Draft Environmental Assessment: Rangeland Grasshopper and Mormon Cricket Suppression Program

Oregon:

Crook County

CEQ Identification Number: OR-25-02-EAXX-005-32-24P-1747306665

Figure 1. Photo of damaging grasshopper populations in Malheur County rangeland, July 2021. Credit: private citizen.

Prepared by:

United States Department of Agriculture (USDA)
Animal and Plant Health Inspection Service (APHIS)
Plant Protection and Quarantine (PPQ)
6035 NE 78th Court, Ste 100
Portland, Oregon 97218

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

May 17th, 2025

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Acronyms and Abbreviations

ac	acre
a.i.	active ingredient
AChE	acetylcholinesterase
APHIS	Animal and Plant Health Inspection Service (USDA)
ARS	Agricultural Research Service (USDA)
AUM	animal unit month
BLM	Bureau of Land Management (USDOI)
BMP	Best Management Practice
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
CRP	Conservation Reserve Program
EA	environmental assessment
e.g.	example given (Latin, exempli gratia, “for example”)
EIS	environmental impact statement
E.O.	Executive Order
ESA	Endangered Species Act
Et al	indicates additional authors (Latin, “and others”)
FONSI	finding of no significant impact
EIL	economic injury level
g	gram
GIPM	Grasshopper Integrated Pest Management project
GPS	Geographical Positioning System
ha	hectare
HHERA	human health and ecological risk assessment
HQ	hazard quotient
i.e.	in explanation (Latin, id est, “that is” or “in other words”)
IPM	integrated pest management
L	Liter
LD_{50}	median lethal dose, (abbreviation for "lethal dose, 50%")
lbs.	pounds
MBTA	Migratory Bird Treaty Act
mph	miles per hour
MOU	memorandum of understanding
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NIH	National Institute of Health
NMFS	National Marine Fisheries Service (NOAA)
NOAEC	no observed adverse effect concentration
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service (USDA)
NWR	National Wildlife Refuge
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish and Wildlife
OSU	Oregon State University
ORBIC	Oregon Biodiversity Information Center (OSU)
PPA	Plant Protection Act of 2000
PPE	personal protective equipment

ppm	parts per million
PPQ	Plant Protection and Quarantine
RAAT	reduced agent area treatment
RoD	record of decision
TWC	toxicity-weighted concentration
ULV	ultra-low volume
US	United States of America
U.S.C.	United States Code
USDA	United States Department of Agriculture
USDOI	United States Department of the Interior
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service (USDA)
USFWS	United States Fish and Wildlife Service (USDOI)
WSA	Wilderness Study Area

I. Need for Proposed Action

A. Purpose and Need Statement

Infestations of damaging populations of grasshoppers or Mormon crickets occur periodically in arid ecoregions of Oregon, especially basins, plateaus and uplands, in areas of gentle slope with minimal shade, that typify many high desert landscapes east of the Cascade Mountains. Damaging outbreaks can occur in warm microclimates of western Oregon as well but are less frequent or enduring. 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 (including APHIS) plays a coordinating role between Federal agencies, State agricultural departments, and private ranchers to control both grasshoppers and Mormon crickets. APHIS does not have its own management goals for grasshoppers, but rather responds to public demand, and official requests from stakeholders for assistance. The annual coordination cycle for this may be summarized as follows:

April - June	July - Sept.	Oct. - Dec.	Jan. - March
Grasshoppers hatch, followed by nymphal stages: when most damage for year occurs	Adult populations complete their annual lifecycle, followed by dormancy	Remain dormant, in egg pods in soil (for some species this can extend multiple years)	Dormancy continues, typically through March
Land managers report hatch, request survey and potential treatment support, or conduct their own (individually or in collectives)	Assess and document damage, talk to neighbors, research topic and assistance options, evaluate trends and potential goals	Decide on management goals, evaluate options for the coming year, organize collectives, plan or request public meetings	Officially request assistance, submit areas for survey and potential treatment, organize funding, solicit contractors or finalize documentation
APHIS conducts pre-treatment surveys to assess infestation levels communicate with requestors, build on all planning work to follow through on treatments during limited window	Adult survey conducted across state, mostly on federal land to show trends, do post treatment surveys, finalize reporting and documentation of any APHIS treatments	Develop hazard map for coming year and provide to public, follow up on assistance requests, reach out to impacted areas not heard from, start NEPA reviews	Request program resources (from congress), hold public meetings, develop survey plans, communicate with requestors, contractors, and wildlife managers, finalize NEPA reviews

Table 1. Annual Coordination Cycle for Collective Grasshopper Management.

Not shown in this table are that other public agencies and municipalities may conduct their own grasshopper programs with minimal or no assistance from APHIS. In Oregon both the Oregon Department of Agriculture (ODA) and Oregon State University (OSU) Extension Service for example provide their own resources to stakeholders requesting assistance with the management of grasshoppers. Populations of grasshoppers that may result in the need for an APHIS suppression program require official request from and cooperation with land manager(s) and are considered on a case-by-case basis. They are also difficult to accurately forecast or detect, delimit and suppress within the limited annual treatment window, as dictated by the annual grasshopper lifecycle.

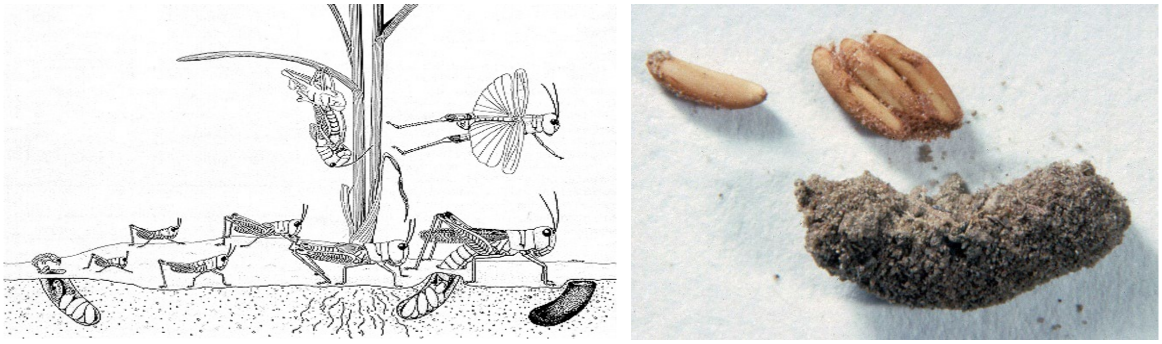


Figure 2. Lifecycle of the bigheaded grasshopper Alucara elliotti (Pfadt 2002) *and egg pod of clearwinged grasshopper* Camnula pellucida *(Brust et al 2020. Grasshoppers of the Western U.S., Edition 4. idtools.org/grasshoppers/index.cfm).*

Most species of grasshoppers are dormant as eggs in the ground for 10 or more months of the year, followed by rapid development during which most damage occurs, then an adult phase which is most evident but also hardest to suppress. The Grasshopper Hazard Map, which is produced each fall and offered to the public at our program website (www.aphis.usda.gov/plant-pests-diseases/ghmc), is the best forecasting tool available for predicting locations of outbreaks in the coming year.

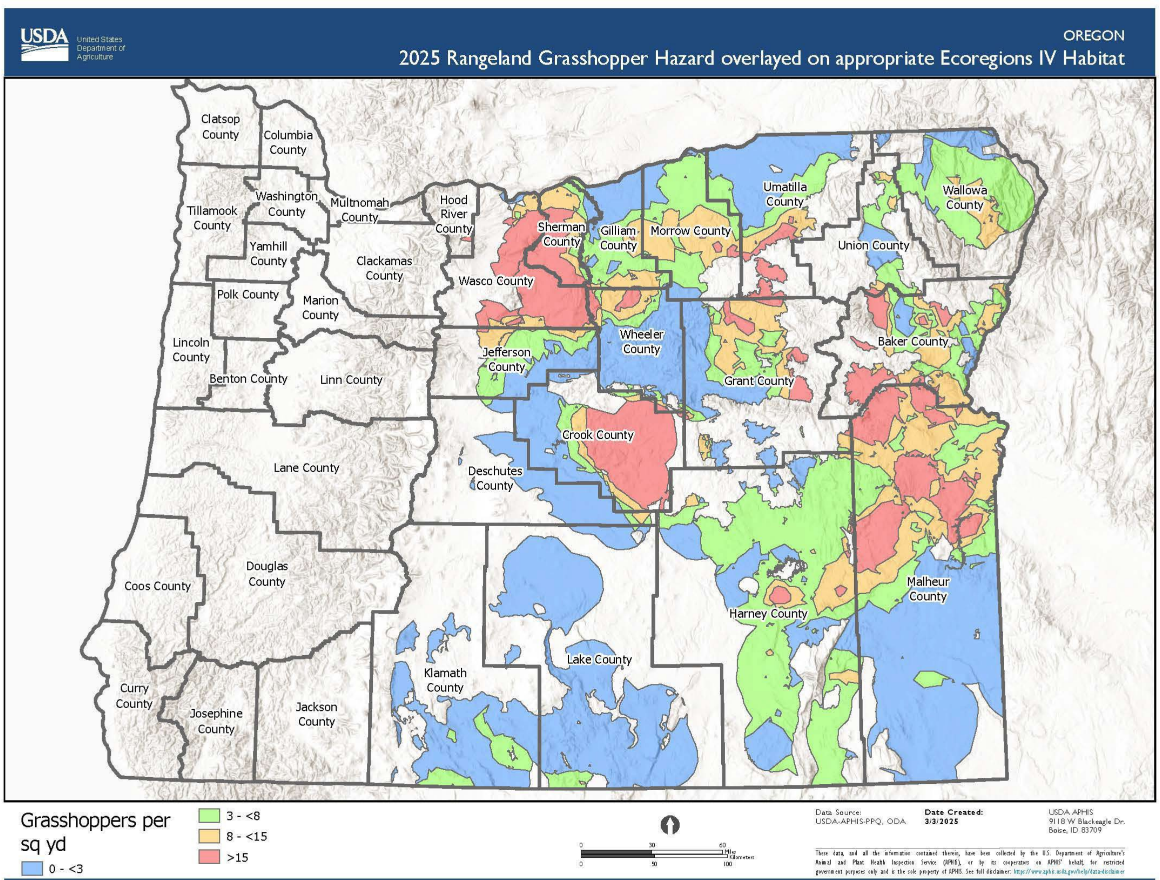


Figure 3. 2025 Rangeland Grasshopper Hazard Map of Oregon, based on 2024 survey results, excluding unconducive ecoregions.

There are significant limitations to such hazard maps however, such as not catching small outbreak areas (a.k.a. 'hotspots'), or spillover of projected hazard level from areas prone to outbreak into areas that are unconducive, such as forests, steep terrain or perennial wetlands. If the Level IV ecoregions of Eastern Oregon in the following table are clipped out of the hazard map, this better indicates geographical limits of the forecast grasshopper outbreaks. For hotspots to show up better on the other hand, either more survey is required or, such as with Klamath Falls and Lakeview, surveys must focus more on problem areas. Currently, survey protocols favor federal rangeland, due to consistency of access and land use, however that can mask a hotspot if survey from such areas do not capture what is occurring on nearby private agricultural land.

Table 2. Level IV Ecoregions of Central and Eastern Oregon Considered Unconducive to Grasshopper Outbreaks

Level III Ecoregion	Level IV Ecoregion	Reason
9 - Eastern Cascades Slopes and Foothills	9b - Grand Fir Mixed Forest	Shade/Moisture
9 - Eastern Cascades Slopes and Foothills	9c - Oak/Conifer Foothills	Shade/Moisture
9 - Eastern Cascades Slopes and Foothills	9d - Ponderosa Pine/Bitterbrush Woodland	Shade/Moisture
9 - Eastern Cascades Slopes and Foothills	9e - Pumice Plateau	Shade/Moisture
9 - Eastern Cascades Slopes and Foothills	9i - Southern Cascades Slope	Shade/Moisture
10 - Columbia Plateau	None	All Conducive
11 - Blue Mountains	11c - Maritime-Influenced Zone	Shade/Moisture
11 - Blue Mountains	11d - Melange	Shade/Moisture
11 - Blue Mountains	11e - Wallowas/Seven Devils Mountains	High Altitude
11 - Blue Mountains	11h - Continental Zone Highlands	Shade/Moisture
11 - Blue Mountains	11l - Mesic Forest Zone	Shade/Moisture
11 - Blue Mountains	11m - Subalpine-Alpine Zone	High Altitude
12 - Snake River Plain	None	All Conducive
80 - Northern Basin and Range	80j - Semiarid Uplands	High Altitude
80 - Northern Basin and Range	80k - Partly Forested Mountains	High Altitude
80 - Northern Basin and Range	80m - Barren Playas	Lack of Vegetation

The scope of this EA is limited to the counties listed. Secondarily, it is limited to areas wherein grasshopper populations of 8 per square yard or more have been documented in those counties at any time since 1953, as shown in the aggregate survey data presented in Figure 3 as 'Economic Infestations' which provides a solid baseline for a minimal expected potential for outbreaks. Based on this, the removal of Level IV Ecoregions listed in Table 1 and presented visually as excluded areas in Figure 2, is possible. Finally, as discussed in section III, the scope of this EA is further limited by special management areas such as Wilderness Study Areas and others. These are all hard limits to the coverage range of this EA in terms of potential program areas analyzed.

Ecological factors within the remaining landscapes further reduce what areas represent feasible program areas, due to the absence of grasshopper outbreaks on a finer scale. Grasshopper outbreaks in Oregon occur on crops, grasslands and shrublands (typically below 6,000 feet elevation) with minimal tree cover and of minimal slope. Shade cover and perennial moisture are major limiting factors for grasshoppers, though seasonal wetlands can see outbreaks, especially in years of drought. Slope is also a significant limiting factor, except for Mormon Crickets which can thrive in canyon lands. Even if outbreaks occur in rough terrain however, these areas should be excluded from consideration for treatment due to safety issues. Generally speaking, the potential program area does not include mountains, forests or perennial wetlands.

The potential program area is limited by land use. Areas of human habitation or congregation are excluded from the program. Croplands (including hay fields and Conservation Reserve Program crops) are only permitted to be included in APHIS treatments to a very limited extent, if at all, and no APHIS cost share is provided. Crops have not been treated in Oregon in 20 years or more. The program is specifically for control of outbreaks on rangeland, though at times the purpose of the suppression effort may be to prevent migration of outbreaks onto adjacent crops or communities.

Finally, in Oregon, available resources have limited the program focus to federally, tribally, or state managed range land. Private rangeland can potentially be included in APHIS treatment programs, however in Oregon, this is rare. The functional cost share from APHIS after overhead is only 16.5%, while the treatment must be fully run and supervised by APHIS, including access to all areas of the treatment block and surrounding, is subject to delays or cancellation for various reasons, and comply with greater environmental protection measures than a privately managed treatment would require. As a result, it is not generally considered an efficient option for private land. If a private rangeland were to be treated it would be due to it being interwoven with public land to the extent that treating the land separately would be unsafe or extremely inefficient, such as with a checkerboard ownership pattern.

Programmatic buffers, as described in Appendix A, and in relevant sections throughout the EA, further limit where application of pesticides may occur, with larger than pesticide label buffers being required for all water bodies and areas of human congregation, such as buildings or campgrounds. Non-target species specific buffers also may apply as described in section III.D.

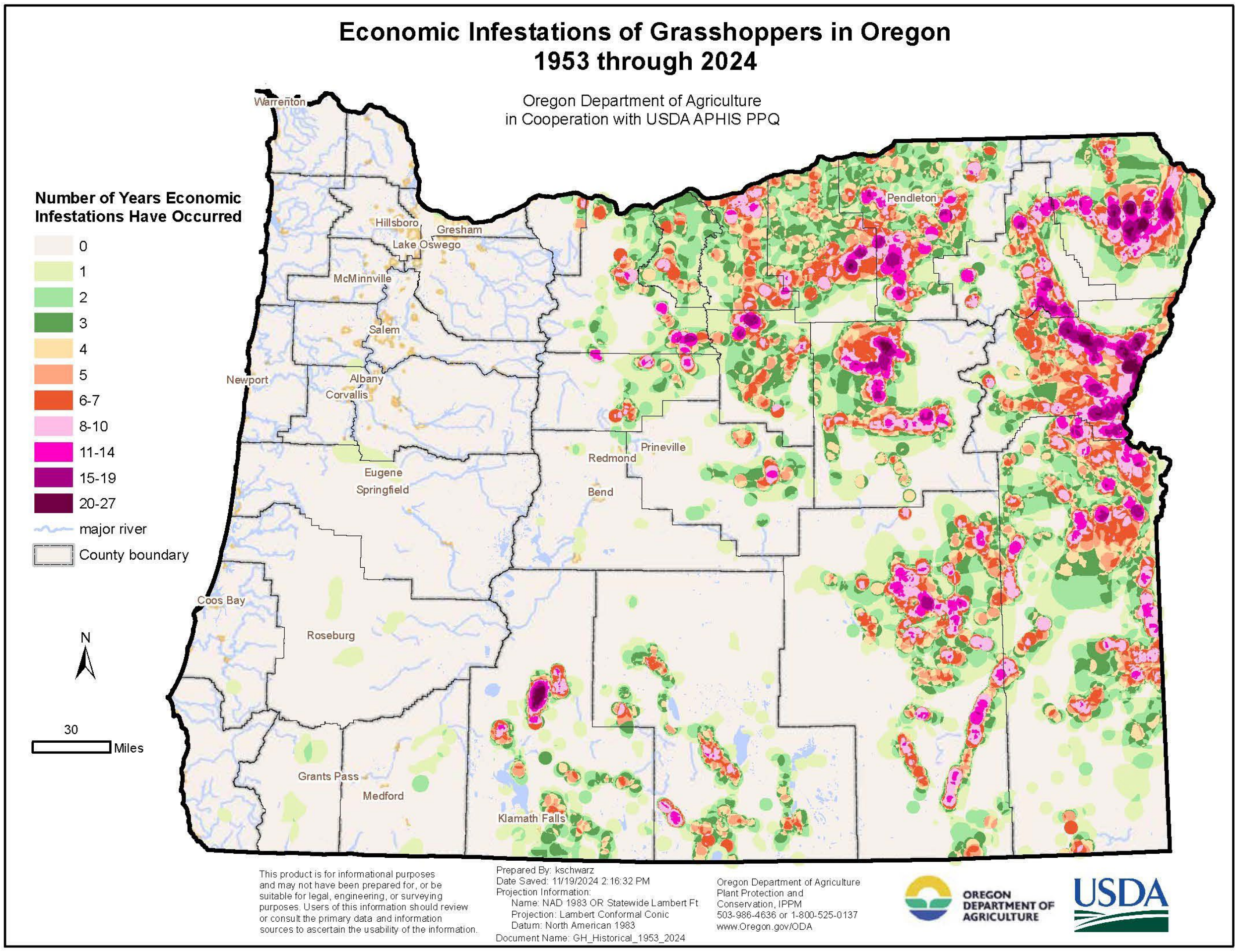


Figure 4. Economic Infestations of Grasshopper in Oregon 1953 through 2024. Credit: ODA with support from USDA APHIS.

Through adult grasshopper surveys in July and early August, APHIS attempts to forecast areas where damaging grasshopper populations may occur during the following year. Land managers and property owners may request APHIS assistance to control grasshopper outbreaks because of these survey efforts, a history of damage they have observed themselves, or to try to be a good neighbor to land managers in the area who are complaining of grasshoppers migrating onto their property.

The estimated potential damage to rangeland resources forecast in the current year is determined by spring nymphal assessment and delimitation surveys which are necessarily conducted within the limited treatment window when grasshoppers are active in their annual cycle. Typically, there is only about one month in a given location to conduct this survey, and any feasible treatment, spanning from late spring to early summer, and varying by location, elevation, species and weather. The aggregate history of 70 years of grasshopper outbreak surveys can help to inform the public on areas generally prone to outbreaks, as illustrated in Figure 4, which shows how many years 8 or more grasshoppers per square yard were observed, which Oregon Department of Agriculture (ODA) is defining as an 'Economic Infestation'. (This is not an Economic Injury Level or action threshold for a given area, but it is a consistent metric which goes back many decades throughout the western US.) Even the most prone areas do not have outbreaks every year however, and the exact location of outbreaks can shift from year to year. Changes caused over time due to survey protocols, land use, water availability or other long-term trends may be slow to show up in this aggregate map. One of most impacted areas of recent years, the Klamath and Goose Lake Basins, again shows only moderate hazard for example, which is does not match observations of recent years.

Only about 15 of the 400 western US grasshoppers species are considered major economic pests, exceeding damage rates from all other rangeland arthropod families with annual forage losses estimated at 25%. As Dakhel et al 2020 go on to elucidate:

> Historical records of severe grasshopper damage in North America are documented from the second half of the 19th century, when devastating Rocky Mountain locust (*Melanoplus spretus*) swarms decimated crops and rangelands from Central Canada to Texas. From 1874 to 1877, *M. spretus* infestations were extremely expansive and severe over large areas of the Great Plains, which led to the institution of the United States Entomological Commission by Congress to study and control grasshopper plagues. Later on, in the 1930s, grasshopper outbreaks covered millions of hectares of federally and privately-owned land in 17 western states. In 1972, the implementation of publicly supported control programs on rangelands was authorized by… [USDA APHIS]. One of its functions was to prevent severe grasshopper rangeland damage. Forage losses to grasshoppers could be overwhelming: for example, in 1985, grasshopper populations… inflicted economic losses estimated at over $393 million.

Many areas prone to damaging grasshopper populations are more rural and closely tied to the land for economic productivity than average, even for a state that takes pride in these metrics. Harney County for example, where most APHIS grasshopper treatments have occurred in Oregon, is the largest county by area (10,226 square miles) but has a population which averages less than one person per square mile, which is less than 1/40th of the state's average population density. Such areas also typically have a high percentage of public land (e.g., 75% in Harney County), and rely heavily on natural resources for economic development and quality of life of its citizens. When grasshopper population are at high levels, known as outbreaks, intensive feeding on available vegetation can degrade natural resources and negatively impact rural communities, including:

- Reduction of herbivore capacity, including agricultural livestock and wildlife,
- Reduction of flowers for pollinators and seed production including for rare plants,
- Increased soil erosion,
- Reduced water quality,
- Damage to private crops, orchards/vineyards, and gardens
- Increased use of pesticides,
- Public health impacts due to slippery roads, poor windshield visibility, airplane bird-strikes, and damage to infrastructure from flooding of clogged gutters,

- Reduction of tourism, property values and municipal tax income.

Outbreaks also have the potential to continue for many years without diminishment from natural causes, such as wildfire, disease and/or unfavorable climatic conditions, which are difficult to predict. Benefits of controlling damaging grasshopper outbreaks include the protection of rangeland ecosystem resources and nearby cropland from decimating impacts in the current year, and reduced potential for continuing damage in subsequent years. 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 applies to a proposed suppression program that would take place from May 1st to August 1st within rangeland ecosystems of the following ecoregions and counties of Oregon:

- Columbia Plateau (Jefferson, Wasco, and Umatilla counties) primarily in support of potential treatment requests from tribal governments.
- Blue Mountains (Baker and northern Malheur counties) primarily in support of BLM Vale District.
- Northern Basin and Range (Harney, Lake, and Malheur counties) primarily in support of BLM Burns and Lakeview Districts.
- Snake River Plain (Baker and Malheur counties) due to proximity.

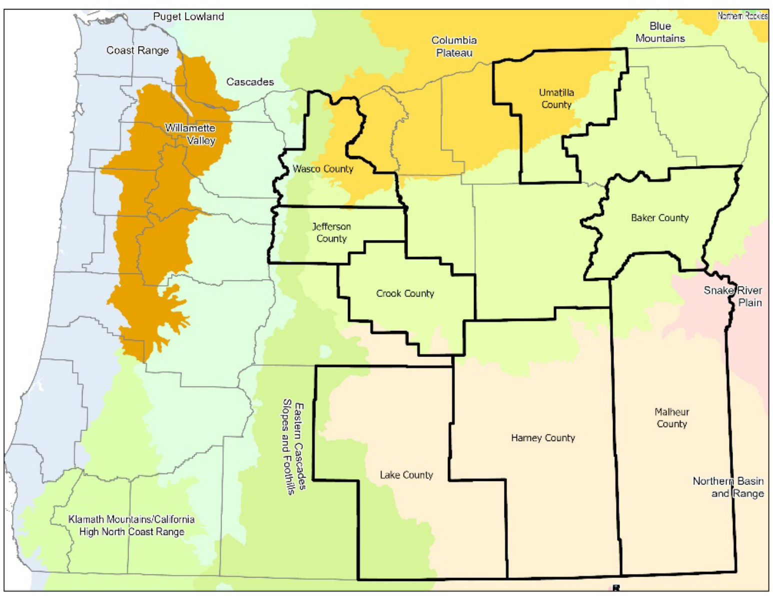


Figure 5. Map of Level III Ecoregions of Oregon, seven counties from a separate EA, and an eighth (Crook) analyzed in this EA.

As discussed in this introduction, many other counties in the state, including significant parts of nearly every county in Central and Eastern Oregon, are prone to some level of grasshopper outbreaks, demonstrated visually in figures 2 and 3 (as forecast or as shown in aggregate). For that reason, in previous years more counties were included in the program EA for Oregon. No viable treatment request from stakeholders in these excluded counties have been received in past decade however, meaning that APHIS has responded to requests for assistance, but ultimately found no way to provide program run suppression treatments, due to limitations of authority or program guidelines. If a viable request for an APHIS treatment is received from outside the counties or ecoregions listed in this EA, a supplemental EA could be produced, or additional coverage area(s) would be added to a future Oregon EA for the program, or as in this case, an additional EA created for Crook County.

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 in 2025 and for subsequent years until and unless an updated EA is prepared, for rangeland in Crook County of Oregon. 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; 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). Outbreaks are amplified and exacerbated by drought, as vegetative regrowth is reduced and more bare ground provides increased egg laying habitat, especially in areas that might otherwise have a layer of thatch or more persistent flooding (Schell, 2023). Clearwing grasshoppers have been observed at extremely high levels in Oregon in recent years, probably resulting from this dynamic to a significant extent.

APHIS supports the use of integrated pest management (IPM) principles in the management of grasshoppers. IPM is the selection, integration, and implementation of systematic pest control tactics 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 a site specific 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, as shown in the following figure. Action thresholds can be developed in a variety of ways including subjective determinations based on local experience, to objective functions of the EIL.

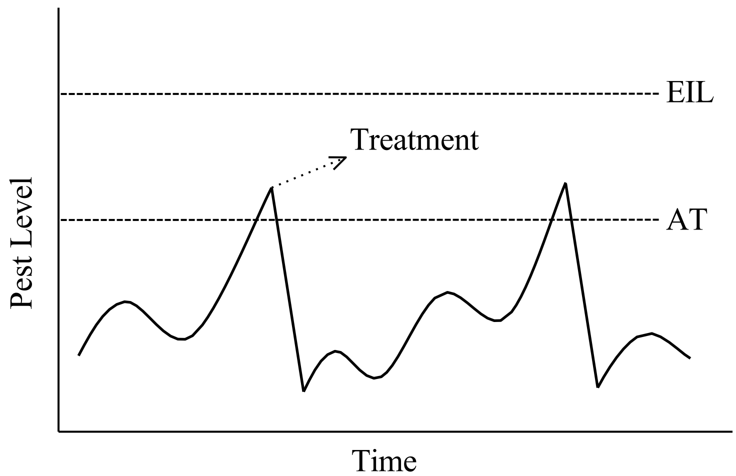


Figure 6. Diagram of the typical relationship between the economic injury level (EIL) and action threshold (AT) for applying pest treatments (Rashford et al., 2012).

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 may build to economic injury levels despite ecologically sound general land management practices and efforts to prevent outbreaks. Noxious weeds and erosion are linked to grasshopper outbreaks and are actively managed against by agencies that may request help from APHIS, such as the BLM, which surveys for and suppresses noxious weeds, especially those linked increased wildfire and works to prevent erosion. Many areas they manage are prone to cyclical wildfire increased by invasive annual grasses, including medusahead rye, *Taeniatherum caputmedusae*, and cheatgrass, *Bromus tectorum*. In response major projects have occurred to suppress these species and plant cool-season grass species (e.g., crested wheatgrass, *Agropyron christatum*). Grazing is limited seasonally to help protect these revegetation projects which also helps to reduce grasshopper outbreaks. Where possible, vegetative thatch and soil biomass is encouraged to promote fungal, protozoal and beneficial insect growth conditions to help limit grasshopper outbreaks. These efforts can be moisture limited however and compete with other land manager responsibilities.

When forage and land management have failed to prevent grasshopper outbreaks insecticides may be needed to reduce the destruction of rangeland vegetation and to limit damage to neighboring agricultural operations. 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 (PPA), 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 reduce 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 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 (for all states). 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 potential 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 in part during the limited duration spring nymph survey, specifically pest grasshopper density, species, nymphal stage and distribution. Focusing spring survey for cost effectiveness, among the millions of acres where harmful grasshopper infestations may occur in the state, is aided by adult surveys which are reported out in the fall of the previous year and are ideally analyzed by land managers over the winter to provide early notice to APHIS of a concern and request for assistance. As discussed in Chapter 1.A. forecasts and tentative plans are limited in accuracy, as maybe land managers awareness of an emergent outbreak. Section 417 of the PPA requires among other things that:

> Subject to the availability of funds… on request of the administering agency or the agriculture department of the affected State… to protect rangeland, [APHIS] shall immediately treat… lands that are infested with grasshoppers… at levels of economic infestation, unless [APHIS] determines that delaying treatment will not cause greater economic damage to adjacent owners of rangeland.

As with many ecological matters, determining if there is an economic infestation (and if delaying treatment will not cause greater damage to adjacent owners of rangeland) requires a complex evaluation, often limited by the practicality and cost of gathering truly comprehensive data. 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 (AUMs) present in grazing allotment, forage damage estimates, number of potential AUMs consumed by grasshopper population, potential AUMs managed for allotment and value of the AUM, estimated cost of replacement feed for livestock, rotational time frame for grazing allotments, and number of livestock in grazing allotment are all potential factors. APHIS is also not a land management or research agency, so a reliance on outside partners, such as ARS and the requesting land managers, to contribute much of this information is a limitation of the agency's legal mandate. In addition to official requests for assistance, APHIS therefore requires what data or justification is available to help determine the economic benefits of proposed treatments. These assessments are aided by the following: 1.) Treatment request typically comes from areas with a history of demonstrated losses, 2.) Treatment funds are limited, and requests compete for urgency, 3.) Treatments prioritize areas that have been reseeded or otherwise are considered fragile, such as post fire or noxious weed project areas, or a demonstrable 'good neighbor' goal, such as protecting adjacent high productivity land.

In Oregon the 2025 surcharge AUM rate is $6.35 on average (for public and private land). Protecting AUM investments is one potential economic benefit of grasshopper suppression projects, however many other factors also contribute potential value (as discussed in Chapter 1.A.). As Table 5 in section III.A shows, the typical treatment in Oregon in the past decade were implemented with densities of 36 per square yard on average, though in some cases it was determined that lower rates justified treatments based on all available data. Considerations of phenological timing as it relates to the limited annual treatment window determined by the grasshopper lifecycle, creates a hardback stop each year to approval of APHIS treatment programs for economic reasons, since the primary goal of suppression is to prevent losses in the current year. Adult grasshoppers are generally more expensive to suppress and have already caused most of their potential damage for the year, meaning that delay till the following year is unlikely to cause greater economic damage.

Although APHIS does extensive surveys and considers the factors described above to determine whether treatment is warranted, pestiferous grasshopper species can be found in suitable habitat statewide and can increase exponentially over one or two years, making the location of individual requests for treatments difficult to predict. By the time new significant outbreaks are first reported each year, it is often too late in the annual development cycle of the grasshoppers to delimit the outbreak and organize an effective treatment. Response to outbreaks may take multiple years of survey and planning, however populations can also crash due to natural causes or migrate to new areas, which again makes exact locations of outbreaks prior to the limited treatment window difficult to predict each year. For roughly 80% of the year grasshoppers are dormant eggs in the soil, with active immature stages lasting roughly one month, and adult phases varying by weather and access to sustaining resources. Use of the most ecologically responsible pesticides available (i.e., those that don't kill on contact) has resulted in a shorter effective treatment window, typically lasting a month or less, following detection of hatch. APHIS cannot predict the specific locations each year where resource managers may request assistance and must be ready to respond to requests if possible.

3. Description of Grasshopper Species in Oregon

Grasshoppers (Orthoptera: Caelifera, Acridoidea) are important endemic herbivores and decomposers of grassland ecosystems worldwide, stimulating plant growth while aggregating protein for carnivorous species and providing a significant amount of biodiversity. When populations of certain species boom to extreme levels however, devastating impacts on agriculture and ecological processes at a landscape scale can result. Rapid loss of vegetation can negatively impact rare species of plants and pollinators, decreasing overall biodiversity and abundance, increasing run-off and soil erosion, and decreasing water quality (Latchininsky et al, 2011, Huo et al, 2020). More than 100 species of Acridid grasshoppers have been recorded from localities in Oregon, though only nine species during the past five decades have been known to reach outbreak levels that threaten crops or valuable range resources. The most frequent economic pest grasshopper species of concern in Oregon roughly in order of damage are as follows (with active hyperlinks to ARS hosted factsheets in the electronic version of this document):

Melanoplus sanguinipes (Fabricius)	migratory grasshopper*
Camnula pellucida (Scudder)	clear-winged grasshopper
Aulocara elliotti (Thomas)	big-headed grasshopper
Oedaleonotus enigma (Scudder)	valley grasshopper*
Melanoplus bivittatus (Say)	two-striped grasshopper*
Melanoplus femurrubrum (DeGeer)	red-legged grasshopper*
Ageneotettix deorum (Scudder)	white-whiskered grasshopper
Melanoplus packardii Scudder	Packard grasshopper*
Melanoplus foedus Scudder	striped sand grasshopper*

**Species exacerbated by weeds, erosion, or irrigation (Pfadt 2002)*

The most widespread and commonly encountered pest species in North America is the **migratory grasshopper,** which is considered a locust species due to its propensity to build to dense populations in which they change appearance, improve flight ability to migrate in swarms, and march in destructive bands. Migratory grasshopper populations can be exacerbated by agricultural practices (e.g., thriving on weeds, soil erosion or over-grazed land, and from lush growth in summer from irrigation, or even old fields and no till practices). They are capable of forming massive swarms flying at high altitude to infest lands miles away at densities of 60-140 per square yard, and feed heavily on grains, legumes, vegetables, and ornamentals.

Figure 7. Photos of adult grasshoppers thriving on scotch thistle and alfalfa in Malheur County, July 2021. Credits: private citizen.

The functional egg-laying period for grasshoppers may increase in areas where irrigation occurs, potentially leading to more rapid and sustained up-cycles in the population, as compared to areas where plant resources diminish rapidly in the dry heat of summer, since they rely on plant hosts for moisture, shelter and some protein rich sustenance to prolong egg laying (Schell, 2023).

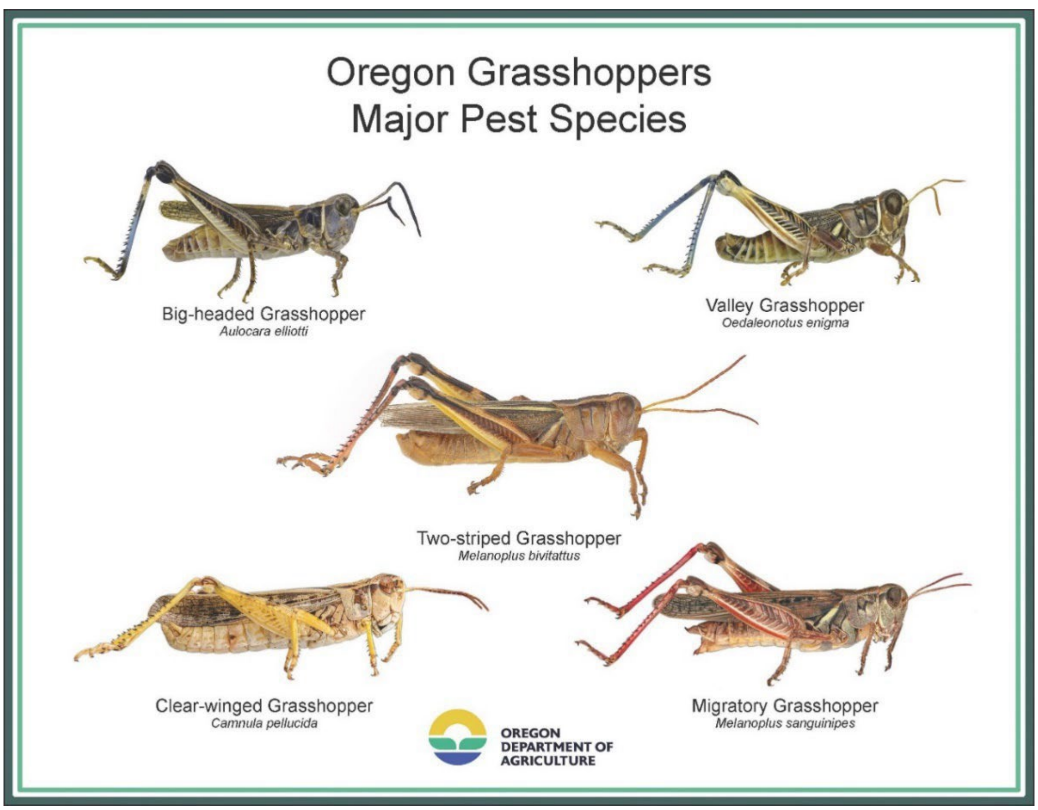


Figure 8. Oregon Grasshoppers - Major Pest Species. Credit: ODA (with support from APHIS).

With the help of cooperative agreement funding from APHIS, ODA published an identification guide to grasshoppers in Oregon, including high quality color photos of early instars which are more difficult to identify than adults. It is available for download at www.odaguides.us/guides.html.

The **valley, two-striped, red-legged, Packard's**, and **striped sand grasshoppers** can also build up rapidly in areas impacted by agricultural land disturbances, but are not considered locusts, having not demonstrated the requisite phase shift. **Clear-winged grasshopper** and **big-headed grasshopper** have been reported at extremely damaging high densities and can be especially devastating to small grains and grasses. These species as well as the **white-whiskered grasshopper** can spread from well-managed, substantially intact native ecosystems, such as seasonal wetlands and prairies, into widespread outbreaks devastating to agricultural areas. Once in outbreak, populations can continue to build to increasingly damaging levels that spread geographically and sustain over several years. (Pfadt 2002)

According to the State Entomologist at ODA, the widespread grasshopper outbreaks of the mid-1980s were comprised primarily of 'spur-throated' grasshoppers in the subfamily Melanoplinae: migratory grasshopper (*Melanoplus sanguinipes*), red-legged grasshopper (*M. femurrubrum*), two-striped grasshopper (*M. bivittatus*), Packard grasshopper (*M. packardii*), and striped sand grasshopper (*M. foedus*). Localized outbreaks in the 1990s and early 2000s were mainly clear-winged grasshopper (*Camnula pellucida*). Outbreaks beginning in 2019 have included the economically damaging species of big-headed grasshopper (*Aulocara elliotti*) and valley grasshopper (*Oedaleonotus enigma*) in addition to *Melanoplus* spp. and *Camnula pellucida*.

The following grasshopper species are potentially significant pests which are present in Oregon but not usually causing much damage (active hyperlinks to factsheets in PDF):

Amphitornus coloradus (Thomas)	striped grasshopper
Aulocara femoratum Scudder	white-crossed grasshopper
Cordillacris occipitalis (Thomas)	spotted-winged grasshopper
Melanoplus bruneri Scudder	Bruner spur-throated grasshopper
Melanoplus devastator Scudder	devastating grasshopper
Melanoplus differentialis (Thomas)	differential grasshopper
Melanoplus infantilis Scudder	little spur-throated grasshopper
Melanoplus rugglesi Gurney	Nevada Sage grasshopper
Trachyrhachys kiowa (Thomas)	Kiowa grasshopper

The following minor pest species occur in Oregon. They may be problematic under certain conditions or in conjunction with more significant pest species:

Arphia conspersa Scudder	speckle-winged grasshopper
Arphia pseudonietana (Thomas)	red-winged grasshopper
Chorthippus curtipennis (Harris)	meadow grasshopper
Derotmema haydeni (Thomas)	Hayden grasshopper
Dissosteira carolina (Linnaeus)	Carolina grasshopper
Melanoplus alpinus Scudder	alpine grasshopper
Phoetaliotes nebrascensis (Thomas)	large-headed grasshopper
Psoloessa delicatula (Scudder)	brown-spotted grasshopper
Trimerotropis pallidipennis (Burmeister)	pallid-winged grasshopper
Xanthippus corallipes (Haldeman)	red-shanked grasshopper

At least two species found in Oregon are considered directly beneficial due to their preference for consuming economic weeds:

Aeoloplides turnbulli (Thomas)	Russianthistle grasshopper
Hesperotettix viridis (Thomas)	snakeweed grasshopper

Mormon cricket, *Anabrus simplex* (Orthoptera: Tettigoniidae, Decticinae) is a shield-backed katydid, not a true cricket, although they share the same suborder (Ensifera). Most species of shield-backed katydids are arboreal and uncommon in rangelands, and those that do occur are not generally considered pests. Outbreaks of Mormon crickets on the other hand are unpredictable, increase over several years, and typically last longer than grasshoppers outbreaks, with eggs having the potential to remain in diapause for multiple years and hatch out in an area over time, potentially sustaining high densities even following suppression efforts. Though incapable of flight, during outbreaks adults march in dense bands, travelling up to a mile per day. Their behavior and coloring are bold, since their abundance overwhelms the appetites of predator populations. In contrast, when population densities are low, Mormon crickets are more camouflaged, solitary and do not migrate. Mormon crickets are well adapted to arid, rough terrain and valleys. Radiocarbon-dating of remains excavated from an ancient roasting pit shows that they were abundant enough in the area to catch for foodstuffs by Native Americans at least 2,000 years prior to European settlement. (Pfadt 2002)

Figure 9. Photo of typical Mormon cricket densities on roads near Idaho or Nevada during outbreaks, which are too numerous to count.

Feeding damage to crops and garden vegetables can be devastating, and a single individual per acre is estimated to consume 38 dry weight pounds of rangeland forage (Pfadt 2002). Mormon crickets also present an economic contamination issue for many crops, giving off a rotten fish smell as they decompose. Additionally, high roadkill of Mormon crickets can make road surfaces slick and unsafe for motorists, which is exacerbated by the fact that, as cannibalistic omnivores, they are attracted to the road to feed. Often congregating on buildings in large numbers, they further can become a general nuisance to town residents, clogging drains, biting people, and discourage tourism, in impacted communities such as Jordan Valley, McDermitt, and Arlington, Oregon. In comments from the public, it has been pointed out that each of these remarkably large insects make excellent fish bait, or poultry feed, and to some extent entrepreneurs do harvest them for such uses. This, and take by wildlife of this resource, however, does not significantly diminish their extreme abundance and distribution during outbreaks. During a peak outbreak in 1938 for example, it was estimated that 19 million acres in 11 states were infested (Pfadt 2002). To date, no Mormon cricket bands have been documented to occur in Crook County.


Figure 10. Photo of Mormon cricket outbreak in residential area of Gilliam County, 2017. Credit: Private Citizen.

Special programmatic considerations with Mormon crickets include the fact that they migrate much more actively than most grasshoppers, often shifting location significantly in a single day or a daily cycle, though clear-wing grasshopper adults can have similarly frequent and vigorous migratory behavior. They also occur in more mountainous canyon lands and passes and, most problematically, are attracted to roads and areas of human habitation. To date, suppression efforts targeting this species in Oregon have been far less common than in surrounding states, especially Nevada and Idaho, and certain areas of Washington State. A sustained effort in Oregon over several years was coordinated by Gilliam County with support from ODA, utilizing preferred program pesticides. Requests for treatment of bands which migrated from Idaho and Nevada and became locally established in SE Oregon, extending into Harney County, have also occurred in recent years. Few areas where Mormon crickets have been observed in Oregon are feasible for program treatments, due to their attraction to roads and towns, and program requirements for avoiding greater-sage grouse (discussed in Section III.D.3.2). A suppression treatment was conducted on rangeland by the program in 2022, at the request of BLM in southern Malheur County, but promising reductions in the outbreak in the area did not persist the following year. APHIS has subsequently attempted to provide local municipalities with information on how Gilliam County was able to successfully mitigate an outbreak, as well as how transportation departments in other states take the lead on mitigation efforts aimed at improving roadway safety.

4. 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 (HHERAs) 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).

In 2022, 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). This MOU clarifies that APHIS will prepare and issue to the public site-specific 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 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 (Form FS-2100-2) for APHIS to treat infestations. According to the provisions of the MOU, APHIS can begin treatments after APHIS issues an appropriate decision document and BLM prepares and approves the Pesticide Use Proposal.

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 managers. 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 to improve non-target effects. Reduced agent area treatment (RAAT) methods were developed to decrease pesticide use and provide refugees for non-target organisms within the treatment block during suppression activities while reducing target populations below the level causing economic harm. APHIS typically employs RAAT methods in which the application rate of insecticide is reduced from conventional levels, and treated swaths are alternated with swaths that are not directly treated. RAATs rely on selected insecticide to effectively suppress grasshoppers 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 populations, including biological control. Other land management practices available to landowners to suppress pestiferous grasshopper outbreaks which are researched and provided by USDA in the GIPM, include:

- Altering grazing practices such as intensity and timing;
- Increasing thatch and biomass at the soil level to create conditions conducive to grasshopper parasites and diseases;
- Reducing weeds and erosion to limit adult egg laying sustenance and habitat;
- Tilling or prescribed fire to decrease viability of eggs in soil;
- Encouraging kestrel nesting sites and other insectivorous vertebrate predator species.

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) regulations 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 above (I.B.) 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 adds Crook County, which was included in past EAs and borders other program counties, to account for the wide geographic areas in which grasshoppers and Mormon crickets occur on rangelands. Then, when grasshopper populations grow to nuisance levels, program managers examine the proposed treatment area to ensure that this EA applies to the specific areas where control activities will be conducted and can act quickly. At the same time, the Program strives to alert the public in a timely manner to its more concrete treatment plans and avoid or minimize harm to the environment in implementing those plans.

Section 1619 of the Farm Bill (7 USC 8791) also prohibits disclosure of certain information from agricultural producers who provide information to participate in programs of the department.

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 Oregon.

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 (i.e., The Oregonian); Regulations.gov; Stakeholder Registry Notice; direct emailing to those who have expressed interest in the program, and public meetings. After reviewing and considering all the 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. Though not technically scoping, EAs for grasshopper suppression have been created for 50 years, and this iterative process has resulted in extensive feedback from the public. In fact, the suppression of grasshoppers created the first federal agricultural department in the US, predating NEPA by approximately a century.
Broadly, the cumulative process of receiving feedback on proposed actions has been profound. APHIS reviews and considers all comments received in preparing EAs for this program in Oregon.

II. Alternatives

A. Framing

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 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 land managers.

APHIS has funded the investigation of various IPM strategies for the grasshopper program. Congress established the Grasshopper Integrated Pest Management (GIPM) project 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 are published at the USDA ARS website: 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 Oregon to analyze more site-specific impacts. The EA tiers to the 2019 programmatic EIS and incorporates by reference the carbaryl, and diflubenzuron HHERAs also published in 2019. Copies of the 2019 programmatic EIS and ROD are available for review at 6035 NE 78th Court, Ste 100 Portland, OR 97218. These documents are also available at the Rangeland Grasshopper and Mormon Cricket Program web site at www.aphis.usda.gov/plant-pests-diseases/ghmc.

B. 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 Oregon. 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 utilizing Reduced Agent Area Treatments (RAATs) - 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 carbaryl (bait formulation), and diflubenzuron. These two chemicals have different modes of action. Carbaryl inhibits acetylcholinesterase (enzymes involved in nerve impulses). Diflubenzuron inhibits the formation of chitin by insects which causes weak exoskeletons. APHIS would make a single application per year of one of these chemicals to a treatment area using a Reduced Agent/Area Treatments (RAATs) methodology—described further at the University of Wyoming entomology department website: www.uwyo.edu/entomology/grasshoppers/raat/index.html.

APHIS selects which insecticides and coverage rates are appropriate for suppression of a particular 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 is the remaining control options. Circumstances where the use of carbaryl bait would be best are reduced because of the higher cost per acre than liquid ULV formulations and that only certain species of grasshopper are attracted to and consume carbaryl bait. Bait may be a preferred option when migratory or banding behavior allows targeted treatments over smaller areas or larger skip-swaths, such as with clearwinged grasshopper (*Camnula pellucida*) and Mormon cricket (*Anabrus simplex*) species.

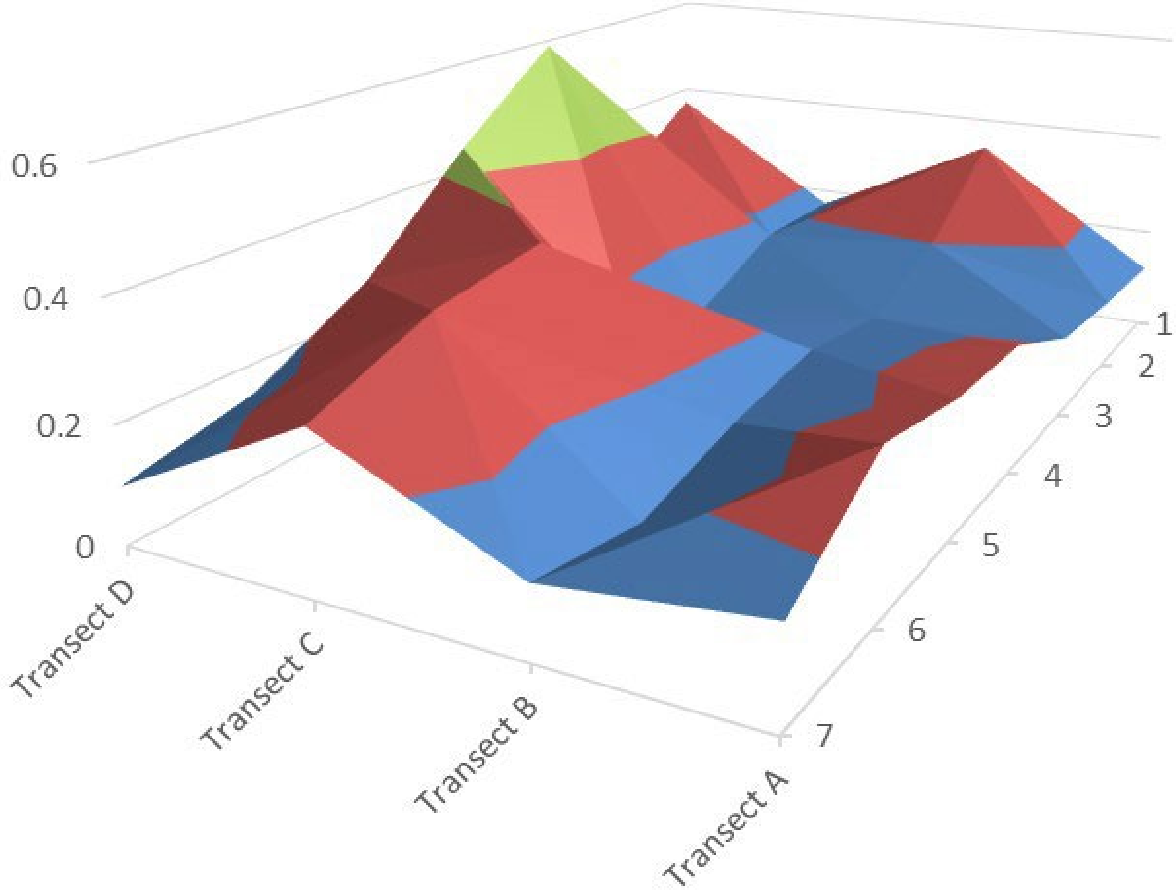
RAATs strategy is effective for grasshopper suppression because the insecticide controls grasshoppers within treated swaths while conserving grasshopper predators and parasites in swaths not directly treated. RAATs can decrease the rate of insecticide applied by using lower than label insecticide concentrations and decreasing the deposition of insecticide applied by alternating treated and untreated swaths, with untreated swaths typically of equal or greater width than the treated swaths, as determined by various factors such as application method (air or ground) and target species. Combined (i.e., reduced pesticide rate and reduced coverage rate), these methods significantly lower the total amount of insecticide applied and application costs, while providing refugia for non-target invertebrates within the treatment block. Either carbaryl bait or diflubenzuron would be utilized at the following application rates to treat swaths for any given area treated (Lockwood et al., 2000, Foster et al., 2000, USDA APHIS, 2019):

- 4.0 pounds (0.2 lbs. or 9.07 grams a.i.) per acre treated of 5% carbaryl bait; or
- 1.0 fluid ounce (0.0156 lbs. or 7.07 grams a.i.) per acre sprayed of diflubenzuron.

The width of the area not directly treated (untreated swaths) under RAATs methodology is not standardized, though a solid body of research (see below) paved the way for its broad adoption in the early 2000s, and good results have been observed in a variety of sites and situations. Rather than suppress grasshopper populations to the greatest extent possible, the goal of this method is to suppress grasshopper populations to less than the economic injury level. Typically, 50% untreated area is the minimum target utilized in Oregon, while in some cases (e.g., bait applications by ground in sparse vegetation or applications targeting Momon cricket by air) a 2/3rds untreated (a.k.a., double skip-swath) or have produced acceptable results. Most of the cost savings of RAATs methodology comes from maximizing untreated areas, so efforts are made to do this to the best extent possible. 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 associated swath widths is site dependent. Rather than suppress grasshopper populations to the greatest extent possible, the goal of this method is to suppress grasshopper populations to less than the economic injury level.

The variation in pesticide deposition resulting from following the RAATs procedures is not expected to result in uniformly absent chemical residues within the untreated 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 6 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/m^2, approximately three times greater than the highest dye card concentration.

Figure 11. Graph of diflubenzuron concentration (mg/m^2) 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 utilizing RAATs 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).

This methodology has been used very successfully in Oregon since the early 2000s. In the past 10 years in Oregon, APHIS has protected a quarter million acres of public land through applications of 82.7 kg a.i. and four days duration per year, on average.

Table 3. Oregon APHIS Grasshopper Treatments, Past 10 Years Summary.

2015-2024 Summary	Days Duration	Protected Acres	Treated Acres	Kg a.i.
Total:	41	251,024	116,755	827.5
Average per Treatment:	5.9	35,861	16,679	118.2
Average per Year:	4.1	25,102	11,676	82.7

* 2.0 lbs. active ingredient (a.i.) per gallon equals 0.00708738 kg per *treated* acre (at 1 oz product per acre rate).

Table 4. Oregon APHIS Grasshopper Treatments, Past 10 Years by Project, Logistics.

Start Date	End Date	Days Duration	Protected Acres	Treated Acres	% Area Reduced	% Agent Reduced	% Agent/Area Reduction	County
6/21/2017	7/7/2017	17	37,500	18,707	50%	50%	75%	HARNEY
6/7/2021	6/12/2021	6	25,600	12,800	50%	50%	75%	HARNEY
6/21/2021	6/23/2021	3	13,312	6,656	50%	50%	75%	HARNEY
6/28/2022	7/2/2022	5	53,504	26,752	50%	50%	75%	MALHEUR
6/15/2023	6/21/2023	7	85,000	33,792	60%	50%	80%	MALHEUR
7/10/2023	7/11/2023	2	31,500	15,744	50%	50%	75%	HARNEY
7/10/2024	7/10/2024	1	4,608*	2,304	50%	50%	75%	HARNEY

* Separate treatment had occurred already on adjoining private land.

Table 5. Oregon APHIS Grasshopper Treatment, Past 10 Years by Projects, Land Manager Objectives & Efficacy.

Start Date	Target	Land Manager	Objective	Pre Treatment Density	Post Treatment Density	Target Reduction	% Reduction
6/21/2017	GH	BLM & USFWS	Prevent migration/good neighbor, protect improved pasture	24.35	7.31	17.04	70%
6/7/2021	GH	BLM	Prevent migration/good neighbor, protect improved pasture	44.86	6.65	38.21	85%
6/21/2021	GH	BLM	Prevent migration/good neighbor, protect improved pasture	43.33	1.50	41.83	97%
6/28/2022	GH	BLM	Prevent migration/good neighbor, protect improved pasture	35.38	10.26	25.12	71%
6/15/2023	MC	BLM	Prevent migration/good neighbor, protect improved pasture	41.00	10.58	30.42	74%
7/10/2023	GH	BLM	Prevent migration/good neighbor, protect improved pasture	45.00	3.00	42.00	93%
7/10/2024	GH	BLM	Prevent migration/good neighbor	22.00	n/a*	n/a	n/a

* Wildfire prevented post treatment survey.

All treatments in past 10 years utilized RAATS with a rate of 1 oz. diflubenzuron (half full label rate of 2 oz.) per treated acre and treated swaths covering 50% of total area within the treatment block(s) or less. The column labeled Target Reduction shows the percent reduction in surveyed population densities from before and after the treatment, within the treatment blocks or immediate area, and is used as a rough estimate of the efficacy of the treatment. Days Duration are the number of days during which the treatment was ongoing, including any delays due to weather or logistics which may not have had any actual treatment occurring. On average in the last decade, 11,676 acres (18.244 square miles) were directly treated per year in Harney and/or Malheur counties, which is less than 1/1000th (roughly 0.09%) of the area of these two counties (20,156 square miles). Extensive survey and RAAT methodology, as well as cooperative partnerships with land managers, university extension and local community leaders, has allowed IPM to be applied to solving landscape scale problems with the best ecologically and economically sound practices available, in areas where treatment was requested and feasible, showing a mode target reduction of 80% and sustained reduction in following years of survey for those protected areas.

C. 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, border protection, or spot treatments of precise areas.

Compared to liquid formulations, 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 (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 for APHIS application however due to program application buffers from aquatic sites as well as 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 (Catangui 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 through standard protocols including program buffers and monitoring of wind conditions, as well as adjuvants including crop oil concentrate or natural oils (e.g., methylated seed oil or canola oil) which increases specific gravity and droplet size to further reduce drift.

As discussed in the previous section, the RAAT strategy reduces the treatment area, the application rate of insecticides, or both. RAATs 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 reduce cost and conserve non-target biological resources (including predators and parasites of grasshoppers and other beneficial invertebrates) in untreated areas.

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. Environmental monitoring and flight line review are conducted daily during treatments to ensure accurate applications and buffering, as well as appropriate pesticide specifications and rates.

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).

GPS shapefiles showing exact treatment block boundaries and sensitive site buffers are provided to contracted applicators or to APHIS staff conducting treatments prior to start of operations, and blocks designated for treatment are inspected for unexpected sensitive sites and waterbodies to ground truth these maps. Dye cards are placed around sensitive sites to detect drift into buffer areas and aircraft are observed by binoculars during treatments to ensure deposition is at the expected rate and locations.

Figure 12. Dye card monitoring.

Figure 13. Contractor application visual monitoring.

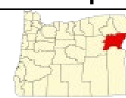
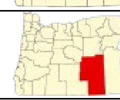
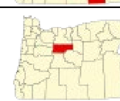
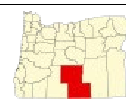
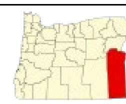
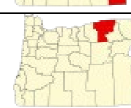
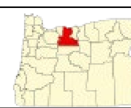
III. Environmental Consequences

A. Description of Affected Environment

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 and documented in the appropriate decision document.

The potential suppression program areas covered for the program overall includes eight central and eastern Oregon counties which collectively encompass 41,388 square miles, listed in the following table:

Table 6. Oregon Counties: seven from a separate EA and an eighth (Crook) analyzed in this EA.

County	FIPS code	County Seat	Population	Area (miles^2)	Area (km^2)	Map
Baker County	1	Baker City	16,912	3,068	7,946	
Crook County	13	Prineville	27,336	2,980	7,718	
Harney County	25	Burns	7,440	10,135	26,250	
Jefferson County	31	Madras	25,454	1,781	4,613	
Lake County	37	Lakeview	8,293	7,940	20,565	
Malheur County	45	Vale	32,044	9,888	25,610	
Umatilla County	59	Pendleton	80,053	3,215	8,327	
Wasco County	65	The Dalles	26,333	2,381	6,167	
		Sum:	**223,865**	**41,388**	**107,196**	

The level III ecoregions of these counties that are conducive to grasshopper outbreaks and APHIS treatment may be feasible in are Columbia Plateau (10), Blue Mountains (11), and Northern Basin and Range (80) as shown in Figure 15, Ecoregions of Oregon.

Columbia Plateau (10): This is an arid sagebrush steppe and grassland, surrounded by wetter, mostly forested, mountainous ecoregions. This region is underlain by a thick layer of lava rock. Particularly in the region's eastern portion, where precipitation is greater, deep wind-deposited loess soils have been extensively cultivated for wheat. This ecoregion does not extend to Crook County

Blue Mountains (11): This ecoregion is a complex of mountain ranges that are lower and more open than the neighboring Cascades and northern Rocky Mountains. Like the Cascades but unlike the Rockies, the Blue Mountains region is mostly volcanic in origin. Only its highest ranges, particularly the Wallowa and Elkhorn mountains, consist of intrusive rocks that rise above the dissected lava surface of the region. Much of this ecoregion is grazed by cattle, unlike the Cascades and northern Rockies. Most of Crook County is in this ecoregion.

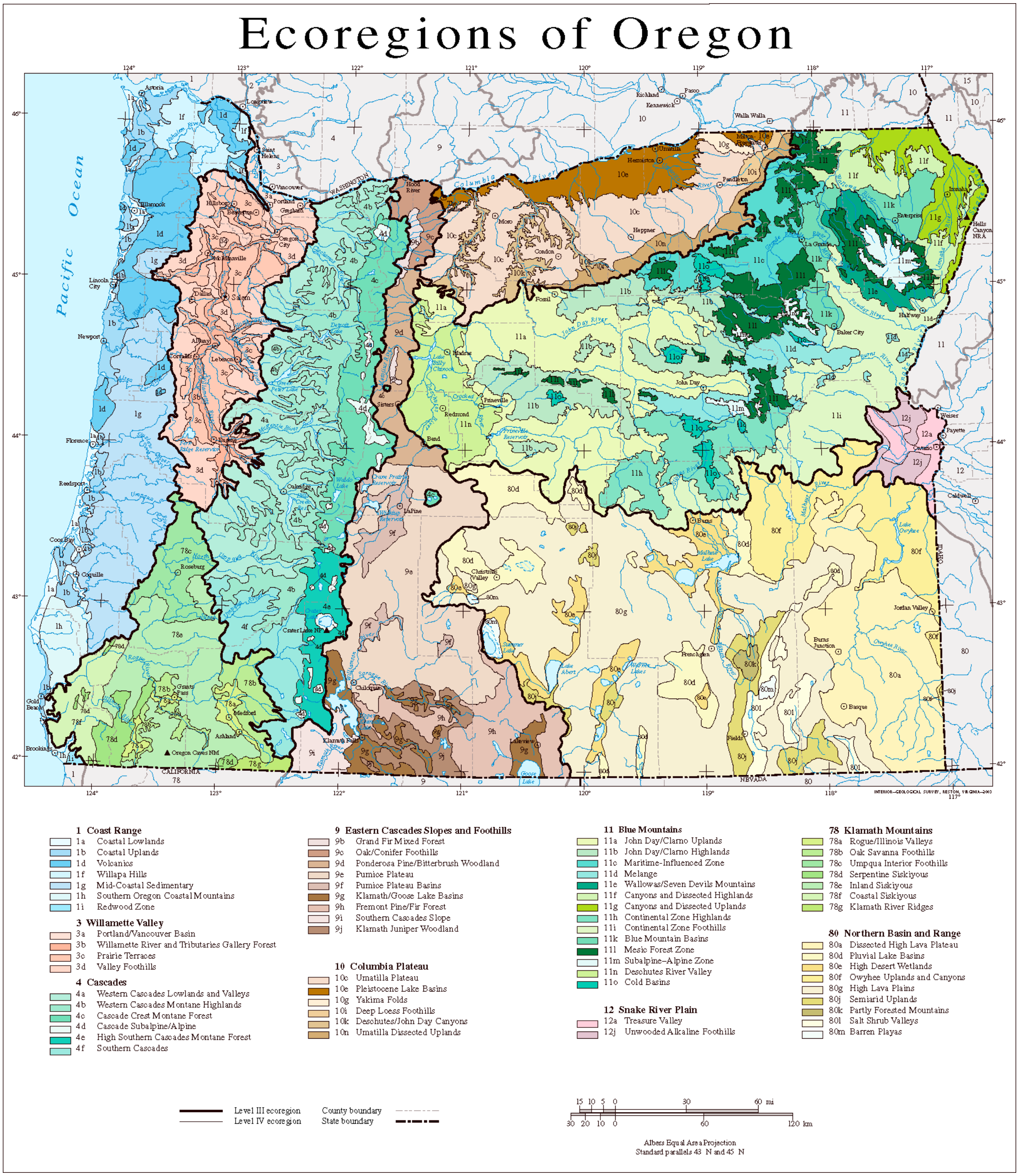


Figure 14. Map of Level III and IV Ecoregions of Oregon.

Northern Basin and Range (80): A small part of Crook County, this ecoregion consists of dissected lava plains, rolling hills, alluvial fans, valleys, and scattered mountains. Mountains are more common in the eastern part. Overall, it is higher and cooler than the Snake River Plain and has fewer ranges than the Central Basin and Range. Sagebrush steppe is extensive here. Juniper dominated woodland occurs on the rugged stony uplands. Much of the region is used for rangeland.

As described and listed in Chapter 1.A., certain level IV ecoregions do not appear to be conducive to grasshopper outbreaks and therefore will not be included in this EA or therefore be considered part of the program area as regards to potentially impacting non-target species of concern. In the Blue Mountains ecoregion, these areas are 11c - Maritime-Influenced Zone, 11d - Melange, 11e - Wallowas/Seven Devils Mountains, 11h - Continental Zone Highlands, 11l - Mesic Forest Zone, 11m - Subalpine-Alpine Zone. In the Norther Basin and Range ecoregion, these areas are 80j - Semiarid Uplands, 80k - Partly Forested Mountains, 80m - Barren Playas.

APHIS in cooperation with state and university collaborators provides general information to the public on grasshoppers in all parts of the state, for example in 2022 a report was received from Mary's Peak Botanical Special Interest Area which stated, "The grasshoppers seem to be decimating a robust population of Lupinus albicaulis. They, from what I can tell, are damaging the flowers and substantially reducing the number of seed pods and seed produced." It was identified by the state entomologist as *Melanoplus saltator,* "… a native species of grasshopper (family Acrididae) first described from specimens from Portland OR. *M. saltator* is endemic to Northwestern Oregon, distributed from Washington and Yamhill Counties south to Linn County in meadows, open woodlands and woods edges. It is one of two Oregon-endemic flightless grasshopper species known to occur at the top of Mary's Peak (the other is *Melanoplus immunis*, the Mary's Peak short-winged grasshopper, a smaller species)." Such outreach or response to inquiries is a service that the public has come to expect regardless of potential for further action.

This EA, on the other hand, is attempting to focus as closely as possible on areas where treatment requests received may be feasible to conduct. At this time, this is primarily limited to federal, state or tribally managed rangeland, with the possible incorporation of adjacent private rangeland to a limited extent. Cropland, including Conservation Reserve Program (CRP) crops are limited by law to 20% of overall project area with no cost share being provided, and of course must also meet pesticide label requirements.

B. Special Management Areas

APHIS is aware there are areas that have greater scenic and environmental value within or adjacent to 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. Many of these areas are excluded from grasshopper outbreak habitat and therefore from this EA, as described in Chapter 1.A. and in the above section. For example, the Steens Mountain Wilderness and similar Semiarid Uplands (80j), Partly Forested Mountains (80k), as well as the Barren Playas (80m) which typify the Alvord Desert have always been excluded from grasshopper treatments by way of never having grasshopper outbreaks ever observed. Similarly, in the Blue Mountains in particular, significant portions are forested and or mesic, thus have also always been excluded from grasshopper outbreak observations.

In general, areas designated as Wilderness Areas, National Parks or Monuments in Oregon share the characteristic of not having outbreaks, or at minimum, not being sources of requests from land management submitted to APHIS for help with grasshoppers. Wilderness Study Areas (WSAs) have been excluded from treatment requests heretofore as well however this is ultimately a decision of the land management agency, specifically the BLM, with APHIS having no authority to oversee land management on their behalf. These and other features can be viewed by the public at BLM National Public Lands Access Data Web Map, and demonstrates in the following figure that WSAs cover a significant portion of SE Oregon. Many of these areas also have protection

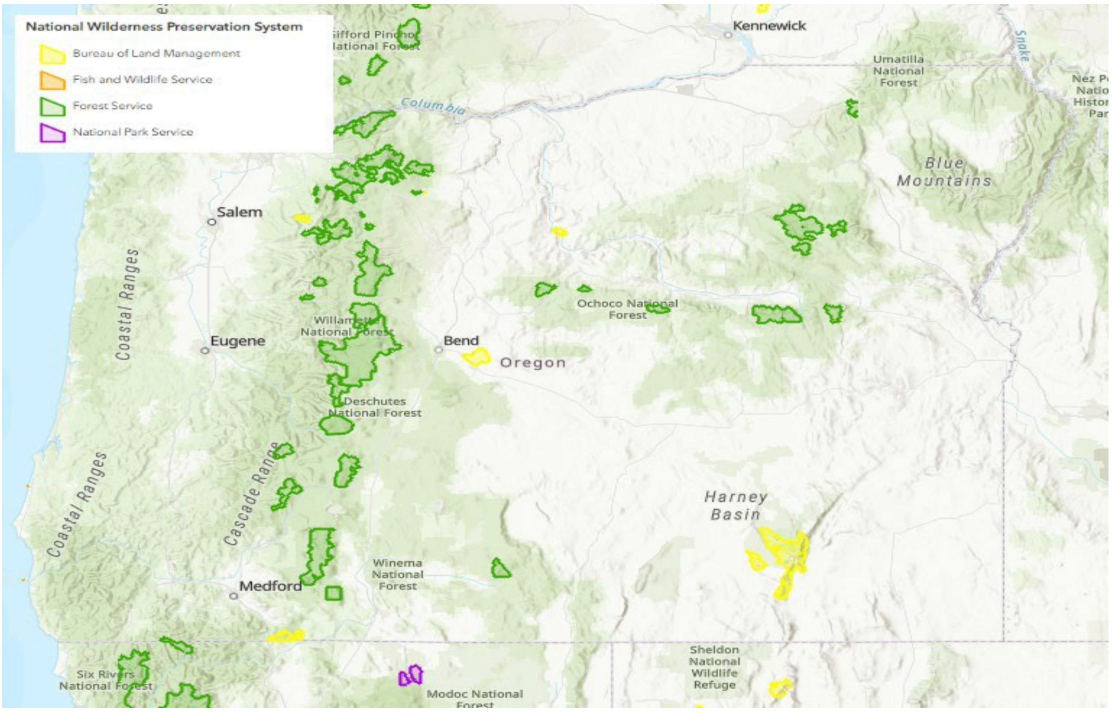


Figure 15. Map of current National Wilderness Preservation System Areas by Land Management Agency.

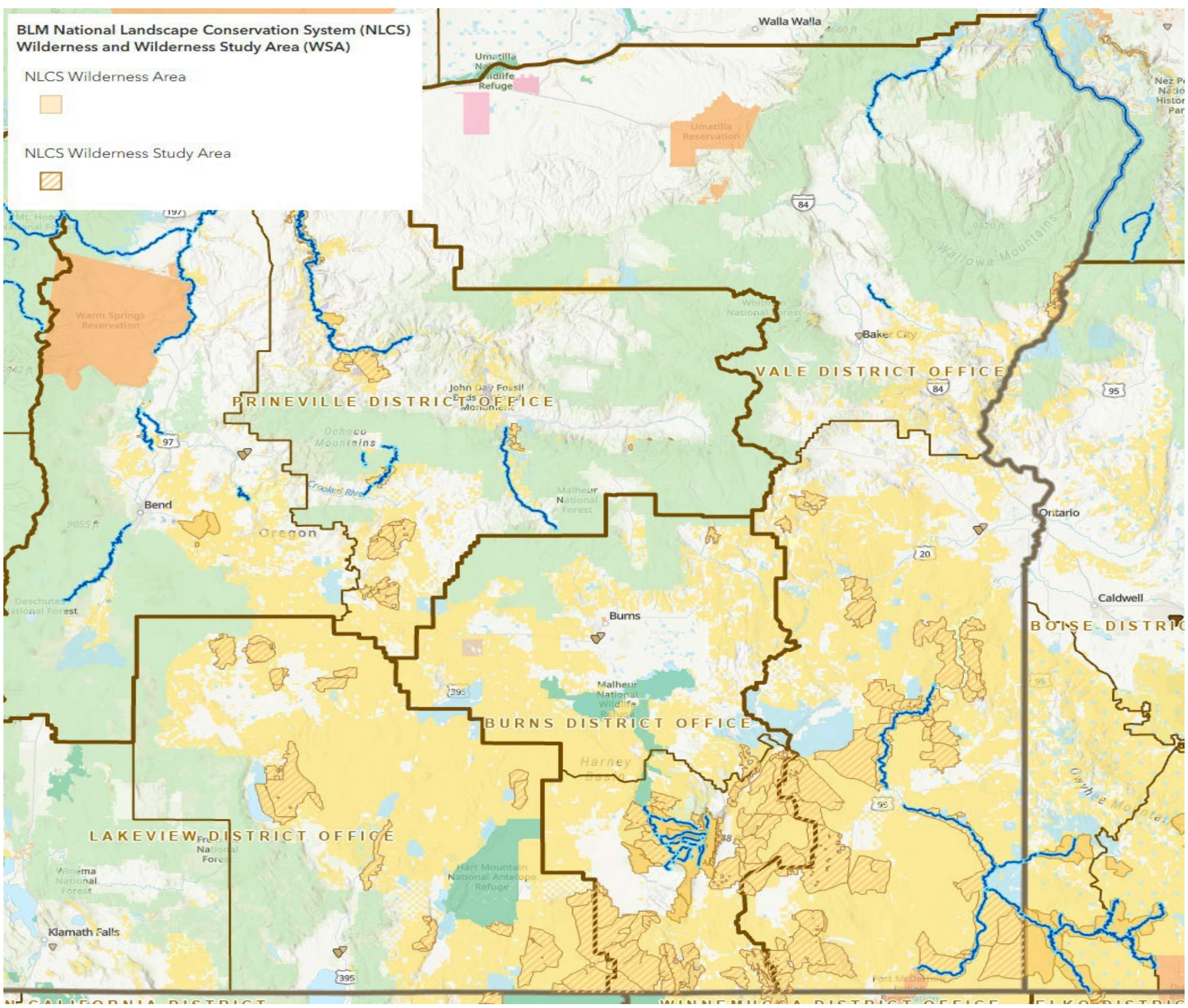


Figure 16. Map of current Wild Scenic Rivers (deep blue), and Wilderness Study Areas by BLM District Office in Eastern Oregon.

areas for Greater Sage Grouse, meaning that treatments are not generally considered in those areas for that reason as well, as discussed further in part e of this chapter, Additional Species of Concern Protection Measures. If treatment requests begin coming to APHIS for WSAs, greater environmental analysis would be needed prior to proceeding with treatments. As discussed in the Mormon Cricket section of Chapter 1.B., one possible reason why WSAs and areas not typically associated with grasshopper outbreaks or requests might need to be reconsidered in the future, would be due to expanding ranges of this highly migratory and upland habitat adapted species.

An additional such area designation is the BLM's Areas of Critical Environmental Concern, which they describe as, "areas within the public lands where special management attention is required to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources or other natural systems or processes, or to protect life and safety from natural hazards" (BLM GBP Hub: https://gbp-blm-egis.hub.arcgis.com/datasets/11c9e34831c7446a8202b334bc64898a/about.) Similar to WSAs, such areas or other similar designations for various land managers would presumably not be requested for assistance on by those land managers, and APHIS will attempt to determine any such special designations which are not covered by this EA with the land manager prior to assisting them. If assistance in such areas is specifically requested, if there are specific restrictions for those areas not addressed in this EA, as supplemental EA will need to be published prior to any treatments.

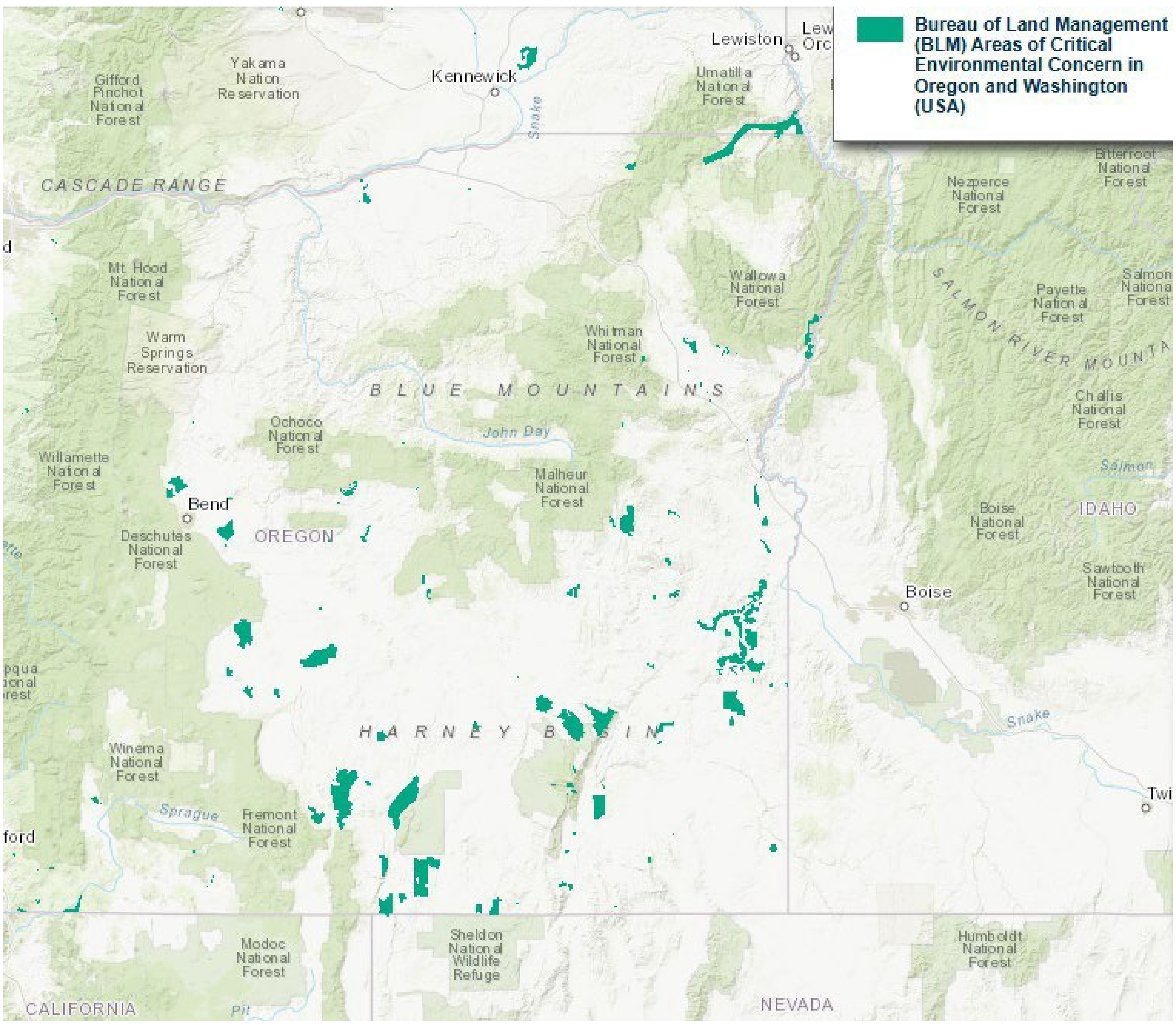


Figure 17. Current BLM Areas of Critical Environmental Concern in Oregon.

Currently, program activities adjacent to special designation lands such as WSAs may occur and be covered by this EA. (This would be in areas where grasshopper outbreaks coincide and are otherwise outside of Greater Sage Grouse or other sensitive species buffers which extend beyond WSAs.) A representative area for this would be along the east slope of Steens Mountain north of Mann Lake, which is an especially arid mixed-use rangeland that the BLM has worked to recondition but is prone to frequent grasshopper outbreaks due to frequent drought. Nearby survey work conducted by BLM found expansion of Sullivan's sulfur butterfly (*Colias christina sullivani*) out of the WSA and into an allotment which APHIS has treated three times in the past decade, indicating that program activities are not adversely impacting the adjacent WSA or the rare species of invertebrates in that general area. Indeed, since this butterfly is strongly supported by stiff pea (*Lathyrus rigidus*), the suppression of herbivory by grasshopper outbreaks may theoretically be helping their population expansion. (Based on their detection and delimitation of this rare butterfly population BLM buffered the specific area in question out of their potential treatment request for the year. This species is designated a sensitive species in Oregon and Washington by BLM.)

Figure 18. Photo of Invertebrate predator of grasshoppers observed in frequently treated area north of Mann Lake, July 2023.

A conservation biocontrol agent of grasshoppers, the ground mantis (*Litaneutria minor*) can also be observed in this allotment where frequent treatments have occurred, as with this photo observation taken by APHIS personnel in July 2023, providing further evidence of generally sound ecological management of this mixed-use rangeland area where APHIS has recently suppressed grasshoppers on request from BLM more frequently than anywhere else in the state. Conservation biocontrol is the only viable option for grasshopper outbreak management other than pesticides. (See III.D.2.)

C. Effects Evaluated Including Cumulative Impacts

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 may reach economically damaging thresholds and require treatment. Since a general outbreak started in Oregon in 2020, areas where sufficiently large acreage treatment occurred have seen sustained reductions in grasshoppers based on a single treatment. Blocks treated which were smaller or more fragmented however have seen some repeated requests for treatments in subsequent years. Treatment by APHIS in 2024 was limited due to a shortage of personnel and funding and is not expected to significantly alter grasshopper outbreaks on a broad scale in coming years on its own. The Preferred Alternative 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. For a second time in recent years, the Oregon legislature provided enhanced funding to private land managers to conduct subsidized treatments in certain counties for the control of grasshoppers. No information on how widespread this program was utilized is available, despite requests for it made by APHIS, and it is unclear how this alters the continued outbreak observed in many parts of the state in previous years or currently. For federal land managers however, these funds and potential treatments were not applicable. Having no treatments overlap in location, or nearly any being made on federal land by APHIS in 2024, make cumulative impacts from private treatments last year also unlikely.

The 2002 EIS Appendix B, Environmental Risk Assessment for Rangeland Grasshopper Suppression Program—Insecticides, analyzed effects of various insecticide formulations and treatment rates in detail and found minimal negative impacts of any kind for either carbaryl bait or diflubenzuron. Cumulative and synergistic effects were also analyzed and found to be minimal or non-existent for these. “Diflubenzuron is only reported to be synergistic with defoliant DEF (NLM, 1988)” (page 134). Def is a defoliant registered for use in cotton crops, which are not grown in Oregon, with the active ingredient Tribuphos (S,S,S-Tributyl phosphorotrithioate). No record of this or related chemicals being used in Oregon was found. For carbaryl in general (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 were analyzed below.

Wieben, 2019 estimates annual agricultural pesticide use by major crop (or crop group) for states of the conterminous United States from 1992-2017. The most recent 10-year dataset, 2008-2017, establishes general trends for pesticide use by crops in Oregon which are comparable to the recent 10-year dataset summarizing program chemical use. Estimates specific to the program chemicals are also captured here, though formulations and county level spatial data, are not specified. In total for the decade, an estimated 76,713,875 kg of pesticides were applied, an average of 767,139 kg per year. 84% of the estimate was applied to Vegetables & Fruit crops (61%) and Orchard & Grape crops (23%). All other crop groups (Wheat, Pasture & Hay, Alfalfa, Corn, and Other) received the estimated remainder of 16%.

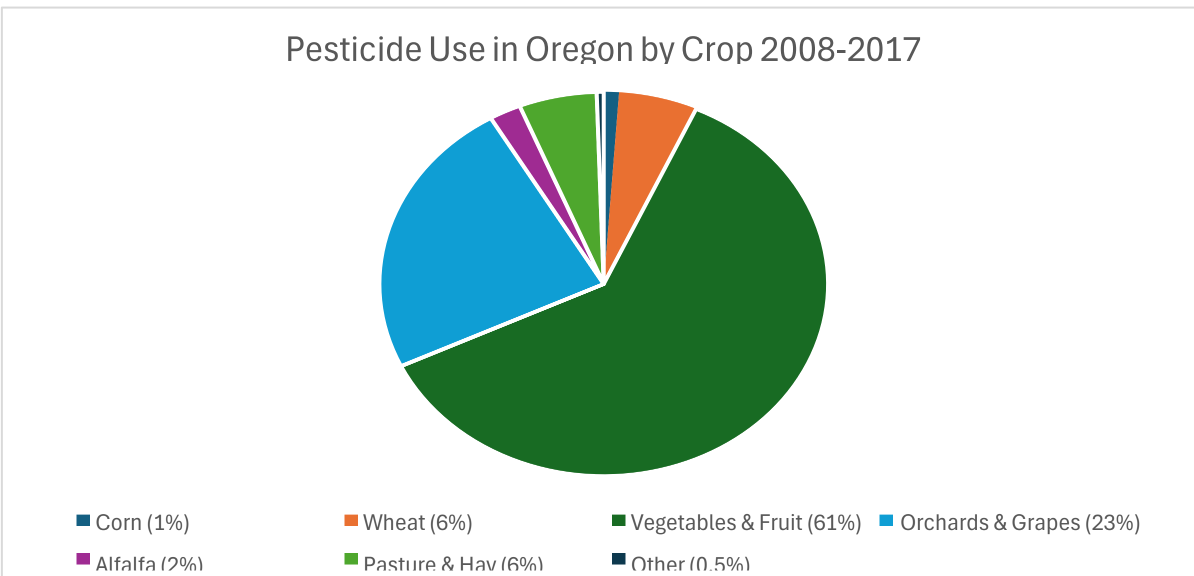


Figure 19. Pie chart of Pesticide Use in Oregon by Crop, 2008-2017.

The APHIS Rangeland Grasshopper Program avoids treatment of cropland which includes any fields planted with the intent to market as a harvested commodity, including hay—though rarely done, up to 20% of a project may include crops, with no cost share provided. Private rangeland or pasture may be included in APHIS treatments, especially in areas where public and private land is interspersed in a checkerboard pattern. In general, therefore, these pesticide-use statistics do not include any areas where APHIS treatment programs have occurred or are likely to occur, which is typically limited to publicly managed (or potentially tribally managed) rangeland. Nevertheless, pasture is essentially high productivity rangeland and the closest stand in for rangeland management capture in these data. Of the 32 pesticides applied at volume significant enough to be captured by this very comprehensive estimate, all were herbicidal, as shown in Figure 20.

The 2022 agricultural census (www.nass.usda.gov) estimates that 42% of acreage harvested for hay in Oregon occurred in the seven counties considered in this EA, and were the largest crop in terms of land use in the state overall, utilizing 5.8% of the 15.3 million acres of operational farmland. (This estimate does not include any acreage for pasture or rangeland.) The next largest commodity by harvested acreage statewide was wheat at 4.7%, followed by corn, hazelnuts, and potatoes (with none greater than 0.6%). In sum, Hay & Pasture crops have a larger geographical size than all other agricultural operations in the state, require less than a tenth of agricultural pesticides and no routine insecticides at all.

Management of rangeland varies much more than any agricultural lands, even pasture, however as with pasture, weeds are generally considered the leading pests of concern. Invasive grasses are the leading pest in rangeland in Oregon, according to the Oregon SageCon Dashboard with 4.1 million acres impaired, and 1.1 million acres treated to address invasive plants, as of 2021 (oe.oregonexplorer.info/externalcontent/sagecon/SageCon_Dashboard.pdf). Though not tracked as closely as agricultural statistics, the SageCon partnership clearly sees invasive weeds as a primary pest to rangeland, worth treating, especially for their mission of supporting functional sagebrush rangeland, summarized on their website as follows: "In 2012, the Oregon Sage-grouse Conservation Partnership (SageCon) was convened at the request of the Governor's office to formulate an 'all lands, all threats' approach to sage-grouse conservation." Many noxious weed species thrive in arid conditions, increasing the frequency and intensity of wildfire and out competing native and more ecologically beneficial species, making their management a priority in rangelands. With some notable exceptions such as classical biocontrol agents that specialize in.

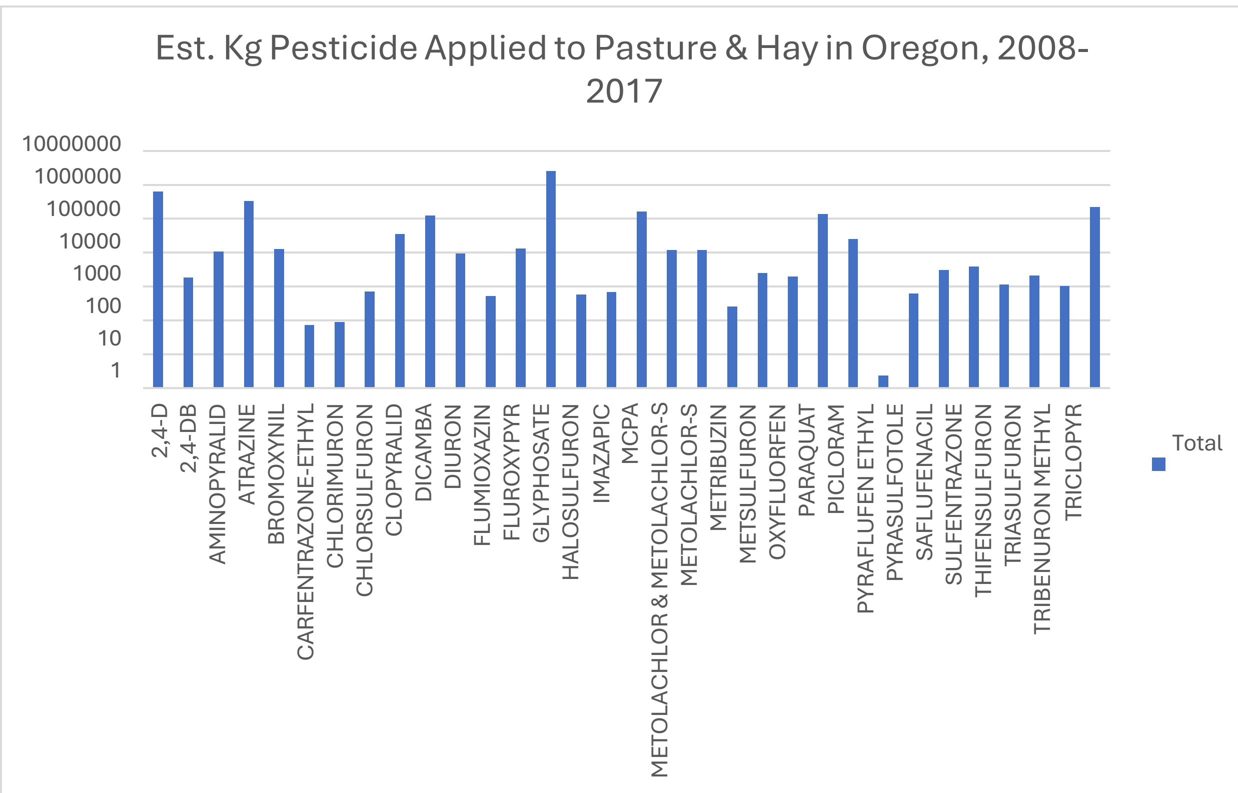


Figure 20. Bar graph of Estimated Kilograms of Pesticide Applied to Pasture and Hay in Oregon from 2008-2017.

feeding on a handful of exotic noxious weeds, few if any options besides herbicide are typically feasible for treatment of these invasives on rangeland. It can be expected therefore that projects utilizing herbicide will be occurring on both private and public rangeland, including potential program treatment. No cumulative or synergistic effects are anticipated to result from herbicide in general, including on rangeland. Aside from intermittent requests to APHIS to treat grasshopper outbreaks, insecticide applications, especially on public rangeland, are not documented or anticipated. They are also expected to be very rare on private rangeland, with little upside benefit to treatments to be found outside of grasshopper outbreaks, even in the higher production Hay & Pasture crops, as reflected by the lack of insecticide applications to be found in Wieben, C.M, 2019.

Looking specifically at the pesticides considered in this EA, Wieben, C.M., 2019 show diflubenzuron to be generally uncommon, with only three years of treatments estimated in the whole decade, all in Orchard & Grape crops, for 1,253 kg total, an average of 125 kg per year across the entire state. Based on this limited use and lack of geographic overlap, no cumulative effects are anticipated from this agricultural use.

Table 7. Estimated Kilograms of Diflubenzuron Applied to Crops in Oregon, 2008-2017

Compound	Year	Units	Orchards & Grapes
DIFLUBENZURON	2008	kg	1185.1
DIFLUBENZURON	2009	kg	25.5
DIFLUBENZURON	2015	kg	42.4
10-year Sum			**1,253**
Average per Year			125

Carbaryl is a faster acting and broader spectrum insecticide, especially in the liquid form that is primarily used, and is not a restricted-use pesticide like diflubenzuron, so no special applicator license is necessarily required. As expected, it was more widely and consistently used, however none was estimated to have occurred in Pasture & Hay crops. Orchards & Grapes made up 71% of usage and was the most consistent use over the decade. Vegetable & Fruit crops showed the 2nd highest and most consistent usage rates, though a trend of decreased use in the 2nd half of the decade is evident. Alfalfa crop usage varied the most, averaging almost the same application rate per year over the decade as Vegetable & Fruit crops, despite only being recorded in three years, with a massive single year spike recorded in 2009. Other crops (e.g., small grains or legumes) showed very slight usage estimates, and zero usage in eight years of the 10 years.

Table 8. Estimated Kilograms of Carbaryl Applied to Crops in Oregon, 2008-2017

Compound	Year	Units	Vegetables & Fruit	Orchards & Grapes	Alfalfa	Other	Total
CARBARYL	2008	kg	1123.8	3810.4			4934.2
CARBARYL	2009	kg	1685.6	3356.9	10957.4	138.7	16138.6
CARBARYL	2010	kg	3529.2	11287.6			14816.8
CARBARYL	2011	kg	3988.7	7705.4			11694.1
CARBARYL	2012	kg	1239.5	10749.9	116		12105.4
CARBARYL	2013	kg	159	9356.3			9515.3
CARBARYL	2014	kg	599	9846.3		19.2	10464.5
CARBARYL	2015	kg	211.7	772.3	544.2		1528.2
CARBARYL	2016	kg		1060.9			1060.9
CARBARYL	2017	kg	92.9	2681.6			2774.5
10-year Sum			**12,629**	**60,628**	**11,618**	**158**	**85,033**
Average per Year			**1,263**	**6,063**	**1,162**	**16**	**8,503**

Since no estimates on non-agricultural use were available, and carbaryl is a popular option available to home gardeners, it can be assumed that residences, gardeners, and possibly municipal green spaces, near potential APHIS treatment areas may be treated with this pesticide. Given the Restricted Use Pesticide labeling of Diflubenzuron, public use of that pesticide is less likely.

Cumulative effects from organophosphate pesticides in Oregon are also a potential concern, since 10 pesticides of this type occur in the 10-year data, though again, none for Pasture & Hay. Alfalfa shows consistent use of these insecticides, as do most other crops. Other sources of these pesticides in the environment may be from municipal mosquito abatement programs. The 2002 EIS Appendix B (page 160) notes that in comparison to liquid carbaryl: "Carbaryl incorporated into bran flakes or other solid media acts only upon ingestion by the organism and is considered to be more selective and environmentally benign than other chemical control means (Peach et al., 1994). This suppression method may offer a viable alternative when grasshopper treatment is required in close proximity to endangered and threatened species, water bodies, or other sensitive sites." Given the Oregon program formulation of bait only with use of carbaryl, the lack of geographic overlap with any of the above treatments, and the infrequency of treatments for grasshoppers due to their cyclical pest nature, the additive effects of carbaryl resulting from the program remain insignificant, even though organophosphate use in the greater environment continues to be a popular option for other agricultural pests and mosquito suppression.

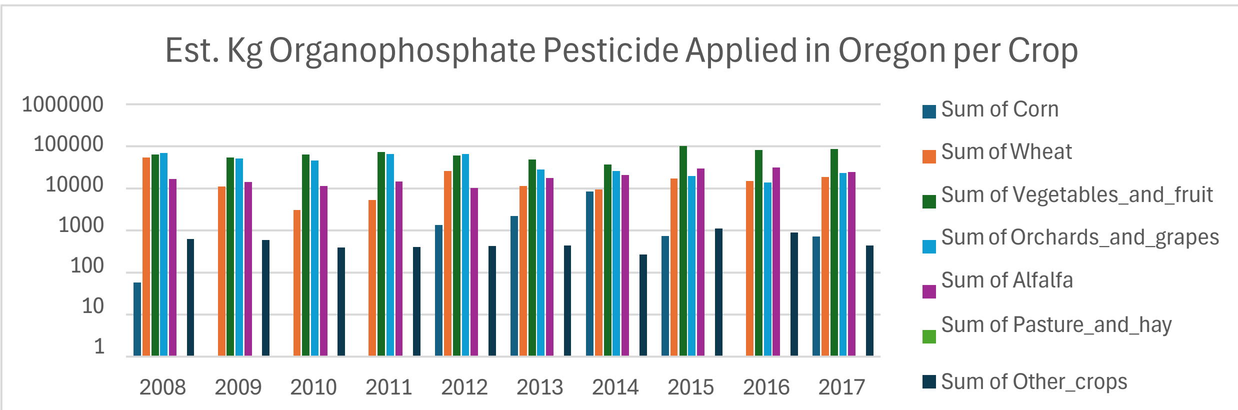


Figure 21. Bar graph of Estimated Kilograms of Organophosphate Pesticide Applied in Oregon per Crop, 2008-2017

Based on the above analysis of Wieben, C.M., 2019, which is the best currently available for this purpose, there is no reason in evidence that cumulative impacts from the program would occur, given the low use of program insecticides overall, and the lack of geographic or crop usage overlap that is discernable.

For many years, APHIS and ODA have provided the interested public with information on program pesticides, timing and preferred application methods (i.e., RAATs), so it is likely that increases in use of these methods have occurred in areas impacted by pestiferous grasshopper outbreaks, which are not adequately captured by these data. ODA in particular has responded to public pressure to provide funding mechanisms through the Oregon legislature to aid private growers impacted by grasshoppers. APHIS will continue to evaluate this source of application data as it becomes available.

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

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

APHIS has prepared this EA for Oregon because treatments could be requested if grasshopper populations reach outbreak levels. Past experience and continuing/cyclical grasshopper outbreaks impacting rangeland health and agricultural producers, as well as the possibility of exacerbating drought 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. Additionally, requested treatments may be cancelled or change location if land manager priorities and policies shift, APHIS funding and staffing is too limited, or higher priority work emerge. Thunderstorms, heat waves or wildfires may also make areas inaccessible or delay treatments past the optimal window.

As summarized in Table 4 and 5 (section II.A.) all treatments in the past 10 years have occurred on BLM rangeland in Harney and Malheur counties. Tentative requests were received from Lake and Baker counties for BLM rangeland also, but to date no viable project areas have emerged, primarily due to buffers for Greater Sage Grouse or ESA fish critical habitat occurring in the same areas as high grasshopper populations. The BLM continues to look at mixed use rangeland locations they manage that do not have such limitations (or other special designations) where grasshoppers outbreaks have occurred historically, tentatively requesting ongoing assistance with the grasshopper upcycle identified starting in 2020, as well as progressive migration of Mormon crickets from Idaho and Nevada. Based on spring survey results, they may finalize treatment request submissions to be acted upon in the limited phenological treatment window, or if a downcycle in grasshopper populations is observed, no treatment will be advisable. There are no areas that have been retreated by APHIS in the past decade to date aside from very arid areas on the east slope of Steens Mountain, with most seeing sustained reductions from a single treatment.

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

Direct exposure to program chemicals because 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.

As summarized in Table 6, approximately 223,865 people live in the eight counties covered by the separate Draft EA and this one which adds Crook County. Collectively they have an area of 41,388 square miles, creating an average population density of 5.4 persons per square mile overall. Program suppression activities are conducted on rangelands that are far more sparsely inhabited however, typically with few or no people present or in residence. Most habitation in rangeland areas is comprised of singular houses, but some rangeland areas may have denser areas of habitation nearby. Such areas are treated as sensitive sites, and provided programmatic buffers and notification of treatment activities is provided to residents in advance of nearby treatments. 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.

Recreationists are sometimes present on rangelands receiving program treatment, though this is very uncommon. Recreationists may theoretically use rangelands in question for hiking, camping, bird watching, hunting, rock hunting, or other uses, and ranchers may work be at work. Individuals with allergic or hypersensitive reactions to insecticides may live near or may utilize rangelands in the proposed suppression program area also, in theory. Some rural schools may be in areas near treatment blocks but not observed to date and would be buffered. To date, no recreationists have been observed in or near treatment blocks in Oregon (aside from driving past on buffered roads inside vehicles) outside of a BLM campground at Mann Lake, which was buffered. Notice is routinely provided to any recreationist found in areas of treatment, to limit their announce or potential exposure to program chemicals, and applicators are advised to avoid direct treatment of people, vehicles or buildings unexpected encountered.

Those most at risk during operations would be persons mixing or applying chemicals. Adherence to pesticide label recommendations is therefore mandatory, and APHIS employees receive annual health screening to monitor for harmful pesticide exposure. 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 because 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 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 because 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 because of combustion from a rangeland fire but these are typically less toxic based on available human health data. The safety data sheet for each insecticide identifies these combustion products as well as recommendations for personal protective equipment 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 rangeland firefighters would also be protected from exposure resulting from the burning of residual insecticides.

2. Nontarget Species

a) Ecological Summary

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, in consultation with U.S Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). Protection measures that resulted from this consultation also helps to prevent take of state-listed species (sensitive or sensitive-critical species designation in Oregon as determined by ODFW) 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, beetles) and other beneficial insects.

Grasslands and shrublands (typically below 6,000 feet elevation, with minimal tree cover and gentle slope) and associated seasonal wetlands are most likely to host outbreaks of grasshoppers. Collectively, these lands host abundant and diverse terrestrial and aquatic organisms. Potential program areas, that is areas where viable treatment requests are made to APHIS to consider for suppression treatments are primarily federally, tribally, or state managed and must not be subject to other exclusionary management area policies or designations (see section III.B). Private rangeland can potentially be included in APHIS treatment programs, however in Oregon, this is rare.

Croplands including hay fields also host grasshopper outbreaks, however these can have only a very limited role in any program treatments, if any, and no APHIS cost share is provided. For any APHIS suppression program, all enhanced measures for protecting non-targets are required regardless of land manager, which are far more than what private applicators are legally bound to.

APHIS completed national consultation with USFWS and NMFS for the program overall, but each state also works locally with jurisdictional wildlife management agencies on a rolling basis, which may involve pertinent updates on new species listings, annual communication on program updates, providing of Environmental Monitoring reports, site-specific ESA checks for proposed treatment areas, and of course consultation. For the Oregon program, an all-taxa summary of consultation efforts is provided in Appendix C and discussed in the next section (III.D.3), Consultation and Assessment Determinations.

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.

The Oregon Biodiversity Information Center (ORBIC) tracks the distribution and status of flora and fauna in the state, with location and populations data managed from all observations and occurrence data. Tiered to this are iNaturalist projects as well which empower citizen scientists to volunteer in aid of these efforts in a way that is scientifically reviewed. Their efforts are made available to the public on their rare species publications page (inr.oregonstate.edu/orbic/rare-species/oregon-rare-species-publications).

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 Oregon 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.

The program has suppressed grasshopper populations on at most about a tenth of one percent of the area of the seven counties considered by this EA in any given year. As shown in Chapter II.A., 11,676 acres on average per year were treated in the past decade, out of 24,581,120 acres in the seven counties, or 0.0475%; while in the largest treatment year, 33,792 acres were treated or 0.137%. Within blocks protected through treatments, 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. In sum, 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 (happening once per 1-3 years at most, usually just once in a decade or longer).

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.

b) Invertebrates

Biodiversity of invertebrate organisms is generally recognized as crucial for overall ecosystem health in natural environments. In addition to the benefits of general biodiversity, specific groups of beneficial invertebrates are identified as providing important ecological services. Biological control organisms (species that feed on and help control pests) and pollinators (species that pollinate flowering plants) in particular help control pests and provide pollination services which are crucial to sustaining diverse ecosystems, while predatory arthropods (carnivores including insects, arachnids, and chilopods such as centipedes) help to regulate herbivorous populations and maintain balanced food-webs generally. Overuse of broad-spectrum pesticides and other artificial disturbances can disrupt the herbivore control and pollination services which populations of beneficial invertebrates provide. IPM is largely the practical science of creating the least disruption to invertebrate communities, while reducing the population of target pest(s), to prevent larger ecological problems from artificial imbalance in these communities. For crop producers this may mean preventing a 'flush' of very difficult to control pestiferous mites, or the costly replacement of honeybees, resulting from overuse of pesticides which broadly impact insects, such as organophosphates. For stewards of natural resources, IPM is also crucial for maintaining an overall balance of invertebrate biodiversity, not due to cost calculations, but as a primary *goal* of grasshopper outbreak suppression efforts. Currently, the pesticides considered for this program are very specific in terms of mode of uptake, requiring ingestion to be effective, which is only likely to occur from a small subset of invertebrates and most especially, grasshoppers (as discussed further in part E. of this chapter, Environmental Consequences of the Alternatives).

In public comments, concern is often raised about impacts on beneficial invertebrates from blanket, broad-spectrum insecticide applications, which have been found to result in significant mortality of beneficial invertebrates, including those with the greatest potential to help regulate grasshopper populations over the long term (Branson et al 2006). This EA does not consider using such methods. An important body of research investigated how methods and materials which were previously used to control grasshopper outbreaks on rangelands, such as blanket, broad-spectrum insecticide applications, were unsustainable and counterproductive. Similar and supporting research developed the IPM techniques currently preferred for control of grasshopper outbreaks, being both ecologically and economically improved from past methods. The USDA Grasshopper IPM User Handbook and the ARS Grasshopper Management website share this research with the public. APHIS promotes and helps to summarize these IPM resources to land managers seeking guidance on this topic and continues to follow improvements the control methods of pest grasshoppers in North America, recently summarized by Dakhel et al, 2020, especially biopesticides. Currently, none are a feasible alternative to provide to land managers requesting assistance with outbreak from APHIS. However, the methods GIPM helped to develop, and APHIS utilizes and promotes, are compatible with biological control methods, a.k.a. biocontrols.

Biological pest control is a broad topic that is studied and presented in great detail in the above resources and provide a cornerstone for ecological pest control and IPM generally. They typically do not provide sufficient control to stand alone without other complementary control methods. As relates to controlling grasshopper outbreaks, biological control populations typically become saturated and decrease in effectiveness during pest outbreaks, as the density of pest surpasses the demand for them as food.

This is one of the findings in the USDA Grasshopper IPM User Handbook, including in section VII.14 on Grasshopper Population Regulation, which aims to describe relationships between available food, weather, and abundance of natural enemies, as ecological factors contributing to the regulation of grasshopper populations. Past public comments cited this study as indicating that grasshopper populations have a high potential for being limited by natural enemies. While this is generally presented in the study as a sort of ecological first principle, equated in the text to how wolves have a strong potential to regulate deer, it is not the conclusion of the study generally. It does not draw any overarching conclusion as to the effectiveness of biological control on known outbreaks of grasshoppers. Rather it attempts to describe specific instances where survey of grasshopper populations may not be necessary at all due to limiting factors including biological control, weather, and food availability.

One type of biocontrol is **conservation biocontrol,** which is the encouragement of endemic natural enemies to control a pest species. This is generally recognized as a key factor in regulation of outbreaks, particularly as caused by disease when combined with difficult weather and food scarcity conditions. Encouraging beneficial elements of conservation biocontrol is a long-term process that land managers may support through soil health and land management practices, though some uncontrollable factors such as climate are equally important. Since overall treatment programs for grasshoppers are statistically rare, conservation biocontrol is the main method of control that is utilized globally for control of grasshoppers and locust, and suppression project should use IPM that supports it, such as:

- Limiting when treatments occur based on survey results,
- Providing non-treated swaths with RAATs,
- Selecting pesticides with modes of action targeting orthopteran pests which do not kill a broad spectrum of invertebrates on contact.

Conservation biocontrol species (a.k.a agents) which help to regulate populations of grasshopper in the western US are listed in the following table, drawn from the GIPM User Handbook made available to the public at ARS: www.ars.usda.gov/pa/nparl/pmru/IPMHandbook. The methods and materials developed for GIPM that are utilized by APHIS and transferred to land managers in direct consultation and public meetings to support populations of these and other 'beneficials' to help prevent future outbreaks and improve rangeland ecosystem health and productivity.

Table 9. Arthropod Predators & Parasites of Grasshoppers in the Western US.

Arthropod Predators & Parasites of Grasshopper Pests in Western US	
Arachnida	**Mites and Spiders**
Mites	3 families of mites are known to parasitize grasshoppers but aside from reducing egg viability, population regulation is considered minimal.
Spiders	Web-building spiders and hunting spiders, both ground dwelling (e.g. 'wolf spiders') and foliage dwelling (e.g. 'jumping spiders'), are often abundant.
Coleoptera	**Beetles**
Carabidae	Ground beetle adults and larvae are generalist predators, including of grasshopper eggs, that can have significant impacts.
Meloidae	Blister beetles larvae attack grasshopper eggs significantly, however adults are herbivorous and can be crop pests, also can cause blisters on human skin.
Cleridae, Tenebrionidae & Trogidae	Generalist predators that may feed on grasshopper eggs.
Diptera	**Flies**
Parasitoids	Internal parasites that kill their host, many species of flies target grasshoppers (in families Anthomyiidae, Nemestrinidae, Sarcophagidae, & Tachinidae).
Asilidae	'Robber flies' are the raptors of the insect world and many prefer grasshoppers; in one 6 year WY study, they reduced grasshopper populations by 11-15%.
Bombyliidae	'Bee fly' species can resemble bumble bees and many species are considered important predators, with larvae that hunt grasshopper eggs in the soil.
Calliphoridae & Chloropidae	Generalist predators that may feed on grasshopper eggs.
Hymenoptera	**Ants and Wasps**
Formicidae	Ants are localized, general predators, especially of eggs and newly hatched grasshoppers, with little impact on larger instars or distances from colonies.
Scelionidae	Large family of wasp that parasitize insect and spider eggs, including about 20 species that specialize on grasshoppers; very small (1-3 mm, 1/16-1/8").
Sphecidae & Crabronidae	Large families of solitary wasp with about 30 species that capture grasshoppers to provision their nests (e.g. 'digger wasps'); distribution & control varies.

Odonata	Dragonflies and Damselflies
	Generalist predators that breed in aquatic habitats but can fly into crop fields or rangelands.
Orthoptera - Mantidae	**Mantids**
Litaneutria minor	The 'agile ground mantis' or 'minor ground mantid' is a generalist ground hunting predator in dry habitats of the arid mountain west, 30 mm, 1.2" long.

Two other methods of natural pest control are often referred to as kinds of biological control: **Classical biocontrol** is the intentional release of natural enemies from an exotic pest's native range. Since pestiferous grasshoppers currently in North America are native species, this categorically does not readily apply a viable control strategy, though it has been considered and is discussed in Dakhel et al 2020. **Augmentative biocontrol** is the artificial release of a large number of natural enemies to overwhelm pest populations, and is the area most studied as a potential replacement to pesticides. There is not currently a viable control option for APHIS to use efficiently. Although promising lines of research do exist only minimal control potential has been shown in studies to date.

Table 10. Enotomopathogens of Grasshoppers in the Western US.

Entomopathogens of Grasshopper Pests in Western US	
Fungi	***Infect on contact--useful for conservation biocontrol or biopesticide***
Beauveria bassiana	-a mold causing white "powered sugar" coating - can be purchased
Metarhizium anisopliae	-a mold causing green "powered sugar" coating
Aspergillus flavus	-a mold causing green "powered sugar" coating - more saprophytic
Entomophaga grylli	-causes "summit disease" since insects grip top of stems in death
Microsporidia	***Protozoa have been studied for use biopesticide but results irregular.***
Nosema	"Protozoa" are spore-forming unicellular parasites…
Antonospora	…that can persist in host populations.
Vairimorpha	-attacks Mormon cricket
Bacteria	***Bacteria have been studied for biopesticide use, but with no success.***
Bacillus thuringiensis	-limited impacts so far, unlike *Bt kurstaki* in moths
Viruses	***Viruses have potential as biopesticides, but difficult to mass-produce.***

entomopox	-infects fat body tissue - sluggishness/slow growth/death
crystalline array	-too similar to mammalian viruses to study as biopesticide

Possibly of even greater significance than the imperative of supporting populations of biocontrols, may for supporting pollinators. Based on current available scientific research, there is a decrease in quantity of pollinators across the country and in rangeland ecosystems. Existing research serves to outline the impact of pesticides on pollinators of the order Hymenoptera (bees, wasps and ants) and Lepidoptera (moths and butterflies) primarily but also delves into pollinators of other orders to a lesser extent, such as Coleoptera (beetles) and Diptera (flies).

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). In Oregon rangeland, treatments could affect these abundant and species rich areas, but nearby untreated areas will allow recolonization if so.

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

Pollinators in Oregon include economically important managed exotic species such as European honeybee and alfalfa leafcutting bee, and a vast diversity of native species, including many kinds of solitary and eusocial bees. Additional pollinators include wasps and ants, flies, hoverflies and bee-mimicking flies, many families of beetles, true bugs, moths and butterflies, as well as vertebrate pollinators. All pollinators are considered non-target species requiring consideration and protection from treatment program impacts, but a large and particularly diverse group of pollinators that deserve special attention are native bees. The Oregon Bee Atlas project (extension.oregonstate.edu/bee-atlas) funded in part by the USDA, has documented approximately 750 species of bees native to Oregon, most of which occur in the more arid parts of the state, especially in wilderness areas and areas with diverse floral nectaries. This cooperative public science project has significantly clarified relationships between bee species and the host plants from which they gather nectar and pollen and help to pollinate and reproduce sexually in the process. Some species of insects are obligate pollinators of rare plants, meaning the plants cannot reproduce without them, and such relationships are helping to be clarified by the project.

Other ecological 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 and omnivorous arthropods including a great diversity of grasshoppers are in this general category. Finally, as described already, parasitic and 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 quantitatively the greatest animal biodiversity within these ecosystems.

Two specific non-target invertebrate species of potential concern, which have been previously identified in public scoping for the program, are Leona's little blue butterfly (*Philotiella leona*) and the monarch butterfly (*Danaus plexippus*). The monarch butterfly may potentially be found throughout Oregon and is proposed for ESA status. In contrast, the Leona's little blue butterfly is only documented in certain areas of Klamath County, particularly near the Upper Klamath Marsh National Wildlife Refuge. A request for program treatment in Klamath county by federal land managers has not been directed to APHIS since 2013. Subsequent Endangered Species Act (ESA) listings have resulted in a lack of federally managed rangeland in the county that does not also have an abundance of ESA protected species and critical habitat. For these reasons, Klamath County is no longer included in this EA.

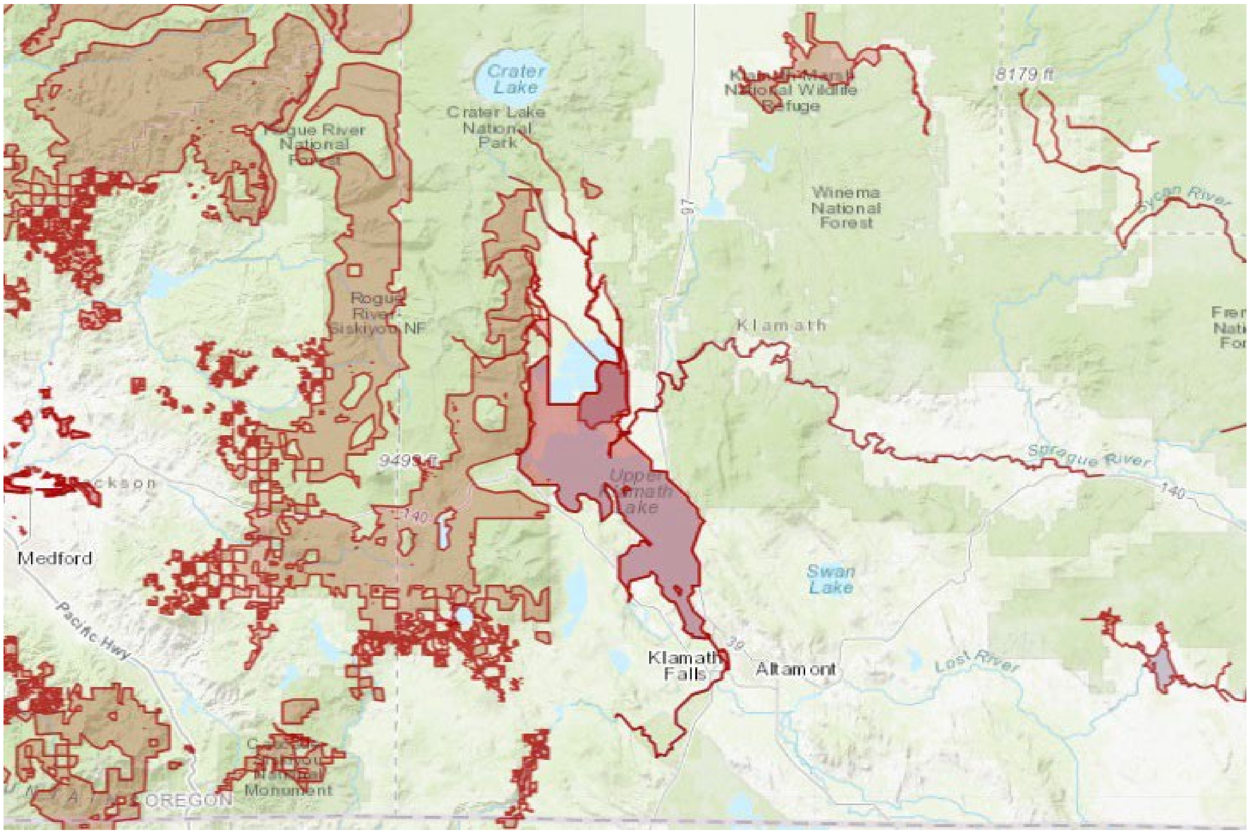


Figure 23. ESA Critical Habitat in Klamath County (IPAC 2023).

The program will not have any impact on this butterfly therefore, except as described in the No Suppression Program Alternative in Section II: the absence of an APHIS run program may result in neighboring private landowners using more and stronger pesticides, which could potentially impact this species negatively.

c) Vertebrates

Though less directly at risk from many modern pesticides targeting insects, including both considered in this EA, many other non-target species occur in areas prone to grasshopper outbreaks and potential treatments. Vertebrates occurring in rangelands of Oregon 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). Various reptiles, amphibians and fish are also present.

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 expanded into the area. Sage obligate bird species, typified by sage-grouse, are potentially present in much of eastern Oregon rangeland. Herbivorous vertebrate species may compete with some species of grasshoppers for forage, while omnivorous and predacious species can utilize grasshoppers and other insects as an important food source. There is special concern about the role of grasshoppers as a food source for sage-grouse, sharp-tail grouse, and other bird species. Given program methods and materials, impacts on vertebrate species are expected to be minimal, as described in greater detail in various parts of the Environmental Consequences Chapter.

d) Flora

A diverse community of terrestrial plants also occur in potential program areas. Non-native plants, including invasive weeds such as 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) are common in areas prone to grasshopper outbreaks and may help to support these populations (see Photos 4 & 5, and discussion in part II.B. Description of Grasshopper Species). Land managers can help limit future outbreaks by controlling invasive weeds on their property, in some cases, but not always, as discussed in part III.b. Description of Grasshopper Species.

A great diversity of native plants (e.g. sagebrush, bitterbrush, numerous grasses and forbs) are endemic to eastern Oregon rangeland. Rare flowering plants may also occur in or near areas where treatments are requested. As with buffering of other rare species, this is a collaborative responsibility of the land manager, APHIS, and wildlife management agencies, to identify and buffer out plants species as dictated by applicable policy or preference from treatment requests during the planning phase, or proposed treatment blocks during final review. Though not rare, milkweed plants (which support monarch butterfly) would be an example of a plant species that would be desirable to buffer, as requested by anyone involved. APHIS has done so for all projects in Oregon for the past five years. The Oregon Flora project (oregonflora.org) supported in part by the USDA, is one helpful resource for reviewing treatment areas for plants of concern. Due to methods and materials, impacts to flowering plants, including pollination services, are not anticipated to be significant by proposed actions, except for the no action alternative, which may results in fewer such plants due to herbivory by damaging grasshopper population outbreaks.

e) Miscellaneous

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) though less visible in rangelands of eastern Oregon are nonetheless present and contribute to these ecosystems in various ways. Negative impacts on these non-targets from the program are expected to be minimal, as described in greater detail in the Section III.

3. Consultation and Assessment Determinations

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 seven counties and three level III ecoregions under consideration by this EA there are federally listed species and areas of designated critical habitat.

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 USFWS and/or 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 also consults with USFWS field offices at the local level to ensure listed species habitats are properly buffered during grasshopper suppression treatments, completing consultation in 2022, and communicating regularly since then, including on proposed ESA species.

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

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

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

a) Species Protections Summary Tables

(1) Determinations of No Effect (NE) and Not Likely to Adversely Impact (NLAA) for Species Likely No Longer in Program Area

The program consulted USFWS locally in 2022 for 17 central and eastern Oregon counties. Nationally the program consulted USFWS in 2015, also including 17 central and eastern Oregon counties, and a Letter of Concurrence (LOC) was issued for that national consultation in 2024. The following table summarizes ESA protected species for which the program's determination of No Effect (NE) was concurred with by USFWS in either or both of these consultations. Also following the reduction in counties (specifically removing Deschutes, Gilliam, Grant, Klamath, Morrow, Sherman, Union, Wallowa, Wasco, and Wheeler counties) consultations which indicate Not Likely to Adversely Impact (NLAA) determinations for species ranges which do not extend into current potential program areas, are potentially outdated. Required buffers and mitigation procedures for all NLAA species are still binding however, should they be encountered in the current potential program areas, and are listed in Appendix C. The ESA designations occurring here are either: Threatened (T) or Endangered (E), and Critical Habitat (CH) or Proposed Critical Habitat (PCH).

Table 11. Determinations of No Effect (NE) and Not Likely to Adversely Impact (NLAA) for Species Likely No Longer in Program Area.

Common name	Specific taxon	Designa-tion status	Effects Determination	Justification
Amphibians:				
Oregon spotted frog	*Rana pretiosa*	T, CH	NLAA*	*No longer in program area: This species is found in and near the Cascade Mountains including the Upper Klamath Marsh NWR, which resulted in requests for assistance from that grasshopper outbreak prone area no longer being eligible for the APHIS program.
Birds:				
Northern spotted owl	*Strix occidentalis caurina*	T CH	NE - not in prog. Area	This species occurs in deep forest habitats.
Invertebrates:				
Franklin's bumble bee	*Bombus franklini*	E	NLAA*	*Not in program area: This species lives in an approximately 13,000 square mile area of the Klamath Mountain region of southern Oregon (and northern California) including Klamath County.
Snake River physa snail	*Physella natricina*	E	NLAA*	*This freshwater mollusk is found only in the Snake River, which is not near potential program areas.
Mammals:				
Canada lynx	*Lynx canadensis*	T CH	NE - not in prog. area	No known resident populations in Oregon, but rare transitory occurrences would be expected to be at higher elevations than potential program activities.
North American wolverine	*Gulo gulo luscus*	T	NE - not in prog. area	In Oregon, this species inhabits forested areas above 6,000 feet.
Plants:				
Applegate's milk-vetch	*Astragalus applegatei*	E	NLAA*	*Not in program area: Limited to Klamath County.
Gentner's fritillary	*Fritillaria gentneri*	E	*	*Not in program area: Limited to southwest Oregon and Northwest California.

Greene's tuctoria	*Tuctoria greenei*	E CH	NLAA*; No adv. mod. CH	*Not in program area: Populations may extend into vernal pools of Klamath County but is primarily limited to California.
Mac-Farlane's four-o'clock	*Mirabilis macfarlanei*	T	NE - not in prog. area	Oregon populations are limited to Snake River Canyon and Imnaha River area of Wallowa County.
Slender Orcutt grass	*Orcuttia tenuis*	T CH	NLAA*; No adv. mod. CH	*Not in program area: Populations may extend into vernal pools of Klamath County but is primarily limited to California.
Slickspot peppergrass	*Lepidium papilliferum*	T PCH	NLAA*; No adv. mod. CH	*Not in program area: Populations do not extend into Oregon as far as Adrian, along the Idaho border, far from potential program areas.
Spalding's catchfly	*Silene spaldingii*	T PCH	NLAA*; No adv. mod. CH	*Not in program area: Populations are in the Palouse Foothills including Wallowa County but not know to extend into Baker or Umatilla counties.
Whitebark pine	*Pinus albicaulis*	T	NE - not in prog. area	Populations of this species are at higher elevations than where pestiferous grasshopper outbreaks occur.
Reptiles:				
Giant garter snake	*Thamnophis gigas*	T	NLAA*	*Not in program area: USFWS species overview does not list this species extending to Oregon.

(2) May Affect – Not Likely to Adversely Affect (NLAA) Determination for ESA Species.

The following determinations were also concurred with by USFWS as described above but are clearly not potentially outdated due to the reduction in counties listed for the program in Oregon since 2023. Mitigation measures listed for all NLAA determination species are a legal requirement for the program. The ESA designations listed here are either: Threatened (T) or Endangered (E), Experimental Population (EXP) and/or Critical Habitat (CH). Standard aquatic buffers: In cases where no additional buffers are proposed the standard program buffers for aquatic sites applies: Diflubenzuron: aerial - 500 feet; ground - 200 feet; Carbaryl bait: 200 ft aerial - 50 feet ground.

Table 12. May Affect – Not Likely to Adversely Affect (NLAA) Determination Protective Measures for ESA Species.

Species (ESA Status)	Effects Determination	Carbaryl Bait Application Buffers	Difluben-zuron Application Buffers	Justification for Application Buffers and/or Determination, Plus Description of Any Additional Protective Measures
Birds:				
Yellow-billed cuckoo, Western U.S. DPS (T, CH) *Coccyzus americanus*	NLAA; No adverse modification of CH	500/750 ft ground/air from edge of CH or known locations	500/1000 ft ground/air from edge of CH or known locations	This species is a small insectivore. Buffers were generated based on bird size, prey type, and potential exposure to the insecticides. Floodplain forests of 50 acres or larger will be buffered also unless consultation with USFWS determines it is not potential species habitat.
Fishes:				

Bull trout (T, EXP, CH) *Salvelinus confluentus*	NLAA; No adverse modification of CH	100/750 ft ground/air	200/1320 ft ground/air	National BA discusses environmental concentrations with the proposed buffer sizes for the insecticides (Table 2-3). Comparison of the distribution of acute and sublethal and chronic effects data for fish to the residues estimated under different applications demonstrates that the range of residues are below the range of response data that was discussed (figures 4–1, 4-2 and 4-3). Where a listed fish species occupies habitat consisting of a stream or river, buffers will apply for a distance of 500 feet upstream of the location or habitat for ground applications and 1,000 feet upstream for aerial applications. (This species also is most commonly found at higher elevations and shade-cover than grasshopper outbreaks.)
Hutton tui chub (T) *Gila bicolor* ssp.	NLAA	100/750 ft ground/air	200/1320 ft ground/air	The singular location of this species is in spring systems and outflow channels on private land in Lake County. Requests from BLM near this area have not occurred to date. If in the future they are requested, APHIS will ensure the 1/4 mile aquatic buffers for ESA fish is maintained.
Lahontan cutthroat trout (T) *Oncorhynchus clarkii henshawi*	NLAA	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Lost River sucker (E, CH) *Deltistes luxatus*	NLAA; No adverse modification of CH	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Shortnose sucker (E, CH) *Chasmistes brevirostris*	NLAA; No adverse modification of CH	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Warner sucker (T, CH) *Catostomus warnerensis*	NLAA; No adverse modification of CH	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Mammals:				
Gray wolf (E, EXP, CH) *Canus lupus*	NLAA; No overlap of CH	None	None	Proposed chemicals and rates will not adversely affect species or its prey base.
Plants:				

Howell's spectacular thelypody (T) *Thelypodium howellii spp. spectabilis*	NLAA	ground 50 ft	ground 50 ft	Limited ground buffers intended to reduce the chance of physical disturbance. For pollinators, the lack of an exposure pathway (carbaryl bait), or low comparative toxicity (diflubenzuron), discussed in the national BA (Section III), result in no aerial buffer requirement.
Malheur wire-lettuce (E, CH) *Stephanomeria malheurensis*	NLAA; No adverse modification of CH	Standard aquatic	Standard aquatic	The single known population (near Harney Lake) is not in an area feasible for treatment historically or currently.

(3) Proposed or Delisted ESA Species and Oregon Sensitive or Sensitive-critical Species Mitigation Measures.

Legally, APHIS does not have to implement conservation recommendations for candidate and non-listed species; however, addressing these species may minimize or avoid adverse effects to the species and may avert potential future conflicts. Additionally, there may be agency policies which are in effect, such as with Oregon Greater Sage-grouse Approved Resource Management Plan, which are discussed further in part b of this section. The following is a list of not currently ESA designated species which the program has considered and in some cases decided to provide voluntary buffers or other mitigation measures. Some of these have been reviewed by USFWS for concurrency, as listed in Appendix C. The ESA designations listed here are either: Proposed Endangered (PE), Proposed Threatened (PT), and/or Proposed Critical Habitat (PCH); while Oregon specific designations are: Sensitive (S), and/or Sensitive-Critical (SC).

Table 13. Proposed or Delisted ESA Species and Oregon Sensitive or Sensitive-critical Species Mitigation Measures.

Common name & Status	Specific taxon	Carbaryl Bait App-lication Buffers	Difluben-zuron App-lication Buffers	Justification for Application Buffers and/or Determination, Plus Description of Any Additional Protective Measures
Amphibians:				
Columbia spotted frog (SC)	*Rana luteiventris*	100/750 ft ground/air	200/1320 ft ground/air	The risk of each insecticide to listed taxa, including amphibians, are discussed in more detail in the national BA, Section IV. Estimates of exposure at the various distances proposed for each application method are intended to result in direct and indirect effects to listed amphibians that are considered insignificant and discountable. Specific distances for buffer application included in these buffers are related to the specific PCEs for amphibian species with critical habitat.
Rocky Mountain tailed frog (S)	*Ascaphus montanus*	100/750 ft ground/air	200/1320 ft ground/air	See Columbia spotted frog justification.
Western toad (S)	*Anaxyrus boreas*	100/750 ft ground/air	200/1320 ft ground/air	See Columbia spotted frog justification.
Birds:				

American three-toed woodpecker (S)	*Picoides dorsalis*	None	None	Woodpeckers specialize on internal feeders of woody plants, which prevents exposure of prey to program chemicals.
Black-backed woodpecker (S)	*Picoides arcticus*	None	None	See American three-toed woodpecker justification.
Black-necked stilt (S)	*Himantopus mexicanus*	Standard aquatic	Standard aquatic	This species forages and nests shallow wetlands including ephemeral waterbodies and shorelines. Pre-treatment surveys to ensure accurate buffering of seasonal water will be conducted to prevent treatment of potential habitat.
Bobolink (S)	*Dolichonyx oryzivorus*	Program limitations	Program limitations	This species is primarily found in high productivity grasslands and croplands, not the more arid rangeland in which APHIS grasshopper suppression programs occur.
Brewer's sparrow (S, SC)	*Spizella breweri breweri*	GSG mitigations	GSG mitigations	This species is linked to tall stands of sagebrush, which are typically excluded from treatments already due to Greater Sage Grouse protection measures.
Burrowing owl (Western) (SC)	*Athene cunicularia hypugaea*	650 ft from nesting burrows	650 ft from nesting burrows	Buffers conform with Oregon conservation strategy regarding pesticide applications for this species. This species is a small insectivore. Buffers were generated based on bird size, prey type, and potential exposure to the insecticides.
Columbian sharp-tailed grouse (SC)	*Tympanuchus phasianellus columbianus*	NA	NA	Known range does not include counties currently assessed for potential grasshopper treatments.
Common nighthawk (S)	*Chordeiles minor*	Standard aquatic	Standard aquatic	Treatments in Columbia Plateau ecoregion are feasible but infrequent, with none having occurred in the past 10 years. This species feeds on nocturnal flying insects associated with wetlands, which are not expected to be impacted by program.
Ferruginous hawk (S, SC)	*Buteo regalis*	0.6 miles, April 5th - June 15th only	0.6 miles, April 5th - June 15th only	Effects on much of the prey of the hawk (e.g., jackrabbits, ground squirrels are not expected). Buffers (per Oregon conservation strategy) are to reduce the possibility of disturbance. To protect against disturbance, program personnel will determine whether a nest is present in an area prior to treatment by contacting the state wildlife agency or by visual inspection.
Flammu - lated owl (S)	*Psiloscops flammeolus*	NA	NA	This species occurs in and near mid-elevation forests, not near rangeland where pestiferous grasshopper outbreaks occur.
Franklin's gull (S)	*Leucophaeus pipixcan*	Standard aquatic	Standard aquatic	This species forages and nests in wetlands. Pre-treatment surveys to ensure accurate buffering of seasonal water will be conducted to prevent treatment of potential habitat.

Grasshopper sparrow (S)	*Ammodra-mus savannarum perpallidus*	500/750 ft ground/air from edge of known locations	500/750 ft ground/air from edge of known locations	Treatments in Columbia Plateau ecoregion are feasible but infrequent, with none having occurred in the past 10 years. Grasshopper Sparrows are uncommon and locally distributed in Oregon. This species is a small insectivore. Buffers are generated based on bird size, prey type, and potential exposure to the insecticides.
Great grey owl (S)	*Strix nebulosa*	NA	NA	This species uses mid-elevation, late-successional forest mixed with montane grassland clearings, unlikely to have grasshopper outbreaks or be feasible for APHIS treatments.
Greater sage-grouse (GSG) (PT, PCH, S, SC)	*Centrocerus urophasianus*	1 mile from leks, 100 ft ground, 500 ft air from edge of occupied habitat	1 mile from leks, 100 ft ground, 500 ft air from edge of occupied habitat	Diet includes insects and sagebrush. Mitigation measures to protect leks from disturbance and any potential impacts from program applications to nesting and brood development and for known locations of adults will be followed in accordance with Sage-grouse Approved Resource Management Plan (GRSG ARMPA). Requesting land managers must consult with ODFW to ensure proposed projects conform with latest plan requirements. 1 mile buffers are for noise pollution, so applicable to all program traffic/activities including survey and environmental monitoring. Further buffering of suitable habitat may be required, as determined by land-manager to ODFW consultation.
Greater sandhill crane (S)	*Antigon canadensis tabida*	Standard aquatic	Standard aquatic	This species forages and nests in wetlands. Pre-treatment surveys to ensure accurate buffering of seasonal water are conducted to prevent treatment of potential habitat.
Juniper titmouse (S)	*Baeolophus ridgwayi*	NA	NA	This species is uncommon and locally distributed in Oregon, requiring expansive areas of mature juniper habitat, which has not corresponded with rangeland areas with pestiferous grasshopper outbreaks and treatment requests to APHIS.
Lewis's woodpecker (S)	*Melanerpes lewis*	None	None	See American three-toed woodpecker justification.
Loggerhead shrike (S)	*Lanius ludovicianus*	GSG mitigations	GSG mitigations	This species is linked to tall stands of sagebrush, which are typically excluded from treatments already due to Greater Sage Grouse protection measures. Treatments to suppress grasshoppers conducted by APHIS and the public do not eliminate or even substantially reduce grasshopper populations on a regional scale, making any reduction in prey site specific and not likely to adversely affect such a mobile species.
Long-billed curlew (S, SC)	*Numenius americanus*	Standard aquatic; Program limitations	Standard aquatic; Program limitations	This species forages and nests near wetlands and flood irrigated fields. APHIS Rangeland Grasshopper program does not treat crops including hay fields. Pre-treatment surveys to ensure accurate buffering of seasonal water will be conducted to prevent treatment of potential habitat.

Mountain quail (S, SC)	*Oreortyx pictus*	NA	NA	This species is found in shrubby, riparian sites in more rugged upland habitat than grasshopper outbreaks typically occur or are feasible to safely treat.
Olive-sided flycatcher (S)	*Contopus cooperi*	500/750 ft ground/air from edge of known locations	500/750 ft ground/air from edge of known locations	This species is a small insectivore. Buffers were generated based on bird size, prey type, and potential exposure to the insecticides.
Peregrine falcon (American) (S)	*Falco peregrinus anatum*	National Bald Eagle Manage-ment Guidelines, USFWS 2007	National Bald Eagle Manage-ment Guidelines, USFWS 2007	Effects on much of the prey of the falcon (small birds, insects, reptiles, and amphibians) are not expected. Mitigation measures were recommended to reduce the possibility of disturbance. To protect the falcon against disturbance, program personnel will determine whether a nest is present in an area prior to treatment by contacting the state wildlife agency and/or by visual inspection.
Pileated woodpecker (S)	*Dryocopus pileatus*	None	None	See American three-toed woodpecker justification.
Sagebrush sparrow (SC)	*Atemisiospiza nevadensis*	GSG mitigations	GSG mitigations	This species is linked to tall stands of sagebrush, which are typically excluded from treatments already due to Greater Sage Grouse protection measures.
snowy egret (S)	*Egretta thula*	Standard aquatic	Standard aquatic	This species nest in riparian areas with stout herbaceous vegetation, trees or shrubs, which are uncommon in rangeland areas prone to pestiferous grasshopper outbreaks. Pre-treatment surveys to ensure accurate buffering of seasonal water conducted to prevent treatment of potential habitat.
Swainson's hawk (S)	*Buteo swainsoni*	None	None	This is a highly mobile species with the largest migration pattern of any hawk, and buffering nesting sites to avoid disturbance as utilized for other raptor species does not seem to be an option. This species is not endangered overall, just rare in Oregon and California according to the USFWS. Use of pesticides to control grasshoppers and locusts is blamed for past reductions in populations, however the citation for this is for Argentina and DDT (which was banned in the US for over 50 years ago). Treatments to suppress grasshoppers conducted by APHIS and the public do not eliminate or even substantially reduce grasshopper populations on a regional scale, making any reduction in prey site specific and not likely to adversely affect such a mobile species.
Trumpeter swan (S)	*Cycnus buccinator*	Standard aquatic	Standard aquatic	Pre-treatment surveys to ensure accurate buffering of seasonal water will be conducted to prevent treatment of potential habitat.
Upland sandpiper (SC)	*Bartramia longicauda*	NA	NA	This species has a limited range in Oregon in small valleys of the Blue Mountains such as Logan Valley, Bear Valley, and around Ukiah, that will not be treated.

White-headed woodpecker (SC)	*Picoides albolarvatus*	None	None	See American three-toed woodpecker justification.
Willow flycatcher (S)	*Empidonax traillii*	500/750 ft ground/air from edge of known locations	500/750 ft ground/air from edge of known locations	See Olive-sided flycatcher justification.
Fishes:				
Borax lake chub	*Gila boraxobius*	NA	NA	This species was delisted from endangered status by USFWS in 2020. This species is in Borax Lake which is owned and managed by The Nature Conservancy. It is surrounded by miles of salt flats, which is not grasshopper habitat, so functionally not in program area.
Foskett speckled Dace	*Rhinichthys osculus*	100/750 ft ground/air	200/1320 ft ground/air	This species was delisted from threatened status by USFWS in 2019. This species is in Foskett Spring which is surrounded on one side by salt flats, which is not grasshopper habitat. No requests to APHIS for treatment near the spring has occurred, but if it did, enhanced aquatic buffers would be used.
Great Basin redband trout (S)	*Oncorhyn-chus mykiss newberrii*	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Pacific lamprey (S)	*Entosphenus tridentata*	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Pit sculpin (S)	*Cottus pitensis*	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Steelhead - summer / Columbia Basin rainbow trout (S)	*Oncorhyn-chus mykiss / gairdneri*	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Western brook lamprey (S)	*Lampetra richardsoni*	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Western river lamprey (S)	*Lampetra ayresii*	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Westslope cutthroat trout (S, SC)	*Oncoryhn-chus clarki lewisi*	100/750 ft ground/air	200/1320 ft ground/air	See bull trout justification.
Invertebrates:				

Monarch butterfly (PE, PCH)	*Danaus plexippus*	None	100/500 ft ground/air from edge of larval hosts	Conservation measures are being developed with USFS locally for this proposed endangered species focusing on buffering milkweeds, which is the obligatory host of larvae of this species. Carbaryl bait has no significant exposure pathway for lepidoptera, while diflubenzuron (an insect growth regulator) does not kill adult invertebrates that consume it. No PCH is being considered in potential program areas.
Suckley's cuckoo bumble bee (PE)	*Bombus suckleyi*	250/500 ft ground/air	750 ft/1 mile ground/air	Functionally not in potential program area. Figure 4 and 5 of the petition of this species shows that all occurrence data are in Type IV Ecoregions excluded from this EA, likely due to the reliance on rich meadow habitat and woodland interface that is described in the life-history section.
Mammals:				
American pika (S)	*Ochotona princeps*	NA	NA	Species occurs at higher elevations than where pestiferous grasshopper outbreaks occur.
California myotis (S)	*Myotis californicus*	NA	NA	Species associated with forests featuring large snags, which are not found near rangeland where pestiferous grasshopper outbreaks occur.
Fringed myotis (S)	*Myotis thysanodes*	NA	NA	Species associated with forests featuring large snags, which are not found near rangeland where pestiferous grasshopper outbreaks occur.
Hoary bat (S)	*Lasiurus cinereus*	NA	NA	Species associated with late-successional conifer forests, which are not found near rangeland where pestiferous grasshopper outbreaks occur.
Long-legged myotis (S)	*Myotis volans*	NA	NA	Species associated with late-successional conifer forests, which are not found near rangeland where pestiferous grasshopper outbreaks occur.
Pacific marten (S)	*Martens caurina*	NA	NA	Species associated with late-successional conifer forests, which are not found near rangeland where pestiferous grasshopper outbreaks occur.
Pallid bat (S)	*Antrozous pallidus*	None	None	This species has a broad range which may include rangeland where pestiferous grasshopper outbreaks occur. Emerging later than many bat species, they are nocturnal feeders, primarily gleaning adult arthropods and small lizards from the ground by detecting sounds of movement (Gervais 2016). Carbaryl bait and diflubenzuron are not likely to have direct or indirect impacts to this species, since foraging behavior and method targets larger, nocturnally active, primarily adult arthropods, not smaller, immature or inactive insects. Treatments to suppress grasshoppers conducted by APHIS and the public do not substantially reduce insect populations on a regional scale, making any reduction in potential prey site specific and not likely to adversely affect such a mobile species.
Pygmy rabbit (S)	*Brachylagus idahoensis*	GSG mitigations	GSG mitigations	This species is herbivorous and linked to dense stands of sagebrush, typically excluded from treatments due to Greater Sage Grouse protection measures.

Rocky Mountain bighorn sheep (S)	*Ovis candensis candensis*	NA	NA	This species requires more rugged terrain than where grasshopper suppression efforts are requested or feasible.
Silver-haired bat (S)	*Lasionycteris noctivagans*	NA	NA	Species associated with late-successional conifer forests, which are not found near rangeland where pestiferous grasshopper outbreaks occur.
Spotted bat (S)	*Euderma maculatum*	GSG mitigations	GSG mitigations	This species is linked to dense stands of sagebrush, which are typically excluded from treatments already due to Greater Sage Grouse protection measures, and more rugged terrain than where grasshopper suppression efforts are feasible.
Townsend's big-eared bat (SC)	*Corynorhinus townsendii*	NA	NA	Updated potential range for this species in Oregon excludes areas prone to pestiferous grasshopper outbreaks, partly due to strong surface water preference (Gervais 2017).
White-tailed jackrabbit (S)	*Lepus townsendii*	None	None	Mode of action of carbaryl bait and low toxicity of diflubenzuron make direct impacts to this herbivore unlikely. Indirectly it may benefit from reduced competition for bunchgrass and other food sources resulting from successful grasshopper suppression efforts.
Reptiles:				
Columbia mountain kingsnake (S)	*Lampropeltis zonata*	NA	NA	Known range does not include counties currently assessed for potential grasshopper treatments.
North-western pond turtle (PT)	*Actinemys marmorata*	100/750 ft ground/air	200/1320 ft ground/air	The range of this species extends from the Puget Sound lowlands in Washington through western Oregon and California, south to Baja California.
Western painted turtle (SC)	*Chrysemys picta bellii*	100/750 ft ground/air	200/1320 ft ground/air	The risk of each insecticide to listed taxa are discussed in national BA (Section IV). Estimates of exposure at the various distances proposed for each application method are intended to result in direct and indirect effects to listed reptiles that are considered insignificant and discountable. This is an aquatic species with minimal range overlap of a single county (Umatilla) currently assessed for potential grasshopper treatments.

b) Protective Measures for Terrestrial Animals

(1) General Protective Measures

APHIS implements best management practices (BMPs) in 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. 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.

(2) Greater Sage-Grouse, Centrocerus urophasianus

There is special concern about the role of grasshoppers as a food source for sage grouse and other insectivorous vertebrate species found in Oregon rangeland. Grasshopper suppression programs reduce grasshoppers and potentially non-target insects in the treatment area that are food items for such species, including sage grouse chicks. There is low potential that the program insecticides would be toxic to these populations, either by direct exposure to the insecticides or indirectly through eating moribund grasshoppers. Further, because grasshopper numbers are so high in outbreak years, and usually composed of just a few species, treatments would not likely reduce the number of grasshoppers below levels present in a normal year and may increase the diversity of herbivorous insects overall. What constitutes 'normal' grasshopper population levels will vary by location, but in general a diversity of grasshopper species at densities of 5 per square yard might be considered normal in many areas. Should grasshoppers be unavailable in small, localized areas, sage grouse chicks may catch what grasshoppers are available as well as other insects, which would be normal in naturally down-cycle years for grasshopper populations. 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 many other species of concern which utilize tall sage habitat extensively.

The Oregon Greater Sage-grouse Approved Resource Management Plan (GRSG ARMPA) of 2015 was developed in leu of listing this species under endangered species act protection and is overseen by the Oregon Department of Fish & Wildlife (ODFW) pursuant to state law (www.dfw.state.or.us/wildlife/sagegrouse/docs/OAR_140_Greater_Sage-Grouse_Cons_Strat.pdf). A summary of mitigation plans, policies and GIS tools is maintained at www.dfw.state.or.us/wildlife/sagegrouse/mitigation.asp, including the following map of habitat designations.

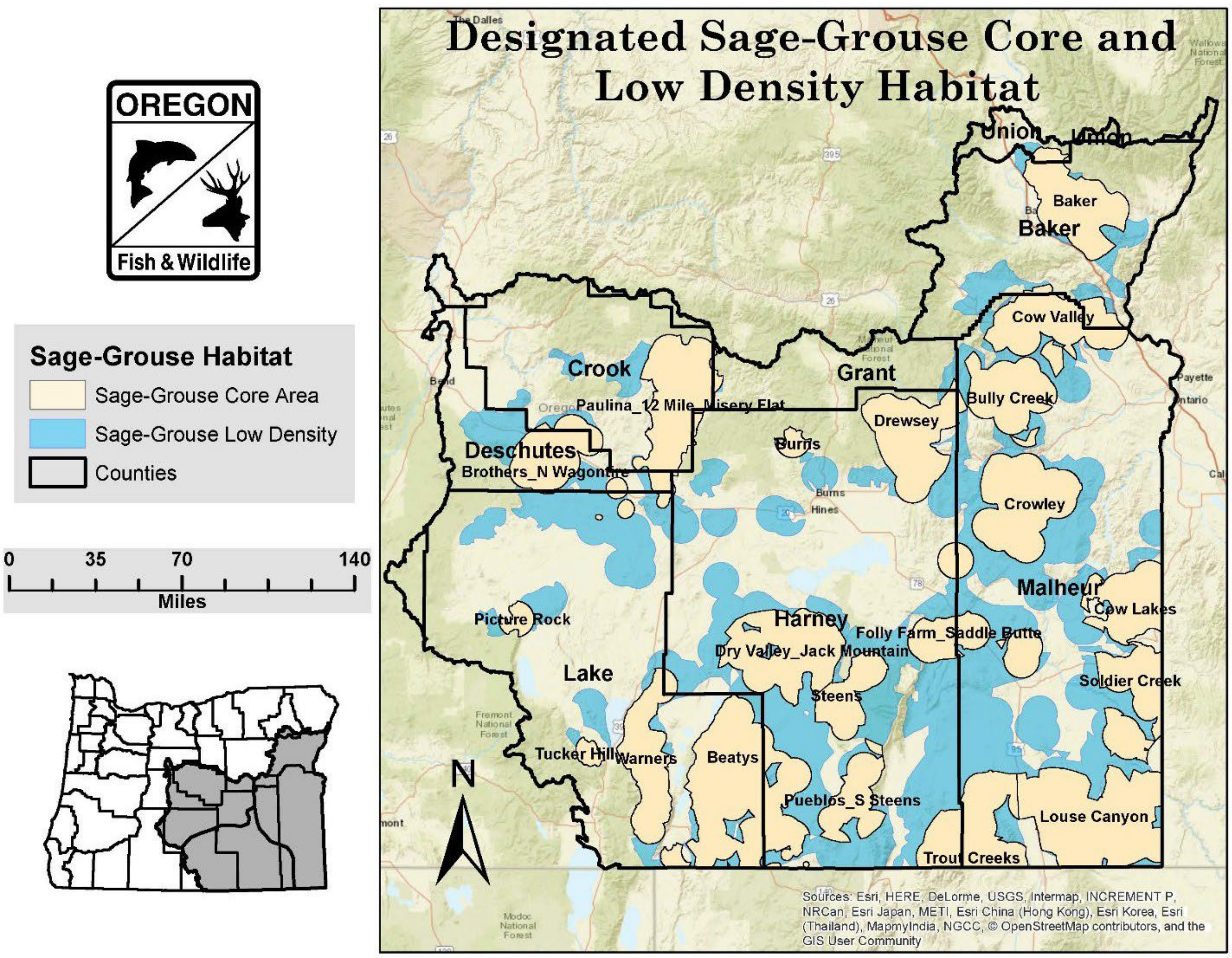


Figure 22. ODFW Designated Sage-Grouse Core and Low Density Habitat.

APHIS or requesting land managers are required to consult with ODFW to ensure that the latest protective measures proscribed by this plan are abided to for any APHIS treatments in Oregon. BLM has also requested that APHIS exclusively use Methylated Seed Oil (MSO) adjuvant which is a vegetable-based alternative to conventional crop oil concentrate, citing that this will minimize any impacts of this spreader agent contacting nesting bird eggs. This would be less of a concern for sage grouse in particular however, as part of the current BMPs utilized include very large operational buffers around any sage grouse leks due to prevent damaging noise pollution.

Mitigation measures to protect leks from disturbance and any potential impacts from program applications to nesting and brood development and for known locations of adults will be followed in accordance with GRSG ARMPA, including 1 mile activity buffer from leks (for noise pollution), and treatment buffer of 100 ft ground and 500 ft air from edge of occupied habitat. Requesting land managers must consult with ODFW to ensure proposed projects conform with latest plan requirements. Further buffering of suitable habitat may be required, as determined by land-manager to ODFW consultation which APHIS will help facilitate as necessary.

(3) Yellow-billed cuckoo, Coccyzus americanus

In Oregon, cuckoos, although never common, have become even rarer with the loss of floodplain forests along the Willamette and Columbia Rivers. The last confirmed breeding records in Oregon were in the 1940s. Records of cuckoos continued in eastern Oregon at Malheur National Wildlife Refuge in Harney county specifically, and from Malheur and Deschutes counties generally. Over the last 20 years however, more recent reports have come from western Oregon. Mature riparian stands on the east side such as on the Owyhee, Snake and Umatilla Rivers are expected to continue to have cuckoos reported. Two years ago, one was reported from Harney county at Fields.

Yellow-billed cuckoos are migratory. Historically, cuckoos arrived in Oregon in mid-May and flew south to their wintering grounds in September. The bird primarily eats large insects including caterpillars, cicadas, grasshoppers, and Mormon crickets. Breeding coincides with the emergence of cicadas and tent caterpillars.

The greatest threat to the species has been reported to be loss of riparian habitat. It has been estimated that 90 percent of this cuckoo's stream-side habitat has been lost. Habitat loss in the Western US is attributed to agriculture, dams, and river flow management, overgrazing and invasive plants such as tamarisk. Activities which alter or destroy riparian habitat are of particular concern, including unmanaged cattle grazing that contributes to the loss of sub-canopy vegetation and cottonwood regeneration.

APHIS grasshopper and Mormon cricket program activities may affect the yellow-billed cuckoo. While diflubenzuron and carbaryl are highly toxic to insects they are both only slightly toxic to birds. These chemicals should have no direct effect to the yellow-billed cuckoo, but they may cause a temporary reduction of prey species, though use of RAATs will help to mitigate this.

Yellow-billed cuckoo distribution has not been systematically surveyed in eastern Oregon in recent years, but the existing record of reports do indicate that Harney County has areas where observations are more likely to occur, especially in June and July. APHIS will confer with the USFWS to consult recent survey records or conduct surveys of high potential for nesting and foraging habitat prior to implementing the suppression program to determine locations of yellow-billed cuckoo nests or occupied habitat prior to treatment. In addition to this, or if this is not possible for any reason, the water buffers of 500’ for liquid insecticide and 200’ for bait when applied by air, 200’ for liquid applied by ground, and 50’ for bait when applied by ground, will be extended to begin at the edge of any riparian stands greater than 50 acres or larger, not just from the waterbodies present therein, and not exclusive to stands proven to have yellow-billed cuckoo populations present. Additionally, the RAATS application method is required when treating near known, or suspected, yellow-billed cuckoo habitat to preserve non-target insect prey, although that is also the only method considered in Oregon currently anyway. Implementation of these protective measures will assure that the APHIS Grasshopper Suppression Program will not likely adversely affect yellow-billed cuckoo.

(4) Monarch butterfly, Danaus plexippus

Monarch butterfly (*Danaus plexippus*) is proposed for endangered species status. In the Pacific Northwest, monarch butterfly adults migrate from overwintering sites in California to utilize seasonal habitat, including Oregon. Adult monarch butterflies feed on flower nectar from a wide range of plants. Any impacts from grasshopper treatments to adult monarchs therefore are likely to be a positive since grasshopper outbreaks can reduce flowering, with some species such as migratory and two-striped grasshoppers preferring forbs when available (Pfadt, 2002). Further, neither diflubenzuron nor carbaryl bait are expected to impact adult butterflies due to mode of action requiring ingestion. For larval development, monarch caterpillars are obligate to milky- sapped perennial plant in the dogbane family, primarily showy milkweed (*Asclepias speciosa*) in the counties considered in this EA. The planting and protection of this host species, coupled with and preventing spraying lepidoptera impacting pesticides, has been identified as an important tool for supporting monarch butterfly populations. Milkweed is common in much of the state, though not necessarily common in areas treated for grasshoppers. Although it is a drought-resistant plant in general, it is not thrifty enough to thrive in arid rangeland areas of the state where grasshopper outbreaks are most problematic. Since it is toxic to vertebrates, in many cases it has been managed against for decades in agricultural areas. As a result, incidences of milkweed in areas of Malheur and Harney County that have been treated for grasshoppers in are extremely limited, mostly occurring in small patches in roadside ditches, which is not ideal caterpillar habitat due to patch size limitations and disturbances caused by traffic, and would be buffered already if a state hi-way or interstate. Impacts caused by the program will further be limited by the infrequency and limited scale of treatments, coupled by the relative lack of obligate species habitat, however APHIS in Oregon will also work with land-managers to exclude any milkweed sites and buffer them as sensitive sites with standard program buffers.

c) Protective Measures for Aquatic Species

(1) General Protective Measures

The APHIS Grasshopper and Mormon Cricket Suppression Program does 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, APHIS provides the following standard aquatic buffers: 500-foot buffer with aerial liquid insecticide; 200 foot buffer with ground liquid insecticide; 200-foot buffer with aerial bait; and 50-foot buffer with ground bait.

These standard buffers are in place to reduce the chance that a pesticide used for grasshopper suppression will enter water. Monitoring of APHIS grasshopper treatments by Beyers and McEwen (1996) concluded that the standard buffer resulted in trace amounts of pesticide in aquatic habitats, and that grasshopper control operations had no biologically significant effect on aquatic resources.

However, APHIS recognizes that even trace amounts of pesticides entering locations inhabited by listed fish species may be of concern. Therefore, the standard buffers for carbaryl bait and diflubenzuron liquid applications have been increased in distance in order to protect listed fish species and their prey, that is no aerial application of liquid pesticides within 0.25 mile (1320 ft), 200 ft by ground; or 750 feet aerial carbaryl bait, 100 ft by ground of occupied habitats. For the buffers, where a listed fish species occupies habitat consisting of a stream or river the mitigation measures will apply for a distance of 500 feet upstream of the location or habitat for ground applications and 1,000 feet upstream for aerial applications.

Chronic effects to listed fish species are unlikely even assuming the worst case scenario because: 1) the insecticides APHIS uses are non-persistent in water; 2) APHIS applies only a single application of a single insecticide to a grasshopper treatment area only one time a year – there are no multiple treatments; 3) in the unusual case that APHIS would return to an area treated the previous year, any insecticides applied by APHIS would have degraded; and 4) the insecticide APHIS could use and at the application rate APHIS would apply, there are few, if any, chronic properties that could affect listed fish species.

There is also some potential for a very effective grasshopper treatment to affect listed fish species indirectly and adversely by reduction of prey base. RAATs will ensure that the suppression treatment does not suppress grasshoppers or non-target insects too severely. Additionally, normal treatment buffers for riparian areas will help to ensure a continued food source in the area to limit such indirect adverse effects.

(2) Bull trout, Salvelinus confluentus

"Bull trout have specific habitat requirements that are called the Four Cs; cold, clean, complex, and connected habitats. They are most common in high mountainous areas where snowfields and glaciers are present. They mainly occur in deep pools of large, cold, rivers and lakes" (https://www.fws.gov/species/bull-trout-salvelinus-confluentus). Such areas are not likely to have grasshopper outbreaks. This general lack of ecological and geographic overlap of potential program treatment areas, as well as the above-described general protection measures for waterbodies, and the enhanced buffers for known ESA fish species populations, should ensure treatments are not likely to adversely affect, either directly or indirectly.

(3) Hutton tui chub, Gila bicolor spp.

The Hutton tui chub is found in spring systems and outflow channels. The size of the Hutton Spring holes range from 20-40 feet in width, and about 15 ft in depth at its center. The smaller spring hole is about 10 feet across and 2 feet deep. The spring holes are surrounded by water parsley, sedge, saltgrass, and squirreltail, which the chub use for cover. No details of reproduction are known, except that fish of 17 millimeters (mm) have been seen in late July, which infers that spawning probably takes place in May or June.

The fish feed on zooplankton, insects, gastropods, and plants. Juvenile Hutton tui chubs feed on zooplankton of appropriate size, and apparently feed on small insects as well. At 50 to 60 mm in length, the fish's diet shifts toward plant material and they remain omnivorous, feeding on vegetation, insect, and gastropods.

It is found only in Hutton Spring, a small spring system with surface flow in two areas located in the now dry alkali lake in Lake County, South Central Oregon and in another small unnamed spring 3/8 mile southeast of Hutton Spring (3/8 Mile Spring)(USDOI, USFWS, 1998).

Threats to the populations of Hutton tui chubs includes pumping of water for agricultural irrigation from the springs which occurred in the past but has since decreased. Other threats include trampling of habitats by livestock and contamination of ground water by dispersal of chemicals from a nearby herbicide-manufacturing residue disposal site south of Hutton Spring.

Hutton Spring and 3/8 Mile Spring are located on private lands in Lake County. It is unlikely that the private landowner(s) would make a request to APHIS to apply pesticides on their lands around Hutton Spring or 3/8 Mile Spring, however if a treatment in the area did occur, standard program buffers would of course apply, whether the habitat was included in the treatment area directly or simply adjacent to it. The above-described general protection measures for waterbodies, and the added buffers for known ESA species populations, should ensure treatments are not likely to adversely affect, either directly or indirectly, Hutton tui chub populations.

(4) Lahontan cutthroat trout, Oncorhynchus clarkii henshawi

The Lahontan cutthroat trout is a lacustrine subspecies, which was isolated as a consequence of geologic change. Within southeastern Oregon, Lahontan cutthroat trout occur in Willow Creek and

Whitehorse Creek and their tributaries, which are within the Coyote Lake watershed which is within the larger Alvord Lake basin. In addition, Lahontan cutthroat trout were transferred to previously fishless streams flowing off the east side of the Steens and Pueblo Mountains. Willow Creek and one unnamed tributary stream to Willow Creek is the entire occupied Lahontan cutthroat trout habitat in the Willow Creek watershed. Whitehorse Creek, Little Whitehorse Creek, Sheepline Canyon Creek, Cottonwood Creek, Antelope Creek, Twelvemile Creek, and Doolittle Creek are tributaries to Whitehorse Creek which are either occupied or historic Lahontan cutthroat trout habitat. The streams into which Lahontan cutthroat trout were transferred on the east side of the Steens Mountains are Big Alvord Creek, Cottonwood Creek, Little Alvord Creek, McCoy Creek, Mosquito Creek, Pike Creek, and Willow Creek. In the Pueblo Mountains, Denio Creek and Van Horn Creek were planted with Lahontan cutthroat trout. Within the northern portion of the Quinn River watershed, Lahontan cutthroat trout are located in McDermitt Creek and its tributaries. Tributaries which are or historically were occupied by Lahontan cutthroat trout include McDermitt Creek, North Fork McDermitt Creek, Sage Creek, Line Canyon Creek, Corral Canyon Creek and Riser Creek. Lahontan cutthroat trout may have historically occupied Indian Creek; however, the current status of the population in Indian Creek is unknown.

During periods of high precipitation, Lahontan cutthroat trout are believed to ascend river or stream waterways to spawn in the gravel riffles, depositing fertilized eggs in the gravel sediment. Upon hatching, the young remain in that habitat for a time, feeding on aquatic invertebrates or insect larvae before migrating downstream.

The above-described general protection measures for waterbodies, and the added buffers for known ESA species populations, should ensure treatments are not likely to adversely affect, either directly or indirectly, Lahontan cutthroat trout populations.

(5) Lost River sucker, Deltistes luxatus and Shortnose sucker, Chasmistes brevirostris

Both the Lost River and shortnose suckers are lake dwelling species, but spawn in tributary streams or springs. Larval Lost River and shortnose suckers usually spend little time in tributary streams and migrate back to the lake shortly after their swim up. Larval sucker migration from the spawning sites can begin in May or June. After emigrating from the parental spawning sites in late spring, larval and juvenile Lost River and shortnose suckers inhabited near shore waters, primarily under 50 cm in depth.

The primary refuge for both species is Upper Klamath Lake, Klamath County, Oregon. Hybridized populations of both species are also known from the Lost River system and other nearby areas of Klamath County, Oregon. Both species also have been collected from J. C. Boyle Reservoir, Klamath County, Oregon. Shortnose suckers have also been collected in Winema National Forest of Klamath County from Lake of the Woods, although these were reportedly lost in 1952 during a fish eradication project aimed at other species.

The shortnose sucker (*Chasmistes brevirostris*) and the Lost River sucker (*Deltistes luxatus)* are restricted to the Klamath Basin of south central Oregon and north central California. The Upper Klamath Lake and its tributaries are the primary refuge for the species although both have been found in Copco Reservoir and Clear Lake Reservoir, California, and Boyle Reservoir, Oregon. Shortnose suckers have also been taken from Lake of the Woods, Oregon. Lost suckers have been found from Sheepy Lake, Lower Klamath Lake, and Tule Lake in California.

Forms of water manipulation, such as damming, instream flow diversion, draining of marshes, and dredging of the Upper Klamath Lake, have contributed to the widespread decline of both species. In addition, hybridization, competition and predation by exotic species, insularization of habitat, and water quality problems associated with timber harvest, removal of riparian vegetation, livestock grazing, and agricultural practices are also suggested as reasons for their decline.

The above-described general protection measures for waterways, and the added buffers for known ESA species populations, should ensure treatments are not likely to adversely affect, either directly or indirectly, shortnose sucker populations.

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(6) Warner sucker, Catostomus warnerensis

The species is endemic to the Warner Basin of south-central Oregon, with known populations that include: the Warner Lake Basin of south-central Oregon, Lake County, near the California/Nevada line, and Nevada portion of Twelvemile Creek, Nevada. It reported in portions of Crump and Hart Lakes; a spillway canal north of Hart Lake; Snyder Creek; Deep (=Warner) Creek; Honey Creek (above the dam at Plush, and at its mouth at Hart Lake); Twentymile Creek (between the south end of Warner Valley floor and the confluence with Twelvemile Creek); and Twelvemile Creek (immediately above and below the O'Keefe Diversion Dam) (Williams *et al.,* 1990).

The Warner sucker spawns over silt-free gravel substrate in low gradient streams. At least some young may move immediately into lakes, but this remains an outstanding question (Lee *et al.,* 1980). It has been threatened by water diversion structures, siltation of gravel beds used for spawning, and the introduction of exotic species which prey upon juveniles. A spreading labyrinth of irrigation ditches, dams, and canals now block the major creeks that feed the Warner Valley lakes thus disrupting spawning runs.

Understanding of this species complex, obligatory life-cycle and seasonal distribution within its limited range, continue to improve, as well as resulting proactive measures to support them:

"Relatively recent anthropomorphic alterations to the aquatic environment in the valley presents challenges to the species' ability to express the full suite of its life history characteristics. Recently, there has been a concerted effort among management agencies and landowners to provide fish passage through the numerous diversion dams and to screen irrigation canals in the valley. These changes, along with other habitat improvements, should help Warner Suckers better carry out all aspects of their life history" (ODFW, 2019).

Since this is a relatively dynamic species and science, any requests for APHIS treatments in the Warner Basin will require additional consultation from APHIS with land managers and wildlife experts to ensure that the latest population modelling is used for the enhanced ESA protection buffers around potential Warner sucker populations.

The above-described general protection measures for waterbodies, and the added buffers for known ESA species populations, should ensure treatments are not likely to adversely affect, either directly or indirectly, Warner sucker populations.

(7) Columbia Spotted Frog, Rana luteiventris

The Columbia spotted frog (*Rana luteiventris*) Great Basin Distinct Population Segment is known to occur in potential program counties of Lake, Harney, and Malheur, Oregon. USFWS has determined that protection under the Endangered Species Act is no longer warranted and has withdrawn the species from the candidate species list. However, USFWS is recommending protection measures of this species, similar to Oregon spotted frog (which does not occur in the counties covered by this EA). The program will work with USFWS to avoid areas occupied by Columbia spotted frog and to implement conservation objectives and protection measures recommended by USFWS and BLM prior to commencing with any treatment projects.

Program activities may affect spotted frogs, since direct toxic effects could occur to Spotted frogs should they be exposed to program insecticides. Further, indirect effects through loss of prey items could occur if program chemicals were to reach occupied habitat. The program maintains a standard 500 foot buffer from water for all aerial ULV treatments, a 200 foot buffer from water for all aerial bait treatments, a 200 foot buffer from water for all liquid ground treatments, and a 50 foot buffer from water for all ground bait treatments. These buffers are in place to reduce the chance that a pesticide used for grasshopper suppression will enter water. Monitoring of APHIS grasshopper treatments by Beyers and McEwen (1996) concluded that the standard buffer resulted in trace amounts of pesticide in aquatic habitats, and that grasshopper control operations had no biologically significant effect on aquatic resources.

APHIS will confer with USFWS to determine locations of spotted frog habitat prior to treatment and apply programmatic buffers to these and other water bodies. Implementation of these protective measures will assure that the program will not likely adversely affect spotted frog.

d) Protective Measures for Plant Species

(1) General Protective Measures

In consultations with USFWS, program activities in Oregon were concurred upon to not likely adversely affect: Applegate's milk-vetch, Greene's tuctoria, Howell's spectacular thelypody, Malheur wire-lettuce, slender Orcutt grass, slickspot peppergrass, and Spalding's catchfly. The national consultation which was concluded 2024 looked at potential impacts of various pesticides to pollinators and application methods and created mitigation measures specific to each ESA plant species, pesticide and application method. In Oregon, only RAATs application of Carbaryl bait or Diflubenzuron are applicable. For these, the primary concern is that ground equipment might physically damage ESA protected plants, requiring a 50 ft buffer. Pollinators are important for some plant species, but there is not a significant exposure pathway for the proposed pesticides to significantly impact pollination, and any potential impacts to pollinator populations in a given area are mitigated by the rarity of treatments and the use of RAATs. In Oregon in particular, no ESA plants are currently within dozens of miles of potential program areas, with the possible exception of Howell's spectacular thelypody, Malheur wire-lettuce, or Spalding's catchfly.

(2) Howell's spectacular thelypody, Thelypodium howellii ssp. spectabilis

Howell's spectacular thelypody is a biennial herb of the mustard family endemic to a small range in eastern Oregon. The plant is currently known from 11 sites (5 populations) ranging in size from 0.03 acres to 41.4 acres in the Baker-Powder River Valley in Baker and Union counties. The total occupied habitat for this species is approximately 100 acres, all of which is privately-owned. The entire extant range of this taxon lies within a 13 mile radius of Haines, Oregon.

Howell's spectacular thelypody occurs in moist, alkaline meadow habitats at approximately 3,000 feet to 3,500 feet elevation, usually in and around woody shrubs such as greasewood or rabbitbrush. Soils are pluvial-deposited alkaline clays mixed with recent alluvial silts and are moderately well-drained.

This taxon is threatened by a variety of factors including habitat destruction and fragmentation from agricultural and urban development; spring and early summer grazing by domestic livestock; competition from non-native vegetation; and alterations of wetland hydrology. Pollination is not considered a significant limiting factor for this species.

(3) Malheur wire-lettuce, Stephanomeria malheurensis

Malheur wire-lettuce is an annual herb of the aster family. It is threatened by drought, flood, and competition from non-native vegetation. The single known population (near Harney Lake) is not in an area feasible for treatment historically or currently but if that changes, standard aquatic buffers will be used around the known habitat.

(4) Spalding's catchfly, Silene spaldingii

The Spalding's catchfly is a long-lived perennial herb of the carnation family. It blooms from late June to August. The foliage is light to dense coverage with sticky hairs. Reproduction is by seed only; it has no rhizomes or other means of vegetative reproduction.

It is primarily restricted to mesic grasslands of the canyons and Palouse region of southeastern Washington, northwestern Montana, adjacent portions of Idaho and Oregon and into British Columbia. The areas that supported the Palouse grasslands are now extensively cultivated and approximately 98 percent of it has been lost to agriculture (94%), development, or other causes. Remaining populations of Spalding's catchfly are found in steep canyon grasslands or on the periphery of agriculture.

Threats to the species generally revolve around the loss of habitat, either to development or agriculture (specifically cultivation, the use of herbicides and grazing). In addition, the fragmented habitat that is available is threatened by the intrusion of invasive weeds. Pollination is not considered a significant limiting factor for this species.

4. Physical Environment Components

a) Geology and Soils

The Oregon Department of Geology and Mineral Industries hosts a highly-detailed interactive map at www.oregon.gov/dogami/geologicmap/Pages/index.aspx which is generalized in the Oregon Blue Book website with the following map (sos.oregon.gov/blue-book/) showing an abundance of volcanic, alluvial and lacustrine materials.

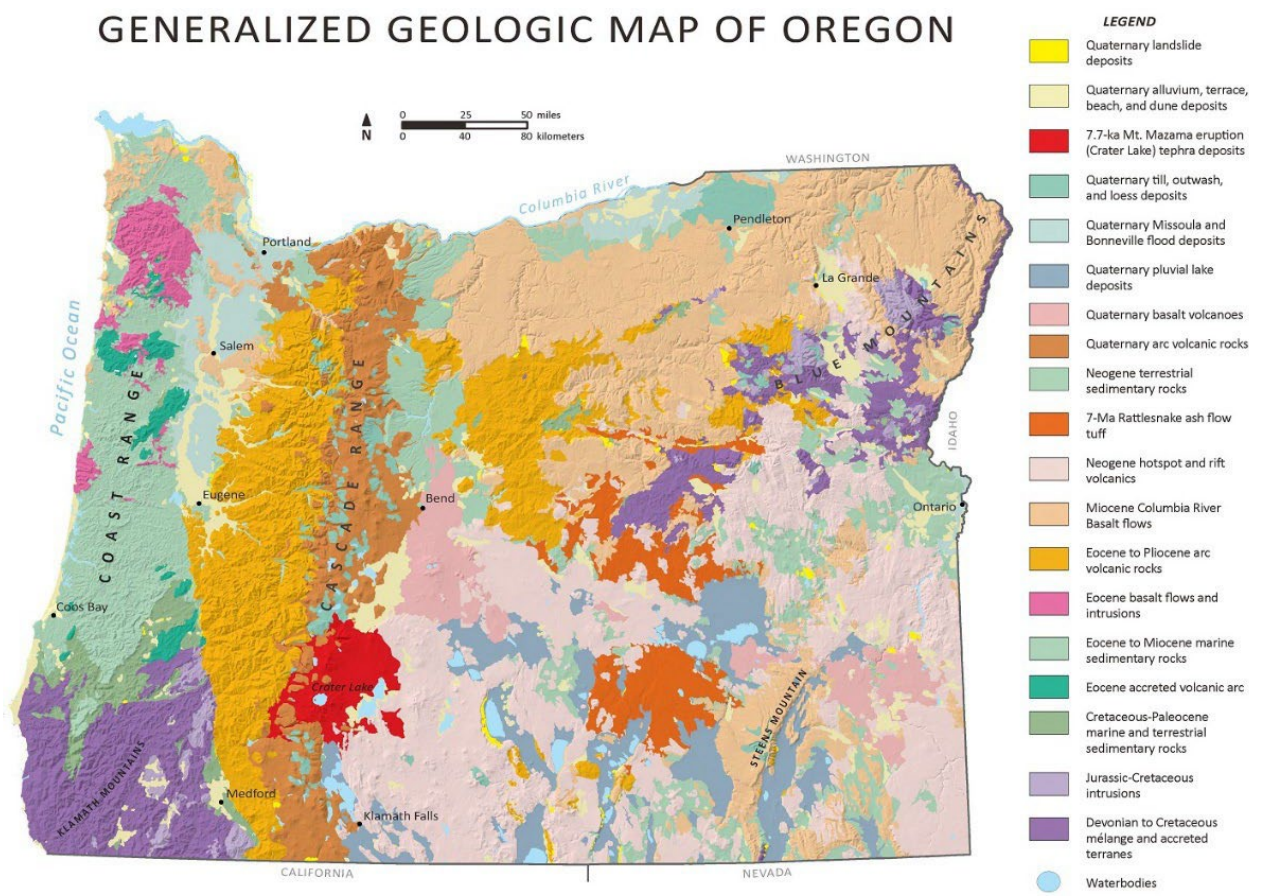

Figure 22. Generalized Geologic Map of Oregon.

In terms of soils, The Soils of Oregon by Thorson et al (2022) ranks the dominant soil orders in the counties listed in this EA as Mollisols followed by Aridisols. Of the Mollisols, which are loamy, fertile soils, Xerolls are the most abundant suborder in Oregon which the NRCS characterizes as, "the more or less freely drained Mollisols of regions that have Mediterranean climates. Xerolls are dry for extended periods in summer, but moisture moves through most of the soils in winter and is stored above the deep layers or above bedrock in normal years" (www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/mollisols).

In the SE corner of the state as well as the Pendleton area, Aridisols become dominant, which are alkaline, moisture limited soils, low in carbon concentrations, often associated with pluvial lakes. These soils require irrigation as a prerequisite for most agriculture but may naturally host prairie ecosystems where adequate seasonal moisture occurs.

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.

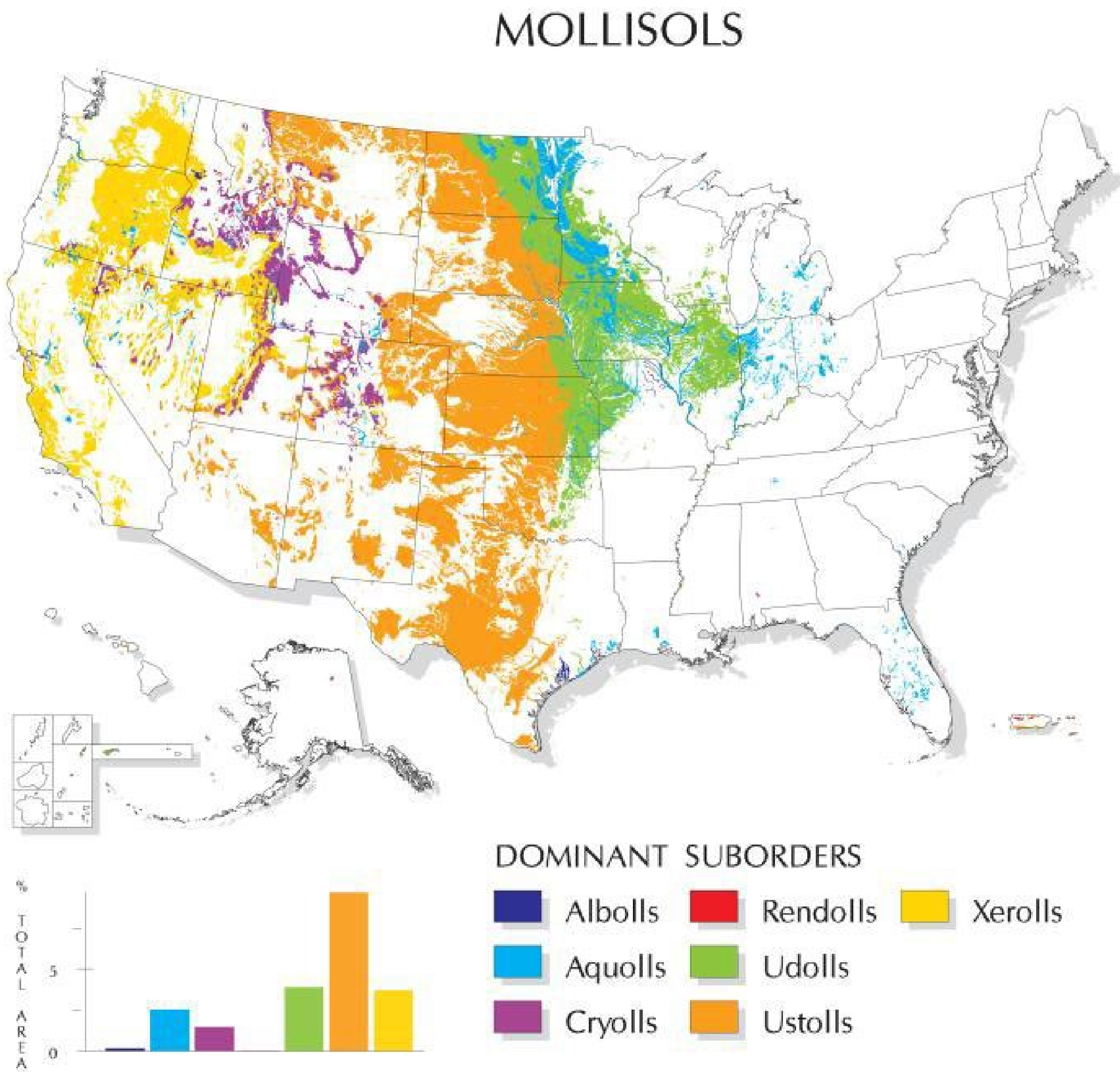

Figure 23. USDA NRCS Distribution Map of Dominant Mollisol Suborders.

b) Hydrology and Water Resources

Most watersheds in Oregon feed into to the Columbia River. For Baker and Malheur counties, this occurs via the Snake River by way of the Powder or Burnt River watersheds, or the Malheur or Owyhee River watersheds respectively. Most of Umatilla county drains into the Columbia via the Umatilla River, while Jefferson and Wasco counties do so via the Deschutes River. Rivers in Harney and Lake counties drain into pluvial lake basins, especially Malheur, Harney, Summer, Abert, Wamer and Goose lakes. National Rivers and Streams Assessments (www.epa.gov/national- aquatic-resource-surveys/nrsa) do appear to have utilized some sampling sites from Harney and Malheur counties and the Deschutes River watershed in their Xeric ecoregion report, as shown in their sampling sites map.

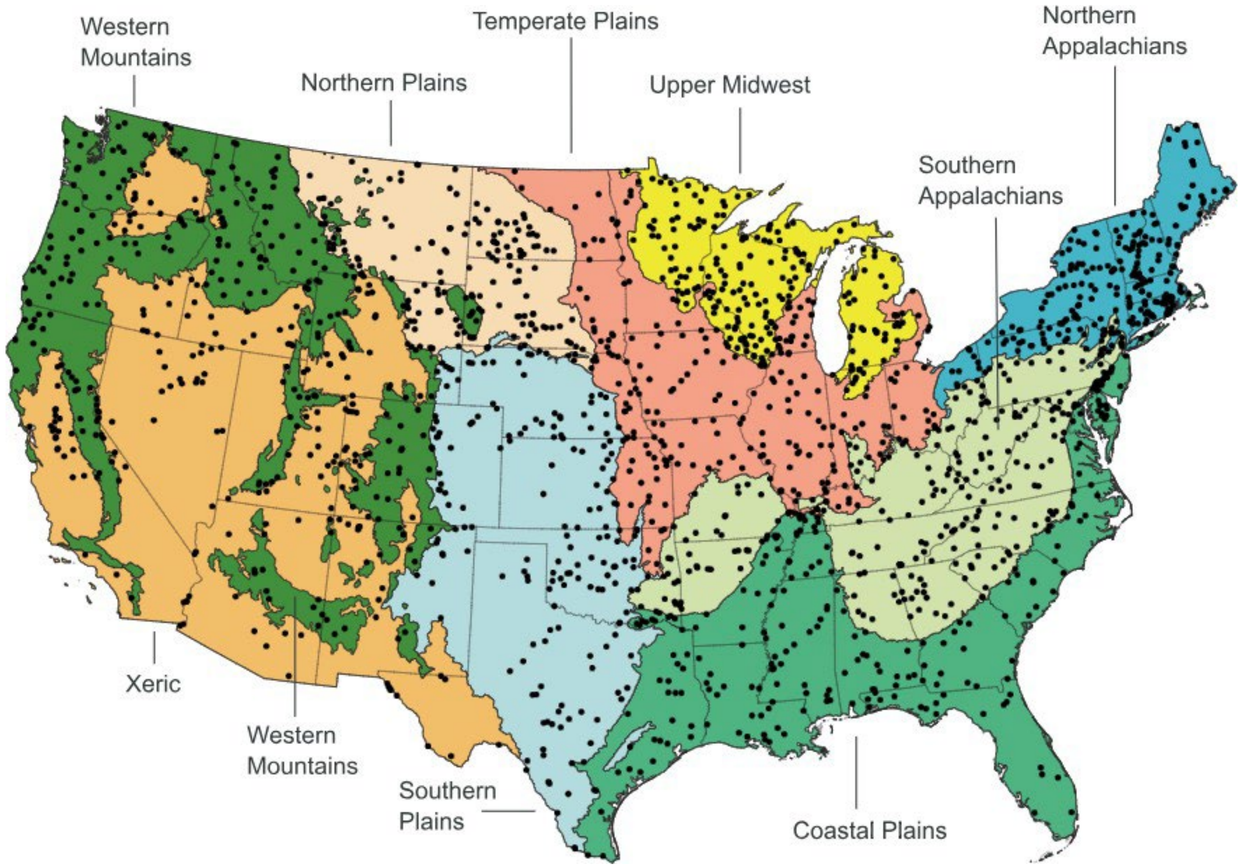

Figure 24. Map of NRSA 2018-19 Sampling Sites in Each Ecoregion

In the most recent assessments, only 24% of the 66,540 miles of waterways assessed in the Xeric region were in good biological condition, with widespread stressors cited as disturbance and excess nutrient runoff leading to toxic microcystins, with 71% of 9,370 lakes assessed having the same issue.

c) Air Quality and Climate

According to the Oregon Department of Environmental Quality, the whole state meets national health standards for air pollution, however smoke from wildfire can lead to unhealthy regional conditions. Attempts to manage smoke from proscribed burning is an ongoing area of focus and community coordinating. The climate of much of the state lends itself to wildfire, with a combination of moist winters and dry summers and strong winds that build in part between the cool Pacific Ocean coast and the semi-arid interior of the state. As the introduction of Soils of Oregon states, "The origin of the word 'Oregon' is disputed. However, three suggestions suggest that it originates from (1) the French Canadian word, ouragan, which means 'windstorm' after the chinook winds on the lower Columbia River; (2) orejón, meaning 'big ear,' after Indigenous Peoples living in the area; and (3) the spice, orégano, which grew in the territory." Precipitation in Oregon rangeland varies from 5 inches per year in the Alvord Desert, typically from local thunderstorms, as the tertiary rain shadow of Steens Mountain pulls away nearly all remaining moisture traveling from the Pacific, to a more typical 25 inches per year maximum, which falls primarily either in cool season or as summer thunderstorms.

5. 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 an important part of Eastern Oregon's economy and landscape. More than half the area is used for cropland or rangeland (Meacham et. al. 2001). Croplands are concentrated on the Columbia Plateau with other small, scattered pockets of mainly irrigated cropland in arable valleys. Crop growers in areas adjacent to possible suppression areas grow feed for dairies and feedlots as well as high value crop such as potatoes, sugar beets, wheat, barley, oats, hay, grass seed, and a variety of other crops. Grain production is concentrated on the Columbia Plateau. Umatilla county also produces alfalfa, corn, and potatoes. Central Oregon counties produce a variety of vegetable seeds, mint, grain, and hay. Malheur County is a major producer of seed crops, potatoes, onions and sugar beets. Tree fruit production is important in Wasco and Umatilla Counties (Bradbury 2001). Processing plants add value in several of the rural communities.

Livestock grazing is one of the primary uses of rangeland in the area, and is the dominate agricultural activity in many areas, including Harney and Lake Counties. 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.

There is a significant amount of acreage in organic production in the area. In 2019, there was 196,000 acres in production yielding $454,000 in sales statewide (USDA ERS).

Beekeepers maintain hives to produce honey and other bee products in central and eastern Oregon, especially near crop production areas. Alfalfa, seed crops, and tree fruits rely on pollination services from bees, including native bees, which may nest or forage on or near proposed suppression areas. Alfalfa leafcutting bees, *Megachile rotundata*, are intensively managed solitary bees used in the production of alfalfa seed.

Much of the land in the seven counties considered in this EA are publicly owned. They contain parts of Malheur, Umatilla, Wallowa-Whitman, Fremont-Winema National Forests which are administered by USDA Forest Service (USFS). (Grasshopper outbreaks have not been associated with these areas. USFS entomologists are aware of the APHIS grasshopper program, no requests for assistance have come from this federal land manager in Oregon.) USFWS administers the Hart Mountain National Antelope Refuge, Malheur National Wildlife Refuge (NWR), McKay Creek NWR, Cold Springs NWR, and Umatilla NWR. Currently, coordination with APHIS is limited to grasshopper survey and outreach only for any NWRs in Oregon. The BLM administers much of the public rangeland in the southeast and south-central part of Oregon.

Though typically not recreation destinations of note, the public may use some rangelands in the seven counties of Oregon included in this EA for a variety of recreational purposes including: hiking, horseback riding, camping, fishing, swimming, hot-springs soaking, astronomy, photography, general wildlife viewing and bird watching, insect, plant, rock or fossil collecting, archeology, hunting, shooting, archery, falconry, road or mountain biking, off-roading, and even rocketry. Members of the public may 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, though trails and roads are relatively sparse.

6. 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.

Cultural and historical sites include locations and artifacts associated with Native Americans, explorers, pioneers, religious groups and developers. Native American petroglyphs have been discovered in several areas within the proposed suppression area, as have artifacts from knapping (stone tool making). Elements of the Oregon Trail transect portions of the proposed suppression area, and monuments have been erected in several places. Museums, displays, and structures associated with mining, logging, Japanese internment camps, and irrigation development exist in Central and Eastern Oregon.

As described by the Oregon Secretary of State (sos.oregon.gov/), central and eastern Oregon includes sovereign tribal governments with land holdings and protected cultural rights, including:

The Confederated Tribes of Warm Springs has a reported tribal member population of 5,363 and a 1019 square mile reservation, primarily in Wasco and Jefferson counties.

The Confederated Tribes of the Umatilla Indian Reservation has 3,152 enrolled members and a 172,000 acre reservation in Umatilla county.

The Burns Paiute Tribe has 420 members, a 13,736 acre reservation in Harney county.

The Fort McDermitt Paiute-Shoshone Tribe's reservation straddles the Oregon-Nevada border, 18,829 acres are in Oregon in Malheur county.

The Klamath Tribes, 5,200 members, exercise court affirmed treaty rights within the 1954 former

Klamath Reservation Boundary, approximately 1.8 million acres in the northern half of the county. This area includes the Klamath Marsh National Wildlife Refuge and large portions of the Freemont-Winema Forests. In addition to treaty resources in this area, cultural resources and tribal traditional use areas extend beyond the 1954 Reservation Boundary to the aboriginal homelands of the Klamath Tribes.

The 1855 Treaty that created the Warm Springs and Umatilla Reservations reserved specific rights including the right to hunt and gather traditional foods and medicines on open and unclaimed lands. These rights are generally referred to as 'Treaty reserved rights' and extend to approximately 16.4 million acres of ceded land in Washington and Oregon.

Other Native Americans may practice traditional food and medicine gathering in or near proposed suppression areas.

7. Special Considerations for Certain Populations

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).

Children, along with the general populus, in or near rangeland areas likely to have grasshopper outbreaks and potential suppression treatments are quite low; and further would have all the protective measures that area standardized to protect humans from any program hazards, such as buffering of any houses, schools, churches or other areas of potential human congregation.

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, 2019bC). These Environmental Documents can be found at our program website: 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 Oregon the responsibility would rest with the BLM, Oregon Department of Agriculture, tribal or municipal governments and industry groups to coordinate and perform grasshopper control treatments. 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 or prophylactically treat areas with minimal survey efforts. 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 runoff, 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 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 bait or ULV 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 reduced pesticide rate and treatment area 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, 2009; 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 bait applications of the carbaryl 5% 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 proposed use of carbaryl 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 (2022) 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 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 in a preprint manuscript 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. They 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 $logK_{ow}$ value of 2.36 the chemical is less likely to adsorb and accumulate in lipid-rich plant tissues such as cuticular waxes or pollen. A chemical's ionizability is given as pK_a, the pH at which a chemical is 50% ionized, or in equilibrium between its undissociated and ionized state (calculated as the negative base-10 logarithm of the acid dissociation constant at 25°C). Chemicals with 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 (2019) 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 hours 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, 2017) have suggested that one difference between a healthy colony and a colony suffering from colony collapse disorder can be a decrease in *Alphaproteobacteria* in gut bacterial communities.

Lastly, there were other bacteria that are not commonly found in the gut microbiota of 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 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) 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, 2019b; USEPA, 2018).

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

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

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

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

Diflubenzuron is moderately toxic to spiders and mites (USDA APHIS, 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 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 LD_{50} value for the honeybee, *Apis mellifera*, is reported at greater than 114.8 μg a.i./bee while the oral LD_{50} 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 and Thompson et al 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 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 in 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 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).

c) Reduced Area Agent Treatments (RAATs)

The use of RAATS is the standard methodology used by APHIS in Oregon. 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 (carbaryl bait 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 or less following the RAATs strategy. APHIS would apply a single treatment per year to affected rangeland areas to suppress grasshopper outbreak populations.

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

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VI. Listing of Agencies and Persons Consulted

Bureau of Land Management
Grace Haskins
Invasive Species Program Lead OR/WA
1301South G St.
Lakeview, OR 97630

Oregon Department of Agriculture
Todd Adams, Field Operations and Survey Lead
30588 Feedville Rd.
Hermiston, OR 97838

Thomas Valente, State Entomologist
635 Capitol St NE
Salem, OR 97301-2532

U.S. Fish and Wildlife Service
Jackie Cupples
Wildlife Biologist
U.S. Fish and Wildlife Service
3502 Highway 30
La Grande, OR 97850

Appendix A: APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program Treatment Guidelines

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 availability, the Federal government will bear the cost of treatment up to 100 percent on Federal and Tribal Trust land, 50 percent of the cost on State land, and 33 percent of cost on private land. There is an additional 16.15% charge, however, on any funds received by APHIS for federal involvement with suppression treatments.
6. Land managers are responsible for the overall management of rangeland under their control to prevent or reduce the severity of grasshopper and Mormon cricket outbreaks. Land managers are encouraged to have implemented Integrated Pest Management Systems prior to requesting a treatment. In the absence of available funding or in the place of APHIS funding, the Federal land management agency, Tribal authority or other party/ies may opt to reimburse APHIS for suppression treatments. Interagency agreements or reimbursement agreements must be completed prior to the start of treatments which will be charged thereto.
7. There are situations where APHIS may be requested to treat rangeland that also includes small areas where crops are being grown (typically less than 10 percent of the treatment area). In those situations, the crop owner pays the entire treatment costs on the croplands.

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

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

Operational Procedures

GENERAL PROCEDURES FOR ALL AERIAL AND GROUND APPLICATIONS

1. Follow all applicable Federal, Tribal, State, and local laws and regulations in conducting grasshopper and Mormon cricket suppression treatments.
2. Notify residents within treatment areas, or their designated representatives, prior to proposed operations. Advise them of the control method to be used, proposed method of application, and precautions to be taken.
3. One of the following insecticides that are labeled for rangeland use can be used for a suppression treatment of grasshoppers and Mormon crickets:
    1. Carbaryl (solid bait or ultra-low volume (ULV) spray)
    2. Diflubenzuron ULV spray
    3. Malathion ULV spray
    4. 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).

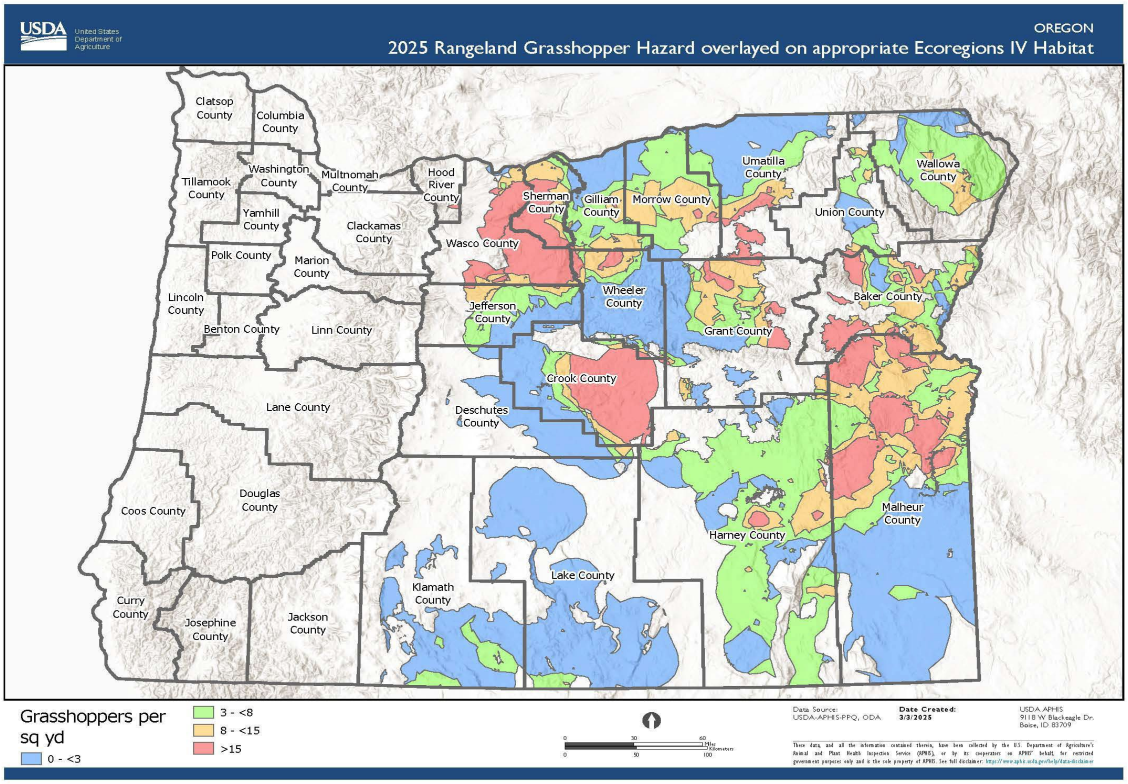
2. Minimize the potential for drift and volatilization by not using ULV sprays when the following conditions exist in the spray area:
   a) Wind velocity exceeds 10 miles per hour (unless state law requires lower wind speed);
   b) Rain is falling or is imminent;
   c) Dew is present over large areas 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.

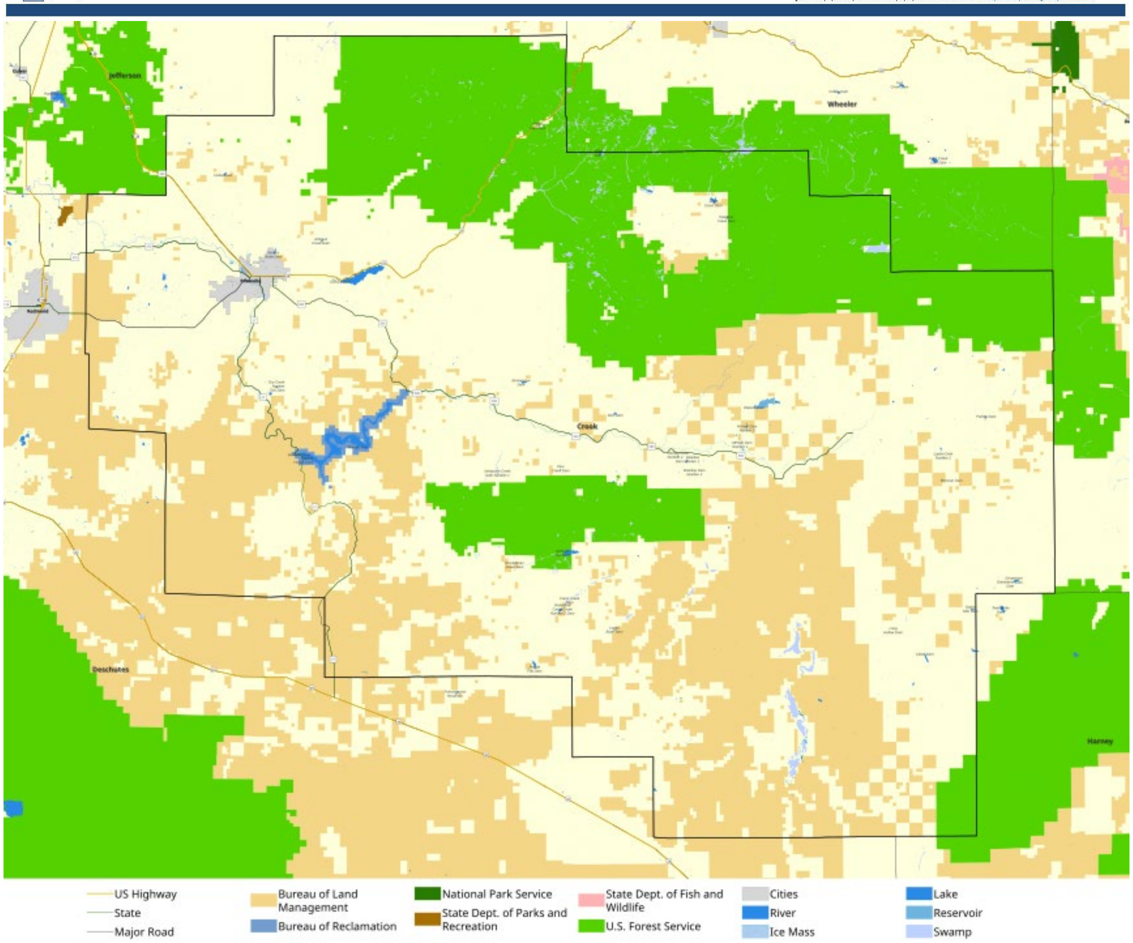
3. Weather conditions will be monitored and documented during application and treatment will be suspended when conditions could jeopardize the correct spray placement or pilot safety.

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





Credit: LaMamelle https://commons.wikimedia.org/w/index.php?curid=129192699

Appendix C: USFWS/NMFS Correspondence

Contents:

1) NMFS consultation Letter of Concurrence available on request.
2) National USFWS consultation Letter of Concurrence – Page 112
3) Local USFWS consultation Letter of Concurrence – Page 134

The comprehensive non-target species table, listing consultation status, determinations, justifications and mitigations, was intended to be included but cannot be made section 508 compliant due to its size and therefore cannot be published. It is available by request by emailing: SM.ORGHOP@USDA.gov

United States Department of the Interior

FISH AND WILDLIFE SERVICE

5275 Leesburg Pike
MS-ES
Falls Church, Virginia 22041

In Reply Refer To:

FWS/AES/DER/BNC/080572
2024-0053674-S7

Tracy Willard

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

Dear Ms. Willard:

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

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

Description of the Proposed Action

The intent of APHIS’ Program is to reduce populations of various species of grasshoppers and Mormon crickets on rangeland in Arizona, California (partial), Colorado, Idaho, Kansas, Montana, Nebraska, Nevada (partial), New Mexico, North Dakota, Oklahoma (partial), Oregon (partial), South Dakota, Texas (partial), Utah, Washington (partial), and Wyoming. Chemical treatments include a seasonal one-time treatment of diflubenzuron, carbaryl, malathion, or chlorantraniliprole which can be applied from the ground or air. All four chemicals are applied at substantially reduced rates, compared to their recommended label uses, and are applied over an entire treatment area/spray block, or in alternating swaths within a treatment area/spray block.

Decisions to conduct grasshopper treatments are based on many factors including the number of grasshoppers present in the area, grasshopper and plant species composition, life-cycle stage of the grasshoppers, range condition, the economic significance of the infestation, and whether it is economically and logistically feasible to conduct an effective program.

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

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

Best Management Practices (BMPs)

Surveys

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

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

The survey data collected by the program is used by the agency and land managers/owners to assess whether treatments are warranted. Treatments must be requested from a Federal land management agency or a State agriculture department (on behalf of a State or local government, or private group or individual) that has jurisdiction over the land before APHIS can begin a treatment (USDA, 2024). Upon request, APHIS personnel conduct a site visit to determine whether APHIS action is warranted (USDA, 2024). Relevant factors influencing this decision may include, but are not limited to, the pest species, timing of treatment relative to the biological stage of the pest species, costs and benefits of conducting the action, and ecological impacts (USDA, 2024). Based on survey results conducted during the growing season, APHIS is better able to predict the potential for large grasshopper populations and to respond quickly before extensive loss occurs to rangeland (USDA, 2024). Thus, State and Federal officials may initiate early coordination of local programs and request APHIS’ assistance in a timely and effective cooperative effort (USDA, 2024).

Insecticide Application

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

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

Buffers and Conservation Measures

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

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

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

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

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

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

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

Exposure

Observed Residue Values from Program Applications

Monitoring data from drift cards collected from 2003 to 2022 was reviewed and compared to modeled data to determine if the drift assumptions were representative of the drift expected from the Program applications. Drift card data provides a standardized unit of measurement (mg/m^2) to compare with the outputs of terrestrial deposition estimates in AgDrift. The drift card comparisons are made primarily with diflubenzuron as this is the preferred active ingredient to be used for the Program activities, and thus, there are data to address the drift assumptions.

Aquatic residues from the monitoring data are also summarized but are not able to be compared to AgDrift outputs due to difficulties with quantifying the waterbody types, sizes, and flow regimes.

Modeling Estimates for all three pesticides using AgDrift

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

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

Residue Estimates for Terrestrial Non-Target Organisms

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

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

Effects of the Action

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

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

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

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

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

Carbaryl

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

Aquatic Species

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

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

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

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

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

Terrestrial Species

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

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

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

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

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

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

Chlorantraniliprole

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Diflubenzuron

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

Aquatic species

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

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

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

Terrestrial species

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

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

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

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

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

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

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

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

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

Toxicity of metabolites of carbaryl, chlorantraniliprole, and diflubenzuron

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

Risk Assessment and Effects Determinations

Aquatic Species

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

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

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

Terrestrial Species

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

To assess the acute and chronic risk to birds the most sensitive acute and chronic endpoints were used and compared to residue values on respective dietary items (based on the size of the bird), estimated using T-REX calculations discussed on pages 69, 78, and 84 to generate RQ values.

RQs greater than 1 were reduced by implementing the proposed buffers to address impacts from program insecticides. For carbaryl, which shows a slight acute risk to birds that consume contaminated prey (see Table 4-5 p. 70 in the BA), additional buffers for carbaryl applications were applied for known locations of adults (see Appendix A–9).

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

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

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

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

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

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

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

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

Risk of adverse effects to terrestrial plants from all three APHIS program insecticides is considered minimal. Based on the available toxicity data discussed above for carbaryl, chlorantraniliprole, and diflubenzuron, phytotoxic effects are not anticipated from program insecticide applications. However, potential indirect effects of carbaryl on pollinators is considered. As discussed above in the Effects of the Action section for carbaryl and terrestrial invertebrates, laboratory studies have indicated several species of honeybees and bumblebees are sensitive to carbaryl, but these are at rates above those used in the program, and effects have not been measured extensively in field studies. One study based on a carbaryl application rate of

0.80 lb a.i./acre in a fruit orchard indicated no effects on honeybee mortality or behavior 7 days post application. Any potential impacts to honey bees or bumble bees may also be mitigated by the reduced application rates for the program, the RAATs (alternating swaths where the insecticide is applied), as well as use of carbaryl bait as opposed to ground or aerial spray applications (Peach, Alston, & Tepedino, 1994), (Peach, Alston, & Tepedino, 1995).

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

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

Bait Applications of Carbaryl

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

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

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

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

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

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

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

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

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

Critical Habitat

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

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

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

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

Summary and Conclusion

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

Aquatic Species

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

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

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

*ULV = ultra-low volume

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

Terrestrial Species

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

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

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

*ULV = ultra-low volume

Bait Applications for Carbaryl

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

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

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

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

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

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

Sincerely,

Jane Ledwin

Chief, Branch of National Consultations
Ecological Services Program

Enclosures

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Bend Field Office
63095 Deschutes Market Road

Bend, Oregon 97701

March 28, 2022

File Number: 2022-IC-0018
File Name: APHIS Grasshopper Suppression Program 2022
TS Number: TS22-281
Doc Type: Final

Colin Park, Plant Health Safeguarding Specialist
USDA, APHIS, PPQ

6035 NE 78th Court, Suite 100

Portland, Oregon 97218

Subject: Concurrence on the effects to listed species and critical habitat from Oregon Grasshopper Mitigation by USDA APHIS PPQ

Dear Mr. Park:

The U.S. Fish and Wildlife Service (Service) has reviewed the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service's (APHIS) Plant Protection and Quarantine (PPQ) program's request for concurrence that the Grasshopper Mitigation Program (Program) *may affect but is not likely to adversely affect* species or habitats listed under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.; Act). Your March 7, 2022 request for informal consultation and accompanying biological assessment (Assessment; APHIS 2022) was received by the Service on the same day. The species and their critical habitats subject to informal consultation pursuant to section 7 of the Act are presented in Table 1 below.

APHIS also determined that implementation of the Program will have no effect on the following species: Canada lynx (*Lynx canadensis*), Gray wolf (*Canis lupus*), Northern spotted owl (*Strix occidentalis caurin*), Gentner's fritillary (*Fritillaria gentneri*), MacFarlane's four-o'clock (*Mirabilis macfarlanii*), Malheur wire-lettuce (*Stephanomeria malheurensis*), Whitebark pine (*Pinus albicaulis*), Slender Orcutt grass (*Orcuttia tenuis*), and Green's Tuctoria (*Tuctoria greenei*). The regulations implementing section 7 of the Act do not require the Service to review or concur with no effect determinations. However, the Service acknowledges that the basis for these no effect determinations is clear and reasonable.

APHIS also included protective measures for formerly designated candidate species (greater sage-grouse, *Centrocercus urophasianus* and the Columbia spotted frog, *Rana luteiventris*); and recently delisted species (Borax Lake chub, *Gila boraxobius* and Foskett speckled dace, *Rhinichthys osculus*). Legally, APHIS does not have to implement conservation recommendations for candidate and non-listed species; however, addressing these species at this stage of consultation may minimize or avoid adverse effects to the species and may avert potential future conflicts.

Table 1. This list includes federally-listed species and their proposed or designated critical habitat, where applicable, for which APHIS has determined that implementation the Program may affect, but is not likely to adversely affect.

Species	Status	Critical Habitat
Western DPS of Yellow-billed cuckoo (*Coccyzus americanus*)	Threatened	No Critical Habitat Designated in Oregon
Oregon spotted frog (*Rana pretiosa*)	Threatened	Final Designated
Lahontan cutthroat trout (*Oncorhynchus clarkii henshawi*)	Threatened	No Critical Habitat Designated
Hutton tui chub (*Gila bicolor* spp.)	Threatened	No Critical Habitat Designated
Warner sucker (*Catostomus warnerensis*)	Threatened	Final Designated
Lost River sucker (*Deltistes luxatus*)	Endangered	Final Designated
Shortnose sucker (*Chasmistes brevirostris*)	Endangered	Final Designated
Bull trout (*Salvelinus confluentus*)	Threatened	Final Designated
Applegate's milk-vetch (*Astragalus applegatei*)	Endangered	No Critical Habitat Designated
Howell's spectacular thelypody (*Thelypodium howellii* ssp. *spectabilis*)	Threatened	No Critical Habitat Designated
Spalding's campion (*Silene spaldingii*)	Threatened	No Critical Habitat Designated

In November 2019, APHIS published an updated Environmental Impact Statement (EIS) document, from the original 2002 EIS, concerning suppression of grasshopper (*Camnula pellucida*) and Mormon cricket (*Anabrus simplex*) populations in 17 western states, and incorporated the available data and analysis of the environmental risk of new program tools. The EIS described the actions available to APHIS to reduce the damage caused by grasshopper populations in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. APHIS includes discussion of information cited in the 2019 EIS and refers to it as "incorporated by reference" in the Assessment. The Service would like to clarify that the Service is not concurring on the 2019 EIS proposed action. The reference to the 2019 EIS is for informational purposes only and not as a request for consultation on that proposed action.

The proposed action which is being consulted on, is the "Site-Specific Environmental Assessment Rangeland Grasshopper and Mormon Cricket Suppression Program - Oregon" (OR-22-01) prepared by APHIS (EA) which describes site specific issues related to potential grasshopper suppression programs. The described action is located in Baker, Crook, Deschutes, Gilliam, Grant, Harney, Jefferson, Klamath, Lake, Malheur, Morrow, Sherman, Umatilla, Union, Wallowa, Wasco, and Wheeler counties of Oregon. Cropland of any kind (including lands enrolled in the Conservation Reserve Program) is not eligible for treatment under this Assessment. Implementation of the Program will only be conducted when potential economically damaging populations of grasshoppers occur, funding exists, there is a written request from the land manager(s), and APHIS determines that treatment is necessary.

After several coordination meetings between APHIS and the Service prior to the informal consultation conducted in 2003, APHIS developed a proposed action with protective buffers designed to prevent application of pesticides within a prescribed distance of federally-listed species to prevent effects from spray application. In order to implement the avoidance buffers, APHIS will need to survey for certain species whose distributions are unknown or poorly understood. Such surveys are not likely needed for fish species or frogs for whose distributions are limited to specific habitats such as waterways, or plants that are sessile and whose distributions are well known. Since yellow-billed cuckoo distribution is not well understood or unknown in the project area, APHIS will confer with the Service to consult recent survey records or conduct surveys of high potential for nesting and foraging habitat prior to implementing the suppression program.

PROPOSED ACTION

The proposed action is a statewide program for grasshopper and Mormon cricket suppression activities described in the site-specific EA (OR-22-01) tiered to the 2002 EIS. APHIS treatment programs also follow the Treatment Guidelines (included in the EA) and the Grasshopper Program Statement of Work (or Prospectus) developed by APHIS. Suppression treatments are typically implemented from May through early June. Treatments later in the growing season are strongly discouraged due to lack of effect for the available pesticides in the Program, as well as a greatly reduced likelihood of preventing damage in the current year. However, treatments may still be advisable with sites or grasshopper populations exhibiting unusual phenology and will be considered on a case-by-case basis through July and into August.

The chemical control methods used by APHIS include the use of liquid sprays of diflubenzuron and a bait formulation of carbaryl, applied at conventional rates and as reduced agent area treatments (RAATs). The preferred chemical control methods for treatment of grasshoppers in Oregon by APHIS PPQ include the use of liquid spray diflubenzuron and carbaryl in a bait formulation applied as RAATs.

Under this Program, APHIS would make a single application per year to a treatment area and could apply insecticide at rate conventionally used for grasshopper suppression treatments, or more typically as RAATs. APHIS will select which insecticides and rates are most appropriate for suppression of a grasshopper outbreak based on several biological, logistical, environmental, and economical criteria. The identification of grasshopper species and their life stage largely determines the choice of insecticides used among those available to the program. RAATs are the most common application method for all program insecticides, and only rarely do rangeland pest conditions warrant full coverage and higher rates. Under this Program, carbaryl or diflubenzuron would cover all treatable sites within the designated treatment block per label directions, typically at the following application rates:

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

Insecticide applications at conventional rates and complete area coverage, is an approach that APHIS has used in the past but is currently uncommon. Under this Program, carbaryl bait or diflubenzuron would cover all treatable sites within the designated treatment block per label directions. The application rates under this Program are typically at the following application rates:

- 10.0 pounds (0.50 lbs. a.i.) of 5 percent carbaryl bait per acre;
- 2.0 fluid ounce (0.032 lbs. a.i.) of diflubenzuron per acre.

Starting in 2017, APHIS removed the use of malathion from the proposed action based on review of recent information and the Environmental Protection Agency's (EPA) January 2016 Assessment regarding the environmental effects of malathion (Lentz 2017, *in litt)*. Additionally, APHIS is suspending their investigation of the use of chlorantraniliprole, which was included on a provisional basis in the 2020 Assessment (Park 2021, *in litt*). Thus, chlorantraniliprole will not be considered for use in the program in 2022 and is not included in this consultation. Service concurrence is limited to the use of liquid diflubenzuron and carbaryl bait as described in the proposed action in APHIS' 2022 Assessment.

The proposed action maintains a standard, programmatic 500 foot buffer from water for all aerial ultra low volume (ULV) treatments, a 200 foot buffer from water for all aerial bait treatments, a 200 foot buffer from water for all liquid ground treatments, and a 50 foot buffer from water for all ground bait treatments. These standard buffers are in place to reduce the chance that a pesticide used for grasshopper suppression will enter water. In order to protect listed plant species, APHIS will implement the following measures from the edge of known listed plant species locations: a 3 mile buffer for aerial applications will be used for from known locations of listed plant species. Carbaryl bait ground application may be used up to 50 feet from the edge of known locations of listed plant species.

EFFECTS TO FEDERALLY LISTED WILDLIFE AND THEIR CRITICAL HABITAT

The buffers are mandatory as part of the proposed action and are designed to avoid contamination of federally-listed species habitats. APHIS's assessment concludes the buffers reduce or eliminate the potential for direct exposure to the federally-listed species and reduces the chance of indirect effects being substantial enough to adversely affect the federally-listed species. The buffers were not derived by specific impact and distance data, but are based on field tests demonstrating the absence of detectable levels of chemical. APHIS's determination is the Project's protective measures reduce the potential effects of the action to the point that the effects are insignificant or the probability of adverse effect is discountable and therefore the project may affect but is not likely to adversely affect the federally-listed species listed in Table 1.

CONCURRENCE

The Service reviewed the Project described in the Assessment in accordance with section 7(a)(2) of the Act. Based on the Service's review of the Assessment and other information, we concur with APHIS's determination that the Program actions proposed for 2022, in 17 counties of Oregon (described previously) may affect, but are not likely to adversely affect the 11 endangered and threatened species listed in Table 1, nor their designated critical habitats, where applicable.

Our concurrence with your "not likely to adversely affect" determination for threatened and endangered species is based on the conservation measures that will be incorporated into the action. Risk of adverse effects to the federally-listed species listed in Table 1 is minimal due the following factors as described in the proposed action:

1. All applicable Federal, State, Tribal, and local environmental laws and regulations will be followed in conducting suppression activities.

2. Information displayed in the Assessment on effects from application of diflubenzuron and carbaryl support the conclusion that adverse effects to federally-listed species are avoided under the proposed action. APHIS will restrict or avoid insecticide applications such that indirect effects to federally-listed species and their habitats will be insignificant and discountable.

3. APHIS will avoid applying pesticides in areas of known or potentially occupied threatened and endangered species habitat to reduce direct and indirect effects consistent with Table 2 of the Assessment. Potential indirect effects described in the Assessment include reductions in insect prey for local populations of birds, impacts to aquatic environments, and effects on plant productivity from reductions in non-target pollinator insect populations.

4. Pesticides will not be applied in areas known to have a high water table, or where sub surface leaching is likely. Carbaryl bait will not be applied within 500 feet of any water which contains threatened and endangered species at any time. Designated critical habitat that is currently unoccupied would be treated as occupied habitat unless otherwise directed by the Service prior to treatment.

5. Aerial spray applications of diflubenzuron or carbaryl will not be conducted within 0.5 mile of any flowing or standing water which contains threatened and endangered fish species at any time. Aerial spray applications will not occur within 500 feet of occupied Oregon spotted frog habitat at any time. Ground application of diflubenzuron or carbaryl, will not be conducted within 500 feet of any flowing or standing water which contains threatened and endangered fish species at any time. Ground application will not be conducted within 200 feet of occupied Oregon spotted frog habitat at any time. Designated critical habitat that is currently unoccupied would be treated as occupied habitat unless otherwise directed by the Service prior to treatment. Aerial application of pesticides will not be conducted when winds exceed ten miles per hour. To avoid drift and volatilization, aerial application of pesticides will not be conducted when it is raining or rain is imminent, when foliage is wet, when it is foggy, when temperature exceeds 80 degrees Fahrenheit, when there is air turbulence, or when a temperature inversion exists in the project area. Boundaries and buffers will be clearly marked. Aircraft used in aerial application will be equipped with systems to prevent nozzle dribble when the spray mechanism is disabled and emergency shut off valves to minimize pesticide loss in the event of broken lines, or system malfunctions.

6. All mixing and loading will be done in approved areas where spills cannot enter any body of water. All pesticide tanks will be leak proof and constructed of corrosion resistant

materials. Aircraft used in aerial application will be equipped with APHIS-approved differentially corrected global positioning systems that guide pilots along desired flight paths with an accuracy of plus or minus three feet. Free flying will not be allowed.

7. APHIS will monitor insecticide applications and will document compliance with the protective measures in the Assessment. Emphasis should be on determining the effectiveness of avoidance buffers for federally-listed species including indirect affects to prey animals and pollinators and indirect transportation of insecticide products to non-target areas, including all water bodies.

8. APHIS will notify the Service before any application of pesticide and determine the location of any federally-listed or proposed threatened or endangered listed species. APHIS will provide the Service with maps and GIS shape files of proposed treatment areas for the Service to use to determine accurate locations of the action in relation to known species locations.

This concurrence is based on APHIS's implementation of the avoidance and mitigation measures outlined above. To assist in future consultations we request APHIS provide the Service a summary of environmental monitoring activities conducted each year in which suppression activities are conducted. The report shall be submitted on or before January 1 (or an APHIS and Service mutually agreed upon date) every year prior to initiation of the next grasshopper and cricket suppression activity.

This concludes informal consultation on the subject action. This informal consultation does not exempt APHIS from prohibition of take under section 7(a)(2) of the ESA for any of the 11 species listed above. This informal consultation may be superseded by a future programmatic consultation and covers only those activities carried out in 2021 as described in the Assessment. As provided in 50 CFR § 402.16, reinitiation of consultation may be necessary if: (1) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered herein; (2) the action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered herein; or (3) a new species is listed or critical habitat designated that may be affected by the action.

ADDITIONAL (CANDIDATE AND NON-LISTED) SPECIES PROTECTION

In addition to the above species listed under the Act, the Service maintains a list of species that are candidates for listing. Candidate species are plants and animals for which the Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Act, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. Candidate species are separate from species that are listed as threatened or endangered, in that they do not receive the regulatory protections of the Act. In previous consultations, APHIS considered protective measures for the greater sage-grouse and Columbia spotted frog; however, these species have subsequently been removed (USFWS 2015, 2016) from the candidate list. In addition, APHIS will continue to provide protective measures and consult the Service annually on Borax Lake chub and Foskett speckled dace which were delisted on July 13, 2020 and October 15, 2019, respectively, due to recovery. The Service is also recommending protection of the monarch butterfly (*Danaus plexippus*), a candidate under the Act. The Service values ongoing conservation and protection of these species to prevent the need to list in the future, thus we are including the following conservation recommendations.

Greater Sage-Grouse

In March 2010, the Service determined that protection of the greater sage-grouse (hereafter, sage-grouse) under the Act was warranted. However, listing sage-grouse was precluded by the need to address other species' listings facing greater risk of extinction (USFWS 2010). On October 2, 2015, the Service announced a 12-month finding on petitions to list sage-grouse both rangewide and the Columbia Basin population, as an endangered or threatened species under the Act (USFWS 2016). After review of the best available scientific and commercial information, the Service found that the Columbia Basin population does not qualify as a distinct population segment (DPS). In addition, the Service found listing sage-grouse was not warranted for protection under the Act at the time.

Sage-grouse in Oregon are found in Union, Baker, Deschutes, Crook, Lake, Harney and Malheur counties. Sage-grouse have not been observed in Klamath County since 1993 (USFWS 2010). In 2015, the Oregon Department of Fish and Wildlife (ODFW) finalized the "The Oregon Sage-Grouse Action Plan" to help manage sage-grouse populations in Oregon. This plan was an update to previous versions from 2005 and 2011 (Hagen 2005, ODFW 2011, Sage-Grouse Conservation Partnership 2015). The strategy relies upon Core Areas of habitat that are essential to sage-grouse conservation. The maps and data provide a tool for planning and identifying appropriate avoidance areas and mitigation in the event of human development in sage-grouse habitats. The Core Area maps, available on ODFW's website, define areas that should be targeted for conservation actions or avoided when large scale disturbances are proposed. Core Area maps also provide a broad-scale filter to assist planners, County, State and Federal agencies in identifying areas of likely high and low resource conflicts associated with development proposals. APHIS should ensure that all suppression activities conducted in Oregon are consistent with the measures identified within the 2015 plan, specifically those found in Section IV and Appendix 4 (Sage-Grouse Conservation Partnership 2015).

The Bureau of Land Management (BLM) developed protective measures for sage-grouse to be implemented on BLM-administered lands. The Service recommends APHIS follow recommendations in the "Oregon Greater Sage-Grouse Approved Resource Management Plan Amendment" (BLM 2015), such as, Required Design Features, including seasonal restrictions. The Service also recommends following information found in the BLM Instructional Memorandum (IM) Number 2016-115, dated June 24, 2016, for all spray activity on BLM-administered lands (BLM 2016), which the APHIS references in the proposed action. Within, Priority Habitat Management Areas (PHMA) and occupied habitat the IM requires that sage-grouse nesting/early brood-rearing habitat or summer/late brood-rearing habitat areas are not treated (spray or bait) during the respective seasonal use periods, unless:

1) An emergency case exists as determined locally by both BLM and APHIS, or

2) Habitat conditions are unsuitable for sage-grouse and the area is not likely to be occupied by sage-grouse at the time of treatments.

3) If treatments in PHMAs and occupied habitat cannot be avoided, treat the minimum amount of area needed to ensure grasshopper and Mormon cricket control objectives.

Within General Habitat Management Areas (GHMA), the IM requires treatment of the minimum amount of area needed to ensure grasshopper or Mormon cricket control objectives, as agreed to by BLM and APHIS locally, while avoiding occupied or likely occupied nesting or late brood-rearing habitat to the extent possible.

Insect reduction as a result of rangeland grasshopper control has been found to reduce brood sizes in a wild sage-grouse population (Johnson 1987). The Service recommends APHIS works with the BLM to plan around areas occupied by sage-grouse during periods of sage-grouse chick foraging and development in May and June (or as appropriate to local circumstances) to provide insect availability for early development of sage-grouse chicks. In addition, sage-grouse brood areas should be located if not already known, and protected from insecticide spraying (Johnson 1987). Grasshopper control should also be delayed in brood-rearing areas to allow for maximal chick development before spraying reduces their insect forage (Johnson 1987). Treatment areas near active or pending leks will be evaluated by wildlife specialists prior to being considered for treatment. In general, a 4-mile buffer around active and pending leks will be avoided to protect nesting and early brood-rearing of sage-grouse chicks and food sources unless close to heavily infested private lands or areas within the buffer are determined by a wildlife biologist to not be suitable habitat for nesting or early brood-rearing. The Service recommends APHIS use these guidelines to avoid pesticide spraying of nesting and brood-rearing areas for sage-grouse in order to prevent further declines from current sage-grouse population levels. Exceptions to buffer restrictions for aerial spray and ground application of diflubenzuron or carbaryl should be made in consultation with the Service, appropriate ODFW area biologists, and BLM District resource specialists, on a case-by-case basis.

The Service recommends APHIS study the potential effect of the rangeland grasshopper and Mormon cricket control program on sage-grouse, particularly related to reduction in insects as forage, within nesting and brood-rearing habitat. We request that APHIS provide us with information regarding how they will avoid areas occupied by sage-grouse during time periods of sage-grouse chick foraging and development. The Service is available to assist APHIS to minimize and avoid impacts to sage-grouse.

Columbia spotted frog Great Basin DPS

The Columbia spotted frog Great Basin DPS (Great Basin DPS) is known to occur in Lake, Harney, Malheur, and Grant counties, Oregon. In addition to the counties in Oregon, the Great Basin DPS is also known to occur in portions of Idaho and Nevada. The Great Basin DPS is widely distributed throughout southeastern Oregon, and local populations are isolated from each other by natural or human-induced habitat barriers. Threats to the Great Basin DPS include poor management of habitat including water development, improper grazing, mining activities, and nonnative species.

The Service recommends APHIS avoid pesticide spraying of habitat for the Great Basin DPS and buffer the area surrounding Columbia spotted frog habitat similar to measures taken for Oregon spotted frog covered under this consultation in order to reduce risk of exposure of the Great Basin DPS to pesticide chemicals. We recommend that APHIS provide information to the

Service regarding how they will avoid areas occupied by the Great Basin DPS prior to commencing with spray projects. The Service is available to assist APHIS to minimize and avoid impacts to the Great Basin DPS.

Borax Lake Chub

Borax Lake chub was delisted from the Act on July 13, 2020, due to recovery. This species is found in Borax Lake, a shallow 10-acre, thermal spring fed lake in Harney County, Oregon. The lake is named for its concentration of borax, and its ecosystem is considered highly susceptible to modification due to irrigation and geothermal projects.

The Service recommends APHIS avoid pesticide spraying of habitat for Borax Lake chub and buffer the area surrounding Borax Lake chub habitat similar to measures taken for other federally-listed fish species covered under this consultation in order to reduce the risk of exposure of Borax Lake chub to pesticide chemicals. We recommend that APHIS provide information to the Service regarding how they will avoid areas occupied by Borax Lake chub prior to commencing with spray projects. The Service is available to assist APHIS to minimize and avoid impacts to Borax Lake chub.

Foskett Speckled Dace

The Foskett speckled dace was delisted from the Act on October 15, 2019, due to recovery. This species occurs naturally in Foskett Spring, a small spring system found in the Coleman Basin on the west side of the Warner Valley, Lake County, and an introduced subpopulation at nearby Dace Springs. Trampling by cattle is perceived as the main reason for diminution of the habitat. Other threats include encroachment of vegetation, such as cattails, pumping of ground water or channelization which would affect water level, flow and increased silt.

The Service recommends APHIS avoid pesticide spraying of habitat for Foskett speckled dace and buffer the area surrounding Foskett speckled dace habitat similar to measures taken for other federally-listed fish species covered under this consultation in order to reduce the risk of exposure of Foskett speckled dace to pesticide chemicals. We recommend that APHIS provide information to the Service regarding how they will avoid areas occupied by Foskett speckled dace prior to commencing with spray projects. The Service is available to assist APHIS to minimize and avoid impacts to Foskett speckled dace.

We appreciate the opportunity to work with you on this action. Please note that the proposed action requires further coordination to inform the Service of pesticide application activities in areas of any listed threatened or endangered species. If we can be of further assistance, please contact me at (541) 383-7146 or Dawn Davis at (503-319-0594).

Sincerely,

Bridget Moran
Field Supervisor

cc: Marisa Meyer, FWS, La Grande, Oregon
Adam Johnson, FWS, Klamath Falls, Oregon
Jenny Marek, FWS, Klamath Falls, Oregon

References