`

Draft Environmental Assessment Rangeland Grasshopper and Mormon Cricket Suppression Program

ALBANY, BIG HORN, CAMPBELL, CARBON, CONVERSE, CROOK, FREMONT, GOSHEN, HOT SPRINGS, JOHNSON, LARAMIE, NATRONA, NIOBRARA, PLATTE, SHERIDAN, WASHAKIE, WESTON counties, and Wind River Indian Reservation, WYOMING

PPQ and CEQ Identification Number: WY-25-01-EAXX-005-32-24P-1742898385

Photo: Typical landscape of an area that historically has had reoccurring high populations of grasshoppers. USDA APHIS PPQ B. Shambaugh

Prepared by:

United States Department of Agriculture (USDA)
Animal and Plant Health Inspection Service (APHIS)
Plant Protection and Quarantine (PPQ)
5353 Yellowstone Road
Suite 208
Cheyenne, Wyoming 82009

Available at above address or:
www.aphis.usda.gov/plant-health/grasshopper

May 2025

`

Non-Discrimination Policy

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (PDF) within 45 days of the date of the alleged discriminatory act, event, or in the case of a personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at How to File a Program Discrimination Complaint and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

Persons With Disabilities

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

Mention of companies or commercial products in this report does not imply recommendation or endorsement by USDA over others not mentioned. USDA neither guarantees nor warrants the standard of any product mentioned. Product names are mentioned to report factually on available data and to provide specific information.

This publication reports research involving pesticides. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish and other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended label practices for the use and disposal of pesticides and pesticide containers

`

Table of Contents

Contents

`

Acronyms and Abbreviations

ac	acre
a.i.	active ingredient
AChE	acetylcholinesterase
APHIS	Animal and Plant Health Inspection Service
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
EIL	economic injury level
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
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
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

ALBANY, BIG HORN, CAMPBELL, CARBON, CONVERSE, CROOK, FREMONT, GOSHEN, HOT SPRINGS, JOHNSON, LARAMIE, NATRONA, NIOBRARA, PLATTE, SHERIDAN, WASHAKIE, WESTON counties, and Wind River Indian Reservation, WYOMING

I. Need for Proposed Action

A. Purpose and Need Statement

An infestation of grasshoppers or Mormon crickets may occur in any of the counties or areas listed above. The Animal and Plant Health Inspection Service (APHIS) 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 spring/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. Some benefits of preventing high populations of grasshoppers include the following: Rural economies depend on rangelands that managed for productive forage to provide for livestock grazing. A reduction in forage has significant impact on cattle health and 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 economic injury levels in order to protect the natural resources of rangeland ecosystems, the value of livestock and wildlife forage, and cropland adjacent to rangeland.

This EA analyzes potential effects of the proposed action and its alternatives. This EA supersedes Wyoming EA # WY-22-01. This EA applies to a potential suppression programs that would take place in Albany, Big Horn, Campbell, Carbon, Converse, Crook, Fremont, Goshen, Hot Springs, Johnson, Laramie, Natrona, Niobrara, Platte, Sheridan, Washakie, Weston counties, and Wind River Indian Reservation, Wyoming.

This EA is prepared in accordance with the requirements under the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et seq*.); Council on Environmental Quality's (CEQ) regulations implementing NEPA (40 CFR 1500 *et seq*.); USDA (7 CFR Part 1b) and APHIS NEPA Implementing Procedures (7 CFR Part 372). APHIS make and issue a decision 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 2025-2030 Control Program for infested rangeland in Albany, Big Horn, Campbell, Carbon, Converse, Crook, Fremont, Goshen, Hot Springs, Johnson, Laramie, Natrona, Niobrara, Platte, Sheridan, Washakie, Weston counties, Wyoming.

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.

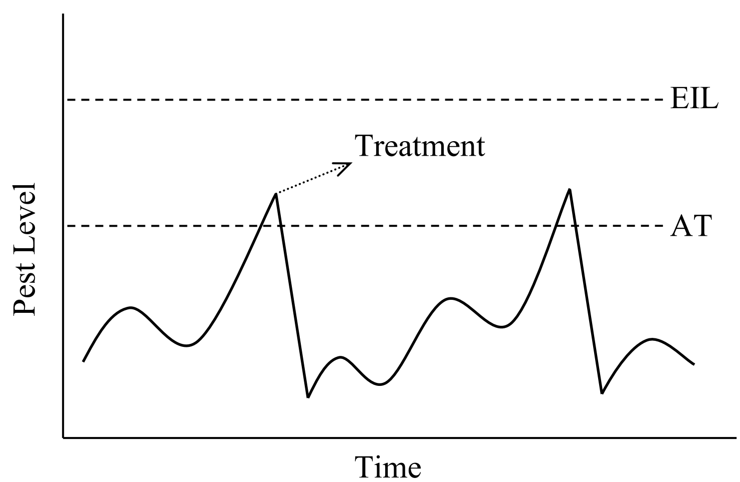


Figure 1. Diagram of the typical relationship between the economic injury level (EIL) and action threshold (AT) for applying pest treatments (Rashford et al., 2012).

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 and 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. Wyoming has a long history of grasshopper management on rangelands. Traditionally, land managers use integrated pest management tools and practices to care for rangeland ecosystems. 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).

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.

As a cooperative program, APHIS works alongside with land managers to provide options which aide in the decision whether suppression programs or no suppression program may be the best course of action. This process starts the year prior, when APHIS grasshopper scouts survey rangeland statewide and determine adult grasshopper densities and species makeup. The adult survey density information is used to make a statewide grasshopper hazard map that is shared with cooperators. APHIS provides technical assistance which can occur at public meetings where the agency describes grasshopper biology and the specifics of the Rangeland Grasshopper and Mormon Cricket Suppression Program. Following public meetings, some land managers may decide to sign up for the program. During the spring, after land managers inform APHIS which areas to include and exclude from potential treatment areas, APHIS grasshopper scouts will verify if grasshopper populations densities are high enough to warrant treatment in these potential treatment areas. If treatments are warranted and still requested, APHIS may conduct suppression treatments. Decisions to treat or not, where to treat, and when to treat are driven by spring survey data, requests from land managers and available resources from all involved parties (including funding). APHIS collects grasshopper density and species distribution data, which is combined with land manager management strategies and ecosystem health data collected

`

from cooperators to reach a mutual decision. These many factors are considered when determining the economic injury level.

Although APHIS does surveys 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.

Nymphal grasshopper surveys generally occur in May to late June, with the first adults of species most likely to cause economic harm emerging in early to mid June. Hatches of economically harmful species like *Melanoplus sanguinipes* can occur over a period of time resulting in several life stages within a single population. APHIS's preferred insecticide to suppress grasshopper outbreaks is diflubenzuron which must be used only on grasshoppers in the nymphal life stages. Therefore, very little time can pass after nymphs of the most destructive grasshopper species are discovered (i.e., several days or a week) and when treatments with diflubenzuron must happen. Diflubenzuron is the preferred insecticide of the program due to its selectivity and cost effectiveness. For Mormon Crickets, the process begins with surveying for hatching beds in April. If the hatching beds are widespread and there is risk of Mormon crickets migrating into land used for crop agriculture, treatments may be warranted to protect agricultural commodities. This is generally achieved by treating Mormon cricket infested rangeland within a half-mile wide area adjacent to the cropland. Spring weather may shift grasshopper and/or Mormon cricket hatching by several weeks earlier or later depending if weather is drier and warmer or cooler and wetter.

In the Affected Environment Section below, 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 within the counties previously described in this document 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.

3. APHIS Environmental Compliance and Cooperators

In June 2002, APHIS completed an EIS describing the agency's most effective methods of reducing 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 human health and ecological risk assessments (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).

`

Wind River Indian Reservation has its own infrastructure and government which requests and approves suppression activities. APHIS requires letters of request from both the Tribe and the Bureau of Indian Affairs (BIA).

Wyoming has county weed and pest districts which have, by statue, grasshoppers and Mormon crickets listed as regulated pest species. APHIS partners with these county districts in survey technical assistance and potential treatments. These districts often represent private landowners in APHIS suppression treatments, and also conduct their own suppressions of pests. APHIS will provide technical assistance for land managers and landowners when requested, however APHIS services are not always requested.

The Director for the Wyoming State Lands issues a letter of support to APHIS requesting assistance for state lands in Wyoming needing assistance for the APHIS Rangeland Grasshopper and Mormon Cricket Program for Wyoming.

In October 2015, APHIS and the Bureau of Land Management (BLM) signed a Memorandum of Understanding (MOU) detailing cooperative efforts between the two groups on suppression of grasshoppers and Mormon crickets on BLM lands (Document #22-8100-0870-MU, January 11, 2022). This MOU clarifies that APHIS will prepare and issue to the public environmental documents that evaluate potential impacts associated with proposed measures to suppress economically damaging grasshopper and Mormon cricket populations. The MOU also states that these documents will be prepared under the APHIS NEPA implementing procedures with cooperation and input from the BLM.

The MOU further states that the responsible BLM official will 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 (and any other documentation needed for their NEPA process) 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.

In September 2016, APHIS and the Bureau of Indian Affairs (BIA) signed a Memorandum of Understanding (MOU) detailing cooperative efforts between the two groups on suppression of grasshoppers and Mormon crickets on BIA lands (Document #10-8100-0941-MU, September 16, 2016). This MOU clarifies that APHIS will prepare and issue to the public environmental documents that evaluate potential impacts associated with proposed measures to suppress economically damaging grasshopper and Mormon cricket populations. The MOU also states that these documents will be prepared under the APHIS NEPA implementing procedures with cooperation and input from the BIA.

The MOU further states that the responsible BIA official will request in writing the inclusion of appropriate lands in the APHIS suppression project when treatment on BIA land is necessary. The request should include the dates and locations of all tribal ceremonies and cultural events, as well as “not to be treated” areas that will be in or near the proposed treatment block(s). According to the provisions of the MOU, APHIS can begin treatments after APHIS issues an appropriate decision document.

In November 2019, APHIS and the United States Forest Service (USFS) signed a Memorandum of Understanding (MOU) detailing cooperative efforts between the two

`

groups on suppression of grasshoppers and Mormon crickets on National Forest system lands (Document #19-8100-0573-MU, November 6, 2019). This MOU clarifies that APHIS will prepare and issue to the public environmental documents that evaluate potential impacts associated with proposed measures to suppress economically damaging grasshopper and Mormon cricket populations. The MOU also states that these documents will be prepared under the APHIS NEPA implementing procedures with cooperation and input from the USFS.

The MOU further states that the responsible USFS official will request in writing the inclusion of appropriate lands in the APHIS suppression project when treatment on national forest land is necessary. According to the provisions of the MOU, APHIS can begin treatments after APHIS issues an appropriate decision document.

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. 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. Reduced agent area treatments (RAATs) is one of the methods that has been developed to reduce the amount of pesticide used in suppression activities and is a component of IPM because grasshopper populations are reduced below the level causing economic harm. APHIS typically employs the RAATs method in which the application rate of insecticide is reduced from conventional levels, and treated swaths are alternated with swaths that are not directly treated. The RAATs strategy relies on the effects of an insecticide to suppress grasshoppers within treated swaths while conserving grasshopper predators and parasites in swaths not directly treated (USDA APHIS, 2002). APHIS continues to evaluate new suppression tools and methods for grasshopper and Mormon cricket populations, including biological control.

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 Section B above, 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 is all counties previously described in this document to account for the wide geographic areas in which grasshoppers and Mormon crickets occur on rangelands. Then, when grasshopper populations grow to damaging 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 Nation.

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 Wyoming.

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 newspaper – legal notices in Casper Star Tribune and Wyoming Livestock Roundup. In addition to newspapers, the draft EAs are published on Regulations.gov, and sent via direct mailings and email distribution as well. Printed copies are also on file at Wyoming PPQ field office in Cheyenne.

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 suppression program. The process can occur formally and informally through meetings, conversations, or written comments from individuals and groups. APHIS reviewed and considered all comments in preparing the draft EA.

II. Alternatives

To engage in comprehensive NEPA risk analysis APHIS must frame potential agency decisions into distinct action alternatives. 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 three pesticides (carbaryl, diflubenzuron, and malathion). 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 allows use of four pesticides (carbaryl, diflubenzuron, malathion, and chlorantraniliprole). 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 counties previously described in this document to analyze more site-specific impacts. The EA tiers to the 2019 programmatic EIS and incorporates by reference the carbaryl, chlorantraniliprole, diflubenzuron, and malathion HHERAs also published in 2019. Copies of the 2019 programmatic EIS and ROD are available for review at 5353 Yellowstone Road, Suite 208; Cheyenne, Wyoming 82009. 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 the counties previously described in this document. 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 Reduced Agent Area Treatments (Preferred Alternative)

Under Alternative B, the Preferred Alternative, APHIS would manage a grasshopper treatment program using techniques and tools discussed hereafter to suppress outbreaks. The insecticides available for use by APHIS include the U.S. Environmental Protection Agency (USEPA) registered chemicals of carbaryl (bait and liquid formulations), chlorantraniliprole, and diflubenzuron. These chemicals have varied modes of action. Carbaryl works by inhibiting acetylcholinesterase (enzymes involved in nerve impulses). Chlorantraniliprole activates insect ryanodine receptors which causes an uncontrolled release of calcium, impairing insect muscle regulation and leading to paralysis. 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 an APHIS rate conventionally used for grasshopper suppression treatments, or more typically as 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.

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 grasshoppers 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, chlorantraniliprole or rarely malathion are the remaining control options. The circumstances where the use 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 are highly susceptible to carbaryl bait is described in figure 2. Those species under ideal conditions can expect 80- 85% mortality. However, if conditions are less than optimal or species complex is greatly varied with species less susceptible to bait acceptance then mortality using bait could be greatly reduced. Under this condition if the window for diflubenzuron is closed and the species complex is not ideal for bait acceptance then chlorantraniliprole would be the last chemical option to suppress populations.

`

Classification of grasshopper species according to susceptibility to carbaryl wheat bran bait

Class and expected levels of control	Species
Sensitive (>55-% control) Control is expected to average about 70%. Worst-case and best-case scenarios will be about 55% and 85%, respectively.	*Ageneotettix deorum* *Anabrus simplex* *Aulocara elliotti* *Camnula pellucida* *Hadrotettix trifasciatus* **Melanoplus bivittatus* *Melanoplus confusus* *Melanoplus dawsoni* *Melanoplus foedus* **Melanoplus infantilis* **Melanoplus occidentalis* **Melanoplus packardii* *Melanoplus sanguinipes* *Spharagemon equale* *Stenobothrus brunneus* **Mermiria bivittata*
Vulnerable (30- to 55-% control) Control is expected to average about 42%. Worst-case and best-case scenarios will be about 12% and 72%, respectively.	**Aulocara femoratum* *Eritettix simplex* *Melanoplus femurrubrum* *Oedaloenotus enigma* *Opeia obscura* *Phoetaliotes nebrascensis* *Psoloessa delicatula*
Nonsusceptible (<30-% control) Control is expected to average about 15%. Worst-case and best-case scenarios will be about 0% and 30%, respectively.	*Aeropedellus clavatus* *Amphitornus coloradus* *Cordillacris crenulata* *Cordallacris occipitalis* *Hesperotettix viridis* *Metator pardalinus* **Phlibostroma quadrimaculatum* *Trachyrhachys kiowa*

*These species are not likely to suffer best-case scenario levels of control.

Figure 2. Bait Acceptance by Different Grasshopper Species and Instars (Onsager etal. 1996)

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, chlorantraniliprole, diflubenzuron, or malathion would be considered under this alternative, typically at the following application rates ((Lockwood et al., 2000, Foster et al., 2000, USDA APHIS, 2019):

`

- 8.0 fluid ounces (0.25 lbs a.i./ac sprayed) of carbaryl spray;
- 10.0 pounds (0.20 lbs a.i./ac treated) of 2 percent carbaryl bait;
- 4.0 fluid ounces (0.013 lbs a.i./ac sprayed) of chlorantraniliprole;
- 0.75 or 1.0 fluid ounce (0.012 lbs a.i./ac sprayed) of diflubenzuron; or
- 4.0 fluid ounces (0.31 lbs a.i./ac sprayed) of malathion.

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), chlorantraniliprole, and diflubenzuron, and 25 feet for malathion. 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 infestation level.

Treatments conducted using the Reduced Agent Area Treatment (RAAT's) method of skipping swaths (Figure 3) decreases the amount of chemical and acreage treated still maintaining an effective kill rate. Swath widths usually range from 35-45 feet depending on ground equipment used. Aerial treatments may have a swath width of 100feet. Grasshoppers in untreated areas will tend to move to treated areas, thus becoming exposed to the insecticide. For example, if the area in figure 3 was 100 acres, with 50% RAAT's the acreage treated would be 50 acres. Protection would include the entire 100 acres, only exposing half the area with half the chemical amount compared to a conventional blanket treatment covering the entire 100 acres and the label rate of application.

Figure 3. Reduced Agent Area Treatment (RAAT's).

The recommended skipped swath width is typically no more than 100 feet for carbaryl (liquid), chlorantraniliprole, and diflubenzuron, and 25 feet for malathion. 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 feet, then the skipped habitat area will also be 150 feet.

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 X 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.

`

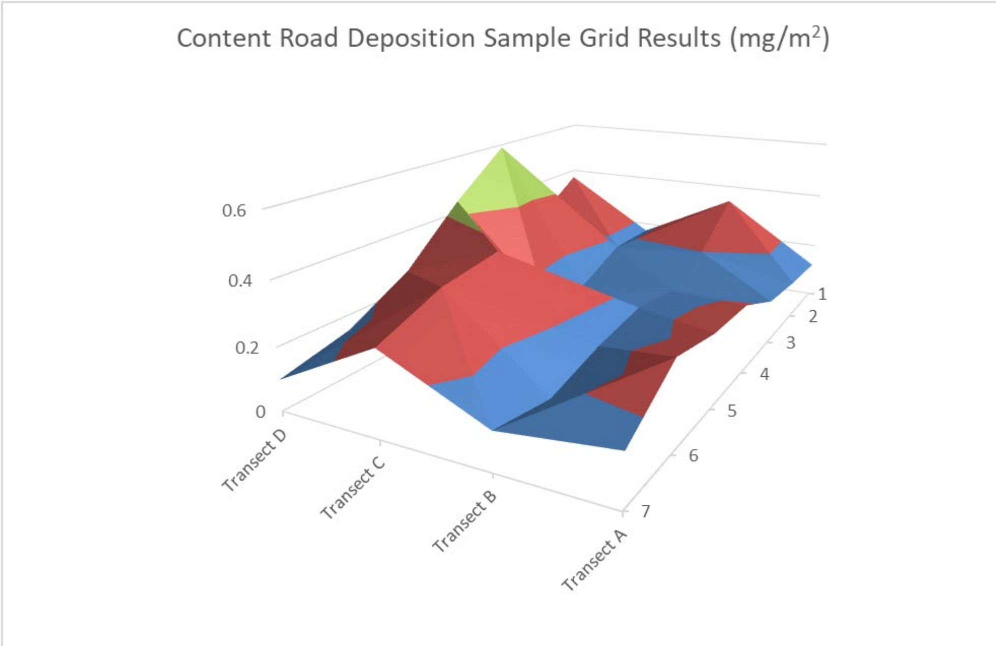


Figure 4. Diflubenzuron concentration on dye cards placed 150 feet apart in a grid.

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).

In recent years, APHIS alternates spray and no-spray (skipped) swaths resulting in treatment of 50% of an area where grasshopper populations are being suppressed. APHIS anticipates continuing using the RAATs method most often in the future. Starting early in the year, land manager meetings are held, submit letters of request for potential treatment areas. As grasshoppers or Mormon Crickets begin to hatch in May/June, and after PPQ employees survey these areas to determine actual populations, preliminary maps are prepared of the potential treatment areas. At densities of eight grasshoppers per square yard, APHIS and the land managers cooperatively decide if treatments are warranted. However, typically treatments will not occur unless the grasshopper population densities are consistently greater than ten per square yard. Generally, grasshopper densities of eight per square yard, or two per square yard for Mormon crickets may warrant intervention by the land manager.

3. Insecticide Applications at Conventional Rates with Total or 100% Coverage

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, chlorantraniliprole and diflubenzuron would cover all treatable sites within the designated treatment block per maximum treatment rates following label directions:

- 16.0 fluid ounces (0.50 lb a.i.) of carbaryl spray per acre
- 10.0 pounds (0.20 lbs a.i./ac treated) of 5 percent carbaryl bait;
- 8.0 fluid ounces (0.027 lbs a.i./ac sprayed) of chlorantraniliprole;
- 1.0-2.0 fluid ounce (0.016 lbs a.i./ac sprayed) of diflubenzuron;

The generalized potential environmental effects of the application of carbaryl, chlorantraniliprole, diflubenzuron, and malathion, 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 IV of this EA.

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.

Contractors participating in suppression programs in Wyoming must have a valid and current state of Wyoming pesticide license and pass the required exam. APHIS personnel hold both, a state of Wyoming commercial applicators license and passed tests in each category needed for application and a federal pesticide applicators license. Program managers oversee the mixing and loading of pesticide by contractors and monitor application rates to ensure proper calibration is maintained over the entire application process.

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 10 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.

`

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).

Aerial applicators contracted for suppression programs use GPS Navigation equipment to navigate and capture shapefiles of the treatment areas. All sensitive sites are buffered out of the treatment area and are shown in the final treatment area maps that go into the pilot's navigation system. All sensitive sites are reviewed in the daily briefing with APHIS personnel including the applicator working on the treatment site. No-spray buffers are greater than what the label requires, for a distance of 500 feet from sensitive sites. APHIS may collect chemical residue samples to monitor for off target spray drift during treatments. These include setting up oil-sensitive dye cards adjacent to sensitive areas. Field personnel also take periodic wind and weather readings and communicate them to the program manager who can cancel or delay aerial treatments to prevent pesticide drift and run off. Pesticide spills at loading and refueling sites are to be immediately contained and remedied by the contractor and are reported to the proper state pesticide regulatory officials.

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 Albany, Big Horn, Campbell, Carbon, Converse, Crook, Fremont, Goshen, Hot Springs, Johnson, Laramie, Natrona, Niobrara, Platte, Sheridan, Washakie, Weston counties, and Wind River Indian Reservation, Wyoming. Additionally, APHIS recognizes that concerns outside this area could necessitate protection buffers that extend into this area.

The size of this region is approximately 64,700 square miles (41,408,000 acres). The total relief is 10,690 feet and ranges from 3,114 feet to 13,804 feet at Gannett Peak. Grasshopper and Mormon cricket treatments occur primarily between 3,640 feet and 7,500 feet in this region. Semiarid shrub and grass covered plains dominate this region but alluvial valleys, volcanic plateaus, forested mountains, woodlands, shrubland covered hills, glacial peaks and wetlands are also present in places. Pine forests dominate the higher elevations. Annual

`

precipitation in the primary area of concern ranges from 6 inches to 22 inches. Precipitation is higher in the mountains. Temperatures can be extremely variable at any location. Summer temperatures in the 90's and low 100's are common in the lower elevations. Winter low temperatures are often well below 0 degrees Fahrenheit (ºF). The yearly mean temperatures for the region are 40 ºF to 48 ºF.

The major population centers are in the towns of Cheyenne and Casper. Smaller towns are located throughout the region. The total population is approximately 573,851 (2020 census figure).

Wyoming is the fifth driest state in the United States. More than 70 percent of the state receives less than 16 inches of precipitation on average each year. At 6,700 feet, Wyoming also has the second highest mean elevation in the United States. Mountain snowpack runs off to form the headwaters of Wyoming's major river systems and helps recharge aquifer systems. Three of America's major river systems have their headwaters in Wyoming: the Missouri, Colorado, and Columbia. Other major rivers include the Yellowstone, Bighorn, North Platte, Green, and Snake. Wyoming's six river basins contain another eighteen significant rivers of importance plus twenty reservoirs and twenty-one significant lakes. Numerous small streams, ponds, reservoirs, lakes, seasonal streams, and stock ponds are located throughout the area.

Alluvial and shallow bedrock aquifers produce most of Wyoming's groundwater. Groundwater is recharged naturally by rain and snowmelt. This precipitation plays a key role in replenishing groundwater resources under the earth's surface. This hydrologic process involves water moving downward from surface water to groundwater. Recharge for Wyoming's aquifers originates largely as rainfall or snowpack in the state's mountain ranges. During snowmelt in late spring and early summer, the water released infiltrates the ground surface to recharge underlying aquifers or it turns into runoff that contributes to stream and river flows. Wyoming's semi-arid basins, characterized by low precipitation, high evaporation, and reduced soil permeability, generally provide much less recharge to its aquifers. The state's alluvial aquifers interact closely with associated surface water flows. In high mountain catchments, groundwater contributes to streamflow when it is discharged from springs and seeps along "gaining" stream reaches. Further downstream, the flow of water may be reversed and the stream may recharge an associated alluvial aquifer in a "losing" reach. In many cases, gaining and losing reaches alternate along the same streambed depending on the relative elevations of groundwater and streamflow and local geologic conditions.

Major recreational areas in Wyoming include twelve state parks, twenty-four state historical sites, eight National Forests and one National Grassland. The roads through the region are a major thoroughfare for tourist traffic to and from Wyoming's two National Parks, two National Monuments, seven National Wildlife Refuges, two National Recreation Areas and 45 Wilderness Study Areas.

Domestic honeybee yards are found throughout Wyoming. Approximately 346 hobbyist (10 hives or less) apiarists and 100 general commercial apiarists make up the total registered 446 apiarists who operate approximately 48,000 bee yards and over 100 million bee hives in Wyoming. A large number of these colonies seasonally migrate to California to pollinate the almond orchards. Wyoming also has a hearty alfalfa seed production industry and alfalfa leafcutter bees are commonly used in some areas covered by this EA. Site specific locations can be found through apiary registrations at the Wyoming Department of Agriculture or checking with alfalfa seed producers in the case of leafcutter bees.

Agriculture is the number one industry in Wyoming economics, livestock grazing (primarily cattle, horses, sheep, some goats) occurs in every county in the state. Generally, the crops grown in the area covered by this EA are small grains such as wheat, barley, oats, irrigated and non-irrigated hay (alfalfa and grass), and irrigated row crops such as sugar beets, corn (silage and grain), and beans.

Many species of big game (antelope, mule deer, whitetail deer, elk, and others) and smaller animals (rabbits, squirrels, muskrats, beavers, minks, weasels, badgers, coyotes and foxes) range within the varied habitats. Livestock ponds, streams and reservoirs within the proposed treatment area provide a nesting and breeding habitat for waterfowl. Many nongame birds migrate through or nest in the region. Golden eagles, peregrine falcons and other raptors nest within the region and game birds (ringed necked pheasant, greater sage-grouse, wild turkey, Hungarian partridge, chukar and dove) are present. Recreational hunting is very important to the local economy.

Information on the species composition of grasshoppers is available from USDA APHIS PPQ in Cheyenne, Wyoming through the Wyoming Grasshopper Information System. The species of major economic importance are: *Ageneotettix deorum, Amphitornus coloradus, Anabrus simplex, Aulocara elliotti, Aulocara femoratum, Camnula pellucida, Cordillacris crenulata, Cordillacris occipitalis, Melanoplus bivittatus, M. differentialis, M. femurrubrum, M. infantilis, M. occidentalis, M. sanguinipes, Phlibostroma quadrimaculatum, Phoetaliotes nebrascensis, and Trachyrhachys kiowa*. Approximately 96 other lesser important species are represented in surveys from this region. These approximate 96 species may become economic pests if part of a high density species complex. Warm, dry weather is generally the most favorable for high populations, and severe loss of forage most often occurs in conjunction with drought.

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. APHIS only treats areas that are requested for treatment, and land managers will define requested areas they want excluded. All areas of critical habitat and federally protected species are discussed, and mitigation measures are addressed in Appendix 4 and consulted on with the USFWS.

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 the Council on Environmental Quality (CEQ) NEPA implementing regulations (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.

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. 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 in the same year reduce 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.

A majority of the suppression programs include federal land, which are generally not treated by the lessee prior to APHIS rangeland grasshopper suppression programs.

Other non-APHIS pesticide application activities may or may not take place in the vicinity of grasshopper suppression treatment areas. They may be undertaken by private applicators, members of the public, or state and county governments for a variety of reasons and without APHIS involvement. For instance, typically, mosquito control programs are an example of an activity where pesticide application is conducted in areas outside of grasshopper suppression areas, such as towns. These treatments are conducted by licensed county-personnel, not APHIS personnel. Mosquito abatement programs and their operations vary throughout Wyoming. In general, the approach is either to use larvicide or adulticide for mosquito suppression and conduct the applications in the early morning or at night when pollinators are not active.

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.

The 2002 EIS Appendix B, Environmental Risk Assessment for Rangeland Grasshopper Suppression Program – Insecticides, analyzed effects of various insecticide formulations and treatment rates and found minimal negative impacts for either carbaryl or diflubenzuron using the RAATs treatment strategies. "Diflubenzuron is only reported to be synergistic with the defoliant 'DEF' (NLM 1988)" (page 134). DEF is a defoliant registered for use in cotton crops with the active ingredient tribuphos (S,S,S-Tributyl phosphorotrithioate). Cotton crops are not grown in Wyoming, and no record of any of these compounds being used in Wyoming were found. For Carbaryl (all 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). Regarding cumulative effects of these program pesticides, pesticide use data as well as land use are analyzed below.

A 2019 study by Wieben, C.M. from the U.S. Geological Survey (USGS) published estimates of annual agricultural pesticide use by major crop type (or crop group) for states of the conterminous United States from 1992 to 2017. The most recent ten-year dataset (2008-2017) establishes general trends of pesticide use by crop in Wyoming specific to the three program chemicals (carbaryl, diflubenzuron, and chlorantraniliprole) considered for use in the program, though the exact formulations, rates, and county level spatial data are not specified.

Wyoming specific data from the 2019 Wieben USGS estimates study are shown in figure 5. These are the high estimates from the Wieben study; actual pesticide use will be lower. Low estimates of pesticide use used in this study are not displayed in this EA.

Over a ten year time span from 2008-2017 in Wyoming, an estimated 1,479,263.10 kilograms (kg) of pesticide were used on alfalfa, 1,089,110.40 kg of pesticide were used on corn, 977,774.70kg of pesticide were used on pasture and hay, 679,562.80 kg of pesticide were used on vegetables and fruits, 335,700.00 kg of pesticide were used on wheat, and 734,035.80kg of pesticide were used on other crops.

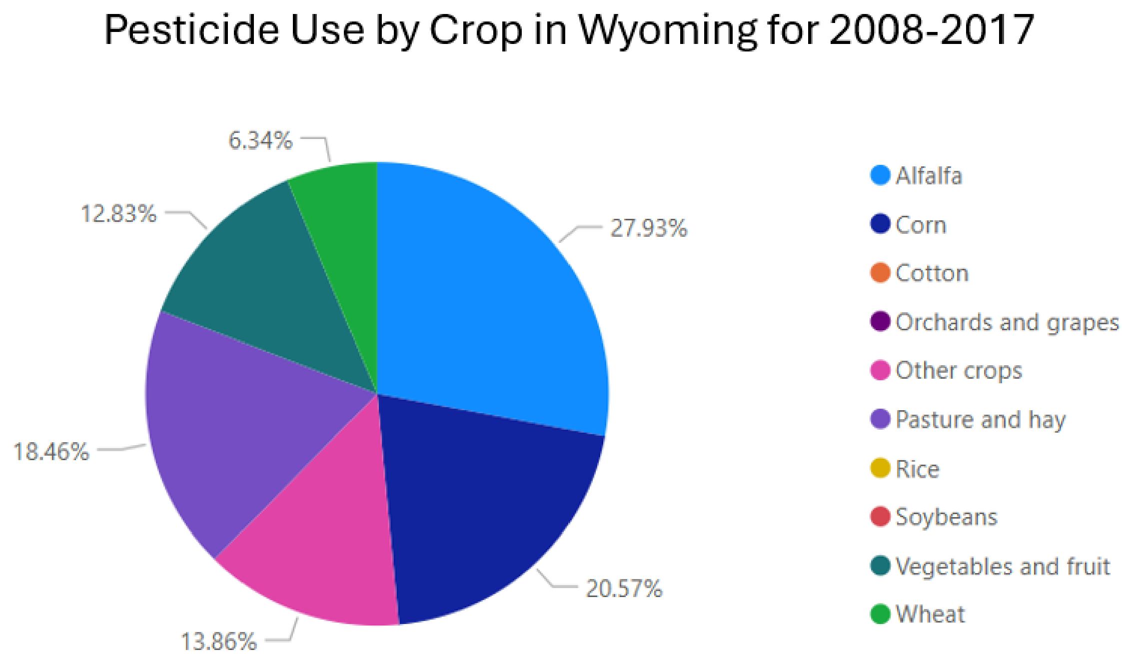


Figure 5. Estimated percentage of pesticide use by crop in Wyoming from 2008-2017.

The APHIS rangeland Grasshopper and Mormon Cricket Suppression Program is not primarily intended for the treatment of cropland which includes any fields planted with the intent to market as a harvested commodity, including hay. Private rangeland or pasture may be included in APHIS treatments, especially in areas where public, federal, state, and private land is interspersed in a checkerboard like pattern. Though these land use patterns are not common throughout much of Wyoming. However, these pesticide-use statistics from Wieben, C.M. (2019), likely do not include areas where APHIS treatment programs have occurred, or are likely to occur, due to the fact that APHIS led suppression programs are typically limited to publicly managed (or tribally managed) rangeland. Nevertheless, pasture is essentially high productivity rangeland and the closest 'stand in' for rangeland management captured in this data.

Hay and Pasture made up the third highest percentage of pesticide use by crop type in Wyoming. The graph below shows the major pesticide categories applied to Pasture and Hay from 2008-2017 in Wyoming. In sum, Hay and Pasture crops have a large share of the geographical size compared with other agricultural operations in Wyoming and require less agricultural pesticides and no routine insecticides

`

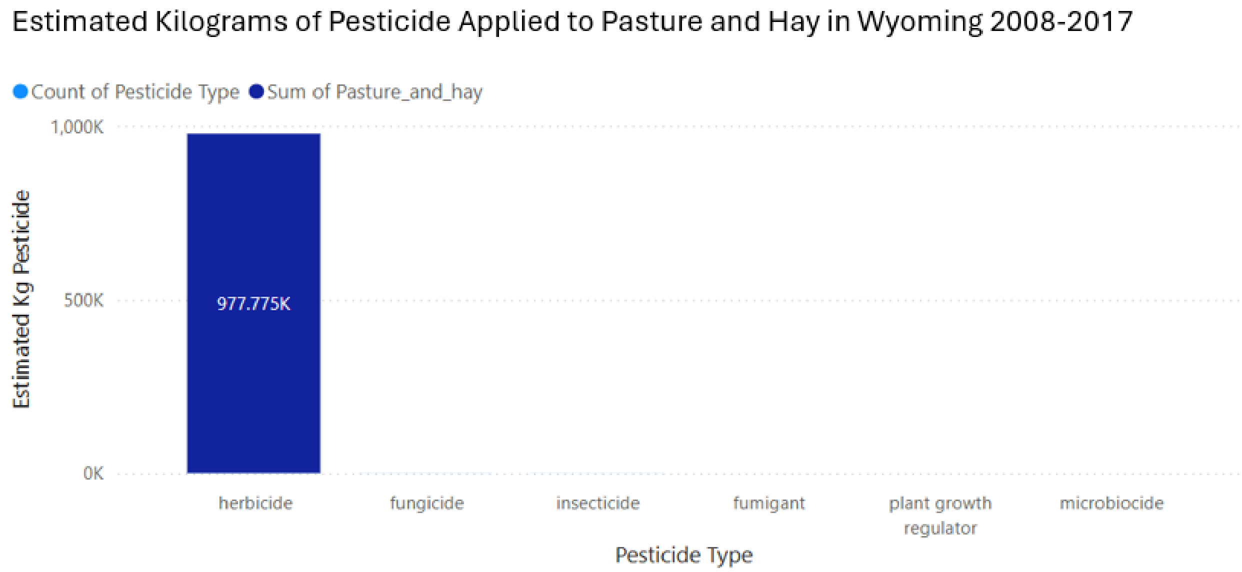


Figure 6. Estimated pesticide applied to Pasture and Hay (in kilograms) in Wyoming from 2008-2017.

Weeds pose one of the two biggest concerns when it comes to rangeland and pasture management in Wyoming (other concern being water/moisture). Many noxious weed species thrive in arid conditions common to rangeland ecosystems, increasing the frequency and intensity of wildfire and out-competing native and other ecologically beneficial species. Control methods include herbicide applications, mechanical control, prescribed grazing, and the utilization of biological control agents to target specific weed species. With a few exceptions, treatment of noxious weeds for the most part is accomplished via herbicide applications. Therefore, one can surmise that that herbicide applications occur on both private and public rangeland. Despite this, no cumulative or synergistic effects are anticipated to occur between the herbicides described above and the insecticides used during APHIS led grasshopper suppression programs.

Beyond requests for APHIS to conduct suppression of grasshopper outbreaks, insecticide application on federally managed rangeland is neither well documented nor anticipated. Insecticidal treatments on private low-value rangeland which is reflected by the lack of insecticide documentation contained in the analysis by Wieben, C.M., (2019).

Analyzing the three program approved chemicals, starting with diflubenzuron, the chemical's use in Wyoming has been extremely uncommon in crop treatments. The chemical was only documented in Wheat and Alfalfa for a total of 384.30 kg over a 10-year period, or an average of 38 kg per year. It is important to note that diflubenzuron is a restricted use pesticide, which may account for its low total use during this period compared to some others.

Diflubenzuron Usage (Kilograms) Per Year

Compound	Year	Alfalfa	Corn	Cotton	Orchards and grapes	Other crops	Pasture and hay	Soybeans	Rice	Vegetables and fruit	Wheat
DIFLUBENZURON	2010	107.50									
DIFLUBENZURON	2011	189.70									1.60
DIFLUBENZURON	2014	22.80									
DIFLUBENZURON	2015	14.60									
DIFLUBENZURON	2016	11.90									
DIFLUBENZURON	2017	37.80									
Total		**384.30**									**1.60**

Table 1. Estimated diflubenzuron application (in kilograms) in Wyoming across crop types for 2008-2017.

Chlorantraniliprole is another APHIS approved pesticide considered under this EA; however, it has not been used by the program in Wyoming to date. The chemical also appears to be rarely used for crop treatments elsewhere in Wyoming, with low usage on record for the treatment of Alfalfa and other crops in 2012 and 2013.

Chlorantraniliprole Usage (Kilograms) Per Year

Compound	Year	Alfalfa	Corn	Cotton	Orchards and grapes	Other crops	Pasture and hay	Soybeans	Rice	Vegetables and fruit	Wheat
CHLORANTRANILIPROLE	2012					40.00					
CHLORANTRANILIPROLE	2013	20.00								0.00	
Total		**20.00**				**40.00**				**0.00**	

Table 2. Estimated chlorantraniliprole application (in kilograms) in Wyoming across crop types for 2008-2017.

Unlike diflubenzuron and chlorantraniliprole, carbaryl has been applied more in Wyoming between 2008-2017. Carbaryl is a faster acting and broader spectrum insecticide and is not classified as a restricted use pesticide. Both factors make it a more popular choice for use by the public compared to other chemicals.

Carbaryl Usage (Kilograms) Per Year

Compound	Year	Alfalfa	Corn	Cotton	Orchards and grapes	Other crops	Pasture and hay	Soybeans	Rice	Vegetables and fruit	Wheat
CARBARYL	2008	5,737.80									
CARBARYL	2009	25,843.10									
CARBARYL	2010										1.50
CARBARYL	2011										87.80
CARBARYL	2014									0.00	
Total		**31,580.90**								**0.00**	**89.30**

Table 3. Estimated carbaryl application (in kilograms) in Wyoming across crop types for 2008-2017.

`

The dataset from Wieben C.M., (2019) is currently the best analysis available for crop pesticide application in the state of Wyoming. Based on this data, there is no evidence that cumulative impacts would occur because of APHIS led grasshopper suppression programs given the low use of program insecticides overall, and the likely lack of geographic or crop usage overlap.

APHIS continues to provide interested landowners and other members of the public information concerning program pesticides, timing and preferred application (i.e. RAATs) through technical assistance and public meetings. APHIS will continue to evaluate chemical application data as it becomes available.

APHIS has prepared this EA for the counties previously listed because treatments could be requested if grasshopper populations reach outbreak levels. Past experience and continuing land use, climate, and grasshopper population conditions 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. Requested treatments may not end up occurring for various reasons including land managers not following through with cooperative program obligations, land managers withdrawing their request for suppression assistance, or a lack of funding.

Treatments conducted by APHIS generally occur for a variety of reasons including land use, land ownership, grasshopper densities, landowner/managers' familiarity with the program, and other considerations. Historically, treatments occur more frequently in the central and eastern half of Wyoming.

`

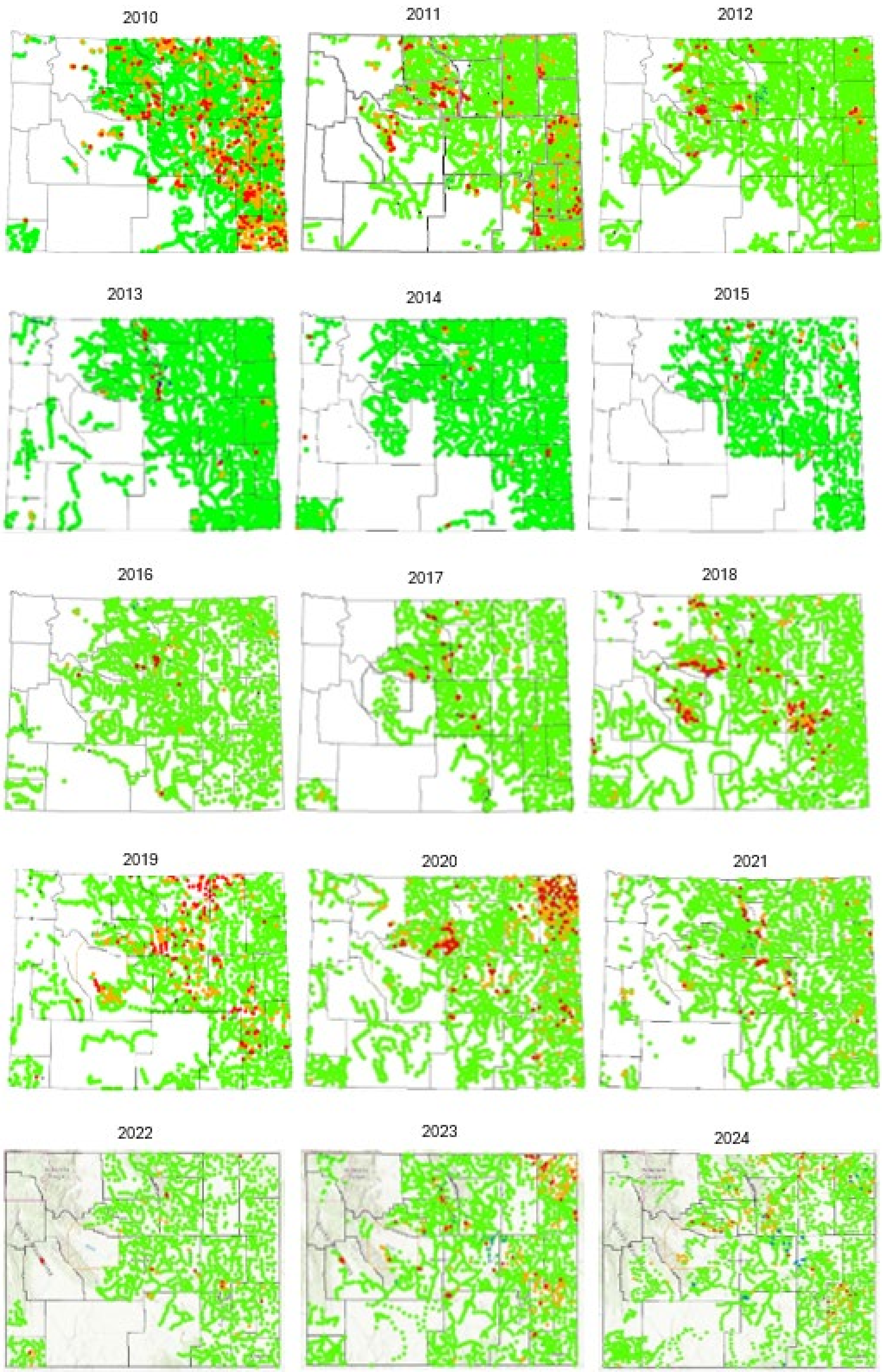


Figure 7. Grasshopper outbreak trends in Wyoming from 2010-2024.

`

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

The rangeland areas where treatments may occur are sparsely populated by isolated ranch units having mainly cattle operations and "ranchettes" (homesteads generally five acres or less). Rangeland grazing is the predominant livestock feeding method.

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, hospitals and tribal agencies will be notified prior to any treatment as an advisory to access any safety risk, the treatment date and location and contact personnel.

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 rural areas covered under this EA are between 0.2 and 7.1 persons per square mile (United States Census Bureau, 2018).

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).

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.

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 Wyoming 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 may not be factored into these calculations, nor is density based on quantity of habitat. 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.

In Wyoming, species wide population estimate data is available from the 'Wyoming Natural Diversity Database' Website (www.uwyo.edu/wyndd), a University of Wyoming and State of Wyoming program. WYNDD is a member of the Natural Heritage Network. These sites detail species occurrences throughout the state of Wyoming. Population and distribution data relies heavily on documented occurrences.

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. 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.). 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). 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 bees communities across broad Canadian ecoregions Kohler et al, 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.

Wyoming, a state that is approximately 85% rangeland, has a diverse landscape of plants and pollinators. Wyoming plant communities are mostly categorized as either a sagebrush steppe or shortgrass prairie (Mealor and Kruger). The University of Wyoming has inventoried many of the plant and pollinator species that exist within Wyoming. Though not an exhaustive list, the inventory includes a variety of bees from the families Andrenidae, Apidae, Colletidae, Halictidae, and Megachilidae, and a variety of butterflies from the families Hesperiidae, Papiliondae, Pieridae, Lycaenidae, and Nymphalidae.

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.

The monarch butterfly (*Danaus plexippus*), Suckley's cuckoo bumble Bee (*Bombus suckleyi*), and the western regal fritillary (*Argynnis idalia*, sometimes known as *Sepeyeria idalia*) are three invertebrate pollinators that occur in rangeland across Wyoming that are of special concern. The USFWS proposed listing of the monarch butterfly and Suckley's cuckoo bumble bee under the Endangered Species Act in December of 2024. Similarly, the eastern and western subspecies of the regal fritillary were also proposed for listing as threatened in August 2024.

The monarch butterfly (*Danaus plexippus*) is a conspicuous insect that has experienced population declines over the past few decades. There are several factors which may be contributing to this butterflies' dwindling populations, habitat loss is considered the most significant threat to monarchs. In the United States, loss of milkweed, a host plant, particularly in the Midwest, has greatly reduced the available breeding habitat for monarchs. This has led to extensive efforts to conserve and restore milkweed resources throughout the Midwest (Brym etal. 2020).

Major stressors on monarch populations in North America are widely considered to be habitat loss, climate change, and increase use of pesticides (Thogmartin etal. 2017).

Neonicotinoid use in North America increased dramatically from 1994–2011, coinciding with a 55–67% decline in the size of monarch overwintering populations recorded by Douglas & Tooker (2015). James (2024) suggests that neonicotinoid use is the primary driver to the decline of Western Monarch since 1997. The class of insecticides used by APHIS does not include neonicotinoids. The other factors of habitat loss and climate change are detailed by James (2024) to climate factors in California during which winter storms, flooding and high winds contributed to the "textbook extinction vortex" which led to an 86% decline in overwintering populations.

There are two populations of monarch butterfly in North America, separated by the continental divide (i.e. west and east of the Rocky Mountains). In the fall, monarchs in the more temperate western and eastern regions of the United States migrate long distances and overwinter in coastal California and parts of Mexico, respectively. In the spring and summer, monarchs again migrate vast distances to their spring and summer breeding grounds which encompass much of the United States. The entire state of Wyoming is within the summer breeding areas for the species, with western and eastern populations separated by the Rocky Mountains.

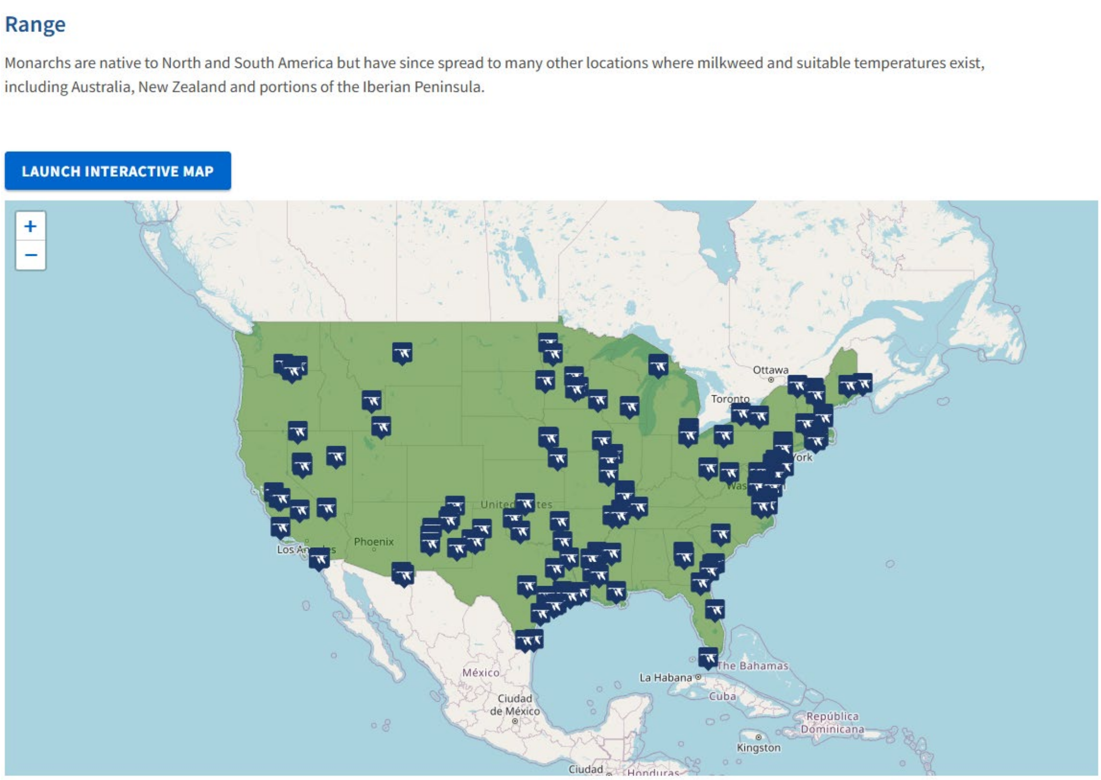


Figure 8. Range map of monarch butterfly. Map from U.S. Fish and Wildlife Service (https://www.fws.gov/species/monarch-danaus-plexippus).

Milkweed species are a necessity in the species lifecycle, particularly for oviposition and larval feeding. In western North America, milkweed and other nectar resources are most often associated with riparian corridors but also grow in a variety of habitats including roadsides and other heavily disturbed areas, fields, prairies, grasslands, and areas with soils that are typically sandy, loamy, rocky, and dry.

The Suckley's cuckoo bumble bee is a rare pollinator species that has been historically found in several habitats including prairies, grasslands, and meadows across the western United States, including Wyoming. However, populations of the species are thought to be currently much more fragmented, with the last confirmed sighting of the species occurring in Oregon in 2016. Suckley's cuckoo bumble bee is a special parasitic species and is dependent on other bumble bee host species. Thus, population declines of the species could be linked to concomitant declines of other pollinating bumble bee.

Current range maps are only shown within the jurisdictional boundaries of the United States of America. The species may also occur outside this region.

- **Listing status:** **Proposed Endangered**
  - **States/US Territories** in which this population is known to or is believed to occur: Arizona, California, Colorado, Idaho, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wisconsin, Wyoming
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur:
  - **Countries** in which this population is known to occur: Canada, United States

Figure 9. Range of Suckley's cuckoo bumble bee. Map from U.S. Fish and Wildlife Service Environmental Conservation Online System (https://ecos.fws.gov/ecp/species/10885).

Another rare pollinator species, the regal fritillary is a butterfly species divided into two subspecies consisting of eastern and western populations. The eastern regal fritillary is currently only found in a single location at a National Guard installation in Annville, Pennsylvania. However, the western subspecies, the western regal fritillary, is found in several central and western states. The species habitat preferences include wet meadows, prairie in proximity to marshes, and grasslands containing flowering plants and forbs. Dense grassland vegetation provides shelter for the species across all life. Regal fritillaries rely on violet species as a host plant for nectar resources and to supplement larval growth stages (U.S. Fish and Wildlife Service. Regal Fritillary).

Current range maps are only shown within the jurisdictional boundaries of the United States of America. The species may also occur outside this region.

- **Wherever found**

  Listing status: **Proposed Threatened**

  - **States/US Territories** in which this population is known to or is believed to occur: Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, Oklahoma, South Dakota, Wisconsin, Wyoming
  - **US Counties** in which this population is known to or is believed to occur: View All
  - **USFWS Refuges** in which this population is known to occur:

Figure 10. Range of regal fritillary. Map from U.S. Fish and Wildlife Service Environmental Conservation Online System (https://ecos.fws.gov/ecp/species/12017).

APHIS will continue to use WYNDD.org to help identify occurrences of monarch butterfly, Suckley's cuckoo bumble bee, and regal fritillary in Wyoming. APHIS will also continue to annually consult with local USFWS to discuss areas of milkweed and minimize the potential for exposure of monarchs to program insecticides.

According to the 2019 Rangeland Grasshopper and Mormon Cricket Program Final EIS, some programmatic pesticides may minimally impact larval stages of the lepidopteran species, particularly diflubenzuron, due to the pesticide being an insect growth regulator. APHIS will continue to consult with the USFWS regarding these sensitive pollinator species should they become listed for protections under the Endangered Species Act. More analysis of program applied pesticides and their possible effects on terrestrial invertebrate species is provided in the Environmental Consequences of the Alternatives section of this EA.

Vertebrates occurring in rangelands of areas covered under this EA 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).

The tricolored bat (*Perimyotis subflavus*) is one of the smallest bats native to North America. The once common species is wide ranging across the eastern and central United States and portions of southern Canada, Mexico and Central America. During the winter, tricolored bats are found in caves and mines, although in the southern United States, where caves are sparse, tricolored bats are often found roosting in road-associated culverts. During

`

the spring, summer and fall, tricolored bats are found in forested habitats where they roost in trees, primarily among leaves. As its name suggests, the tricolored bat is distinguished by its unique tricolored fur that appears dark at the base, lighter in the middle and dark at the tip. White-nose syndrome, a disease that impacts bats, is caused by a fungal pathogen. It has led to 90 to 100% declines in tricolored bat winter colony abundance at sites impacted by the disease. Since white-nose syndrome was first observed in New York in 2006, it has spread rapidly across the majority of the tricolored bat range (U.S. Fish and Wildlife Service. Tricolored Bat).

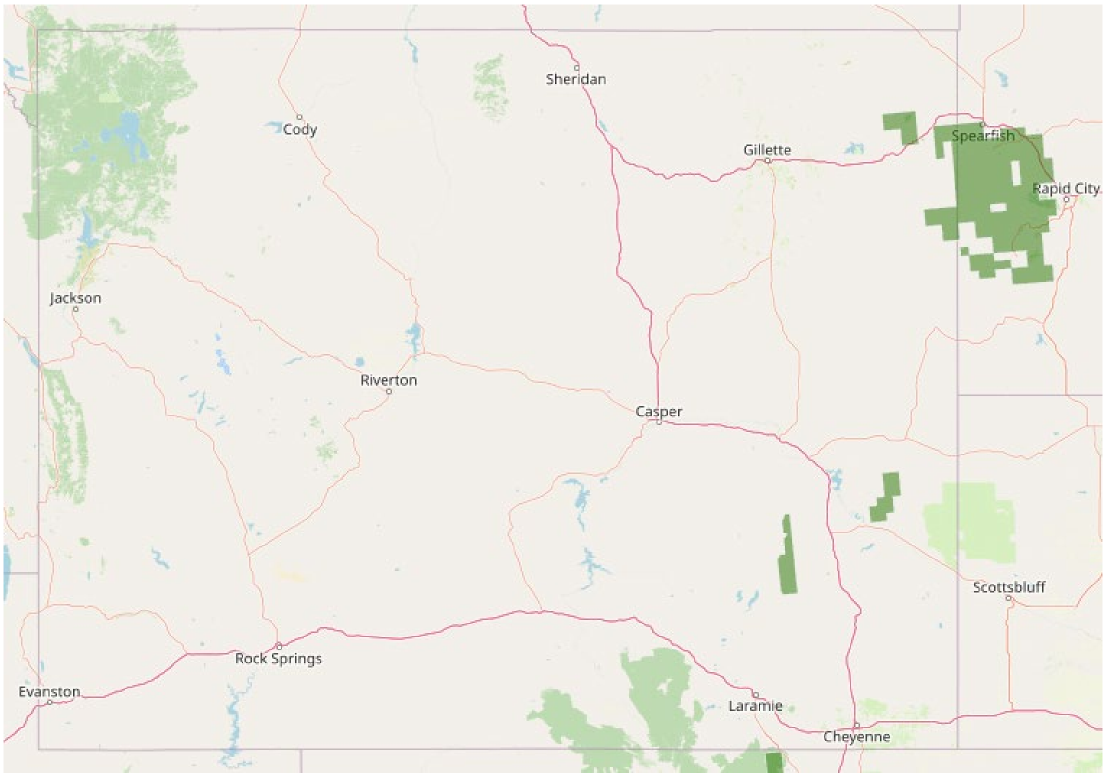


Figure 11. Range of tricolored bat in Wyoming. Map from U.S, Fish and Wildlife Service (https://www.fws.gov/species/tricolored-bat-perimyotis-subflavus).

APHIS will continue to use WYNDD.org to help identify occurrences of tricolored bat in Wyoming. APHIS will also continue to annually consult with local USFWS to discuss areas of concern and known hibernacula to minimize the potential for exposure of tricolored bats to program insecticides.

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 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.

`

The Wyoming Game and Fish Department (WGFD) and Bureau of Land Management (BLM) have indicated concern regarding the impacts of grasshopper suppression programs on Greater Sage-Grouse, hereafter referred to as sage-grouse. Potential impacts to sage-grouse from grasshopper suppression programs include: the toxicity effects from the chemicals used in grasshopper suppressions, the effects to the food base of the sage-grouse, and the physical disturbance factors related to a grasshopper suppression program. Wyoming historically supports larger populations of sage-grouse than other states due to the approximately 50% of land area that is composed of sagebrush habitats (Patterson 1952).

Concern and protection of sage-grouse in Wyoming has been a priority for leaders in Wyoming for many years and has been expressed through the Governor's Executive Orders. Throughout the years, Executive Orders 2008-2, 2010-4, 2011-5, 2013-3, 2015-4, 2017-2, and 2019-3 have protected sage-grouse and their habitat and developed management strategies. The Governor's Sage-Grouse Implementation Team developed the sage-grouse core population area concept in order to protect critical habitat from further degradation. Executive Order 2019-3 supersedes all previous executive orders. The BLM currently manages sage-grouse according to the 2015 Record of Decision and Approved Resource Management Plan Amendments for the Rocky Mountain Region on Wyoming BLM Administered Public Lands Including the Federal Mineral Estate.

Sage-grouse as a species of concern was addressed in the 2002 EIS and is addressed in the updated 2019 EIS. While it is clear that diflubenzuron poses less direct toxicity to sage-grouse than carbaryl, toxicities were analyzed in the risk assessment and concluded that grasshopper suppression RAATs alternatives would not directly affect sage-grouse for any of the proposed insecticides.

The effect of grasshopper suppression programs to the food base of the sage-grouse can be important during the early brood rearing timing of the sage-grouse life cycle. Study results indicate that sage-grouse chicks require insects for survival until about three weeks of age (Johnson, May 1987). For most of Wyoming, this timing coincides with the earliest likely timing of grasshopper suppression programs. In order to limit the effects to the food base of the sage-grouse APHIS PPQ will utilize grasshopper suppression RAATs alternatives within sage-grouse core population areas. By using the RAATs method, effects to non-target insects and grasshoppers will be reduced. The Governor's Executive Order 2019-3 specifically lists Grasshopper/Mormon cricket control following Reduced Agent Area Treatments (RAATs) protocols as a de-minimis (exempt) activity under Appendix G, "De-minimis Activities".

In extreme cases, grasshopper infestations may be so damaging that crucial sage-grouse habitat is compromised. These areas may not be apparent in time to use diflubenzuron and a faster knockdown may be required to protect the habitat. For these situations, APHIS reserves the ability to use carbaryl and chlorantraniliprole in sage-grouse core population areas. If treatments are late enough in the season that diflubenzuron is deemed ineffective, then it is also most likely that sage-grouse chicks will be mature enough that they will have adjusted their diet to a mixture of forbs and sage brush versus insects only. Situations that require the use of carbaryl or chlorantraniliprole within sage-grouse core population areas will be considered on a case by case situation only with input from the land manager, landowner and WGFD.

In 2015 the USFWS requested data from 11 western states, including Wyoming, to aide in the ESA listing decision of the sage-grouse. The data included sage-grouse populations' status, trends and numbers, habitat status and trends, hunting and other uses, disease and predation, impacts from pesticides, contaminants, recreational activities, and any literature pertinent to the USFWS status review. The compiled data demonstrated Wyoming's commitment and assurance to sage-grouse conservation and the determination of the western states to conserve sage-grouse habitat and protect the sage-grouse species logistically and financially. Reviews of the complied data lead to the United States Department of the Interior determining that listing the sage-grouse range wide as a threatened or endangered species was precluded making it a candidate species which will not receive statutory protection under the ESA. Sage-grouse are no longer considered a candidate species by the U.S. Fish and Wildlife Service (50 FR 24292). In the WGFD 2017 State Wildlife Action Plan, sage-grouse are identified as a Tier II SGCN (Tier II is moderate priority). If grasshopper suppression treatments are requested in sage-grouse core population areas, APHIS PPQ will consider additional conditions and mitigation measures outlined in the request. Discussions with local entities such as WGFD and BLM will also occur to determine appropriate steps to suppress grasshopper populations and protect sage-grouse populations and habitat ranges.

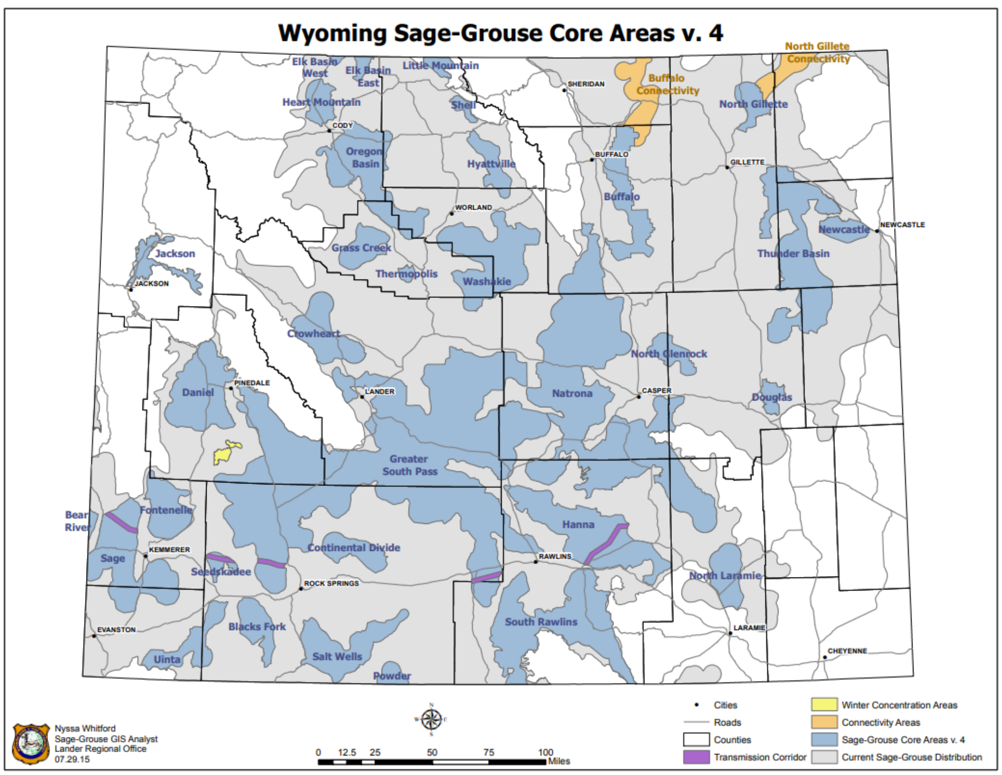


Figure 12. Map of Wyoming sage-grouse core areas, connectivity, and winter concentration areas. Map from WGFD (Webpage: https://wgfd.wyo.gov/wyoming-wildlife/sage-grouse-management/sage-grouse-data, Map pdf: https://wgfd.wyo.gov/media/2465/download?inline).

`

An assorted community of terrestrial plants occurs within the proposed suppression area. Many are considered as non-native, invasive weeds including annual grasses (e.g. cheat grass, Venenata), 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.

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 1 to 4 mm 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 (e.g. fungi and fungus-like organisms, algae and lichens, non-vascular plants, earthworms and other annelids, both terrestrial and aquatic microorganisms) are often less visible in rangelands of Wyoming but are nonetheless present and contribute to these ecosystems in various ways.

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 21 federally listed species including Black-footed Ferret, Canada Lynx, Grizzly Bear, Northern Long-eared Bat, Preble's Meadow Jumping Mouse, Wyoming Toad, Yellow-Billed Cuckoo, Colorado River Fish Species (Bonytail, Colorado Pikeminnow, Humpback Chub, Razorback Sucker), Kendal Warm Springs Dace, Platte River Species (Pallid Sturgeon, Piping Plover, Western Prairie Fringed Orchid, Whooping Crane), Western Glacier Stonefly, Blowout Penstemon, Desert Yellowhead, Ute Ladies'-tresses, and Whitebark Pine, although not all occur within or near potential grasshopper suppression areas.

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:

> "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.

APHIS completed a programmatic Section 7 consultation with NMFS for use of carbaryl 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.

APHIS considers the role of pollinators in any consultations conducted with the USFWS to protect federally listed plants. Mitigation measures, such as no treatment buffers are applied with consideration of the protection of pollinators that are important to a listed plant species.

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.

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.

There is special concern about the role of grasshoppers as a food source for some bird species in rangeland habitats (see Species of Concern List in Appendix D) in areas covered under this EA. Grasshopper suppression programs reduce grasshoppers and at least some other insects in the treatment area that can be a food item for some of those species, including sage grouse chicks, however grasshopper suppression programs do not completely eradicate grasshopper populations in a treatment area. 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, ideally less than

`

eight grasshoppers per square yard. Should grasshoppers be unavailable in small, localized areas, sage grouse chicks may consume other insects, which those species including sage grouse chicks 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 other species habitat.

APHIS works closely BLM throughout the rangeland grasshopper and Mormon cricket suppression program process. BLM is consulted on all treatment blocks, and BLM provides exclusions and mitigation measures based on BLM specific policies.

APHIS has compiled a list of species of concern (SOC) that may occur within rangeland ecosystems and habitats within the area covered under this EA. This list of species can be viewed in Appendix D. This list was compiled using the WYNDD Natural Heritage Program Species List tool. This tool allowed APHIS to view lists for BLM sensitive species, USFS sensitive species, USFWS species of local concern, and Wyoming Game and Fish Tier Ranks and species of greatest conservation need. Species are then evaluated for rangeland presence. While aquatic habitats may occur within rangeland ecosystems, these species were not included within the SOC appendix because aquatic habitats are excluded from treatment areas by 500 foot or greater with protective no-spray buffers. Because of these buffers, no harmful effects are expected to be caused by suppression programs, thus aquatic species such as fish are not included in Appendix D.

Any potential effects to species of concern listed in Appendix D are evaluated on a species class level, already discussed within this EA. APHIS is not required by the state of Wyoming to consult on species that are not federally protected but has included this consideration and discussion of effects on SOC to ensure the completeness of our environmental analysis. Discussion of potential effects determinations to federally listed species that occur within the areas covered under this EA can be referenced by viewing Appendix C-G the Final 2024 National USFWS Grasshopper Mormon Cricket Suppression Program Consultation.

APHIS also implements several best management practices in the program's 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

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. It is also the home for many insects and microorganisms. It 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 top soil 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.

Geologic processes in Wyoming have shaped the region's topography and its agricultural productivity today. Sedimentary deposits, glacial deposits, and alluvial plains have resulted in fertile soils that have provided a foundation for assorted agricultural practices. However, large swaths of the region are not suitable for agriculture practices. This is because these areas are too rugged, prone to wind and water erosion, and lack organic matter in the soil.

The soils characterized in Wyoming vary and are influenced by a semi-arid climate and a topography made up of grasslands and hilly, mountainous terrain. These soils include Mollisols, Aridisols, Alfisols, Entisols, and Inceptisols. Molisols and alfisols nearby major river valleys are the most suitable for ranch and crop-based agriculture activities.

b) Hydrology and Water Resources

Major water resources in Wyoming covered under this EA include, but are not limited to: Missouri River Watershed, South Platte River Watershed, Colorado River Watershed, Columbia River Watershed, Great Salt Lake Watershed, Pathfinder Reservoir, Glendo Reservoir, Boysen Reservoir, Alcova Reservoir, Guernsey Reservoir, and Lake De Smet. Numerous other small streams, ponds, reservoirs, lakes, seasonal streams, and stock ponds are located throughout the area covered under this EA.

c) Air Quality and Climate

Wyoming is historically a harsh, semi-arid climate with cold winters, hot summers, and low precipitation. Average yearly rainfall is between 10 to 16 inches, making the region prone to droughts and subsequent wildfires. Agricultural challenges are reflected in a short growing season and harsh arid climate. Air quality is generally good but can be affected by seasonal dust storms, wildfires, winter inversions, and agricultural activities.

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).

Agriculture is a very important part of Wyoming's economy. A vast majority of the land covered by this EA is used primarily for agricultural purposes, either rangeland or cropland. Most of the irrigated cropland lies along river corridors and are not included in any APHIS treatments. Predominant dryland crops are small grains with occasional pulse crops in certain areas. Dryland hay can be common with its harvested product utilized the same way as rangeland, as feed for livestock, generally during winter months. Livestock grazing of rangeland by cattle, sheep, horses and wild animals is the dominant use throughout the area. Most of the communities in this area are dependent on agriculture.

Livestock grazing is one of the primary uses of rangeland in the area and is the dominate agricultural activity in many areas. Livestock enterprises include rangeland grazing by cattle, sheep, and horses; feedlots for beef; and concentrated dairy and hog farms. Rangeland may be utilized for grazing during the summer or reserved for fall and winter grazing.

As previously described, beekeepers maintain hives to produce honey and other bee products in Wyoming. Alfalfa, seed crops, and tree fruits rely on pollination from bees which may nest or forage on or near proposed suppression areas. Domestic honeybee yards are found throughout Wyoming. Wyoming also has a hearty alfalfa seed production industry and alfalfa leafcutter bees are commonly used in some areas covered by this EA.

Much of the land in the potential suppression area is publicly owned. Wyoming's public lands encompass a significant portion of the state, with half of Wyoming's lands federally managed as national parks, forests, and wildlife refuges. Key public land management agencies include the BLM and the U.S. Forest Service. These lands offer diverse recreational opportunities such as hiking, camping, fishing, and hunting.

This area also contains many parks, wilderness areas, public forests, and wilderness study areas administered by federal, state or local governments. There may also be areas of rangeland habitat considered as sensitive areas for the survival of non-listed species of concern.

The general public uses rangelands in the proposed suppression area for a variety of recreational purposes including hiking; camping; general wildlife viewing and bird watching, insect collecting and watching; hunting; falconry; shooting; plant collecting; rock and fossil collecting; artifact collecting; sightseeing; and dumping. Members of the general public traverse rangelands in or near the proposed suppression area by various means including on foot, horseback, all-terrain vehicles, bicycles, motorcycles, four-wheel drive vehicles, snowmobiles, and aircraft.

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.

APHIS asks all cooperators, if there are any areas with historical, cultural, or other significance that they'd like excluded from pesticide application. APHIS works directly with Tribes and the Bureau of Indian Affairs to determine any area with historical, cultural or other significant to be excluded from requested treatment areas. APHIS also works closely with BLM to review all shapefiles of BLM lands that leasers request to be treated and direct APHIS on any necessary exclusions.

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 review of the 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.

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 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).

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, non-target wildlife, and its environmental fate in soil, air, and water. The assessments rely on data required by USEPA for pesticide product registrations, as well as peer-reviewed and other published literature. The HHERAs are heavily referenced in the 2019 EIS and this Draft EA is likewise tiered to that analysis (USDA APHIS, 2019a, 2019b, 2019c, 2019d). 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 the area covered under this EA, the responsibility would rest with private parties, as no other federal agencies would likely be involved due to the fact that National MOU's with BLM, USFS, and BIA rely on APHIS to complete this work. Occasionally, county governments may provide reimbursement to landowners who conduct their own treatments. The most economical choice of pesticides available to private parties would be up to the land manager. APHIS discusses insecticides approved for use by the program and explains their benefits in conjunction with the RAATs approach but does not explicitly recommend specific insecticide brands to private parties. The conventions of IPM APHIS has 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 land owners 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 land owners. 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 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 land owners 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 a 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, chlorantraniliprole, 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 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 ($\log K_{ow}$) is the relative concentration of a chemical in n-octanol versus water at pH 7, 20°C. Higher values of $\log K_{ow}$ indicate greater lipophilicity (and a lower affinity for water). Since carbaryl has a $\log K_{ow}$ 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 pKa < 7 are most likely to reach vascular tissue and mobilize systemically throughout the plant. A 'neutral' pKa 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 (LD_{50}) 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 honeybees, which had come in contact with rapeseed plants (*Brassica napus*) sprayed with carbaryl wettable powder. Honeybee 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 honeybee 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.) 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 honeybees 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 can be harmed by acute exposures to carbaryl, but the studies were at rates above those proposed in the program. The chronic exposures and effects modelled in the studies described above are unlikely to result from one-time applications conducted by the program. 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 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) Chlorantraniliprole

Chlorantraniliprole (Rynaxypyr™) is a recently introduced insecticide that belongs to the anthranilic diamide insecticide class. The mode of action is the activation of insect ryanodine receptors which causes an uncontrolled release of calcium from smooth and striated muscles that impairs muscle regulation and causes paralysis in insects (USEPA, 2008). Although these receptors occur in mammals, the insecticide is very selective to insect ryanodine receptors with more than 350-fold differential selectivity compared to mammalian receptors (Cordova et.al. 2006, USEPA, 2008). Primary activity of chlorantraniliprole is through ingestion with some contact toxicity against lepidopteran pests but also against Orthoptera, Coleoptera, Diptera, and Hemiptera pests (Hannig et al., 2009).

(1) Human Health

Chlorantraniliprole is considered practically nontoxic via oral, dermal, and inhalation exposures (DuPont, 2012; USEPA, 2008). Median lethality values (LD50) from oral and dermal exposure to the active ingredient, chlorantraniliprole, and the proposed formulation exceeded the highest concentration tested (5,000 milligrams/kilogram (mg/kg)). Inhalation toxicity is also very low for the technical material and the formulation (Vantacor®) with median lethality values exceeding the highest test concentration (5.16 mg/L, 4.0 hours exposure, dust/mist atmosphere). Available acute toxicity data suggests that the acute toxicity between the active ingredient and the formulation are comparable. Chlorantraniliprole is not considered to be carcinogenic or mutagenic and is not known to cause reproductive or developmental toxicity. The no observable effect level (NOEL) in reproductive and developmental toxicity studies was 1,000 mg/kg/day, or the highest concentration tested (USEPA, 2008). Studies designed to assess neurotoxicity and effects on the immune system show no effects at a range of doses from the low mg/kg range to greater than 1,000 mg/kg.

Exposure and risk to all population groups is expected to be negligible. The potential for exposure is greatest for workers from handling and applying Vantacor®, however the very low toxicity and label required personal protective equipment result in minimal exposure and risk to this subgroup of the population. Exposure and risk to the general public will also be negligible based on program use of Vantacor®. Conservative estimates of potential groundwater contamination using standard USEPA models suggest residues would be orders of magnitude below any levels of concern for the general public, including children. Drift may occur during applications however program restrictions regarding treatment proximity to schools, and other measures to reduce drift, will minimize the potential for exposure and risk to the general public (USDA APHIS, 2013).

(2) Nontarget Species

USDA APHIS (2019b) assessed the available literature regarding the toxicity of chlorantraniliprole to animals. In summary, the report indicates the chemical is of low toxicity to most terrestrial invertebrates, practically non-toxic to honeybees, low toxicity to fish, and is practically nontoxic to birds and mammals (USDA APHIS, 2019b). Aquatic invertebrates are more sensitive to chlorantraniliprole when compared to fish (USDA APHIS, 2019b). No reptile toxicity data appears to be available. In those cases where reptile toxicity data is not available, the avian data has been used as a surrogate to characterize sensitivity to reptiles. Chlorantraniliprole would be expected to be practically nontoxic to reptiles based on the available avian toxicity data (USDA APHIS, 2019b). The lack of toxicity in other insect groups at rates that are toxic to grasshoppers is related to the activity of chlorantraniliprole, which is primarily through ingestion. Insects such as grasshoppers and larval Coleoptera and Lepidoptera would receive a larger dose from consuming treated plant material, compared to many of the non-target pests that do not eat plants.

Toxicity to most non-target organisms is low based on available toxicity data. Acute toxicity for terrestrial wildlife such as mammals and birds is very low with median lethality values exceeding the highest concentration tested for mammals and birds, such as bobwhite quail and the mallard (USEPA, 2012b).

Acute fish toxicity is low with median lethality values (LC50) for freshwater and marine test species above the highest test concentration. Amphibian toxicity data does not appear to be available however based on the reported toxicity values for fish, the toxicity to amphibians is expected to be low. Aquatic invertebrates are more sensitive to the effects of chlorantraniliprole with median lethality and effect concentrations ranging from 0.0098 milligrams per liter (mg/L) for the freshwater cladoceran, *Daphnia magna*, to 1.15 mg/L for marine mysid shrimp (Barbee et al., 2010; EPA, 2012b). Chronic no observable effect concentrations (NOEC) range from 0.0045 mg/L for *D. magna* to 0.695 mg/L for a marine mysid (USEPA, 2012b). Available aquatic plant toxicity data suggests low toxicity of chlorantraniliprole to diatoms, algae, and aquatic macrophytes with median effect concentrations exceeding the highest test concentration (USEPA, 2008). Primary and secondary metabolites that could occur in aquatic environments are less toxic than the parent material when comparing toxicity values for the freshwater cladoceran, *D. magna* (USEPA, 2012b).

The exposure and risk to aquatic organisms from chlorantraniliprole will be negligible based on the low toxicity of the insecticide, and program restrictions regarding applications near surface water. The program currently uses a 200-foot ground and 500-foot aerial application buffer from surface water. Using standardized drift modeling at the highest application rate proposed in this study results in shallow water residues of chlorantraniliprole that are approximately ten-fold below the most sensitive sublethal endpoint for aquatic invertebrates (USDA APHIS, 2019b). Residue values were also approximately ten-fold below the most sensitive acute toxicity value for aquatic vertebrates and four orders of magnitude below the acute toxicity values for fish.

Laboratory toxicity data for technical and formulated chlorantraniliprole shows that the product is practically non-toxic to honeybees in oral or contact exposures. In semi-field studies using two formulations reported NOECs ranging from 52.5 to 156.16 g a.i. chlorantraniliprole/ha (Dinter et al., 2009; USEPA, 2008). Three semi-field honeybee tunnel tests demonstrated no behavioral or flight intensity effects nor were any hive related impacts noted at a dose of 52.5 g/ha (Dinter et al., 2009). The lowest reported NOEC is approximately four times the proposed RAATs application rate for chlorantraniliprole and two times the proposed full rate. Similar NOECs have been observed for other invertebrates such as the hover fly, *Episyrphus balteatus*, ladybird beetle larvae, *Coccinella septempunctata*, green lacewing, *Chrysoperla carnea*, the plant bug, *Typhlodromus pyri*, and predatory mite, *Orius laevigatus* (USEPA, 2008; USEPA, 2012b). The low toxicity to non-target terrestrial invertebrates has also been observed in greenhouse and field applications. Gradish et al. (2011) reported low acute toxicity of formulated chlorantraniliprole to the parasitoid, *Eretmocerus eremicus*, the pirate bug, *Orius insidiosus* and the predatory mite, *Amblyseius swirskii*, in 48-hour exposures. Brugger et al. (2010) evaluated lethal and sublethal impacts of formulated chlorantraniliprole to seven parasitic hymenopterans and found no negative impacts on adult survival, percentage parasitism, or emergence when compared to controls at rates well above the full and RAATs program rates. The lack of toxicity in other insect groups at rates that are toxic to grasshoppers is related to the activity of chlorantraniliprole which is primarily through ingestion. Insects such as grasshoppers and larval Coleoptera and Lepidoptera would receive a larger dose consuming treated plant material compared to many of the non-target pests that have been evaluated in the literature.

A researcher examined the effects of four- and 72-hour chlorantraniliprole oral exposures for both technical grade active ingredient and three formulations. After 24 hours, uncoordinated movement, lethargy, and trembling was observed in bees provided the highest treatments of technical-grade and formulated chlorantraniliprole for four hours. Although these intoxication symptoms subsided by 48 hours, bees exposed for 72 hours displayed the same symptomologies for the duration of the experiment (i.e., 30 days).

Bees receiving a more field-relevant short-term exposure of Chlorantraniliprole survived and moved similarly to untreated bees, reiterating the relative safety of chlorantraniliprole exposure to adult honeybees at recommended label concentrations. A 4-hour treatment of technical-grade and formulated Chlorantraniliprole did not significantly affect the 30-day survivorship, although significantly higher mortality was observed after 30 days for bees receiving a 72-hour treatment of technical-grade Chlorantraniliprole and two formulated products. The locomotion activity, or total walking distance, of bees receiving a 4-hour treatment of one Chlorantraniliprole formulation was significantly reduced, with these individuals recovering their normal locomotion activity at 48-hour post exposure. Conversely, there was observed lethargic behavior and significantly reduced walking distances for bees provided with a 72-hour treatment of technical-grade Chlorantraniliprole and each formulated product.

The survivorship was not significantly reduced for bees exposed to chlorantraniliprole for four hours compared to the control groups. The researcher observed a significant reduction in survivorship for bees provided the 72-hour treatment of technical grade and two formulated chlorantraniliprole products when compared to the untreated bees. However, a LC_{50} was not estimated for technical-grade chlorantraniliprole or the tested formulations at the label concentration due to the low mortality observed (Williams, 2020).

Researchers investigate the effects of chlorantraniliprole using a worst-case exposure model on bumblebee (*B. terrestris*) colonies under semi-field conditions in *Phacelia tanacetifolia*. The *P. tanacetifolia* crop was grown in soil treated with modelled worst-case 20-year plateau concentration of chlorantraniliprole in the top 20 cm of soil (equivalent to 0.088 mg a.s./kg). Additionally, two chlorantraniliprole spray applications at 60 g a.s./ha were made. Dinter et al., found no effects on queen and drone production or adult and larval mortality.

`

There were not statistically significant decreases between the control and two chlorantraniliprole groups in flight activity, weight, mortality, and number of young queen and males.

Researchers determined that chlorantraniliprole caused chronic effects on queen larvae, and these effects are positively correlated with pesticide doses (He et al., 2024). The researchers found that queen larvae began to show reduced capping and emergence rates when exposed to 2 ng/larva of chlorantraniliprole. The differences were significant at 10 ng/larva; at 20 ng/larva queen capping and emergence rates were the lowest, and larva exhibited higher mortality at five days. There were significant reductions in larval hormone level. Queen larvae were exposed to these concentrations through dietary exposure (i.e., contaminated brood food of beebread or royal jelly) for six days.

The researchers noted that accurate concentrations of chlorantraniliprole in brood food (beebread or royal jelly) offered to larvae inside the hive during field exposure has not yet been determined. This can be attributed to chemical decomposition of pesticide molecules over time, and the individual bee organisms producing brood food are also capable of detoxification (Ardalani et al., 2021). Other researchers have proposed that detoxification of xenobiotic compounds among eusocial honeybees may be complemented by a "social detoxification system", which includes colony food processing via microbial fermentation, dilution by pollen mixing, and worker discrimination (Berenbaum and Johnson, 2015).

According to Shankar and Mukhtar, chlorantraniliprole applications to control *H. armigera* on sunflower also reduced pollinator foraging visits, up to ten days after treatment. However, it also drastically reduced the floral visitation of pollinators. The study in Jammu, India showed Hymenoptera accounted for 89% of the total pollina-tors visiting sunflower crops followed by Lepidoptera and Diptera which covered 10% and 1% of the total for-aging pollinators, respectively (Shankar and Mukhtar, 2023).

Haas et al. found a synergistic relationship between chlorantraniliprole and propioconazole (a triazole fungicide) in acute contact toxicity in honeybees. This study was centered around California almond production, an industry that regularly use both fungicides and insecticides. Pretreatment of honeybees with propiconazole in laboratory bioassays one hour prior to insecticide application significantly increased the acute contact toxicity of chlorantraniliprole, thus confirming a previously reported synergism. While topical application of 2 µg/bee and 0.2 µg/bee chlorantraniliprole alone resulted in mortality of <15% (in accordance with the reported LD_{50} of >4 µg/bee[5]), honeybee pretreatment with 10 µg/bee propiconazole significantly increased the mortality at the same chlorantraniliprole exposure levels.

The low treatment rates and low acute toxicity of chlorantraniliprole to Hymenoptera should reduce any potential harmful effects of exposure of most pollinators during treatments for grasshopper suppression. Any potential chronic or synergistic effects are not expected to be significant because grasshopper infestations are treated once per year and overlap with other pesticide applications are unlikely. In areas of direct application where impacts may occur, alternating swaths and reduced rates (i.e., RAATs) would reduce risk to nontarget insects. The effects on pollinators resulting from control of rangeland grasshopper populations with chlorantraniliprole are not expected to cause significant impacts to the human environment.

Exposure and risk to terrestrial vertebrates that may consume treated plant material or insects in the proposed spray blocks will be negligible. USEPA acute and chronic direct risk exposure models to this group of non-target organisms from treated plant material and insects at maximum Vantacor® rates showed that residues were at least two orders of magnitude below the NOELs for various sized birds and mammals (USDA APHIS, 2015). A potential indirect effect of chlorantraniliprole applications is loss of habitat or food items. The selective nature of chlorantraniliprole to certain insect taxa and the low application rates suggests that impacts to all terrestrial invertebrates would not be anticipated. Indirect risk to terrestrial vertebrate wildlife is also not anticipated based on the selectivity of chlorantraniliprole to certain insect taxa, survival and recovery of chlorantraniliprole effected prey in untreated swaths (i.e., RAATs) and from outside treatment blocks. The potential for terrestrial indirect effects to amphibians and reptiles is also expected to be minimal. Chlorantraniliprole is not phytotoxic; therefore, risk to terrestrial wildlife habitat is minimal.

Aquatic habitat would consist of aquatic plants while aquatic food items would consist of algae, aquatic invertebrates, and small fish. To better understand the potential indirect effects of these applications, chlorantraniliprole levels were compared to the available chlorantraniliprole effects data for aquatic plants, invertebrates and fish (USDA APHIS, 2019b). Indirect risk to amphibians is expected to be minimal because expected residues do not exceed any effect endpoint for aquatic plants, invertebrates, or fish.

(3) Physical Environment Components

The potential for impacts to soil, air and water quality are expected to be negligible based on the proposed use pattern and available environmental fate data for chlorantraniliprole. Air quality is not expected to be significantly impacted since chlorantraniliprole has chemical properties that demonstrate it is not likely to volatilize into the atmosphere (USEPA, 2008). There will be some insecticide present in the atmosphere within and adjacent to the spray block immediately after application as drift but this will be localized and of short duration. Chlorantraniliprole has low solubility in water (<1 mg/L) and is susceptible to sunlight with a half-life of 0.31 days. Microbial degradation in water and pH-related effects to chlorantraniliprole are minor with half-lives greater than 125 days (USEPA, 2008). Slow degradation in soil is also anticipated with half-lives ranging from 228 to 924 days in various soil types (USEPA, 2008). Chlorantraniliprole has a varying affinity for binding to soil, but is generally low, suggesting that it may be susceptible to run-off during storm events. However, the proposed use rates and program restrictions regarding buffers suggest that surface and ground water quality will not be impacted from the proposed program use of chlorantraniliprole.

(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 chlorantraniliprole 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.

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 chlorantraniliprole 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 chlorantraniliprole 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 chlorantraniliprole 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 chlorantraniliprole 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 chlorantraniliprole insecticide treatments to suppress grasshopper populations in rural rangeland areas that are largely uninhabited. Disproportionately high and adverse human health or environmental impacts on 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 chlorantraniliprole 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) 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, 2019b).

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, 2019b).

(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, 2019c; 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, 2019c). 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, 2019c). 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 IC_{50} (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 honeybee 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 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 LD_{50} (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. Honeybee LD_{50} was used as LD_{50} 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 honeybee 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 honeybee forager if it flies through a cloud of spray, to the contact acute LD_{50}. 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 honeybees 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 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, 2019c).

d) 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 Tribes 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 [abridge this list and the following risk analysis sections as appropriate for this EA] carbaryl, chlorantraniliprole, diflubenzuron, or malathion, 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).

V. Literature Cited

Ardalani H, Vidkjær NH, Kryger P, Fiehn O, Fomsgaard IS. 2021. Metabolomics unveils the influence of dietary phytochemicals on residual pesticide concentrations in honey bees. Environment International Vol. 152-106503, ISSN 0160-4120, https://doi.org/10.1016/j.envint.2021.106503.

Baker NT., Stone WW. 2015 Estimated Annual Agricultural Pesticide Use for Counties of the conterminous United States 2008-2012. U.S, Geological Survey Data Series 907. http://doi.org/10.3133/ds907.

Barbee GC, McClain WR, Lanka SK, MJ Stout. 2010. Acute toxicity of chlorantraniliprole to non-target crayfish (*Procambarus clarkii*) associated with rice–crayfish cropping systems. Pest Manag. Sci. 66: 996–1001.

Beauvais S. 2014. Human exposure assessment document for carbaryl. Page 136. California Environmental Protection Agency, Department of Pesticide Regulation.

Belovsky GE, Joern A, Lockwood J. 1996. VII.16 Grasshoppers—Plus and Minus: The Grasshopper Problem on a Regional Basis and a Look at Beneficial Effects of Grasshoppers. Pages 1-5 in G. L. Cunningham and M. W. Sampson, editors. Grasshopper Integrated Pest Management User Handbook, Technical Bulletin No. 1809. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Washington, DC.

Belovsky GE. 2000. Part 1. Grasshoppers as integral elements of grasslands. 1. Do grasshoppers diminish grassland productivity? A new perspective for control based on conservation. Pages 7-29 in J. A. Lockwood et al, editor. Grasshoppers and Grassland Health. Kluwer Academic Publishers, Netherlands.

Berenbaum MR and Johnson RM. 2015. Xenobiotic detoxification pathways in honey bees. Current Opinion in Insect Science, Vol. 10 p.51-58. ISSN 2214-5745. https://doi.org/10.1016/j.cois.2015.03.005.

Black SH, Shepherd M, Vaughan M. 2011. Rangeland manage-ment for pollinators. Rangelands 33(3):9–13. https://doi.org/10.2111/1551-501x-33.3.9

`

Blanchette GE. 2019. Native Pollinators: The Effects of Livestock Grazing on Montana Rangelands. M.S. Thesis, Montana State University. https://scholarworks.montana.edu/server/api/core/bitstreams/32421d07-f4e3-45b0-9aa2-4748f635f7a6/content

Bogo G, Caringi V, Albertazzi S, Capano V, Colombo R, Dettori A, Guerra I, Lora G, Bortolotti L, Medrzycki P. 2024. Residues of agrochemicals in beebread as an indicator of landscape management. Sci. Total Env. 945 (2024). https://doi.org/10.1016/j.scitotenv.2024.174075

Bonderenko S, Gan J, Haver DL, Kabashima, JN. 2004. Persistence of selected organophosphate and carbamate insecticides in waters from coastal watershed. Env. Toxicol. Chem. 23:2649-2654.

Bradshaw JD, Jenkins KH, Whipple SD. 2018. Impact of grasshopper control on forage quality and availability in western Nebraska. Rangelands 40:71-76.

Branson D, Joern A, Sword G. 2006. Sustainable management of insect herbivores in grassland ecosystems: new perspectives in grasshopper control. BioScience 56:743-755.

Broyles G. 2013. Wildland firefighter smoke exposure. Page 26. U.S. Department of Agriculture, Forest Service.

Brugger KE, Cole PG, Newman IC, Parker P, Scholz B, Suvagia P, Walker G, Hammond TG. 2010. Selectivity of chlorantraniliprole to parasitoid wasps. Pest Manag. Sci. 66: 1075–1081.

Brym MZ, Henry C, Lukashow-Moore SP, Henry BJ, van Gestel N, Kendal RJ. 2020. Prevalence of monarch (*Danaus plexippus*) and queen (*Danaus gilippus*) butterflies in West Texas during the fall of 2018. BMC Ecology 20:33. https://doi.org/10.1186/s12898-020-00301-x

Buckner CH, Kingsbury PD, McLeod BB, Mortensen KL, Ray DGH. 1973. The effects of pesticides on small forest vertebrates of the spruce woods provincial forest, Manitoba. The Manitoba Entomologist 7:37-45.

Burling I, Yokelson R, Griffith D, Johson T, Veres P, Roberts J, Warneke C, Urbanski S, Reardon J, Weise D, Hao W, de Gouw J. 2010. Laboratory measures of trace gas emissions from biomass burning of fuel types from the southeastern and southwestern United States. Atmospheric Chemistry and Physics 10:11115-111130.

Buxton SH, Hopwood J, Moranz R, Powers R. 2020. Rangeland Management: Practices for Rangeland Health and Pollinators. https://xerces.org/sites/default/files/publications/20-001.pdf

Camp AA, Batres A, Williams WC, Lehmann DM. 2020. Impact of Diflubenzuron on Bombus Impatiens (Hymenoptera: Apidae) Microcolony Development. Environmental Entomology Vol. 49 (1): 203–10. https://doi.org/10.1093/ee/nvz150.

Caro JH, Freeman HP, Turner BC. 1974. Persistence in soil and losses in runoff of soil-incorporated carbaryl in a small watershed. J. Agricul. Food Chem. 22:860-863.

Catangui MA, Fuller BW, Walz AW. 1996. Impact of Dimilin® on nontarget arthropods and its efficacy against rangeland grasshoppers. *In* U.S. Department of Agriculture, Animal and Plant Health Inspection Service, 1996. Grasshopper Integrated Pest Management User Handbook, Tech. Bul. No. 1809. Sec. VII.3. Washington, DC.

Chandel RS and Gupta PR. 1992. Toxicity of diflubenzuron and penfluron to immature stages of *Apis cerana indica* and *Apis mellifera*. Apidologie 23:465–473.

Cordova DE, Benner EA, Sacher MD, Rauh JJ, Sopa JS, Lahm GP, Selby TP, Stevenson TM, Flexner L, Gutteridge S, Rhoades DF, Wu L, Smith RM, Tao Y. 2006.

Anthranilic diamides: a new class of insecticides with a novel mode of action, ryanodine receptor activation. In *Pesticide Biochemistry and Physiology* (pp. 196-214).

Cooper RJ, Dodge KM, Marinat PJ, Donahoe SB, Whitmore RC. 1990. Effect of diflubenzuron application on eastern deciduous forest birds. J. Wildl. Mgmt. 54:486-493.

Council on Environmental Quality. 2005. Guidance on the consideration of the consideration of past actions in cumulative effects analysis. Council on Environmental Quality. Washington, D.C., USA.

Deakle JP and Bradley JR. 1982. Effects of early season applications of diflubenzuron and azinphosmethyl on populations levels of certain arthropods in cotton fields. J. Georgia Entomol. Soc. 17:189-200.

Deneke D and Keyser J. 2011. Integrated Pest Management Strategies for Grasshopper Management in South Dakota. South Dakota State University Extension.

Dinkins MF, Zimmermann AL, Dechant JA, Parkins BD, Johnson DH, Igl LD, Goldade CM, Euliss BR. 2002. Effects of Management Practices on Grassland Birds: Horned Lark Northern Prairie Wildlife Research Center. Page 34. Northern Prairie Wildlife Research Center, Jamestown, ND.

Dinter A, Brugger KE, Frost NM Woodward MD. 2009. Chlorantraniliprole (Rynaxypyr): A novel DuPont™ insecticide with low toxicity and low risk for honey bees (*Apis mellifera*) and bumble bees (*Bombus terrestris*) providing excellent tools for uses in integrated pest management. Hazards of pesticides to bees – 10th International Symposium of the ICP-Bee Protection Group. Pp. 84-96.

Dinter A, Klein O, Franke L. 2021. Lack of Effects On Bumblebee (Bombus Terrestris) Colony. Preprint manuscript. DOI:10.21203/rs.3.rs-572507/v1

Dobroski CJ, O'Neill EJ, Donohue JM, Curley WH. 1985. Carbaryl: a profile of its behaviors in the environment. Roy F. Weston, Inc. and V.J. Ciccone and Assoc., Inc., West Chester, PA; Woodbridge, VA.

Dolan AC, Delphia CM, O'Neill KM, Ivie MA. 2017. Bumble Bees (Hymenoptera: Apidae) of Montana. Annals of the Entomological Society of America, Volume 110, Issue 2, March 2017, Pages 129–144. https://doi.org/10.1093/aesa/saw064.

Douglas, M.R. & Tooker, J.F. Large-scale deployment of seed treatments has driven rapid increase in use of neonicotinoid insecticides and preemptive pest management in US field crops. 2015. Environ. Sci. Technol. 49: 5088–5097.

Dupont. 2012. Material Safety Data Sheet - Prevathon®.

Eisler R.1992. Diflubenzuron Hazards to Fish, Wildlife, and Invertebrate: A Synoptic Review. U.S. Department of Interior, Fish and Wildlife Service, Washington, D.C.

Eisler R. 2000. Handbook of chemical risk assessment: health hazards to humans, plants, and animals. Lewis Publishers, New York.

El-Refai A and Hopkins TL. 1972. Malathion adsorption, translocation, and conversion to malaoxon in bean plants. J. Assoc. Official Analytical Chemists 55:526-531.

Fine JD. 2020. Evaluation and comparison of the effects of three insect growth regulators on honey bee queen oviposition and egg eclosion. Ecotox Environ Saf. 2020; 205: 111142. https://doi.org/10.1016/j

Fine JD, Foster LJ, McAfee A. 2023. Indirect exposure to insect growth disruptors affects honey bee (Apis mellifera) reproductive behaviors and ovarian protein expression. PLoS ONE 18(10): e0292176. https://doi.org/10.1371/journal.pone.0292176

`

Fischer SA and Hall LW. 1992. Environmental concentrations and aquatic toxicity data on diflubenzuron (Dimilin). Critical Rev. in Toxicol. 22:45-79.

Follett RF and Reed DA. 2010. Soil carbon sequestration in grazing lands: societal benefits and policy implications. Rangeland Ecology & Management 63:4-15.

Forister ML, Halsch CA, Nice CC, Fordyce JA, Dilts TE, Oliver JC, Prudic KL, Shapiro AM, Wilson JK, Glassberg J. 2021. Fewer butterflies seen by community scientists across the warming and drying landscapes of the American West. Science Vol. 371, 1042–1045. https://www.science.org/doi/10.1126/science.abe5585

Foster RN. 1996. Baits for Controlling Rangeland Grasshoppers: An Overview. U.S. Department of Agriculture, Animal and Plant Health Inspection Service Grasshopper Integrated Pest Management User Handbook Tech. Bul. No. 1809: 1-2

Foster RN and Onsager JA. 1996. IPM Targets Grasshoppers. Vol. 44, No. 1 ISSN 2169-8244 https://agresearchmag.ars.usda.gov/1996/jan/ipm/

Foster RN, Reuter KC, Fridley K, Kurtenback D, Flakus R, Bohls R, Radsick B, Helbig JB, Wagner A, Jeck L. 2000. Field and Economic Evaluation of Operational Scale Reduced Agent and Reduced Area Treatments (RAATs) for Management of Grasshoppers in South Dakota Rangeland. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Phoenix, AZ.

Fuller BW, Catangui MA, Boetel MA, Foster RN, Wang T, Walgenbach DD, Walz AW. 1996. Bran bait or liquid insecticide treatments for managing grasshoppers on croplands adjacent to rangeland or conservation reserve program acreages. Grasshopper Integrated Pest Management User Handbook. Tech. Bull. No. 1809. Sec. II.21, USDA-APHIS, Washington, D.C., USA.

Gao J, Yang Y, Ma S, Liu F, Wang Q, Wang X, Wu Y, Zhang L, Liu Y, Diao Q, Dai P. 2022. Combined transcriptome and metabolite profiling analyses provide insights into the chronic toxicity of carbaryl and acetamiprid to Apis mellifera larvae. Nature-Scientific Reports (2022) 12:16898. https://doi.org/10.1038/s41598-022-21403-0

George TL, McEwen LC, Peterson BE. 1995. Effects of grasshopper control programs on rangeland breeding bird populations. J. Range Manage. 48:336–342.

Gilgert W and Vaughan M. 2011. The value of pollinators and pollinator hab-itat to rangelands: connections among pollinators, insects, plant communities, fish, and wildlife. Rangelands 33(3):14–19. https://doi.org/10.2111/1551-501x-33.3.14

Goosey HB, Blanchette GE, Naugle DE. 2024. Pollinator response to livestock grazing: implications for rangeland conservation in sagebrush ecosystems. Journal of Insect Science, (2024) 24(4): 13; ieae069 https://doi.org/10.1093/jisesa/ieae069

Gradish AE, Scott-Dupree CD, Shipp L, Harris R. 2011. Effect of reduced risk pesticides on greenhouse vegetable arthropod biological control agents. Pest Manag. Sci. 67: 82–86.

Guerrant GO, Fetzer LE, Miles JW. 1970. Pesticide residues in Hale County, Texas, before and after ultra-low-volume aerial applications of Malathion. Pesticide Monitoring J. 4:14-20.

Haas J, Glaubitz J, Koenig U, Nauen R. 2022. A mechanism-based approach unveils metabolic routes potentially mediating chlorantraniliprole synergism in honey bees, Apis mellifera L., by azole fungicides. Pest Manag. Sci. 78, 965–973. https://doi.org/10.1002/ps.6706

Hanberry BB, DeBano SJ, Kaye TN, Rowland MM, Hartway CR, Shorrock D. 2021. Pollinators of the Great Plains: Disturbances, Stressors, Management, and Research

Needs. Rangeland Ecology & Management 78 (2021) 220–234. https://doi.org/10.1016/j.rama.2020.08.006

Hannig GT, Ziegler M, Marcon PG. 2009. Feeding cessation effects of chlorantraniliprole, new anthralinic diamide insecticide, in comparison with several insecticides in distinct chemical classes and mode-of-action groups. Pest Manag. Sci. 65: 969–974.

Havstad KM, Peters DP, Skaggs R, Brown J, Bestelmeyer B, Fredrickson E, Herrick J, Wright J. 2007. Ecological services to and from rangelands of the United States. Ecological Economics 64:261-268.

He Q, Wei Y, Wu Y, Yang Q, Wang Y, Gao Q, Xiao J, Yu L, Cao H. 2024. Does the use of chlorantraniliprole during queen development adversely impact health and viability? Pesticide Biochemistry and Physiology 202 DOI:10.1016/j.pestbp.2024.105920

Hewitt GB. 1977. Review of forage losses caused by rangeland grasshoppers. U.S. Department of Agriculture Miscellaneous Publication No. 1348: 1-25

Hewitt GB and Onsager JA. 1983. Control of grasshoppers on rangeland in the United States - a perspective. Journal of Range Management 36:202-207.

Higley LG and Pedigo LP. 1996. Economic thresholds for integrated pest management. University of Nebraska Press, Lincoln, Nebraska, pp. 327.

Hladik ML, Vandever M, Smalling KL. 2016. Exposure of native bees foraging in an agricultural landscape to current-use pesticides. Science of the Total Environment 542, 469–477. https://doi.org/10.1016/j.scitotenv.2015.10.077

Howe FP, Knight RL, McEwen LC, George TL. 1996. Direct and indirect effects of insecticide applications on growth and survival of nestling passerines. Ecol. Appl. 6:1314-1324.

James DG. 2024. Monarch Butterflies in Western North America: A Holistic Review of Population Trends, Ecology, Stressors, Resilience and Adaptation. Insects Jan 7;15(1):40. doi: 10.3390/insects15010040. PMID: 38249046; PMCID: PMC10817040.

Johnson GD. 1987. Effects of Rangeland Grasshopper Control on Sage Grouse in Wyoming: A Thesis Submitted to the Department of Zoology and Physiology and the Graduate School of the University of Wyoming in Partial Fulfillment of Requirements for the Degree of Master of Science. University of Wyoming.

Kao AS. 1994. Formation and removal reactions of hazardous air pollutants. J. Air and Waste Mgmt. Assoc. 44:683-696.

Keever DW, Bradley JR, Ganyard MC. 1977. Effects of diflubenzuron (Dimilin) on selected beneficial arthropods in cotton fields. J. Econ. Entomol. 6:832-836.

Kimoto C, DeBano SJ, Thorp RW, Rao S, Stephen WP. 2012. Short-term responses of na-tive bees to livestock and implications for managing ecosystem serv-ices in grasslands. Ecosphere 3(10):1–19. https://doi.org/10.1890/es12-00118.1

Kohler M, Sturm A, Sheffield CS, Carlyle CN, Manson JS. 2020. Native bee communities vary across three prairie ecoregions due to land use, climate, sampling method and bee life history traits. Insect Conservation and Diversity (2020) 13, 571–584 https://doi.org/10.1111/icad.12427

Krueger AJ, Early TM, Ripperger RJ, Cabrera AR, Schmehl DR. 2021. The Utility of a Bumble Bee (Bombus spp. [Hymenoptera: Apidae]) Brood Test for Evaluating the Effects of Pesticides. Environmental Entomology, 50(5), 2021, 1105–1117. https://doi.org/10.1093/ee/nvab072

LaFleur KS. 1979. Sorption of pesticides by model soils and agronomic soils: rates and equilibria. Soil Sci. 127:94-101.

Larsen J and Foster RN. 1996. Using Hopper to Adapt Treatments and Costs to Needs and Resources. U.S. Department of Agriculture, Animal and Plant Health Inspection Service Grasshopper Integrated Pest Management User Handbook, Washington, D.C.

Larson DL, Larson JL, Buhl DA. 2018. Conserving all the pollinators: vari-ation in probability of pollen transport among insect taxa. Nat. Areas J. 38(5):393–401. https://doi.org/10.3375/043.038.0508

Latchininsky AV and VanDyke KA. 2006. Grasshopper and Locust Control with Poisoned Baits: A Renaissance of the Old Strategy? Outlooks on Pest Management 17: 105-111.

Latchininsky AV, Sword G, Sergeev M, Cigiliano M, Lecoq M. 2011. Locusts and grasshoppers: behavior, ecology, and biogeography. Psyche 2011:1-4.

Liu D, Thomson K, Strachan WMJ. 1981. Biodegradation of carbaryl in simulated aquatic environment. Bul. Environ. Contam. Toxicol. 27:412-417.

Lockwood JA and Schell SP. 1997. Decreasing economic and environmental costs through reduced area and agent insecticide treatments (RAATs) for the control of rangeland grasshoppers: empirical results and their implications for pest management. J. Orthoptera Res. 6:19-32.

Lockwood JA, Schell SP, Foster RN, Reuter C, Rahadi T. 2000. Reduced agent-area treatments (RAAT) for management of rangeland grasshoppers: efficacy and economics under operational conditions. International Journal of Pest Management 46:29-42.

Lockwood JA and Latchininsky A. 2000. The Risks of Grasshoppers and Pest Management to Grassland Agroecosystems: An International Perspective on Human Well-Being and Environmental Health. Pages 193-215 in A. Latchininsky and M. Sergeev, editors. Grasshoppers and Grassland Health. Kluwer Academic Publishers.

Lockwood JA, Anderson-Sprecher R, Schell S. 2002. When less is more: optimization of reduced agent-area treatments (RAATs) for management of rangeland grasshoppers. Crop Protection 21:551-562.

Matsumara F. 1985. Toxicology of insecticides. Plenum Press, New York.

McEwen LC, Althouse CM, Peterson BE. 1996. Direct and indirect effects of grasshopper integrated pest management (GHIPM) chemicals and biologicals on nontarget animal life. *In* U.S. Department of Agriculture, Animal and Plant Health Inspection Service, 1996. Grasshopper Integrated Pest Management User Handbook, Tech. Bul. No. 1809. Sec. III.2. Washington, DC.

Michener C. 2007. The bees of the world. 2nd ed. Baltimore, MD: Johns Hopkins University Press.

Miles CJ and Takashima S. 1991. Fate of malathion and O.O.S. trimethyl phosphorothioate byproduct in Hawaiian soil and water. Arch. Environ. Contam. Toxicol 20:325-329.

Mommaerts V, Sterk G, Smagghe G. 2006. Hazards and uptake of chitin synthesis inhibitors in bumblebees *Bombus terrestris*. Pest Mgt. Science 62:752–758.

Murphy CF, Jepson PC, Croft BA. 1994. Database analysis of the toxicity of antilocust pesticides to non-target, beneficial invertebrates. Crop Protection 13:413-420.

Muzzarelli R. 1986. Chitin synthesis inhibitors: effects on insects and on nontarget organisms. CRC Critical Review of Environmental Control 16:141-146.

Narisu J, Lockwood JA, Schell SP. 1999. A novel mark-capture technique and its application to monitoring the direction and distance of local movements of

rangeland grasshoppers (Orthoptera: Acridade) in context of pest management. J. Appl. Ecol. 36:604-617.
Narisu J, Lockwood JA, Schell SP. 2000. Rangeland grasshopper movement as a function of wind and topography: implications for pest movement. J. Appl. Ecol. 36:604-617.
Nation JL, Robinson FA, Yu SJ, Bolten AB. 1986. Influence upon honeybees of chronic exposure to very low levels of selected insecticides in their diet. J. Apic. Res. 25:170–177.
Nigg HN, Cannizzaro RD, Stamper JH. 1986. Diflubenzuron surface residues in Florida citrus. Bul. Environ. Contam. Toxicol. 36:833-838.
NIH. 2009a. Carbaryl, CASRN: 63-25-2. National Institutes of Health, U.S. National Library of Medicine, Toxnet, Hazardous Substances Database.
NIH. 2009b. National Institutes of Health, U.S. National Library of Medicine, National Center for Biotechnology Information. PubChem. https://pubchem.ncbi.nlm.nih.gov/compound/4004
Nogrado K, Lee S, Chon K, Lee JH. 2019. Effect of transient exposure to carbaryl wettable powder on the gut microbial community of honey bees. Appl. Biol. Chem. (2019) 62:6 https://doi.org/10.1186/s13765- 019- 0415-7
Norelius EE and Lockwood JA. 1999. The effects of reduced agent-area insecticide treatments for rangeland grasshopper (Orthoptera: Acrididae) control on bird densities. Archives of Environmental Contamination and Toxicology 37:519-528.
Novotny JL, Hung KJ, Lybbert AH, Kaplan I, Goodell K. Short-term persistence of foliar insecticides and fungicides in pumpkin plants and their pollinators. Preprint manuscript. doi: https://doi.org/10.1101/2024.09.24.614697
Otto CR, Roth CL, Carlson BL, Smart MD. 2016. Land-use change reduces habitat suitability for supporting managed honey bee colonies in the Northern Great Plains. Proceedings of the National Academy of Sciences 113, 10430–10435. https://doi.org/10.1073/pnas.1603481113
Pascual JA. 1994. No effects of a forest spraying of malathion on breeding blue tits (*Parus caeruleus*). Environ. Toxicol. Chem. 13:1127–1131.
Patterson RL. 1952. The Sage Grouse in Wyoming. Wyoming Game and Fish Commission Sage Books, Inc. Denver. Federal Aid to Wildlife Restoration Project 28-R.
Peach MP, Alston DG, Tepedino VJ. 1994. Bees and bran bait: is carbaryl bran bait lethal to alfalfa leafcutting bee (Hymenoptera: Megachilidae) adults or larvae? J. Econ. Entomol. 87:311-317.
Peach MP, Alston DG, Tepedino VJ. 1995. Subleathal effects of carbaryl bran bait on nesting performance, parental investment, and offspring size and sex ratio of the alfalfa leafcutting bee (Hymenoptera: Megachilidae). Environ. Entomol. 24:34-39.
Pedigo LP, Hutchins SH, Higley LG. 1986. Economic injury levels in theory and practice. *Annual Review of Entomology* 31: 341-368.
Pfadt RE. 2002. Field Guide to Common Western Grasshoppers, Third Edition. Wyoming Agricultural Experiment Station Bulletin 912. Laramie, Wyoming.
Potts SG, Vulliamy B, Dafni A, et al. 2003. Linking bees and flowers: how do floral communities structure pollinator communities? Ecology 84(10):2628–2642. https://doi.org/10.1890/02-0136
Purdue University. 2018. National Pesticide Information Retrieval System. West Lafayette, IN.
Quinn MA, Kepner RL, Walgenbach DD, Foster RN, Bohls RA, Pooler PD, Reuter KC, Swain JL. 1991. Effect of habitat and perturbation on populations and community

structure of darkling beetles (Coleoptera: tenebrionidae) on mixed grass rangeland. Environ. Entomol. 19:1746-1755.

Quinn MA. 2000. North Dakota Grasshopper Integrated Pest Management Demonstration Project, Technical Bulletin No. 1891: 124 pp.

Rashford BS, Latchininsky AV, Ritten JP. 2012. An Economic Analysis of the Comprehensive Uses of Western Rangelands. U.S. Department of Agriculture, Animal and Plant Health Inspection Service.

Raymann K, Shaffer Z, Moran NA. 2017. Antibiotic exposure perturbs the gut microbiota and elevates mortality in honeybees. PLoS Biol 15(3): e2001861. doi:10.1371/journal. pbio.2001861

Reinhardt T and Ottmar R. 2004. Baseline measurements of smoke exposure among wildland firefighters. Journal of Occupational and Environmental Hygiene 1:593-606.

Reisen F and Brown S. 2009. Australian firefighters' exposure to air toxics during bushfire burns of autumn 2005 and 2006. Environment International 35:342-353.

Relyea RA and Diecks N. 2008. An unforeseen chain of events: lethal effects of pesticides at sublethal concentrations. Ecol. Appl. 18:1728-1742.

Richmond ML, Henny CJ, Floyd RL, Mannan RW, Finch DW, DeWeese LR. 1979. Effects of Sevin 4-oil, Dimilin, and Orthene on Forest Birds in Northeastern Oregon. USDA, Pacific SW Forest and Range Experiment Station.

Rohde AT, Pilliod DS. 2021. Spatiotemporal dynamics of insect pollinator communities in sagebrush steppe associated with weather and vegetation. Global Ecology and Conservation Vol. 29. https://doi.org/10.1016/j.gecco.2021.e01691

Rosenberg KV, Ohmart RD, Anderson BW. 1982. Community organization of riparian breeding birds: response to an annual resource peak. The Auk 99:260-274.

Sample BE, Cooper RJ, Whitmore RC. 1993. Dietary shifts among songbirds from a diflubenzuron-treated forest. The Condor 95:616-624.

Schaefer CH and Dupras EF. 1977. Residues of diflubenzuron [1-(4-chlorophenyl)-3(2,6-difluorobenzoyl) urea] in pasture soil, vegetation, and water following aerial applications. J. Agric. Food Chem. 25:1026-1030.

Shankar U and Mukhtar Y. 2023. Pest management practices impact Helicoverpa armigera infestation and foraging behavior of pollinators in sunflower, International Journal of Pest Management, DOI: 10.1080/09670874.2023.2216667

Smith DI and Lockwood JA. 2003. Horizontal and trophic transfer of diflubenzuron and fipronil among grasshoppers and between grasshoppers and darkling beetles (Tenebrionidae). Archives of Environmental Contamination and Toxicology 44:377-382.

Smith DI, Lockwood JA, Latchininsky AV, Legg DE. 2006. Changes in non-target populations following applications of liquid bait formulations of insecticides for control of rangeland grasshoppers. Internat. J. Pest Mgt. 52:125-139.

Stone WW. 2013. Estimated Annual Agricultural Pesticide Use for Counties of the conterminous United States, 1991-2009. U.S Geological Survey Data Series 752. http://pubs.usgs.gov/ds/752/.

Stanley JG and Trial JG. 1980. Disappearance constants of carbaryl from streams contaminated by forest spraying. Bul. Environ. Contam. Toxicol. 25:771-776.

Stoner KA and Eitzer BD. 2013. Using a Hazard Quotient to Evaluate Pesticide Residues Detected in Pollen Trapped from Honey Bees (*Apis mellifera*) in Connecticut. PLoS ONE 8(10): e77550. https://doi.org/10.1371/journal.pone.0077550

`

Swain RB. 1944. Nature and extent of Mormon cricket damage to crop and range plants. Technical Bulletin No. 866. United States Department of Agriculture.

Tepedino VJ. 1979. The importance of bees and other insect planetaries in maintaining floral species composition. Great Basin Naturalist Memoirs 3:139-150.

Thelin GP, Stone WW. 2013. Estimation of Annual Agricultural Pesticide Use for Counties of the Conterminous United States 1992-2009. U.S. Geological Survey Scientific Investigations Report 2013-5009. http://pubs.usgs.gov/sir/2013/5009/.

Thogmartin, W.E.; Widerholt, R.; Oberhauser, K.; Drum, R.G.; Diffendorfer, J.E.; Altizer, S.; Taylor, O.R.; Pleasants, J.; Semmens, D.;Semmens, B.; etal. 2017. Monarch butterfly decline: Identifying the threatening processes. Roy. Soc. Open Sci., (4)

Thompson HM. 2021. The use of the Hazard Quotient approach to assess the potential risk to honeybees (Apis mellifera) posed by pesticide residues detected in bee-relevant matrices is not appropriate. Pest Manag Sci 2021; 77: 3934–3941. DOI 10.1002/ps.6426. https://scijournals.onlinelibrary.wiley.com/doi/epdf/10.1002/ps.6426

Thompson HM, Wilkins S, Battersby AH, Waite RJ, Wilkinson D. 2005. The effects of four insect growth-regulating (IGR) insecticides on honeybee (*Apis mellifera* L.) colony development, queen rearing and drone sperm production. Ecotoxicology 14:757–769.

Thompson HM and Thorbahn D. 2009. Review of honeybee pesticide poisoning incidents in Europe – evaluation of the hazard quotient approach for risk assessment. Julius-Kühn-Archiv 423, 103–107.

Tuell JK, Fiedler AK, Landis D, et al. 2014. Visitation by wild and man-aged bees (Hymenoptera: Apoidea) to eastern US native plants for use in conservation programs. Environ. Entomol. 37(3):707–718. https://doi.org/10.1603/0046-225x(2008)37[707:vbwamb]2.0.co;2

USDA APHIS– see U.S. Department of Agriculture, Animal and Plant Health Inspection Service

U.S. Department of Agriculture, Animal and Plant Health Inspection Service, 1999. APHIS Directive 5600.3, Evaluating APHIS programs and activities for ensuring protection of children from environmental health risks and safety risks. September 3, 1999. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Riverdale, MD. [online] available: http://www.aphis.usda.gov/library/directives.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service, 2008. Grasshopper Guidebook Provisional. U.S. Department of Agriculture, Animal and Plant Health Inspection Service.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service, 2011. Report to the PPQ Management Team, Rangeland Grasshopper and Mormon Cricket Suppression Program. U.S. Department of Agriculture, Animal and Plant Health Inspection Service.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2015. Biological Assessment for the APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program. Page 162. U.S. Department of Agriculture, Animal and Plant Health Inspection Service.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service, 2016. APHIS Rangeland Grasshopper/Mormon Cricket Suppression Program Aerial

`

Application, Statement of Work. Page 39 pp. U.S. Department of Agriculture, Animal and Plant Health Inspection Service.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2019. Rangeland Grasshopper and Mormon Cricket Suppression Program Final Environmental Impact Statement. United States Department of Agriculture, Animal and Plant Health Inspection Service.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2019a. Human Health and Ecological Risk Assessment for Carbaryl Rangeland Grasshopper and Mormon Cricket Suppression Applications. United States Department of Agriculture, Animal and Plant Health Inspection Service.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2019b. Human health and Ecological Risk Assessment for Chlorantraniliprole used in Rangeland grasshopper and Mormon Cricket Suppression Program. United States Department of Agriculture, Animal Plant and health Inspection Service.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2019c. Human Health and Ecological Risk Assessment for Diflubenzuron Rangeland Grasshopper and Mormon Cricket Suppression Applications. United States Department of Agriculture, Animal and Plant Health Inspection Service.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2019d. Human Health and Ecological Risk Assessment for Malathion Rangeland Grasshopper and Mormon Cricket Suppression Applications. United States Department of Agriculture, Animal and Plant Health Inspection Service.

USDA FS– see U.S. Department of Agriculture, Forest Service

U.S. Department of Agriculture, Forest Service. 2004. Control/eradication agents for the gypsy moth—human health and ecological risk assessment for diflubenzuron (final report). United States Department of Agriculture, Forest Service

U.S. Department of Agriculture, Forest Service. 2008a. Carbaryl - Human Health and Ecological Risk Assessment (Revised Final Report). U.S. Department of Agriculture, Forest Service.

U.S. Department of Agriculture, Forest Service. 2008b. Malathion- Human Health and Ecological Risk Assessment. U.S. Department of Agriculture, Forest Service.

U.S. Department of Agriculture, Natural Resources Conservation Service. https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/range-pasture/range-resources

USEPA – See U.S. Environmental Protection Agency

U.S. Environmental Protection Agency. 1997. Reregistration Eligibility Decision (RED): Diflubenzuron. U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2000a. Malathion Reregistration Eligibility Document Environmental Fate and Effects. Page 146. U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances.

U.S. Environmental Protection Agency. 2000b. Reregistration Eligibility Decision (RED) for Malathion. U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2003. Environmental Fate and Ecological Risk Assessment for Re-Registration of Carbaryl. U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2006. Malathion Reregistration Eligibility Document. Page 147. U.S. Environmental Protection Agency, Office of Pesticide Programs.

U.S. Environmental Protection Agency. 2007. Reregistration Eligibility Decision (RED) for Carbaryl. Page 47. U.S. Environmental Protection Agency, Prevention, Pesticides and Toxic Substances.

U.S. Environmental Protection Agency, 2008. Pesticide fact sheet: Chlorantraniliprole. Office of Prevention, Pesticides and Toxic Substances. 77 pp.

U.S. Environmental Protection Agency. 2012a. Sevin XLR Plus Label. Pages 1-40 Pesticide Product and Label System. U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency, 2012b. Ecotox database accessed at: http://cfpub.epa.gov/ecotox/

U.S. Environmental Protection Agency. 2012c. Fyfanon ULV AG. U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2015a. Annual Cancer Report 2015, Chemicals Evaluated for Carcinogenic Potential Page 34. U.S. Environmental Protection Agency, Office of Pesticide Programs.

U.S. Environmental Protection Agency. 2015b. Memorandum - Diflubenzuron: human health risk assessment for an amended Section 3 registration for carrot, peach subgroup 12-12B, plum subgroup 12-12C, pepper/eggplant subgroup 8010B, cottonseed subgroup 20C, alfalfa (regional restrictions) and R175 Crop Group Conversion for tree nut group 14-12. Page 71 U.S. Environmental Protection Agency, Office of Pesticide Programs.

U.S. Environmental Protection Agency. 2016a. Appendix 3-1: Environmental transport and fate data analysis for malathion. In: Biological Evaluation Chapters for Malathion ESA Assessment.

U.S. Environmental Protection Agency. 2016b. Chapter 2: Malathion Effects Characterization for ESA Assessment. In: Biological Evaluation Chapters for Malathion ESA Assessment.

U.S. Environmental Protection Agency. 2016c. Malathion: Human Health Draft Risk Assessment for Registration Review. Page 258. U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2017. Memorandum - Carbaryl: Draft Human Health Risk Assessment in Support of Registration Review. Page 113 U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2018. Preliminary Risk Assessment to Support the Registration Review of Diflubenzuron.

U.S. Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. Page 23 pp. U.S. Department of Interior, Fish and Wildlife Service.

U.S. National Marine Fishery Service. 2009. National Marine Fisheries Service Endangered Species Act Section 7 Consultation; Final Biological Opinion for Pesticides Containing Carbaryl, Carbofuran and Methomyl. Environmental Protection Agency Registration of Pesticides Containing Carbaryl, Carbofuron and Methomyl. U.S. Department of Commerce, National Marine Fisheries Service.

Wade A, Lin C-H, Kurkul C, Regan ER, Johnson RM. Combined toxicity of insecticides and fungicides applied to California almond orchards to honey bee larvae and adults. Insects. 2019; 10: 20. https://doi.org/10.3390/insects10010020

Wakeland C and Shull WE. 1936. The Mormon cricket with suggestions for its control, Extension Bulletin No. 100. University of Idaho, College of Agriculture, Idaho Agricultural Extension.

Wakeland C and Parker RJ. 1952. The Mormon cricket. Yearbook of Agriculture 1952: 605-608.

Wieben CM. 2019. Estimated Annual Agricultural Pesticide Use for Counties of the Conterminous United States 2013-2017 (ver. 2.0, May 2020). U.S. Geological Survey data release. https://doi.org/10.5066/P9F2SRYH.

Williams JR, Swaleb DR, Anderson TD. 2020. Comparative effects of technical-grade and formulated chlorantraniliprole to the survivorship and locomotor activity of the honey bee, Apis mellifera (L.). Pest Management Science 76:8, 2582-2588 (2020). https://scijournals.onlinelibrary.wiley.com/doi/full/10.1002/ps.5832

Yang Y, Ma S, Liu F, Wang Q, Wang X, Hou C, Wu Y, Gao J, Zhang L, Liu Y, Diao Q, Dai P. 2019. Acute and chronic toxicity of acetamiprid, carbaryl, cypermethrin and deltamethrin to Apis mellifera larvae reared in vitro. Pest Manag. Sci. (2020)76, 978–985. https://doi.org/10.1002/ps.5606

Zinkl JG, Henny CJ, DeWeese LR. 1977. Brain cholinesterase activities of birds from forests sprayed with trichlorfon (Dylox) and carbaryl (Sevin 4-oil). Bul. Environ. Contam. Toxicol. 17:379-386.

`

VI. Listing of Agencies and Persons Consulted

PPQ- Science and Technology PPQ- Field Operations

PPQ- Policy and Management

Tyler A. Abbott, Field Supervisor, Wyoming State Office, Fish and Wildlife Service, 334 Parsley Boulevard, Cheyenne, WY 82007

Lisa Solberg Schwab, Fish and Wildlife Biologist, Wyoming ES Field Office, Fish and Wildlife Service, 1625 West Pine Street, P.O. Box 768, Pinedale, WY 82941

Lea Crisostomo Lehmann, Fish and Wildlife Biologist, Wyoming ES Field Office, U.S. Fish and Wildlife Service, 334 Parsley Boulevard, Cheyenne, WY 82007

Kevin Salgado, Fish and Wildlife Biologist, Wyoming ES Field Office, U.S. Fish and Wildlife Service, 334 Parsley Boulevard, Cheyenne, WY 82007

John Hughes, Sagebrush Coordinator, Wyoming ES Field Office, U.S. Fish and Wildlife Service, 334 Parsley Boulevard, Cheyenne, WY 82007

John Kennedy, Deputy Director, Wyoming Game and Fish, 5400 Bishop Boulevard, Cheyenne, WY 82006

Leslie Schreiber, Greater Sage Grouse Coordinator, Wyoming Game and Fish, 351 Astle Avenue, Green River, WY 82935

Zack Walker, Non-Game Coordinator, Wyoming Game and Fish, 260 Buena Vista, Lander, WY 82520

Ian Tator, Wildlife and Habitat Manager, Wyoming Game and Fish, 5400 Bishop Boulevard, Cheyenne, WY 82006

APHIS also consulted with the BLM Wyoming State Office Division of Resource Policy and Management.

Appendix A: APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program

FY-2025 Treatment Guidelines
Version 1/9/2023

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 availablity, 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.

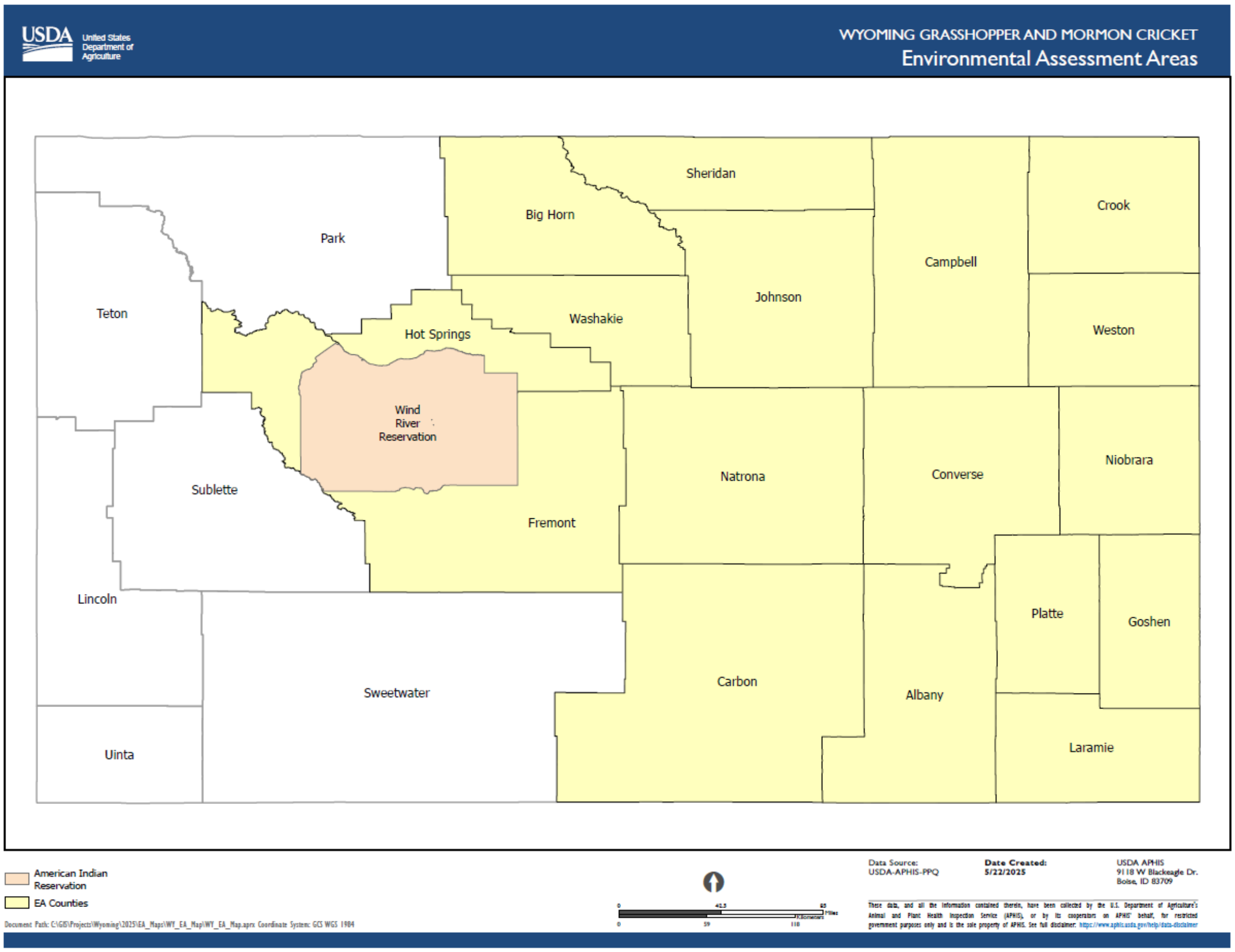
3. Weather conditions will be monitored and documented during application and treatment will be suspended when conditions could jeopardize the correct spray placement or pilot safety.

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.

`

Appendix B: Map of the Affected Environment



`

Appendix C: FWS/NMFS Correspondence

Official correspondence will be included here and published in the Final EA.

`

Appendix D: List of Species of Concern within the Affected Area

Wyoming Game and Fish Species of Greatest Conservation Need					
Scientific Name	**Common Name**	**Major Taxonomic Group**	**Minor Taxonomic Group**	**Statewide Occurrence**	**Statewide Origin**
Ambystoma mavortium	Western Tiger Salamander	Vertebrate Animals	Amphibians	Regular	Native
Anaxyrus baxteri	Wyoming Toad	Vertebrate Animals	Amphibians	Regular	Native
Anaxyrus boreas	Western Toad	Vertebrate Animals	Amphibians	Regular	Native
Anaxyrus cognatus	Great Plains Toad	Vertebrate Animals	Amphibians	Regular	Native
Lithobates pipiens	Northern Leopard Frog	Vertebrate Animals	Amphibians	Regular	Native
Lithobates sylvaticus	Wood Frog	Vertebrate Animals	Amphibians	Regular	Native
Rana luteiventris	Columbia Spotted Frog	Vertebrate Animals	Amphibians	Regular	Native
Spea bombifrons	Plains Spadefoot	Vertebrate Animals	Amphibians	Regular	Native
Spea intermontana	Great Basin Spadefoot	Vertebrate Animals	Amphibians	Regular	Native
Accipiter atricapillus	American Goshawk	Vertebrate Animals	Birds	Regular	Native
Aechmophorus clarkii	Clark's Grebe	Vertebrate Animals	Birds	Regular	Native
Aechmophorus occidentalis	Western Grebe	Vertebrate Animals	Birds	Regular	Native
Aegolius funereus	Boreal Owl	Vertebrate Animals	Birds	Regular	Native
Ammodramus savannarum	Grasshopper Sparrow	Vertebrate Animals	Birds	Regular	Native
Anarhynchus montanus	Mountain Plover	Vertebrate Animals	Birds	Regular	Native
Anarhynchus nivosus	Snowy Plover	Vertebrate Animals	Birds	Regular	Native
Anthus rubescens	American Pipit	Vertebrate Animals	Birds	Regular	Native
Aphelocoma woodhouseii	Woodhouse's Scrub-Jay	Vertebrate Animals	Birds	Regular	Native
Aquila chrysaetos	Golden Eagle	Vertebrate Animals	Birds	Regular	Native
Archilochus alexandri	Black-chinned Hummingbird	Vertebrate Animals	Birds	Regular	Native
Ardea herodias	Great Blue Heron	Vertebrate Animals	Birds	Regular	Native
Ardea ibis	Western Cattle-Egret	Vertebrate Animals	Birds	Regular	Native
Artemisiospiza nevadensis	Sagebrush Sparrow	Vertebrate Animals	Birds	Regular	Native
Asio flammeus	Short-eared Owl	Vertebrate Animals	Birds	Regular	Native
Athene cunicularia	Burrowing Owl	Vertebrate Animals	Birds	Regular	Native
Baeolophus ridgwayi	Juniper Titmouse	Vertebrate Animals	Birds	Regular	Native

`

Bartramia longicauda	Upland Sandpiper	Vertebrate Animals	Birds	Regular	Native
Botaurus lentiginosus	American Bittern	Vertebrate Animals	Birds	Regular	Native
Buteo regalis	Ferruginous Hawk	Vertebrate Animals	Birds	Regular	Native
Buteo swainsoni	Swainson's Hawk	Vertebrate Animals	Birds	Regular	Native
Calcarius ornatus	Chestnut-collared Longspur	Vertebrate Animals	Birds	Regular	Native
Catherpes mexicanus	Canyon Wren	Vertebrate Animals	Birds	Regular	Native
Centrocercus urophasianus	Greater Sage-Grouse	Vertebrate Animals	Birds	Regular	Native
Centronyx bairdii	Baird's Sparrow	Vertebrate Animals	Birds	Regular	Native
Chlidonias niger	Black Tern	Vertebrate Animals	Birds	Regular	Native
Chordeiles minor	Common Nighthawk	Vertebrate Animals	Birds	Regular	Native
Coccyzus americanus	Yellow-billed Cuckoo	Vertebrate Animals	Birds	Regular	Native
Coccyzus erythropthalmus	Black-billed Cuckoo	Vertebrate Animals	Birds	Regular	Native
Cygnus buccinator	Trumpeter Swan	Vertebrate Animals	Birds	Regular	Native
Dolichonyx oryzivorus	Bobolink	Vertebrate Animals	Birds	Regular	Native
Egretta thula	Snowy Egret	Vertebrate Animals	Birds	Regular	Native
Empidonax traillii	Willow Flycatcher	Vertebrate Animals	Birds	Regular	Native
Falco columbarius	Merlin	Vertebrate Animals	Birds	Regular	Native
Falco peregrinus	Peregrine Falcon	Vertebrate Animals	Birds	Regular	Native
Falco sparverius	American Kestrel	Vertebrate Animals	Birds	Regular	Native
Gavia immer	Common Loon	Vertebrate Animals	Birds	Regular	Native
Geothlypis tolmiei	MacGillivray's Warbler	Vertebrate Animals	Birds	Regular	Native
Geothlypis trichas	Common Yellowthroat	Vertebrate Animals	Birds	Regular	Native
Glaucidium gnoma	Northern Pygmy-Owl	Vertebrate Animals	Birds	Regular	Native
Haliaeetus leucocephalus	Bald Eagle	Vertebrate Animals	Birds	Regular	Native
Histrionicus histrionicus	Harlequin Duck	Vertebrate Animals	Birds	Regular	Native
Hydroprogne caspia	Caspian Tern	Vertebrate Animals	Birds	Regular	Native
Icterus parisorum	Scott's Oriole	Vertebrate Animals	Birds	Regular	Native
Lanius ludovicianus	Loggerhead Shrike	Vertebrate Animals	Birds	Regular	Native
Leiothlypis virginiae	Virginia's Warbler	Vertebrate Animals	Birds	Regular	Native
Leucophaeus pipixcan	Franklin's Gull	Vertebrate Animals	Birds	Regular	Native

`

Leucosticte atrata	Black Rosy-Finch	Vertebrate Animals	Birds	Regular	Native
Leucosticte australis	Brown-capped Rosy-Finch	Vertebrate Animals	Birds	Regular	Native
Loxia curvirostra	Red Crossbill	Vertebrate Animals	Birds	Regular	Native
Melanerpes erythrocephalus	Red-headed Woodpecker	Vertebrate Animals	Birds	Regular	Native
Melanerpes lewis	Lewis's Woodpecker	Vertebrate Animals	Birds	Regular	Native
Myiarchus cinerascens	Ash-throated Flycatcher	Vertebrate Animals	Birds	Regular	Native
Nucifraga columbiana	Clark's Nutcracker	Vertebrate Animals	Birds	Regular	Native
Numenius americanus	Long-billed Curlew	Vertebrate Animals	Birds	Regular	Native
Nycticorax nycticorax	Black-crowned Night Heron	Vertebrate Animals	Birds	Regular	Native
Oreoscoptes montanus	Sage Thrasher	Vertebrate Animals	Birds	Regular	Native
Passerina caerulea	Blue Grosbeak	Vertebrate Animals	Birds	Regular	Native
Pelecanus erythrorhynchos	American White Pelican	Vertebrate Animals	Birds	Regular	Native
Picoides arcticus	Black-backed Woodpecker	Vertebrate Animals	Birds	Regular	Native
Plegadis chihi	White-faced Ibis	Vertebrate Animals	Birds	Regular	Native
Polioptila caerulea	Blue-gray Gnatcatcher	Vertebrate Animals	Birds	Regular	Native
Progne subis	Purple Martin	Vertebrate Animals	Birds	Regular	Native
Psaltriparus minimus	Bushtit	Vertebrate Animals	Birds	Regular	Native
Psiloscops flammeolus	Flammulated Owl	Vertebrate Animals	Birds	Regular	Native
Rallus limicola	Virginia Rail	Vertebrate Animals	Birds	Regular	Native
Rhynchophanes mccownii	Thick-billed Longspur	Vertebrate Animals	Birds	Regular	Native
Selasphorus calliope	Calliope Hummingbird	Vertebrate Animals	Birds	Regular	Native
Selasphorus rufus	Rufous Hummingbird	Vertebrate Animals	Birds	Regular	Native
Setophaga nigrescens	Black-throated Gray Warbler	Vertebrate Animals	Birds	Regular	Native
Sitta pygmaea	Pygmy Nuthatch	Vertebrate Animals	Birds	Regular	Native
Sphyrapicus thyroideus	Williamson's Sapsucker	Vertebrate Animals	Birds	Regular	Native
Spiza americana	Dickcissel	Vertebrate Animals	Birds	Regular	Native
Spizella breweri	Brewer's Sparrow	Vertebrate Animals	Birds	Regular	Native
Sterna forsteri	Forster's Tern	Vertebrate Animals	Birds	Regular	Native
Strix nebulosa	Great Gray Owl	Vertebrate Animals	Birds	Regular	Native
Thryomanes bewickii	Bewick's Wren	Vertebrate Animals	Birds	Regular	Native

`

Tympanuchus phasianellus columbianus	Columbian Sharp-tailed Grouse	Vertebrate Animals	Birds	Regular	Native
Vireo olivaceus	Red-eyed Vireo	Vertebrate Animals	Birds	Regular	Native
Vireo vicinior	Gray Vireo	Vertebrate Animals	Birds	Regular	Native
Anodonta californiensis	California Floater	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Anodontoides ferussacianus	Cylindrical Papershell	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Lampsilis cardium	Plain Pocketbook	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Musculium lacustre	Lake Fingernailclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium adamsi	Adam Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium casertanum	Ubiquitous Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium compressum	Ridgedbeak Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium cruciatum	Ornamented Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium ferrugineum	Rusty Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium idahoense	Giant Northern Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium insigne	Tiny Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium milium	Quadrangular Pillclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium nitidum	Shiny Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium rotundatum	Fat Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium variabile	Triangular Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pisidium ventricosum	Globular Peaclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Pyganodon grandis	Giant Floater	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Sphaerium occidentale	Herrington Fingernailclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Sphaerium simile	Grooved Fingernailclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Sphaerium striatinum	Striated Fingernailclam	Invertebrate Animals	Bivalvia (Mussels and Clams)	Regular	Native
Anostraca	Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native

`

Artemia	No Common Name Available	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Artemiidae	Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Branchinecta	No Common Name Available	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Branchinecta coloradensis	Colorado Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Branchinecta constricta	Constricted Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Branchinecta lateralis	Pocket Pouch Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Branchinecta lindahli	Versatile Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Branchinecta packardi	Rock Pool Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Branchinecta paludosa	Circumpolar Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Branchinecta serrata	a fairy shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native

`

Branchinectidae	Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Chirocephalidae	Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Cyzicus belfragei	Great Plains Clam Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Cyzicus californicus	California Clam Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Eubranchipus	No Common Name Available	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Eubranchipus bundyi	Knobbedlip Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Eubranchipus intricatus	Smoothlip Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Eulimnadia diversa	Diversity Clam Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Holopedium gibberum	a water flea	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Lepidurus	No Common Name Available	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native

`

Lepidurus bilobatus	Great Basin Tadpole Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Lepidurus couesii	Couse Tadpole Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Lepidurus lemmoni	Lynch Tadpole Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Leptestheria compleximanus	Spineynose Clam Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Lynceus brachyurus	Holarctic Clam Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Lynceus brevifrons	Short Finger Clam Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Macrothrix montana	a water flea	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Notostraca	Tadpole Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Polyphemus pediculus	a water flea	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Streptocephalidae	Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native

`

Streptocephalus	Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Streptocephalus coloradensis	Colorado Spiny Tailed Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Streptocephalus dorothae	New Mexico Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Streptocephalus mackini	Chihuahuan Desert Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Streptocephalus texanus	Greater Plains Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Thamnocephalidae	Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Thamnocephalus	No Common Name Available	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Thamnocephalus platyurus	Beavertail Fairy Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Triops	No Common Name Available	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Triops longicaudatus	Longtail Tadpole Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native

`

Triopsidae	Tadpole Shrimp	Invertebrate Animals	Branchiopoda (Fairy Shrimp, Clam Shrimp, Water Fleas, and Tadpole Shrimp)	Regular	Native
Catostomus discobolus	Bluehead Sucker	Vertebrate Animals	Fishes	Regular	Native
Catostomus latipinnis	Flannelmouth Sucker	Vertebrate Animals	Fishes	Regular	Native
Chrosomus neogaeus	Finescale Dace	Vertebrate Animals	Fishes	Regular	Native
Etheostoma exile	Iowa Darter	Vertebrate Animals	Fishes	Regular	Native
Etheostoma spectabile	Orangethroat Darter	Vertebrate Animals	Fishes	Regular	Native
Fundulus kansae	Northern Plains Killifish	Vertebrate Animals	Fishes	Regular	Native
Fundulus sciadicus	Plains Topminnow	Vertebrate Animals	Fishes	Regular	Native
Gila robusta	Roundtail Chub	Vertebrate Animals	Fishes	Regular	Native
Hiodon alosoides	Goldeye	Vertebrate Animals	Fishes	Regular	Native
Hybognathus argyritis	Western Silvery Minnow	Vertebrate Animals	Fishes	Regular	Native
Hybognathus hankinsoni	Brassy Minnow	Vertebrate Animals	Fishes	Regular	Native
Hybognathus placitus	Plains Minnow	Vertebrate Animals	Fishes	Regular	Native
Lepidomeda copei	Northern Leatherside Chub	Vertebrate Animals	Fishes	Regular	Native
Lota lota	Burbot	Vertebrate Animals	Fishes	Regular	Native
Luxilus cornutus	Common Shiner	Vertebrate Animals	Fishes	Regular	Native
Macrhybopsis gelida	Sturgeon Chub	Vertebrate Animals	Fishes	Regular	Native
Margariscus nachtriebi	Northern Pearl Dace	Vertebrate Animals	Fishes	Regular	Native
Nocomis biguttatus	Hornyhead Chub	Vertebrate Animals	Fishes	Regular	Native
Notropis dorsalis	Bigmouth Shiner	Vertebrate Animals	Fishes	Regular	Native
Oncorhynchus clarkii behnkei	Snake River Fine-spotted Cutthroat Trout	Vertebrate Animals	Fishes	Regular	Native
Oncorhynchus clarkii bouvieri	Yellowstone Cutthroat Trout	Vertebrate Animals	Fishes	Regular	Native
Oncorhynchus clarkii pleuriticus	Colorado River Cutthroat Trout	Vertebrate Animals	Fishes	Regular	Native
Oncorhynchus clarkii utah	Bonneville Cutthroat Trout	Vertebrate Animals	Fishes	Regular	Native
Phenacobius mirabilis	Suckermouth Minnow	Vertebrate Animals	Fishes	Regular	Native
Platygobio gracilis	Flathead Chub	Vertebrate Animals	Fishes	Regular	Native
Rhinichthys osculus thermalis	Kendall Warm Springs Dace	Vertebrate Animals	Fishes	Regular	Native

`

Sander canadensis	Sauger	Vertebrate Animals	Fishes	Regular	Native
Scaphirhynchus platorynchus	Shovelnose Sturgeon	Vertebrate Animals	Fishes	Regular	Native
Acroloxus coloradensis	Rocky Mountain Capshell	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Amnicola limosus	No Common Name Available	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Aplexa elongata	Lance Aplexa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Cochlicopa lubrica	Glossy Pillar Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Cochlicopa lubricella	Thin Pillar Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Colligyrus greggi	Rocky Mountain Duskysnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Columella columella	Mellow Column Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Columella columella alticola	Mellow Column Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Columella edentula	Toothless Column Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Cryptomastix mullani	Coeur d'Alene Oregonian Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Cryptomastix mullani mullani	Oregonian	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Deroceras laeve	Meadow Slug	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Deroceras reticulatum	Gray Fieldslug	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Nonnative
Discus catskillensis	Angular Disc Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Discus shimekii	Striate Disc Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Discus whitneyi	Forest Disc Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Elimia cahawbensis	Cahaba Elimia	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Euconulus fulvus	Brown Hive Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Ferrissia californica	Fragile Ancylid	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Ferrissia rivularis	Creeping Ancylid	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Fisherola nuttalli	Shortface Lanx	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Fluminicola coloradoensis	Green River Pebblesnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Fluminicola nuttallianus	Dusky Pebblesnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native

`

Galba bulimoides	Prairie Fossaria	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Galba dalli	Dusky Fossaria	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Galba humilis	Marsh Fossaria	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Galba modicella	Rock Fossaria	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Galba obrussa	Golden Fossaria	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Galba parva	Pygmy Fossaria	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Gastrocopta abbreviata	Plains Snaggletooth Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Gastrocopta armifera	Armed Snaggletooth Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Gastrocopta pentodon	Comb Snaggletooth Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Gastrocopta procera	Wing Snaggletooth Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Gastrocopta similis	Great Lakes Snaggletooth Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Gyraulus circumstriatus	Disc Gyro	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Gyraulus crista	Star Gyro	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Gyraulus deflectus	Flexed Gyro	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Gyraulus parvus	Ash Gyro	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Gyraulus vermicularis	Pacific Coast Gyraulus	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Hawaiia minuscula	Minute Gem Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Helisoma anceps	Two-ridged Ramshorn	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Helisoma anceps anceps	Two-ridged Ramshorn	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Helisoma newberryi	Great Basin Ramshorn	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Hinkleyia caperata	Wrinkled Marshsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Ladislavella apicina	Abbreviate Pondsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Ladislavella catascopium	Woodland Pondsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native

`

Ladislavella elodes	Marsh Pondsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Ladislavella emarginata	St. Lawrence Pondsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Ladislavella hinkleyi	Rustic Pondsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Lymnaea stagnalis	Swamp Lymnaea	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Mediappendix gelida	Frigid Ambersnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Absent	Native
Mediappendix rehderi	Chrome Ambersnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Mediappendix stretchiana	Sierra Ambersnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Mediappendix vermeta	No Common Name Available	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Menetus opercularis	Button Sprite	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Microphysula ingersollii	Spruce Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Nesovitrea binneyana	Blue Glass Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Nesovitrea electrina	Amber Glass Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oreohelix	Land Snails	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oreohelix cooperi	Cooper's Rocky Mountainsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oreohelix peripherica	Deseret Mountainsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oreohelix pygmaea	Pygmy Mountainsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oreohelix strigosa	Rocky Mountainsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oreohelix strigosa depressa	Rocky Mountainsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oreohelix strigosa ssp. 1	Bear Lodge Mountainsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oreohelix subrudis	Subalpine Mountainsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oreohelix yavapai	Yavapai Mountainsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oreohelix yavapai extremitatis	Yavapai Mountainsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oxyloma decampi	Marshall Ambersnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Oxyloma haydeni	Niobrara Ambersnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Absent	Native
Oxyloma retusum	Blunt Ambersnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native

`

Physa jennessi	Obtuse Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physa megalochlamys	Cloaked Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physa skinneri	Glass Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physella acuta	Pewter Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physella ancillaria	Pumpkin Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Absent	Native
Physella columbiana	Rotund Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physella cooperi	Olive Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physella gyrina	Tadpole Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physella humerosa	Corkscrew Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physella integra	Ashy Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physella lordi	Twisted Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physella propinqua	Rocky Mountain Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Absent	Native
Physella spelunca	Cave Physa	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Physella utahensis	No Common Name Available	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Planorbella duryi	Seminole Ramshorn	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Nonnative
Planorbella oregonensis	Lamb Ramshorn	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Planorbella scalaris	Mesa Ramshorn	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Nonnative
Planorbella subcrenata	Rough Ramshorn	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Planorbella tenuis	Mexican Ramshorn	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Planorbella trivolvis	Marsh Ramshorn	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Planorbula campestris	Meadow Ramshorn	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Promenetus exacuous	Sharp Sprite	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Promenetus umbilicatellus	Umbilicate Sprite	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Pseudosuccinea columella	Mimic Lymnaea Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Nonnative
Punctum californicum	Ribbed Spot Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native

`

Punctum minutissimum	Small Spot Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Punctum pygmaeum	Dwarf Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Nonnative
Pupilla blandii	Rocky Mountain Column	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Pupilla hebes	Crestless Column Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Pupilla muscorum	Widespread Column Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Pupoides inornatus	Rocky Mountain Dagger	Invertebrate Animals	Gastropoda (Snails and Slugs)	Absent	Native
Pyrgulopsis pilsbryana	Bear Lake Springsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Pyrgulopsis robusta	Jackson Lake Springsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Succinea grosvenori	Santa Rita Ambersnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Succinea rusticana	Rustic Ambersnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Tryonia clathrata	Grated Tryonia	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vallonia albula	Indecisive Vallonia Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vallonia costata	Costate Vallonia Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vallonia cyclophorella	Silky Vallonia Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vallonia excentrica	Iroquois Vallonia Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vallonia gracilicosta	Multirib Vallonia Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vallonia parvula	Trumpet Vallonia Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vallonia perspectiva	Thin-lip Vallonia Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vallonia pulchella	Lovely Vallonia Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Valvata humeralis	Glossy Valvata	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Valvata sincera	Mossy Valvata	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Valvata tricarinata	Threeridge Valvata	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Valvata utahensis	Desert Valvata	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vertigo arthuri	Callused Vertigo Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vertigo binneyana	Cylindrical Vertigo Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vertigo gouldii	Variable Vertigo Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native

`

Vertigo modesta	Cross Vertigo Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vertigo modesta concinnula	Mitered Vertigo	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vertigo ovata	Ovate Vertigo Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vertigo ventricosa	Five-tooth Vertigo Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vespericola megasoma	Redwood Hesperian	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Vitrina pellucida	Western Glass-snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Walterigalba montanensis	Mountain Marshsnail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Zonitoides arboreus	Quick Gloss Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Zonitoides nitidus	Black Gloss Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Zoogenetes harpa	Boreal Top Snail	Invertebrate Animals	Gastropoda (Snails and Slugs)	Regular	Native
Faxonius immunis	Calico Crayfish	Invertebrate Animals	Malacostraca (Crayfish, Scuds and Sow Bugs)	Regular	Native
Faxonius neglectus	Ringed Crayfish	Invertebrate Animals	Malacostraca (Crayfish, Scuds and Sow Bugs)	Regular	Native
Lacunicambarus nebrascensis	Great Plains Mudbug	Invertebrate Animals	Malacostraca (Crayfish, Scuds and Sow Bugs)	Regular	Native
Pacifastacus gambelii	Pilose Crayfish	Invertebrate Animals	Malacostraca (Crayfish, Scuds and Sow Bugs)	Regular	Native
Alces alces	Moose	Vertebrate Animals	Mammals	Regular	Native
Antrozous pallidus	Pallid Bat	Vertebrate Animals	Mammals	Regular	Native
Bassariscus astutus	Ringtail	Vertebrate Animals	Mammals	Regular	Native
Chaetodipus hispidus	Hispid Pocket Mouse	Vertebrate Animals	Mammals	Regular	Native
Corynorhinus townsendii	Townsend's Big-eared Bat	Vertebrate Animals	Mammals	Regular	Native
Cynomys leucurus	White-tailed Prairie Dog	Vertebrate Animals	Mammals	Regular	Native
Cynomys ludovicianus	Black-tailed Prairie Dog	Vertebrate Animals	Mammals	Regular	Native
Euderma maculatum	Spotted Bat	Vertebrate Animals	Mammals	Regular	Native
Geomys lutescens	Sand Hills Pocket Gopher	Vertebrate Animals	Mammals	Regular	Native
Glaucomys sabrinus	Northern Flying Squirrel	Vertebrate Animals	Mammals	Regular	Native
Gulo gulo	Wolverine	Vertebrate Animals	Mammals	Regular	Native
Lasiurus borealis	Eastern Red Bat	Vertebrate Animals	Mammals	Regular	Native
Lemmiscus curtatus	Sagebrush Vole	Vertebrate Animals	Mammals	Regular	Native

`

Lontra canadensis	Northern River Otter	Vertebrate Animals	Mammals	Regular	Native
Lynx canadensis	Canada Lynx	Vertebrate Animals	Mammals	Regular	Native
Microtus richardsoni	North American Water Vole	Vertebrate Animals	Mammals	Regular	Native
Mustela nigripes	Black-footed Ferret	Vertebrate Animals	Mammals	Regular	Native
Mustela nivalis	Least Weasel	Vertebrate Animals	Mammals	Regular	Native
Myotis ciliolabrum	Western Small-footed Myotis	Vertebrate Animals	Mammals	Regular	Native
Myotis evotis	Long-eared Myotis	Vertebrate Animals	Mammals	Regular	Native
Myotis lucifugus	Little Brown Myotis	Vertebrate Animals	Mammals	Regular	Native
Myotis septentrionalis	Northern Myotis	Vertebrate Animals	Mammals	Regular	Native
Myotis thysanodes	Fringed Myotis	Vertebrate Animals	Mammals	Regular	Native
Myotis volans	Long-legged Myotis	Vertebrate Animals	Mammals	Regular	Native
Myotis yumanensis	Yuma Myotis	Vertebrate Animals	Mammals	Regular	Native
Neotamias amoenus	Yellow-pine Chipmunk	Vertebrate Animals	Mammals	Regular	Native
Neotamias dorsalis	Cliff Chipmunk	Vertebrate Animals	Mammals	Regular	Native
Neotamias dorsalis utahensis	Utah Cliff Chipmunk	Vertebrate Animals	Mammals	Regular	Native
Neotamias umbrinus	Uinta Chipmunk	Vertebrate Animals	Mammals	Regular	Native
Neotamias umbrinus fremonti	Fremont's Uinta Chipmunk	Vertebrate Animals	Mammals	Regular	Native
Neotamias umbrinus montanus	Southern Rocky Mountain Uinta Chipmunk	Vertebrate Animals	Mammals	Regular	Native
Neotamias umbrinus umbrinus	Utah Uinta Chipmunk	Vertebrate Animals	Mammals	Regular	Native
Ochotona princeps	American Pika	Vertebrate Animals	Mammals	Regular	Native
Ochotona princeps princeps	Northern Rocky Mountain Pika	Vertebrate Animals	Mammals	Regular	Native
Ochotona princeps uinta	Uinta Pika	Vertebrate Animals	Mammals	Regular	Native
Ovis canadensis	Bighorn Sheep	Vertebrate Animals	Mammals	Regular	Native
Perognathus fasciatus	Olive-backed Pocket Mouse	Vertebrate Animals	Mammals	Regular	Native
Perognathus flavescens	Plains Pocket Mouse	Vertebrate Animals	Mammals	Regular	Native
Perognathus flavus	Silky Pocket Mouse	Vertebrate Animals	Mammals	Regular	Native
Perognathus mollipilosus	Great Basin Pocket Mouse	Vertebrate Animals	Mammals	Regular	Native
Peromyscus crinitus	Canyon Deermouse	Vertebrate Animals	Mammals	Regular	Native

`

Peromyscus truei	Pinon Deermouse	Vertebrate Animals	Mammals	Regular	Native
Reithrodontomys montanus	Plains Harvest Mouse	Vertebrate Animals	Mammals	Regular	Native
Sciurus aberti	Abert's Squirrel	Vertebrate Animals	Mammals	Regular	Native
Sorex eximius	Western Pygmy Shrew	Vertebrate Animals	Mammals	Regular	Native
Sorex eximius montanus	Southern Rocky Mountain Western Pygmy Shrew	Vertebrate Animals	Mammals	Regular	Native
Sorex haydeni	Prairie Shrew	Vertebrate Animals	Mammals	Regular	Native
Sorex nanus	Dwarf Shrew	Vertebrate Animals	Mammals	Regular	Native
Sorex preblei	Preble's Shrew	Vertebrate Animals	Mammals	Regular	Native
Spilogale gracilis	Western Spotted Skunk	Vertebrate Animals	Mammals	Regular	Native
Spilogale interrupta	Plains Spotted Skunk	Vertebrate Animals	Mammals	Regular	Native
Sylvilagus idahoensis	Pygmy Rabbit	Vertebrate Animals	Mammals	Regular	Native
Thomomys clusius	Wyoming Pocket Gopher	Vertebrate Animals	Mammals	Regular	Native
Thomomys idahoensis	Idaho Pocket Gopher	Vertebrate Animals	Mammals	Regular	Native
Vulpes velox	Swift Fox	Vertebrate Animals	Mammals	Regular	Native
Xerospermophilus spilosoma	Spotted Ground Squirrel	Vertebrate Animals	Mammals	Regular	Native
Zapus hudsonius	Northern Meadow Jumping Mouse	Vertebrate Animals	Mammals	Regular	Native
Zapus hudsonius campestris	Bear Lodge Meadow Jumping Mouse	Vertebrate Animals	Mammals	Regular	Native
Zapus hudsonius preblei	Preble's Meadow Jumping Mouse	Vertebrate Animals	Mammals	Regular	Native
Apalone spinifera spinifera	Eastern Spiny Softshell	Vertebrate Animals	Reptiles	Regular	Native
Aspidoscelis sexlineata viridis	Prairie Racerunner	Vertebrate Animals	Reptiles	Regular	Native
Charina bottae	Northern Rubber Boa	Vertebrate Animals	Reptiles	Regular	Native
Chrysemys picta bellii	Western Painted Turtle	Vertebrate Animals	Reptiles	Regular	Native
Coluber taeniatus	Striped Whipsnake	Vertebrate Animals	Reptiles	Regular	Native
Coluber taeniatus taeniatus	Desert Striped Whipsnake	Vertebrate Animals	Reptiles	Regular	Native
Crotalus oreganus concolor	Midget Faded Rattlesnake	Vertebrate Animals	Reptiles	Regular	Native
Crotalus viridis	Prairie Rattlesnake	Vertebrate Animals	Reptiles	Regular	Native

`

Heterodon nasicus	Plains Hog-nosed Snake	Vertebrate Animals	Reptiles	Regular	Native
Holbrookia maculata maculata	Great Plains Earless Lizard	Vertebrate Animals	Reptiles	Regular	Native
Lampropeltis gentilis	Western Milksnake	Vertebrate Animals	Reptiles	Regular	Native
Opheodrys vernalis	Smooth Greensnake	Vertebrate Animals	Reptiles	Regular	Native
Phrynosoma hernandesi	Greater Short-horned Lizard	Vertebrate Animals	Reptiles	Regular	Native
Phrynosoma hernandesi bauri	Baur's Short-horned Lizard	Vertebrate Animals	Reptiles	Regular	Native
Phrynosoma hernandesi brevirostris	Plains Short-horned Lizard	Vertebrate Animals	Reptiles	Regular	Native
Pituophis catenifer deserticola	Great Basin Gophersnake	Vertebrate Animals	Reptiles	Regular	Native
Plestiodon multivirgatus multivirgatus	Northern Many-lined Skink	Vertebrate Animals	Reptiles	Regular	Native
Plestiodon skiltonianus utahensis	Great Basin Skink	Vertebrate Animals	Reptiles	Regular	Native
Sceloporus consobrinus	Prairie Lizard	Vertebrate Animals	Reptiles	Regular	Native
Sceloporus tristichus	Plateau Fence Lizard	Vertebrate Animals	Reptiles	Regular	Native
Storeria occipitomaculata	Red-bellied Snake	Vertebrate Animals	Reptiles	Regular	Native
Tantilla nigriceps	Plains Black-headed Snake	Vertebrate Animals	Reptiles	Regular	Native
Terrapene ornata	Ornate Box Turtle	Vertebrate Animals	Reptiles	Absent	Native
Terrapene ornata ornata	Plains Box Turtle	Vertebrate Animals	Reptiles	Absent	Native
Thamnophis radix	Plains Gartersnake	Vertebrate Animals	Reptiles	Regular	Native
Thamnophis sirtalis	Common Gartersnake	Vertebrate Animals	Reptiles	Regular	Native
Thamnophis sirtalis fitchi	Valley Gartersnake	Vertebrate Animals	Reptiles	Regular	Native
Thamnophis sirtalis parietalis	Red-sided Gartersnake	Vertebrate Animals	Reptiles	Regular	Native
Urosaurus ornatus wrighti	Northern Tree Lizard	Vertebrate Animals	Reptiles	Regular	Native

- Above data retrieved from WYNDD Species List on 1 May 2025 (www.wyndd.org). Wyoming Game and Fish Department (WGFD) Species of Greatest Conservation Need (SGCN) List was selected, filtered by counties covered under this EA.

`

U.S. Fish and Wildlife Service Wyoming Species of Concern

Wildlife

American bumble bee – *Bombus pensylvanicus*
Bald Eagle - *Haliaeetus leucocephalus*
Black-tailed Prairie Dog - *Cynomys ludovicianus*
Gray Wolf - *Canis lupus*
Greater Sage-grouse - *Centrocercus urophasianus*
Iowa skipper - *Atrytone arogos iowa*
Little brown bat - *Myotis lucifugus*
Mountain Plover - *Charadrius montanus*
Pinyon jay - *Gymnorhinus cyanocephalus*
Pygmy Rabbit - *Brachylagus idahoensis*
Southern plains bumble bee - *Bombus fraternus*
Western bumble bee - *Bombus occidentalis*
White-tailed Prairie Dog - *Cynomys leucurus*
Yellowstone National Park Bison herd - *Bison bison bison*

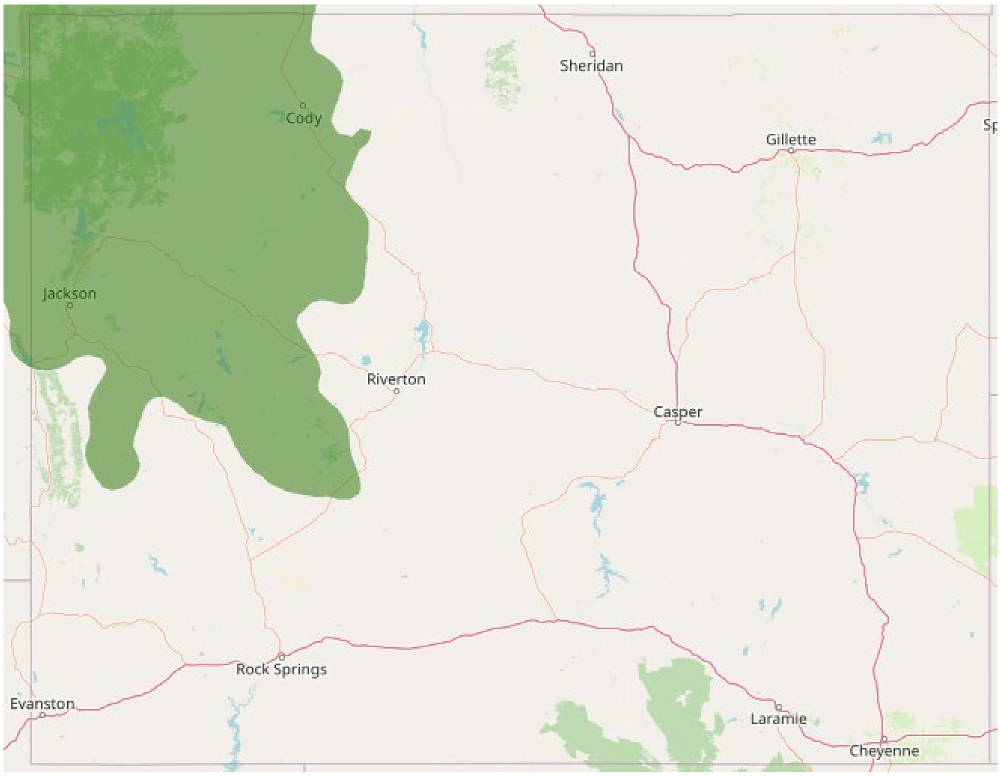
Plants

Colorado Butterfly Plant - *Gaura neomexicana ssp. coloradensis*
Thick-leaf bladderpod - *Physaria pachyphylla*

`

Appendix E: Summary of Species Determinations and Impact Mitigation Measures

1. Grizzly Bear; *Ursus arctos horribilis*
   a. Species Status Map

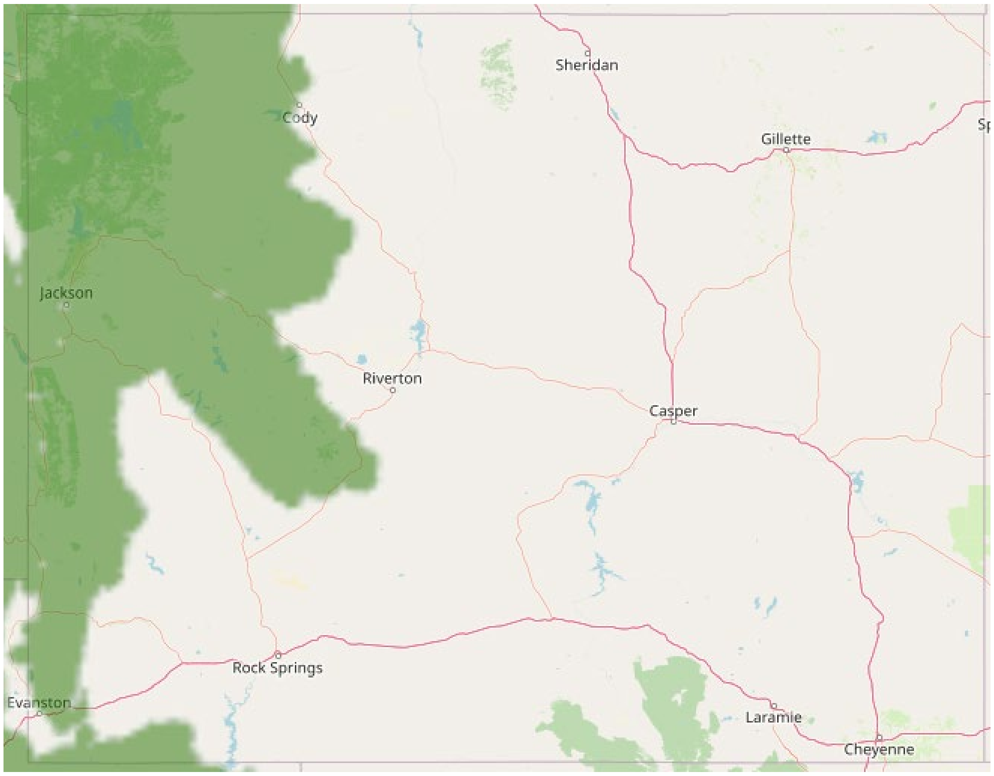


   b. USFWS status: Threatened

APHIS grasshopper suppression programs will have no effect on the grizzly bear. It is not likely that APHIS grasshopper suppression programs will occur in areas of the bear's preferred habitat, montane forests. If a suppression program does overlap with the habitat areas of the grizzly bear, then a site specific consultation will be initiated with USFWS.

`

2. North American Wolverine, *Gulo gulo luscus*
   a. Species Status Map

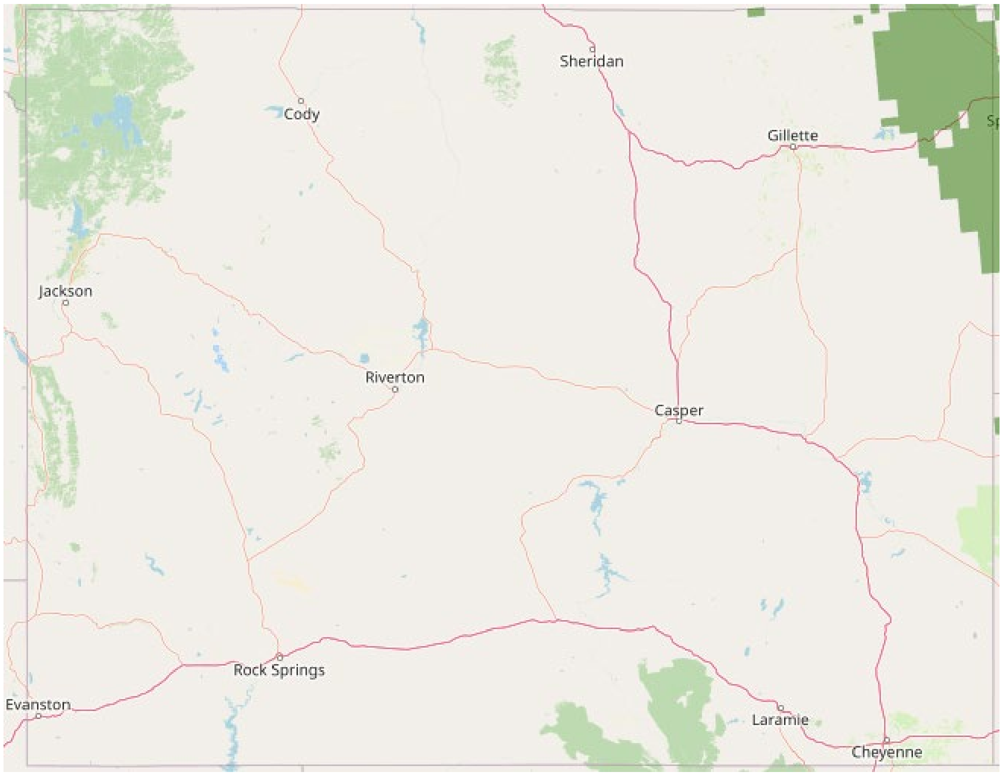


   b. USFWS Status: Threatened

APHIS grasshopper suppression programs will have no effect on the wolverine. Most of the range for wolverine is outside of the area covered under this EA. Wolverine range inside the scope of this EA will likely not be subject to suppression treatments. It is not likely that APHIS grasshopper suppression programs will occur in areas of the wolverine's preferred habitat, montane forests. If a suppression program does overlap with the habitat areas of the wolverine, then a site specific consultation will be initiated with USFWS.

`

3. Northern Long-Eared Bat; *Myotis septentrionalis*
   a. Species Status Map



   b. USFWS Status: Endangered

APHIS grasshopper suppression programs may affect but are not likely to adversely affect the Northern Long Eared Bat (NLEB).

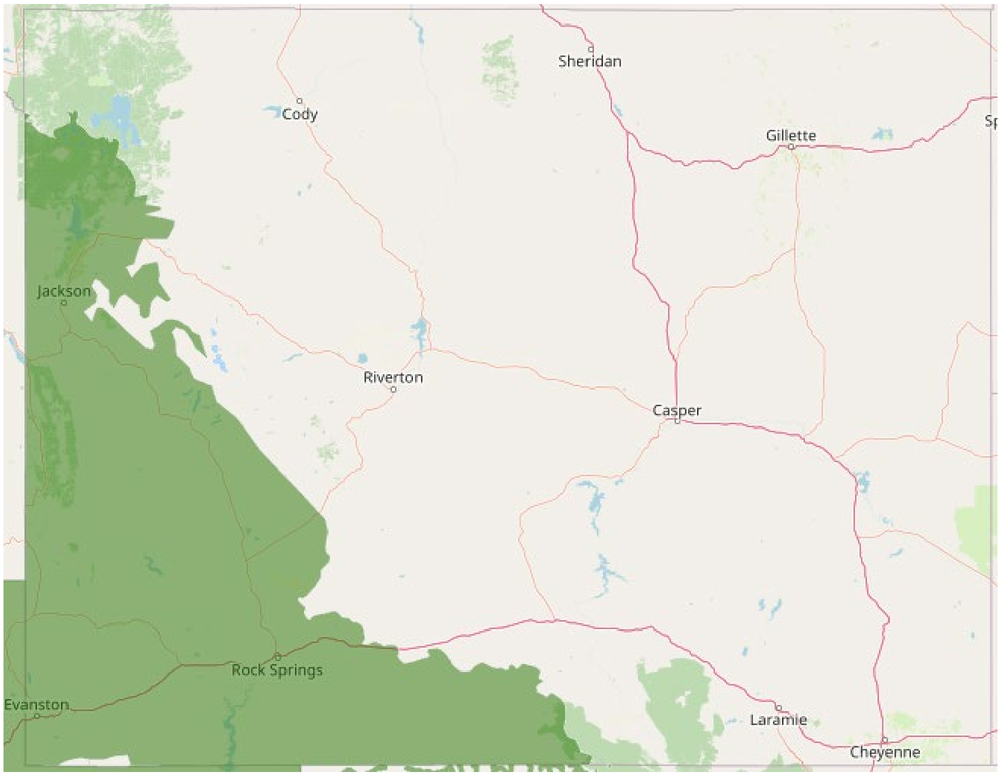
Wyoming is on the edge of the species range and there are few known active maternity areas in Wyoming. These known locations are all within the Black Hills National Forest of northeastern Wyoming. APHIS would use RAATs methodologies for treatments in most cases and this would be expected to leave adequate prey base for insectivorous species such as the NLEB. The preferred foraging areas for the NLEB are forested areas that would not receive grasshopper or Mormon cricket treatments. In addition, treatments would not occur during peak foraging activity reducing the potential for exposure to program insecticides. Dietary exposure from ingestion of contaminated prey or water is also not anticipated to be a major pathway of exposure for the NLEB. Indirect impacts to the NLEB from loss of invertebrate prey items due to program treatments are not anticipated. There may be insignificant or discountable effects to foraging resources or water due to grasshopper suppression programs outside of (but near to) the NLEB roosting and foraging areas. However, grasshoppers and Mormon crickets are not the typical or primary prey for the NLEB.

Please see Appendix 5 for additional risk summary information.

`

4. Yellow-billed Cuckoo; *Coccyzus americanus*

a. Species Status Map



b. USFWS Status: Threatened

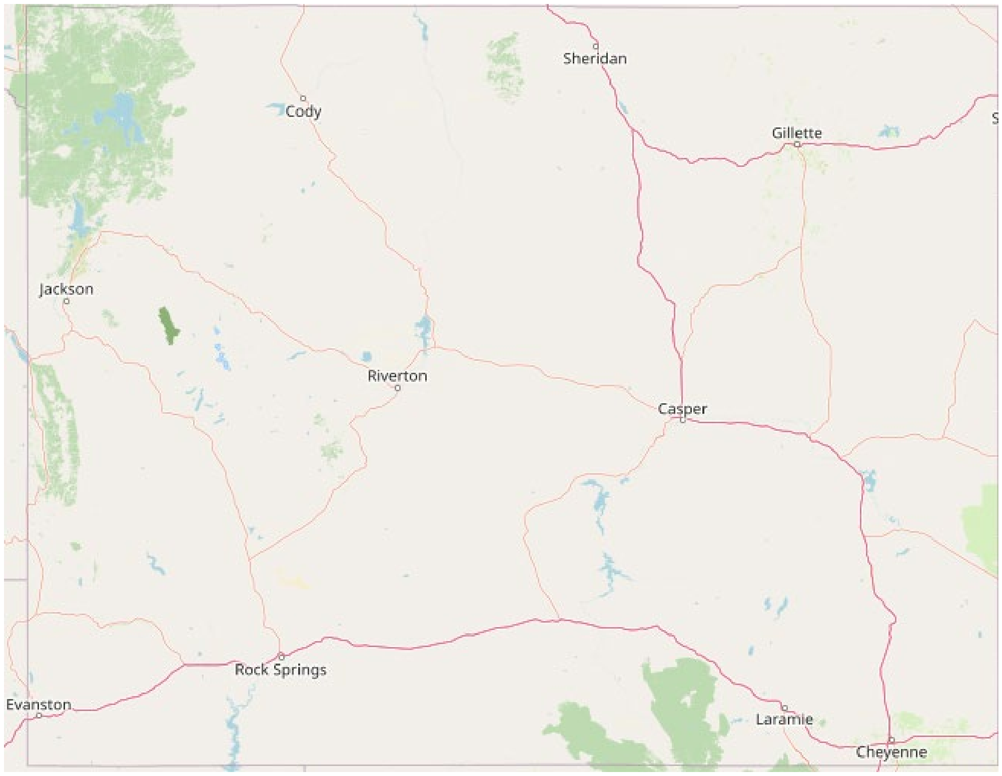
The distinct population segment of the Yellow-billed Cuckoo west of the Continental Divide is listed under the ESA as a threatened species. Most of this range is not covered under this EA. Only Carbon County would possibly be requested for APHIS treatments and APHIS rarely treats these areas. APHIS grasshopper suppression programs may affect but are not likely to adversely affect the Yellow-billed Cuckoo. The following mitigation measures will be followed:

1. Carbaryl bait: 500 foot ground buffer and 750 foot aerial buffer at the edge of known locations of Yellow-billed Cuckoos or their suitable habitat.
2. Chlorantraniliprole ULV: 500 foot ground/aerial buffer at the edge of known locations of Yellow-billed Cuckoos or their critical habitat.
3. Diflubenzuron: 500 foot ground buffer and 1000 foot aerial buffer at the edge of known locations of Yellow-billed Cuckoos or their suitable habitat.

Please see Appendix 4 for additional risk summary information.

`

5. Kendall Warm Springs Dace; *Rhinichthys osculus thermalis*
a. Species Status Map



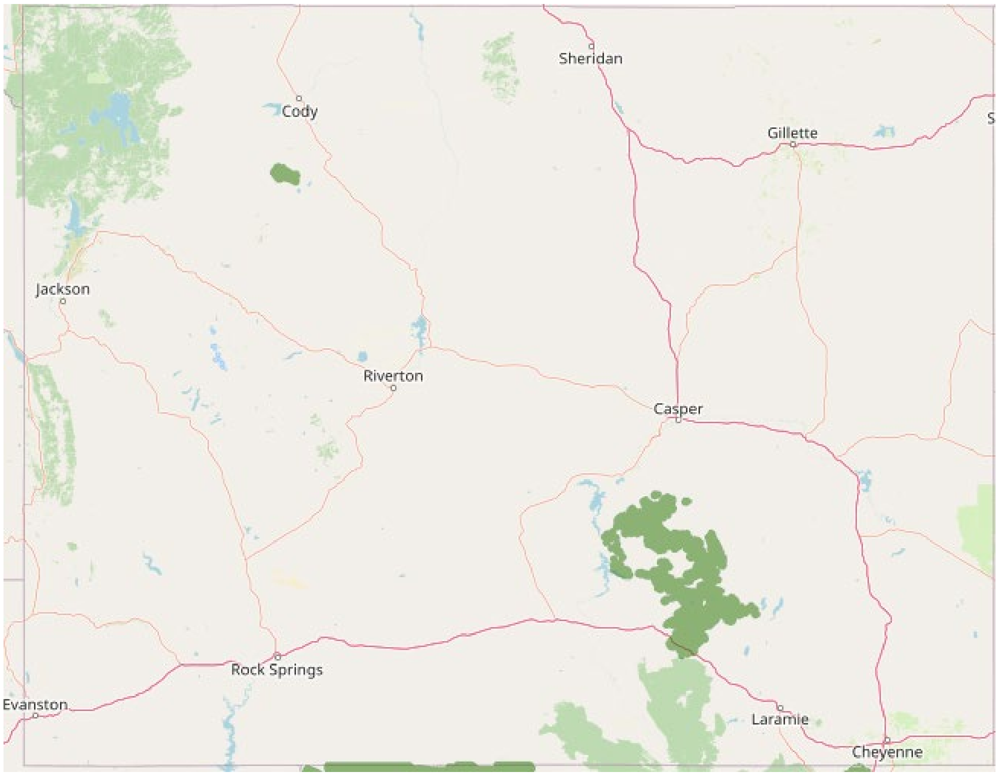
b. USFWS status: Endangered

APHIS grasshopper suppression activities in Wyoming will have no affect on the Kendall warm springs dace. APHIS grasshopper suppression activities will not occur in the vicinity of Kendall warm springs because this area is outside of the areas covered under this EA. APHIS suppression activities will not be conducted in Sublette County.

`

6. Black-footed Ferret; *Mustela nigripes*

a. Species Status Map



b. USFWS status: Endangered

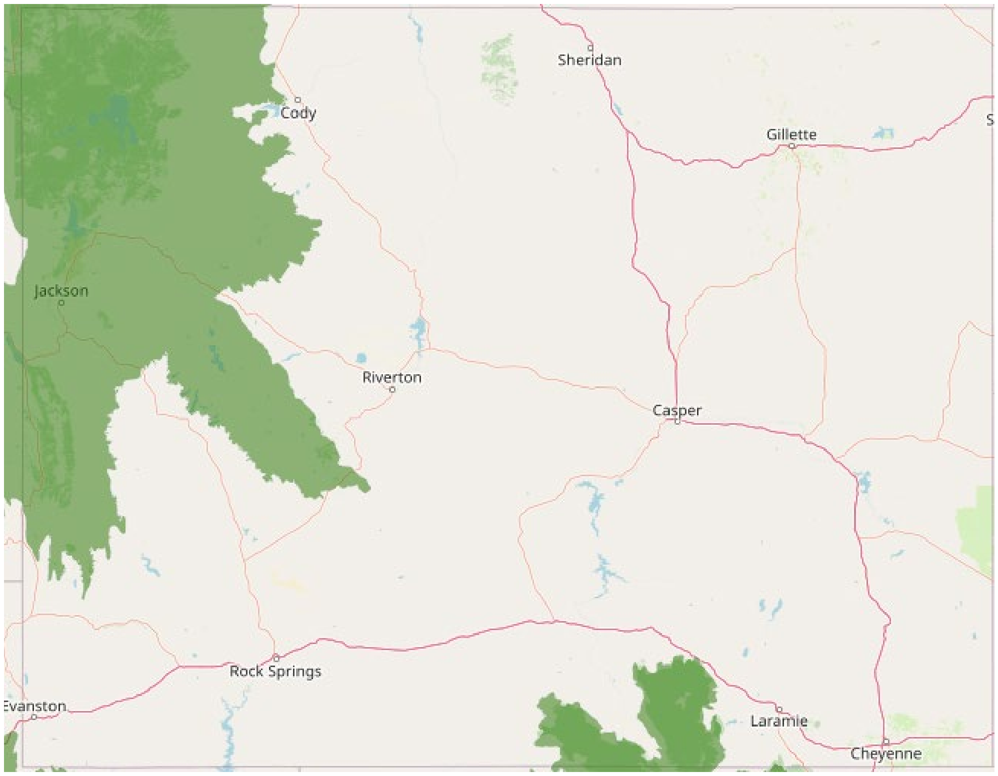
Grasshopper suppression activities in Wyoming will have no affect on black-footed ferrets. This determination is based on the fact that there are no known non-reintroduced black-footed ferret populations in Wyoming.

c. USFWS Status: Experimental (Shirley Basin population and Meeteetse population) There are two non-essential experimental populations of black-footed ferrets in Wyoming. Reintroduction efforts of black-footed ferrets began in 1991 in Shirley Basin and Meeteetse.

Grasshopper suppression activities in Wyoming are not likely to jeopardize the continued existence of the species based on the fact, by definition; any effects to an experimental non-essential population of any species will not jeopardize the continued existence of the species. The Shirley Basin recovery area has historically not been a high grasshopper density area, so APHIS does not expect to have treatments in this area. High grasshopper populations have been known to occur near Meeteetse, however this area is not covered under this EA. APHIS will not conduct suppression programs around or near the Meeteetse population.

`

7. Canada Lynx; *Lynx canadensis*
   a. Species Status Map



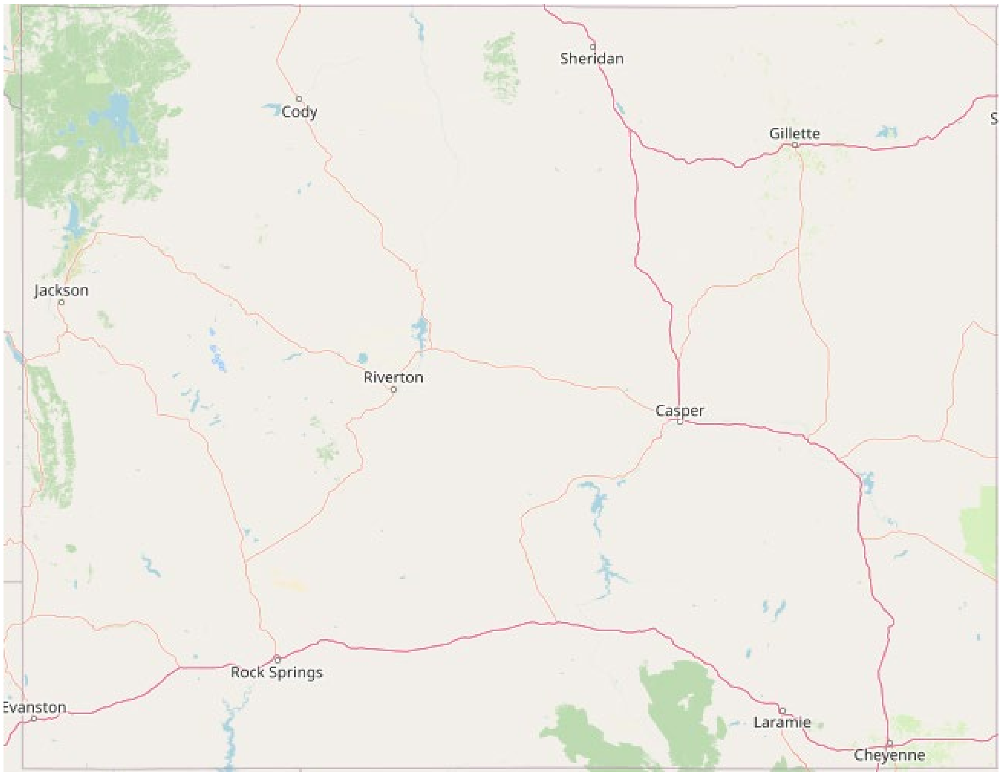
   b. USFWS status: Threatened, Critical Habitat designated

APHIS grasshopper suppression programs will have no effect on the Canada Lynx or its designated critical habitat. Most Canada Lynx habitat is outside of the covered area for this EA. For Canada Lynx habitat covered under this EA, it is not likely that APHIS grasshopper suppression programs will occur in areas of the lynx preferred habitat, boreal forests. If a suppression program does overlap with the critical habitat areas of the Canada Lynx, then a site specific consultation will be initiated with USFWS.

`

8. Preble's Meadow Jumping Mouse; *Zapus hudsonius preblei*

a. Species Status Map



b. USFWS status: Threatened, Critical Habitat designated: Colorado only

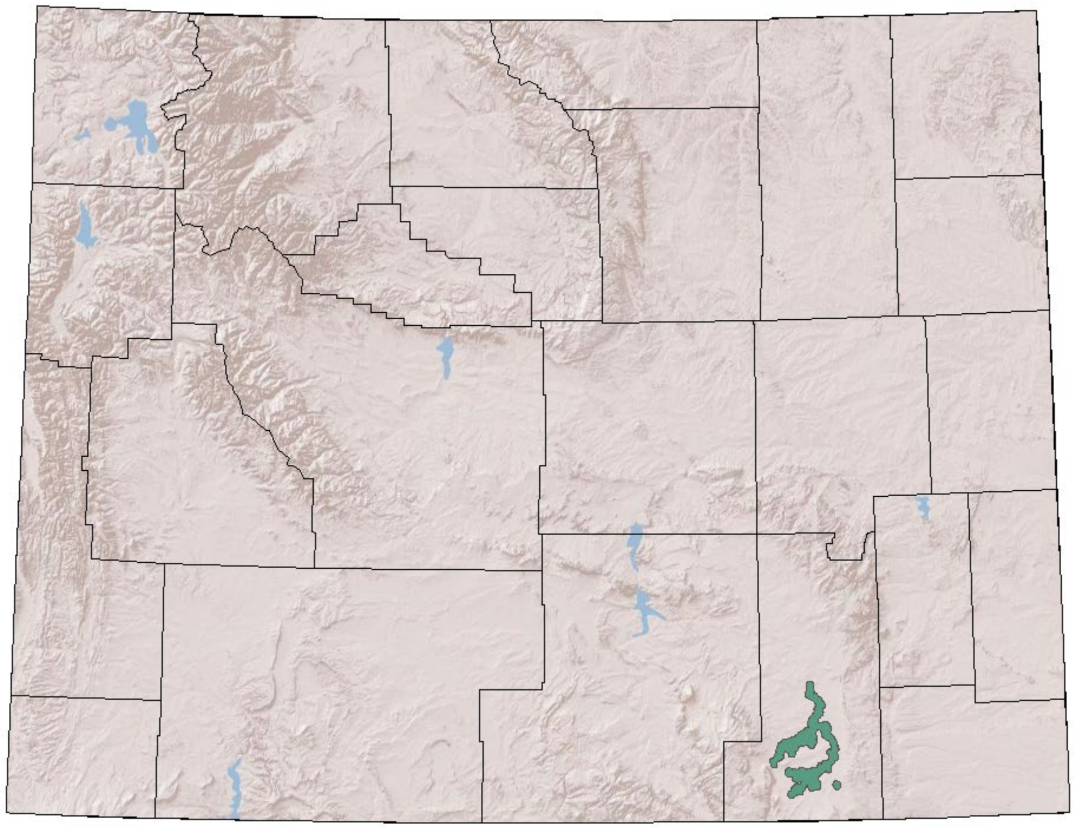
APHIS grasshopper suppression activities in Wyoming are not likely to adversely affect the Preble's meadow jumping mouse. It is not likely that APHIS grasshopper suppression programs will occur in areas of the mouse's preferred habitat due to a buffer placed around water and riparian areas. As per APHIS Grasshopper and Mormon Cricket Suppression Program Treatment Guidelines, the following mitigation measures will be followed:

1. 500 foot standard programmatic buffer around water and riparian areas for aerial suppression programs.
2. 50 foot standard programmatic buffer around water and riparian areas for ground suppression programs will be increased to 500 foot buffer in Preble's meadow jumping mouse suitable habitat within the range of the species.
3. 500 foot standard programmatic buffer from the edge of known occupied habitat or critical habitat to protect prey base from ULV application of chlorantraniliprole.

`

9. Wyoming Toad; *Anaxyrus baxteri*

a. Species Status Map



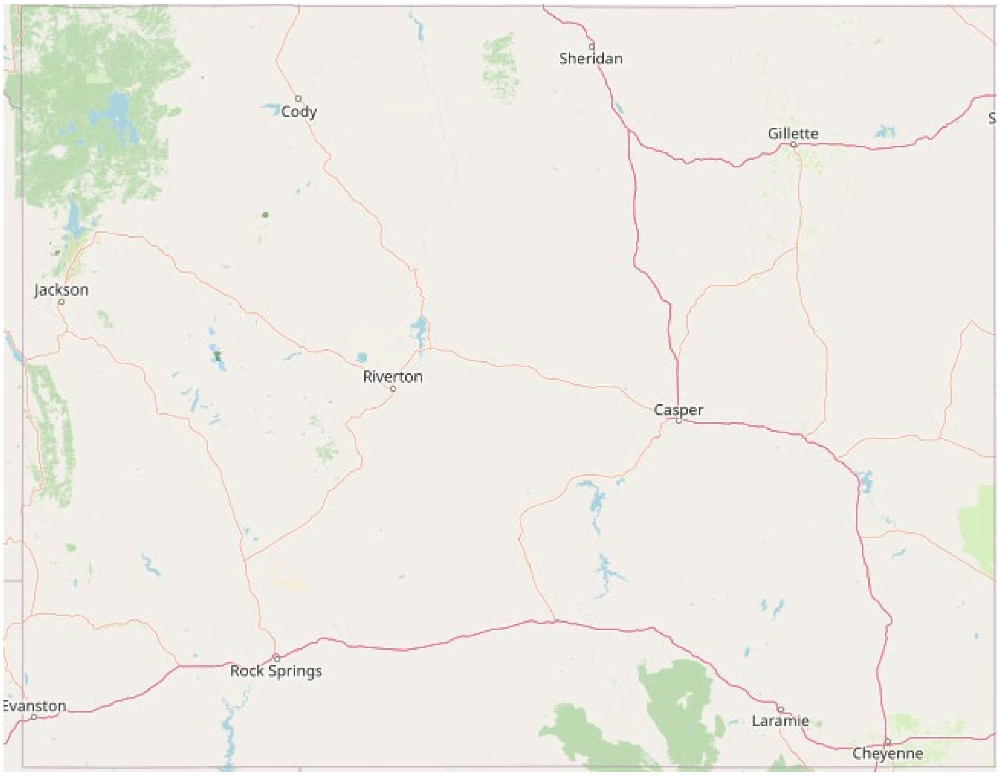
b. USFWS status: Endangered

APHIS grasshopper suppression activities in Wyoming are not likely to adversely affect the Wyoming Toad. It is not likely that APHIS grasshopper suppression activities will occur in the vicinity of Mortenson Lake. In addition to the population at Mortenson Lake National Wildlife Refuge, Wyoming Toad populations occur at several safe harbor sites in Albany County. While unlikely to occur, if suppression activities are needed within the range of the species (as outlined on the map above), a site specific consultation will be initiated with USFWS.

`

10. Western Glacier Stonefly; *Zapada glacier*

a. Species Status Map



b. USFWS status: Threatened, Critical Habitat designated

APHIS grasshopper suppression activities in Wyoming will have no affect on the Western Glacier Stonefly. APHIS grasshopper suppression activities will not occur in the vicinity of Western Glacier Stonefly because this area is outside of the areas covered under this EA. APHIS suppression activities will not be conducted in Teton or Park Counties.

`

11. Ute Ladies' Tresses; *Spiranthes diluvialis*

a. Species Status Map

b. USFWS status: Threatened

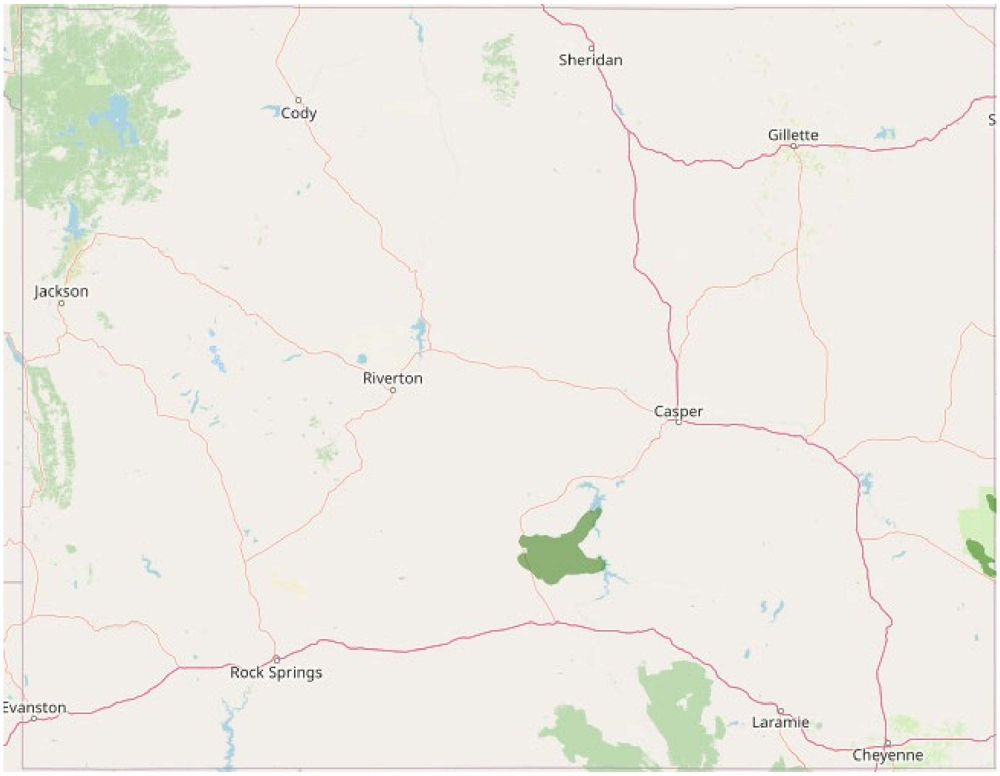
APHIS grasshopper suppression activities in Wyoming are not likely to adversely affect the Ute ladies' tresses. Some populations of Ute ladies' tresses are outside of the area covered under this EA and APHIS will not conduct suppression treatments in those areas. APHIS will take the following impact minimization measures for the protection of pollinators if a spray block occurs within known occupied habitat. The latest data available from WYNDD will be used to determine the known distribution of Ute ladies' tresses. If treatments occur after August 1st the following buffers will be put in place for areas of potential habitat and known populations of Ute ladies' tresses (as determined by WYNDD) in addition to the programmatic 500 foot buffer from water bodies.

1. No aerial application of carbaryl within 3 miles of known occupied habitat.
2. Only carbaryl bran bait, diflubenzuron, or chlorantraniliprole combined with RAATS will be used within the 3 mile buffer.
3. No application of carbaryl bran bait will be applied within a 0.25 mile buffer of the potential range of species.
4. A 50 foot buffer for ground applications will be applied around known locations.

`

12. Blowout Penstemon; *Penstemon haydenii*

a. Species Status Map



b. USFWS status: Endangered

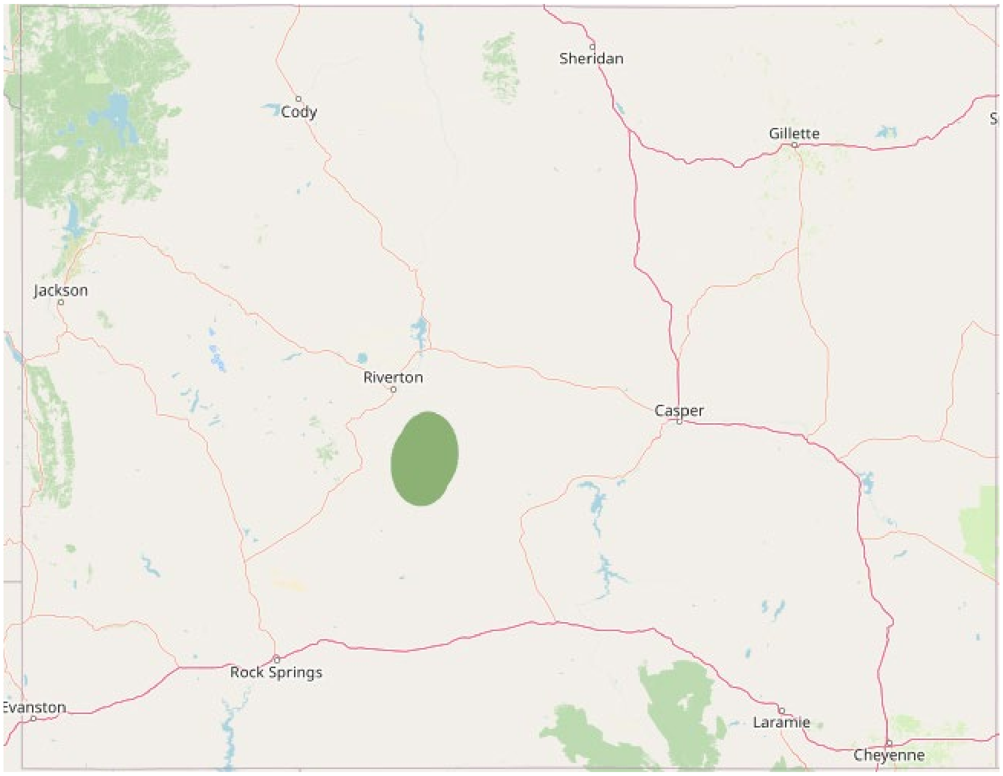
Grasshopper suppression activities in Wyoming are not likely to adversely affect the blowout penstemon. APHIS will take the following impact minimization measures for the protection of pollinators if a spray block occurs within the USFWS potential range of species.

1. No aerial application of carbaryl within 3 miles of the potential range of species.
2. Only carbaryl bran bait, diflubenzuron, or chlorantraniliprole combined with RAATS will be used within the 3 mile buffer.
3. No application of carbaryl bran bait will be applied within a 0.25 mile buffer of the potential range of species.
4. A 50 foot buffer for ground applications will be applied around known locations.

`

13. Desert Yellowhead; *Yermo xanthocephalus*

a. Species Status Map



b. USFWS status: Threatened, Critical Habitat designated

Grasshopper suppression activities in Wyoming are not likely to adversely affect the desert yellowhead or its designated critical habitat. APHIS will take the following impact minimization measures for the protection of pollinators if a spray block occurs within critical habitat or occupied habitat.

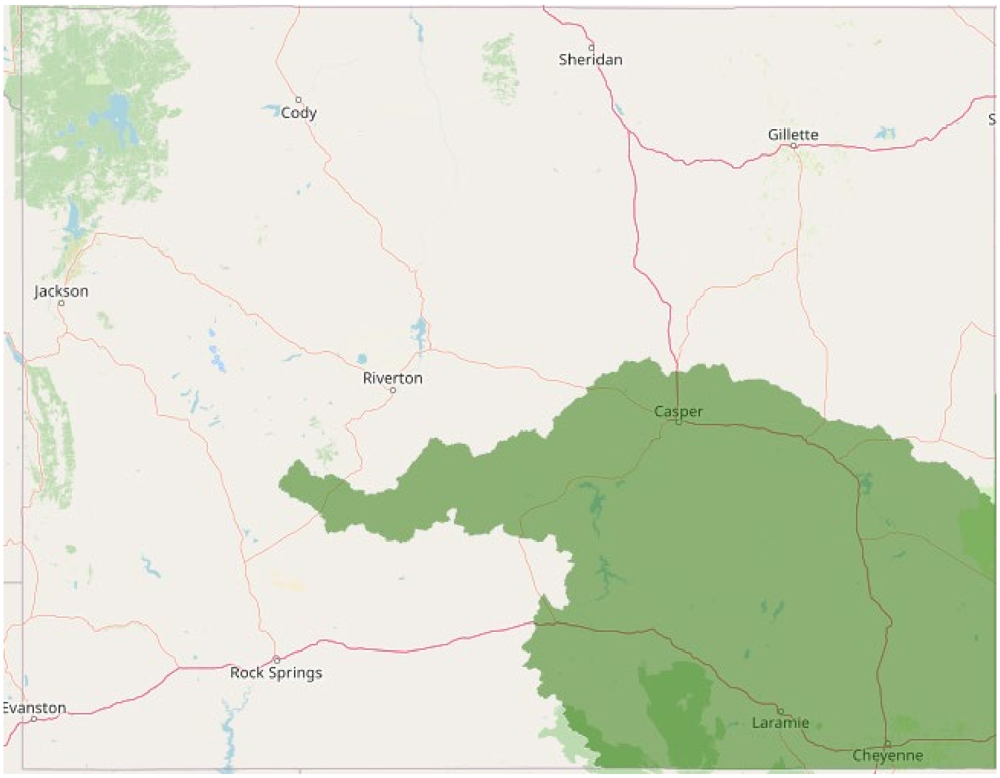
1. No aerial application of carbaryl within 3 miles of the critical habitat or known occupied habitat.
2. Only carbaryl bran bait, diflubenzuron, or chlorantraniliprole combined with RAATS will be used within the 3 mile buffer.
3. No application of carbaryl bran bait will be applied within a 0.25 mile buffer of the potential range of species.
4. A 50 foot buffer for ground applications will be applied around known locations.

`

14. River Species

a. Platte River Species

Least Tern - Interior Population (*Sterna antillarum*) Status: Endangered
Pallid Sturgeon (*Scaphirhynchus albus*) Status: Endangered
Piping Plover (*Charadrius melodus*) Status: Endangered
Western Prairie Fringed Orchid (*Platanthera praeclara*) Status: Threatened
Whooping Crane (*Grus americana*) Status: Endangered



Grasshopper suppression activities in Wyoming will have no effect on any of the river species listed by USFWS. Suppression activities will not deplete any water sources listed as tributaries to the Platte or Colorado River system, nor will any activities have any effect on water quality downstream from Wyoming.

b. Colorado River Fish Species

Bonytail (*Gila elegans*) Status: Endangered
Coloradao Pikeminnow (*Ptychocheilus lucius*) Status: Endangered
Humpback Chub (*Gila cypha*) Status: Endangered
Razorback Sucker (*Xyrauchen texamus*) Status: Endangered

Grasshopper suppression activities in Wyoming will have no effect on any of the river species listed by USFWS. Suppression activities will not deplete any water sources listed as tributaries to the Platte or Colorado River system, nor will any activities have any effect on water quality downstream from Wyoming.

`

Appendix F: Yellow-billed Cuckoo (YBC) Risk Summary for Grasshopper and Mormon Cricket Suppression Program

The distinct population segment of the Yellow-billed Cuckoo (*Coccyzus americanus*) west of the Continental Divide is listed under the ESA as a threatened species (USFWS, Oct. 2014). Hereafter, the western distinct population segment of the YBC will be referred to as the YBC.

The acute toxicity of Program insecticides, in particular carbaryl and diflubenzuron, range from practically nontoxic to highly toxic for birds, in the case of carbaryl, and practically nontoxic in the case of diflubenzuron (USDA APHIS, 2015). Carbaryl avian toxicity is variable based on the test species with the European starling, (*Sturnis vulgaris*) being the most sensitive and the ring-necked pheasant, *Phasianus colchicus*, being the least sensitive bird species (USDA APHIS, 2015). Carbaryl acts by inhibiting the neurotransmitter, acetylcholinesterase, while diflubenzuron acts to inhibit chitin synthesis in developing invertebrates. The acute toxicity of chlorantraniliprole to birds is very low with no acute lethal or sublethal effects noted at all doses in the oral gavage or dietary studies with bobwhite qual (*Colinus virginianus*) and mallard (*Anas platyrhynchos*) (USDA APHIS, 2015). Chronic toxicity between the two chemistries (carbaryl and diflubenzuron) is similar with a lack of effects at field-relevant doses (USDA APHIS, 2015). Chronic toxicity of chlorantraniliprole was also low in 22-week exposure studies used to evaluate reproductive impacts (USDA APHIS, 2015). The potential for risk to the YBC from the proposed use of program insecticides is related to the toxicity of each chemical and the probability of exposure which is discussed below.

Direct exposure to the YBC from proposed grasshopper and Mormon cricket applications is expected to be unlikely. In Wyoming, the YBC use riparian habitats that contain willow-cottonwood and other woodland habitats. Optimal habitat size for the YBC is 200 acres with nesting rarely occurring in sites that are less than 50 acres. Forested areas typically have dense closed canopies. Nesting usually occurs in willow trees of various species but may also occur in other riparian tree species (USFWS, 2014). These are habitats that are not part of the Program for treatment and due to their proximity to water would have no application buffers regardless of whether they may contain YBC or their designated suitable habitat. In cases where there are YBC and/or suitable habitat APHIS increases the no application buffer which further reduces the potential for direct exposure to any Program applications. Estimates of drift from the use of proposed treatments and no application buffers suggest that any potential residues that could move into YBC habitat would be below any potential for direct risk (USDA APHIS, 2015). The presence of dense, closed canopies of riparian trees in YBC habitat would also serve to intercept and remove the small amount of insecticide that could drift into these types of habitat.

Dietary exposure from ingestion of contaminated prey or water is also not anticipated to be a major pathway of exposure for the YBC. There may be some incidental consumption of program insecticides that could be on the surface of some insect prey that receive a sublethal dose following treatment, however, there is not a plausible exposure scenario that could result in the ingestion of enough prey to result in risk to the YBC. Insects that receive a lethal dose would not be available for foraging by the YBC since they prefer live prey items. In the case of carbaryl bait applications, the probability of exposure would be less since the material is not applied as a liquid where it could result in residues on the surface of insects. Dietary exposure from the ingestion of contaminated surface water is also not anticipated to be a major pathway of

`

exposure for the YBC. The program use of no application buffer zones from aquatic areas minimizes the potential for exposure to surface water.

Indirect impacts to the YBC from loss of invertebrate and vertebrate prey items due to program treatments are not anticipated. The YBC has a varied diet including invertebrates as well as some vertebrates including tree frogs and lizards. Diet studies show that approximately 45% of its diet consists of lepidopteran larvae, followed by tree frogs (24%), katydids (22%), grasshoppers (9%) and the remaining amount from various invertebrates including, but not limited to beetles, flies, spiders, caddisflies, dragonflies, crickets and cicadas (USFWS, 2014). This preference may change based on availability of large invertebrate fauna. YBC prefer nesting and foraging in tree canopies along riparian corridors using a "sit and wait" strategy watching foliage movement for prey items (USFWS, 2014). The primary constituent elements and preferred habitat of YBC for nesting and foraging are not areas where the Program will be making applications. Proposed no application buffers from suitable habitat and known locations of the YBC, as well as the use of Reduced Agent Area Treatments (RAATs) where applications will occur adjacent to habitat would mitigate the impacts to potential food items for the YBC. In cases where YBC would forage outside of their preferred habitat there would be adequate food items for foraging based on their varied diet and the lack of effects to terrestrial invertebrates and vertebrates in the no application buffer zones that have been proposed, as well as negligible impacts to nontarget terrestrial invertebrates and vertebrates in treatment blocks. The impacts to nontarget invertebrates within treatment blocks from Program applications are summarized below and show minimal impacts to most nontarget terrestrial invertebrates.

Available field studies suggest the program insecticide applications have minimal impacts to nontarget terrestrial invertebrates (Quinn et al., 1990; Swain, 1986; Smith et al., 2006). Smith et al. (2006) assessed changes in nontarget arthropod populations following applications of diflubenzuron, carbaryl, or malathion using RAATs. In the 2-year study, post application surveys of the major insect fauna revealed that only ants were negatively affected by grasshopper applications within treatment areas. As stated previously, Weiland et al. (2002) assessed the impacts of Sevin XLR Plus applications at 750 g a.i./ha to several invertebrate groups over a 21-day period. This rate equates to 0.67 lb a.i./ac which is 1.34 times higher than the highest rate allowed in the program. Results from the study demonstrated no negative effects on abundance in the following insect groups: Homoptera, Hymenoptera, Coleoptera, Hemiptera, Lepidpotera, and Neuroptera. Previously conducted research, as well as field studies carried out as part of the grasshopper IPM project, indicates that diflubenzuron has minimal impact on most terrestrial nontarget arthropods (Catangui et al., 1996). Weiland et al. (2002) in Wyoming monitored the effects of Dimilin 25W for 21 days post-application on terrestrial invertebrates after full treatment applications of 17.5 and 52.5 g a.i./ha. From high and low sweep net captures, no effect on invertebrates in the orders Homoptera, Hymenoptera, Coleoptera, Hemiptera, Lepidoptera, or Neuroptera were found. There was a statistically significant increase in Diptera and a statistically significant decrease in Araneae (spiders) but the authors question the spider analysis since untreated populations dropped dramatically during the study. Tingle (1996) assessed the impacts of diflubenzuron applications in two field trials occurring in two separate years with applications of 93 g a.i./ha (0.08 lb a.i./ac). Based on an analysis of 28 taxonomic groupings only two were affected and included nontarget grasshoppers and lepidopteran larvae. This effect only occurred in the treated areas but did not occur in the untreated buffer areas that

`

were sampled. Grasshopper 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 7 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). No significant reductions in flying nontarget arthropods, including honey bees, were reported. Within 1 year of diflubenzuron applications in a rangeland environment, no significant reductions of bee predators, parasites, or pollinators were observed for any level of diflubenzuron treatment (Catangui et al., 1996). Graham et al. (2008) evaluated the impacts of diflubenzuron treatments on aquatic and terrestrial invertebrates for Mormon cricket suppression in Utah. A majority of terrestrial invertebrate taxa were not significantly different pre- and post-treatment among three sites that were evaluated. There was a noted decrease in some ant genera but results were not consistent between sites and not all genera were impacted. Non-ant Hymenoptera showed increased numbers at two of the three sites and a decrease at a third site when comparing numbers pre- and post-treatment. Impacts to aquatic invertebrates, such as caddisflies and dragonflies, that may serve as prey for the YBC would be minimal due to the implementation of Program no-application buffer zones adjacent to aquatic habitat. Impacts to vertebrate food items for the YBC such as frogs and lizards would also be minimal based on risk estimates for each Program insecticide and the proposed mitigation to protect the YBC (USDA APHIS, 2015).

Based on the qualitative risk assessment above and the proposed mitigation for protection of YBC and its suitable habitat, APHIS has determined that the Program may affect but is not likely to adversely affect the YBC.

References

Catangui, M.A., Fuller, B.W., and Walz, A.W., 1996. Impact of Dimilin on nontarget arthropods and its efficiency against rangeland grasshoppers. *In* Grasshopper Integrated Pest Management User Handbook, Tech. Bul. No.1809. Sec. VII.3. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Washington, DC.

Graham, T.B., Brasher, A.M.D., and Close, R.N., 2008, Mormon cricket control in Utah's west desert; evaluation of impacts of the pesticide diflubenzuron on nontarget arthropod communities: U.S. Geological Survey Open-File Report 2008–1305, 82 p. [http://pubs.usgs.gov/of/2008/1305/].

Quinn, M.A., Kepner, R.L., Walgenbach, D.D., Foster, R.N., Bohls, R.A., Pooler, P.D., Reuter, K.C. and J.L. Swain. 1991. Effect of habitat and perturbation on populations and community structure of darkling beetles (*Coleoptera: tenebrionidae*) on mixed grass rangeland. Environ. Entomol. 19(6): 1746-1755.

Smith, D.I., Lockwood, J.A., Latchininsky, A.V., and Legg, D.E., 2006. Changes in nontarget populations following applications of liquid bait formulations of insecticides for control of rangeland grasshoppers. Internat. J. Pest Mgt. 52(2):125-139.

Swain, J.L. 1986. Effect of chemical grasshopper controls on nontarget arthropods of rangeland in Chaves County, New Mexico. Master's Thesis. New Mexico State University. 102 pp.

`

Tingle, C.C.D. 1996. Sprayed barriers of diflubenzuron for control of the migratory locust (*Locusta migratoria capito* (Sauss.)) [Orthoptera: Acrididae] in Madagascar: short term impact on relative abundance of terrestrial nontarget invertebrates. Crop Protection 15(6): 579-592.

USDA APHIS. 2015. Biological Assessment for the APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program. Submitted to the USFWS March 2015.

U.S. Fish and Wildlife Service. August 2014. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Western Distinct Population Segment of the Yellow-Billed Cuckoo. Federal Register / Vol. 79, No. 158: 48548-48652.

U.S. Fish and Wildlife Service. October 2014. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (*Coccyzus americanus*); Final Rule. Federal Register / Vol. 79, No. 192: 59992. [Docket No. USFWS-R8-ES-2013-0104; 4500030113]

Weiland, R.T., Judge, F.D., Pels, T., and Grosscurt, A.C., 2002. A literature review and new observations on the use of diflubenzuron for control of locusts and grasshoppers throughout the world. J. Orthoptera Res. 11(1):43-54.

`

Appendix G: Northern Long-eared Bat (NLEB) Risk Summary for Grasshopper and Mormon Cricket Suppression Program

The acute toxicity of Program insecticides, in particular carbaryl and diflubenzuron, are considered moderate for mammals, in the case of carbaryl, and practically nontoxic in the case of diflubenzuron (USDA APHIS, 2015). Similar differences in toxicity between the two insecticides are seen in sublethal and chronic studies, as well. The difference in toxicity between the two insecticides is related to the mode of action. Carbaryl acts by inhibiting the neurotransmitter, acetylcholinesterase, while diflubenzuron acts to inhibit chitin synthesis in developing invertebrates. Acute and chronic direct risk exposure levels of chlorantraniliprole were at least two orders of magnitude below the NOELs for various sized mammals and because no sublethal effects were observed, even at the highest test concentrations, risk to mammals from chlorantraniliprole exposure is low (USDA APHIS, 2015). The report on toxicity of chlorantraniliprole to animals indicates the chemical is practically nontoxic to mammals (USDA APHIS, 2018b). The potential for risk to the NLEB from the proposed use of program insecticides is related to the toxicity of each chemical and the probability of exposure.

Direct exposure to the NLEB from proposed grasshopper and Mormon cricket applications is expected to be minimal. Program applications will occur during the day when bats are not foraging and would be under bark on trees, in crevices, and in mines or caves where exposure to drift would be limited (USFWS, 2014). Emerging at dusk, most hunting occurs above the understory, 1 to 3 meters (m) (3 to 10 feet (ft)) above the ground, but under the canopy (Nagorsen and Brigham, 1993) on forested hillsides and ridges, rather than along riparian areas (Brack and Whitaker, 2001; LaVal et al., 1977). This coincides with data indicating that mature forests are an important habitat type for foraging NLEBs (Caceres and Pybus, 1997). Occasional foraging also takes place over forest clearings and water, and along roads (van Zyll de Jong, 1985). Foraging patterns indicate a peak activity period within 5 hours after sunset followed by a secondary peak within 8 hours after sunset (Kunz, 1973). The preferred foraging areas for the NLEB are areas that would not receive grasshopper or Mormon cricket treatments. In addition, treatments would not occur during peak foraging activity reducing the potential for exposure to Program insecticides.

Dietary exposure from ingestion of contaminated prey or water is also not anticipated to be a major pathway of exposure for the NLEB. There may be some incidental consumption of program insecticides that could be on the surface of some insect prey that receive a sublethal dose following treatment, however, there is not a plausible exposure scenario that could result in the ingestion of enough prey based on the daily food consumption rates for similar Myotis species. Insects that receive a lethal dose would not be available for foraging by the NLEB since they prefer live prey items. In the case of carbaryl bait applications, the probability of exposure would be less since the material is not applied as a liquid where it could result in residues on the surface of insects. Dietary exposure from the ingestion of contaminated surface water is also not anticipated to be a major pathway of exposure for the NLEB. The program use of no application buffer zones from aquatic areas minimizes the potential for exposure to surface water.

Indirect impacts to the NLEB from loss of invertebrate prey items due to program treatments are not anticipated. NLEB depends on a variety of invertebrates in its diet using

`

foraging behaviors including hawking, and gleaning of insect prey from plant surfaces and water (Ratcliffe and Dawson, 2003). Its diet may include insects from the orders Lepidoptera, Neuroptera, Coleoptera, Trichoptera, Hymenoptera, Diptera, Hemiptera, and Homoptera (Thomas et al., 2012; Feldhamer et al., 2009; Carter et al., 2003; Lee and McCracken, 2004). Coleoptera and Lepidoptera appear to make up the largest percentage of their diet, although proportions vary spatially and temporally, similar to other Myotis species, suggesting opportunistic feeding for available flying invertebrates (Griffith and Gates, 1985; Whitaker, 1972). Available field studies suggest the program insecticide applications have minimal impacts to nontarget terrestrial invertebrates (Quinn et al., 1990; Swain, 1986; Smith et al., 2006). Smith et al. (2006) assessed changes in nontarget arthropod populations following applications of diflubenzuron, carbaryl, or Malathion using RAATs. In the 2-year study, post application surveys of the major insect fauna revealed that only ants were negatively affected by grasshopper applications within treatment areas.

As stated previously, Weiland et al. (2002) assessed the impacts of Sevin XLR Plus applications at 750 g a.i./ha to several invertebrate groups over a 21-day period. This rate equates to 0.67 lb a.i./ac which is 1.34 times higher than the highest rate allowed in the program. Results from the study demonstrated no negative effects on abundance in the following insect groups: Homoptera, Hymenoptera, Coleoptera, Hemiptera, Lepidpotera, and Neuroptera. Previously conducted research, as well as field studies carried out as part of the grasshopper IPM project, indicates that diflubenzuron has minimal impact on most terrestrial nontarget arthropods (Catangui et al., 1996). Weiland et al. (2002) in Wyoming monitored the effects of Dimilin 25W for 21 days post-application on terrestrial invertebrates after full treatment applications of 17.5 and 52.5 g a.i./ha. From high and low sweep net captures, no effect on invertebrates in the orders Homoptera, Hymenoptera, Coleoptera, Hemiptera, Lepidpotera, or Neuroptera were found. There was a statistically significant increase in Diptera and a statistically significant decrease in Araneae (spiders) but the authors question the spider analysis since untreated populations dropped dramatically during the study. Tingle (1996) assessed the impacts of diflubenzuron applications in two field trials occurring in two separate years with applications of 93 g a.i./ha (0.08 lb a.i./ac). Based on an analysis of 28 taxonomic groupings only two were affected and included nontarget grasshoppers and lepidopteran larvae. This effect only occurred in the treated areas but did not occur in the untreated buffer areas that were sampled. Grasshopper 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 7 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). No significant reductions in flying nontarget arthropods, including honey bees, were reported. Within 1 year of diflubenzuron applications in a rangeland environment, no significant reductions of bee predators, parasites, or pollinators were observed for any level of diflubenzuron treatment (Catangui et al., 1996). Graham et al. (2008) evaluated the impacts of diflubenzuron treatments on aquatic and terrestrial invertebrates for Mormon cricket suppression in Utah.

A majority of terrestrial invertebrate taxa were not significantly different pre- and post-treatment among three sites that were evaluated. There was a noted decrease in some ant genera but results were not consistent between sites and not all genera were impacted. Non-ant

`

Hymenoptera showed increased numbers at two of the three sites and a decrease at a third site when comparing numbers pre- and post-treatment. Impacts to aquatic invertebrates that may serve as prey would be minimal due to the implementation of Program no-application buffer zones adjacent to aquatic habitat.

Based on the qualitative risk assessment above, APHIS has determined that the Program will not jeopardize the continued existence of the northern long-eared bat foraging and in roosts in the program area.

References

Brack, V. and J.O. Whitaker. 2001. Foods of the northern myotis, Myotis septentrionalis, from Missouri and Indiana, with notes on foraging. Acta chiropterologica. 3: 203–210.

Caceres, M.C., and M. J. Pybus. 1997. Status of the northern long-eared bat (Myotis septentrionalis) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 3, Edmonton, AB.

Carter, T.C., M.A. Menzel, S.F. Owen, J.W. Edwards, J.M. Menzel, and W.M. Ford. 2003. Food habits of seven species of bats in the Allegheny plateau and ridge valley of West Virginia. Northeastern Nat. 10(1):83.88.

Catangui, M.A., Fuller, B.W., and Walz, A.W., 1996. Impact of Dimilin on nontarget arthropods and its efficiency against rangeland grasshoppers. In Grasshopper Integrated Pest Management User Handbook, Tech. Bul. No.1809. Sec. VII.3. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Washington, DC.

Feldhamer, G.A., T.C. Carter, J.O. Whitaker, Jr. 2009. Prey Consumed by Eight Species of Insectivorous Bats from Southern Illinois. The American Midland Naturalist. 162(1): 43–51.

Graham, T.B., Brasher, A.M.D., and Close, R.N., 2008, Mormon cricket control in Utah's west desert; evaluation of impacts of the pesticide diflubenzuron on nontarget arthropod communities: U.S. Geological Survey Open-File Report 2008–1305, 82 p. [http://pubs.usgs.gov/of/2008/1305/].

Griffith, L.A. and J.E. Gates. 1985. Food habits of cave-dwelling bats in the central Appalachians. Journal of Mammalogy. 66(3): 451−460.

Kunz, T.H. 1973. Temporal and Spatial Components of Bat Activity in Central Iowa. Journal of Mammalogy. 54(1): 14–32.

LaVal, R. K., R. L. Clawson, M. L. LaVal and W. Caire. 1977. Foraging Behavior and Nocturnal Activity Patterns of Missouri Bats, with Emphasis on the endangered species Myotis grisescens and Myotis sodalis. Journal of Mammalogy. 58(4): 592−599.

Lee, Y.F. and G.F. McCracken. 2004. Flight activity and food habits of three species of Myotis bats (Chiroptera: Vespertilionidae) in sympatry. Zoological Studies 43(3): 589-597.

`

Nagorsen, D.W., and R.M. Brigham. 1993. The Mammals of British Columbia. 1. Bats. Royal British Columbia Museum, Victoria, and the University of British Columbia Press, Vancouver. pp. 16412.

Quinn, M.A., Kepner, R.L., Walgenbach, D.D., Foster, R.N., Bohls, R.A., Pooler, P.D., Reuter, K.C. and J.L. Swain. 1991. Effect of habitat and perturbation on populations and community structure of darkling beetles (Coleoptera: tenebrionidae) on mixed grass rangeland. Environ. Entomol. 19(6): 1746-1755.

Ratcliffe, J.M., and J.W. Dawson. 2003. Behavioral flexibility: the little brown bat, Myotis lucifugus, and the northern long-eared bat, M. septentrionalis, both glean and hawk prey. Animal Behaviour 66: 847−856.

Smith, D.I., Lockwood, J.A., Latchininsky, A.V., and Legg, D.E., 2006. Changes in nontarget populations following applications of liquid bait formulations of insecticides for control of rangeland grasshoppers. Internat. J. Pest Mgt. 52(2):125-139.

Swain, J.L. 1986. Effect of chemical grasshopper controls on nontarget arthropods of rangeland in Chaves County, New Mexico. Masters Thesis. New Mexico State University. 102 pp.

Thomas, H. H., P.R. Moosman, Jr., J.P. Veilleux, and J. Holt. 2012. Foods of bats (Family Vespertilionidae) at five locations in New Hampshire and Massachusetts. Canadian Field-Naturalist 126(2): 117–124.

Tingle, C.C.D. 1996. Sprayed barriers of diflubenzuron for control of the migratory locust (Locusta migratoria capito (Sauss.)) [Orthoptera: Acrididae] in Madagascar: short term impact on relative abundance of terrestrial nontarget invertebrates. Crop Protection 15(6): 579-592.

USDA APHIS. 2015. Biological Assessment for the APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program

U.S. Fish and Wildlife Service. 2014. Northern long-eared bat interim conference and planning guidance. 67 pp.

Weiland, R.T., Judge, F.D., Pels, T., and Grosscurt, A.C., 2002. A literature review and new observations on the use of diflubenzuron for control of locusts and grasshoppers throughout the world. J. Orthoptera Res. 11(1):43-54.

Whitaker, J.O., Jr. 1972. Food habits of bats from Indiana. Canadian Journal of Zoology. 50(6): 877−883.

`

Appendix H: Comments Received During Open Comment Period

Comments received during the open comment period will be included here along with pertinent responses and published in the Final EA.