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Inspection
Service

Gypsy Moth Cooperative Eradication Program in Benton County, Oregon

Environmental Assessment
April 2019

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I. Introduction

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), in cooperation with the Oregon Department of Agriculture (ODA), is proposing to conduct a program to eradicate the gypsy moth (GM) (*Lymantria dispar* L.) in Corvallis in Benton County, Oregon. The GM is one of the most destructive pests of trees and shrubs in the United States. There are two types of GM—the European (also known as North American) and the Asian. The North American GM was imported into Massachusetts from Europe in 1869 for silk production experiments. However, some moths were released accidentally and became established. The GM infestation spread relentlessly and now covers the entire northeastern part of the United States, from Maine south to North Carolina, and west to Michigan and parts of Minnesota. The European GM has a host range of over 300 species of trees and shrubs; however, they prefer oaks and aspen. GM hosts are located throughout most of the continental United States. Isolated outbreaks of European GM have also occurred west of the Mississippi River.

The GM life cycle begins in the early spring with the hatching of first instar larvae from eggs laid the previous summer. Newly hatched larvae hang by silken threads and are caught by the wind and, thereby, are dispersed to other trees in forests. Small larvae begin feeding on leaves. GM larvae go through 5 or 6 feeding stages. Between stages, the GM larvae molt by shedding their skin. Larvae typically feed at night and rest in bark crevices during the day. In areas with high caterpillar densities, feeding may occur all day which can result in defoliation and, in severe cases, cause tree mortality.

Pupation generally occurs about 8 weeks after egg hatch. Once they emerge as adults, the female GM emits a pheromone that the males can detect through their antennae. The males locate the females and mate. After mating, the female lays eggs in a single mass on any solid object, including tree trunks, shrubs, nursery stock, vehicles, camping equipment, and outdoor household articles.

Heavy infestations of GM can alter ecosystems and disrupt people's lives. The larval life stage can cause defoliation and can, in extreme cases, cause tree mortality. Defoliated trees are vulnerable to other insects and diseases. Repeated or widespread defoliation events from larval feeding can alter wildlife habitat, change water quality, reduce property and esthetic value, and reduce the recreational and timber value of forested areas. When present in large numbers, GM caterpillars can be a nuisance, as well as a hazard to health and safety (USDA, 1995).

II. Purpose and Need

USDA APHIS in cooperation with Oregon Department of Agriculture (ODA), propose to eradicate the GM infestation located in Benton County, Oregon (within Corvallis). The alternatives being considered have been analyzed in detail in the 1995 final environmental impact statement (EIS) for GM management in the United States and a recent supplemental EIS (USDA, 1995; 2012). The findings of that EIS regarding the alternatives being considered will be summarized and incorporated by reference into this environmental assessment (EA). The need for this proposed action is based on the potential adverse ecological and economic impacts of GM infestations on the infested and surrounding areas.

ODA has been surveying for GM populations in Oregon since 1977. Isolated infestations have been detected periodically, resulting in successful eradication efforts with the most recent program being conducted in the Portland area in 2016.

GM egg masses and pupae have been known to attach to items that people bring with them when they enter and leave Oregon. Therefore, if GM were to become established and allowed to spread throughout these areas, it could potentially spread to other areas within Oregon, as well as other parts of the country, including the surrounding States. In the absence of timely eradication action, the associated damage, defoliation, and mortality of host plants from such an occurrence could be devastating.

This EA is tiered to USDA's 1995 final EIS and 2012 supplemental EIS for GM management in the United States. Eradication is being proposed because of the isolated nature of these infestations and the threat that a reproducing population of GM would pose to the vegetation resources of this area.

This site-specific EA is designed to examine the environmental consequences in the proposed treatment areas when using a range of treatment options analyzed in the 1995 final EIS and 2012 supplemental EIS for GM management in the United States that may accomplish the program's goals. The goal of this project is to eliminate GM from the identified area in Benton County, Oregon.

This EA is prepared consistent with National Environmental Policy Act of 1969 (NEPA) (42 United States Code (U.S.C.) § 4231 et. seq.), the Council of Environmental Quality NEPA regulations (40 Code of Federal Regulations (CFR) part 1500 et. seq.), APHIS' NEPA implementing regulations (7 CFR part 372), and FS' NEPA implementing regulations (36 CFR part 220) for the purpose of evaluating how the proposed action and alternatives described in the following sections, if implemented, may affect the quality of the human environment.

A. Public Outreach

ODA has contacted residents within the small treatment area and provided information regarding the proposed treatments. ODA will continue to update residents about the proposed treatments prior to and after treatments to address any questions or concerns.

B. Authorizing Laws

1. USDA Authorities

Authorization to conduct treatments for GM infestations is given in the Plant Protection Act of 2000 (7 U.S.C. section 7701), and the Cooperation with State Agencies in Administration and Enforcement of Certain Federal Laws (7 U.S.C. section 450). The Cooperative Forestry Assistance Act of 1978 (P.L. 95–313) provides the authority for Federal and State cooperation in managing forest insects and diseases. The 1990 Farm Bill (P.L. 101-624) reauthorizes the basic charter of the Cooperative Forestry Assistance Act. The National Environmental Policy Act (NEPA) of 1969 requires detailed environmental analysis of any proposed Federal action that may affect the human environment. The Federal Insecticide, Fungicide and Rodenticide Act of 1947, as amended, known as FIFRA, requires insecticides used within the United States be registered by the U.S. Environmental Protection Agency (EPA). Section 7 of the Endangered Species Act prohibits Federal actions from jeopardizing the continued existence of federally listed threatened, endangered, or candidate species or adversely affecting critical habitat of such species. Section 106 of the National Historical Preservation Act and 36 CFR part 800: Protection of Historic Properties requires the State Historic Preservation Officer be consulted regarding the proposed activities.

2. State Authorities

ORS 570.305. This statute gives broad enabling authority to eradicate dangerous insect pests and plant diseases. It states that "the director [State Department of Agriculture], and the chief of the division of plant industry, are authorized and directed to use such methods as may be necessary to prevent the introduction into the state of dangerous insect pests and plant diseases, and to apply methods necessary to prevent the spread, and to establish control and accomplish the eradication of such pests and diseases, which may seriously endanger agricultural and horticultural interests of the state, which may be established or may be introduced, whenever in their opinion such control or eradication is possible and practicable."

C. Decisions to be Made

The preferred alternative in this document proposes a multiagency approach between APHIS and ODA. The responsible officials must decide the following:

- Should there be a cooperative treatment program, and if so, what type of treatment options should be used?

- Is the proposed action likely to have any significant impacts requiring further analysis in an environmental impact statement (EIS) if treatments are to be implemented?

D. Responsible Officials

The responsible official for the APHIS is:

Anthony Man-Son-Hing
National GM Program Manager
USDA/APHIS/PPQ
920 Main Campus Drive
Raleigh, NC 27606

The responsible official for APHIS will make a decision prior to treatment to ensure timely funding for the proposed eradication program.

The official responsible for implementation for ODA is:

Jake Bodart
Manager, Insect Pest and Prevention Management Program
Oregon Department of Agriculture
635 Capitol St. NE
Salem, OR 97301

E. Other Gypsy Moth Work

No additional GM treatment work is currently planned elsewhere in Oregon for 2019. In the event that there is a need for additional treatment a separate EA and decision notice will be issued for this work.

III. Alternatives

This EA is tiered to the USDA's 1995 Final EIS and 2012 supplemental EIS for GM Management in the United States. The preferred alternative in the 1995 EIS is alternative 6: Suppression, Eradication, and Slow the Spread. This alternative was proposed because of the isolated nature of GM infestations in Oregon. This site-specific EA is designed to examine the environmental consequences of a range of treatment options listed under the EIS preferred alternative (alternative 6) that may accomplish the program's goal.

Under alternative 6 of the EIS, six treatment options were analyzed in the 1995 EIS with an additional treatment option analyzed in the 2012 supplemental EIS:

1) Btk—a biological insecticide containing the bacterium *Bacillus thuringiensis* var *kurstaki* (Btk). The insecticide is specifically effective against caterpillars of many species of moths and butterflies, including GM.

2) Diflubenzuron (Dimilin®)—an insect growth regulator that interferes with the growth of some immature insects.

3) GM Virus (Gypcheck®)—a nucleopolyhedrosis virus which occurs naturally and is specific to GM. Gypcheck is an insecticide product made from the GM nucleopolyhedrosis virus.

4) Mass Trapping—a treatment that consists of large numbers of pheromone traps used to attract the male GM thus preventing them from mating with females and, thereby, causing a population reduction.

5) Mating Disruption—a treatment that consists of a carrier (i.e., tiny plastic flakes, beads, etc.) that release disparlure, a synthetic GM sex pheromone. The pheromone confuses male moths and prevents them from locating and mating with females.

6) Sterile Insect Technology—a treatment that consists of an aerial release of a large number of sterile male GM. This reduces the chance that female moths will mate with fertile males, which results in progressively fewer and fewer fertile egg masses being produced, and eventual elimination of the population.

7) Tebufenozide—an insecticide that controls molting in various insects and other invertebrates.

Of the treatment options listed above, Btk and diflubenzuron have proven to be the most effective eradication tools for use with small populations of GM, such as the area being proposed in this site-specific EA.

The remaining treatment options were not selected due to availability, or environmental or efficacy concerns. Diflubenzuron is an insect growth regulator that has a broader nontarget host range than Btk, and can kill many other insects in addition to moths and butterfly caterpillars. Its use may adversely affect other insect populations and, therefore, was not selected. Similar types of impacts would be expected with the use of tebufenozide. GM virus (Gypcheck®) is very host-specific, but is not widely available in the market; therefore, it was not selected. Mating disruption was not selected due to the presence of alternate life stages. Sterile insect release experiments show variable results for eradication programs and, consequently, sterile insect technology was not selected.

This EA analyzes two alternatives (1) the no action alternative and (2) the proposed action that will utilize three applications of Btk, combined with post-treatment delimit trapping for three years to ensure that the treatment is effective.

A. No Action

Under the no action alternative, GM would reproduce and populations would spread to surrounding areas. This is not a preferred alternative because environmental damage and regulatory action will occur sooner than if other alternatives are selected. If no action was taken APHIS would not aid in the treatment of the area. Some control measures could be taken by other Federal and non-federal entities however these measures would neither be controlled nor funded by APHIS.

B. Proposed Action

Under the proposed action alternative, APHIS would provide funding for the proposed treatment area. Btk (Foray® XG) will be applied by ground equipment over the proposed treatment area. The proposed formulation is certified for organic production. Two applications of Btk will be applied with an interval of approximately five to 14 days between each application. These applications are estimated to begin sometime in mid to late April 2019. The exact date of application will be timed so that the applications occur during the early larval stages when GM caterpillars hatch from their eggs and are most susceptible to treatments.

Pheromone-baited GM traps will be used to monitor success of the treatments.

IV. Affected Environment

The treatment site proposed for GM eradication is approximately 45 acres. A map of the area is available in Appendix A with a brief description of the area below.

Human Health

The proposed 45-acre treatment area for GM treatments is located in the western portion of Corvallis, OR (appendix A). The area is primarily residential containing the Oak Vale and Witham Hill Oak apartment complexes and approximately ten residential homes. No schools, hospitals or day care centers are present within the proposed treatment area. Additionally, no historic properties are present within the proposed treatment area.

Ecological/Environmental Resources

The Witham Hill Natural Area is located to the south and west of the proposed treatment area. The natural area contains mixed upland forest with Douglas-fir, grand fir, Oregon white oak, snowberry, sword fern, and Oregon grape. The Woodland Meadow Park is located to the east of the proposed treatment area. No aquatic resources are present within the proposed treatment area.

V. Environmental Impacts of the Proposed Action and Alternatives

There are potential environmental consequences from both alternatives being considered. The risks associated with ecological and human impacts are examined under both alternatives.

A. No Action

Selection of the no action alternative would likely result in the establishment of GM populations in Multnomah County which could lead to damage to trees relative to the level of infestation. The no action alternative would allow GM to flourish in the existing area, and continue to spread into surrounding areas. With the establishment of GM, the environmental concerns discussed below would likely occur. The ecological and human health effects associated with GM were examined in the 1995 final EIS and the 2012 supplemental EIS for GM management in the United States (USDA, 2012; USDA, 1995). This EA incorporates the EIS evaluation by reference and the material discussed in both of the EIS documents. The ecological and human health effects are summarized below from the EIS as well as any new information.

1. Gypsy Moth

a. Ecological Impact

Most of the environmental impacts associated with GM are caused by the larval stage. This stage of GM is the feeding stage which can lead to changes in forest stand composition (USDA, 1995). In areas where GM populations are high, trees can be defoliated, leading to stress (USDA, 1995). Trees that are stressed are more susceptible to diseases and other plant pests (USDA, 1995). In circumstances where high populations are sustained over several years, GM feeding damage can cause tree mortality (USDA, 1995). GM-related defoliation of trees can also result in negative impacts to native Lepidoptera (Redman and Scriber, 2000; Manderino et al., 2014).

The areas of infestation, as well as surrounding areas such as the Witham Hill Natural Area, contain host trees that would be threatened by GM defoliation. GM larval feeding can lead to changes in forest stand composition and nesting sites, and cover for birds and other animals could be reduced (USDA, 1995). If GM were to spread to other areas, changes in water quality and effects to aquatic organisms could occur (USDA, 1995). The loss of vegetation in the affected areas could lead to increased erosion of soil and loss of moisture retention (USDA, 1995).

b. Human Impact

In addition to these effects, some people have been shown to be allergic to the tiny hairs on GM caterpillars. These people could suffer minor allergic reactions (primarily rashes) if GM were allowed to become established. Also, irritation to eyes and throat are common reactions with increased GM infestations (USDA, 1995). In heavily infested areas, large numbers of caterpillars limit enjoyment of the outdoors for some people due to GM larval droppings and defoliation (USDA, 1995).

B. Proposed Action

The preferred action alternative is the aerial application of Btk and placement of pheromone-baited traps. Potential impacts to human health and the environment are discussed below.

1. Btk

Bacillus thuringiensis var *kurstaki*, or Btk, is a naturally occurring bacterium that has selective insecticidal activity against certain butterflies and moths. The bacillus bacterium is a large group of bacteria that occurs naturally in soil, water, air, plants, and wildlife. The subspecies, kurstaki, is part of the *Bacillus thuringiensis* biopesticide group that has been registered for more than 45 years for a variety of agricultural and nonagricultural uses. Btk is widely used in agriculture, both conventional and organic, and as a transgene in genetically engineered crops to control pests on a variety of crops. Btk also has multiple nonagricultural uses and has been the preferred material for GM eradication programs in the United States for several years. The specificity of Btk to certain insects is based on its mode of action which requires ingestion by lepidopteran larvae where, once in the midgut, the alkaline pH breaks down the crystalline proteins that produce the toxins which bind to the midgut cells in the larvae (Cooper, 1994). The alkaline conditions and binding sites present in the midgut of lepidopteran larvae are not present in mammals and most other nontarget organisms.

Btk is available in several formulations, depending on its use. The formulation proposed for use in this program is Foray® XG which is certified as organic.

Two ground applications of Foray® XG, 7- to 14-days apart, will be made at a rate of 0.5 to 2.5 to fl oz. per 1000 ft^2 of product per acre. The lower rate is typically used however rates of application vary based on the life stage of GM found and the level of infestation. The program uses the lowest rate possible that will still ensure adequate control of GM.

a. Ecological Impact

Nontarget species (i.e., birds, mammals, amphibians, and reptiles) should not be affected by the proposed Btk treatments for this program. A lack of effects would also be expected for domestic animals as well. Available toxicity data for all terrestrial vertebrates indicate low toxicity (EPA, 1998; WHO, 1999; USDA, 2004; USDA, 2012). Although no direct effects to birds and wild mammals are expected, there is the possibility of indirect effects through the loss of invertebrate prey items which may serve as a temporal input into their diet. Based on the available data, indirect effects have not been noted in studies with wild mammals (Innes and Bendell, 1989; Belloco et al., 1992); however, one study reports indirect reproductive effects to birds that rely on caterpillars as a primary food source (USDA, 2004). Slight effects on reproduction in spruce grouse (such as nestling growth rates) were seen when applications occurred over large forested areas (Norton et al., 2001); nevertheless, in several other studies assessing impacts to a wide diversity of songbirds, no indirect effects on reproduction or other endpoints were noted (USDA, 2004). Bird populations that may occur in the proposed treatment areas are not expected to be impacted by the loss of prey items. Bird species expected in these areas have shown no indirect effects based on Btk applications over larger areas. In addition, the potential treatment areas are relatively small compared to the foraging areas that birds may use. Finally, only some lepidopteran larvae will be impacted in the potential treatment areas, while other terrestrial insects will be available as prey items for birds.

Effects to most nontarget terrestrial invertebrates are not expected with the exception of lepidopteran larvae, with early instars more sensitive than later instars. Within the lepidopteran group, sensitivities can be highly variable (Peacock et al., 1998). In general, due to Btk's unique mode of action, toxicity to pollinators and beneficial insects are considered low based on laboratory and field studies testing honey bees, as well as other beneficial insects (USDA, 2004). Effects to honey bees, in particular, are not expected based on the available published studies designed to evaluate short- and long-term effects from exposure to Btk or Bt-related proteins (EPA, 1998; Sterk et al., 2002; Bailey et al., 2005; Duan, et al, 2008). These studies evaluated impacts to larval and adult honey bees from oral or contact exposures with no lethal or sublethal impacts noted at concentrations above those expected from the proposed use pattern for Btk in this program. Some nontarget Lepidoptera larvae (caterpillars) present in the proposed spray areas would likely be killed by the application of Btk. However, depressions in caterpillar populations are expected to be temporary due to recolonization from adjacent untreated areas and the small area proposed for treatment.

Btk is not expected to be of significant risk to aquatic resources due to the low toxicity of Btk to aquatic organisms and the lack of proximity to any receiving waters.

After application, exposure to light, higher temperatures, and moisture decrease the amount of Btk remaining in the environment. In a summary of studies regarding the environmental fate of Btk, the majority of studies indicated that insects were only affected for approximately one week; however, other studies have shown that while persistence of Btk in the environment may decrease rapidly, the insecticidal activity can persist up to three months under certain environmental conditions (USDA, 1995). Btk's persistence in water depends on organic matter, content, and salinity (USDA, 1995). Btk has been found in aquatic field studies for up to 13 days, and in some studies up to four weeks, after application (USDA, 1995). Variations in environmental fate are attributable to various factors, including environmental conditions, formulation chemistry, study protocols, and sampling substrates.

b. Human Impact

Based on the extensive use of Btk and its long historical use in these types of programs, a large amount of mammalian toxicity data exists, as well as information from surveillance programs in previously conducted treatments. Available acute laboratory toxicity data with Btk and its various formulations demonstrate low acute mammalian oral, dermal, and inhalation toxicity and pathogenicity (McClintock et al., 1995; EPA, 1998, WHO, 1999; Siegel, 2001; USDA, 2004). The material safety data sheet (MSDS) of Foray® 48B, states that the formulated material can be a transient mild eye and skin irritant and is considered practically non-toxic in oral, dermal and inhalation exposures (Valent, 2011). The information in the MSDS applies to workers handling larger quantities of the concentrated material compared to the reduced potential exposure from material applied during application. Previously conducted human health risk assessments, which compare potential exposure data from similar applications to those proposed in this program, have demonstrated wide margins of safety with potential exposure values to the general public ranging from 28,000 to 4 million times below levels where effects were observed in laboratory studies (EPA, 1998; USDA, 2004).

Concerns have been raised regarding the pathogenicity of Btk and, in particular, the production of enterotoxins (which are summarized in a publication from an anti-spray advocacy group) (Ginsberg, 2006). Btk belongs to a group of bacteria within the *Bacillus* genus, including *Bacillus cereus*, which has been linked to foodborne illness incidents via the production of enterotoxins which can cause gastrointestinal symptoms, such as diarrhea. The Centers for Disease Control report that *B. cereus* is responsible for approximately 0.6 percent of the total number of foodborne illness cases reported between 1988 and 1992, as well as between 1998 and 2002 (EPA, 1998; CDC, 2006).

Btk has been shown to produce low levels of enterotoxin in cultures; however, no reported foodborne illness cases linked to Btk exist in more than 45 years of extensive use. The lack of pathogenicity may be related to the relatively low levels of enterotoxin produced in Btk compared to *B. cereus* (Damgaard, 1995), or the enterotoxins are not typically present in commercial formulations that are produced in North America. Siegel (2001) reported that enterotoxins may be degraded during the fermentation process, or that the isolates used may not produce enterotoxins under the conditions of the fermentation process. In addition, impacts of *B. cereus* enterotoxin are only realized in cases where the enterotoxin can multiply under appropriate conditions; this does not appear to occur for Btk in the environment. This is supported by a lack of gastrointestinal symptoms linked to Btk applications by workers or the public, and laboratory studies that report no enterotoxin production in rats orally dosed with Btk or associated symptoms (EPA, 1998; USDA, 2004; Wilcks et al., 2006). The lack of reported gastrointestinal symptoms associated with Btk use in workers and the general public, as well as a lack of effects observed in laboratory studies, indicate factors other than the presence of enterotoxin are required to cause symptoms similar to those in *B. cereus* (Federici and Siegel, 2008). Immune response and infectivity data for Btk, as well as results from surveillance studies, suggest that immune-related adverse effects in the general public are unlikely (USDA, 2004; Federici and Siegel, 2008).

Several epidemiology studies have been published based on surveillance data from applications similar to those proposed in this program in the United States, Canada, and New Zealand. These studies are summarized in several publications and indicate that no significant adverse effects were reported in the general population, including sensitive subgroups, such as children or asthmatics (Aer'Aqua Medicine, 2001; Siegel, 2001; Noble, et al., 1992; Pearce et al., 2002; Parks Canada, 2003; USDA, 2004; Otvos et al., 2005).

One of the larger monitoring studies conducted in association with forestry Btk applications was in New Zealand (Aer'Aqua Medicine, 2001). Applications to an area containing approximately 88,000 residents were monitored using self-reporting of adverse effects, as well as information from participating physicians. Results from the study demonstrated no Btk-related cases of anaphylaxis, incidences of birth defects, or changes in birth weight, meningococcal disease, or infections. Adverse effects that were self-reported during the study were related to dermal, respiratory, and eye irritation.

Petrie et al. (2003) conducted a study to investigate the impacts of an aerial application of Foray® 48B on self-reported symptom complaints and visits to health care providers after applications in West Auckland, in 1999, to control the painted apple moth. A group of 292 residents within the spray area were questioned prior to treatment, with only 192 residents (or 62 percent) responding after treatment. The authors of the paper assessed the frequency of 25 potential health problems before and after treatment. Of these 25 symptoms, including sleep problems, dizziness, difficulty concentrating, irritated throat, itchy nose, diarrhea, stomach discomfort, and gas discomfort, 8 were found to have increased after application. These results are similar to those reported from the same area by an advocacy group opposed to the spray (Blackmore, 2003; Goven et al., 2007). Petrie et al. (2003) states that sleep problems, dizziness, and difficulty concentrating may be related to anxiety regarding perceptions about the risk of the program. A significant increase in participants with hay fever symptoms was noted; however, this may be incidental, as the authors point out, because the onset of the pollen season could have influenced reporting. The authors attribute the gastrointestinal symptoms to possible enterotoxin production from the microbial insecticide; however, this possibility is not supported by any available literature, and no other additional information is offered. The authors do not discuss the possibility that the gastrointestinal symptoms may be related to the reported anxiety from the perceived risks of the application. In addition, the statistical comparisons that were utilized in the study are not considered appropriate for the multiple comparisons that were made (Federici and Siegel, 2008; USDA, 2004). A review of the study and the application of conservative statistical analysis more appropriate for multiple comparisons revealed that none of the endpoints were found to be statistically significant (USDA, 2004). The authors point out that the results should be interpreted with caution as only slightly more than half of the original residents responded post-application through self-reporting which could bias the results. It is important to note that there was no increase in the frequency of visits to general practitioners or other health care providers after treatment which is consistent with results from other surveillance studies of Btk applications.

Proposed applications of Btk in this program pose minimal risk to the general population, based on the large amount of available toxicity data, surveillance data, and long-term use without significant reports of adverse effects. Glare and O'Callaghan (2000) provide a comprehensive review of *Bacillus thuringiensis*, including Btk. They conclude with this statement, "After covering this vast amount of literature, our view is a qualified verdict of safe to use" (Glare and O'Callaghan, 2000). The World Health Organization's Environmental Health Report (1999) states "Bt products can be used safely for the control of insect pests of agricultural and horticultural crops as well as forests."

Mild irritation of the eyes, skin, and respiratory tract may be associated with exposures to Btk; however, this is more likely to occur to applicators who are handling the concentrated material. Risks to applicators will be minimized as long as Foray® XG is handled according to label requirements.

c. Summary

Human health risks are expected to be minimal from Btk applications in this program, based on its long-term safety which has been demonstrated through laboratory and monitoring studies. The potential for exposure is greatest to workers who handle the concentrated product; however, exposure will be minimized by following label requirements. It is likely that a small buffer area surrounding the eradication area will receive some *B.t.k.*, but in quantities much less than inside the eradication area. Movement of *B.t.k.* beyond the eradication area is likely to be affected by conditions such as temperature, humidity, wind direction, wind speed, and terrain. A continuation of local outreach and education will minimize anxiety and health concerns associated with these treatments.

There will be minimal risk to most nontarget terrestrial and aquatic organisms due to limited exposure and low toxicity. Impacts to some native lepidopteran larvae within the spray areas may occur; however, the effects are expected to be transient due to the size of the treatment areas and specificity of Btk to the larval stage of the insect. Label requirements and other restrictions, where appropriate, will further reduce risk to sensitive organisms, such as some aquatic invertebrates and pollinator species as described above.

2. Trapping

Trapping will involve disparlure/pheromone-baited traps to attract male GM. Disparlure is the common name for cis-7, 8-epoxy-2-methyloctadecane, a synthetically produced sex pheromone of the natural pheromone that is used by the female GM to attract the male GM. The environmental impacts and human impacts are summarized below.

a. Ecological Impact

In acute toxicity tests, disparlure was not toxic to mammals, birds, or fish (USDA, 2006). Disparlure does exhibit toxicity to aquatic invertebrates; however, the effects are related to study design and the limited solubility of the pheromone (USDA, 2006). Studies using cladocerans revealed toxicity was related to the organisms becoming physically trapped at the water surface where undissolved pheromone was present (USDA, 2006). Risks to aquatic organisms are not expected in this program because all pheromone will be placed in sticky traps, thus eliminating any potential offsite run-off or drift. Pheromone traps do catch small numbers of nontarget organisms that accidently fly or crawl into the traps. However, because the pheromone in the trap is specific to GM, nontarget insects will not be attracted to traps, the number of nontarget organisms affected will be very small, and the pheromone will have minimal impacts to the environment.

b. Human Impact

Disparlure belongs to a group of compounds known as straight-chain lepidopteran pheromones. Acute toxicity studies with this group of compounds have shown very low mammalian toxicity through multiple exposure routes. The lack of toxicity with these types of compounds has resulted in reduced data requirements for their registration by the U.S. Environmental Protection Agency (EPA) (EPA, 2004). Subchronic and chronic studies are limited for these types of chemicals; however, given the low acute toxicity and the fact that pheromones occur naturally in the environment, human health risks are expected to be minimal. The reduced data requirements introduce uncertainty into potential long-term risks; however, the lack of significant exposure to the public (given its use in sticky traps and the limited amount used in the proposed program) substantially reduces the potential for exposure and risk. The pheromone can be persistent on individuals who come into physical contact with disparlure; if this were to occur, the individuals may attract adult male moths for prolonged periods of time (up to 2 to 3 years) (USDA, 2006). No toxic effects are expected but it may be a considerable nuisance in GM-infested areas, such as the eastern United States (USDA, 2006). The level of exposure required to cause the attractant effect cannot be characterized, although the likelihood of the effect is much greater for workers than for the general public.

Nevertheless, physical contact with disparlure from trapping is unlikely, and would only occur if someone were to tamper with the traps.

c. Summary

Human health risks are expected to be minimal from using disparlure baited traps in this program based on disparlure's long-term safety and the fact that it would be unlikely that humans would come into contact with disparlure in the traps. The potential for exposure is greatest to workers who handle the concentrated product; however, exposure will be minimized by following label requirements. A continuation of local outreach and education will minimize anxiety and health concerns associated with these treatments.

There will be minimal risk to most nontarget terrestrial and aquatic organisms due to limited exposure and low toxicity. The traps themselves are baited with pheromone specific to gypsy moth. There may be incidental captures of nontarget insects that enter the trap by mistake; however the number affected would be very small.

VI. Other Issues

A. Cumulative Impacts

The proposed GM eradication program has limited impacts to lepidopteran and other nontarget species in the affected areas. These limited impacts are not expected to have a cumulative impact with past, present, or future projects in these areas. Based on the analysis in the environmental impacts section, there are greater potential impacts to the environment with the use of Btk versus trapping. Btk primarily impacts lepidopterans and also species that may rely on lepidopterans as a primary source of food.

Btk has other uses including organic and inorganic crop, and home and garden uses. The amount of Btk currently used in the treatment area is unknown; however, there would be an expected increase in environmental loading of Btk with the proposed treatments. The increase in environmental loading from the proposed Btk applications will be transient since applications will occur over a relatively short period of time. The cumulative impacts from additional Btk use, relative to other stressors is expected to be incrementally negligible to human health and the environment due to the low risk of Btk. Cumulative impact potential is greatest for native Lepidoptera in the treatment block that may be sensitive to Btk applications; however, these impacts are expected to be minor since they would be localized and transient compared to the cumulative impacts that could result in the establishment of GM.

Cumulative impacts from the no action alternative would be expected to be greater than those from the preferred alternative since no treatments would allow GM to become established and spread to other areas within Oregon, Washington, and other areas of the United States. The European GM have a wide host range and damage to these host plants would be expected in the event that the GM is allowed to become established. Cumulative impacts to forest systems already under stress would be expected if GM were allowed to become established in the western United States. The effects of natural and manmade stressors to forests (e.g., timber harvests, acid rain, climate change, and other pests and diseases) can be additive or synergistic, that is, the effects of all of the stressors together become greater than the individual stressors alone (Cox, 1999; Logan et al., 2003). The addition of GM defoliation to forested areas that are already under would be expected to result in cumulative economic and environmental impacts (USDA, 2012). New areas where GM becomes established would be subjected to insecticide applications. Risk to human health and the environment may be increased with these applications since many insecticides are registered for use to control GM and may have a greater risk compared to Btk (USDA, 2012).

In the event that the GM population is not eradicated from these areas, future treatments may be required. Treatment with Btk in the same areas over several years may lead to an increase in effects to lepidopteran species, thus limiting their chances to reestablish in the proposed treatment area. However, if future treatments are needed, a subsequent EA will be conducted and risks will be evaluated further.

B. Threatened and Endangered Species

Section 7 of the Endangered Species Act (ESA) and ESA's implementing regulations require Federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of critical habitat. USDA APHIS has considered the impacts of the proposed program regarding listed species in Benton County. USDA APHIS has determined that the proposed treatments will have no effect to any listed salmonids since the closest habitat is greater than one mile from the proposed treatment area.

APHIS has determined that the proposed treatments will have no effect on the marbled murrelet, *Brachyramphus marmoratus* and its critical habitat; northern spotted owl, *Strix occidentalis caurina* and its critical habitat; streaked horned lark, *Eremophila alpestris strigata* and its critical habitat; yellow-billed cuckoo, *Coccyzus americanus* and its proposed critical habitat; water howellia, *Howellia aquatilis*, Bradshaw's desert-parsley, *Lomatium bradshawii*; Kincaid's lupine, *Lupinus sulphureus* ssp. *kincaidii* and its critical habitat; Nelson's checkermallow, *Sidalcea nelsoniana*; and

Willamette daisy, *Erigeron decumbens*. No critical habitat for these species occurs in the proposed treatment area.

APHIS has determined that the proposed program may affect, but is not likely to adversely affect Fender's blue butterfly, *Icaricia icariodes fenderi* and Taylor's checkerspot butterfly, *Euphydryas editha taylori*. No critical habitat for these species occurs in the proposed treatment area. APHIS received concurrence from the U.S. Fish and Wildlife Service (FWS) in an email on April 15, 2019.

C. Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703–712) established a Federal prohibition, unless permitted by regulations, to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird or any part, nest, or egg of any such bird. FWS released a final rule on November 1, 2013, identifying 1,026 birds on the List of Migratory Birds (FWS, 2013). Species not protected by the Migratory Bird Treaty Act include nonnative species introduced to the United States or its territories by humans and native species that are not mentioned by the Canadian, Mexican, or Russian Conventions that were implemented to protect migratory birds (FWS, 2013).

The proposed use of Btk is not anticipated to result in negative impacts to migratory birds due to its low toxicity to vertebrates. Impacts to nesting and foraging are also not anticipated due to the selective nature of Btk to certain lepidopteran insects. Impacts to certain lepidopteran insects that are prey items for birds may occur; however, the small area of treatment relative to suitable bird habitat in the spray area, and the general feeding habits of most migratory birds suggest that their populations would not be negatively impacted.

D. Historical Preservation

Consistent with the National Historic Preservation Act of 1966, APHIS has examined the proposed action in light of its impacts to national historical properties. No historic properties have been noted within the proposed treatment area. If there are changes in the program treatment area ODA will coordinate with the State Historic Preservation Office to ensure that if any historic properties occur in the proposed treatment area there will be no impacts to these properties.

E. Executive Orders

Consistent with Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," APHIS considered the potential for disproportionately high and adverse human health or environmental effects on any minority or low-income populations. The proposed treatment areas have been determined based on GM finds in the area. The proposed treatment itself will have minimal effects to those that live in this area, and will not have disproportionate effects to any minority or low-income population.

Consistent with EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks," APHIS considered the potential for disproportionately high or adverse environmental health and safety risks to children. The children in the proposed treatment areas are not expected to be adversely affected disproportionately more than adults from the proposed program actions. Available toxicity data and human health risk assessments about the potential risk of Btk have shown that children would not be at risk from the proposed treatments. No schools or day care centers are present in the treatment area. Notification to the public regarding the treatments will allow concerned parents to reduce the potential for exposure during the proposed treatment dates.

Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments" was issued to ensure that there would be "meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications…". Ceded tribal lands within the proposed treatment area were identified and a request for consultation was submitted to the affected tribes on February 27, 2019.

VII. Listing of Agencies and Persons Consulted

Oregon Department of Agriculture
Plant Division
635 Capitol St. NE, Ste. 100
Salem, OR 97301

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
920 Main Campus Drive
Raleigh, NC 27606

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
6135 NE 80th Avenue
Portland, OR 97218

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Policy and Program Development
Environmental and Risk Analysis Services
4700 River Road, Unit 149
Riverdale, MD 20737

U.S. Fish and Wildlife Service
2600 SE 98th Ave. Suite 100
Portland, OR 97266

VIII. References

Aer'Aqua Medicine, 2001. Health surveillance following Operation Evergreen: a programme to eradicate the White Spotted Tussock Moth from Eastern suburbs of Auckland. Report to the Ministry of Agriculture and Forestry. Auckland 1, New Zealand. 85pp.

Auckland District Health Board, 2002. Health risk assessment of the 2002 aerial spray eradication programme for the painted apple moth in some western suburbs of Auckland. A Report to the Ministry of Agriculture and Forestry. Prepared by: Public Health Service, Auckland District Health Board, Auckland, New Zealand. 83 pp.

Bailey, J., Scott-Dupree, C., Harris, R., Tolman, J., and Harris, B., 2005. Contact and oral toxicity to honey bees (*Apis mellifera*) of agents registered for use for sweet corn insect control in Ontario, Canada. Apidologie. 36:623–633.

Belloco, M.I., Bendell, J.F., and Cadogan, B.L., 1992. Effects of the insecticide *Bacillus thuringiensis* on *Sorex cinereus* (masked shrew) populations, diet, and prey selection in a jack pine plantation in northern Ontario. Can. J. Zool. 70:505–510.

Blackmore, H., 2003. Painted apple moth eradication campaign West Auckland. Interim Report of the Community-based Health and Incident Monitoring of the Aerial Spray Programme. January–December 2002.

CDC – see Center for Disease Control

Center for Disease Control, 2006. Surveillance for foodborne-disease outbreaks—United States, 1998—2002. MMWR Surveillance Summaries. 11/10/2006. 55:10 (1–34). [Online]. Available: http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5510a1.htm?s_cid=ss5510a1_e

Cooper, D., 1994. *Bacillus thuringiensis* toxins and mode of action. Agric., Ecosystems and Env. 49:21–26.

Cox, G.W., 1999. Eastern forests: The dark side of forest biodiversity, pp. 96–109, Alien species in North America and Hawaii: Impacts on natural ecosystems. Island Press.

Damgaard, P.H., 1995. Diarrhoeal enterotoxin production by strains of *Bacillus thuringiensis* isolated from commercial *Bacillus thuringiensis*-based insecticides. FEMS Immun. Med. Microbiol. 12:245–250.

Duan, J.J., Marvier, M., Huesing, J., Dively, G. and Huang, Z.Y.. 2008. A meta-analysis of effects of Bt crops on honey bees (Hymenoptera: Apidae). PLoS ONE 3(1): e1415. doi:10.1371/journal.pone.0001415.

EPA—See U.S. Environmental Protection Agency

Federici, B.A., and Siegel, J.P., 2008. Safety assessment of *Bacillus thuringiensis* and Bt crops used in insect control. *In*: Food Safety of Proteins in Agricultural Biotechnology. Chapter 3:45–102. Ed. B,G,

FWS – See U.S. Fish and Wildlife Service.

Ginsberg, C., 2006. Aerial spraying of *Bacillus thuringiensis kurstaki* (Btk). J. Pest. Reform. 26(2):13–16.

Glare, T.R. and O'Callaghan, M., 2000. *Bacillus thuringiensis*: Biology, ecology and safety. John Wiley & Sons, Ltd., New York, 350 pp.

Goven, J., Kerns, T., Quijano, R.F., and Wihongi, D., 2007. Report of the March 2006 People's inquiry into the impacts and effects of aerial spraying pesticide over urban areas of Auckland. 117 pp.

Green, M., Heumann, M., Sokolow, R., Foster, L.R., Bryant, R., and Skeels, M., 1990. Public health implications of the microbial pesticide Bacillus thuringiensis: an epidemiological study, Oregon, 1985–86. Am. J. Public Health. 80:848–852.

Innes, D.G.L., and Bendell, J.F., 1989. The effects on small mammal populations of aerial applications of *Bacillus thuringiensis*, fenitrothion, and Matacil® used against jack pine budworm in Ontario. Can. J. Zool. 67:1318–1323.

Logan, J.A., Regniere, J., and Powell, J.A., 2003. Assessing the impacts of global warming on forest pest dynamics. Frontiers in Ecol. and the Environ. 1: 130–137.

Manderino, R., Crist, T.O., and Haynes, K.J., 2014. Lepidoptera-specific insecticide used to suppress gypsy moth outbreaks may benefit non-target forest Lepidoptera. Agr. Forest Ent. 16:359–368.

McClintock, J.T., Schaffer, C.R., and Sjoblad, R.D., 1995. A comparative review of the mammalian toxicity of *Bacillus thuringiensis* based pesticides. Pest. Sci. 45:95–105.

Noble, M.A. Riben, P.D., and Cook, G.J., 1992. Microbiological and epidemiological surveillance programme to monitor the health effects of Foray 48B BTK spray. Vancouver, Canada, Ministry of Forests of the Province of British Columbia. p. 1–63.

Norton, M.L., Bendell, J.F., Bendell-Young, L.I., and Leblanc, C.W., 2001. Secondary effects of the pesticide *Bacillus thuringiensis kurstaki* on chicks of spruce grouse (*Dendragapus Canadensis*). Arch. Environ. Contam. Toxicol. 41(3):369–373.

Otvos, I.S., Armstrong, H., and Conder, N., 2005. Safety of *Bacillus thuringiensis* var. *kurstaki* applications for insect control to humans and large mammals. Sixth Pacific Rim Conference on the Biotechnology of Bacillus thuringiensis and its Environmental Impact. Pp. 45–60.

Parks Canada, 2003. Western Canada Service Centre. Assessment of environmental and human health effects from proposed application of Foray® 48B in Waskesiu, Prince Albert National Park of Canada. 120 pp.

Peacock, J.W., Schweitzer, D.F., Carter, J.L., and Dubois, N.R., 1998. Laboratory assessment of the native effects of *Bacillus thuringiensis* on native Lepidoptera. Environ. Entomol. 27(2):450–457.

Pearce, M., Habbick, B., Williams, J., Eastman, M., and Newman, M., 2002. The effects of aerial spraying with *Bacillus thuringiensis kurstaki* on children with asthma. Can. J. Public Health. 93(1):21–25.

Petrie, K., Thomas, M. and Broadbent, E., 2003. Symptom complaints following aerial spraying with biological insecticide Foray 48B. New Zealand Med. J. 116(1170):1–7.

Redman, A.M., and Scriber, J.M, 2000. Competition between the gypsy moth, *Lymantria dispar*, and the northern tiger swallowtail, *Papilio candensis*: interactions mediated by host plant chemistry, pathogens, and parasitoids. Oecologia. 125:218–228.

Siegel, J.P., 2001. The mammalian safety of *Bacillus thuringiensis*-based insecticides. J. Invert. Pathol. 77(1):13–21.

Sterk, G., Heuts, F., Merck, N., and Bock, J., 2002. Sensitivity of non-target arthropods and beneficial fungal species to chemical and biological plant protection products: results of laboratory and semi-field trials. 1st International Symposium on Biological Control of Arthropods. 306–313.

USDA—See U.S. Department of Agriculture

U.S. Department of Agriculture, 1995. GM management in the United States: A cooperative approach. Final Environmental Impact Statement, November 1995. U.S. Forest Service and Animal and Plant Health Inspection Service.

U.S. Department of Agriculture, 2004. Control/eradication agents for the GM—Human health and ecological risk assessment for *Bacillus thuringiensis* var. *kurstaki* (*B.t.k.*) final report. U.S. Forest Service. SERA TR 03–43–05–02c. 152 pp.

U.S. Department of Agriculture, 2006. Control/eradication agents for the GM—Human health and ecological risk assessment for disparlure (a.i.) and Disrupt II formulation—revised draft. U.S. Forest Service. SERA TR 06–52–07–01a. 79 pp.

U.S. Department of Agriculture, 2008. Gypsy moth management in the United States: a cooperative approach. Draft supplemental environmental impact statement. Summary. U.S. Department of Agriculture, Newtown Square, Pennsylvania. NA–MR–01–08.

U.S. Department of Agriculture, 2012. GM management in the United States: A cooperative approach. Supplemental Final Environmental Impact Statement, August 2012. U.S. Forest Service and Animal and Plant Health Inspection Service.

U.S. Environmental Protection Agency, 1998. Office of Prevention, Pesticides and Toxic Substances. Reregristration eligibility decision: *Bacillus thuringiensis*. EPA738–R–98–004. 170 pp.

U.S. Environmental Protection Agency, 2004. Lepidopteran pheromones fact sheet. [Online]. Available: http://www3.epa.gov/pesticides/chem_search/reg_actions/registration/fs_G-113_01-Sep-01.pdf [2016, Jan. 5].

U.S. Fish and Wildlife Service. 2013. General provisions: revised list of migratory birds. Federal Register: 65844-65864.

U.S. Fish and Wildlife Service. 2016. Current Service recommendations for monitoring of bald eagle nests in the Pacific Region – Unpublished draft. 6 pp.

Valent, 2011. Material Safety Data Sheet - Foray® 48B. Issued 10/17/11. 6 pp.

Wilcks, A., Hansen, B.M., Hendriksen, N.B., and Licht, T.R., 2006. Persistence of *Bacillus thuringiensis* bioinsecticides in the gut of human flora associated rats. FEMS Immunol. Med. Microbiol. 48:410–418.

WHO—See World Health Organization

World Health Organization, 1999. Environmental health criteria: microbial pest control agent—*Bacillus thuringiensis*. 125 pp.

Appendix A. Map of Treatment Area