure is not likely to affect populations of non-target organisms. Since disparlure attracts only the gypsy moth in North America, no cumulative effects are expected on nontarget organisms.

Dichlorvos (as Used in Mass Trapping) (Alternatives 1, 2, 3).

Two types of traps are used in mass trapping; both contain disparlure to attract male moths. The smaller delta trap captures moths with a sticky inside surface but contains no dichlorvos. The large milk carton trap contains a pest strip impregnated with the insecticide dichlorvos. Both traps are also commonly used for survey purposes.

Risk to Human Health.

Dichlorvos as used in milk carton traps would pose a health risk to humans only if the individual were to disassemble the trap and tamper with the dichlorvos-impregnated strip. Skin contact with the strip or eating the strip could inhibit the production of acetylcholinesterase. This enzyme prevents the accumulation of acetylcholine, the buildup of which can impair the function of the nervous system. Obvious signs of toxicity to the nervous system are possible but unlikely. Exposure to other substances that inhibit acetylcholinesterase, including similar insecticides, could have a cumulative effect with dichlorvos. The carcinogenic potential of diclorovos has been classified as "suggestive" under the 1999 Environmental Protection Agency Cancer Guidelines.

Risk to Nontarget Organisms.

Invertebrates that inadvertently enter delta or milk carton traps are likely to die. Invertebrates that come into contact with a dichlorvos strip that has accidently fallen on the ground, on vegetation, or in water might also be adversely affected. The potential for adverse effects decreases over time as dichlorvos dissipates from the strip. Large animals, such as bears, that may tamper with traps are not likely to be affected by the dichlorvos strips. Experience with traps used in mass trapping and survey programs shows that there are no cumulative effects on nontarget organisms even over years of use.

Gypchek (Alternatives 1, 2, 3).

Risk to Human Health.

Irritation of the eyes, skin and respiratory tract is possible from exposure to Gypchek. Gypchek contains gypsy moth parts and may cause irritant effects similar to those caused by the gypsy moth caterpillars. Consequently, exposure to both the gypsy moth caterpillars and Gypchek could be cumulative, although there are no data showing this occurs.

Risk to Nontarget Organisms.

Since Gypchek is specific to the gypsy moth, no effects or cumulative effects on nontarget organisms are expected.

Sterile Insect Technique (Alternatives 1, 2, 3).

The release of sterile insects adds large numbers of sterile gypsy moths to an area, resulting in population reduction and eventual elimination of the infestation.

Risk to Human Health.

The sterile insect technique temporarily increases the number of gypsy moths in the treatment area, increasing both the chance of effects due to the gypsy moth and contact with gypsy moth caterpillars.

Risk to Nontarget Organisms.

No effects or cumulative effects on non-target species are expected.

New Treatment of Tebufenozide (Alternatives 2 and 3).

Risk to Human Health.

Exposure to very high levels of tebufenozide may increase detectable levels of methemoglobin, an abnormal blood pigment that reduces the oxygen-carrying capacity of the blood. These exposure levels far exceed those exposures expected to occur in project workers and the general public from the USDA gypsy moth management program. The presence of other compounds that raise levels of methemoglobin, such as cigarette or other combustion smoke, carbon monoxide, and nitrates in air or water, may be cumulative. Tebufenozide does not appear to be carcinogenic and does not appear to cause birth defects. No human health effects are likely from exposure to tebufenozide as used in gypsy moth projects.

Tebufenozide and diflubenzuron could have a cumulative effect on methemoglobin but USDA gypsy moth management programs would not use these two chemicals together in the same area at the same time. However, tebufenozide might be applied to the same area in multiple years for eradication projects. These multiple applications of tebufenozide over a period of time may increase the potential risk of methemoglobinemia. Exposure to other methemoglobinemia-inducing compounds in the environment may contribute to a cumulative effect. For example, individuals exposed to combustion smoke or carbon monoxide (agents causing oxidative damage to blood) in addition to exposure to tebufenozide may be at increased risk of developing methemoglobinemia. Individuals exposed to high levels of nitrates, either in air or in water, demonstrate increased levels of methemoglobin and may be at increased risk with exposure to compounds such as tebufenozide.

Risk to Nontarget Organisms.

Tebufenozide may affect other Lepidoptera, especially spring-feeding moths and butterflies. No adverse effects on birds, mammals, or aquatic species are likely to occur from exposure to tebufenozide.

Tebufenozide generally would not be used in conjunction with other treatments. Multiple year applications of tebufenozide might occur for eradication projects in the same area, but generally these areas are small. Tebufenozide might have a cumulative effect on non-target caterpillars of moths and butterflies, but will not affect other aquatic and terrestrial species.

New Treatments That May Be Available in the Future Under Alternative 3.

Treatments that might become available in the future for managing the gypsy moth cannot be predicted. Given the parameters and protocol built into Alternative 3, any new treatment would pose no greater risk to human health and nontarget organisms than are disclosed in this SEIS for the currently approved treatments and for tebufenozide.

9 Mitigating Adverse Effects.

Given the variety of places and circumstances where gypsy moth projects could be implemented, it will be necessary to develop and implement specific mitigation measures for each project. Mitigation measures will be developed and implemented on a site-specific basis for each project based on local conditions and concerns.

Table 1. Comparative Hazard Quotients (HQs) for the effects of gypsy moths and treatments on human health and nontarget organisms. Wherever a 0 appears in the table, the hazard quotient value is less than 0.01.

Population	Gypsy Moth HQ	*B.t.k.* HQ	Dichlorvos HQ	Diflubenzuron HQ	Disparlure HQ	Gypchek HQ	Tebufenozide HQ
Human health	1.6 to 625 Upper range is based on major outbreaks	0 to 0.04 Unlikely effects	0 to 380 Upper range based on child tampering with strip.	0.05 to 0.5 – workers, 0.09 to 0.1 – public Upper range for workers based on ground spray operations.	0 No potential risk can be identified	0 to 0.02 No risks are plausible	0.03 to 1.5 Highest HQ based on long-term consumption of contaminated fruit following two applications at the highest application rate.
Nontarget terrestrial species	0.25 to 400 Upper range based on gypsy moth outbreak in sensitive stands	0.36 to 9.4 Upper range based on sensitive caterpillars of moths and butterflies	0 Effects not likely	0.18 to 32 Upper range based on sensitive species of invertebrates	0 No potential hazard identified	0 Effects not likely	0 to 4 Upper range based on the consumption of contaminated vegetation by a large mammal
Nontarget aquatic species	0 No adverse effects	0 to 0.5 Upper level based on sensitive species	0 No risks plausible in normal use. HQ for aquatic invertebrates could reach up to 8 in accidental exposures	0 to 5 Upper range based on acute exposure to aquatic invertebrates (Daphnia)	0 to 0.4 Upper range based on acute exposures to sensitive aquatic invertebrates (Daphnia)	0 No adverse effects	0 to 0.4 Upper range based on longer term toxicity in sensitive aquatic invertebrates

Pesticide Precautionary Statement

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

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