Draft Environmental Assessment Rangeland Grasshopper and Mormon Cricket Suppression Program

Esmeralda, Lincoln, Nye, and White Pine Counties, Nevada
CEQ Identification Number: NV-25-02-EAXX–005–32–24P-1737125499

Photo 1. Mormon Crickets in Austin, NV   Photo Credit: Jeff Knight, NDA

Prepared by:

State Plant Heath Director Office
Animal and Plant Health Inspection Service
8775 Technology Way
Reno, NV 89521

Available at Above Address or: www.aphis.usda.gov/plant-health/grasshopper

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Acronyms and Abbreviations

ac	acre
a.i.	active ingredient
AChE	acetylcholinesterase
APHIS	Animal and Plant Health Inspection Service
BCF	bioconcentration factor
BLM	Bureau of Land Management
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
EA	environmental assessment
e.g.	example given (Latin, exempli gratia, “for the sake of example”)
EIS	environmental impact statement
E.O.	Executive Order
FONSI	finding of no significant impact
FR	Federal Register
FS	Forest Service
g	gram
ha	hectare
HHERA	human health and ecological risk assessments
i.e.	in explanation (Latin, id est “in other words.”)
IPM	integrated pest management
lb	pound
MBTA	Migratory Bird Treaty Act
MOU	memorandum of understanding
NDA	Nevada Department of Agriculture
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NIH	National Institute of Health
ppm	parts per million
PPE	personal protective equipment
PPQ	Plant Protection and Quarantine
RAATs	reduced agent area treatments
S&T	Science and Technology
ULV	ultra-low volume
U.S.C.	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Services

Draft Site-Specific Environmental Assessment

Rangeland Grasshopper and Mormon Cricket Suppression Program
Esmeralda, Lincoln, Nye, and White Pine Counties, Nevada

I. Need for Proposed Action

A. Purpose and Need Statement

An infestation of grasshoppers or Mormon crickets may occur in Nevada, specifically Esmeralda, Lincoln, Nye, and White Pine Counties. The Animal and Plant Health Inspection Service (APHIS) and Nevada Department of Agriculture (NDA) may, upon request by land managers or State departments of agriculture, conduct treatments to suppress grasshopper infestations as part of the Rangeland Grasshopper and Mormon Cricket Suppression Program (program). The term "grasshopper" used in this environmental assessment (EA) refers to both grasshoppers and Mormon crickets, unless differentiation is necessary.

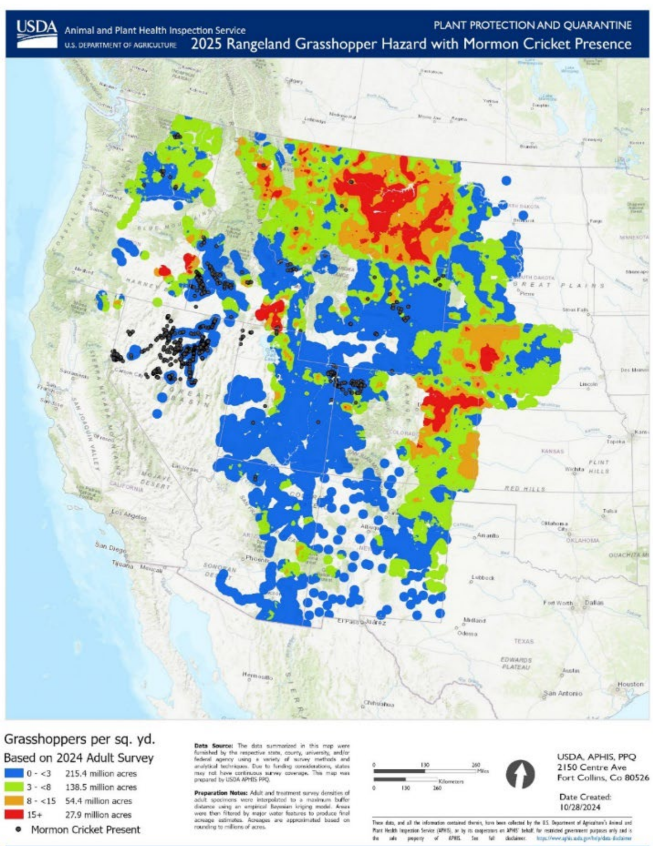
Under the guidance of Section 417 of the Plant Protection Act of 2000, USDA plays a coordinating role between Federal agencies, State agricultural departments, and private ranchers to control both grasshoppers and Mormon crickets.

Populations of grasshoppers that trigger the need for a suppression program are normally considered on a case-by-case basis and are difficult to predict. Through late summer and autumn adult grasshopper surveys, APHIS can sometimes forecast areas where damaging grasshopper populations may occur during the following year (the next summer). Land managers and property owners request APHIS assistance to control grasshopper outbreaks because of a history of damage, the potential damage to rangeland resources forecast in the current year, and as determined by spring nymphal assessment and delimitation surveys conducted prior to the summer treatment season. Rural economies depend on rangelands that are managed for productive forage to provide for livestock grazing. A reduction in forage has significant impact on cattle health and weight gain which adversely impacts producers and their livelihoods. Economic values of rangelands also include energy production sites, both fossil and renewable, and recreation sites. Besides these direct market values, rangelands also provide important ecosystem services, such as purification of air and water, water conservation, generation and preservation of soils and renewal of their fertility, detoxification and decomposition of wastes and pollutants, pollination of crops and natural vegetation, dispersal of seeds, cycling and movement of nutrients, control of potential agricultural pests, maintenance of biodiversity, and aesthetic beauty. The goal of the proposed suppression program analyzed in this EA is to reduce grasshopper populations below economical infestation levels in order to protect rangeland ecosystems or cropland adjacent to rangeland.

Photo 2. Mormon Crickets along the road near Austin, NV   Photo Credit: Jeff Knight, NDA

APHIS is proposing a program to suppress outbreak populations and is consulting with land management agencies and others in the design and implementation of the program. Specifically, APHIS is consulting with Bureau of Land Management (BLM), U.S. Forest Service (FS), U.S. Fish and Wildlife Service (USFWS), and the Nevada Department of Agriculture (NDA). This Environmental Assessment (EA) analyzes potential environmental consequences of the proposed action and its alternatives.

Figure 3. 2025 Rangeland Grasshopper Hazard With Mormon Cricket Presence Map



This EA analyzes potential effects of the proposed action and its alternatives. This EA applies to a proposed suppression program that would take place from April 1st to July 31st in Esmeralda, Lincoln, Nye, and White Pine counties. All special management areas including areas of critical environmental concern, wilderness areas, wilderness study areas, and critical habitats will be excluded from treatments. Historically in Nevada, these areas have not experienced outbreaks or been treated. The majority of these locations would be impossible to treat due to their mountainous topography, the program's treatment buffers away from water resources, and issues with private land ownership (see section III.B).

This EA is prepared in accordance with the requirements under the National Environmental Policy Act of 1969 (NEPA) (42 United States Code § 4321 et. seq.) and the NEPA procedural requirements promulgated by the Council on Environmental Quality, United States Department of Agriculture (USDA), and APHIS. A decision will be made by APHIS based on the analysis presented in this EA, the results of public involvement, and consultation with other agencies and individuals. A selection of one of the program alternatives will be made by APHIS for the 2025-2029 Control Program for Esmeralda, Lincoln, Nye, and White Pine counties.

APHIS is aware of the November 12, 2024 decision in Marin Audubon Society v. Federal Aviation Administration, No. 23-1067 (D.C. Cir. Nov. 12, 2024). To the extent that a court may conclude that the CEQ regulations implementing NEPA are not judicially enforceable or binding on this agency action, APHIS has nonetheless elected to follow those regulations at 40 C.F.R. Parts 1500– 1508, in addition to the APHIS's procedures and regulations implementing NEPA at 7 CFR Part 372, to meet the agency's obligations under NEPA, 42 U.S.C. §§ 4321 et seq

B. Background Discussion

1. Grasshopper Ecology

Rangelands provide many goods and services, including food, fiber, recreational opportunities, and grazing land for cattle (Havstad et al., 2007; Follett and Reed, 2010). Grasshoppers and Mormon crickets are part of rangeland ecosystems, serving as food for wildlife and playing an important role in nutrient cycling. However, grasshoppers and Mormon crickets have the potential to occur at high population levels, referred to as outbreaks (Belovsky et al., 1996), that result in competition with livestock and other herbivores for rangeland forage and can result in damage to rangeland plant species (Wakeland and Shull, 1936; Swain, 1944; Wakeland and Parker, 1952; Hewitt, 1977; Hewitt and Onsager, 1983; Belovsky et al., 1996; Belovsky, 2000; Pfadt, 2002; Branson et al., 2006; Bradshaw et al., 2018). Out of approximately 650 western grasshopper species, only 10 to 15 are recurrent economic pests. However, even during "normal" population years, they remove over 20% of above-ground rangeland forage annually at an estimated cost of $1.2 billion per year (Hewitt & Onsager, 1983; dollar amount adjusted). During severe outbreaks, grasshoppers consume substantial forage, which may disrupt the ecological functioning of rangelands (Rashford et al., 2012).

APHIS supports the use of Integrated Pest Management (IPM) principles in the management of grasshoppers and Mormon Crickets. Integrated pest management is the selection, integration, and implementation of pest control tactics in a systems approach on the basis of anticipated economic, environmental, and sociological consequences. The economic injury level (EIL) concept is the most widely accepted decision-making framework for pest management (Pedigo et al. 1986). The basic principle is to determine the pest level (e.g., population per unit area) that results in monetary damages greater than the cost of treatment – benefit cost ratio greater than one in standard economic terminology. The mathematical formulations can vary depending on the application and data available, but the basic formulation for EIL is given by (see Higley and Pedigo 1996):

$$\text{EIL} = \frac{C}{VDK}$$

where, C is treatment cost (e.g., $/acre), V is market value per unit of production (e.g., $/lb), D is production loss per pest (e.g., lb/pest) and K is the proportional reduction in loss from applying control. The EIL identifies the pest population (e.g., pest/acre) that justifies spending C dollars on control.

The EIL can be used as an actionable criterion; however, given pest population dynamics and delays in treatment effect, applying treatment once EIL pest levels are observed may result in substantial economic losses. APHIS and our cooperators assess whether grasshopper populations are exceeding an action threshold (historically termed the "economic infestation level"), which identifies the pest level when treatment should be initiated to avoid an increasing pest population from reaching the EIL. The action threshold therefore identifies a temporal criterion to initiate management given observations of pest levels (Figure 1). Action thresholds can be developed in a variety of ways including subjective determinations based on local experience, to objective functions of the EIL.

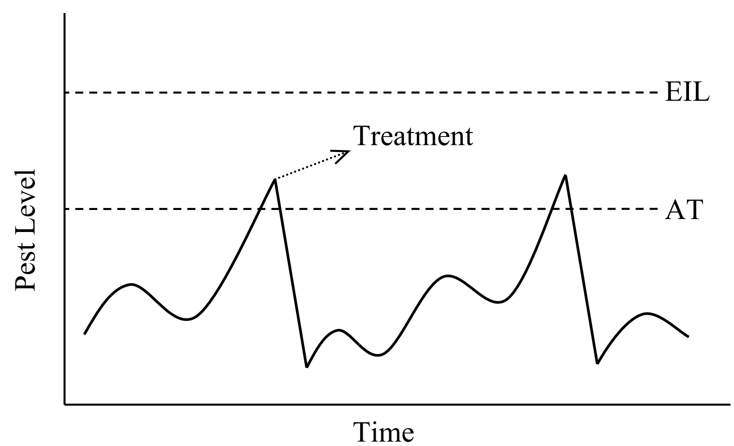


Figure 2. Diagram of the typical relationship between the economic injury level (EIL) and action threshold (AT) for applying pest treatments (Rashford et al., 2012).

The "economic injury level" is a measurement of the economic losses caused by a particular population level of grasshoppers to the infested rangeland. This value is determined on a case-by-case basis with knowledge of many factors including, but not limited to, the following: economic use of available forage or crops; grasshopper species, age, and density present; rangeland productivity and composition; accessibility and cost of alternative forage; and weather patterns. In decision making, the level of economic injury is balanced against the cost of treating to determine an "economic threshold" below which there would not be an overall benefit for the treatment. Short-term economic benefits accrue during the years of treatments, but additional long-term benefit may accrue and be considered in deciding the total value gained by treatment. Grasshopper caused losses to rangeland habitat, cultural and personal values (e.g., aesthetics and cultural resources), although a part of decision making, are not part of the economic values in determining the necessity of treatment.

While market prices are good proxies for the direct market value of commodities damaged by pests (e.g., crops or forage), market prices do not capture all of the potential economic values affected by pests. Market prices, for example, can be highly variable over time and space, depending on local supply and demand conditions (Rashford et al., 2012).

2. Grasshopper Population Control

Grasshopper populations sometimes build to economic injury levels despite even the best land management and other efforts to prevent outbreaks. Some of these efforts include disturbing grasshopper egg beds before winter, exposing them to the cold which limits the next year's emergence. Rotational grazing to promote healthier rangelands, along with constructing walls of aluminum flashing or metal to protect smaller areas have been done to reduce impacts, specifically against the flightless Mormon cricket. Private landowners have performed treatments on their own land, including using a dish soap-water mix or pesticides as means to combat outbreaks. When forage and land management have failed to prevent grasshopper outbreaks insecticides may be needed to reduce the destruction of rangeland vegetation. APHIS' enabling legislation provides, in relevant part, that 'on request of the administering agency or the agriculture department of an affected State, the Secretary, to protect rangeland, shall immediately treat Federal, State, or private lands that are infested with grasshoppers or Mormon crickets'… (7 U.S.C. § 7717(c)(1)).

Under the guidance of Section 417 of the Plant Protection Act of 2000, USDA plays a coordinating role between federal agencies, state agricultural departments, and private ranchers to control both grasshoppers and Mormon crickets. APHIS accomplishes this by conducting cooperative surveys during the early spring and late summer to measure both nymphal and adult populations of grasshoppers, respectively. The annual adult surveys can be used to forecast grasshopper population levels in the following year. Where outbreaks are common, the program selectively employs nymphal surveys to delimit potential treatment boundaries.

IPM procedures are thoroughly incorporated into the management of grasshoppers by APHIS. IPM strategies consider economic, environmental, and pesticide resistance consequences of pest control tactics. The primary objective of IPM is to control agricultural pest populations below the economic injury level. APHIS published a programmatic EIS in 1987 for rangeland grasshopper control that included IPM methods as the preferred alternative. At that time APHIS expected the IPM alternative would primarily include biological or chemical methods for grasshopper control. APHIS would continue to participate in research and testing to identify other feasible cultural and mechanical control methods. The current program uses IPM principles by selecting a particular control method on an individual site after taking into consideration of economic (the cost and the cost-effectiveness of various methods in both the short and long term), ecological (the impact on nontarget organisms and the environment), and sociological (the acceptability of various IPM methods to cooperators, or the potential effects on land use) factors.

APHIS uses survey data to inform stakeholders of the potential for economic damage associated with grasshoppers. The program also provides technical assistance on insecticides, application methodology and cost benefit analysis to equip land managers with information needed to make economically and environmentally sound grasshopper treatment decisions.

APHIS responds to solicitations from land managers to assess, and if necessary, suppresses grasshopper infestations. While many stakeholders interact with the program, Federal Land Managers represent about 75% of suppression requests. Engaging in grasshopper suppression is complicated, and funding, rangeland conditions, environmental regulations, politics and public sentiment all impact the process. The need for rapid and effective response when an outbreak occurs limits the options available to APHIS. The application of an insecticide within all or part of the outbreak area is often the only response available to APHIS to rapidly suppress or reduce grasshopper populations and effectively protect rangeland (USDA APHIS, 2011). APHIS uses several factors to determine if grasshopper suppression is warranted, including, but not limited to, the pest species present, maturity of the pest species population, timing of treatment, costs and benefits of conducting the action, and ecological considerations (USDA APHIS, 2008).

Typically, the site-specific data used to make treatment decisions in real time is gathered during spring nymph surveys. Surveys help to determine general areas, among the millions of acres where harmful grasshopper infestations may occur in the spring of the following year. Survey data provides the best estimate of future grasshopper populations, while short-term climate or environmental factors change where the outbreak populations occur. The general site-specific data include: grasshopper densities, species complex, dominant species, dominant life stage, grazing allotment terrain, soil types, range conditions, local weather patterns (wind, temp., precipitation), slope and aspect for hatching beds, animal unit months (AUM's) present in grazing allotment, forage damage estimates, number of potential AUM's consumed by grasshopper population, potential AUM's managed for allotment and value of the AUM, estimated cost of replacement feed for livestock, rotational time frame for grazing allotments, number of livestock in grazing allotment.

Surveys in Nevada conducted by the Nevada Department of Agriculture over the past ten years have taken several metrics when in the field. These metrics are grasshopper densities, species complex, dominant species, dominant life stage, and local weather conditions. Evinced by these metrics, Mormon cricket population trends are generally highly dependent on long term weather, where drought seems to enhance outbreak probability. Cyclical outbreak events occur with most of northern Nevada being subject to possible outbreaks. Over the past 40 years, outbreaks historically have averaged about five to six years in duration with two to three peak years. In northern Nevada, multi-year outbreaks seem to trend west to east starting out around Winnemucca, while progressing in later years out towards Elko until numbers decline. To reach a treatment decision, the previous year's survey data is examined to determine possible treatment areas. Several pre-treatment surveys conducted during the early spring help determine current presence, population, extent of infestation and life stages. New areas may occur with early surveys if populations warrant treatment. Other criteria for determining necessity and prioritization of treatments include public safety issues (paved roads and freeways), threatened crop areas, grazing usage, and possible urban impact. Surveys also include hazard (water, structures, topography, vegetation, etc.) determination for buffers or elimination of areas all together. Private landownership and their willingness to pay also plays a role, especially when private property fills in the holes of a larger treatment area. Baseline thresholds for Mormon crickets are two per square yard and grasshoppers are eight per square yard, though neither of those thresholds guarantees justification for treatment alone. These are all factors that are considered when determining the economic injury level.

Although APHIS and its cooperators survey and considers the factors described above to determine whether treatment is warranted, many grasshopper and Mormon cricket species can be found statewide within suitable habitat meaning that damage or threats of damage to rangelands can occur wherever those species occur. Program activities fall within the category of actions in which the exact location of individual requests for treatments can be difficult to predict with sufficient notice to accurately describe the locations within which APHIS can reasonably expect to be acting. Typically, grasshopper surveys in northern Nevada commence in March as things start to warm and nymphal hatching begins. From the data gathered by survey, aerial treatments are planned to occur in May or early June if possible. This is the ideal treatment time because most of the grasshoppers are still developing. The pesticide used, diflubenzuron, targets these developmental periods and will have no effect once the grasshoppers reach adulthood. Treatments in May will therefore have the greatest chance of reducing economically harmful grasshopper populations for this reason. In the Affected Environment Section below (III.A), APHIS does its utmost to predict locations where treatments may occur based on survey data, past and present requests for treatments, and historical data and trends. However, APHIS cannot predict all the specific locations at which affected resource owners would determine that a rangeland damage problem has become intolerable to the point that they request treatment, because these locations change from year to year. Therefore, APHIS must be ready for treatment requests on short notice anywhere in Esmerelda, Lincoln, Nye, and White Pine Counties to protect rangeland where consistent with applicable federal and state laws, land management agency policies, and where funding and resources to conduct treatments are available. For 2025, the Nevada Department of Agriculture will have a live program activity map, available to the public. The map will be consistently updated to reflect current survey efforts, public reports, and proposed aerial treatment blocks throughout the state.

3. APHIS Environmental Compliance and Cooperators

In June 2002, APHIS completed an environmental impact statement (EIS) document concerning suppression of grasshopper populations in 17 Western States (Rangeland Grasshopper and Mormon Cricket Suppression Program, Environmental Impact Statement, June 21, 2002). The EIS described the actions available to APHIS to reduce the damage caused by grasshopper populations in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. During November 2019, APHIS published an updated EIS to incorporate the available data and analyze the environmental risk of new program tools. The risk analysis in the 2019 EIS is incorporated by reference.

Nevada Revised Statutes 561.245 provides the Nevada Department of Agriculture (NDA) authority to cooperate with and enter into contracts or agreements with the Federal government. Nevada Revised Statutes 555.2605 – 555.470 are laws on the custom application of pesticides and restricted use pesticides. These contain the requirements for a license to apply pesticides and certification to use and sell restricted use pesticides.

In August 2024, APHIS and the Forest Service (FS) signed a Memorandum of Understanding (MOU) detailing cooperative efforts between the two groups on the suppression of grasshoppers on FS system lands (Document # 24-8100-0573-MU, August

16, 2024). This MOU clarifies that APHIS would prepare and issue to the public site-specific environmental documentations that evaluate potential impacts associated with the proposed measures to suppress economically damaging grasshopper populations. The MOU also states that these documents would be prepared under the APHIS NEPA implementation procedures with cooperation and input from the FS.

The MOU further states that the responsible FS official would request in writing the inclusion of appropriate lands in the APHIS suppression project when treatment on FS land is necessary. The FS must also prepare a Pesticide Use Proposal (Form: FS-2100-2) for APHIS to treat infestations. According to the provisions of the MOU, APHIS can begin treatments after APHIS issues an appropriate decision document and FS prepares and approves the Pesticide Use Proposal.

In January 2022, APHIS and the Bureau of Land management (BLM) signed a Memorandum of Understanding (MOU) detailing cooperative efforts between the two groups on the suppression of grasshoppers on BLM system lands (Document # 22-8100-0870-MU, January 11, 2022). This MOU clarifies that APHIS would prepare and issue to the public site-specific environmental documents that evaluate potential impacts associated with proposed measures to suppress economically damaging grasshopper populations. The MOU also states that these documents would be prepared under the APHIS NEPA implementing procedures with cooperation and input from BLM.

The MOU further states that the responsible BLM official would request in writing the inclusion of appropriate lands in the APHIS suppression project when treatment on BLM land is necessary. The BLM must also prepare a Pesticide Use Proposal for APHIS to treat infestations. According to the provisions of the MOU, APHIS can begin treatments after APHIS issues an appropriate decision document and BLM prepares and approves the Pesticide Use Proposal.

APHIS supports the use of Integrated Pest Management (IPM) principles in the management of grasshoppers and Mormon Crickets. APHIS provides technical assistance to Federal, Tribal, State and private land managers including the use of IPM. However, implementation of on-the-ground IPM activities is limited to land management agencies and Tribes, as well as private landowners. In addition, APHIS' authority under the Plant Protection Act is to treat Federal, State, and private lands for grasshoppers and Mormon cricket populations. APHIS' technical assistance occurs under each of the three alternatives proposed in the EIS.

In addition to providing technical assistance, APHIS completed the Grasshopper Integrated Pest Management (GIPM) project. One of the goals of the GIPM is to develop new methods of suppressing grasshopper and Mormon cricket populations that will reduce non-target effects. RAATs are one of the methods that has been developed to reduce the amount of pesticide used in suppression activities and is a component of IPM. APHIS continues to evaluate new suppression tools and methods for grasshopper and Mormon cricket populations, including biological control, and as stated in the EIS, will implement those methods once proven effective and approved for use in the United States.

C. About This Process

Activities under the program are subject to the National Environmental Policy Act (NEPA)

(42 U.S.C. 4321 et seq.). APHIS follows the Council on Environmental Quality's (CEQ) guidance implementing NEPA (40 CFR 1500 et seq.) along with USDA (7 CFR Part 1b) and APHIS NEPA Implementing Procedures (7 CFR Part 372) as part of the decision-making process. NEPA sets forth the requirement that all federal actions be evaluated in terms of the following:

- Their potential to significantly affect the quality of the human environment for the purpose of avoiding or, where possible, mitigating and minimizing adverse impacts;
- Making informed decisions; and
- Including agencies and the public in their NEPA planning in support of informed decision-making.

As previously discussed in (I.B.2), the NEPA process for grasshopper management is complicated by the fact that there is a limited window of time when treatments are most effective, and it is difficult to forecast which specific sites within the area covered by this EA will both have requests for treatment and be warranted for treatment to suppress grasshopper outbreaks. As such, the geographic scope of the actions and analyses in this EA covers Esmerelda, Lincoln, Nye, and White Pine counties to account for the wide geographic areas in which grasshoppers and Mormon crickets occur on rangelands. Then, when grasshopper populations grow to nuisance levels, program managers examine the proposed treatment area to ensure that this EA applies to the specific areas where control activities will be conducted and can act quickly. At the same time, the Program strives to alert the public in a timely manner to its more concrete treatment plans and avoid or minimize harm to the environment in implementing those plans.

Section 1619 of the Farm Bill (7 USC 8791) also prohibits disclosure of certain information from agricultural producers who provide information to participate in programs of the department. Intergovernmental agreements between APHIS and cooperators with Tribal Nations may preclude disclosure of Tribal information to the public without the consent of the Tribal Administrator. Individuals may request information on the specific treatment areas on Tribal Lands from the individual Tribal Nations.

Public involvement under the CEQ Regulations for Implementing the Procedural Provisions of NEPA distinguishes Federal actions with effects of national concern from those with effects primarily of local concern (40 CFR 1501.9). The 2019 EIS is a programmatic analysis of the environmental impacts of the Program across 17 Western States, including Nevada.

When the program receives a treatment request and determines that treatment is necessary, the specific site within the state will be evaluated to determine if environmental factors were thoroughly evaluated in the Draft EA. If all environmental issues were accounted for in the Draft EA, the program will prepare a Final EA and FONSI. Once the FONSI has been finalized copies of those documents will be sent to any parties that submitted comments on the Draft EA, and to other appropriate stakeholders. To allow the program to respond to comments in a timely manner, the Final EA and FONSI will be posted to the APHIS website. The program will also publish a notice of availability in the same manner used to advertise the availability of the Draft EA

To assist with understanding applicable issues and reasonable alternatives to manage grasshopper outbreaks in rangelands and to ensure that the analysis is complete for informed decision making, APHIS has made this Draft EA available for a 30-day public review and comment period. Public outreach notification methods for this EA include local newspapers including the Reno Gazette Journal, The Great Basin Sun, The Elko Daily Free Press and The Ely Times; APHIS website, Stakeholder Registry Notice, direct mailings, and public meetings. After reviewing and considering all timely received comments, APHIS will issue a decision and will notify the public of the decision using the same methods as for the advertising the availability of the Draft EA.

Scoping as defined by NEPA is an early and open process for determining the scope of issues to be addressed by the environmental risk analysis and for identifying the significant issues related to a proposed action (40 CFR 1501.7). APHIS uses the scoping process to enlist land managers and the public to identify alternatives and issues to be considered during the development of a grasshopper or Mormon cricket suppression program. Scoping was helpful in the preparation of the draft EAs. The process can occur formally and informally through meetings, conversations, or written comments from individuals and groups.

II. Alternatives

To engage in comprehensive NEPA risk analysis APHIS must frame potential agency decisions into distinct alternative actions. These program alternatives are then evaluated to determine the significance of environmental effects. The 2019 programmatic EIS looked at the environmental impacts of three different alternatives:

1. **Alternative 1:** No action alternative, which would maintain the status quo of allowing applications of two pesticides (carbaryl and diflubenzuron). Pesticides may be applied as a spray or bait using ground or aerial equipment at full coverage rates or, more typically, by using RAATs.
2. **Alternative 2:** No suppression alternative where APHIS would not fund or participate in any program to suppress grasshopper infestations. Any suppression program would be implemented by another entity; and
3. **Alternative 3:** Preferred alternative updates the information and allows use of two pesticides (carbaryl and diflubenzuron). Upon request, APHIS would make a single application per year to a treatment area, and would apply it at conventional or, more likely, RAAT rates. The approach to use either conventional treatment or RAATs is an adaptive management feature that allows the Program to make site-specific applications with a range of rates to ensure adequate suppression. The preferred alternative further incorporates adaptive management by allowing treatments that may be approved in the future, and by including protocols for assessing the safety and efficacy of any future treatment when compared to currently approved treatments.

APHIS selected Alternative 3 in the Record of Decision (ROD). However, under each alternative APHIS would conduct survey activities, provide technical assistance, and may make insecticide treatments according to the agency's authority under the Plant Protection Act. An example of APHIS technical guidance is the agency's work on integrated pest management (IPM) for the grasshopper program. IPM is defined as a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks (7 U.S. Code 136r-1). IPM for grasshoppers includes biological control, chemical control, rangeland and population dynamics, and decision support tools. Under all the alternatives considered in the EIS APHIS would continue to conduct grasshopper surveys and provide information on ways to manage grasshopper populations in the long-term, such as livestock grazing methods and cultural control by farmers.

APHIS has funded the investigation of various IPM strategies for the grasshopper program. Congress established the Grasshopper Integrated Pest Management (GIPM) to study the feasibility of using IPM for managing grasshoppers. The major objectives of the APHIS GIPM program were to: 1) manage grasshopper populations in study areas, 2) compare the effectiveness of an IPM program for rangeland grasshoppers with the effectiveness of a standard chemical control program on a regional scale, 3) determine the effectiveness of early sampling in detecting developing grasshopper infestations, 4) quantify short- and long-term responses of grasshopper populations to treatments, and 5) develop and evaluate new grasshopper suppression techniques that have minimal effects on non-target species (Quinn, 2000). The results for the GIPM program have been provided to managers of public and private rangeland (www.sidney.ars.usda.gov/grasshopper/index.htm).

The 2019 programmatic EIS provides a solid analytical foundation, but no site-specific suppression pesticide treatments are implemented relying entirely on the risk analysis of the EIS and ROD. The EIS provides the basic background information needed for the "tiering" of future project-specific analyses on rangelands in accordance with the CEQ regulations for implementing NEPA. APHIS instead prepares state-or site-specific EAs to address local issues before implementing suppression pesticide treatments. Therefore, APHIS decided to prepare an EA for Esmerelda, Lincoln, Nye, and White Pine counties to analyze more site-specific impacts. The EA tiers to the 2019 programmatic EIS and incorporates by reference the carbaryl and diflubenzuron HHERAs also published in 2019. Copies of the 2019 programmatic EIS and ROD are available for review at 8775 Technology Way, Reno, NV. These documents are also available at the Rangeland Grasshopper and Mormon Cricket Program web site, http://www.aphis.usda.gov/plant-health/grasshopper.

A. Alternatives Considered for Comparative Analysis

1. No Suppression Program Alternative

Under Alternative A, the No Action alternative, APHIS would not conduct a program to suppress grasshopper infestations within Esmerelda, Lincoln, Nye, and White Pine counties. Under this alternative, APHIS would continue to conduct grasshopper surveys and provide information on ways to manage grasshopper populations in the long-term, such as different livestock grazing methods and cultural control by farmers. Any suppression program would be implemented by a federal land management agency, a state agriculture department, a local government, or a private group or individual.

2. Insecticide Applications at Conventional Rates or Reduced Agent Area Treatments with Adaptive Management Strategy (Preferred Alternative)

Under Alternative B, the Preferred Alternative, APHIS would manage a grasshopper treatment program using techniques and tools discussed hereafter to suppress outbreaks. Modern GPS technology provides for accurate application and documentation of treatments and is a program requirement. Weather conditions, public safety, buffering of sensitive sites and other supervision work is conducted by APHIS for every treatment, as proscribed policy in annual Treatment Guidelines (Appendix A), Environmental Monitoring Plans and Environmental Monitoring Reports, to ensure that treatments occur with minimal drift and adequate buffering of sensitive sites.

The insecticides available for use by APHIS and considered for use in Nevada include the U.S. Environmental Protection Agency (USEPA) registered chemicals carbaryl (bait) and diflubenzuron (liquid). These chemicals have varied modes of action. Carbaryl works by inhibiting acetylcholinesterase (enzymes involved in nerve impulses). Diflubenzuron inhibits the formation of chitin by insects which causes weak exoskeletons. APHIS would make a single application per year to a treatment area and could apply insecticide at a rate conventionally used for grasshopper suppression treatments, or more typically at a reduced rate as part of Reduced Agent Area Treatments (RAATs). RAATs are the most common application method for all program insecticides, and only rarely do rangeland pest conditions warrant full coverage and higher rates. Full coverage and higher rates may be more beneficial in areas with dense vegetation for the pesticide to have the desired effect. Higher grasshopper densities and the need for higher grasshopper mortality can also warrant full coverage and higher rates. This holds true for protecting resources in peril such as cropland that can be decimated by grasshopper outbreaks.

APHIS selects which insecticides and rates are appropriate for suppression of a grasshopper outbreak based on several biological, logistical, environmental, and economical criteria. The primary biological factor is the grasshopper species and the most common life stage of the dominant species of concern. When grasshopper populations are mostly comprised of the first three instars diflubenzuron is typically selected because it is effective, economical and least harmful to non-target species. Diflubenzuron limits the formation of chitin in arthropod exoskeletons and can produce 90 to 97% grasshopper mortality in nascent populations with a greater percentage of early instars. If the window for the use of diflubenzuron closes, as a result of treatment delays, then carbaryl is the remaining control option. The circumstances where the use of carbaryl bait would be best are reduced because of the higher cost per acre than liquid insecticide formulations. Only certain species consume carbaryl insecticide when it is formulated as a bait and their migratory or banding behavior allows targeted treatments over smaller areas. Some examples of species that meet these criteria are clearwinged grasshopper (*Camnula pellucida*) and Mormon crickets (*Anabrus simplex*).

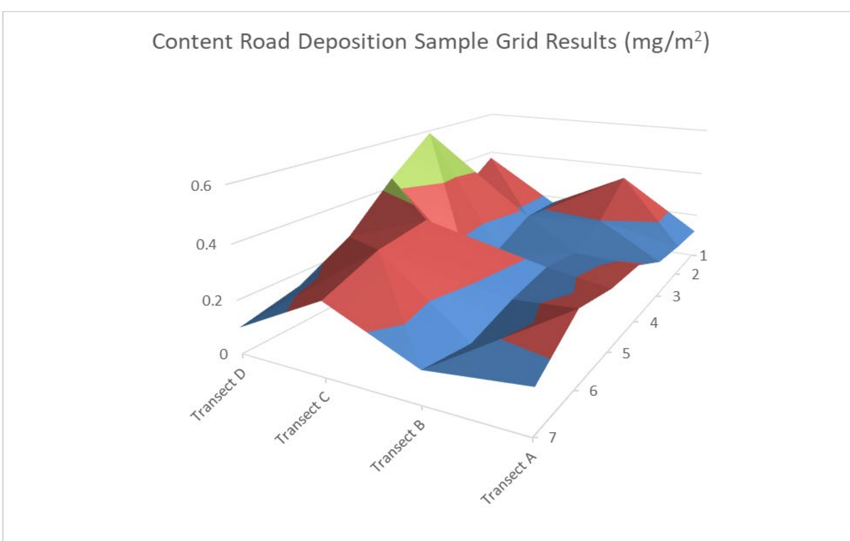
The RAATs strategy is effective for grasshopper suppression because the insecticide controls grasshoppers within treated swaths while conserving grasshopper predators and parasites in swaths not directly treated. RAATs can decrease the rate of insecticide applied by either using lower insecticide concentrations or decreasing the deposition of insecticide applied by alternating treated and untreated swaths. Typically, program managers choose both options to lower the total amount of insecticide applied and treatment costs. Either carbaryl bait or diflubenzuron would be considered under this alternative, typically at the following application rates (Lockwood et al., 2000, Foster et al., 2000, USDA APHIS, 2019):

- 10.0 pounds (0.20 lbs a.i./ac treated) of 2 percent carbaryl bait;
- 0.75 or 1.0 fluid ounce (0.012-0.016 lb a.i.) of diflubenzuron per acre.

The width of the area not directly treated (the untreated swath) under the RAATs method is not standardized. The proportion of land treated during RAATs is a complex function of the rate of grasshopper movement, which is a function of developmental stage, population density, and weather (Narisu et al., 1999, 2000), as well as the properties of the insecticide (insecticides with longer residuals allow wider spacing between treated swaths). Foster et al. (2000) left 20 to 50% of their study plots untreated, while Lockwood et al. (2000) left 20 to 67% of their treatment areas untreated. Following the conventions and procedures established by these studies, the grasshopper program typically leaves 50% of a spray block untreated for ground applications where the swath width is between 20 and 45 feet. For aerial applications, the recommended skipped swath width is typically no more than 100 feet for carbaryl (liquid) and diflubenzuron. However, many Federal government-organized treatments of rangelands tend to prefer to use a 50% skipped swath width, meaning if a fixed-wing aircraft's swath width is, for example, 150 ft., then the skipped habitat area will also be 150 ft. The selection of insecticide and the use of an associated swath widths is site dependent. Rather than suppress grasshopper populations to the greatest extent possible, the goal of this method is to suppress grasshopper populations to less than the economic injury level.

The variation in pesticide deposition resulting from following the RAATs procedures is not expected to result in chemical residues within the no spray swaths. Instead, swaths with maximum application rates alternate with swaths of low deposition rates. Program managers decided to increase the number of deposition dye card samples during 2021 to gather more data on actual application rates inside treatment blocks. Field personnel stationed 28 dye cards in a 150-foot spaced grid with four transects of seven cards. The long axis of the grid was oriented approximately parallel with the direction the aircraft were flying during the treatment. Unfortunately, strong winds caused pesticide drift from the flight swaths that were sprayed to the unsprayed swaths. Shortly after the portion of the treatment block containing the dye card grid was sprayed, the program managers ceased operations for the morning because wind gusts were measured over ten miles per hour. Figure 3 is a graph showing the pesticide concentrations on the dye cards as they were positioned in the grid. Despite the strong winds, the linear variation in deposition during an application using the RAAT method is evident. The program diflubenzuron application rate is 1.0 fluid ounce per acre which is equivalent to 1.75 mg/m2, approximately three times greater than the highest dye card concentration.

Figure 3 – Diflubenzuron concentration on dye cards placed 150 feet apart in a grid



The concept of reducing the treatment area of insecticides while also applying less insecticide per treated acre was developed in 1995, with the first field tests of RAATs in Wyoming (Lockwood and Schell, 1997). Applications can be made either aerially or with ground-based equipment (Deneke and Keyser, 2011). Studies using the RAATs strategy have shown good control (up to 85% of that achieved with a total area insecticide application) at a significantly lower cost and less insecticide, and with a markedly higher abundance of non-target organisms following application (Deneke and Keyser, 2011; Lockwood et al., 2000). Levels of control may also depend on variables such as body size of targeted grasshoppers, growth rate of forage, and the amount of coverage obtained by the spray applications (Deneke and Keyser, 2011). Control rates may also be augmented by the necrophilic and necrophagic behavior of grasshoppers, in which grasshoppers are attracted to volatile fatty acids emanating from cadavers of dead grasshoppers and move into treated swaths to cannibalize cadavers (Lockwood et al., 2002; Smith and Lockwood, 2003). Under optimal conditions, RAATs decrease control costs, as well as host plant losses and environmental effects (Lockwood et al., 2000; Lockwood et al., 2002).

Figure 4. Reduced Agent Area Treatment (RAATs):

Typical aerial treatment designs in Nevada have historically used 1.0 fl. oz. of diflubenzuron per acre with 50% or 33% coverage (single or double swath skips). Dependent on the size of the treatment and the aircraft capabilities, previous treatments had spacings of 150-foot swath widths alternating between treated and untreated swaths. The aim for these treatments is to take place sometime in May, with mid-June being the latest. For the most part, aerial treatment blocks are a minimum of 10,000 acres consisting mainly of public land possibly interspersed with private or state parcels. However, the number of blocks treated in a year depends on many factors such as the budget, and the severity of the infestation that year. The length of a treatment varies substantially due to weather conditions, personnel available, and scope of the treatments to name a few. One example of a prior treatment from 2024 is an approximately 48,000-acre block from central Nevada with over two Mormon crickets per square yard. Double skip swathing or 33% coverage was used, so ~16,000 acres were sprayed with diflubenzuron. Overall, the 2024 aerial program consisted of nine treatment blocks and took about a week to complete, which is longer than normal. This was due to a higher number of blocks that were treated, and daily high winds that shut down spraying in the late mornings.

Ground treatments using 2% carbaryl bait are carried out by the Nevada Department of Agriculture (NDA) using pickup trucks with attached bait spreaders. Due to Nevada's rough terrain, only roadside ground treatments are performed, specifically later in the season or in areas where an aerial treatment wouldn't be feasible. About two pounds of bait are used per acre, with an area being treated once per year. The carbaryl bait pesticide labels do however allow for two treatments per year if there is a minimum retreatment interval of 14 days. To limit cumulative effects however, the program and all cooperators will only treat an area once. The size of ground treatments varies, usually with several hundred feet of roadside treated at a time. These treatments are utilized to target grasshopper hotspots, especially later in the season when diflubenzuron is less effective.

Insecticide applications at conventional rates and complete area coverage, is an approach that APHIS has used in the past but is currently uncommon because RAATs treatments use less insecticide and take less time to treat the same area resulting in substantial cost savings. Under this alternative, carbaryl and diflubenzuron would cover all treatable sites within the designated treatment block per maximum treatment rates following label directions:

- 4 pounds (0.20 lbs a.i./ac treated) of 5 percent carbaryl bait;
- 1.0 fluid ounce (0.016 lb a.i.) of diflubenzuron per acre

The potential generalized environmental effects of the application of carbaryl and diflubenzuron under this alternative are discussed in detail in the 2019 EIS. A description of anticipated site-specific impacts from this alternative may be found in Part III of this document.

B. Protective Measures and Program Procedures to Avoid or Reduce Adverse Impacts

The Program applies insecticides as liquid ultra-low volume (ULV) sprays or solid-based carbaryl baits through aerial or ground applications. Habitat diversity, topographical features, meteorological conditions, economic concerns, and environmental considerations all have important roles in choosing the best form of treatment (Foster and Onsager, 1996). Aerial applications are typical for treatments over large and less accessible areas. Ground applications are most likely to be made when treating localized grasshopper outbreaks or for treatments where the most precise placement of insecticide is desired.

Compared to sprays, baits are easier to direct toward the target area, are much more specific toward grasshoppers, act primarily through ingestion, and affect fewer non-target organisms than sprays (Peach et al., 1994; Foster, 1996; Latchininsky and VanDyke, 2006). The baits have a carrier, such as bran, that absorbs the carbaryl, making it less bioavailable, particularly in dermal exposures (USDA APHIS, 2015). Biodegradation of carbaryl occurs readily in soil, but there is moderate potential for bioconcentration in aquatic organisms. This is unlikely to occur due to the application buffers from aquatic sites and the lack of significant drift due to the large bait size used during application.

ULV applications use lower than the conventional label rates, specifically 0.5 gallon or less per acre of insecticide in liquid form. Liquid applications typically produce a quicker, greater, and more predictable grasshopper mortality rate than bait applications (Fuller et al., 1996). Generally, contract costs are substantially lower for applying ULV sprays compared to conventional liquid application rates and bait applications because ULV sprays use less product (Foster and Onsager, 1996). The program avoids off target drift to protect environmentally sensitive areas and maintain treatment efficacy. Various spray carriers and adjuvants minimize off-target movement of ULV sprays including synthetic or natural oils (e.g., canola oil).

The RAATs strategy reduces the treatment area, the application rate of insecticides, or both. RAATs methods suppress grasshopper populations below the economic injury level, rather than to the greatest extent possible, keeping with the IPM principles that have governed the program since the 1980s. Insecticides suppress grasshoppers within treated swaths, yet RAATs reduces cost and conserves non-target biological resources (including predators and parasites of grasshoppers, as well as beneficial grasshoppers) in untreated areas. With less area being treated, more beneficial grasshoppers and pollinators survive treatment. There is no standardized percentage of area that is left untreated. The proportion of land treated in a RAATs approach is a complex function of the rate of grasshopper movement, which is a function of developmental stage, population density, and weather (Narisu et al., 1999, 2000), as well as the properties of the insecticide (insecticides with longer residuals allow wider spacing between treated swaths).

APHIS grasshopper treatments must follow all applicable Federal, State, tribal, and local laws and regulations regarding pesticide use, including all USEPA- and State-approved label instructions. APHIS has also implemented several measures that go beyond label instructions to protect workers and the environment. All aircraft must have a positive on/off system that will prevent leaks from the nozzles and a positive emergency shutoff valve between the tank and the pump. Whenever possible, applicators must avoid aerial ferrying and turnaround routes over water bodies and sensitive habitats (USDA APHIS, 2013). This will reduce the risk of accidental release of insecticides into aquatic habitats and other sensitive habitats. The pesticide labels of chemicals used by the program set forth specific application instructions to control grasshoppers. This unified message ensures that any party: federal, state, or local that is applying the pesticide understands how the pesticide should be applied, and at what rates. Along with the label, all applicators that cooperate on the program are trained on how to properly apply the used pesticides. Moreover, diflubenzuron is a restricted use pesticide and can only be used by those applicators who are certified to do so.

The program has procedures to limit potential movement of applied insecticides outside of the intended treatment area. Operationally, the accurate placement of the ULV spray insecticide is essential if grasshopper populations are to be suppressed efficaciously. Winds may displace the insecticide, and high air temperatures combined with low humidity may cause fine droplets to evaporate and drift without reaching the targeted vegetation. During applications, APHIS personnel constantly monitor wind conditions because when steady wind speeds exceed ten miles per hour (mph), or wind direction changes towards sensitive habitat treatments are suspended until conditions improve. Field personnel measure ground and air temperatures to check for temperature inversions characterized by stable air with little mixing. Temperature inversions can cause ULV spray droplets to remain aloft increasing the potential for off-site transport of drift. Diflubenzuron formulations are mixed with crop oil in tank mixtures which decreases drift potential since individual droplet weights increase.

The program has also established treatment restriction buffers around water bodies to protect those features from insecticide drift and runoff. The labels for all program insecticides prohibit direct application to water (defined as reservoirs, lakes, ponds, pools left by seasonal streams, springs, wetlands, and perennial streams and rivers). APHIS maintains the following additional buffers for water bodies that are not designated critical habitat for listed aquatic species: 500-foot buffer for aerial sprays, 200-foot buffer for ground sprays, and a 50-foot buffer for bait applications (USDA APHIS, 2013).

Contractors' use of Trimble GPS Navigation or equivalent system equipment is used to navigate and capture shapefiles of the treatment areas. All sensitive sites are buffered out of the treatment area using flagging which is highly visible to the applicator. All sensitive sites are reviewed in the daily briefing with APHIS personnel including the applicator working on the treatment site.

III. Environmental Consequences

Chapter III identifies the affected environment where the Program will be implemented, identifies the types of impacts or effects that will be evaluated, and the environmental issues that will be studied. Each environmental issue section addresses a separate environmental resource, and includes background information, an evaluation of the impacts on those resources, and a conclusion. The alternatives are compared with the environmental consequences of the proposed action at the end of each issue section. Determination of significance of the impacts predicted in this chapter does not occur in this EA but is made by the APHIS decisionmaker documented in the appropriate decision document.

A. Description of Affected Environment

The proposed suppression program area included in the EA encompasses 26,396,800 acres (41,245 sq. mi.) within southern and central Nevada. Approximately 90% of the land area is classified as Federal with the remainder State and private lands. Most of the area is high desert, Mojave Desert, and mountain country. The lowest elevation is approximately 500 feet and 13,000 feet elevation at its highest. A map of the program suppression area is attached hereto as Appendix B. The actual program area that may be treated will be determined by surveys done in early spring.

The area is semi-arid, and the majority of precipitation falls from October to June, as a result of Pacific storms. Monsoon storms occur in Lincoln and White Pine counties during mid to late summer. The precipitation varies from four inches a year in the valleys to over 20 inches a year in the mountains. Normally, the area is snow free from June to October, but snow can occur at any time. The soils are in climatic groups including desert, semi desert, upland mountain and high mountain with some irrigated soils. Agriculture areas include native and improved rangeland, pasture and cropland. Treatment guidelines in Appendix A would be followed to provide the least effect on soils (see section VII).

Major waterways include, but are not limited to: White River, Egan Creek, Duck Creek, Spring Valley Creek, Muncy Creek, Bull Creek, Wilson Creek, Cobb Creek, Camp Valley Creek, Snake Creek, Smith Creek, Swan Creek, Illipah Creek, East Creek, Bird Creek, Berry Creek, Steptoe Creek, Reese River, Chiatovich Creek, Indian Garden Creek, Ophir Creek, Jeff Creek, Cherry Creek, Jefferson Creek, Barley Creek, Amargosa River, Hot Creek, Bull Creek, Currant Creek, Cloverdale Creek, Moores Creek, Clear Creek, Barker Creek, Bowman Creek, Peavine Creek, Pine Creek, Savory Creek, Tulle Creek, Sawmill Creek, Willow Creek, Snowball Creek, Mosquito Creek, San Juan Creek, Cottonwood Creek, and Steward Creek.

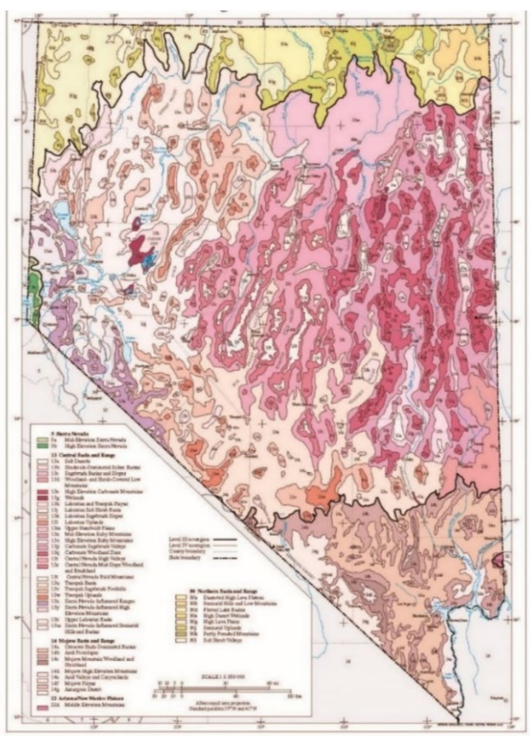
Livestock grazing is one of the main uses of most of the affected area, which provides summer range for ranching operations. Permittees may run cattle, sheep and/or horses for a season that runs generally from the first of June to the end of September, weather and vegetation conditions permitting.

Recreation activities vary considerably throughout the area. Primary activities include hunting, fishing, off-road vehicle use, hiking, backpacking, rockhounding and horseback riding. Related uses are camping, sightseeing, photography and nature study. Overall, primary use is low except in developed recreation sites and along major reservoirs. Major recreational areas in this region include: Lunar Crater Volcanic Field, Railroad Valley Wildlife Management Area, Great Basin National Park, Cathedral Gorge State Park, Spring Valley State Park, Cave Lake State Park, Echo Canyon State Park, Ruby Lake National Wildlife Refuge, Ward Charcoal Ovens State Historic Park, Death Valley National Monument, and Boundary Peak. The water resources provide water for wildlife, wild horses, burros, and domestic livestock use as well as habitat for wildlife.

The Railroad Valley, Sunnyside, and Ash Meadows Management areas are within the assessment area. Ruby Lake Wildlife Refuge and Great Basin National Park are within White Pine County. Nellis Airforce Base Bombing and Gunnery Range as well as the Nevada Test Site are within the assessment area. The Humboldt-Toiyabe National Forest is also within the area. Unless requested by the landowner, the previously listed locations will not be treated by the program.

The principal rangeland vegetation in the area is: Bitterbrush, Big Sagebrush, Indian ricegrass, Winterfat, Greasewood, Horsebrush, Rabbitbrush, Paintbrush, Perennial bunchgrasses, and Blue grasses.

Figure 5. Ecoregions of Nevada



The 16 counties covered by the Nevada EAs can be divided into five ‘level three’ ecoregions, four of which can be found in the program area. Nevada’s physiography is composed of a repeating pattern of fault block mountains and intervening valleys. Valleys are shrub-covered or shrub- and grass-covered. Mountains may be brush-, woodland-, or forest-covered. Land use is primarily rangeland, but many mines and large military reservations occur. Most of the state is internally drained and lies within the Great Basin; rivers in the southeast are part of the Colorado River system and those in the northeast drain to the Snake River (Woods et. al. 2001).

There are two distinct ecoregions that make up the land area covered in this EA:

Central Basin and Range: The largest ecoregion in Nevada is composed of northerly trending fault-block ranges and intervening drier basins. Valleys, lower slopes, and alluvial fans are either shrub- and grass-covered, or shrub-covered. Higher elevation mountain slopes support woodland, mountain brush, and scattered forests. The Central Basin and Range is internally drained by rivers flowing off the east slopes of the Sierra Nevada and by the Humboldt River. This ecoregion is generally drier than the Sierra Nevada, cooler than the Mojave Basin and Range, and warmer and drier than the Northern Basin and Range. The land is primarily used for grazing and a greater percentage is used for livestock grazing.

Mojave Basin and Range: This zone is composed of broad basins and scattered mountains that are generally lower, warmer, and drier than those of the Central Basin and Range. Its creosote bush-dominated shrub community is distinct from the saltbush–greasewood and sagebrush–grass associations that occur to the north in the Central Basin and Range and Northern Basin and Range. Most of this zone is federally owned and there is relatively little grazing activity because of the lack of water and forage for livestock.

B. Special Management Areas

APHIS is aware there are areas that have greater scenic and environmental value within the rangeland areas considered by this EA. These areas might have remote recreational uses, special ecological characteristics or species that are of special concern to land management agencies, the public, or other groups and individuals.

Within Nevada’s program area, there are a plethora of wilderness study areas (WSA), critical habitats, and areas of critical environmental concern (ACEC). Most of these areas however aren’t near where outbreaks or treatments have historically taken place in Nevada, which is in the center of the state between and near Winnemucca, Eureka, and Elko. In recent times, the program has not seen any outbreaks, or treated any designated wilderness areas, WSAs, or critical habitat. Therefore, future outbreaks and treatments are not expected to occur at or near these locations. Furthermore, critical habitats would not be treated due to buffers enforced for threatened and endangered species. The WAs and WSAs containing water features would also not be treated because of the program’s water buffers. Many of the remaining WAs and WSAs are mountain habitats where the topography makes treatments nearly impossible. If for some reason treatment is requested or warranted, the decision to treat would be examined and made on a case-by-case basis with the landowner. One special designation area which might benefit from treatment is the Osgood Mountains Milkvetch ACEC. This area is home to the rare Osgood Mountain Milkvetch (*Astragalus yoder-williamsii*) that showed signs of having been eaten by some kind of insect several years ago, but the culprit was never identified. Baiting around this small ACEC would probably be more effective than treating inside of it.

Areas of critical environmental concern within the program area include: Swamp Cedar ACEC, Rose Guano Bat Cave, Shosone Ponds, Honeymoon Hill, Blue Mass Scenic Area, Baking Powder Flat, and White River Valley.

The wilderness study areas are: Goshute Canyon, Bristlecone, Government Peak, Mount Moriah, China Mountain, Tobin Range, Cain Mountain, Clan Alpine Mountains, Desatoya Mountains, Simpson Park, Roberts Mountain, Burbank Canyons, Gabbs Valley Range, Antelope Range, Park Range, Fandango, Morey Peak, Rawhide Mountain, Palisade Mesa, The Wall, Blue Eagle, Riordan's Well, South Egan Range, Far South Egans, Fortification Range, Mount Grafton, Highland Range, White Rock Range, Parsnip Range, Weepah Spring, Worthington Mountains, South Reveille, Kawich, Big Rocks, Silver Peak Range, and Pinyon Joshua ISA.

Critical habitats for threatened and endangered species in the program area are located in Duckwater and Railroad Valleys for the Railroad Valley Springfish and near White River Valley for the White River Spinedace.

C. Effects Evaluated

Chapter III examines the direct, indirect, and cumulative effects of each of the alternatives on the biological, physical, and sociocultural aspects of the human environment (issues). Direct effects are caused by the action and occur at the same time and place (40 CFR § 1508.1(i)(1)). Indirect effects are caused by the action but are later in time and farther removed in distance (40 CFR § 1508.1(i)(2)). Cumulative effects are the effects on the environment that result from the incremental effects of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency or person undertakes such other actions (40 CFR § 1508.1(i)(3)). Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.1(i)(3)).

Cumulative impact, as defined in NEPA implementing guidelines (40 CFR § 1508.1) "is the impact on the environment which results from the incremental impact of the action when added to the past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

Potential cumulative impacts associated with the No Action alternative where APHIS would not take part in any grasshopper suppression program include the continued increase in grasshopper populations and potential expansion of populations into neighboring range and cropland. In addition, State and private land managers could apply insecticides to manage grasshopper populations however, land managers may opt not to use RAATs, which would increase insecticides applied to the rangeland. Increased insecticide applications from the lack of coordination or foregoing RAATs methods could increase the exposure risk to non-target species. In addition, land managers may not employ the extra program measures designed to reduce exposure to the public and the environment to insecticides.

APHIS does provide some survey and technical guidance to private producers on the use of program methods and materials (without overseeing treatments) with the goal of assisting land-manager requests while reducing pesticides use overall. APHIS does not collect data on the treatment of grasshoppers by private land managers unless they are organized as part of a larger APHIS supervised treatment. Private land is very rarely treated by APHIS in Nevada, and crop land never is, so any contribution of program treatments to overtreatment of private land or crop land is extremely unlikely.

Potential cumulative impacts associated with the Preferred Alternative are not expected to be significant because the program applies an insecticide application once during a treatment season. The program may treat an area with different insecticides but does not overlap the treatments. The program does not mix or combine insecticides. Based on historical outbreaks in the United States, the probability of an outbreak occurring in the same area where treatment occurred in the previous year is unlikely; however, given time, populations eventually will reach economically damaging thresholds and require treatment. During 2024, most treatments occurred in the eastern half of northern Nevada, targeting thousands of acres in Elko, Eureka, and Lander counties. These counties comprise millions of acres of rangeland in northern Nevada, so while the previously treated areas will not be treated in 2025, other sites within the three counties might warrant treatments. The environmental risk analysis for the mentioned counties can be found in the document (NV-25-04-EAXX–005–32–24P–1737125532). The insecticide application reduces the insect population down to levels that cause an acceptable level of economic damage. The duration of treatment activity, which is relatively short since it is a one-time application, and the lack of repeated treatments in the same area over consecutive years reduces the possibility of significant cumulative impacts.

The insecticides proposed for use in the grasshopper program are not anticipated to persist in the environment or bioaccumulate. Therefore, a grasshopper outbreak that occurs in an area previously treated for grasshoppers is unlikely to cause an accumulation of insecticides from previous program treatments.

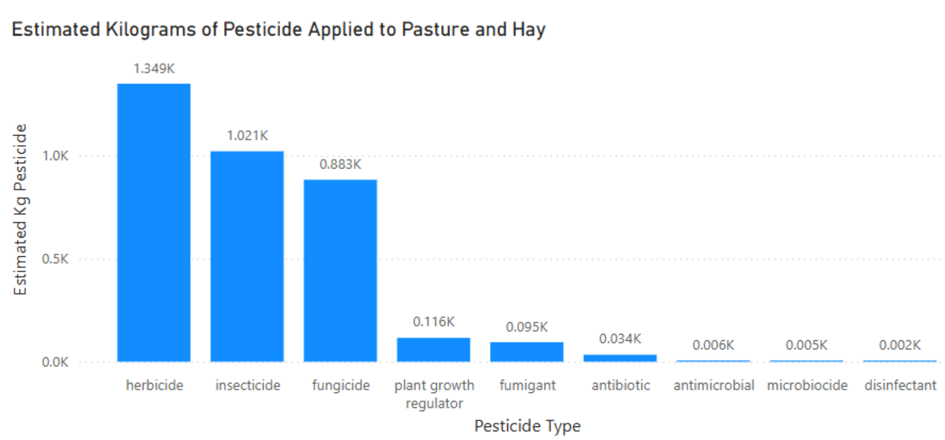
With around 85% of Nevada's land being public, most treatments are conducted on BLM land. May through June is a busy time for BLM, its partners (weeds districts, conservation districts), and permittees (mines, rights-of-way holders, geothermal plants, etc.) to treat weeds with herbicides. Treatments at this time of year are ground-based using backpacks, trucks, all terrain vehicles (ATVs), and utility terrain vehicle (UTV) mounted sprayers targeting actively growing weeds. Many of these are roadside treatments and may overlap with ground baiting for Mormon crickets. Specifically, roadside treatments at that time of year use aminopyralid, 2,4-D, glyphosate, imazapyr, metsulfuron methyl, clopyralid, or chlorsulfuron. Usually, one or two of these chemicals is used for a treatment (not all seven mixed together), depending on what weeds are targeted and their stage of development. Many of the mines and powerplants also use Bromacil and Diuron to maintain bare ground. Only one application per year takes place for these control programs. The only animal pest treatments BLM might conduct are piscicide treatments, and these would usually be later in the summer when water levels are lowest. In wet years mosquitoes are sprayed along different water bodies such as the Humboldt River, but these treatments are on private property that would be within the program's no-spray buffers for water resources. In any event, before any APHIS program, discussions would be held with land-managing officials to ensure that the two programs would not cause increased injurious effects to any treatment area.

The 2002 EIS Appendix B, Environmental Risk Assessment for Rangeland Grasshopper Suppression Program—Insecticides, analyzed effects of various insecticide formulations and treatment rates in detail and found minimal negative impacts of any kind for either carbaryl bait or diflubenzuron. Cumulative and synergistic effects were also analyzed and found to be minimal or non-existent for these. "Diflubenzuron is only reported to be synergistic with defoliant DEF (NLM, 1988)" (page 134). Def is a defoliant registered for use in cotton crops, which are not grown in Nevada, with the active ingredient Tribuphos (S,S,S-Tributyl phosphorotrithioate). No record of this or related chemicals being used in Nevada was found. For carbaryl in general (all Page | 35 formulations): "The only studies of chemical interactions with carbaryl indicate that toxicity of organophosphates combined with carbaryl is additive not synergistic (Keplinger and Deichmann, 1967; Carpenter et al, 1961)" (page 130).

There are biocontrol programs established by various land managers as well as county, state, and federal agencies. The NDA works in conjunction with APHIS personnel through a cooperative agreement. NDA also maintains a healthy biocontrol program where all biocontrol sites are mapped and logged for relocation of biocontrol agents. If a biocontrol site overlapped with a proposed treatment, APHIS and NDA would agree upon mitigation measures prior to beginning treatment. Biocontrol populations established by other land managers would be the responsibility of the land manager to identify to APHIS personnel during site specific consultation between APHIS and the land manager.

Private agricultural entities could apply herbicides or insecticides to their cropland during times which could coincide with APHIS programs. For example, from 2000-2017, it's estimated the top three types of pesticide used to treat pasture and hay in Nevada were herbicides, insecticides, and fungicides (Figure 6). APHIS however would only treat private rangelands and not cropland, so cumulative impacts would not result on cropland.

Figure 6. Estimated Kilograms of Pesticides Applied to Pasture and Hay in Nevada from 2000-2017 (USGS)



Potential cumulative impacts resulting from the use of pesticides include insecticide resistance, synergistic chemical effects, chemical persistence and bioaccumulation in the environment. The program use of reduced insecticide application rates (i.e. ULV and RAATs) are expected to mitigate the development of insect resistance to the insecticides. Grasshopper outbreaks in the United States occur cyclically so applications do not occur to the same population over time further eliminating the selection pressure that increases the chances of insecticide resistance.

The insecticides proposed for use in the program have a variety of agricultural and non-agricultural uses. There may be an increased use of these insecticides in an area under suppression when private, State, or Federal entities make applications to control other pests. However, the vast majority of the land where program treatments occur is uncultivated rangeland and additional treatments by landowners or managers are very uncommon making possible cumulative or synergistic chemical effects extremely unlikely.

APHIS has prepared this EA for Esmerelda, Lincoln, Nye, and White Pine counties because treatments could be request by if grasshopper populations reach outbreak levels. Past experience and continuing cattle grazing, drought, and high grasshopper populations lead APHIS to believe treatments will be needed in the near future. Unfortunately, the agency can't accurately predict exact treatment locations and usually discovers building grasshopper populations only a few weeks in advance. Treatments may be requested and may not occur for various reasons such as budgetary constraints, inclement weather, or insufficient grasshopper populations to name a few. Proposed treatment areas can change for many reasons, especially if grasshopper populations are no longer present. For example in 2024, three proposed treatment areas were not treated because pretreatment surveys showed the Mormon cricket populations had moved on from each of these areas. However, the program treated three other similarly sized locations that had high Mormon cricket numbers supported by survey. Treatment areas can also change if a landowner no longer wants the area treated, or in the case of an extreme event such as wildfire or flooding.

In total during the past ten years, the following treatments (Table 1) were conducted by APHIS and the NDA in Nevada using the methods described in the preferred alternative section (II.A.2). Treatment requests are received every year from the five BLM districts (Winnemucca, Carson City, Battle Mountain, Ely, Elko). These requests allow for treatments on any BLM land in the associated district. This allowed for the worst grasshopper outbreaks to be treated while allowing changes to be made as grasshopper populations relocate.

Table 1: APHIS Grasshopper Treatments in Nevada 2015-2024

Start Date	End Date	Target	Treated Acres	Protected Acres	Land Manager	County	Air or Ground
6/22/2015	6/23/2015	GH	600	3500	BLM	Humboldt	Ground
6/27/2016	6/28/2016	GH	313	1920	BLM	Humboldt	Ground
7/6/2016	7/6/2016	MC	88	640	BLM	Humboldt	Ground
7/7/2016	7/7/2016	GH	66	1280	BLM	Lander	Ground
6/5/2019	6/5/2019	MC	2435	4870	BLM	Humboldt	Air
6/12/2019	8/15/2019	MC	10196	10196	BLM	Humboldt, Pershing, Lander	Ground
6/4/2020	6/24/2020	MC	389.5	779	BLM	Humboldt, Pershing, Eureka	Ground
6/10/2020	6/10/2020	MC	44.5	89	BLM	Washoe	Ground
5/26/2021	5/27/2021	MC	12666	29892	BLM/Private	Humboldt	Air
6/1/2021	7/1/2021	MC	465	930	BLM	Humboldt, Pershing, Elko	Ground
5/26/2022	6/2/2022	MC	55936	155742	BLM/Private	Humboldt, Pershing, Lander	Air
6/6/2022	7/8/2022	MC	687	687	BLM	Humboldt, Pershing, Lander	Ground
6/6/2022	7/8/2022	MC	70	70	BLM	Humboldt, Eureka, Elko	Ground
6/16/2023	6/21/2023	MC	32737	65474	BLM	Humboldt, Eureka, Lander	Air
6/21/2024	6/28/2024	MC	69853	209559	BLM/Private	Elko, Eureka, Lander, Pershing, Churchill	Air

APHIS treatments in past ten years utilized RAATS with a rate of 1.0 oz. diflubenzuron per treated acre and treated swaths covering 50% of total area within the treatment block(s) or less for aerial treatments. Treated acres refers to the area actually treated with pesticide, while protected acres includes the entire treatment area including skipped swaths resulting from the RAATs method. For full coverage treatments, the treated and protected acreage would be the same. Ground treatments conducted by the Nevada Department of Agriculture (NDA) used both RAATs and conventional treatments for spreading carbaryl bait. Both aerial and ground treatments covered BLM lands while some private properties were incorporated into aerial treatments to create continuous treatment blocks with BLM land. The most recent programs have been to combat Mormon cricket outbreaks that have occurred throughout northern Nevada. Only five aerial treatments have been conducted over the past decade, while the remainder have consisted of ground bating. Table 1 consistently shows Humboldt County being treated apart from the years 2017, 2018, and 2024. Within that timeframe, around 64,448 acres have been treated in the county over the past decade. A majority of the treatments in Humboldt County have occurred in proximity to Winnemucca and Orovada. The undulating, undisturbed terrain around these population centers, along with the abundance of rangeland makes these areas more vulnerable to grasshopper outbreaks. Moreover, high grasshopper numbers in these areas can create public safety hazards for drivers due to their location near major roadways. Winnemucca is situated around I-80, the major east-west highway in Nevada, while Orovada is near Route 95 which leads to Oregon. Therefore, in years when budgetary constraints limit the number of treatments, areas such as Winnemucca and Orovada will see multiple treatments in different areas throughout the vicinity. This was brought up in an earlier section where the decision process for treatments in Nevada is explained (Section I.B.2). The same can be said for areas near population centers such as Elko, Eureka, and Battle Mountain as outbreaks often pose threats to public safety and rangeland. Humboldt County has seen a decrease in grasshopper numbers and treatments over the past few years while Elko County has conversely increased. This follows the historical trend of Mormon cricket outbreaks that start out west and shift eastward through the state until numbers decrease.

D. Site-Specific Considerations and Environmental Issues

Environmental issues are the resources that may be affected by the proposal, or concerns about the risks to humans from implementing the Program. The following issues are analyzed in Section E. Environmental Consequences of the Alternatives in the order outlined.

1. Human Health

Population centers within the area considered by this EA include the towns of Goldfield, Coaldale, Dyer, Lida, Beatty, Amargosa Valley, Pahrump, Ruth, Cherry Creek, Pioche, Panaca, Lund, Preston, Ely, McGill, Baker, Currant, Duckwater, Manhattan, Warm Springs, Tonopah, Round Mountain, Sunnyside, and Ione. No ULV aerial applications of carbaryl or diflubenzuron would be conducted over these congested areas. The major schools are located within city limits of these towns. The population of the four counties is approximately 69,430 (U.S. Census Bureau, July 2024).

Four Indian Reservations exist within the boundaries of the assessment area. They are Goshute, Yomba, Duckwater, and Ely Shoshone Indian Reservations.

A buffer of 1.25 miles from the treatment area to the perimeter of any town and other communities will be used. Ranch buildings and structures (such as stock tanks) will have a buffer of 200 feet. Federal highways and State roads will have a buffer of 25 feet. Local law enforcement, fire departments, emergency medical services, and tribal agencies will be notified prior to any treatment before program activities occur.

Potential exposures to the general public from traditional application rates are infrequent and of low magnitude. Program use of carbaryl and diflubenzuron has occurred routinely in many past programs, and there is a lack of any adverse health effects reported from these projects. Therefore, routine safety precautions as listed on chemical labels would continue to provide adequate protection of worker health. Immunotoxic effects from carbaryl exposure are generally expected at concentrations much higher than those from grasshopper applications, but individuals with allergic or hypersensitive reactions to the insecticides or other chemicals in the formulated product could be affected. These individuals would be advised to avoid treatment areas at the time of application until the insecticides has time to dry on the treated vegetation.

The suppression program would be conducted on federally managed rangelands that are not inhabited by humans. Human habitation may occur on the edges of the rangeland. Most habitation is comprised of farm or ranch houses, but some rangeland areas may have suburban developments nearby. Average population density in Esmerelda, Lincoln, Nye, White Pine counties is 2 persons per square mile (U.S. Census Bureau, 2024).

Recreationists may use the rangelands for hiking, camping, bird watching, hunting, falconry or other uses. Ranchers and sheepherders may work on the rangelands daily. Individuals with allergic or hypersensitive reactions to insecticides may live near or may utilize rangelands in the proposed suppression program area. Some rural schools may be in areas near the rangeland which might be included in treatment blocks. Children may visit areas near treatment blocks or may even enter treatment blocks before or after treatments.

The 2019 EIS contains detailed hazard, exposure, and risk analyses for the chemicals available to APHIS. Impacts to workers and the general public were analyzed for all possible routes of exposure (dermal, oral, inhalation) under a range of conditions designed to overestimate risk. The operational procedures and spraying conditions examined in those analyses conform to those expected for operations.

Direct exposure to program chemicals as a result of suppression treatments is unlikely due to the infrequency of treatments and the general lack of humans in treatment areas. In addition, program buffers and procedures further reduce the chances of human exposure. Finally, pesticide label specifications, standard spill prevention and rapid response measures mitigate the risk of accidental human exposure resulting from program activities. Potential exposures to the general public from conventional application rates are infrequent and of low magnitude. The RAATs approach reduces this potential even further by using reduced rates and less actual directly treated area. The proposed program should benefit human and environmental health by reducing the risk of insect annoyance, blowing dust, higher light reflection and higher temperature on the semi-arid land surface.

Various compounds are released in smoke during wildland fires, including carbon monoxide (CO), carbon dioxide, nitrous oxides, sulfur dioxide, hydrogen chloride, aerosols, polynuclear aromatic hydrocarbons contained within fine particulate matter (a byproduct of the combustion of organic matter such as wood), aldehydes, and most notably formaldehyde produced from the incomplete combustion of burning biomass (Reisen and Brown, 2009; Burling et al., 2010; Broyles, 2013). Particulate matter, CO, benzene, acrolein, and formaldehyde have been identified as compounds of particular concern in wildland fire smoke (Reinhardt and Ottmar, 2004).

Many of the naturally occurring products associated with combustion from wildfires may also be present as a result of combustion of program insecticides that are applied to rangeland. These combustion byproducts will be at lower quantities due to the short half-lives of most of the program insecticides and their low use rates. Other minor combustion products specific to each insecticide may also be present as a result of combustion from a rangeland fire but these are typically less toxic based on available human health data (http://www.aphis.usda.gov/plant-health/grasshopper).

The safety data sheet for each insecticide identifies these combustion products as well as recommendations for personal protective equipment (PPE) which is equal to what typically is used in fighting wildfires. Material applied in the field will be at a much lower concentration than what would occur in a fire involving a concentrated formulation. Therefore, the PPE worn by rangeland firefighters would also be protective of any additional exposure resulting from the burning of residual insecticides.

2. Nontarget Species

While the program conducts grasshopper control treatments any other species affected by the insecticides can be viewed as non-target effects or unintentional take. The program has established and follows procedures to prevent take of species federally listed under the Endangered Species Act as endangered or threatened. The programmatic protection measures that resulted from consultation with the Services also prevent take of state listed species (sensitive species or species of concern) in the same habitats or having similar ecological (i.e., the relationship between species and their environment) niches as federal listed species. These procedures (e.g., no-spray buffers, RAATs, insecticide choices) also limit effects on pollinators (e.g., butterflies, moths, bees) and other beneficial insects.

NEPA requires agencies to use "high-quality information, including reliable data and resources, models, and Indigenous Knowledge. Agencies may rely on existing information as well as information obtained to inform the analysis. Agencies may use any reliable data sources, such as remotely gathered information or statistical models. Agencies shall explain any relevant assumptions or limitations of the information, or the particular model or methodology selected for use." 40 C.F.R. § 1506.6(b). The Nevada Division of Natural Heritage (NDNH) is currently tracking over 640 species on the At-Risk Plant and Animal Tracking List and nearly 200 on the Plant and Animal Watch List. Species placed on the Tracking List are those species that NDNH actively maintain inventories for, including compiling and mapping data; and regularly assessing conservation status. These species generally are ranked S1-S3, which indicates some level of imperilment, and typically have federal or other state agency status. Species placed on the Watch List are those species that are considered to be of long-term concern. In some cases, these species are showing a declining trend, but overall their population numbers are still robust. NDNH passively collects and maintains data on these species, however population estimates of these species for the entire state are not recorded, just the observed number of individuals at the observed location. An important thing to note is that not all species on the tracking or watch list are located in the program area. Overall, Nevada has 370 confirmed endemic species identified within the state, including six amphibians, nine mammals, 68 insects, two arachnids, 75 mollusks, 156 dicot plant species, two monocot plant species, and 52 endemic species of fishes (NDNH 2022).

The NDNH tracking list for Nevada does not currently have any insects, mollusks, ferns, or bryophytes as state listed species. There are however numerous dicots, monocots, fishes, amphibians, reptiles, birds, and mammals that have some sort of state designation or protection. Not all state listed species have populations found in the program area, as many are restricted to the southern part of the state. Still, there are around 60 state listed species found throughout northern Nevada which illustrates the incredible biodiversity of Nevada. This biodiversity can be attributed to the state's basin and range topography. Due to this, terrestrial species endemic to specific highlands would be protected since treatments would not occur at higher elevations. State listed fish and amphibian species throughout the program area will not be affected by treatments because of enacted buffers for water bodies. Reptiles, birds, and mammals that are insectivorous may experience a decrease in available prey, although treatment areas are relatively small compared to the larger environment. The mobility of these organisms along with RAATs treatments will allow them to find food in untreated locations. One impact to state listed monocots and dicots could be the loss of pollinators as a result of treatments. These plants with known locations could be buffered similarly to federally listed plants to offer more complete protection. Other program procedures such as ULV treatments and RAATs will help to mitigate treatment effects on state listed plants and their pollinators.

Estimating nontarget species population sizes over large areas can be extremely difficult, labor intensive, and expensive. State and federal wildlife management agencies have limited resources to conduct flora and fauna population surveys and monitor trends. States may monitor the status of wildlife populations by assessing sex ratios and age distribution. Plant species surveys often identify historical or potential habitat locations. In accordance with CEQ regulations and to preserve the professional and scientific integrity of the analysis, this EA uses reliable existing data and resources provided by jurisdictional agencies and peer-reviewed literature to estimate nontarget species population sizes.

Available data on species of special concern in Nevada includes locations where species of concern have been sighted along with the number of individuals from that observation. Also, the agency status for multiple agencies including USFWS and BLM is recorded for each species. To estimate population size for these species, conservative estimates are derived from the best available density estimates reported in the literature, with preference given to publications and studies in Nevada or states having similar habitat. Density estimates may be for adults or all age classes. Population estimates based on potential habitat includes further extrapolation and speculation. The lowest estimate is assumed to be the minimum population. Habitat suitability indices, localized density fluctuations, and immigration or emigration are not factored into these calculations, nor is density based on quantity of habitat. This Nevada specific information on species of special concern is not available from any source after a prolonged search. The data consists of single observations that have been reported to and complied by the NDNH. Range maps and population trends are not available. All population estimates are considered to be conservative, as we have used the lowest population estimate among the ranges of those available in the literature.

The program suppresses grasshopper populations on a small portion of the area considered by this EA in any given year. In those treatment areas substantial portions are excluded from direct insecticide applications because of buffers around sensitive sites and the alternating spray and skip swaths inherent in the RAATs method. Thus, the potential impacts from the program activities on nontarget species populations occur in a small portion of the area considered by this EA and for a limited duration.

According to USDA's Natural Resource Conservation Service (NRCS), rangelands comprise about 30% of the entire land cover of the United States, totaling about 770 million acres. These lands are described by the NRCS as lands on which the indigenous vegetation is predominately grasses, grass-like plants, forbs, and possibly shrubs or dispersed trees, containing plant communities of either native or introduced plants. Grasslands, open forest, shrublands and associated wetlands are most likely to host outbreaks of grasshoppers and be targeted for suppression programs. These lands host abundant and diverse terrestrial and aquatic organisms.

Based on the available scientific research, there is a decrease in quantity of pollinators across the country and in rangeland ecosystems. However, the extent of program insecticide's role in this decrease is not clear. Existing research serves to outline the impact of these pesticides on pollinators of the order Hymenoptera and Lepidoptera primarily but also delves into pollinators of other orders to a lesser extent.

The availability of native floral resources is a primary determinant of the composition and abundance of bees and other pollinators in rangeland ecosystems in the United States (Potts et al. 2003, Gilgert and Vaughan 2011, Tuell et al. 2014). Approximately 4,000 different bee species aid in pollination in the United States (Black et al. 2011, Gilgert and Vaughan 2011). Many secondary pollinators such as moths and butterflies, wasps, flies, and beetles also contribute to distributing pollen despite being less efficient than bees (Larson et al. 2018).

According to Goosey et al., rangeland ecosystems are primarily pollinated by bee species. At 27 pastures in central Montana specimens from 27, 24, and 16 different bee genera were captured during 2016, 2017, and 2018, respectively. *Lasioglossum (Dialictus)*, *Agapostemon*, and *Eucera* were the most common genera captured constituting more than half (58%) of bee specimens. *Halictus* was the fourth most common genera, adding another 7% to the total bee capture. In 2016, secondary pollinators were ~8% of total pollinator catch. Lepidopterans were 10-fold more abundant than Syrphidae as secondary pollinators across all years. Secondary pollinators were 19% and 13% of the total catch in 2017 and 2018, respectively.

Furthermore, the researchers found in 2016 and 2017 bee abundance increased where periodic grazing of pastures provided suitable nesting habitat for these rangeland pollinators. They suggested forage consumption and hoof action likely created the unvegetated space required for reproduction by these mostly solitary, ground-nesting bees. However, abundances of secondary pollinators (i.e., butterflies and hover flies) were unrelated to grazing during two of the three study years. According to Gilgert and Vaughan, the diverse plant landscapes that rangelands are composed meet the needs of a variety of pollinators, including Hymenopterans and Lepidopterans. Idling large swaths of rangelands could be detrimental to bee populations because most ground-nesting species exhibit breeding-site fidelity, with multiple generations returning to nest in the same pasture (Michener 2007).

The Xerces society promotes a symbiotic relationship between pollinators and rangelands, with each benefitting from the others existence (Buxton et al. 2020). Noting rangelands provide large contiguous areas of food and shelter habitat for pollinators. Likewise, the pollination of a wide array of wildflowers produces valuable forage for cattle and wildlife, supports soil health, and makes grasslands more resilient. Information about rangeland pollinators species is generally limited, with most of it coming from "uncoordinated, short-term, small-scale sampling focusing on bees and butterflies" (Hanberry et al. 2021). Though this information is limited, studies on bees of the Great Plains indicate that about two-thirds of the bee species in rangelands are generalists, which use many families of plants for nectar and nesting. With this information about generalist nature of bees in rangelands, and the increased biodiversity caused by grazing, pollinators of the rangelands are very likely widespread in both species and location, which can increase their resiliency to disturbances.

Therefore, pesticides applications will also potentially impact a much more abundant and rich collection of pollinators due to the unique qualities of rangeland habitats. Additionally, the presence of agrochemicals and other pesticides have been found in samples of bee tissue from the Great Plains, likely due to the conversion of land from pollinator friendly rangeland to crop fields (Hladik et al 2016, Otto et al 2016).

According to a sampling of native bee communities across broad Canadian ecoregions Kohler et al. (2020), found climate and geographic variables caused differences in species abundance, richness, and composition, indicating that assessments on impacts may not be generalizable across the entire rangeland ecosystem. The researchers found bee community composition was significantly different across regions (i.e., Canadian grassland, parkland and boreal areas) and between land use types (i.e., rangeland and canola cropland). Within rangeland communities it may be difficult to understand the best conservation measures for bees due to the variance in responses on a larger scale.

Major vegetation types in Nevada rangeland include alpine, coniferous forest and woodland, mountain brush, sagebrush (big, low, black and others), low or salt desert shrub, aspen or cottonwood, willow or alder riparian areas, mountain meadows, marshlands, Mojave Desert types, and introduced annual grasslands. Many are considered as non-native, invasive weeds including annual grasses (e.g. cheat grass, venenata, medusahead), annual forbs (e.g. diffuse knapweed, Scotch thistle, yellow starthistle), perennial forbs (e.g. Canada thistle, Russian thistle, leafy spurge, white top), and woody plants (e.g. Russian olive, tamarisk). A full complement of native plants (e.g. sagebrush, bitterbrush, numerous grasses, and forbs) have coevolved with and provide habitat for native and domesticated animal species, while providing broad ecological services, such as stabilizing soil against erosion. The rangeland areas where treatments occur contain communities of sagebrush adapted plant life which are prevalent throughout the state. Covering such a large area, it's impossible to get population numbers for the various plant species, including those that are invasive. Treatments may benefit many of the plant species by reducing outbreak numbers of grasshoppers feeding on them. Washoe County has developed a Pollinator Plant List for Northern Nevada and River-Friendly Landscaping: Pollinator Plants list used to educate the public on native plants of northern Nevada, and their associated pollinators.

The Nevada Department of Conservation and Natural Resources estimates that there are thousands of native pollinator species, including over 600 species of lepidopterans. These pollinator species range from generalists to specialists, such as the Yucca moth. The most common families of bees in Nevada are *Apidae, Megachilidae, Andrenidae,* and *Halictidae*. Butterflies are declining at an estimated rate of 25% every 20 years across the West (Forister et al., 2021). Nevada has high bee species diversity, with over 800 species recorded in the state, including members of all six bee families found within the U.S. Within the Nevada bee fauna, there are solitary, eusocial, and social parasitic bees, and threats and conservation needs differ for these groups. Eusocial bees and social parasites (*Bombus spp.*) are at higher risk of pathogen spillover from commercially managed bees. Many solitary bees, especially those in arid regions, exhibit a variety of voltinism adaptations, and can also delay their emergence for years to hedge their bets against catastrophic losses in very dry years. This makes it challenging to assess bee population stability within any one year. In general, knowledge of pollinator population trends in Nevada is scarce compared to those for most vertebrate species. The Nevada Butterfly Monitoring Network, a partner with the North American Butterfly Monitoring Network, has been collecting data on butterfly populations in the northwest Nevada region since 2015, and the North American Butterfly Association has had an annual 4th of July Count in the Toiyabe Range since 2021. While the locations of many endemic butterfly subspecies are known, much less is known about the distribution of native bees in Nevada, and many parts of the state remain relatively unexplored. Few, if any, regional inventories exist on the bee diversity of particular mountain ranges or valleys. This is evinced by the current Bumble Bee Atlas map which has very little data in Nevada for the past seven years. The Atlas is a community science project aimed at gathering the data needed to track and conserving bumble bees. Knowledge of species distributions is largely focused on vulnerable habitats such as sand dunes. However, bee diversity is likely high, even in urban areas and urban edges; a 2021 pollinator survey of the Steamboat buckwheat, *Eriogonum ovalifolium var. williamsae,* found 12 distinct morphospecies of bees. The high levels of habitat specificity and resulting endemism for bees and butterflies result in several "hotspot" regions of bee and butterfly diversity. In particular, many species of plants and animals are endemic to inland sand dune regions due to their unique soil, temperature, and disturbance characteristics, along with large distances between dunes. Alkaline saltgrass habitats are a second habitat type that shares edaphic and abiotic traits distinct from nearby areas, and these regions are also home to a number of endemic flying insect populations. Low elevation riparian areas, including the Humboldt and Reese Rivers, appear to harbor significant numbers of endemic butterfly species and also create corridors that extend ranges of some species, such as the viceroy butterfly (*Limenitis archippus*) along the Humboldt River, or Lorquin's admiral butterfly (*Limenitis loquini*) along the Walker River. Finally, many species of pollinators, including solitary bees and members of the *Lycaenidae* butterfly family, appear to thrive in low-elevation canyons that are dominated by shrubs in both the Great Basin and Mojave Desert, including in the edges of the Carson Range, Wassuck Range, and Pilot Mountain (Nevada Department of Wildlife 2022). Program treatments have not historically occurred at inland sand dunes, alkaline saltgrass habitats, or low elevation riparian areas. Therefore, these unique habitats will continue to be excluded from treatments.

Biodiversity of invertebrate organisms is crucial for ecosystem health. Biocontrol insects and pollinators in particular help control noxious weeds and provide pollination services crucial to sustaining diverse ecosystems. Pollinators include managed exotic species such as European honeybees and a huge diversity of native species including many kinds of solitary and eusocial bees, wasps and ants, flies, hoverflies and bee-mimicking flies, many families of beetles, true bugs, moths and butterflies among others. In addition to general pollination services, some species of insects are obligate pollinators of rare plants, meaning the plants cannot reproduce without them. Other services which both terrestrial and aquatic invertebrates provide are less obvious but equally important, including nutrient cycling, decomposition and stimulating plant regrowth. Many species of herbivorous insects including grasshoppers are in this general category. Predacious invertebrates (e.g. arachnids, mantids, and dragonflies) help regulate herbivores while also providing food to larger animals. Invertebrates in general are incredibly important to ecosystem health and provide the greatest animal biodiversity within these ecosystems. Accurate population estimates are not possible for this group of organisms due to the sizeable program area. Program activities, such as aerial treatments using diflubenzuron, may affect invertebrate populations in those smaller treatment areas. Immature grasshoppers, beetle larvae, lepidopteran larvae, and chewing herbivorous insects appear to be more susceptible to diflubenzuron than other invertebrates. The RAATs method is meant to limit the number of non-target insects affected by aerial treatments (Appendix C).

One non-target invertebrate species of potential concern that has been previously brought up in public scoping for the program is the monarch butterfly (*Danaus plexippus*). The monarch butterfly may potentially be found throughout Esmerelda, Lincoln, Nye, and White Pine counties and is being considered for ESA protections. Though not rare, milkweed plants (which support monarch butterfly) would be an example of a plant species that would be desirable to buffer, as requested by anyone involved. The Western Monarch Milkweed Project is part of a collaborative effort to map and better understand monarch butterflies and their host plants across the western United States. This site can be cross referenced with proposed treatment areas to alert the program of any monarch activity or host plants in the area. A majority of the monarch and milkweed sightings made in Nevada have been from the western and southern parts of the state. Historically, these areas have not seen large scale grasshopper treatments and are not expected to in the future. Ground baiting has occasionally occurred in the western part of the state out towards Reno to control grasshopper hotspots. Due to methods and materials, impacts to flowering plants, including pollination services, are not anticipated to be significant by proposed actions, except for the no action alternative, which may result in fewer such plants due to herbivory by damaging grasshopper population outbreaks. The majority of milkweed species found in Nevada occur in riparian habitats or near roadsides, which are buffered for treatments.

Vertebrates occurring in rangelands of throughout Esmerelda, Lincoln, Nye, and White Pine include introduced livestock and pets (e.g. cows, goats, sheep, horses, poultry, cats, dogs) and native species including carnivores (e.g. coyotes, foxes, wolves, cougars), large herbivorous mammals (e.g. deer, elk, pronghorn antelope, bighorn sheep), smaller ones (e.g. rabbits, gophers), omnivores (e.g. badgers, mice, bats). While populations of these organisms vary throughout the program area, program activities are not expected to have an effect on them. The effects of program pesticides on mammals are discussed in Appendix C.

The common reptiles of the program area include the Desert Horned Lizard, Great Basin Fence Lizard, Great Basin Gopher Snake, Great Basin Rattlesnake, Greater Short-horned Lizard, Long-nosed Leopard Lizard, Northern Rubber Boa, and the Pygmy Short-horned Lizard. These species can be found in a variety of habitats such as sandy fats, alluvial fans, along washes, grasslands, shrublands, at the edges of dunes, and sometimes found among rocks. These areas could be treated and are not buffered.

Only a few common amphibians inhabit the program area the Great Basin Spadefoot, Northern Leopard Frog, and the Western Toad. The Great Basin Spadefoot is an arid toad that prefers sagebrush flats, pinyon-juniper woodlands, and desert shrublands. They need soft soils to burrow in, meaning their habitat could possibly be treated and not buffered. Leopard frogs need water for breeding and will not stray too far from water during the nonbreeding season, so buffers will cover their habitat. The Western Toad is found in many different habitats which may be sprayed and not buffered.

Multiple fish species live within the program area such as the Bullhead Catfish, Bluegill Sunfish, Bonneville Cutthroat Trout, Bowcutt (hybrid) Trout, Brook Trout, Brown Trout, Channel Catfish, Common Carp, Crappie, Lake Trout, Largemouth Bass, Mountain Whitefish, Paiute Sculpin, Rainbow Trout, Redband Trout, Smallmouth Bass, Tiger Trout, Wiper (Bass hybrid), Yellow Perch, and the Yellowstone Cutthroat Trout. These fish species inhabit rivers, lakes, reservoirs, streams, and ponds throughout program area which are all buffered.

Birds comprise a large portion of the vertebrate species complex, and they also include exotic and native species. Some exotic game birds, like pheasant and partridge, have been deliberately introduced into the area, and other species such as starlings and pigeons have spread from other loci of introduction. Sage obligate bird species, typified by sage grouse, are present in Esmerelda, Lincoln, Nye and White Pine county rangeland. Herbivorous vertebrate species compete with some species of grasshoppers for forage, while omnivorous and predacious species utilize grasshoppers and other insects as an important food source. Some of these species that feed on grasshoppers include the American Kestrel, Western Meadowlark, Western Bluebird, and Horned Lark. Predacious species such as those listed that feed on grasshoppers have varied diets and can find other food sources in the event that treatments drastically reduce grasshopper numbers. Most of the migratory and yearly birds that inhabit the program area are classified as least concern, meaning their population size and trends are above the vulnerable threshold. Accurate population estimates for bird species that inhabit the program area are unavailable. Program mitigation measures such as the RAATs method and ULV applications reduce the effects program pesticides might have on birds in the program area. Overall, the populations of countless bird species have been declining over the past decades, owing largely to habitat loss.

Biological soil crusts, also known as cryptogamic, microbiotic, cryptobiotic, and microphytic crusts, occur within the proposed suppression area. Biological soil crusts are formed by living organisms and their by-products, creating a crust of soil particles bound together by organic materials. Crusts are predominantly composed of cyanobacteria (formerly blue-green algae), green and brown algae, mosses, and lichens. Liverworts, fungi, and bacteria can also be important components. Crusts contribute to various functions in the environment. Because they are concentrated in the top four millimeters of soil, they primarily affect processes that occur at the land surface or soil-air interface. These include stabilizing soil against erosion, fixing atmospheric nitrogen, providing nutrients to plants, and improving soil-plant-water relations, infiltration, seedling germination, and plant growth.

Finally, sundry other organisms Finally, sundry other organisms (e.g. fungi and fungus-like organisms, algae and lichens, non-vascular plants, earthworms and other annelids, crustaceans, fish, aquatic insects, mollusks, flatworms, and aquatic plants) are often less visible in rangelands of in Esmerelda, Lincoln, Nye and White Pine counties but are nonetheless present and contribute to these ecosystems in various ways.

a) Endangered Species Act: Section 7

Section 7 of the Endangered Species Act (ESA) and its implementing regulations require Federal agencies to ensure their actions are not likely to jeopardize the continued existence of listed threatened or endangered species or result in the destruction or adverse modification of critical habitat. Within the area under consideration by this EA there are nine federally listed species and two areas of designated critical habitat, although not all occur within or near potential grasshopper suppression areas.

Endangered species within the program area include Hiko White River Springfish, Independence Valley Speckled Dace, Pahranagat Roundtail Chub, Pahrump Poolfish, White River Spinedace, and White River Springfish. The threatened species comprise of Yellow-Billed Cuckoo, Lahontan cutthroat trout, and Railroad Valley Springfish. Suckley's Cuckoo Bumble Bee is the only proposed endangered species in the program area, but the species has not been observed in the contiguous United States since 2016 despite widespread historical occurrence records and increased sampling effort for bumble bees (USFWS, 2024). The proposed threatened species is the bi-state Greater sage-grouse DPS. Apart from Pahranagat Roundtail Chub, Suckley's Cuckoo Bumble Bee, and Greater sage-grouse, the other mentioned species are all state listed as well. Although proposed species receive no protection under the ESA, APHIS has taken measures to reduce treatment effects on these species such as buffers, ULV pesticide treatments, and local consults with FWS. The application buffers and effects determinations for all threated and endangered species, along with those that are proposed, can be found in Appendix A-9 (Effects Determinations for FWS Species and Critical Habitat) of the USFWS national letter of concurrence. Listed species specific to the program area will be discussed in more detail later in this section.

APHIS considers whether listed species, species proposed for listing, experimental populations, or critical habitat are present in the proposed suppression area. Before treatments are conducted, APHIS contacts the U.S Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) (where applicable) to determine if listed species are present in the suppression area, and whether mitigations or protection measures must be implemented to protect listed species or critical habitat.

APHIS submitted a programmatic biological assessment for grasshopper suppression in the 17-state program area and requested consultation with USFWS on March 9, 2015. In November 2023 APHIS revised the biological assessment to address USFWS comments and include species that had been listed since 2015. USFWS concurred with APHIS' determination the grasshopper program would have no effect or was not likely to adversely affect listed species and the critical habitat on March 21, 2024. USFWS stated (see Appendix C):

> "As a result of the APHIS program conservation measures such as use of the buffer distances discussed above for all taxonomic groups and their designated critical habitats, as applicable, along with the reduced application rates as compared to label rates for each insecticide, and RAAT treatment procedures, any risk of exposure

> associated with the application of the three insecticides used under the APHIS grasshopper and Mormon cricket suppression program is expected to be minimal. Thus, any direct or indirect effects from the proposed action to listed species and their designated critical habitats are expected to be insignificant due to program conservation measures."

APHIS will also continue to consult with USFWS field offices at the local level to ensure listed species habitats are properly buffered during grasshopper suppression treatments. The local USFWS and APHIS offices will continue to observe the state specific buffers used in the 2022 Nevada EAs. These buffers to be followed include 100 ft for carbaryl ground baiting and a 1-mile state specific buffer for diflubenzuron aerial treatments that could impact any listed fish or other aquatic organisms. Furthermore, threatened and endangered invertebrates will have a 250 feet bait buffer and 1-mile aerial buffer from critical habitat. Threatened and endangered plants will have a 3-mile aerial and .25-mile bait buffers from all known locations. Regarding the Yellow-billed Cuckoo, 500 ft ground buffers and 1000 ft aerial buffers will be enacted at the edge of known locations and critical habitat. Consultations with the local USFWS Field Office and incorporation of the pesticide buffers into our operational procedures ensure the program is Not Likely to Adversely Affect protected species.

APHIS completed a programmatic Section 7 consultation with NMFS for use of carbaryl, malathion, and diflubenzuron to suppress grasshoppers in the 17-state program area because of the listed salmonid (*Oncorhynchus* spp.) and critical habitat. To minimize the possibility of insecticides from reaching salmonid habitat, APHIS implements the following protection measures:

- RAATs are used in all areas adjacent to salmonid habitat
- ULV sprays are used, which are between 50% and 66% of the USEPA recommended rate
- Insecticides are not aerially applied in a 3,500-foot buffer zones for carbaryl or malathion, or applied within a 1,500-foot buffer zones for diflubenzuron along stream corridors
- Insecticides will not be applied when wind speeds exceed 10 miles per hour. APHIS will attempt to avoid insecticide application if the wind is blowing towards salmonid habitat
- Insecticide applications are avoided when precipitation is likely or during temperature inversions

APHIS determined that with the implementation of these measures, the grasshopper suppression program may affect, but is not likely to adversely affect listed salmonids or designated critical habitat in the program area. NMFS concurred with this determination in a letter dated April 12, 2010.

b) Protections for Listed Species

The Hiko White River springfish is endemic to spring systems in Pahranagat Valley, Lincoln County, Nevada. Specifically found in three aquatic systems: Crystal Springs, Hiko Spring, and Blue Link Spring. The Hiko spring population was estimated at 310 individuals, Crystal Springs at 3300 individuals, and no recent estimate for Blue Link Spring (USFWS, 2022a). The Pahranagat Valley has not historically been treated by the program, therefore the habitat for this species will continue to be excluded from treatments.

The White River springfish is only found within spring systems in Pahranagat Valley, Lincoln County, specifically a single system, Ash Springs. Snorkel surveys resulted in a population estimate of 2060 individuals (USFWS, 2022a). The Pahranagat Valley has not historically been treated by the program, therefore the habitat for this species will continue to be excluded from treatments.

The Pahranagat Roundtail Chub endemic to thermal waters of Pahranagat Valley, Lincoln County. Their native habitat has since been reduced to approximately 2.2 miles (mi.) of natural stream channel (Pahranagat Creek) and 1.6 mi. of cement lined ditch (Pahranagat Ditch), located entirely on private lands within Pahranagat Valley. The Nevada Department of Wildlife (NDOW) conducts snorkel surveys on an annual basis to enumerate the chub, and these surveys typically result in less than 100 observations of individuals (USFWS, 2022b). The Pahranagat Valley has not historically been treated by the program, therefore the habitat for this species will continue to be excluded from treatments.

Extirpated from its only known native habitat at Manse Spring, near Pahrump Nevada, in 1975, there are currently four refuge locations which contain Pahrump poolfish: 1) Corn Creek; 2) Shoshone Ponds; 3) Springs Preserve; and 4) Spring Mountain Ranch State Park. The Corn Creek population is estimated at 1630 individuals, Shoshone Ponds at 4570, Springs Preserve at 130, and Spring Mountain Ranch State Park at 8800 individuals (USFWS, 2023b). The four named refuges have not historically been treated by the program, therefore the habitat for this species will continue to be excluded from treatments.

White River Spinedace is found in the White River system in Nye and White Pine Counties, Nevada. This fish has been extirpated from all but one of its historical habitats. They are found at the Flag Springs complex on the State of Nevada's Wayne E. Kirch Wildlife Management Area, where population observations have shown a declining trend since 2013 (USFWS, 2021b). The listed wildlife management area has not historically been treated by the program, therefore the habitat for this species will continue to be excluded from treatments.

Railroad Valley springfish are extant at all six historically occupied thermal springs, which compose their entire designated critical habitat. Four of the six springs are located at Lockes Wildlife Management Area (LWMA) and two at Duckwater. Population estimates have varied over the years, but recent surveys of their populations were described as abundant (USFWS, 2021a). The six thermal springs this species inhabits have not historically been treated by the program, therefore the habitat for this species will continue to be excluded from treatments.

The western distinct population segment (DPS) of Yellow-billed Cuckoo is believed to occur in the program counties of Lincoln, Lyon, Mineral, and Nye. However, it could possibly be found outside of these areas. The yellow-billed cuckoo is a neotropical migrant bird that winters in South America and breeds in North America. Currently, the western yellow-billed cuckoo primarily breeds in large tracts of dense riparian woodlands along low-gradient streams. Vegetation typically includes riparian tree species such as cottonwood (*Populus spp.*) and willow (*Salix spp.*). The historical status of this bird in Nevada is poorly documented. Current survey results and the available literature indicate a small breeding population of western yellow-billed cuckoos (fewer than ten breeding pairs) in Nevada (Neel 1999, pp. 118–120). Large tracts of low-gradient streams are not treated by the program and the above-described buffers for this species ensure treatments are not likely to adversely affect, either directly or indirectly, Yellow-billed Cuckoo.

Lahontan cutthroat trout currently exist in about 155 streams and 6 lakes and reservoirs in Nevada, California, Oregon, and Utah. Three population segments of LCT exist: 1) Western Lahontan basin comprised of Truckee, Carson, and Walker River basins; 2) Northwestern Lahontan basin comprised of Quinn River, Black Rock Desert, and Coyote Lake basins; and 3) Humboldt River basin. Lahontan cutthroat trout inhabit lakes and streams and require spawning and nursery habitat characterized by cool water, pools near cover and velocity breaks, well vegetated and stable stream banks, and relatively silt free rocky substrate in riffle-run areas. Population trends are not known, but this species is supported by stocking from fisheries (USFWS, 2023a). The above-described general protection measures for waterbodies, and the added buffers for known ESA species populations, should ensure treatments are not likely to adversely affect, Lahontan cutthroat trout populations.

c) Additional Species of Concern Protection Measures

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.

Birds of Conservation Concern (BCC) in the program area include the American Avocet, American Dipper, American White Pelican, Black Tern, Black-throated Gray Warbler, Bobolink, Broad-tailed Hummingbird, California Gull, Calliope Hummingbird, Cassin's Finch, Clark's Grebe, Evening Grosbeak, Flammulated Owl, Forster's Tern, Franklin's Gull, Lesser Yellowlegs, Lewis's Woodpecker, Long-eared Owl, Marbled Godwit, Northern Harrier, Olive-sided Flycatcher, Pectoral Sandpiper, Pinyon Jay, Rufous Hummingbird, Sage Thrasher, Virginia's Warbler, Western Grebe, and Willet. This list consists of both migratory and non-migratory birds. Treatments could affect non-migratory and breeding birds within the program, while migrants that use the program area as a stopover before reaching their breeding grounds would be less affected. The shorebirds and waterfowl of this group should not be affected by treatments because the bodies of water they inhabit are inherently buffered. Other species that are found in montane zones will also not be impacted since they live in terrain that is impossible to treat. For the remaining species, the proposed action is not likely to adversely affect BCC because the proposed conservation measures are expected to lower the estimated environmental concentrations of these pesticides to levels that would have an insignificant effect on birds, such that the effects cannot be meaningfully measured, detected, or evaluated.

APHIS will support the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or reducing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions. Impacts are minimized as a result of buffers to water, habitat, nesting areas, riparian areas, and the use of RAATs. For any given treatment, only a portion of the environment will be treated, therefore minimizing potential impacts to migratory bird populations.

The Bald and Golden Eagle Protection Act (16 U.S.C. 668–668c) prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. During the breeding season, bald eagles are sensitive to a variety of human activities. Grasshopper management activities could cause disturbance of nesting eagles, depending on the duration, noise levels, extent of the area affected by the activity, prior experiences that eagles have with humans, and tolerance of the individual nesting pair. However, rangeland grasshopper suppression treatments occur during the late spring or early summer, after the nesting season when eagle young typically will have already fledged. The program also recognizes disruptive activities in or near eagle foraging areas can interfere with bald eagle feeding, reducing chances of survival. Program operational procedures that prevent applications near water bodies will reduce the possibility of disturbing eagle foraging activities. USFWS has provided recommendations for avoiding disturbance at foraging areas and communal roost sites that are applicable to grasshopper management programs (USFWS, 2007).

No toxic effects are anticipated on eagles as a direct consequence of insecticide treatments. Toxic effects on the principal food source, fish, are not expected because insecticide treatments will not be conducted over rivers or lakes. Buffers protective of aquatic biota are applied to their habitats to ensure that there are no indirect effects from loss of prey.

There may be species that are of special concern to land management agencies, the public, or other groups and individuals in proposed treatment areas. For example, the sage grouse populations have declined throughout most of their entire range, with habitat loss being a major factor in their decline.

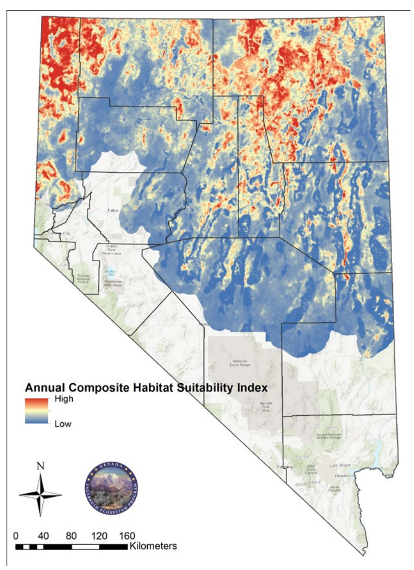
APHIS is not required to develop mitigation buffer zones for candidate or other species of concern. The Columbia spotted frog (Great Basin population) (*Rana luteiventris*), and Greater Sage Grouse are species of concern and located within the proposed treatment areas analyzed in this EA. Consideration of these species will be discussed with the local land managers prior to any treatments to assist in conservation efforts. Agreed upon mitigation measures between USFWS, NDOW, NDA, and APHIS will be followed. Yearly local program consultations with the requesting agency would determine if mitigation measures would allow a suppression program to be done. The life history of the Columbia spotted frog occurs around water, which the program's no spray buffers effectively protects. This applies to the three geographically separated subpopulations in the Jarbidge, Independence, Ruby, and Toiyabe Mountains.

There is special concern about the role of grasshoppers as a food source for sage grouse. Grasshopper suppression programs reduce grasshoppers and at least some other insects in the treatment area that can be a food item for sage grouse chicks. Sage grouse can be found among the sagebrush steppe throughout northern Nevada (Figure 7). As indicated in previous sections on impacts to birds, there is low potential that the program insecticides would be toxic to sage grouse, either by direct exposure to the insecticides or indirectly through immature sage grouse eating moribund grasshoppers. Because grasshopper numbers are so high in an outbreak year, treatments would not likely reduce the number of grasshoppers below levels present in a normal year which is less than eight grasshoppers per square yard and under two Mormon crickets per square yard. Should grasshoppers be unavailable in small, localized areas, sage grouse chicks may consume other insects, which sage grouse chicks and other species likely do in years when grasshopper numbers are naturally low. By suppressing grasshoppers, rangeland vegetation is available for use by other species, and rangeland areas are less susceptible to invasive plants that may be undesirable for sage grouse and the habitat overall.

Through an agreement between Nevada Department of Agriculture, Nevada Department of Wildlife, USDA Plant Protection and Quarantine, the Bureau of Land Management, and the United States Fish and Wildlife Service all parties agree to limit the use of insecticides within sage-grouse habitat for grasshopper and Mormon cricket control during times that would have the greatest chance of disturbing sage-grouse during critical nesting and brooding periods. For aerial applications of diflubenzuron, no applications will occur within three miles of active and pending (lek with one observation of greater than 2 males in the last ten years and at least one observation of greater than males more than ten years ago) sage grouse leks during the intervals of one hour before sunrise to two hours after sunrise, and from two hours before sunset to one hour after sunset between the months of March and May. Lek locations provided by NDOW are compared with planned treatment blocks to ensure these guidelines are followed.

Ground applications will use specially formulated carbaryl baits to mitigate potential impacts to non-target species. No carbaryl bait will be applied within three miles of any active or pending sage grouse lek. Through consultation with NDOW and BLM, areas where crops, roads, or urban areas are to be protected, two track or other categories of roads may be utilized to distribute carbaryl bait within the sage grouse buffer zone, up to one mile from the area to be protected. If a lek is found within one mile from the protected area, further consultation between the program, NDOW, and USFWS will occur. Any ground baiting activity approved by NDOW and USFWS within the sage grouse buffer zone using carbaryl bait would also comply with the time frame constraints consistent with that of the aerial applications of diflubenzuron.

Figure 7. Habitat Suitability Index for Greater Sage Grouse in Nevada (*Sagebrush Ecosystem Technical Team - August 2014)*



APHIS also implements several best management practices in their treatment strategies that are designed to protect nontarget invertebrates, including pollinators. APHIS minimizes insecticide use by using lower than labeled rates for all Program insecticides, alternating swaths during treatment, making only one application per season and minimizing use of liquid broad-spectrum insecticides. APHIS also continues to evaluate new monitoring and control methods designed to respond to economically damaging populations of grasshoppers and Mormon crickets while protecting rangeland resources such as pollinators.

3. Physical Environment Components

a) Geology and Soils

The topographic features that are apart of Esmerelda, Lincoln, Nye, and White Pine counties are analogous to those found throughout Nevada. With 319 named mountain ranges, Nevada's dominant topographic feature is its basin and range topography. Mountain ranges in Nevada, commonly about 10 miles wide and rarely longer than 80 miles, are separated by valleys. The geologic structure that controls this basin-and-range topography is dominated by faults. Nearly every mountain range is bound on at least one side by a fault that has been active, with large earthquakes, during the last 1.6 million years. For the last several million years, these faults have raised and occasionally tilted the mountains and lowered the basins. Over the years, these basins have filled with sediments that are derived from erosion of the mountains and that are locally tens of thousands of feet thick. Repeated and prolonged periods of interactions between the North American Plate and oceanic plates, expressed in folds, thrust faults, strikeslip faults, normal faults, igneous intrusions, volcanism, metamorphism, and sedimentary basins, are recorded in the rocks. Nevada rocks document volcanic and intrusive igneous activity intermittently and repeatedly from earliest geologic history to within the last few thousand years. Nevada's igneous rocks are connected to seafloor spreading about 450 million years ago, collisions of ancient and modern plates, and hot spots in the Earth's mantle and outer core. Some of the volcanic rocks in western Nevada represent the precursor of the Cascade Range, and significant intrusions about 40, 100, and 160 million years ago are linked to similar plate tectonic settings, whereby oceanic plates were subducted beneath western North America. Most, but not all, ore deposits in Nevada are associated with igneous activity. In some cases, metals came from the magmas themselves, and in other cases, the magmas provided heat for circulation of hot water that deposited metals in veins and fractured sedimentary rocks.

Some environmental hazards are associated with the abundant igneous rocks in Nevada. For example, groundwater in Nevada contains elevated concentrations of radon. Since radon is common in silica-rich igneous rocks, and because these rocks are widespread in the mountains and make up much of the sediment in the valleys, radon occurs in groundwater, soil, and air. Similarly, arsenic is relatively abundant in certain types of igneous rocks and is locally a problem as a dissolved natural constituent in Nevada groundwater and surface water (Price 2004).

Soil is the basic component of rangeland ecosystems and is associated with nearly all processes that occur within the ecosystem. It provides a medium to support plant growth and is also the home for many insects and microorganisms. Moreover, soil is a product of parent material, climate, biological factors, topography, and time. The soil formation process is slow, especially in arid and semiarid climates. It is believed to take several hundred years to replace an inch of topsoil lost by erosion. Rangeland soils, as those found in the Great Plains and Palouse Prairie, have been extensively converted to agricultural crop production. Remaining rangeland soils may be rocky, steep, salt affected, or otherwise not very productive compared to prime agricultural lands. The chemical and physical characteristics of a soil determine: its ability to furnish plant nutrients, the rate and depth of water penetration, and the amount of water the soil can hold and its availability to plants.

The millions of acres contained in Esmerelda, Lincoln, Nye, and White Pine counties exhibit an incredibly diverse soil map. Many of these soils are used for rangeland and wildlife habitat. Unique geological conditions, usually in the form of soils, occur in isolated pockets scattered across the state. These conditions have given rise to regionally adapted plants and, at least in some locations, unique species of invertebrates with extremely restricted ranges. Edaphic communities are, by definition, determined by soil conditions. One example of this is the 140 patches of altered andesite scattered across the west-central Great Basin. These sites, in contrast to the surrounding sagebrush-dominated landscape, are characterized by the presence of Jeffrey or ponderosa pine (NDOW 2022). The typical vegetation is mainly big sagebrush, rubber rabbitbrush, Sandberg's bluegrass, bottlebrush squirreltail, basin wildrye, and Thurber's needlegrass to provide some examples. The primary soil map units for each county covered by this EA are as follows:

- Esmerelda: Unsel-Wardenot-Izo association (95,412 a), Blacktop-Rodad-Theriot association (75,261 a), Annaw-Wardenot-Ardivey association (75,269 a)

- Lincoln: Turba-Acti association (135,052 a), Ursine-Mezzer-Armespan association (77,159 a), St. Thomas-Zeheme-Rock outcrop association (95,103 a), Boxspring-Rock outcrop association (100,476 a)

- Nye: Hardhat-Candelaria association (96,701 a), Stewval-Rock outcrop association (113,678 a), Stewval-Bellehelen-Rock outcrop association (186,488 a), Yermo, hot-Yermo-Arizo association (141,062 a)

- White Pine: Pookaloo-Cavehill-Rock outcrop association (209,309 a), Palinor very gravelly loam, 2 to 15 percent slopes (167,966 a), Armespan-Summermute association (49,265 a)

b) Hydrology and Water Resources

Aquatic habitats are rare and sparsely distributed across Nevada but provide numerous benefits to various species and are often a magnet for year-round residents and migratory species alike. Springs dot the entire landscape across Nevada and are comprised of both cold and geothermally active sites. These systems provide critical aquatic and riparian habitat and water for wildlife use, with the complexity of these landscapes giving rise to Nevada’s diverse wildlife communities. As mentioned in the description of the affected environment (III.A), major waterways include, but are not limited to: White River, Egan Creek, Duck Creek, Spring Valley Creek, Muncy Creek, Bull Creek, Wilson Creek, Cobb Creek, Camp Valley Creek, Snake Creek, Smith Creek, Swan Creek, Illipah Creek, East Creek, Bird Creek, Berry Creek, Steptoe Creek, Reese River, Chiatovich Creek, Indian Garden Creek, Ophir Creek, Jeff Creek, Cherry Creek, Jefferson Creek, Barley Creek, Amargosa River, Hot Creek, Bull Creek, Currant Creek, Cloverdale Creek, Moores Creek, Clear Creek, Barker Creek, Bowman Creek, Peavine Creek, Pine Creek, Savory Creek, Tulle Creek, Sawmill Creek, Willow Creek, Snowball Creek, Mosquito Creek, San Juan Creek, Cottonwood Creek, and Steward Creek. These surface water features are fed by annual snow melt from the numerous mountain ranges throughout the state such as the Sierra Nevada. Due to Nevada’s arid climate, there is very little precipitation throughout the year to supply the mentioned water features.

The last National Rivers and Streams Assessment (NRSA) was published for 2018-2019. During spring and summer of 2018 and 2019, 61 field crews sampled 1,851 sites, using standardized sampling procedures to collect data on biological, chemical, physical, and human health indicators. The measured values were compared to benchmarks developed specifically for NRSA, to EPA recommended water quality criteria, or to EPA fish tissue screening levels to assess river and stream condition. Nationally, 28% of river and stream miles were in good biological condition, while almost half were in poor condition. The most widespread stressors were excess nitrogen, phosphorus, and riparian vegetation cover, with poor conditions in 44%, 42%, and 27% of river and stream miles, respectively. Moreover, just over one-third (35%) of river and stream miles had healthy fish communities**.** The NRSA found that the percentage of river and stream miles in poor biological condition could be reduced by 20% if excess nutrient levels could be reduced from poor to good or fair. Finally, bacteria exceeded EPA's recreational benchmark in 20% of river and stream miles (USEPA, 2024).

c) Air Quality and Climate

Much of the northern part of Nevada is within the Great Basin, a mild desert that experiences hot temperatures in the summer and cold temperatures in the winter. Although Nevada is the driest state in the nation, it is also a mountainous state where the climate tends to be colder and wetter at higher elevations. In fact, Nevada means "snow-capped" in Spanish, and much like other Westerners, Nevadans rely heavily on mountain snow for their water supplies.

Differences in climate from one place to another reflect Nevada's size and rugged topography, which ranges from over 13,000 feet in the White Mountains to just 500 feet above sea level at the Colorado River. The fact that elevation is a particularly important driver of weather and climate is no surprise with the increased likelihood of high winds and wet or snowy weather on mountain passes. When wind pushes moist air up steep hills or mountains, such as the Sierra Nevada Range, precipitation occurs. The steep rise in the topography blocks air flow and forces air masses upward; this is known as orographic lifting. Orographic lifting wrings moisture out of the air on the windward slope of the mountain, leaving dry air to descend along the leeward side of the mountain range. The area in the lee of a mountain range, where precipitation is blocked, is known as the rain shadow.

Nevada's weather and climate are both varied and extreme. These include extremes in temperature, amount of precipitation, and wind. The area covered by this EA receives around an average annual precipitation of 9.3 inches. For temperature, the average annual high is 63°F, and the average annual low is 29°F. While any individual flood, heatwave, or snowstorm is a weather event, the fact that they occur, and their frequency are aspects of Nevada's climate (Ormerod and McAfee 2017).

Around 94% of Nevadans live in a community impacted by unhealthy air. The biggest problem with regards to air pollution in Nevada is ozone (O_3). Ozone is formed from the chemicals which are emitted from vehicle exhausts and combine with other substances under the strong ultra-violet light. Tailpipe emissions and extreme heat drive up ozone pollution, while prolonged drought conditions and other impacts from climate change, such as historic Western wildfires, contribute to particle pollution (American Lung Association 2021).

4. Socioeconomic Issues

Rangelands are essential to western livestock producers providing forage for a variety of domestic animals. Economic values of rangelands also include energy production sites, both fossil and renewable, and recreation sites. Two important distinctions are between market and non-market values, and between use and non-use values. Market values are associated with goods and services sold directly in a marketplace (e.g., livestock); market prices are therefore a good estimate value. Non-market values arise from goods and services that are not directly sold in a marketplace (e.g., ecosystem services). Similarly, use values arise from goods that are physically used (now or in the future), such as forage for livestock (market value) or outdoor recreation (usually a non-market value). Non-use values arise from goods that are never physically used. Non-use values, for example, include the concept of "existence value" (i.e., the value people place on simply knowing something, such as an unspoiled wilderness area, exists). Non-use values are often unrelated to any market good, but are real economic values nonetheless. Non-market and non-use values are difficult to estimate; therefore, most economic injury level estimates only consider market values and, in most cases, only the single market value for the commodity (e.g., forage) being damaged. In the case of rangeland, there are a large suite of values, both market and non-market, and use and non-use, that can be affected by pests, such as grasshoppers (Rashford et al., 2012).

Recreation use is moderate over most of the affected area. There are several dispersed camping sites. Hunting seasons increase recreation use in the form of dispersed camping and general hunting activity. Hunting season occurs later in the year during a time when grasshopper populations have begun to dwindle, so hunters probably would not be affected. ATV use is fairly prevalent throughout. The presence of high densities of grasshoppers would result in fewer people engaging in recreational activities during the spring and summer within the affected areas. High grasshopper densities in the campsite detract considerably from the quality of the recreational experience as grasshoppers tend to get into unsecured tents and food. The quality of the recreational experience for ATV users and horseback riders would also be indirectly impaired by high densities of grasshoppers. Large quantities of grasshoppers crossing roads and trails are killed by vehicle traffic, leaving windrows of dead grasshoppers in the travel way as well as providing a vehicular safety hazard by leaving slick residues on local roads. People who normally recreate in areas that are heavily infested would likely relocate then to areas that are not infested. Displacement of users would be more of an inconvenience to the public than an actual effect on the recreational values of the area. Displacement would also increase pressure on other public lands as people move to new locations to camp and to engage in other recreational activities. Social capacity tolerances would be impacted and the potential for user conflict would increase, in particular as motorized recreationists displace to other already heavily used areas. Such locations would experience more pressure and may experience site degradation. Areas currently not impacted or used by dispersed campers may become subject to use and development as people look for areas for recreation which are not infested with grasshoppers. Small towns near the affected areas receive limited business from recreationists who visit public lands. Many local gas stations and public stores rely heavily on summer business to support their operations. Most of the aforementioned issues apply to the towns and cities within northern Nevada as large numbers of Mormon crickets have covered streets and neighborhoods. In the past, large cricket numbers have caused property damage to homes and businesses. Years of consecutive outbreaks harm the usually strong tourism industry for affected cities and towns since visitors do not want to deal with swarms of grasshoppers or crickets. The city of Elko has had problems with attracting doctors to work at the Northeastern Nevada Regional Hospital because of the heavy outbreaks in recent years.

Photo 3. 2023: Mormon Crickets Swarm Northeastern Nevada Regional Hospital in Elko. Credit: Elko Daily Free Press

A substantial threat to the animal productivity of these rangeland areas is the proliferation of grasshopper populations. These insects have been serious pests in the western states since early settlement. Weather conditions favoring the hatching and survival of large numbers of grasshoppers can cause outbreak populations, resulting in damage to vegetation. The consequences may reduce grazing for livestock and result in loss of food and habitat for wildlife. Livestock grazing on public lands contributes important cultural and social values to the area. Intertwined with the economic aspects of livestock operations are the lifestyles and culture that have co-evolved with western ranching. Rural and social values and lifestyles, in conjunction with the long heritage of ranching and farming continue to this day, dating back to the earliest pioneers in Nevada, who shaped the communities and enterprises that make up much of Nevada. The rural western lifestyle also contributes to tourism in the area, presenting to travelers a flavor of the west through tourist-oriented goods and services, photography of sheep bands or cattle in pastoral settings and scheduled events.

Ranchers displaced from public lands due to early loss of forage from grasshopper damage would be forced to search for other rangeland, to sell their livestock prematurely or to purchase feed hay. This would affect other ranchers (non-permittees) by increasing demand, and consequently, cost for hay and pasture in the area. Recently in Nevada, hay bales have been destroyed by ravens picking out baled Mormon crickets, leading ranchers to purchase replacement hay. This has had a beneficial effect on those providing the hay or range, and a negative impact on other ranchers who use these same resources throughout the area. In addition, grazing on private lands resulting from this impact would compound the effects to vegetation of recently drought conditions over the last four years (e.g.., continual heavy utilization by grasshoppers, wildlife and wildfire), resulting in longer-term impacts (e.g., decline or loss of some preferred forage species) on grazing forage production on these lands. The lack of treatment would result in the eventual magnification of grasshopper problems resulting in increased suppression efforts, increased suppression costs and the expansion of suppression needs onto lands where such operations are limited. For example, control needs on crop lands where chemical options are restricted because of pesticide label restrictions. Under the no action alternative, farmers would experience economic losses. Contributing to the economic losses is the fact that outbreak numbers of crickets are known to clog and damage irrigation equipment along with other farm equipment, costing these operations thousands of dollars in repairs and replacements. The suppression of grasshoppers in the affected area would have beneficial economic impacts to local landowners, farmers, and beekeepers. Crops near infested lands would be protected from devastating migrating hordes, resulting in higher crop production; hence, increased monetary returns.

Photo 4, 2024. Hay bale damage from Ravens eating baled Mormon crickets in Fallon, NV   Photo Credit: Jack Spencer, WS

5. Cultural Resources and Events

Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," calls for agency communication and collaboration with tribal officials when proposed Federal actions have potential tribal implications. The Archaeological Resources Protection Act of 1979 (16 U.S.C. §§ 470aa-mm), secures the protection of archaeological resources and sites on public and tribal lands.

Prior to the treatment season, program personnel notify Tribal land managers of the potential for grasshopper and Mormon cricket outbreaks on their lands. Consultation with local Tribal representatives takes place prior to treatment programs to inform fully the Tribes of possible actions APHIS may take on Tribal lands. Treatments typically do not occur at cultural sites, and drift from a program treatment at such locations is not expected to adversely affect natural surfaces, such as rock formations and carvings. APHIS would also confer with the appropriate Tribal authority to ensure that the timing and location of a planned program treatment does not coincide or conflict with cultural events or observances on Tribal lands.

Federal actions must seek to avoid, minimize, and mitigate potential negative impacts to cultural and historic resources as part of compliance with the National Historic Preservation Act (NHPA), the Archaeological Resources Protection Act of 1979, and NEPA. Section 106 of the NHPA requires Federal agencies to provide the Advisory Council on Historic Preservation with an opportunity to comment on their findings.

Federal and public lands that are part of the Region's visual and cultural resources include the Humboldt-Toiyabe National Forest, Great Basin National Park Desert National Wildlife Refuge, and numerous wilderness study areas administered by the BLM in the proposed suppression program area (III.B).

A broad variety and number of activities have occurred, are occurring or would occur throughout the area of concern that affects cultural resources. These activities and any cumulative impacts associated with them would occur regardless of whether or not grasshoppers are treated.

Use of motorized equipment off existing roads could impact surface artifacts by damaging them or displacing them in their overall juxtaposition with other artifacts. Maintaining the integrity of a historical site is important to understanding the significance of the site and the artifacts found therein. Non-treatment of infested land would likely later result in more intensive and extensive treatment of that infested land. Most of the non-public lands that would be affected have already been heavily disturbed and any artifacts on them likely impacted. Consequently, it is unlikely that additional carbaryl bait treatments would result in additional impacts on cultural properties.

With no treatment of grasshoppers on public lands, aerial application of insecticides off public lands would likely increase. However, most if not all of the areas likely to be treated have been heavily disturbed in the past, and any artifacts on them likely impacted. Consequently, it is unlikely that these aerial treatments would result in additional impacts on cultural properties.

Motorized vehicles (pick-up trucks and/or ATV's) may be used to treat portions of the affected areas. This would create a risk of impacting cultural properties. The risk is small given that the off-road use of vehicles would create only minor soil disturbance, and the areas involved are not likely to contain significant sites of which public officials are not already aware. Known sites would be avoided to mitigate impacts. Any sites located during treatment activities would be reported and avoided during continuing operations. Past similar grasshopper treatments throughout the state have not resulted in any known impacts to cultural properties.

In addition to the treatments proposed under this alternative, a broad variety and number of activities throughout the project area could affect, or have affected, cultural resources. These activities and any cumulative impacts associated with them would occur, regardless of whether or not grasshoppers are treated. No direct, indirect or change in cumulative impacts on cultural resources in the area would occur due to implementation of the treatment alternative.

To ensure that historical or cultural sites, monuments, buildings or artifacts of special concern are not adversely affected by program treatments, APHIS would confer with BLM, Forest Service or other appropriate land management agency or cultural resource specialists on a local level to protect these areas of special concern. APHIS also would confer with the appropriate tribal authority and with the BIA office at a local level to ensure that the timing and location of planned program treatments do not coincide or conflict with cultural events or observances, such as sundances, on tribal lands.

6. Special Considerations for Certain Populations

a. Executive Order No. 13045, Protection of Children from Environmental Health

Risks and Safety Risks

The increased scientific knowledge about the environmental health risks and safety risks associated with hazardous substance exposures to children and recognition of these issues in Congress and Federal agencies brought about legislation and other requirements to protect the health and safety of children. On April 21, 1997, President Clinton signed E.O. 13045, Protection of Children From Environmental Health Risks and Safety Risks (62 FR 19885). This E.O. requires each Federal agency, consistent with its mission, to identify and assess environmental health risks and safety risks that may disproportionately affect children and to ensure that its policies, programs, activities, and standards address those risks. APHIS has developed agency guidance for its programs to follow to ensure the protection of children (USDA, APHIS, 1999).

Treatments used for grasshopper programs are primarily conducted on open rangelands where children would not be expected to be present during treatment or enter during the restricted entry period after treatment. Based on the 2019 review of the three insecticides and their use in programs, the risk assessment concludes that the likelihood of children being exposed to insecticides from a grasshopper program is very slight and that no disproportionate adverse effects to children are anticipated over the negligible effects to the general population.

Impacts on children would be minimized by the implementation of the Treatment Guidelines:

Aerial Broadcast Applications of Liquid Insecticides

- Notify all residents in treatment areas, or their designated representatives, prior to proposed operations. Advise them of the control method to be used, the proposed method of application, and precautions to be taken (e.g., advise parents to keep children and pets indoors during ULV treatment). Refer to label recommendations related to restricted entry period.

- No treatments would occur over congested urban areas. For all flights over congested areas, the contractor must submit a plan to the appropriate FAA District Office and this office must approve of the plan; a letter of authorization signed by the city or town authorities must accompany each plan. Whenever possible, plan aerial ferrying and turnaround routes to avoid flights over congested areas, bodies of water, and other sensitive areas that are not to be treated.

Aerial Application of Dry Insecticidal Bait

- Do not apply within 500 feet of any school or recreational facility. Ultra-Low-Volume

Aerial Application of Liquid Insecticides

- Do not spray while school buses are operating in the treatment area.

- Do not apply within 500 feet of any school or recreational facility.

Based on the analysis in the protection measures, we have determined that there would likely be no significant impact within any potential treatment zone of the area of concern.

E. Environmental Consequences of the Alternatives

Each alternative described in this EA potentially has adverse environmental effects. The general environmental impacts of each alternative are discussed in detail in the 2002 and 2019 EIS. The specific impacts of the alternatives are highly dependent upon the particular action and location of infestation. The principal concerns associated with the alternatives are: (1) the potential effects of insecticides on human health (including subpopulations that might be at increased risk); and (2) impacts of insecticides on nontarget organisms (including threatened and endangered species).

APHIS has written human health and ecological risk assessments (HHERAs) to assess the insecticides and use patterns that are specific to the program. The risk assessments provide an in-depth technical analysis of the potential impacts of each insecticide to human health; and non-target fish and wildlife along with its environmental fate in soil, air, and water. The assessments rely on data required by the USEPA for pesticide product registrations, as well as peer-reviewed and other published literature. The HHERAs are heavily referenced in the EIS and this Draft EA. These Environmental Documents can be found at the following website: http://www.aphis.usda.gov/plant-health/grasshopper.

The program suppresses grasshopper populations on a small portion of the area considered by this EA in any given year. In those control treatment areas substantial portions are excluded from direct insecticide applications because of buffers around sensitive sites and the alternating spray and skip swaths inherent in the RAATs method. The potential harmful effects from the program activities on environmental components and nontarget species populations occur in a small portion of the area considered by this EA and for a limited duration. Site-specific environmental consequences of the alternatives are discussed below.

1. Alternative 1- No Suppression Program Alternative

a) Grasshopper Population Control

Under this alternative, APHIS would not conduct a program to suppress grasshoppers other than provide technical assistance and surveys to assist in the implementation of IPM strategies by land managers. When cultural or mechanical methods have failed to prevent harmful grasshopper populations Federal land management agencies, State agriculture departments, local governments, private groups or individuals, may not effectively combat outbreaks in a coordinated effort. Without the coordination that APHIS provides during grasshopper outbreaks, the land managers and owners could use insecticides that APHIS considers too environmentally harsh. Multiple treatments and excessive amount of insecticide could be applied in efforts to suppress or even locally eradicate grasshopper populations. There are approximately 100 pesticide products registered by USEPA for use on rangelands and against grasshoppers (Purdue University, 2018).

Without APHIS' coordination and funding of grasshopper suppression programs in Esmerelda, Lincoln, Nye, and White Pine counties, the responsibility would rest with the Bureau of Land Management (BLM), US Forest Service (FS), Nevada Department of Agriculture, and local governments and industry groups from places such as Elko, Winnemucca, and Battle Mountain to name a few. APHIS estimates more treatments would occur totaling possibly 300,000 acres per year. The most economical choice of pesticides available to the aforementioned entities would include diflubenzuron and carbaryl. The conventions of IPM APHIS have incorporated into our standard program procedures could be too burdensome for other agencies to observe. While the economic benefits of suppressing grasshoppers by using a RAATs method have been widely publicized, less frequent treatments by other agencies might encourage widespread complete coverage treatments to "eradicate" grasshopper populations. Adverse environmental effect particularly on nontarget species, could be much greater than under the APHIS led suppression program alternative due to lack of operational knowledge or coordination among the groups.

(1) Human Health

Human exposure and health risks could increase because of the inexperience of other agencies in planning, contracting and monitoring treatments. APHIS hygiene and safety protocols establish procedures for use of personal protection equipment and handling of hazardous chemicals. Other less experienced agencies might underestimate potential worker or bystander exposures, increasing health risks.

(2) Nontarget Species

Grasshopper treatment programs could occur with more random frequency as various agencies allocate funding when it is available. These programs would almost certainly not have the same procedures and safeguards incorporated into the APHIS program. The possibility of multiple agencies with overlapping jurisdictions could result in multiple treatments per year with the same or incompatible insecticides. This overlapping of treatments could cause synergistic chemical interactions and more severe effects to nontarget species. It is also unlikely the other agencies will be equally equipped as APHIS to incorporate guidance and species location information from USFWS. Therefore, adverse effects on protected species and their critical habitat could increase.

(3) Physical Environment Components

The potential grasshopper control conducted by third parties could result in increases and a greater variety of pesticide residues in the environment. As noted previously, APHIS can only speculate which agencies and landowners will decide to control grasshoppers and what chemicals will be used. The program has also established treatment restriction buffers around water bodies to protect those features from insecticide drift and runoff. The labels for all program insecticides prohibit direct application to water (defined as reservoirs, lakes, ponds, pools left by seasonal streams, springs, wetlands, and perennial streams and rivers). APHIS maintains the following additional buffers for water bodies that are not designated critical habitat for listed aquatic species: 500-foot buffer for aerial sprays, 200-foot buffer for ground sprays, and a 50-foot buffer for bait applications (USDA APHIS, 2013). Almost certainly land management agencies and property owners would not observe the same buffers to prevent accidental spray drift to sensitive environments.

(4) Socioeconomic Issues

In the absence of an APHIS administered grasshopper suppression program the cost of treatments would be paid entirely by land management agencies and landowners. Ranchers that lease land for grazing livestock might also have to pay third parties to protect rangeland forage from grasshopper outbreaks. These additional expenses would increase the cost of rangeland leases and production of livestock in general. Rural economies that depend on ranching and farming would experience increased economic hardship. The economic effects of infrequent and haphazard grasshopper treatments on rangeland forage could be similar to those described below for a scenario where no treatments occur.

(5) Cultural Resources and Events

The potential grasshopper control conducted by third parties might or might not be coordinated with Tribes and other cultural or historical observance events. It is reasonable to assume Tribal interests would ensure grasshopper treatments would not interfere with events or occur in areas of cultural significance.

(6) Special Considerations for Certain Populations

Grasshopper suppression programs are likely to occur in the same rural rangeland areas that are largely uninhabited. No matter who conducts the treatments, disproportionately high and adverse human health or environmental impacts on minority and low-income communities, Tribes, and historical and culturally sensitive sites in a program area are unlikely.

Likewise, potential grasshopper control programs would be conducted in rural rangeland areas, where agriculture is a primary industry. These areas consist of widely scattered, single, rural dwellings in ranching communities with low population density. The other agencies and landowners might notify residents within treatment areas to reduce the potential for incidental exposure to residents including children. None the less, treatments would occur on open rangelands where children would not be expected to be present during treatment or to enter should there be any restricted entry period after treatment. The APHIS grasshopper program also implements mitigation measures beyond label requirements to ensure that no treatments occur within the required buffer zones from structures, such as a 500-foot treatment buffer zone from schools and recreational areas. Also, program insecticides are not applied while school buses are operating in the treatment area (USDA APHIS, 2016). There is a reasonable expectation that treatments conducted by third parties would also avoid spraying chemicals where children are present or congregate.

b) No Grasshopper Population Control

Conversely, in the absence of an APHIS funded grasshopper suppression program the most likely environmental effects would result from other agencies and land managers not controlling outbreaks. As noted, grasshoppers consuming vast amounts of vegetation in rangelands and surrounding areas. Grasshoppers are generalist feeders, eating grasses and forbs first and often moving to cultivated crops. High grasshopper density of one or several species and the resulting defoliation may reach an economic threshold where the damage caused by grasshoppers exceeds the cost of controlling the grasshoppers. Researchers determined that during typical grasshopper infestation years, approximately 20% of forage on western rangeland is removed, valued at an estimated cost of $1.2 billion per year (Hewitt & Onsager, 1983; dollar amount adjusted). This value represents 32 to 63% of the total value of rangeland across the western states (Rashford et al., 2012). Other market and non-market values such as carbon sequestration, general ecosystem services, and recreational use may also be impacted by grasshopper outbreaks in rangeland.

(1) Human Health

The risk of accidental exposure to insecticides would be reduced if no grasshopper control programs are implemented by APHIS or third parties. Grasshopper outbreaks could cause other health hazards including increased dust storms and road hazards.

(2) Nontarget Species

Vegetation damage during serious grasshopper outbreaks may be so severe that all grasses and forbs are destroyed causing impaired plant growth for several years. Rare plants may be consumed during critical times of their development such as during seed production, and loss of important plant species, or seed production may lead to reduced biological diversity of the rangeland habitats, potentially creating opportunities for the expansion of invasive and exotic weeds (Lockwood and Latchininsky, 2000). Rangeland herbivorous wildlife would have to migrate or suffer food shortages caused by the loss of forage.

(3) Physical Environment Components

When grasshoppers consume plant cover, soil is more susceptible to the drying effects of the sun, making plant roots less capable of holding soil in place. Soil damage results in erosion and disruption of nutrient cycling, water infiltration, seed germination, and other ecological processes which are important components of rangeland ecosystems (Latchininsky et al., 2011). A reduction vegetation will make steep rangeland topography more susceptible to erosion which would cause additional sediment loading in streams, rivers, and other water bodies. This would result in a decrease in water quality. Likewise, the denuded rangeland caused by poor grasshopper control would have less evapotranspiration, lower humidity, and higher daily temperature ranges. During windstorms the dry soil would be more likely to allow soil particles to become airborne and result in poor air quality and possibly health and other physical hazards to humans.

(4) Socioeconomic Issues

When the density of grasshoppers reaches economic injury levels, grasshoppers begin to compete with livestock for food by reducing available forage (Wakeland and Shull, 1936; Belovsky, 2000; Pfadt, 2002; Branson et al., 2006; Bradshaw et al., 2018). Ranchers could offset some of the costs by leasing rangeland in another area and relocating their livestock, finding other means to feed their animals by purchasing hay or grain, or selling their livestock. Local communities and families with ranching based incomes could see adverse economic impacts. Grasshoppers that infest rangeland could move to surrounding croplands. Crop agriculture farmers could incur economic losses from attempts to chemically control grasshopper populations or due to the loss of their crops. The general public could see an increase in the cost of meat, crops, and other agricultural products.

(5) Cultural Resources and Events

The lack of grasshopper treatments would reduce the possibility of accidental spraying by third parties of cultural resources and during activities observing cultural or historically significant events. Grasshopper outbreak populations could reduce recreational and cultural uses of rangeland. Uncontrolled grasshopper populations would make these effects more severe.

(6) Special Considerations for Certain Populations

The risk of accidental human exposure to insecticides would be reduced if no grasshopper control programs are implemented by APHIS or third parties.

As previously noted, the general public could see an increase in the cost of meat, crops, and other agricultural products. Low-income populations would suffer greater relative economic hardship from this increase in food prices, especially where grocery shopping choices are limited by longer travel between small rural villages. Likewise, the cost of food staples for families with children could increase.

2. Alternative 2- Insecticide Applications at Conventional Rates or Reduced Agent Area Treatments with Adaptive Management Strategy

Under Alternative 2, APHIS would participate in grasshopper programs with the option of using one of the insecticides carbaryl or diflubenzuron, depending upon the various factors related to the grasshopper outbreak and the site-specific characteristics. The use of an insecticide would typically occur at half the conventional application rates across the treatment area following the RAATs strategy. APHIS would apply a single treatment per treatment season to affected rangeland areas to suppress grasshopper outbreak populations by a range of 35 to 98 percent, depending upon the insecticide used.

a) Carbaryl

Carbaryl is a member of the N-methyl carbamate class of insecticides, which affect the nervous system via cholinesterase inhibition. Inhibiting the enzyme acetylcholinesterase (AChE) causes nervous system signals to persist longer than normal. While these effects are desired in controlling insects, they can have undesirable impacts to non-target organisms that are exposed.

(1) Human Health

Carbaryl can cause cholinesterase inhibition (i.e., overstimulate the nervous system) in humans resulting in nausea, headaches, dizziness, anxiety, and mental confusion, as well as convulsions, coma, and respiratory depression at high levels of exposure (NIH, 2009a; Beauvais, 2014). USEPA classifies carbaryl as “likely to be carcinogenic to humans” based on vascular tumors in mice (USEPA, 2007, 2015a, 2017).

USEPA regulates the amount of pesticide residues that can remain in or on food or feed commodities as the result of a pesticide application. The agency does this by setting a tolerance, which is the maximum residue level of a pesticide, usually measured in parts per million (ppm), that can legally be present in food or feed. USEPA-registered carbaryl products used by the grasshopper program are labeled with rates and treatment intervals that are meant to protect livestock and keep chemical residues in cattle at acceptable levels (thereby protecting human health). While livestock and horses may graze on rangeland the same day that the land is sprayed, in order to keep tolerances to acceptable levels, carbaryl spray applications on rangeland are limited to half a pound active ingredient per acre per year (USEPA, 2012a). The grasshopper program would treat at or below use rates that appear on the label, as well as follow all appropriate label mitigations, which would ensure residues are below the tolerance levels.

Adverse human health effects from the proposed program ULV applications of the carbaryl spray (Sevin® XLR Plus) and bait applications of the carbaryl 5% and 2% baits formulations to control grasshoppers are not expected based on low potential for human exposure to carbaryl and the favorable environmental fate and effects data. Technical grade (approximately 100% of the insecticide product is composed of the active ingredient) carbaryl exhibits moderate acute oral toxicity in rats, low acute dermal toxicity in rabbits, and very low acute inhalation toxicity in rats. Technical carbaryl is not a primary eye or skin irritant in rabbits and is not a dermal sensitization in guinea pig (USEPA, 2007). This data can be extrapolated and applied to humans revealing low health risks associated with carbaryl.

The Sevin® XLR Plus formulation, which contains a lower percent of the active ingredient than the technical grade formulation, is less toxic via the oral route, but is a mild irritant to eyes and skin. The proposed use of carbaryl as a ULV spray or a bait, use of RAATs, and adherence to label requirements, substantially reduces the potential for exposure to humans. Program workers are the most likely human population to be exposed. APHIS does not expect adverse health risks to workers based on low potential for exposure to liquid carbaryl when applied according to label directions and use of personal protective equipment (e.g., long-sleeved shirt and long pants, shoes plus socks, chemical-resistant gloves, and chemical-resistant apron) (USEPA, 2012a) during loading and applications. APHIS quantified the potential health risks associated with accidental worker exposure to carbaryl during mixing, loading, and applications. The quantitative risk evaluation results indicate no concerns for adverse health risk for program workers (http://www.aphis.usda.gov/plant-health/grasshopper).

Adherence to label requirements and additional program measures designed to reduce exposure to workers and the public (e.g., mitigations to protect water sources, mitigations to limit spray drift, and restricted-entry intervals) result in low health risk to all human population segments.

(2) Nontarget Species

The APHIS HHERA assessed available laboratory studies regarding the toxicity of carbaryl on fish and wildlife. In summary, the document indicates the chemical is highly toxic to insects, including native bees, honeybees, and aquatic insects; slightly to highly toxic to fish; highly to very highly toxic to most aquatic crustaceans, moderately toxic to mammals, minimally toxic to birds; moderately to highly toxic to several terrestrial arthropod predators; and slightly to highly toxic to larval amphibians (USDA APHIS, 2019a). However, adherence to label requirements and additional program measures designed to prevent carbaryl from reaching sensitive habitats or mitigate exposure of non-target organisms will reduce environmental effects of treatments.

Acute and chronic risks to mammals are expected to be low to moderate based on the available toxicity data and conservative assumptions that were used to evaluate risk. There is the potential for impacts to small mammal populations that rely on terrestrial invertebrates for food. However, based on the toxicity data for terrestrial plants, minimal risks of indirect effects are expected to mammals that rely on plant material for food. Carbaryl has a reported half-life on vegetation of three to ten days, suggesting mammal exposure would be short-term. Direct risks to mammals from carbaryl bait applications is expected to be minimal based on oral, dermal, and inhalation studies (USDA APHIS, 2019a).

A number of studies have reported no effects on bird populations in areas treated with carbaryl (Buckner et al., 1973; Richmond et al., 1979; McEwen et al., 1996). Some applications of formulated carbaryl were found to cause depressed AChE levels (Zinkl et al., 1977); however, the doses were twice those proposed for the full coverage application in the grasshopper program.

Several field studies that assist in determining impacts of carbaryl on aquatic invertebrates and fish have been published (Relyea and Diecks, 2008; USDA FS, 2008a; NMFS, 2009) and are summarized in the 2019 EIS. The value of these studies is limited because they all had dosing levels or frequencies that are much higher than would occur in the grasshopper program.

While sublethal effects have been noted in fish with depressed AChE, as well as some impacts to amphibians (i.e. days to metamorphosis) and aquatic invertebrates in the field due to carbaryl, the application rates and measured aquatic residues observed in these studies are well above values that would be expected from current program operations. Indirect risks to amphibian and fish species can occur through the loss of habitat or reduction in prey, yet data suggests that carbaryl risk to aquatic plants that may serve as habitat, or food, for fish and aquatic invertebrates is very low.

The majority of rangeland plants require insect-mediated pollination. Native, solitary bee species are important pollinators on western rangeland (Tepedino, 1979). Potential negative effects of insecticides on pollinators are of concern because a decrease in their numbers has been associated with a decline in fruit and seed production of plants.

Research from Gao et al. found that chronic exposure to Carbaryl led to several negative effects on adult bees including impacts on nesting performance, foraging ability and gut microbial community. The researchers posited the no observed adverse effect concentration (NOAEC) of the chronic toxicity test of carbaryl (5 mg/L) to *A. mellifera* larvae were much higher than the field-realistic levels as well as the residual levels detected in bee products. They designed this study to expand the risk assessment to the chronic effects of carbaryl on the transcriptional and metabolic level of *A. mellifera* larvae at the concentration where no adverse reactions were observed.

Stock solution of carbaryl was prepared by dissolving the powder in acetone and then diluted with normal components of bee diet (50% royal jelly, 2% yeast extract, 9% d-glucose, 9% d-fructose). The final concentration of 2 mg/L carbaryl was applied to the third instar larvae for four days and correspond to the no observed adverse effect concentration (NOAEC) determined in a previous study from the researchers (Yang et.al. 2019). However, they noted the carbaryl concentration on developing larvae was 48 times the maximum residual value in nectar or honey.

Carbaryl exposure at the NOAEC disrupted the transcriptional and metabolic regulatory networks of bees, even though no adverse physiological effects were observed in exposed larvae. Metabolome analysis showed that carbaryl treatment led to reduction of amino acids, accumulation of nucleic acid components, and disturbed flavonoids and fatty acids in exposed larvae which would suggest that chronic exposure to carbaryl might change internal metabolism in bee larvae (Gao et al., 2022).

Research from Novotny et al. found that pesticides that are traditionally considered contact-based and applied when flowers are unopened can reach pollen and nectar and produce measurable risk to bees. The persistence of some agrochemicals in leaves, pollen, and nectar up to a week following application merits consideration when managing pollinator-dependent crops. Novotny et al. analyzed residues of three insecticides (carbaryl, lambda-cyhalothrin, permethrin) and three fungicides (chlorothalonil, quinoxyfen, triflumizole) in pumpkin leaves, pollen, and nectar collected from five farms in the north-central United States, one day before a spray event, and one, three, and seven days after. Bees foraging on pumpkin flowers were collected one day before and one day after spraying and screened for the same pesticides. Chemical concentrations and application rates were decided by the farmer based on what a typical schedule would look like. The pumpkin seeds had a systemic treatment containing three fungicides and the neonicotinoid insecticide thiamethoxam.

The octanol-water partition coefficient ($logK_{ow}$) is the relative concentration of a chemical in n-octanol versus water at pH 7, 20°C. Higher values of $logK_{ow}$ indicate greater lipophilicity (and a lower affinity for water). Since carbaryl has a $logK_{ow}$ value of 2.36 the chemical is less likely to adsorb and accumulate in lipid-rich plant tissues such as cuticular waxes or pollen. A chemical's ionizability is given as pK_a, the pH at which a chemical is 50% ionized, or in equilibrium between its undissociated and ionized state (calculated as the negative base-10 logarithm of the acid dissociation constant at 25°C). Chemicals with $pK_a < 7$ are most likely to reach vascular tissue and mobilize systemically throughout the plant. A 'neutral' pK_a indicates the chemical does not ionize under relevant plant conditions. Carbaryl does not offer systemic insecticidal protection because the chemical has a pK_a of 10.4. However, carbaryl has a molecular weight of 201.2 g/mol well below 800 g/mol, the molecular weight typical of chemicals that are able to penetrate plant cuticles (University of Hertfordshire Agriculture and Environment Research Unit. Pesticide properties database (PPDB). 2024. [Cited 1 March 2024]. Available from: http://sitem.herts.ac.uk).

The researchers found foliar insecticide and fungicide spray residues were detected more frequently and in greater concentrations in pumpkin leaves than in pollen, nectar, or foraging bees and insecticide concentrations in leaves often exceeded levels of concern. However, the risk indices used to examine pollinator exposure against the levels of concern assume that a foraging bee would actually come into contact with all the chemical present on or in the leaf sample.

Carbaryl applied to foliage was present in some plant pollen and nectar samples, and in two or the 69 bee samples (male *X. pruinosa*) collected one day after a spraying event. The researchers noted the bees that tested positive (male squash bees) have life history traits that bring them into prolonged contact with sprayed crop plants. Typically, either the proportion of contaminated samples or the maximum concentration of insecticides in pumpkin tissues decreased over the week following foliar application. For example, one day after application of carbaryl spray 43% of nectar samples tested positive for the insecticide, but carbaryl was not present in nectar samples collected one week later. However, the pretreatment data suggested carbaryl residues can persist longer than a week in leaves and pollen.

Carbaryl has only moderate lipophilicity ($logK_{ow} = 2.4$), giving it more potential to mobilize vascularly and be incorporated into developing floral tissue. Consistent with this reasoning, the researchers recorded a five-fold increase in carbaryl concentrations in pollen from the first to the third day after treatment. Carbaryl has a low molecular weight and is a very weak acid. Therefore, the chemical can cross membranes and bind with compounds in plant cells with similar pH before it reaches phloem. These properties contribute to its persistence in leaves, instead of translocation to pollen and nectar that bees eat. However, this persistence prolongs pollinator risk of exposure. The high concentrations of carbaryl in leaves during the week after foliar spray led to the highest bee risk quotient values. As previously noted, the assessments may overestimate bee toxicity from leaf contact because they assume a bee receives the entire dose of chemical present in the leaf sample (Novotny et al., 2024).

Researchers analyzed persistence of pesticides in agroecosystems in the Emilia-Romagna region of northern Italy (Bogo et al. 2024). They investigated pesticide residue in beebread by analyzing 100 samples collected in 25 BeeNet national monitoring project stations in March and June of 2021 and 2022. They looked at the diversity and concentration of the chemicals, their correlation with land use, and the risk they posed to the bees. They calculated a toxicity-weighted concentration (TWC) of chemicals by computing the ratio between the measured concentration in beebread and the oral acute toxicity (LD50) of that chemical for bees. For risk evaluation a risk threshold was assigned by dividing the TWC by an order of magnitude to account for chemical degradation, harmful synergistic interaction with other chemicals and chronic exposure causing sublethal effects. The risk threshold was exceeded in four beebread samples out of 100; one for carbaryl, fipronil, imidacloprid and thiamethoxam (Bogo et al. 2024).

Research from Nogrado et al. investigated the effect of carbaryl pesticides on gut microbiota of honey bees, which had come in contact with rapeseed plants (*Brassica napus*) sprayed with carbaryl wettable powder. Honey bee colonies were placed in tunnels covering an area of 70 meters squared and containing *Brassica napus*. Negative controls were sprayed with tap water (400 L/ha), while the experiments were sprayed with carbaryl (250 g a.i./ha in 400 L tap water/ha) during active flight of bees. Bees were collected from the negative control and the carbaryl-treated groups, after 2 h of exposure. The unexposed bees harbored *Alphaproteobacteria*, which were absent in the exposed bees. Microorganisms found in honey bee guts such as *Snodgrassella alvi* and *L. kullabergensis*, however, were observed only in the exposed bees, but not in the unexposed bees. The difference between the two groups was distinctly recognized when copy numbers of 16S rRNA genes were compared by quantitative PCR. The researchers noted they could not conclude decisively that the differences in the composition of the gut microbial communities from the two groups can be attributed directly to the pesticide exposure. However other researchers (Raymann et al. 2017) have suggested that one difference between a healthy colony and a colony suffering from colony collapse disorder can be a decrease in *Alphaproteobacteria* in gut bacterial communities. Lastly, there were other bacteria that are not commonly found in the gut microbiota of honey bees could have been acquired from the environment and could be considered as opportunistic pathogens. These uncategorized bacteria were observed in more abundance in the exposed group as compared to the unexposed group. *Klebsiella* was only observed in the unexposed group, while *Cronobacter, Edwardsiella, Providencia, Serratia, Erwinia,* and *Pantoea* were observed in the exposed group. The researchers suggested the uncategorized bacteria could probably be indicative of disruption of balance of gut microbiome or disease as mentioned in previous studies in relation to dysbiosis in the presence of a potential cause like chemicals.

The researchers noted the analysis could measure endpoints of sublethal effects, but there is considerable uncertainty in how to relate to adverse effects. Furthermore, there is insufficient data to establish plausible adverse outcome pathways with consistent and reproducible linkages between molecular initiating events and key events across multiple levels of biological organization to an adverse effect at the whole organism or colony or population level (Nogrado et al. 2019).

Laboratory studies have indicated that bees are sensitive to carbaryl applications, but the studies were at rates above those proposed in the program. The reduced rates of carbaryl used in the program and the implementation of application buffers should significantly reduce exposure of pollinators to carbaryl treatments for grasshopper suppression. In areas of direct application where impacts may occur, alternating swaths and reduced rates (i.e., RAATs) would reduce risk. Potential negative effects of grasshopper program insecticides on bee populations may also be mitigated by the more common use of carbaryl baits than the ULV spray formulation. Studies with carbaryl bran bait have found no sublethal effects on adults or larvae bees (Peach et al., 1994, 1995). The reduced rates of carbaryl used in the program and the implementation of application buffers should significantly reduce exposure of pollinators to carbaryl treatments for grasshopper suppression. In areas of direct application where impacts may occur, alternating swaths and reduced rates (i.e., RAATs) would reduce risk. The effects on pollinators resulting from control of rangeland grasshopper populations with carbaryl based insecticides are not expected to cause significant impacts to the human environment.

(3) Physical Environment Components

Temperature, pH, light, oxygen, and the presence of microorganisms and organic material are factors that contribute to how quickly carbaryl will degrade in water. Hydrolysis, the breaking of a chemical bond with water, is the primary degradation pathway for carbaryl at pH 7 and above. In natural water, carbaryl is expected to degrade faster than in laboratory settings due to the presence of microorganisms. The half-lives of carbaryl in natural waters varied between 0.3 to 4.7 days (Stanley and Trial, 1980; Bonderenko et al., 2004). Degradation in the latter study was temperature dependent with shorter half-lives at higher temperatures. Aerobic aquatic metabolism of carbaryl reported half-life ranged of 4.9 to 8.3 days compared to anaerobic (without oxygen) aquatic metabolism range of 15.3 to 72 days (Thomson and Strachan, 1981; USEPA, 2003). Carbaryl's degradation in aerobic soil varies from rapid to slow with half-lives ranging from 4 to 253 days (USEPA, 2017). Half-lives decrease with increasing pH from acidic to alkaline conditions. Under anaerobic soil conditions, carbaryl has a half-life of 72 days. Little transport of carbaryl through runoff or leaching to groundwater is expected due to the low water solubility, moderate sorption, and rapid degradation in soils. There are no reports of carbaryl detection in groundwater, and less than 1% of granule carbaryl applied to a sloping plot was detected in runoff (Caro et al., 1974).

Product use restrictions appear on the USEPA-approved label and attempt to keep carbaryl out of waterways. Carbaryl must not be applied directly to water, or to areas where surface water is present (USEPA, 2012a). The USEPA-approved use rates and patterns and the additional mitigations imposed by the grasshopper program, such as using RAATs and application buffers, where applicable, further minimize aquatic exposure and risk.

It is unlikely that carbaryl will significantly vaporize from the soil, water, or treated surfaces (Dobroski et al., 1985). Carbaryl may be found in the atmosphere within air-borne particulates or as spray drift and can react with hydroxyl radicals in the ambient atmosphere (Kao, 1994). Once in the air, carbaryl has a half-life of 1 to 4 months, however these minute amounts of carbaryl are not expected to reduce air quality. Carbaryl hydrolysis occurs quickly in natural waters with pH values of 7 or above, and the presence of microorganisms and organic material also contribute to the rapid degradation of the chemical. Adverse effects resulting from carbaryl contamination of water resources would harm aquatic organisms (described above) and would be temporary or de minimis.

(4) Socioeconomic Issues

In addition to the environmental baseline conditions, APHIS also considers other factors such as pest population, pest life stage, pest and plant species affected, cost share with State and private landowners, and the cost benefit analysis of making a treatment. Because of the cost sharing private landowners and land managers typically would only use carbaryl to suppress rangeland grasshoppers and preserve forage for livestock. Insecticides applied using the RAATs strategy is expected to provide further economic advantages due to effective treatment at reduced costs. The economics of the RAATs strategy has been studied by both Foster et al. (2000), and Lockwood and Schell (1997). In summarizing both studies (which used various rates of insecticide below the conventional rates for suppression of rangeland grasshoppers and treated less area), the results concluded that treatment costs, under this alternative, when compared to the costs for conventional treatments for rangeland grasshopper infestations, were reduced 57 to 66% with carbaryl.

Another potential economic benefit of chemical treatment of grasshoppers is to crop growers near rangelands. Carbaryl bait treatments are sometimes used to reduce the potential for rangeland grasshoppers to move to surrounding croplands. This would result in socioeconomic benefits because losses, and therefore costs, of meat, crops, and their byproducts should be reduced. Additionally, the suppressed grasshopper populations in rangeland surrounding croplands could mean less of a need for costly chemical treatments by crop farmers at these sites.

There is the potential for organic farms adjacent to carbaryl spray applications in rangeland to control grasshopper outbreak populations. However, mitigations such as buffers are meant to protect adjacent environments from runoff and insecticide drift. These protective measures are expected to protect nearby organic farms, as well as other areas of concern, from the risk of inadvertent exposure to rangeland insecticide treatments. It is also likely the organic farms would also benefit economically from reductions in crop damage caused by grasshopper populations migrating from nearby rangeland.

The suppression of grasshopper populations with carbaryl should benefit public uses rangelands for recreational activities such as camping, fishing, hiking, and biking. The public may temporarily lose the use of rangeland during and directly after carbaryl insecticide applications. However, the preservation of vegetation is expected to benefit recreational activities in the long-term by preserving their aesthetic value. This in turn will also increase the economic value of the rangeland by preserving and improving recreational opportunities.

(5) Cultural Resources and Events

There is the potential for impacts to cultural and historical resources if the proposed carbaryl treatments occur on or near historic trails or properties. If any proposed actions are at, or adjacent to, the site of a historic trail or property, APHIS will consult with the appropriate landowner or land management agency, the State Historic Preservation Office, any affected National Trail's administrative office, or other appropriate agencies. Likewise, APHIS would coordinate the timing of treatments with Tribes or other cooperators to ensure carbaryl treatments would not occur during scheduled cultural events or ceremonies.

(6) Special Considerations for Certain Populations

APHIS uses carbaryl insecticide treatments to suppress grasshopper populations in rural rangeland areas that are largely uninhabited. Disproportionately high and adverse human health or environmental impacts on minority and low-income communities, Tribes, and historical and culturally sensitive sites in a program area are unlikely.

APHIS grasshopper insecticide treatments are conducted in rural rangeland areas, where agriculture is a primary industry. The areas consist of widely scattered, single, rural dwellings in ranching communities with low population density. The program notifies residents within treatment areas, or their designated representatives, prior to proposed operations to reduce the potential for incidental exposure to residents including children. Treatments are conducted primarily on open rangelands where children would not be expected to be present during treatment or to enter should there be any restricted entry period after treatment. The program also implements mitigation measures beyond label requirements to ensure that no treatments occur within the required buffer zones from structures, such as a 500-foot treatment buffer zone from schools and recreational areas. Also, program insecticides are not applied while school buses are operating in the treatment area (USDA APHIS, 2016).

APHIS' HHERA for carbaryl evaluated the potential exposure to each insecticide used in the program and risks associated with these insecticides to residents, including children. The HHERA suggest that no disproportionate risks to children, as part of the general public, are anticipated (USDA APHIS, 2019a).

b) Diflubenzuron

Diflubenzuron is a restricted use pesticide (only certified applicators or persons under their direct supervision may make applications) registered with USEPA as an insect growth regulator. It specifically interferes with chitin synthesis, the formation of the insect's exoskeleton. Larvae of affected insects are unable to molt properly. While this effect is desirable in controlling certain insects, it can have undesirable impacts to non-target organisms that are exposed.

(1) Human Health

Adverse human health effects from ground or aerial ULV applications of diflubenzuron to control grasshoppers are not expected based on the chemical's low acute toxicity and low potential for human exposure. Diflubenzuron has low acute dermal toxicity in rabbits and very low acute oral and inhalation toxicities in rats (USEPA, 2015b). The adverse health effects of diflubenzuron to mammals and humans involves damage to hemoglobin in blood and the transport of oxygen. Diflubenzuron causes the formation of methemoglobin. Methemoglobin is a form of hemoglobin that is not able to transport oxygen (USDA FS, 2004). USEPA classifies diflubenzuron as non-carcinogenic to humans (USEPA, 2015b).

The proposed use of diflubenzuron and adherence to label requirements substantially reduces the potential for exposure to humans and the environment. Program workers are the most likely to be exposed by program applications of diflubenzuron. APHIS does not expect adverse health risks to workers based on low potential for exposure to diflubenzuron when applied according to label directions and use of personal protective equipment (PPE) during applications (e.g., long sleeve shirt and pants, chemical-resistant gloves). APHIS quantified the potential risks associated with accidental exposure of diflubenzuron for workers during mixing, loading, and application based on proposed program uses. The quantitative risk evaluation results indicate no concerns for adverse health risk for program workers (USDA APHIS, 2019c).

Dimilin® 2L is labeled with rates and treatment intervals that are meant to protect livestock and keep residues in cattle at acceptable levels (thereby, protecting human health). Tolerances are set for the amount of diflubenzuron that is allowed in cattle fat (0.05 ppm) and meat (0.05 ppm) (40 CFR Parts 180.377). The grasshopper program would treat at application rates indicated on product labels or lower, which should ensure approved residues levels.

Adverse health risk to the general public in treatment areas is not expected due to the low potential for exposure resulting from low population density in the treatment areas, adherence to label requirements, program measures designed to reduce exposure to the public, and low toxicity to mammals. APHIS treatments are conducted in rural rangeland areas consisting of widely scattered, single, rural dwellings in ranching communities, where agriculture is a primary industry. Applications are not made to farm buildings or homes. Program measures beyond those on the label require application buffers from structures as well as aquatic areas reducing the potential for exposure to the public from direct exposure due to drift and from drinking water sources. The quantitative risk evaluation results indicate no concerns for adverse health risk for humans (USDA APHIS, 2019c).

(2) Nontarget Species

APHIS' literature review found that on an acute basis, diflubenzuron is considered toxic to some aquatic invertebrates and practically non-toxic to adult honeybees. However, diflubenzuron is toxic to larval honeybees (USEPA, 2018). It is slightly nontoxic to practically nontoxic to fish and birds and has very slight acute oral toxicity to mammals, with the most sensitive endpoint from exposure being methemoglobinemia. Minimal direct risk to amphibians and reptiles is expected, although there is some uncertainty due to lack of information (USDA APHIS, 2019b; USEPA, 2018).

In a review of mammalian field studies, Dimilin® applications at a rate of 60 to 280 g a.i./ha had no effects on the abundance and reproduction in voles, field mice, and shrews (USDA FS, 2004). These rates are approximately three to 16 times greater than the highest application rate proposed in the program. Potential indirect impacts from application of diflubenzuron on small mammals includes loss of habitat or food items. Mice on treated plots consumed fewer lepidopteran (order of insects that includes butterflies and moths) larvae compared to controls; however, the total amount of food consumed did not differ between treated and untreated plots. Body measurements, weight, and fat content in mice collected from treated and non-treated areas did not differ.

Poisoning of insectivorous birds by diflubenzuron after spraying in orchards at labeled rates is unlikely due to low toxicity (Muzzarelli, 1986). The primary concern for bird species is related to an indirect effect on insectivorous species from a decrease in insect prey. At the proposed application rates, grasshoppers have the highest risk of being impacted while other taxa have a greatly reduced risk because the lack of effects seen in multiple field studies on other taxa of invertebrates at use rates much higher than those proposed for the program. Shifting diets in insectivorous birds in response to prey densities is not uncommon in undisturbed areas (Rosenberg et al., 1982; Cooper et al., 1990; Sample et al., 1993).

Indirect risk to fish species can be defined as a loss of habitat or prey base that provides food and shelter for fish populations; however these impacts are not expected based on the available fish and invertebrate toxicity data (USDA APHIS, 2019b). A review of several aquatic field studies demonstrated that when effects were observed it was at diflubenzuron levels not expected from program activities (Fischer and Hall, 1992; USEPA, 1997; Eisler, 2000; USDA FS, 2004).

Diflubenzuron applications have the potential to affect chitin production in various other beneficial terrestrial invertebrates. Multiple field studies in a variety of application settings, including grasshopper control, have been conducted regarding the impacts of diflubenzuron to terrestrial invertebrates. Based on the available data, sensitivity of terrestrial invertebrates to diflubenzuron is highly variable depending on which group of insects and which life stages are being exposed. Immature grasshoppers, beetle larvae, lepidopteran larvae, and chewing herbivorous insects appear to be more susceptible to diflubenzuron than other invertebrates. Within this group, however, grasshoppers appear to be more sensitive to the proposed use rates for the program. Honeybees, parasitic wasps, predatory insects, and sucking insects show greater tolerance to diflubenzuron exposure (Murphy et al., 1994; Eisler, 2000; USDA FS, 2004).

Diflubenzuron is moderately toxic to spiders and mites (USDA APHIS, 2019b). Deakle and Bradley (1982) measured the effects of four diflubenzuron applications on predators of *Heliothis* spp. at a rate of 0.06 lb a.i./ac and found no effects on several predator groups. This supported earlier studies by Keever et al. (1977) that demonstrated no effects on the arthropod predator community after multiple applications of diflubenzuron in cotton fields. Grasshopper integrated pest management (IPM) field studies have shown diflubenzuron to have a minimal impact on ants, spiders, predatory beetles, and scavenger beetles. There was no significant reduction in populations of these species from seven to 76 days after treatment. Although ant populations exhibited declines of up to 50 percent, these reductions were temporary, and population recovery was described as immediate (Catangui et al., 1996).

Due to its mode of action, diflubenzuron has greater activity on immature stages of terrestrial invertebrates. Based on standardized laboratory testing diflubenzuron is considered practically non-toxic to adult honeybees. The contact LD50 value for the honeybee, *Apis mellifera*, is reported at greater than 114.8 µg a.i./bee while the oral LD50 value was reported at greater than 30 µg a.i./bee. USEPA (2018) reports diflubenzuron toxicity values to adult honeybees are typically greater than the highest test concentration using the end-use product or technical active ingredient. The lack of toxicity to honeybees, as well as other bees, in laboratory studies has been confirmed in additional studies (Nation et al., 1986; Chandel and Gupta, 1992; Mommaerts et al., 2006). Mommaerts et al. (2006) and Thompson et al. (2005) documented sublethal effects on reproduction-related endpoints for the bumble bee, *Bombus terrestris* and *A. mellifera*, respectively, testing a formulation of diflubenzuron. However, these effects were observed at much higher use rates relative to those used in the program.

For example, in the Mommaerts et al. study researchers exposed bees via a contact application of 288 mg/L aqueous concentration which was topically applied to the dorsal thorax of each worker with a micropipette. Bumblebees also ingested orally sugar/water treated with the same concentration of diflubenzuron solution over a period of 11 weeks. Pollen was sprayed with the same concentration of diflubenzuron until saturation and then supplied to the nests. The bumble bees were not restricted in how much of these contaminated solutions they could consume. The researchers estimated mean LC50 concentrations based on the chronic exposure routes described above. These were 25 mg a.i/L dermal contact, 0.32 mg a.i/L ingested sugar-water, and 0.95 mg a.i/L pollen. The researchers noted, “In practice, bumblebees will rarely be exposed to such high concentrations,” and elaborated, “it is necessary that the laboratory-based results are validated with risk assessments for these insecticides in field related conditions.”

APHIS believes conversion and comparison of program applied foliar spray rates to the concentrations of the solutions applied in this study would rely on unrealistic exposure scenarios. An exposure scenario where pollinators are exposed continuously for 11-weeks is not expected to occur in the APHIS grasshopper and Mormon cricket suppression program. In field applications diflubenzuron levels would decline over the 11-week exposure period due to degradation, flowering plants that have diflubenzuron residues would no longer be available for foraging by pollinators as flowers naturally die and do not provide pollen and nectar, and other plants would bloom after application without residues of diflubenzuron.

Diflubenzuron has been associated with several potentially harmful effects on bees, even when mortality was not recorded. Research from Camp et al. used Eastern bumble bee (*Bombus impatiens*) as surrogates to measure the effect that diflubenzuron has on bee behavior. Diflubenzuron (0.1, 1, 10, 100, 1,000 µg/liter) was formulated as an emulsion of the sugar syrup with 0.5% (v/v) Honey-B-Healthy and 1% (v/v) acetone and was delivered in syrup feeders. Drone production was reduced in a concentration-dependent manner and the 42-d IC50 (half-maximal inhibitory concentration) was calculated by Camp et al. to be 28.61 µg/liter diflubenzuron. They found that diflubenzuron delivered via dietary exposure of sucrose was associated with decreased pollen consumption and decreased drone production in bumble bee without there being a significant increase in adult mortalities (Camp et al., 2020).

However, the tested solutions of diflubenzuron in the supplied syrup and pollen are greater than the range of the pesticide applied during grasshopper suppression treatments. Diflubenzuron is applied once per year to foliar vegetation and only a miniscule proportion would be to flowers with nectar and pollen. In this experiment the bumble bees were fed syrup and pollen with fresh doses of diflubenzuron three times per week. The same difficulty of applying this study’s findings to real field exposures, as is also the case with Mommaerts et.al., 2006, is described above.

Research from Krueger et al. showed that while diflubenzuron exposure didn’t impact bumble bee worker survival, the exposure did result in a significant decrease in drone emergence that is indicative of a greater sensitivity to diflubenzuron in the immature life stage. Microcolonies exposed to 10 mg diflubenzuron/kg pollen (i.e. the pollen was contaminated with 10 parts per million of diflubenzuron) produced fewer adult drones despite no effects on worker survival (Krueger et al., 2021).

A researcher found that exposure to diflubenzuron in a 10 ppm sucrose solution resulted had significant effect on the number of larvae successfully eclosing from eggs three days after collection. The researcher posited that bee embryos with poorly formed cuticle could initiate egg eclosion and perhaps complete it, though the survivorship of the resultant larvae would likely be compromised. The results she reported for diflubenzuron suggest that the larval cuticle was not developed, resulting in mortality before or during the hatching process, and that many of the larvae observed to have hatched may not have survived to the later instar stages. Although the doses examined in this work may be high relative to what has been found inside of honey bee colonies, the exposure did not have an observable effect on egg production. However, successful hatching rates were significantly decreased in response to diflubenzuron, a chitin synthesis inhibitor (Fine 2020).

Further investigations examined two-generational effects to diflubenzuron administered at 1 ppm through the workers' diet, thus exposing queens indirectly in a manner similar to what might occur in the field (Fine et al., 2023). The researchers tracked queen performance and worker responses to queens, then the performance of the exposed queens' offspring was assessed to identify patterns that may contribute to the long-term health and stability of a social insect colony.

None of the treatments had a significant effect on the total number of eggs laid. Treated worker diets had no effect on retinue response. No differences were detected between treatment groups in the consumption of pollen supplement. Treatment had no effect on worker survival (Kaplan Meier, chi-squared = 3.1, $p = 0.5$), and over the two-week monitoring period, mortality rates remained below 3.2% on average across all groups. No difference was detected between treatment groups in queen weight change. Major royal jelly protein-1, MRJP-3, vitellogenin, and vitellogenin precursor proteins were among those quantified, but their abundances were not different with respect to the control queens. The researchers investigated global patterns of differential protein abundance between exposure groups and found no proteins in the diflubenzuron group were significantly altered.

Receiving care from maternally-exposed workers did not have an effect on the laying rates of new queens or their total eggs produced. Receiving care from maternally-exposed workers did not affect the egg hatching rate of eggs laid by new queens or rate of adult eclosions relative to controls. Treatment also had no effect on worker pollen consumption, queen weight change, or weight at adult eclosion. However, treatment had a significant effect on the timing of adult eclosion. Maternal exposure to diflubenzuron and methoxyfenozide resulted in significantly longer average time to adult eclosion relative to maternal exposure to pyriproxyfen or the control group. Maternal pesticide treatment had no effect on worker survival and over the two week monitoring period, mortality rates remained below 1.7% on average across all groups, and no queen death was observed.

Researchers examined synergistic toxicity of common insecticides and fungicides in California almond orchards. Synergistic toxicity is the toxicity of a chemical combination that is greater than that predicted from studies of isolated chemical constituents. Young worker larvae were fed diets contaminated with 2.28 µg diflubenzuron per larva and a fungicidal dose to achieve comparable concentration ratios simulating a tank-mix at the maximum label rate. Diflubenzuron cause significantly reduced adult emergence as measured by larval mortality, but no synergistic effect was observed when combined with fungicides (Wade et al., 2019).

During June 2024 the USDA Agricultural Research Service (ARS) collected 58 plant tissue samples from flowers within a grasshopper treatment area in Prairie County, Montana. The samples were sent to the USDA Agricultural Marketing Service – National Science Laboratory for analysis to determine the concentration of diflubenzuron residue both 24 hours and 14 days after the application. Nine pretreatment flower tissue samples were accidentally collected before the insecticide application because of miscommunication between the PPQ program manager, the ARS field technician and the pilot. The program uses the RAATs method where spray and no-spray swaths are alternated. However, deposition of insecticide within the spray and no-spray swaths is variable because of changes in wind direction and speed, as well as the application height which is dictated by topography and other hazards. Of the 25 flower samples collected 24 hours after the treatment, 14 did not have detectable amounts of diflubenzuron, as was also the case with the nine pretreatment samples. The sample location coordinates, and applicator flight path software indicated only ten of these samples were collected in between spray swaths (i.e. within skip swaths). Laboratory analysis showed six samples collected within skip swaths, 24 hours after the aerial spray treatment had diflubenzuron residues. Of the 24 samples collected 14 days after the treatment, 16 did not have detectable amounts of diflubenzuron. Five of the eight samples that had diflubenzuron residues 14 days after treatment were collected in skip swaths.

Ten of the flower samples collected 24 hours after the treatment had measurable amounts of diflubenzuron that diminished in samples collected at the same location 14 days later. Laboratory analysis showed flower samples collected at five sample locations did not have detectable concentrations one day after the treatment, but did have diflubenzuron residues when samples were collected at the same or nearby locations 14 days later. Diflubenzuron residues on five flower samples collected immediately after treatment either did not attenuate significantly or had greater amounts of the chemical when more samples were collected at the same or adjacent locations 14 days later.

To assess risk to bees from contact with the rangeland flowers and leaves while collecting pollen and nectar after foliar diflubenzuron treatments we calculated the hazard quotient (HQ). The HQ was calculated as the average concentration of diflubenzuron residues detected on plant tissue for both the samples collected 24 hours and 14 days after the treatment divided by acute contact LD50 (Stoner and Eitzer 2013). Non-detection results were assigned a value of 0.099 parts per million (ppm), just below the limit of detection value of 0.100 ppm. Honey bee LD50 was used as LD50 was not consistently available for bumble and solitary bees.

HQ (24 hours) = 245 ppb (0.245 ppm) ÷ 114.8 µg diflubenzuron per bee = 2.134

HQ (14 days) = 159 ppb (0.159 ppm) ÷ 114.8 µg diflubenzuron per bee = 1.385

This analysis can be interpreted there is not a significant risk to bees using a common level of concern (LOC) of HQ > 50 (Thompson and Thorbahn 2009; Thompson 2021). Extrapolation to other pollinators by multiplying the HQ by an order of magnitude also did not indicate significant acute health risk from contact with the flowers with diflubenzuron residues.

In addition to HQ, we calculated contact Risk Quotient (RQcontact) using the BeeREX tool provided by the U.S. Environmental Protection Agency (EPA), which is intended for foliar sprays applied to crops in bloom. Risk quotient has the advantage over HQ of taking into account the amount of the contaminated substance consumed or encountered by a typical honey bee forager. The BeeREX RQcontact is calculated by comparing the chemical application rate, multiplied by a constant that represents the typical amount of chemical encountered by a honey bee forager if it flies through a cloud of spray, to the contact acute LD50. The BeeREX RQcontact index value for 1.0 fl.oz. Dimilin/acre (0.0078125 gal. X 2.0 lb. = 0.015625 lbs./acre) = 0.000367.

To interpret risk to bees from contact with the diflubenzuron residues on flowers and plant tissues collected by USDA, the acute RQcontact value is compared to a pre-determined level of concern set to 0.4, which and is based on the historic average dose response relationship for acute toxicity studies with bees and a 10% mortality level in foragers and worker larvae. Based on calculations in the BeeREX risk model the index value of 0.000367 does not represent a significant risk to honey bees or a likely risk to other bee pollinators (USEPA 2014). Extrapolation to other pollinators by multiplying the RQ by an order of magnitude also did not indicate significant acute health risk from contact with the diflubenzuron flowers.

Insecticide applications to rangelands have the potential to impact pollinators, and in turn, vegetation and various rangeland species that depend on pollinated vegetation. Based on the review of laboratory and field toxicity data for terrestrial invertebrates, applications of diflubenzuron are expected to have minimal risk to pollinators of terrestrial plants. The use of RAATs provide additional benefits by using reduced rates and creating untreated swaths within the spray block that will further reduce the potential risk to pollinators.

APHIS reduces the risk to native bees and pollinators through monitoring grasshopper and Mormon cricket populations and making pesticide applications in a manner that reduces the risk to this group of nontarget invertebrates. Monitoring grasshopper and Mormon cricket populations allows APHIS to determine if populations require treatment and to make treatments in a timely manner reducing pesticide use and emphasizing the use of program insecticides that are not broad spectrum. The treatment history of program since the introduction of diflubenzuron demonstrates it is the preferred insecticide. Over 90% of the acreage treated by the program has been with diflubenzuron. The effects on pollinators resulting from control of rangeland grasshopper populations with diflubenzuron are not expected to cause significant impacts to the human environment.

(3) Physical Environment Components

USEPA considers diflubenzuron relatively non-persistent and immobile under normal use conditions and stable to hydrolysis and photolysis. The chemical is considered unlikely to contaminate ground water or surface water (USEPA, 1997). The vapor pressure of diflubenzuron is relatively low, as is the Henry’s Law Constant value, suggesting the chemical will not volatilize readily into the atmosphere from soil, plants or water. Therefore, exposure from volatilization is expected to be minimal. Due to its low solubility (0.2 mg/L) and preferential binding to organic matter, diflubenzuron seldom persists more than a few days in water (Schaefer and Dupras, 1977). Mobility and leachability of diflubenzuron in soils is low, and residues are usually not detectable after seven days (Eisler, 2000). Aerobic aquatic half-life data in water and sediment was reported as 26.0 days (USEPA, 1997). Diflubenzuron applied to foliage remains adsorbed to leaf surfaces for several weeks with little or no absorption or translocation from plant surfaces (Eisler, 1992, 2000). Field dissipation studies in California citrus and Oregon apple orchards reported half-live values of 68.2 to 78 days (USEPA, 2018). Diflubenzuron persistence varies depending on site conditions and rangeland persistence is unfortunately not available. Diflubenzuron degradation is microbially mediated with soil aerobic half-lives much less than dissipation half-lives. Diflubenzuron treatments are expected to have minimal effects on terrestrial plants. Both laboratory and field studies demonstrate no effects using diflubenzuron over a range of application rates, and the direct risk to terrestrial plants is expected to be minimal (USDA APHIS, 2019c).

(4) Socioeconomic Issues

In addition to the environmental baseline conditions, APHIS also considers other factors such as pest population, pest life stage, pest and plant species affected, cost share with State and private landowners, and the cost benefit estimate of making a treatment. Because of the cost sharing private landowners and land managers typically would only use diflubenzuron to suppress rangeland grasshoppers and preserve forage for livestock. Insecticides applied using the RAATs strategy is expected to provide further economic advantages due to effective treatment at reduced costs. The RAATs strategy reduces treatment costs to half of the costs for conventional treatments for rangeland grasshopper infestations (Foster et al., 2000, Lockwood and Schell, 1997).

Another potential economic benefit of chemical treatment of grasshoppers is to crop growers near rangelands. This would result in socioeconomic benefits because losses, and therefore costs, of meat, crops, and their byproducts should be reduced. Additionally, the suppressed grasshopper populations in rangeland surrounding croplands could mean less of a need for costly chemical treatments by crop farmers at these sites.

There is the potential for organic farms adjacent to diflubenzuron treatments in rangeland to control grasshopper outbreak populations. However, mitigations such as buffers are meant to protect adjacent environments from runoff and insecticide drift. These protective measures are expected to protect nearby organic farms, as well as other areas of concern, from the risk of inadvertent exposure to rangeland insecticide treatments. It is also likely the organic farms would also benefit economically from reductions in crop damage caused by grasshopper populations migrating from nearby rangeland.

The suppression of grasshopper populations with diflubenzuron should benefit public uses rangelands for recreational activities such as camping, fishing, hiking, and biking. The public may temporarily lose the use of rangeland during and directly after diflubenzuron insecticide applications. However, the preservation of vegetation is expected to benefit recreational activities in the long-term by preserving their aesthetic value. This in turn will also increase the economic value of the rangeland by preserving and improving recreational opportunities.

(5) Cultural Resources and Events

There is the potential for impacts to cultural and historical resources if the proposed diflubenzuron treatments occur on or near historic trails or properties. If any proposed actions are at, or adjacent to, the site of a historic trail or property, APHIS will consult with the appropriate landowner or land management agency, the State Historic Preservation Office, any affected National Trail's administrative office, or other appropriate agencies. Likewise, APHIS would coordinate the timing of treatments with Tribes or other cooperators to ensure insecticide applications would not occur during scheduled cultural events or ceremonies.

(6) Special Considerations for Certain Populations

APHIS uses diflubenzuron insecticide treatments to suppress grasshopper populations in rural rangeland areas that are largely uninhabited. Disproportionately high and adverse human health or environmental impacts on minority and low-income communities, Tribes, and historical and culturally sensitive sites in a program area are unlikely.

APHIS grasshopper insecticide treatments are conducted in rural rangeland areas, where agriculture is a primary industry. The areas consist of widely scattered, single, rural dwellings in ranching communities with low population density. The program notifies residents within treatment areas, or their designated representatives, prior to proposed operations to reduce the potential for incidental exposure to residents including children. Treatments are conducted primarily on open rangelands where children would not be expected to be present during treatment or to enter should there be any restricted entry period after treatment. The program also implements mitigation measures beyond label requirements to ensure that no treatments occur within the required buffer zones from structures, such as a 500-foot treatment buffer zone from schools and recreational areas. Also, program insecticides are not applied while school buses are operating in the treatment area (USDA APHIS, 2016).

APHIS' HHERA for diflubenzuron evaluated the potential exposure to each insecticide used in the program and risks associated with these insecticides to residents, including children. The HHERA suggest that no disproportionate risks to children, as part of the general public, are anticipated (USDA APHIS, 2019b).

c) Reduced Area Agent Treatments (RAATs)

The use of RAATS is the most common application method for all program insecticides and would continue to be so, except in rare pest conditions that warrant full coverage and higher rates. The RAATs method is an effective IPM strategy because the goal is to suppress grasshopper populations to a desired level, rather than to reduce those populations to the greatest possible extent. All APHIS grasshopper treatments are conducted in adherence with U.S. EPA approved label directions. Labeled application rates for grasshopper control tend to be lower than rates used against other pests. The RAATs rates used for grasshopper control by APHIS are lower than rates typically used by private landowners. APHIS would apply a single application of insecticide per year, typically using a RAATs strategy that decreases the rate of insecticide applied by either using lower insecticide spray concentrations, or by alternating one or more treatment swaths. Usually, RAATs applications use both lower concentrations and skip treatment swaths. The RAATs strategy suppresses grasshoppers within treated swaths, while conserving grasshopper predators and parasites in swaths that are not treated.

The efficacy of a RAATs strategy in reducing grasshoppers is, therefore, less than conventional treatments and more variable. Foster et al. (2000) reported that grasshopper mortality using RAATs was reduced 2 to 15% from conventional treatments, depending on the insecticide, while Lockwood et al. (2000) reported 0 to 26% difference in mortality between conventional and RAATs methods. APHIS will consider the effects of not suppressing grasshoppers to the greatest extent possible as part of the treatment planning process.

(1) Human Health

The potential effects on human health during the application of pesticides using the RAATs method depends on the choice of insecticide. The possible exposure scenarios are described in detail in the above pesticide specific effects analysis. The minimal risk to program workers would not decrease because the mixing and formulation of the pesticide procedures would remain the same and are expected to prevent exposure. Any potential exposure of bystanders within treatment blocks would be reduced because of the lower application rates and skip swaths where insecticides are not applied.

(2) Nontarget Species

The potential effects on nontarget species during the application of pesticides using the RAATs method depends on the choice of insecticide. The possible environmental impacts are described in detail in the above pesticide specific effects analysis. Any exposure of nontarget species within treatment blocks would be reduced because of the lower application rates and skip swaths where insecticides are not applied. Therefore, the risk of significant impacts to populations of nontarget species would be less than if the program used conventional application rates and complete coverage of the treatment area.

(3) Physical Environment Components

The potential environmental effects of the application of pesticides using the RAATs method depends on the choice of insecticide. The expected fate of program applied chemicals, and possible environmental impacts are described in detail in the above pesticide specific effects analysis. The concentration of pesticide residues within treatment blocks would be reduced because of the lower application rates and skip swaths where insecticides are not applied. Therefore, the risk of significant impacts to air, soil and water resources would be less than if the program used conventional application rates and complete coverage of the treatment area.

(4) Socioeconomic Issues

RAATs reduces treatment costs and conserves non-target biological resources in untreated areas. The potential economic advantages of RAATs were proposed by Larsen and Foster (1996), and empirically demonstrated by Lockwood and Schell (1997). Widespread efforts to communicate the advantages of RAATs across the Western States were undertaken in 1998 and have continued on an annual basis. The viability of RAATs at an operational scale was initially demonstrated by Lockwood et al. (2000), and subsequently confirmed by Foster et al. (2000). The first government agencies to adopt RAATs in their grasshopper suppression programs were the Platte and Goshen County Weed and Pest Districts in Wyoming; they also funded research at the University of Wyoming to support the initial studies in 1995. This method is now commonly used by government agencies and private landowners in States where grasshopper control is required.

(5) Cultural Resources and Events

APHIS expects there is a negligible possibility of harm to cultural resources or disruption of events during grasshopper suppression operations because of our close cooperation with Tribes and other stakeholders. This would be the case regardless of whether the program used the RAATs method or conventional rates at complete coverage.

(6) Special Considerations for Certain Populations

APHIS uses the RAATs method to suppress grasshopper populations in rural rangeland areas that are largely uninhabited. Disproportionately high and adverse human health or environmental impacts on minority and low-income communities in a program area are unlikely. The potential effects on human health during the application of pesticides using the RAATs method depends on the choice of insecticide. The possible exposure scenarios are described in detail in the above pesticide specific effects analysis. Any potential exposure of children near or within treatment blocks would be reduced because of the lower application rates and skip swaths where insecticides are not applied.

IV. Conclusions

This EA examines alternatives available to APHIS when requested to suppress economically damaging outbreaks of grasshoppers. The preferred alternative includes insecticide treatments which are considered based on the site conditions. APHIS decides whether a suppression of the outbreak is warranted based on the IPM principles including an assessment of the economic injury level represented by the grasshopper populations. This EA discusses and examines the tools and strategies employed by APHIS and their potential effects on the human environment. This EA does not decide which alternative will be selected, however, all reasonable options available to the agency for dealing with grasshopper infestations have been adequately considered, including consideration of direct, indirect and cumulative environmental effects. Decisions about whether, how, and when to employ the tools and strategies discussed in the EA will be made as the need to suppress grasshopper populations at specific sites arises.

In June 2002, APHIS completed an EIS describing the agency's most effective methods of reducing the damage caused by grasshopper populations to rangeland in the western United States. During November 2019, APHIS published HHERA for the use of carbaryl, chlorantraniliprole, diflubenzuron and malathion by the program. APHIS also published an updated EIS to consolidate and incorporate the available data and analyze the environmental risk of new program tools. The risk analysis in the 2019 EIS is incorporated by reference (USDA APHIS, 2019).

This EA examined a No Action alternative, where APHIS would not conduct a program to suppress grasshoppers other than provide technical assistance and surveys to assist in the implementation of IPM strategies by land managers. Without an APHIS administered program Federal land management agencies, State agriculture departments, local governments, private groups or individuals, may not effectively combat outbreaks in a coordinated effort. Without the coordination that APHIS provides during grasshopper outbreaks, the land managers and owners could use insecticides that APHIS considers too environmentally harsh. Multiple treatments and excessive amount of insecticide could be applied in efforts to suppress or even locally eradicate grasshopper populations. Conversely, in the absence of an APHIS funded grasshopper suppression program the most likely environmental effects would result from other agencies and land managers not controlling outbreaks. As noted, grasshoppers consuming vast amounts of vegetation in rangelands and surrounding areas. Grasshoppers are generalist feeders, eating grasses and forbs first and often moving to cultivated crops.

Under the Preferred Alternative APHIS would participate in grasshopper programs with the option of using one of the insecticides carbaryl or diflubenzuron depending upon the various factors related to the grasshopper outbreak and the site-specific characteristics. The use of an insecticide would typically occur at half the conventional application rates following the RAATs strategy. APHIS would apply a single treatment per year to affected rangeland areas to suppress grasshopper outbreak populations.

Each alternative described in this EA potentially has adverse environmental effects. The general environmental impacts of each alternative are discussed in detail in the 2019 programmatic EIS published by APHIS. The specific impacts of the alternatives are highly dependent upon the particular action and location of the grasshopper infestation. The principal concerns associated with the alternatives are: (1) the potential effects of insecticides on human health (including subpopulations that might be at increased risk); and (2) impacts of insecticides on nontarget organisms (including threatened and endangered species).

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VI. Listing of Agencies and Persons Consulted

Nevada Department of Agriculture
Jeff Knight (State Entomologist)
405 South 21st St.
Sparks, NV 89431
Meghan Brown (Administrator: Division of Plant Health and Compliance)

4780 East Idaho Street
Elko, NV 89801

Nevada Department of Wildlife
Native Aquatic Species Coordinator*
1100 Valley Road
Reno, NV 89512

U.S. Fish and Wildlife Service
Nevada Fish and Wildlife Service
Justin Barret (Assistant Field Supervisor)
Kaylan Hager*
Andy Starostka (Fish Biologist)*
Tara Vogel *
Edward Koch*
Todd Gilmore*
1340 Financial Blvd. Suite 234
Reno, NV 89502

Bureau of Land Management
Michael McCampbell
5100 E Winnemucca Blvd,
Winnemucca, NV 89445
Kyle Martin
3900 E Idaho St
Elko, NV 89801
Kimberly Allison (State Office Range Management Specialist/Weeds Lead)
Quinn Young* (Monitoring Coordinator (AIM/HAF) and Weeds)
Mark Coca* (Vegetation Management Specialist)
1340 Financial Blvd.
Reno, NV 89502

US Forest Service
Dirk Netz (Forest Botanist/Invasive Plant Program Supervisor)*
Meagan Carter (Invasive Plant Program manager)*
Randall Sharp*
Humboldt-Toiyabe National Forest
1200 Franklin Way
Sparks, NV 89431

USDA APHIS PPQ
Ryan Vazquez (GHMC National Operations Manager)
Bill Wesela (GHMC National Policy Manager)
Jim Warren (Environmental protection Specialist)
Kai Caraher (Biological Scientist)
Charles Brown*
4700 River Road
Riverdale, MD 20737

Nevada Natural Heritage Program
Dept. of Conservation and Natural Resources
Eric S. Miskow
Biologist III/ Data Manager
901 South Stewart St., Suite 5002
Carson City, NV 89706-5245

**Indicates past consultation*

VII. Appendix A: APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program

FY – 2025 Treatment Guidelines

[A national program document, not specific to this site-specific EA provided for the program in Nevada.]

The objectives of the APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program are to 1) conduct surveys in the Western States; 2) provide technical assistance to land managers and private landowners; and 3) when funds permit, suppress economically damaging grasshopper and Mormon cricket outbreaks on Federal, Tribal, State, and/or private rangeland. The Plant Protection Act of 2000 provides APHIS the authority to take these actions.

General Guidelines for Grasshopper / Mormon Cricket Treatments

1. All treatments must be in accordance with:
   a) the Plant Protection Act of 2000;
   b) applicable environmental laws and policies such as: the National Environmental Policy Act, the Endangered Species Act, the Federal Insecticide, Fungicide, and Rodenticide Act, and the Clean Water Act (including National Pollutant Discharge Elimination System requirements – if applicable);
   c) applicable state laws;
   d) APHIS Directives pertaining to the proposed action;
   e) Memoranda of Understanding with other Federal agencies.

2. Subject to the availability of funds, upon request of the administering agency, the agriculture department of an affected State, or private landowners, APHIS, to protect rangeland, shall immediately treat Federal, Tribal, State, or private lands that are infested with grasshoppers or Mormon crickets at levels of economic infestation, unless APHIS determines that delaying treatment will not cause greater economic damage to adjacent owners of rangeland. In carrying out this section, APHIS shall work in conjunction with other Federal, State, Tribal, and private prevention, control, or suppression efforts to protect rangeland.

3. Prior to the treatment season, conduct meetings or provide guidance that allows for public participation in the decision-making process. In addition, notify Federal, State and Tribal land managers and private landowners of the potential for grasshopper and Mormon cricket outbreaks on their lands. Request that the land manager / landowner advise APHIS of any sensitive sites that may exist in the proposed treatment areas.

4. Consultation with local Tribal representatives will take place prior to treatment programs to fully inform the Tribes of possible actions APHIS may take on Tribal lands.

5. On APHIS run suppression programs and subject to funding availability, the Federal government will bear the cost of treatment up to 100 percent on Federal and Tribal Trust land, 50 percent of the cost on State land, and 33 percent of cost on private land. There is an additional 16.15% charge, however, on any funds received by APHIS for federal involvement with suppression treatments.

6. Land managers are responsible for the overall management of rangeland under their control to prevent or reduce the severity of grasshopper and Mormon cricket outbreaks. Land managers are encouraged to have implemented Integrated Pest Management Systems prior to requesting a treatment. In the absence

of available funding or in the place of APHIS funding, the Federal land management agency, Tribal authority or other party/ies may opt to reimburse APHIS for suppression treatments. Interagency agreements or reimbursement agreements must be completed prior to the start of treatments which will be charged thereto.

7. There are situations where APHIS may be requested to treat rangeland that also includes small areas where crops are being grown (typically less than 10 percent of the treatment area). In those situations, the crop owner pays the entire treatment costs on the croplands.

   NOTE: The insecticide being considered must be labeled for the included crop as well as rangeland and current Worker Protection Standards must be followed by the applicator and private landowner.

8. In some cases, rangeland treatments may be conducted by other federal agencies (e.g., Forest Service, Bureau of Land Management, or Bureau of Indian Affairs) or by non-federal entities (e.g., Grazing Association or County Pest District). APHIS may choose to assist these groups in a variety of ways, such as:
   a) loaning equipment (an agreement may be required):
   b) contributing in-kind services such as surveys to determine insect species, instars, and infestation levels;
   c) monitoring for effectiveness of the treatment;
   d) providing technical guidance.

9. In areas considered for treatment, State-registered beekeepers and organic producers shall be notified in advance of proposed treatments. If necessary, non-treated buffer zones can be established.

Operational Procedures

GENERAL PROCEDURES FOR ALL AERIAL AND GROUND APPLICATIONS

1. Follow all applicable Federal, Tribal, State, and local laws and regulations in conducting grasshopper and Mormon cricket suppression treatments.

2. Notify residents within treatment areas, or their designated representatives, prior to proposed operations. Advise them of the control method to be used, proposed method of application, and precautions to be taken.

3. One of the following insecticides that are labeled for rangeland use can be used for a suppression treatment of grasshoppers and Mormon crickets:
   A. Carbaryl
      a. solid bait
      b. ultra-low volume (ULV) spray
   B. Diflubenzuron ULV spray
   C. Malathion ULV spray
   D. Chlorantraniliprole spray

4. Do not apply insecticides directly to water bodies (defined herein as reservoirs, lakes, ponds, pools left by seasonal streams, springs, wetlands, and perennial streams and rivers).

   Furthermore, provide the following buffers for water bodies:

- 500-foot buffer with aerial liquid insecticide.
- 200-foot buffer with ground liquid insecticide.
- 200-foot buffer with aerial bait.
- 50-foot buffer with ground bait.

5. Instruct program personnel in the safe use of equipment, materials, and procedures; supervise to ensure safety procedures are properly followed.

6. Conduct mixing, loading, and unloading in an approved area where an accidental spill would not contaminate a water body.

7. Each aerial suppression program will have a Contracting Officer's Representative (COR) OR a Treatment Manager on site. Each State will have at least one COR available to assist the Contracting Officer (CO) in GH/MC aerial suppression programs.

   NOTE: A Treatment Manager is an individual that the COR has delegated authority to oversee the actual suppression treatment; someone who is on the treatment site and overseeing / coordinating the treatment and communicating with the COR. No specific training is required, but knowledge of the Aerial Application Manual and treatment experience is critical; attendance to the Aerial Applicators Workshop is very beneficial.

8. Each suppression program will conduct environmental monitoring as outlined in the current year's Environmental Monitoring Plan.

   APHIS will assess and monitor rangeland treatments for the efficacy of the treatment, to verify that a suppression treatment program has properly been implemented, and to assure that any environmentally sensitive sites are protected.

9. APHIS reporting requirements associated with grasshopper / Mormon cricket suppression treatments include:
   A. Completion of a post-treatment report (Part C of the Project Planning and Reporting Worksheet (PPQ Form 62)
   B. Providing an entry for each treatment in the PPQ Grasshopper/Mormon Cricket treatment database
   C. For aerial treatments, providing copies of forms and treatment/plane data for input into the Federal Aviation Interactive Reporting System (FAIRS) by PPQ's designee

SPECIFIC PROCEDURES FOR AERIAL APPLICATIONS

1. APHIS Aerial treatment contracts will adhere to the current year's Statement of Work (SOW).

2. Minimize the potential for drift and volatilization by not using ULV sprays when the following conditions exist in the spray area:

    a. Wind velocity exceeds 10 miles per hour (unless state law requires lower wind speed);
    b. Rain is falling or is imminent;
    c. Dew is present over large areas within the treatment block;
    d. There is air turbulence that could affect the spray deposition;
    e. Temperature inversions (ground temperature higher than air temperature) develop and deposition onto the ground is affected.

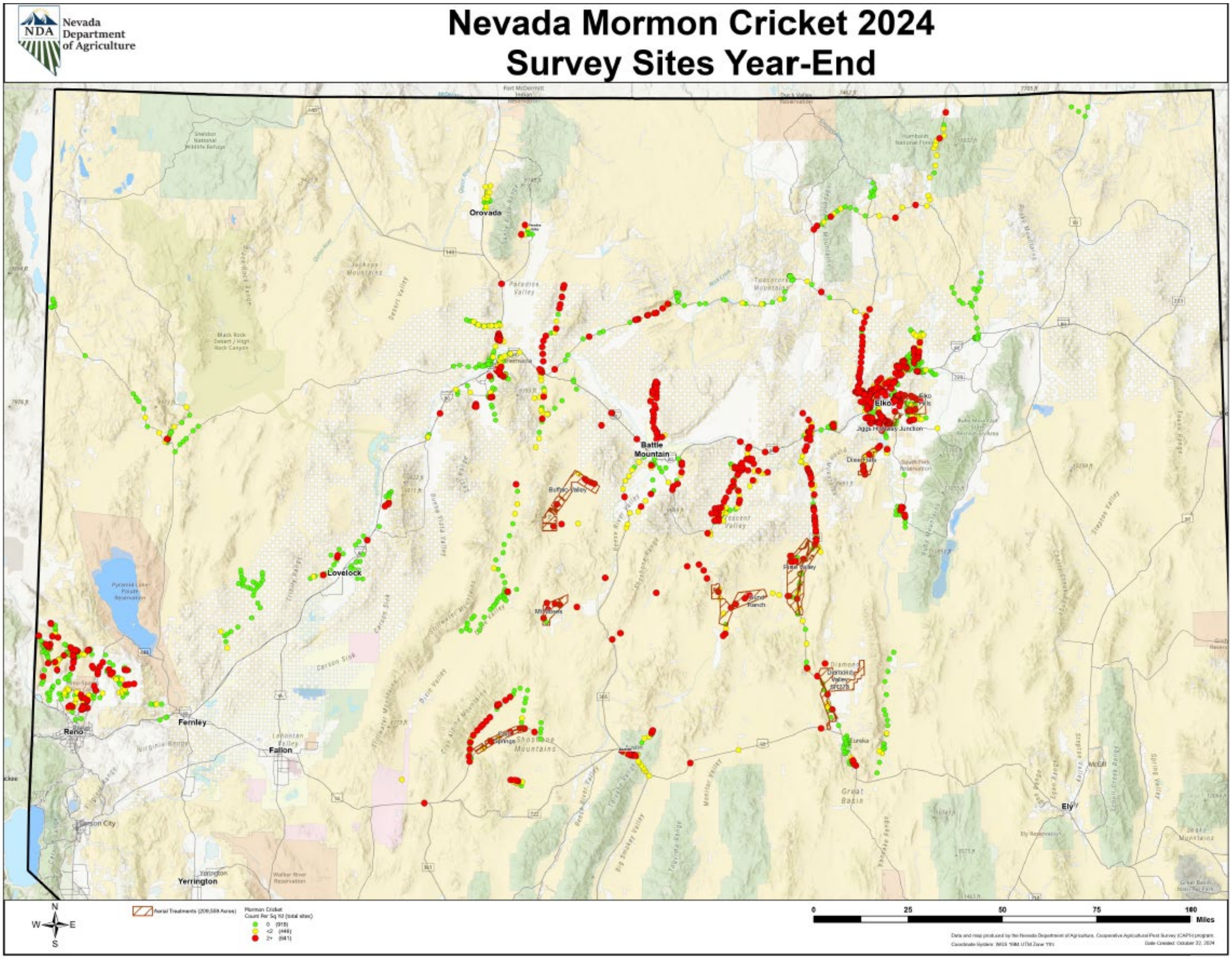
3. Weather conditions will be monitored and documented during application and treatment will be suspended when conditions could jeopardize the correct spray placement or pilot safety.

4. Application aircraft will fly at a median altitude of 1 to 1.5 times the wingspan of the aircraft whenever possible or as specified by the COR or the Treatment Manager.

5. Whenever possible, plan aerial ferrying and turnaround routes to avoid flights over congested areas, water bodies, and other sensitive areas that are not to be treated.

VIII. Appendix B: Map of the Affected Environment

2024 Mormon Cricket Survey Cumulative



Appendix C
USFWS Letter of Concurrence

United States Department of the Interior

FISH AND WILDLIFE SERVICE

5275 Leesburg Pike
MS-ES
Falls Church, Virginia 22041

In Reply Refer To:
FWS/AES/DER/BNC/080572
2024-0053674-S7

Tracy Willard
U.S. Department of Agriculture
Animal and Plant Health Inspection Service Policy
and Program Development
4700 River Road, Unit 149
Riverdale, Maryland 20737

Dear Ms. Willard:

This letter is in response to the United States Department of Agriculture-Animal and Plant Health Inspection Services (APHIS) December 13, 2023, request for concurrence on determinations of "may affect, not likely to adversely affect," (NLAA) federally listed, proposed and candidate species and designated and proposed critical habitats related to APHIS' proposal to conduct chemical treatments to suppress grasshopper infestations as part of the Rangeland Grasshopper and Mormon Cricket Suppression Program (Program) in 17 Western States. In their accompanying Biological Assessment for the APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program, December 2023, revised on January 23, 2024, APHIS uses a risk assessment approach to evaluate response data to characterize the potential hazard/risk of the use of three of four chemicals in the program to aquatic and terrestrial listed species and their habitat. APHIS is adopting the risk assessment and conservation measures from the 2022 U.S. Fish and Wildlife Service Biological Opinion for the reregistration of malathion, and thus, malathion is not considered further in their BA. The Service provides this response pursuant to section 7(a)(2) of the Endangered Species Act of 1973 (ESA), as amended.

APHIS has made a NLAA determination for their Proposed Action for 201 threatened and endangered species, 11 proposed species, 93 designated and 8 proposed critical habitats These species include 10 amphibians, 15 birds, 57 fishes, 31 invertebrates, 15 mammals, 78 plants, and 8 reptiles. A complete list of these species and critical habitats can be found in Enclosure A.

Description of the Proposed Action

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The intent of APHIS' Program is to reduce populations of various species of grasshoppers and Mormon crickets on rangeland in Arizona, California (partial), Colorado, Idaho, Kansas, Montana, Nebraska, Nevada (partial), New Mexico, North Dakota, Oklahoma (partial), Oregon (partial), South Dakota, Texas (partial), Utah, Washington (partial), and Wyoming. Chemical treatments include a seasonal one-time treatment of diflubenzuron, carbaryl, malathion, or chlorantraniliprole which can be applied from the ground or air. All four chemicals are applied at substantially reduced rates, compared to their recommended label uses, and are applied over an entire treatment area/spray block, or in alternating swaths within a treatment area/spray block. Decisions to conduct grasshopper treatments are based on many factors including the number of grasshoppers present in the area, grasshopper and plant species composition, life-cycle stage of the grasshoppers, range condition, the economic significance of the infestation, and whether it is economically and logistically feasible to conduct an effective program.

Toxicity data related to potential direct and indirect effects to listed species were compared to exposure estimates for diflubenzuron, carbaryl, and chlorantraniliprole to characterize risk to listed species and any designated critical habitat. APHIS reviewed the ecology of the listed species, including their distribution throughout the program action area, to determine whether a listed entity is found within the program treatment areas and, thus, would likely be exposed to any of the program chemicals.

Based on this review, APHIS identified listed species that could potentially occur in the program area, and then used results from the risk characterization for the three chemicals to develop program application buffers and other mitigation measures to avoid and/or minimize the potential for adverse impacts to listed species and their critical habitat (See Appendix A-9 of the BA or Enclosure B).

Best Management Practices (BMPs)

Surveys

Prior to any insecticide applications, APHIS conducts immature grasshopper surveys (i.e., nymphal surveys) in the spring and early summer (USDA, 2024). The number of grasshopper nymphs present within a given area are counted (USDA, 2024). Data gathered includes the stage of grasshopper development; location of sensitive areas such as bee yards and aquatic resources; the condition of the rangeland in relation to grasshopper numbers; and the extent of the infestation (USDA, 2024). This data is used for planning large-scale treatment programs and fiscal tracking, and for local decisions on treatments within a State (USDA, 2024).

Adult surveys occur in late summer and early fall (USDA, 2024). This survey is timed to coincide with the peak populations (USDA, 2024). Adult survey data are useful in predicting if and where potential grasshopper problems are likely to occur in the spring and early summer of the next growing season (USDA, 2024).

The survey data collected by the program is used by the agency and land managers/owners to assess whether treatments are warranted. Treatments must be requested from a Federal land management agency or a State agriculture department (on behalf of a State or local government, or private group or individual) that has jurisdiction over the land before APHIS can begin a treatment (USDA, 2024). Upon request, APHIS personnel conduct a site visit to determine whether APHIS action is warranted (USDA, 2024). Relevant factors influencing this decision may include, but are not limited to, the pest species, timing of treatment relative to the biological stage of the pest species, costs and benefits of conducting the action, and ecological impacts

(USDA, 2024). Based on survey results conducted during the growing season, APHIS is better able to predict the potential for large grasshopper populations and to respond quickly before extensive loss occurs to rangeland (USDA, 2024). Thus, State and Federal officials may initiate early coordination of local programs and request APHIS' assistance in a timely and effective cooperative effort (USDA, 2024).

Insecticide Application

When land managers request direct intervention, APHIS' role in the suppression of grasshoppers is through a single application of an insecticide—carbaryl, diflubenzuron, malathion, or chlorantraniliprole (USDA, 2024). All four insecticides are labeled by the U.S. Environmental Protection Agency, Office of Pesticide Programs (EPA–OPP) for rangeland use in the control of grasshoppers, including Mormon crickets (USDA, 2024). APHIS may conduct insecticide treatments in the above mentioned 17 states. With the exception of chlorantraniliprole, the remaining three insecticides are registered for use in all states considered in this program (USDA 2015).

Program insecticide applications can be applied in two different forms: liquid ultra-low-volume (ULV) sprays, or solid-based baits (USDA, 2024). Both ULV sprays and baits can be distributed by aerial or ground applications (USDA, 2024). Aerial applications are typical for treatments over large areas (USDA, 2024). Some grasshopper outbreak locations are economically or logistically accessible only by aircraft, while other locations may be best treated by ground applications (USDA, 2024). Ground applications are most likely to be made when treating localized grasshopper outbreaks or for treatments where the most precise placement of insecticide is desired (USDA, 2024).

Buffers and Conservation Measures

A reduced agent area treatment (RAATs) rate can be used for all four insecticides (USDA, 2024). This strategy uses insecticides at low rates combined with a reduction in the area treated for grasshopper suppression (USDA, 2024). The RAATs strategy relies on the effects of an insecticide to suppress grasshoppers within treated swaths, and the conservation of grasshopper predators and parasites in swaths not directly treated (untreated).

The Program has also established treatment restriction buffers around waterbodies to protect those features from insecticide drift and runoff (USDA, 2024). APHIS maintains the following buffers for water bodies that are not designated critical habitat for listed aquatic species: 500-foot buffer for aerial sprays, 200-foot buffer for ground sprays, and a 50-foot buffer for bait applications (USDA, 2024).

Application buffers as well as additional mitigation measures to protect listed species and their critical habitat have also been established for all four pesticides. Parameters specific to the given pesticide are used for inputs into the modeling program, AgDrift, to establish additional mitigation measure buffer distances for those areas where Program activities and listed species and their designated critical habitat are present (USDA, 2024). Specific buffer distances were established based on the integration of available effects and exposure data to characterize direct and indirect risk to listed species and their critical habitat (USDA, 2024). In addition to the standard spray buffers, conservation measures include additional measures for critical habitat PCEs, larger buffers for lekking sites (e.g., Greater sage-grouse), larger buffers for species (e.g., birds) that rely primarily on insects as food, and additional upstream buffers for fish. These additional conservation measures are described in Enclosure B

In addition to the chemical-specific application buffers, additional label and other requirements have been incorporated into the Program to reduce the potential exposure of threatened and endangered species and designated critical habitat to Program insecticide treatments:

- Avoid applications when sustained winds speeds exceed 10 miles per hour (mph).
- Use RAATs adjacent to locations of listed species and designated critical habitats.
- Avoid applications under conditions where a temperature inversion is possible or when a storm event is imminent.

The use of RAATs will be required for 500 feet from a ground application or 1,000 feet from an aerial application (USDA, 2024). This distance will be used from the location of a listed species, or its critical habitat when no application buffer is required, or from the distance beyond the no application buffer (USDA, 2024). Beyond these distances the program can choose to continue RAATs applications or use full applications depending on site-specific conditions and the need for greater efficacy (USDA, 2024).

The avoidance of applications during storm events is required to reduce the probability of off-site transport of program insecticides via runoff (USDA, 2024). Variability in weather patterns, even within small geographic areas, requires a site-specific evaluation of conditions by program personnel prior to application to determine if a rainfall or storm event would result in conditions where runoff to sensitive habitats could occur given site conditions and the proposed application buffers (USDA, 2024).

Exposure

Observed Residue Values from Program Applications

Monitoring data from drift cards collected from 2003 to 2022 was reviewed and compared to modeled data to determine if the drift assumptions were representative of the drift expected from the Program applications. Drift card data provides a standardized unit of measurement (mg/m^2) to compare with the outputs of terrestrial deposition estimates in AgDrift. The drift card comparisons are made primarily with diflubenzuron as this is the preferred active ingredient to be used for the Program activities, and thus, there are data to address the drift assumptions.
Aquatic residues from the monitoring data are also summarized but are not able to be compared to AgDrift outputs due to difficulties with quantifying the waterbody types, sizes, and flow regimes.

Modeling Estimates for all three pesticides using AgDrift

The aquatic residue values calculated using AgDrift were generated based on conservative assumptions and then compared to toxicity values. The parameters used in AgDrift are discussed in detail in the Drift Simulations section of the BA (p. 30). While drift card data residue values varied, generally the closer to the treatment site, the more residue was detected, but values ranged from < LOD (limit of detection) to 1.07 mg/m^2 overall. The average drift value estimated at 500 feet was 0.246 mg/m^2 which is greater than what is observed from most drift card data at 500 feet (drift card data from 2003 to 2022 at 500 feet ranged from < 0.015 – 0.29 mg/m^2 from both carbaryl and diflubenzuron applications; BA pp 26-30).

Run-off residues in waterbodies are considered minimal due to the reduced application rates and the large buffers in place as standard for all aquatic environments and are discussed in more detail in the Runoff Simulations section of the BA (p.32).

Residue Estimates for Terrestrial Non-Target Organisms

Estimated exposure levels on vegetation and other forage items for terrestrial species were calculated using the Terrestrial Residue Exposure Model (T-REX) developed by EPA (US EPA, 2012). More details on how this model was used and the parameters for the inputs are provided in the BA (p.34). Exposure concentrations for birds and mammals are based on mg/kg diet or mg/kg body weight. The resulting concentrations from the model estimates (for each insecticide) represent what would be expected from a direct application to the listed dietary item and are then used to determine residues for different mammals and birds based on their body size and food consumption. These values are then compared to the effects data toxicity endpoints.

AgDrift was then used to estimate the amount of drift reduction needed to arrive below the toxicity endpoint. The input parameters used for estimating the aquatic residues provided in Tables 2-1 and 2-2 of the BA were the same as those used for estimating drift reduction in terrestrial environments. APHIS developed the proposed buffers using these input parameters to determine removal of 99% of the off-site drift from the program applications that will be protective of listed species and their critical habitat as applicable.

Effects of the Action

Throughout this section we summarize or describe toxicity effects of the three chemicals used in the APHIS grasshopper/cricket suppression program. Toxicity is described for both aquatic and terrestrial species using U.S. EPA criteria based on concentrations of a particular chemical (practically non-toxic, slightly toxic, moderately toxic, highly toxic, very highly toxic; **Aquatic and Terrestrial Organism Criteria for Toxicity**). Where data were unavailable for certain taxonomic groups, surrogate species data are described with assumptions for use of those data where indicated.

For aquatic species, a range of toxicity values is provided for each taxa group to describe the potential effects observed from exposure to the three chemicals, carbaryl, chlorantraniliprole, and diflubenzuron. These values are then compared, in the risk section discussion, to the estimated concentrations from field monitoring data collected, as well as AgDrift modeled estimates.

For terrestrial species, toxicity is also described based on route of exposure (i.e., oral, contact, dermal) and either acute or chronic (i.e., reproductive or developmental). These values are then scaled based on the body weight of the test organism of focus and compared in the risk section discussion. APHIS uses a methodology used by the U.S. EPA (U.S. EPA Ecological Risk Assessment Methodology) to describe risk of exposure to different taxonomic groups of organisms from each of the three program chemicals. A Risk Quotient (RQ) is calculated by dividing a point estimate of exposure (residues on dietary items or thresholds for a given effect) by a point estimate of effect and compared to a level of concern (LOC). RQs <1 are not expected to result in adverse effects, while RQs >1 are expected to result in adverse effects.

For critical habitat, APHIS reviewed the primary constituent elements (PCEs) or physical and biological features (PBFs) to determine if the Program activities would cause destruction or adverse modification of these features.

In addition, the BA goes into detail to discuss the relevant toxicity of the metabolites that may be found in environmental matrices such as soil and water, for all three chemicals as well (see pages 20, 38, 49, 59 in the BA).

Carbaryl

The mode of action of carbamates occurs primarily through acetylcholinesterase (AChE) inhibition (Klaassen, Andur, & Doull, 1986), (Smith J. G., 1987). The AChE enzyme breaks down acetylcholine, a neurotransmitter that allows for the transfer of nerve impulses across nerve synapses. Carbamates have a reversible enzyme binding reaction in that the binding will decrease as the concentration decreases over time due to metabolism and excretion.

Aquatic Species

The 96-hour acute median lethal concentration for carbaryl for fish ranges from 0.14 mg/L for channel catfish (*Ictalurus punctatus*; (Brown, Anderson, Jones, Deuel, & Price, 1979) to 1,188 mg/L for the walking catfish (*Clarias batrachus*; (Chakrawarti & Chaurasia, 1981).

For chronic effects to fish, chronic NOEC concentrations for studies ranging from 32-35 day exposures, are 210, 650, and 445 µg/L for the fathead minnow, bonytail (a listed species considered for this consultation) and the Colorado pikeminnow (also a listed species considered in the consultation; (Beyers, Keefe, & Carlson, 1994), (Carlson, 1972), respectively.

For aquatic invertebrates, carbaryl is very highly toxic to all aquatic insects, and highly to very highly toxic to most aquatic crustaceans. The toxicity from 96-hour acute static tests ranged from 1.5 µg/L in the shrimp, *Paneaus aztecus*, to 22.7 mg/L in the mussel, *Mytilus edulis* (Mayer F. L., 1987), (US EPA, 2003). EC_{50}/LC_{50} values for crustaceans range from 5 to 9 µg/L (cladoceran, mysid), 8 to 25 µg/L (scud), and 500 to 2,500 µg/L (crayfish) (Peterson, et al., 1994). Aquatic insects have a similar range of sensitivity.

Chronic toxicity of carbaryl to aquatic invertebrates varies by taxa group. Reproductive and growth endpoints have been reported for cladocerans that range from 1.0 to 15 µg/L. A NOEC of 500 µg/L was reported for the chironomid midge (Hanazato, 1991), (USDA Forest Service, 2008), (US EPA, 2003).

For aquatic plants, a study testing the effects to the freshwater green algae, *Pseudokirchneriella subcapitata*, reported a EC_{50} and NOEC of 1.27 and 0.29 mg/L, respectively (USDA Forest Service, 2008). (Peterson, et al., 1994) found statistically significant effects at 3.7 mg/L on four algal species and the aquatic macrophyte, *Lemna minor* (duckweed). (Boonyawanich, et al., 2001) reported 96-hour EC_{50} values of 0.996, 0.785, and 0.334 g/L for three aquatic plants:

Ipomoea aquatica, *Pistia stratiotes*, and *Hydrocharis dubia* (water spinach, water lettuce, and frogbit), respectively.

Terrestrial Species

Carbaryl is moderate in toxicity when ingested by male and female rats. The oral LD_{50} in male and female rats is 302.6 mg/kg and 311.5 mg/kg, respectively (US EPA, 2003). Low doses can cause skin and eye irritation. The acute inhalation LD_{50} is 721 mg/kg. The acute dermal toxicity is low with an LD_{50} more than 4,000 mg/kg for rats and more than 5,000 mg/kg for rabbits (US EPA, 2003). For chronic data, USDA-APHIS provides a discussion on the 4-week dermal study, the two-generation reproduction study, and a prenatal developmental study in rats (and one in rabbits) on p. 49 in the BA, and also includes discussion on sub-lethal endpoints such as neurotoxicity, immunotoxicity, and carcinogenicity thereafter, which are standard toxicity testing endpoints for mammalian studies.

The acute oral LD_{50} of carbaryl to avian species ranges from 16 mg/kg to > 2,000 mg/kg for starlings (*Sturnis vulgaris*) and red-winged blackbirds (*Agelaius phoeniceus*) (Hudson, Tucker, & Haegele, 1984) and (Shafer, Bowles, & Hurlbut, 1983). Several toxicity studies evaluating sublethal effects have also been conducted. For a more in-depth discussion on these in the BA, see pages 52-53. Here we discuss the results from a standardized reproduction study in the Japanese quail (*Coturnis japonica*) and mallard duck (*Anas platyrhynchos*). A NOEC of > 3,000 ppm was determined for *C. japonica* and a NOEC of 300 ppm was determined for mallard (*A Platyrhynchos*) based on a decrease in the number of eggs produced.

There are no available studies for reptiles for carbaryl; thus, where reptile data is not available, the avian data is used as a surrogate to estimate sensitivity to reptiles.

For amphibians, the acute oral LD_{50} for carbaryl exposure in the bullfrog (*Rana catesbeiana*) was > 4,000 mg/kg (Hudson, Tucker, & Haegele, 1984). Acute toxicity studies in other species have demonstrated lower LC_{50} values for the tadpole developmental stage and the BA provides more detail on these on pages 53-55. (Kirby & Sih, 2015) found carbaryl to be more lethal to the threatened Foothill yellow-legged frog (*Rana boylii*) than to the Pacific tree frog (*Pseudacris regilla*). The estimated 72-hour LC_{50} value for *R. boylii* was 585 µg/L ± 229 and for *P. regilla* was 3,006 µg/L ± 955. In addition to mortality endpoints for this study, the authors also examined the effect of carbaryl on their competitive interactions with a non-native crayfish predator (*Pacifastacus leniusculus*). *R. boylii* was found to be more susceptible to pesticide exposure than *P. regilla* and exposure reduced their ability to compete with a 50% increase in mortality observed for *R. boylii* and no change to mortality observed (at 50 µg/L) for *P. regilla*. Several sublethal effect studies have also assessed a variety of endpoints related to direct and indirect effects on carbaryl to amphibians. The BA provides a discussion on these reductions in swimming behavior in more detail on page 55.

Carbaryl is very highly toxic to many terrestrial insects. It is very highly toxic to honey bees (*A. mellifera*) with an acute contact LD_{50} of 0.0011 mg/bee (US EPA, 2003), *A. erythronii* females (0.543 µg/bee), and *M. rotundata* females (0.592 µg/bee) as well as bumble bees (*B. terrestris*) where 24- and 72-hour oral LD_{50} values ranged from 3.92 to 3.84 µg/bee, respectively and *B. terricola* workers 41.16 µg/bee (Helson, Barber, & Kingsbury, 1994). It has also been measured in colonies at 111 µg/kg (Mullin, et al., 2010), so there is a potential for population level effects.

Toxicity to terrestrial plants has been evaluated for agronomic crops based on registrant submitted studies for US EPA FIFRA regulation requirements. These studies showed no effects to cabbage, cucumber, onion, ryegrass, soybean, and tomato (US EPA, 2003) at 0.803 lb a.i./ acre based on an application rate of 0.5 lb a.i. / acre, which is higher than that projected for carbaryl used for the grasshopper and Mormon cricket program (0.37 lb a.i. / acre). Plant incident reports have also been reported but at doses well above those proposed for the APHIS program activities (USDA-APHIS BA p. 56).

<u>Chlorantraniliprole</u>

Chlorantraniliprole (Ryanaxypyr™) is an insecticide in the anthranilic diamide insecticide class. The mode of action of chlorantraniliprole is the activation of insect ryanodine receptors, which causes an uncontrolled release of calcium from smooth and striated muscle, causing paralysis in insects (Health Canada, 2008) (US EPA, 2008). This insecticide is very selective to insect ryanodine receptors (Lahm, et al., 2007) and thus does not impact mammals or other vertebrate groups the same way, despite these groups also having these same receptors.

Aquatic Species:

Chlorantraniliprole toxicity in fish is considered low based on available toxicity data reporting mortality above the solubility limit (1 mg/L). Two early life-stage tests in the rainbow trout (*Onchorhynchus mykiss*) and sheepshead minnow (*Cyprinodon variegatus*) showed chlorantraniliprole may have effects at 0.11 and 1.28 mg/L, respectively.

Aquatic invertebrates are more sensitive to chlorantraniliprole in acute studies as compared to fish, with values ranging from 0.0098 mg/L for *D. magna* to 1.15 mg/L for the marine mysid shrimp (Barbee, McClain, Lanka, & Stout, 2010), (US EPA, 2012) and (Rodrigues, et al., 2016). For chronic life cycle studies, toxicity threshold values ranged from 0.0031 mg/L for the midge, *C. riparius* to 0.695 mg/L for the mysid shrimp, 0.695 mg/L.

The available aquatic plant toxicity data for chlorantraniliprole to freshwater and marine algae indicates low toxicity based on EC_{50} and NOEC values greater than the highest test concentrations tested, ranging from 1.78 to 15.1 mg/L (US EPA, 2008).

Terrestrial Species

Chlorantraniliprole is considered practically non-toxic to mammalian species via oral, dermal, and inhalation exposures and is not known to cause reproductive (NOAEL = 1,594 mg/kg/day) or developmental toxicity (1,000 mg/kg/day), respectively (US EPA, 2008). Chlorantraniliprole is also not known to be neurotoxic, carcinogenic, or immunotoxic (see BA Table 3-9).

Toxicity of chlorantraniliprole to avian species is considered low for acute and chronic exposures, where there were no acute or sublethal effects observed at all doses in the oral gavage or dietary studies or in a 22-week reproduction study. The lowest acute NOEL value of 2,250 mg/kg was used to estimate the range of sensitivities to birds based on different body weights and food consumption amounts if they were to forage on treated food items (see BA Tables 3-11 and 3-12).

There are no available studies for reptiles for chlorantraniliprole; thus where reptile data is not available, the avian data is used as a surrogate to estimate sensitivity to reptiles.
Chlorantraniliprole would be expected to be practically nontoxic to reptiles based on the available avian toxicity data.

Several studies reviewed by USDA-APHIS indicate that chlorantraniliprole is practically non- toxic to honeybees, bumblebees, hover fly, ladybug beetle, lacewing, other Hymenoptera species, and a predatory mite (see BA p.62-63).

The lack of toxicity observed in these other insect groups is related to the activity of chlorantraniliprole which is primarily through ingestion such that the larval stages of Coleoptera and Lepidoptera would receive larger doses due to the heightened feeding on treated plant material during this stage of development: Two acute studies in the monarch butterfly (one dietary, the other cuticular) indicated toxicity based on the 96-hour LD_{50}s. The cuticular LD_{50} was 0.012, 0.95, and 0.19 µg/g for the first, third, and fifth instars (European Food Safety Authority, 2013), while the dietary study 96-hour LC_{50} values were 0.0083, 0.046, and 0.96 µg / g leaf for second, third, and fifth instars, respectively (Krishnan, et al., 2020).

Chlorantraniliprole has low toxicity to most soil borne invertebrates such as springtail, isopods, and earthworms as is discussed in the BA (p. 63).

Terrestrial plant seedling emergence and vegetative vigor studies (using various monocot and dicot agricultural crops plants) indicate low toxicity at concentrations > 300 g/ha, which is several times greater than grasshopper/cricket suppression program rates.

Diflubenzuron

Diflubenzuron is classified as an insect growth regulator. The mode of action for this insecticide is inhibition of chitin synthesis (or interference with the formation of the insect's exoskeleton that is comprised of a protein known as chitin). The likely mechanism is through blockage of chitin synthetase, the ultimate enzyme in the biosynthesis pathway to form chitin (Cohen, 1993), (US EPA, 1997). Diflubenzuron exposure can result in both larvicidal and ovicidal effects either from dermal or dietary exposure. Ovicidal effects can occur via direct contact of eggs or through exposure to a gravid (i.e., pregnant) female by ingestion or dermal routes. Inhibition of chitin synthesis can primarily affect immature insects but can also impact other arthropods and some fungi.

Aquatic species

Diflubenzuron toxicity in fish is considered low based on available data. The LC_{50} values range from 10 mg/L for smallmouth bass to 660 mg/L in bluegill sunfish (Julin & Sanders, 1978), (USDA Forest Service, 2004), (US EPA, 1997), (Willcox & Coffey, 1978). Chronic studies from 30-days to 10 months indicate NOEC values range from 29 – 300 µg/L when tested on various species such as fathead minnow, steelhead trout, guppy (*Poecilia reticulata*), and mummichog (*Fundulus heteroclitus;* (Hansen & Garton, 1982), (Julin & Sanders, 1978).

Aquatic invertebrate sensitivity to diflubenzuron varies among different taxonomic groups. For crustaceans the median lethal concentration varies from 0.75 µg/L in *D. magna* (USDA Forest Service, 2004) to 2.95 µg/L in grass shrimp (*Palaemonetes pugio,* (Wilson & Costlow, 1986). For aquatic insects, values range from 0.5 µg/L in the mosquito (*A. nigromaculatum*; (Miura & Takahashi, 1974) to 57 mg/L in the perloid stonefly *Skwala sp*.; (Mayer & Ellersieck, 1986). For aquatic snails, the median lethal concentration in *Physa sp*. is > 125 mg/L (Willcox & Coffey, 1978).

The NOEC and EC_{50} values for aquatic plants exposed to diflubenzuron are 190 µg/L for duckweed (*L. minor*; Thompson and Swigert 1993), and 200 µg/L (US EPA, 1997) for the green algae, *S. capricornutum*, respectively.

Terrestrial species

Diflubenzuron is not very toxic to mammals via the oral route. The BA discusses the threshold values in more detail (see BA p. 41), but the lowest value was the oral LD_{50} in rats of >4,640 mg/kg (Eisler, 2000). The BA also goes into more detail to discuss diflubenzuron effects on the hematopoietic system as well as neurotoxicity, carcinogenicity, and mutagenicity effects, all indicating diflubenzuron has no impact on these physiological systems in mammals (see BA p 41-42).

Several reproductive and developmental toxicity studies in rats and rabbits provided in the BA also indicate diflubenzuron has effects on maternal blood pathologies at a LOAEL of 25 mg/kg/day (US EPA, 2015) but does not affect other endpoints in these studies (e.g., decreased body weight in offspring, fetal abnormalities).

For birds, acute toxicity data show that diflubenzuron is practically non-toxic to birds, with acute oral LD_{50} values ranging from 2,000 mg/kg to 5,000 mg/kg (Eisler, 2000), (Willcox & Coffey, 1978), (US EPA, 1997) using a variety of species such as the red-winged blackbird, mallard duck, and bobwhite quail.

Several reproductive studies are also available that evaluated chronic effects to a variety of avian species such as mallard duck, bobwhite quail, and chickens (US EPA, 1997), (Kubena, 1982), (USDA Forest Service, 2004), (Smalley, 1976), and (Cecil, Miller, & Corely, 1981). The lowest, most sensitive endpoint value used is the LOEC of 1,000 ppm value for effects on eggshell thickness and egg production in both mallard and bobwhite quail (US EPA, 1997).

Little information is available for toxicity of diflubenzuron to reptiles but likely it is low, thus where reptile data is not available, the avian data is used as a surrogate to estimate sensitivity to reptiles. Diflubenzuron would be expected to be practically nontoxic to reptiles based on the available avian toxicity data.

For amphibians one acute toxicity data indicates low sensitivity to diflubenzuron with a 48-hour LC_{50} of 100 mg/L in *Rana brevipoda porosa* tadpoles (Fryday & Thompson, 2012). Where data are scarce for amphibians, a surrogate approach is to use data for fish for diflubenzuron thus the chronic endpoint for amphibians from a 30-d NOEC value of > 45 µg/L for rainbow trout (Hansen & Garton, 1982) is used to assess chronic effects of diflubenzuron to amphibians.

For terrestrial invertebrates, there are a large amount of data available for diflubenzuron, but toxicity can vary by taxonomic group depending on the Order of insect and the life stage being exposed. Available toxicity data for diflubenzuron exposed to adult honeybees indicates that it is practically non-toxic (Chandel & Gupta, 1992), (Mommaerts, Sterk, & Smagghe, 2006), (Nation, Robinson, Yu, & Bolten, 1986). However, diflubenzuron is moderately to highly toxic to developing bees based on residues reported in pollen but not on nectar or honey (Mullin, et al., 2010). Again, this makes sense considering the mode of action of diflubenzuron. The BA discusses other studies confirming similar results (see BA p.44). Other insect Orders such as grasshoppers, beetles, and Lepidoptera at the immature stages are more susceptible than other terrestrial invertebrates, including the bee species discussed above (Eisler, 2000), (Murphy, Jepson, & Croft, 1994), (USDA Forest Service, 2004). Within this group, grasshoppers appear to be the most sensitive; however, the rates used in the above studies based on label recommendations for Dimilin 2L® are still more than 48-50% more than the rates used in the APHIS program (0.75-1.0 fluid oz/acre; see Table 3-6 in the BA). Diflubenzuron is also moderately toxic to spiders and mites, but there are no listed arachnids in the program action area.

Diflubenzuron treated grasshoppers fed to darkling beetles showed significant mortality but at doses 2,000 times the rate of diflubenzuron applied in the grasshopper/cricket APHIS program (Smith & Lockwood, 2003).

For terrestrial plants, toxicity is low due to low absorption and translocation of diflubenzuron residues on plant surfaces (Eisler, R., 1992). (Hatzios & Penner, 1978) determined exposure to diflubenzuron had no effect on photosynthesis, respiration, and leaf structure of soybeans at doses of up to 0.269 kg a.i./ha.

Toxicity of metabolites of carbaryl, chlorantraniliprole, and diflubenzuron

For carbaryl and chlorantraniliprole, toxicity data indicate the parent compounds are more toxic or have comparable toxicity to the metabolites discussed (see BA page 49 and Table 3-2 and page 59 and Table 3-7). Diflubenzuron has several metabolites that are discussed in detail in the BA (see pages 20 and 39). Environmental degradation of diflubenzuron can result in four primary metabolites, including CO2. The other three are 4-chlorophenyl urea, 2-6, diflurobenzoic acid, and 4-chloroaniline. 4-chloroaniline is slightly more toxic than diflubenzuron to fish and aquatic invertebrates (see p. 39 and Table 3-4). Both 2-6, diflurobenzoic acid and 4-chlorophenyl urea are considered less toxic or comparable in toxicity to diflubenzuron based on available data for fish and aquatic invertebrates (see p. 39 in the BA). 4-chloroaniline has also been shown to be slightly carcinogenic in long-term mammalian studies (a NOEL for 4-chloroaniline was slightly higher than the NOEL for diflubenzuron) (USDA Forest Service, 2004).

Risk Assessment and Effects Determinations

Aquatic Species

The distribution of acute and sub-lethal chronic effects data for fish for carbaryl, chlorantraniliprole, and diflubenzuron are compared to the estimated concentrations in aquatic systems under different applications for the APHIS Program. These values are below the range of response data provided. In addition, where data are not available for any program insecticide for aquatic phase amphibians, fish toxicity data is used as discussed above and below in the “Terrestrial Species” section of this document. The residues estimated using AgDrift also suggests that direct acute and sublethal risk of exposure to fish in small, static waterbodies is not expected. Estimated expected residues would range from 0.09 – 1.14 µg/L for carbaryl, 0.009 – 0.4 µg/L for chlorantraniliprole, and 0.007 – 0.21 µg/L diflubenzuron, (see Figures 4-1, 4-2, and 4-3 and Table 2-3 of the BA) when different buffer sizes are applied for the different application types. Field data collected from monitoring of program applications also support these findings (see discussions in BA p. 66 and 75 for carbaryl and diflubenzuron, respectively). The BA also discusses actual run-off related residues from program applications for carbaryl and diflubenzuron from different years and different states (2003 – 2022; see p. 27-30 in the BA).

These values also indicate the measured environmental concentrations in waterbodies within the standard 500-foot buffer or several miles downstream from the application site are still well below the effect data thresholds for aquatic organisms.

For indirect effects, consumption of contaminated prey or loss or reduction in prey items is also not expected to adversely impact fish based on low residues and a low bioconcentration factor (BCF) value for carbaryl (15; values greater than 1,000 are considered to bioconcentrate whereas values lower than 20 are considered compounds with very little ability to bioconcentrate) (USDA Forest Service, 2008). Based on the distribution of available fish and aquatic invertebrate toxicity data for carbaryl, chlorantraniliprole, and diflubenzuron, and the estimated residues discussed above, the adverse risks of exposure to prey items for listed fish species such as other fish or aquatic invertebrates are not expected based on the different application scenarios modeled in the BA. For aquatic plants, risk is discussed with respect to providing habitat and food for other aquatic species. For carbaryl, chlorantraniliprole, and diflubenzuron, no adverse impacts to aquatic plants are anticipated, and residues in water are anticipated to be 400-1600 times below the NOEC value for carbaryl (see BA p. 65), four orders of magnitude below the lowest effect concentration (see BA p. 82) for chlorantraniliprole, and 2,000 times below the NOEC concentrations for diflubenzuron (see BA p. 74).Therefore, the proposed action is not likely to adversely affect listed aquatic species because the proposed conservation measures are expected to lower the estimated environmental concentrations of these pesticides to levels that would have an insignificant effect on aquatic species, such that the effects cannot be meaningfully measured, detected, or evaluated.

Terrestrial Species

For the terrestrial vertebrate risk characterization, insecticide exposure was considered based on the most significant route: ingestion through the diet. Exposure can also occur through dermal contact, ingestion from preening, and water consumption, but the extent of exposure through these means is expected to be minor in comparison to that of ingestion of pesticides through diet. Exposure levels on different types of vegetation or other terrestrial non-target invertebrates as dietary items were calculated using the Terrestrial Residue Exposure Model (T-REX) (US EPA, 2012). To assess the acute and chronic risk to mammals, the most sensitive acute and chronic endpoints were used and compared to the T-REX estimated residues on dietary items with consideration for the size of the bird or mammal. Indirect risk to mammals was evaluated by reviewing impacts on habitat or prey base. For carbaryl, direct effects to mammals of all class sizes that feed on grasses, RQ values exceeded 1 (i.e., likely to cause adverse effects). For chlorantraniliprole, RQs were below 1 (i.e., not likely to cause adverse effects) for all mammalian class sizes and for diflubenzuron, there is a slight risk to small mammals consuming short grass (see Table 4-8 in the BA). For indirect effects for all three pesticides, there is some concern for those mammals that rely on terrestrial invertebrate as prey items than for those consuming terrestrial or aquatic plants or other small mammals (see p. 69, 83, and 77 in the BA). However, the proposed action is not likely to adversely affect listed mammals because the proposed conservation measures are expected to lower the estimated environmental concentrations of these pesticides to levels that would have an insignificant effect on mammals, such that the effects cannot be meaningfully measured, detected, or evaluated.

To assess the acute and chronic risk to birds the most sensitive acute and chronic endpoints were used and compared to residue values on respective dietary items (based on the size of the bird), estimated using T-REX calculations discussed on pages 69, 78, and 84 to generate RQ values.
RQs greater than 1 were reduced by implementing the proposed buffers to address impacts from program insecticides. For carbaryl, which shows a slight acute risk to birds that consume

contaminated prey (see Table 4-5 p. 70 in the BA), additional buffers for carbaryl applications were applied for known locations of adults (see Appendix A–9).

Indirect risk to birds was evaluated by reviewing impacts on habitat or prey base. For carbaryl, direct effects to birds in the 20 and 100 g class sizes that feed on grasses, had RQ values exceeding 1 as mentioned above (see Table 4-5). For chlorantraniliprole and diflubenzuron, RQs were below 1 for all avian class sizes (see p. 69, 84, and 78 in the BA). For indirect effects for all three pesticides, RQ values discussed for small mammals which could be prey items for larger birds, are discussed above. For small birds as prey items for other avian species, RQ values are discussed above as well. For bird species that feed on insects, RQ values were >1 for 20 g and 100 g birds for carbaryl, but were well below 1 for chlorantraniliprole and diflubenzuron (see p. 69,70, 76, and 84). Indirect effects to bird species based on impacts to dietary items (insects) for insectivorous birds from exposure to diflubenzuron is also discussed. However, the rates used in the APHIS Program are such that they would not reach levels or concentrations that would significantly reduce the availability of prey items for these avian species.

Therefore, the proposed action is not likely to adversely affect listed birds because the proposed conservation measures are expected to lower the estimated environmental concentrations of these pesticides to levels that would have an insignificant effect on birds, such that the effects cannot be meaningfully measured, detected, or evaluated. There are no data for all three pesticides used in the APHIS program to assess risks of exposure to reptiles. Although there is uncertainty in making the assumption that the range of sensitivities for birds is representative for reptiles, we make this assumption in the absence of data. Based on the risk characterization and conclusions described above for birds, for both direct and indirect effects, we expect that all three pesticides will have insignificant effects on listed reptile species.

Therefore, the proposed action is not likely to adversely affect listed reptiles because the proposed conservation measures are expected to lower the estimated environmental concentrations of these pesticides to levels that would have an insignificant effect on reptiles, such that the effects cannot be meaningfully measured, detected, or evaluated.

For amphibians, direct risk of exposure was determined by using the highest aquatic concentration in water and comparing that to the acute and chronic values for each pesticide used in the APHIS program. For carbaryl, the highest value in water used was the value discussed above for bait considerations and compared to the toxicity threshold values discussed below for the carbaryl bait application exposures. For chlorantraniliprole, there are no data for amphibians. Instead, we rely on the fish toxicity data. This assumption is similar to using the toxicity data for birds to represent effects for reptiles. While this approach has uncertainty associated with whether the data capture the range of sensitivities to amphibians from chlorantraniliprole, we make this assumption based on the risk characterization described above for fish exposed to chlorantraniliprole. Chlorantraniliprole toxicity in fish is considered low based on available toxicity data reporting mortality above the solubility limit (1 mg/L). Two early life-stage tests in the rainbow trout (*Onchorhynchus mykiss*) and sheepshead minnow (*Cyprinodon variegatus*) showed chlorantraniliprole may have effects at 0.11 and 1.28 mg/L, respectively.

For diflubenzuron, using the fish data, the 30-d NOEC value of > 45 µg/L for rainbow trout (Hansen & Garton, 1982) is compared to the highest residue calculated (0.04 µg/L; described in Section II in the BA). Indirect effects to amphibians can include loss of habitat and dietary items. For habitat, effects to terrestrial and aquatic plants were considered. Carbaryl, chlorantraniliprole, and diflubenzuron at all program rates poses minimal risk to aquatic and terrestrial plants. This is discussed more in the BA on pages 65, 73, 74, 81, 82, and 85 for the program chemicals. For amphibians that feed on aquatic invertebrates or other aquatic vertebrates, risk of exposure from all three program insecticides is discussed above in the "Aquatic Species" section of this Risk Characterization. We anticipate that the effects to these species will be insignificant because pesticide residues for aquatic plants, aquatic invertebrates, or fish do not exceed any toxicity endpoint for these taxonomic groups. For the potential indirect terrestrial route of exposure to amphibians, terrestrial invertebrates could serve as a food source for amphibians (see below discussion). However, the selectivity of diflubenzuron to developing insects would not cause significant decreases in food availability for amphibians, nor does it bioconcentrate if an amphibian were to consume a contaminated insect. Similarly, for carbaryl or chlorantraniliprole, these insecticides do not bioconcentrate. Carbaryl is very highly toxic to insects at label rates (see discussion in BA), and chlorantraniliprole is most toxic to those developing insects such as Lepidoptera and Coleoptera larvae via ingestion and not as toxic via contact exposure (see BA p. 63). Thus, the reduced program application rates would not eliminate the insect prey base entirely and would not reduce the availability of prey items to amphibians in other insect Orders from exposure to carbaryl or chlorantraniliprole. In addition, chlorantraniliprole is not toxic to soil dwelling invertebrates such as isopods, or earthworms (see BA p. 63), which could also be considered for terrestrial based dietary items for amphibians.

Therefore, the proposed action is not likely to adversely affect listed amphibians because the proposed conservation measures are expected to lower the estimated environmental concentrations of these pesticides to levels that would have an insignificant effect on amphibians, such that the effects cannot be meaningfully measured, detected, or evaluated.

For terrestrial invertebrates, risk of exposure from all three program insecticides differs among various insect Orders. This is discussed in more detail on pages 72, 73, 79, and 85 in the BA. A variety of field studies under a variety of application setting, including monitoring from the APHIS program applications have been conducted and demonstrate minimal residues of diflubenzuron. Minimal to no impacts to non-target arthropods such as honey bees, moths, and other insect Orders such as Coleoptera, Diptera, Trichoptera, Heteroptera, Homoptera, Neuroptera, and Plecoptera were demonstrated from diflubenzuron exposure (Emmett & Archer, 1980), (Atkins, Anderson, Kellum, & Heuman, 1976), (Johansen, Mayer, Eves, & Kious, 1983), (Schroeder, Sutton, & Beavers, 1980), (Robinson A. F., 1979) (Deakle & Bradley, 1982), (Sample, Cooper, & Whitmore, 1993), (Catangui, Fuller, & Walz, 1993), (Weiland, Judge, Pels, & Grosscourt, 2002), (Tingle, 1996) (Graham, Brasher, & Close, 2008). In addition, the extensive buffers determined via AgDrift modeling and confirmed with field assessments indicates the proposed buffers from 250 ft for ground applications and up to 1 mile for some aerial applications (buffers of 1,320 ft reduce drift by approximately 89-98%; see BA p. 73) address the impacts to listed terrestrial invertebrates within the program action area. In addition, the program applications rates (0.75 fl. oz/ acre and 1.0 fl. oz/acre for ground and aerial applications, respectively) are well reduced from label rates recommended for Orthoptera, Coleoptera, Homoptera, and Lepidoptera (see Table 3-6 in the BA) and combined with the aforementioned extensive buffers indicates very minimal risk of adverse effects to listed terrestrial invertebrates within the action area.

Therefore, the proposed action is not likely to adversely affect listed terrestrial invertebrate species because the proposed conservation measures are expected to lower the estimated environmental concentrations of these pesticides to levels that would have an insignificant effect on terrestrial invertebrate species, such that the effects cannot be meaningfully measured, detected, or evaluated.

Risk of adverse effects to terrestrial plants from all three APHIS program insecticides is considered minimal. Based on the available toxicity data discussed above for carbaryl, chlorantraniliprole, and diflubenzuron, phytotoxic effects are not anticipated from program insecticide applications. However, potential indirect effects of carbaryl on pollinators is considered. As discussed above in the Effects of the Action section for carbaryl and terrestrial invertebrates, laboratory studies have indicated several species of honeybees and bumblebees are sensitive to carbaryl, but these are at rates above those used in the program, and effects have not been measured extensively in field studies. One study based on a carbaryl application rate of
0.80 lb a.i./acre in a fruit orchard indicated no effects on honeybee mortality or behavior 7 days post application. Any potential impacts to honey bees or bumble bees may also be mitigated by the reduced application rates for the program, the RAATs (alternating swaths where the insecticide is applied), as well as use of carbaryl bait as opposed to ground or aerial spray applications (Peach, Alston, & Tepedino, 1994), (Peach, Alston, & Tepedino, 1995).

Indirect risk to terrestrial plants from impacts to pollinators from chlorantraniliprole is not expected to be significant. Grasshopper nymphs appear to be the most impacted compared to other insect groups. Various laboratory and field data indicate low toxicity to other insect groups such as honeybees and bumblebees (i.e., those groups more likely to be pollinators to terrestrial plants), where no mortality or sublethal effects were observed (see Effects of the Action section for terrestrial invertebrates discussed above), and application rates 4 to 10 times higher than program rates are shown to have better efficacy in controlling Lepidoptera and other insect pests. Indirect risk to terrestrial plants is also not expected from impacts to pollinators from diflubenzuron. As discussed above in the Effects of the Action section for terrestrial invertebrates, a variety of field studies under a variety of application settings, including monitoring from the APHIS program applications, have been conducted and demonstrate minimal residues of diflubenzuron have minimal to no impacts to non-target arthropods such as honeybees, moths, and other insect Orders. Negative effects have been observed in honeybees in some studies, but this was observed at application levels and periods of time that exceed those expected to be used in the program. (Robinson & Johansen, 1978) found that diflubenzuron application rates as high as 0.125 to .25 lbs. a.i./acre (10 and 20 times the program rate for diflubenzuron) resulted in no effect on adult mortality and brood production in honeybees. As discussed above, the use of RAATS provide additional protection by limiting the area of treatment within the spray block to further reduce the potential risk of exposure to pollinators.

Therefore, the proposed action is not likely to adversely affect listed terrestrial plant species because the proposed conservation measures are expected to lower the estimated environmental concentrations of these pesticides to levels that would have an insignificant effect on terrestrial plant species, such that the effects cannot be meaningfully measured, detected, or evaluated.

Bait Applications of Carbaryl

Bait formulations of carbaryl are primarily composed of a grain such as wheat bran or rolled whole grain or a pellet mixed with the carbaryl. They are used mostly to control crickets as some species of grasshopper do not eat the bait, but some other advantages are that they primarily act through ingestion, affect fewer non target organisms, and generate very little drift (Foster, 1996), (Latchininsky & Van Dyke, 2006), (Peach, Alston, & Tepedino, 1994)

For bait applications of carbaryl, direct risk of exposure to mammals was calculated using the LD_{50}'s per square foot method described in the BA (Section IV A. Insecticide Risk Assessment Methodology). When the LD_{50} per square foot is greater than 1, there is an assumed risk as a conservative estimate that the mammal (or bird as the same approach is used for birds) will consume the entire bait. RQs were above 1 for all mammals except the 1,000 g group, when no application buffer is applied. With an adjusted buffer of 500 feet, the RQs are below 1.0 for all mammalian size classes (see Table 4-3 and p. 68 in the BA), and all estimated residues from bait applications are anticipated to be below the acute NOEL value (10mg/kg).

Therefore, the proposed action is not likely to adversely affect listed mammals because the proposed conservation measures are expected to lower the estimated environmental concentrations of carbaryl bait to levels that would have an insignificant effect on mammals, such that the effects cannot be meaningfully measured, detected, or evaluated.

For carbaryl bait applications, direct risk of exposure to birds was also assessed. The lowest acute avian LD_{50} value of 16 mg/kg (European starling; see Carbaryl toxicity section discussed above) was used. RQ values were greater than 1 for all size classes without an application buffer; however, drift reductions are observed when a 500-ft buffer is applied, and RQ values fall below 1 (see Table 4-6 in the BA). As previously discussed, we assume similar impacts from carbaryl bait applications to reptiles as to that of birds. Indirect effects from carbaryl bait to both mammals and birds are also not expected. We do not expect indirect effects to plants used as habitat or dietary items for birds and mammals; we also do not expect indirect effects to small mammals, small birds, or terrestrial invertebrates exposed to carbaryl bait used as dietary items for birds and mammals. This discussion is covered in more detail in the BA p 68-73.

Therefore, the proposed action is not likely to adversely affect listed birds because the proposed conservation measures are expected to lower the estimated environmental concentrations of carbaryl bait to levels that would have an insignificant effect on birds, such that the effects cannot be meaningfully measured, detected, or evaluated.

Direct risk of exposure to amphibians from carbaryl bait applications was assessed by taking the highest estimated concentration of carbaryl in an aquatic system (1.10 µg/L) and comparing that to the acute and chronic values for amphibians. Impacts of carbaryl bait applications on amphibians are minimal based on the LC_{50} values reported for tadpoles (1.73–22.02 mg/L) at approximately 1,572 to 20,018 times below the highest calculated carbaryl residue, suggesting minimal acute risk of bait applications (and ULV applications based on the same toxicity endpoint used for both application methods). Sublethal effects to amphibians are also not anticipated based on chronic studies with a NOEC for swimming behavior of 1.25 mg/L and a tadpole NOEC for mean age at metamorphosis (0.16 mg/L).

Therefore, the proposed action is not likely to adversely affect listed amphibians because the proposed conservation measures are expected to lower the estimated environmental concentrations of carbaryl bait to levels that would have an insignificant effect on amphibians, such that the effects cannot be meaningfully measured, detected, or evaluated.

Direct risk of exposure to terrestrial invertebrates from carbaryl bait applications is considered but is less likely to impact most Orders of terrestrial insects. Studies with carbaryl bran bait have found that no sublethal effects were observed on adult or larval alfalfa leaf cutting bees (Peach, Alston, & Tepedino, 1994), (Peach, Alston, & Tepedino, 1995) and see also p. 73 in the BA). Carbaryl bait also poses a low risk to most insect Orders as it is preferentially consumed by grasshoppers. There also is less exposure to Hymenoptera or Lepidoptera because the active ingredient is contained in the bait and not available for dietary or contact exposure (it is not sprayed) and would not be found on floral resources that would be visited by Lepidoptera or Hymenoptera during normal activities.

Therefore, the proposed action is not likely to adversely affect listed terrestrial invertebrate species because the proposed conservation measures are expected to lower the estimated environmental concentrations of carbaryl bait to levels that would have an insignificant effect on terrestrial invertebrate species, such that the effects cannot be meaningfully measured, detected, or evaluated.

Critical Habitat

For critical habitat, APHIS reviewed the primary constituent elements (PCEs) or physical and biological features (PBFs) to determine if the program activities would cause destruction or adverse modification of these features. For many species, designated critical habitat PCEs or PBFs are aspects of the physical landscape such as geomorphological features, soil types, hydrologic regimes, as well as the necessary vegetative features. None of the program insecticides are expected to impact geomorphological formations or hydrologic regimes. Other PCEs or PBFs for certain species involve an adequate source of invertebrate prey items (many listed bird species and fish), specified water quality parameters for certain aquatic species to support a healthy system (pH, adequate dissolved oxygen, low salinity, lack of pollutants, low turbidity, low ammonia, etc.), and the absence of predators or invasives.

As discussed earlier, there is minimal risk to designated critical habitat PCEs or PBFs involving any vegetative structures for habitat or other plants these species may rely on for feeding, breeding, or sheltering, because the program's proposed use of the insecticides is not expected to result in phytotoxic effects.

There is some risk that the program activities could affect designated critical habitats with PCEs or PBFs described as an adequate prey base of terrestrial invertebrates or aquatic invertebrates. However, the standard program mitigation involving 500 ft buffers for aerial applications, 200 ft buffers for ground applications, and 50 ft for bait applications to all water bodies will minimize the impacts to aquatic invertebrate prey items from drift. Table 5-2 in the BA provides a list of all proposed buffers to protect fish and designated critical habitats. Program designated buffers and reduced application rates along with RAAT applications will also minimize impacts to the terrestrial invertebrate prey base for designated critical habitats. For example, because nesting success and brood survival are directly linked to adequate invertebrate prey available to developing lesser prairie chicken chicks, and ultimately lesser prairie chicken success, adequate buffers protecting lesser prairie chicken are warranted. Adults rely on a variety of food items throughout the year but predominantly vegetation during the fall, winter, and early spring (US FWS, 2012). Additional buffer distances to protect leks and allow for adequate prey items for adults and developing chicks were applied for carbaryl, as it demonstrated some toxicity to terrestrial invertebrates as discussed above (see also p. 52-53 and 93 in the BA). Similar mitigations are also applied for other prairie birds, such as the Gunnison and greater sage grouse.

Therefore, the proposed action is not likely to adversely affect designated critical habitat PCEs or PBFs because the proposed conservation measures are expected to lower the estimated environmental concentrations of these pesticides to levels that would have an insignificant effect on designated critical habitat PCEs or PBFs, such that the effects cannot be meaningfully measured, detected, or evaluated.

Summary and Conclusion

APHIS evaluated their grasshopper and Mormon cricket suppression program application of three insecticides, carbaryl, chlorantraniliprole, and diflubenzuron to listed species and their designated critical habitat as applicable. They provide an overview of the exposure and response analyses for terrestrial and aquatic invertebrate and vertebrate groups, as well as plants, and considered all the relevant pathways of exposure for each. As such they established several avoidance and minimization measures to ensure that the use of these insecticides for their program activities is not likely to adversely impact listed species and their designated critical habitat as applicable. APHIS ensures that buffers established based on modeled estimates and program application data will be applied during all program activities. In addition to substantial buffers used within species' ranges and designated critical habitats, reduced program application rates and RAAT treatment methods will minimize direct and indirect risk of adverse effects from exposure of pesticides to listed mammals, birds, reptiles, amphibians, fish, terrestrial insects, aquatic invertebrates, and plants. Therefore, the proposed action is not likely to adversely affect listed species and designated critical habitat because the proposed conservation measures are expected to lower the estimated environmental concentrations of these pesticides to levels that would have an insignificant effect on these species and their designated critical habitats.

Aquatic Species

For all listed aquatic species within the program action area, the following buffers are applied for each pesticide (Table 1, adapted from Table 5-2 see also Appendix A-9 in the BA or Enclosure B):

Table 1. Proposed Application Buffers for Aquatic Species and designated Critical Habitat Based on Application Method

Insecticide	Application type	Application buffer (feet)
Carbaryl	Aerial (ULV*)	2640
	Aerial Bait	750
	Ground	300
	Ground Bait	100
Chlorantraniliprole	Aerial (ULV*)	500
	Ground	200
Diflubenzuron	Aerial (ULV*)	1320
	Ground	200

*ULV = ultra-low volume

The estimated residues from the application methods and application concentrations in Table 1 are the expected range of concentrations where adverse effects to fish or amphibians are expected to occur. These buffers are applied as such because they are protective of all aquatic species as well as their designated critical habitats, as applicable, and any indirect effects to listed fish species' prey items such as aquatic invertebrates, or terrestrial invertebrates (which are more sensitive; see Figures 2-2, 2-3, and Table 2-3 in the BA for how these buffer distances were determined) are also minimized.

Terrestrial Species

For all listed terrestrial species within the program action area, the following buffers are applied for each pesticide (Table 2, see also Appendix A-9 in the BA or Enclosure B). We provide a range of buffers to demonstrate the differences that exist among the taxonomic groups described in the BA in terms of direct sensitivities to the insecticides as well as the indirect effects to dietary items upon which a species may rely and that may be integral to their survival and overall population level success (see p. 88-89 and p. 93 in the BA).

Table 2. Proposed Ranges of Application Buffers for Terrestrial Species and Designated Critical Habitat

Insecticide	Application type	Application buffer range (feet)
Carbaryl	Aerial (ULV*)	500 - 5,280
	Aerial Bait	500 - 750
	Ground	100 - 5,280
	Ground Bait	50 - 5,280
Chlorantraniliprole	Aerial (ULV*)	500 - 5,280
	Ground	50 - 5,280
Diflubenzuron	Aerial (ULV*)	500 - 5,280
	Ground	50 - 5,280

*ULV = ultra-low volume

Bait Applications for Carbaryl

Run-off or drift from bait applications to water bodies is expected to be minimal as the active ingredient is contained within the bait/bran or grain mix and not susceptible to off-site transport via rain events or volatilization. Labels for carbaryl also do not allow the product to enter water bodies, and thus, to preclude the possibility of the bait moving into aquatic systems, there are standard buffers for water bodies used for all program activities, regardless of the presence of listed species or critical habitat. An example of such a scenario is described on p. 28 in the BA, where carbaryl was detected downstream from where bait applications were made when an area that was treated was irrigated. Residues were measured upstream and downstream of the discharge. Residue values upstream were 1.2 µg/L while residue values at 5.5 and 8.0 miles below the discharge were 2.0 and 1.6 µg/L, respectively. However, there is uncertainty regarding whether these values represent any contribution from APHIS applications.

APHIS also implements additional buffers for water bodies that are not designated as critical habitat for listed aquatic species: 500-foot buffer for aerial sprays, 200-foot buffer for ground sprays, and a 50-foot buffer for bait applications. Thus, the buffers for bait applications of carbaryl for aquatic species are uniformly applied for all species (see Appendix A-9 in the BA, Enclosure B, and Table 1 above) and are sufficiently protective to avoid the likelihood of any adverse effects.

Buffers for bait application of carbaryl vary by terrestrial species taxonomic group and habitat (see Appendix A-9 in the BA, Enclosure B, and Table 2 above). These buffers are generally less distance than for aerial or other ground application methods, except for what is applied for prairie birds or riparian mammals (see discussion below and on p. 93 in the BA, Appendix A-9 in the BA, or Enclosure B), as this application method results in less drift and therefore subsequently less exposure (see p. 6-7 in the BA). In addition, the nature of the bait is also such that because it is a solid and absorbed by the bran or other carrier (see p. 6 in the BA for bait preparation methods), it is less bioavailable, especially for potential dermal contact exposure for all terrestrial species. Drift reductions expected for all size classes of mammals and birds from the application of a 500-ft buffer are estimated at greater than 99% (see Tables 4-3 and 4-6 in the BA). For terrestrial invertebrates, program buffers for bait applications are similar to that of mammals and birds. Any indirect effects to listed species' prey items are discussed above for the different taxonomic groups, and effects to designated critical habitat for listed species from carbaryl bait applications is also expected to be insignificant.

As a result of the APHIS program conservation measures such as use of the buffer distances discussed above for all taxonomic groups and their designated critical habitats, as applicable, along with the reduced application rates as compared to label rates for each insecticide, and RAAT treatment procedures, any risk of exposure associated with the application of the three insecticides used under the APHIS grasshopper and Mormon cricket suppression program is expected to be minimal. Thus, any direct or indirect effects from the proposed action to listed species and their designated critical habitats are expected to be insignificant due to program conservation measures.

This concludes consultation. As stated in 50 CFR § 402.16, reinitiation of consultation is required and shall be requested by APHIS or the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (1) If new information reveals effects of the action that may affect listed species or critical habitat in a manner to an extent not previously considered; (2) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this concurrence letter; or (3) If a new species is listed or critical habitat designated that may be affected by the identified action.

We appreciate the collaboration your staff has provided. If you have any questions, please contact Sara Pollack at (703) 358-2371 or sara_pollack@fws.gov or Keith Paul at (703) 358-2675 or keith_paul@fws.gov in the Branch of National Consultations.

Sincerely,

JANE LEDWIN Digitally signed by JANE LEDWIN Date: 2024.03.21 19:47:50 -04'00'

Jane Ledwin
Chief, Branch of National Consultations
Ecological Services Program

Enclosures

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