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MEMORANDUM

SUBJECT: **Rodenticides:** Final Biological Evaluation, Effects Determinations, and Mitigation Strategy for Federally Listed and Proposed Endangered and Threatened Species and Designated and Proposed Critical Habitats

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The Environmental Fate and Effects Division (EFED) of the United States Environmental Protection Agency (EPA) has completed the Final Biological Evaluation (BE) and associated effects determinations for federally listed and proposed endangered and threatened species (herein referred to as "listed species") and any designated and proposed critical habitats (herein referred to as "CHs") for the currently registered uses of 11 rodenticide active ingredients. EPA also included in its effects determinations its prediction whether there is a potential likelihood that current registrations of the 11 rodenticides may lead to future jeopardy (J) of a listed species or adverse modification (AM) of designated critical habitat (collectively abbreviated as J/AM). While EPA is not required to include J/AM predictions in its effects determinations, EPA is including this analysis with the intention of making the consultation process with the U.S. Fish and Wildlife Service (USFWS) more efficient. EPA expects to consult with USFWS after the finalization of the BE because it includes May Affect (MA) determinations for species and their CHs under its jurisdiction. USFWS will make the final J/AM determinations for listed species and their CHs, respectively. EPA does not anticipate needing to consult with the National Marine Fisheries Service (NMFS) because in this final BE, EPA made No Effect (NE) determinations for all listed species and CHs under the jurisdiction of NMFS.

The conclusions conveyed in this assessment were developed in full compliance with *EPA Scientific Integrity Policy for Transparent and Objective Science*, and EPA Scientific Integrity Program's *Approaches for Expressing and Resolving Differing Scientific Opinions.* The full text of *EPA Scientific Integrity Policy for Transparent and Objective Science*, as updated and approved by the Scientific Integrity Committee and EPA Science Advisor can be found here: https://www.epa.gov/sites/default/files/2014-02/documents/scientific_integrity_policy_2012.pdf. The full text of the EPA Scientific Integrity Program's *Approaches for Expressing and Resolving Differing Scientific Opinions* can be found here: https://www.epa.gov/scientific-integrity/approaches-expressing-and-resolving-differing-scientific-opinions.

Rodenticides: Final Biological Evaluation, Effects Determinations, and Mitigation Strategy for Federally Listed and Proposed Endangered, and Threated Species and Designated and Proposed Critical Habitats

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EXECUTIVE SUMMARY

The purpose of this assessment is to complete final effects determinations including predictions of whether there is a potential likelihood that 11 currently registered rodenticides, currently in the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) section 3(g) registration review (RR) process, could lead to a future jeopardy (J) or adverse modification (AM) finding by the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS), collectively referred to as the "Services" for federally listed endangered and threatened species, those species proposed as listed (collectively referred to as "listed"), and any designated or proposed for designation critical habitat (CH). This final Biological Evaluation (BE) also identifies possible mitigation measures that are intended to avoid potential future jeopardy or adverse modification determinations by the Services and minimize take of listed species. As such, the BE also serves as the EPA's Rodenticide Strategy as outlined in EPA's Endangered Species Act Workplan to guide how the EPA addresses listed species mitigation for rodenticides going forward.

Rodenticides are used to control rodent pests that can cause significant damage to property, crops, and food supplies as well as spread diseases, posing a serious risk to public health. Rodenticides are used in residential, agricultural, and non-agricultural settings to control a variety of pests including house mice, Norway rats, roof rats, moles, voles, pocket gophers, prairie dogs, ground squirrels, feral hogs, and mongooses.

The 11 rodenticides evaluated in the BE are: chlorophacinone, diphacinone and its sodium salt, warfarin and its sodium salt, brodifacoum, bromadiolone, difenacoum, difethialone, bromethalin, cholecalciferol, strychnine, and zinc phosphide. Seven of these rodenticides (*i.e.*, chlorophacinone, diphacinone, warfarin, brodifacoum, bromadiolone, difenacoum, and difethialone) act by disrupting normal blood-clotting mechanisms (referred to as "anticoagulants"[1]); however, there are rodenticides with other modes of action, such as neurotoxicity (*e.g.*, bromethalin and strychnine), disruption of calcium absorption (*e.g.*, cholecalciferol) and impairment of cellular function (*e.g.*, zinc phosphide). Different chemical properties affect the types of species that may be impacted by rodenticides. For example, anticoagulants interfere with blood clotting and cause death from excessive bleeding. Mortality in target animals may occur weeks after ingestion of a lethal dose. Between the time a target animal eats the bait and ultimately dies, they may be consumed by a predator, or their carcass may be consumed by a scavenger after they die. Therefore, predators and scavengers may be exposed to and similarly affected as primary consumers but through exposure to an anticoagulant rodenticide in the target animal. Rodenticides that do not accumulate in the target animal or that do not remain in animals for very long are less likely to affect predators and scavengers. Similarly, rodenticides that kill target rodents faster are also less likely to affect predators and scavengers. The assessment accounts for differences in these properties as they relate to the extent that different types of species may be affected across the 11 rodenticides.

This final BE is comprehensive of all currently registered uses of the 11 rodenticides, all currently submitted toxicity and environmental fate data, and all exposure routes. In addition to the draft BE which EPA released for public comment in November 2023, this analysis builds upon prior FIFRA based

[1] Referred to as first-generation anticoagulants (*i.e.,* chlorophacinone, diphacinone, and warfarin) and second-generation anticoagulants (*i.e.,* brodifacoum, bromadiolone, difenacoum, and difethialone).

risk assessments (USEPA, 2020a – 2020e) and analyses completed for three pilot listed species[2] (herein referred to as the "pilot memo") described in the 4 Proposed Interim Decisions (PIDs) associated with the RR of these 11 rodenticides in November 2022 (USEPA, 2022a – 2022e) for which EPA also took public comment. In this final BE, EPA based the effects determinations solely on existing approved labels (*i.e.*, they do not consider the mitigations identified in the 4 PIDs associated with the 11 rodenticides (USEPA, 2022a – 2022d) or the pilot memo (USEPA, 2022e)). Furthermore, EPA also met regularly with the USFWS for informal consultation and technical assistance during the development of this BE, which informed the methodology, the decision-making processes for species determination including, predictions of the potential likelihood of future J/AM, and the mitigation strategy.

In this final BE, EPA evaluated the effects of the 11 rodenticides to 1827 listed species (including species proposed for listing) and 927 designated and proposed critical habitats in the United States and its territories. For purposes of listed species-specific effects determinations, EPA first grouped each of the 11 rodenticides by mode of action (*e.g.*, anticoagulants, neurotoxins, etc.) and then further grouped by use pattern (*i.e.*, bait station[3], in-burrow, or broadcast). EPA distinguished between these three use patterns because they have different exposure routes to non-target animals. For each species, EPA made effects determinations for each chemical group (*i.e.*, mode of action), consisting of one determination for each of the use patterns associated with that chemical group.

EPA determined whether each of the 11 rodenticides will have No Effect (NE) on, or May Affect (MA), an individual of each listed species or CH. For those species and CHs with MA determinations, EPA performed additional analyses to determine if each rodenticide is Not Likely to Adversely Affect (NLAA) or Likely to Adversely Affect (LAA) an individual species or a CH. EPA made NLAA determinations when effects are either discountable (highly unlikely to occur), insignificant, or wholly beneficial.

The "likely to adversely affect" (LAA) determination means that EPA reasonably expects that at least one individual animal or plant, among a variety of listed species, may be exposed to a rodenticide at a sufficient level to have an adverse effect. The likely "take", which includes unintentional harm or death, of even one individual of a species, is enough to trigger an LAA determination. An LAA determination, however, does not necessarily mean that a pesticide is putting a species in J.

For those species and critical habitats where EPA made an LAA determination, EPA also included its prediction of the potential likelihood of future J/AM. While EPA is not required to include J/AM predictions or mitigation measures in its effects determinations, EPA is including this analysis to help expedite the consultation process with USFWS. The Services make the final J/AM findings in any Biological Opinion they issue at the end of the consultation process.

Although EPA updated effects determinations in the final BE, there were not enough relative changes among the effects determinations (*i.e.*, NE, NLAA, LAA, J, no J, AM, no AM) to impact the overall percentage of species and CH associated with those effects determinations; therefore, the relative

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[2] Species in the pilot memo included the Attwater's greater prairie-chicken (*Tympanuchus cupido attwateri*) represented a primary consumer bird, Stephens' kangaroo rat (*Dipodomys stephensi*) represented a primary consumer mammal, and the California condor (*Gymnogyps californianus*) represented a secondary consumer.
[3] EPA evaluated bait stations to control rodents and bait stations designed to target feral hogs. Feral hog bait stations were considered separately because they are designed to exclude smaller non-target species, resulting in different exposure pathways compared with bait stations designed to control rodents.

percentages did not change between the draft and the final BE. EPA determined that the currently labeled uses of the 11 rodenticides evaluated in this assessment:

- Will have no effect on 88% of listed species and 95% of critical habitats;
- Are not likely to adversely affect 4% to 11% of listed species—depending on the chemical and application type—and 1% of critical habitats;
- Are likely to adversely affect 1% to 8% of listed species—depending on the chemical and application type—and 4% of critical habitats; and,
- Have a likelihood of future Jeopardy/Adverse Modification for less than 5% of listed species and less than 1% of critical habitats.

The final Rodenticide Strategy includes mitigation measures that EPA identified to address the predictions of potential likelihood of future J/AM for 78 listed species and five critical habitats (*see* **Table 5-1** of this assessment). These measures "avoid" or "minimize" exposure, as defined by the Endangered Species Act (ESA) Consultation Handbook. EPA removed the following mitigation measures from this final BE because EPA proposed them in conjunction with specific PIDs for implementation nationally through product labeling updates and they will therefore be addressed in registration review instead of this final strategy:

- Restricted use classification
- Packaging first generation anticoagulant rodenticides (FGARs), bromethalin, and cholecalciferol products for consumer use in quantities of one pound or less in ready-to-use non-refillable bait stations
- Broad national product labeling updates to prohibit broadcast and surface spot/scatter application for turf, lawns, golf courses, campsites, and other recreation areas.

EPA received comments on the draft Rodenticide Strategy that additional clarity was needed in finalizing the mitigation strategy, particularly regarding the applicability of each mitigation measure to each rodenticide product and use. Commenters expressed concern that some mitigation measures may not be effective or feasible depending on the listed species, scenario, or use pattern. EPA wishes to clarify that the intent of the Rodenticide Strategy is to outline all known mitigation measures identified to reduce endangered species exposure, and therefore reduce the potential likelihood of future J/AM.

Unlike the Herbicide Strategy, these mitigation measures are not intended to serve as a mitigation menu for rodenticide users in a manner that implies or contemplates that EPA will take a standardized approach to implementation. Rather, these are the suite of measures that EPA has identified from which EPA expects to choose when identifying measures to reduce exposure to listed species and their CH from the 11 rodenticides for a specific active ingredient, use site, and application method (*i.e.*, bait station, in-burrow, and broadcast). EPA plans to implement the final strategy for each of these 11 rodenticides through their ongoing registration review.

The mitigation strategy section of this document provides some examples of how EPA envisions implementation, which were all informed by public comments EPA received on the draft Rodenticide Strategy. For example, while EPA included carcass search in the draft as a mitigation measure to reduce exposures based on its inclusion in USFWS' previous biological opinion on other rodenticides (*i.e.*, Rozol and Kaput), numerous commenters expressed concerns about its applicability and feasibility for many/most of the rodenticides and uses subject to this strategy. As a result, the EPA is now specifying it expects to only select the carcass search measure when other mitigation measures are not practical or feasible. EPA has included an example of the limited types of scenarios in which EPA would expect to implement this measure in the final Rodenticide Strategy.

Additionally, EPA expects most of the mitigation measures would apply in geographically specific areas only (referred to as Pesticide Use Limitation Areas or PULAs) through Bulletins using its web-based system, Bulletins Live! Two (BLT). PULAs focus on areas where pesticide exposures are likely to impact the continued existence of a listed species, which may include a reduction in survival or recovery of the species and designated critical habitat. EPA is refining the species maps that it will use for PULAs and does not plan to implement mitigations in those areas until those maps are refined.

EPA's final BE made LAA determinations for species under USFWS' jurisdiction; therefore, EPA will initiate formal consultation with the USFWS. At the end of the consultation, the USFWS will make their conclusions on J/AM and determine whether there are additional measures necessary to avoid J/AM for each listed species and critical habitat, and the USFWS will issue their Biological Opinion (BiOp). After the BiOp is issued, EPA will implement any additional measures identified in the BiOp.

1 Background

1.1 Nature of the Regulatory Action

This final BE presents EPA's determinations for the effects of 11 rodenticides on listed species and CH in the U.S., including Hawaii, and its territories[4]. EPA first grouped each of the 11 rodenticides and assessed them according to their modes of action. The three first generation anticoagulant rodenticides (FGARs) are chlorophacinone, diphacinone (and its sodium salt), and warfarin (and its sodium salt). The four second generation anticoagulant rodenticides (SGARs) are brodifacoum, bromadiolone, difenacoum and difethialone. Four of the rodenticides (bromethalin, cholecalciferol, strychnine, and zinc phosphide) have unique modes of action not involving the coagulation of blood and are considered individually. EPA then further grouped by use pattern (*i.e.,* bait station[5], in-burrow, or broadcast). EPA distinguished between these three use patterns because they have different exposure routes to non-target animals. For each species and critical habitat (CH), EPA made effect determinations for each chemical group (*i.e.*, mode of action), consisting of one determination for each of the use patterns associated with that chemical group.

This final BE is comprehensive of all currently registered uses of the 11 rodenticides, all currently submitted toxicity and environmental fate data, all exposure routes, and incorporates current label language to assess potential effects from the use of these rodenticides. This analysis builds upon prior FIFRA-based risk assessments (USEPA, 2020a – 2020e) and analyses completed for three pilot listed species (USEPA, 2022e).

EPA first presents its no effect (NE) and may affect (MA) determinations for species and CH; the latter being further refined to not likely to adversely affect (NLAA) or likely to adversely affect (LAA). For LAA species, consistent with the Services' counterpart regulations, EPA made predictions of potential likelihood of future J/AM. For LAA CH, EPA presents its predictions for the potential likelihood of future AM and not likely future AM. While EPA is not required to include J/AM predictions in its effects determinations, EPA is including this analysis with the intention of making the consultation process more efficient. The Services make the final J/AM findings in any BiOp they issue at the end of the consultation process.

EPA is including a Rodenticide Strategy (mitigations) as part of this final BE that focuses on reducing exposures of listed species to 11 rodenticides. This strategy focuses on reducing exposures so that EPA's predictions of the potential likelihood of future J for listed species and potential likelihood of future AM for CHs based on current uses and label restrictions in this final BE would not be likely. The mitigation measures are also intended to minimize take[6] of those species where EPA made LAA determinations.

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[4] Candidate species and experimental populations were not considered.

[5] EPA evaluated bait stations to control rodents and bait stations designed to target feral hogs. Feral hog bait stations were considered separately because they are designed to exclude smaller non-target species, resulting in different exposure pathways compared with bait stations designed to control rodents.

[6] Take - to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct. [ESA §3(19)] Harm is further defined by USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by USFWS as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. [50 CFR §17.3]

The mitigation measures include measures to “avoid” or “minimize” exposure, as defined by the ESA Consultation Handbook[7]. No “offsets” are proposed at this time; however, EPA is open to considering proposals regarding how offsets may be utilized for rodenticides.

EPA took comment on the draft BE and associated mitigation strategy from November 30, 2023 to February 13, 2024 and a total of 2,016 comments were submitted to the docket. Responses can be found in the RTC document available in the public docket (EPA docket number EPA-HQ-OPP-2023-0365). EPA separately released a draft human health and ecological risk assessment on these rodenticides in 2020, which was followed by a public comment period during which EPA received valuable feedback. In November 2022, EPA proposed measures for multiple rodenticides—including the requirements of tamper-resistant bait boxes and rodent carcass collection—based on the assessment that addressed protections for specific listed species and critical habitat as part of a pilot program and has received valuable feedback on those measures as well. EPA took those comments into consideration when developing the mitigation strategy presented in this final BE. EPA intends to continue discussing the final effects determinations and mitigation measures in this final BE with USFWS and applicants during the consultation process.

Island Eradication Products

The Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) has consulted with USFWS and NMFS on the use of brodifacoum (an SGAR), diphacinone (an FGAR), and bromethalin for the eradication of rodents on uninhabited and remote inhabited islands to reduce ecological impacts. Such consultations are a prerequisite to the addition of any island to the APHIS conservation labels. Consultation has been completed for Wake and Midway Atolls and is pending for other projects.

APHIS is the registrant for several rodenticide labels for conservation purposes. These include but are not limited to Diphacinone®-50 Conservation (EPA Reg. No. 56228-35), Brodifacoum®-25W Conservation (EPA Reg. No. 56228-36), and Brodifacoum®-25D Conservation (EPA Reg. No. 56228-37) to eradicate or control invasive rodents on certain islands. APHIS is planning to conduct rodent eradication projects for the benefit of seabirds and other wildlife on these islands in the next five to seven years (**Table 1-1**). APHIS is also planning to register a diphacinone bait for mongooses (similar to the Special Local Need Section 24(c) label HI980005, EPA Reg. No. 61282-26) for use in Hawaii, Puerto Rico and the U.S. Virgin Islands.

APHIS conducts its own ESA consultation for these uses with USFWS and NMFS. After consultation is complete, APHIS presents a completed BiOp to EPA before any of these projects are added to their labels. EPA relies on these consultations when considering the FIFRA action. EPA has not included these uses in this nationwide final BE and Rodenticide Strategy.

[7] https://www.fws.gov/media/endangered-species-consultation-handbookEndangered Species Consultation Handbook

Table 1-1. Animal and Plant Health Inspection Service (APHIS) Island Eradication Projects Anticipated in the Next 5 to 7 Years[1]

Island	Specific Site
Pacific U.S. islands	Guam Hawaii (all islands) Midway Atoll, US Minor Outlying Islands Wake Atoll, US Minor Outlying Islands Swains Island, American Samoa
Western U.S. islands	Great Sitkin, AK South Farallon Islands NWR
Eastern U.S. islands	Nantucket, MA Marthas Vineyard, MA Boston Harbor, MA Elizabethan Islands, MA Fort Wool, VA
Dry Tortugas National Park	Loggerhead Key Garden Key Long Key Bush Key Hospital Key Middle Key East Key
Pinellas NWR	Egmont Key Jackass Key Little Bird Key Indian Key Tarpon Key Mule Key
Grassy Key, FL	Grassy Key, FL
Caribbean U.S. islands	Savana Island, US Virgin Islands Mona Island, Puerto Rico Culebrita and Luis Peña Islands, Puerto Rico

[1]Email communication from Emily Ruell (APHIS in Fort Collins, Colorado, May 1, 2023)

1.2 Summary of Previous Rodenticide Assessments that Inform the Biological Effects Determinations

The 11 rodenticides have a long regulatory history and a well-established risk profile that has been subject to repeated external peer review. A summary of regulatory actions and related consultations with the Services are described below. EPA considered previous assessments, mitigations and consultations related to the 11 rodenticides to inform the approach and analysis in this final BE.

In 1991, EPA requested formal consultation with USFWS on 31 registered chemicals with MA determinations made by EPA. The 31 chemicals included 16 vertebrate control agents, of which were eight of the 11 rodenticides assessed in this final BE (*i.e.*, brodifacoum, bromadiolone, bromethalin, chlorophacinone, diphacinone, warfarin, cholecalciferol, and zinc phosphide). In 1993, USFWS published a BiOp for the 31 chemicals, which provided their determinations of the impacts of the registered uses of those chemicals (including the 8 rodenticides) to all listed species at the time of publishing (USFWS, 1993).

In 2008, EPA released the Risk Mitigation Decision (RMD) for Ten Rodenticides (USEPA, 2008). The RMD is the Re-Registration Eligibility Decision (RED) for these rodenticides, which is the previous iteration of RR under FIFRA. An independent Science Advisory Panel (SAP) reviewed the underlying scientific FIFRA-based risk assessments supporting the RMD because some registrants questioned the need for and the basis of the RMD mitigations. EPA's mitigations goals were to: 1) minimize children's exposure to rodenticide products used in homes by requiring that all rodenticide bait products marketed to general and residential consumers be sold only with bait stations, with loose bait (*e.g.,* pellets and meal) as a prohibited bait form and, 2) reduce wildlife exposures and ecological risks, by requiring sale and distribution limits intended to prevent general consumers from purchasing residential use bait products containing four of the ten rodenticides that pose the greatest risk to wildlife (*i.e.,* SGARs: brodifacoum, bromadiolone, difenacoum, and difethialone). Moreover, the 2008 RMD required bait stations for all outdoor, above-ground uses of the 4 SGARs to reduce exposure. The RMD rodenticide mitigations reduced the potential of effects of commensal uses to non-listed and listed species.

In 2012, EPA formally consulted with USFWS on the use of Rozol® Prairie Dog Bait (contains chlorophacinone; USFWS, 2012) on potential effects for listed species. During the consultation process, the registrant, EPA, and USFWS determined appropriate mitigations to avoid the potential likelihood of future J for several listed species. The mitigations included geographic and timing restrictions, carcass search and disposal.

In 2020, to support the RR of the rodenticides, EPA prepared five draft FIFRA-based ecological risk assessments that collectively covered the 11 rodenticides (USEPA, 2020a, 2020b, 2020c, 2020d, 2020e, **Table 1-2**). The 2020 FIFRA-based assessments did not include specific listed species evaluations. EPA concluded that non-target birds, mammals, reptiles, and terrestrial-phase amphibians have the potential of risk (*e.g.*, mortality) from dietary exposure (primary or secondary; *see* **Section 2.2** for definition) to rodenticides. EPA presented multiple lines of evidence to support identified FIFRA-based risk conclusions, including exposure-to-effect ratios (*i.e.*, risk quotients; RQs) that exceed EPA's acute risk levels of concern (LOCs) for primary and secondary consumers within various taxa (*see* the draft FIFRA-based risk assessments; USEPA, 2020a-2020e), monitoring data where rodenticides were detected in non-target animals, and multiple reports of mortality incidents likely associated with rodenticides. For this final BE, the FIFRA-based risk assessments served as the basis for determining which taxa needed further review at the species-specific level to determine whether the action (*i.e.*, the RR of the 11 rodenticides) may affect any listed species or CH.

In 2022, EPA completed four PIDs for the 11 rodenticides which included proposed mitigations that would generally reduce exposure to non-listed and listed species (USEPA 2022a – 2022d) and targeted ESA mitigation to protect three pilot listed-species and one CH. Those three species and one CH were assessed in EPA's pilot memo that included (1) draft effects determinations and predictions of the potential likelihood of future J/AM based on currently registered uses of the 11 rodenticides and (2) proposed mitigations to avoid J/AM for those species and CH (USEPA, 2022e). EPA intended for the pilot memo to not only support the 4 PIDs but to also inform stakeholders how EPA would make predictions of the potential likelihood of future J/AM and would identify any associated mitigations in this final BE. EPA chose the three pilot species because they represented examples of the listed species that may be affected by rodenticides through different routes of exposure (*i.e.,* primary and secondary consumption; *see* **Section 2.2**). The species were the Stephens' kangaroo rat (*Dipodomys stephensi*) and Attwater's prairie-chicken (*Tympanuchus cupido attwateri; also referred to as* "Attwater's greater prairie-chicken") both of which represented primary consumers, and the California condor (*Gymnogyps californianus*), which represents a secondary consumer. EPA also made a draft effects determination in 2022 for the CH of the California condor. EFED predicted the potential likelihood of future J or AM for all three of the species and the CH for some but not all 11 rodenticides. EFED considered public comments and feedback from stakeholders and USFWS on the analyses for the pilot species and determined that the approach used to make the effects determinations and associated predictions of the potential likelihood of J/AM was appropriate for this final BE.

EPA used standard risk assessment procedures to arrive at conclusions supported by multiple lines of evidence, which includes incident data that documents effects in primary and secondary consumers. There were 40 documented incidents involving listed species and SGARs and one involving listed species and FGARs, which are described in detail in this BE and in the 2020 risk assessments. Incidents support the conclusions of our risk assessment that are based on toxicity and exposure modeling. The incidents demonstrate that there are multiple complete exposure pathways from rodenticide use sites to non-target taxa that are both primary and secondary consumers of rodenticides.

Table 1-2. Previous FIFRA- and ESA-based Risk Assessments for the RR of 11 Rodenticides

Rodenticide or group	Document reference
Second generation anticoagulants (SGAR): brodifacoum, bromadiolone, difethialone, difenacoum	DP barcode 453282; 03/17/2020; USEPA, 2020a
First generation anticoagulants (FGAR): chlorophacinone, diphacinone, warfarin	DP barcode 453282; 03/17/2020; USEPA, 2020a
Strychnine	DP barcode 453652; 06/23/2020; USEPA, 2020b
Bromethalin	DP barcode 456755; 03/31/2020; USEPA, 2020c
Cholecalciferol	DP barcode 456480; 03/31/2020; USEPA, 2020d
Zinc Phosphide	DP barcode 455987; 06/24/2020; USEPA, 2020e
Draft Effects Determinations and Evaluation of Proposed Mitigations Intended to Avoid Jeopardizing Three Federally Listed Endangered and Threatened Species and Avoid Adversely Modifying One Designated Critical Habitat	DP barcode 464678; 09/28/2022; USEPA, 2022e

DP=Data Package

1.3 Characterization of Rodenticide Uses

Target pests of the 11 rodenticides include commensal rodents (*e.g.*, mice and rats) and other mammals (*e.g.*, feral hogs, prairie dogs, ground squirrels, marmots). In general, rodenticides may be applied in bait stations, within target-rodent burrows, or broadcast onto the surface of treated areas. The application method varies by application site. Application sites include developed areas, agricultural fields, rangeland, and pastures. Each rodenticide active ingredient has its own unique combination of use sites and application methods. **Appendix A** provides a summary of the uses and modes of action of the 11 rodenticides**.**

A primary use of most of the rodenticides is to control commensal rodents (*e.g.*, house mice, roof rats, and Norwegian rats) in urban and developed areas, and in agricultural settings. EPA requires that all products used for commensal rodent control be in tamper-proof bait stations to protect children, pets, and wildlife. Current labels specify that bait stations are required to be placed within 100 feet of a man-made structure.

Four of the 11 rodenticides (chlorophacinone, diphacinone, strychnine, and zinc phosphide) are used in agriculture settings. Current labels for agricultural use allow broadcast, in-burrow, and bait station use patterns.

Warfarin (an FGAR) is the only rodenticide labeled for use within special bait stations for the control of feral hogs.

EPA also considered geographic prohibitions on the labels when they were applicable to making effects determinations and predictions of potential likelihood of future J/AM.

1.3.1 Additional Use Considerations

EPA also considered other special situations that are impactful to where certain rodenticides are unlikely to be used. For example, some strychnine uses do not have geographic restrictions that preclude use on islands; however, the specific target pests are not known to be located outside of the contiguous United States (CONUS). Similarly, while the broadcast use of chlorophacinone and diphacinone do not have any geographic prohibitions for island use, the target pests are not located on islands but are found in the CONUS. Therefore, broadcast use of these FGARs is not anticipated on islands.

2 Effects Determination Methodology

2.1 Overview

In this final BE,[8] EPA evaluated whether the registrations of the 11 rodenticides pose potential effects to listed species and CH[9] that are within the action area.[10] The 1,827 listed species and 927 CHs assessed in the final BE were current as of October 2024.[11] This evaluation did not include 10(j) species which are plants or animal populations that have been designated as experimental under the ESA (*e.g.,* some populations of Black footed ferret, *Mustela nigripes*, are considered a non-essential experimental population; therefore, regulatory and take prohibitions, and consultation requirements of the ESA are relaxed). Any adjustments to 10(j) species will be resolved during consultation with the USFWS.

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[8] 50 CFR § 402.40(b) states: "Effects determination is a written determination by [EPA] addressing the effects of a FIFRA action on listed species or critical habitat. The contents of an effects determination will depend on the nature of the action. An effects determination . . . shall contain the information described in [50 CFR] § 402.14(c) and a summary of the information on which the determination is based, detailing how the FIFRA action affects the listed species or critical habitat."

[9] This assessment focuses upon currently listed and proposed endangered and threatened and designated and proposed CHs. During consultation, EPA may confer with the USFWS to identify any additional species or critical habitats that are relevant to this action.

[10] The action area includes an exposure area extending from each pesticide use site found across use data layers (UDLs) in all directions out to this distance.

[11] Reflects listed species current as of Oct. 2024. This includes accounting for delisted species. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction

One component of making an effects determination is comparing where species are located to identify where they may overlap with areas where these rodenticides are used, referred to as an overlap analysis. If there is no overlap between a species (or its CH, if designated) and areas where these rodenticides are used, then there is no effect to that species (or its CH). If there is overlap, then as described below, EPA conducts additional analyses for that species. EPA used the best available data to develop its overlap analysis for this BE.

For the draft BE, EPA used the Services' spatial datasets containing range and critical habitat data for species listed under ESA as of February 2022.[12] Therefore, EPA's overlap analysis in the draft BE did not include species and CH that were listed or proposed for listing after that date (between February 2022 and April 2023). For the final BE, EPA updated its species list to include all listed species as of Oct. 2024. The most up to date species range and critical habitat spatial files were from Dec. 2023.[13] For both datasets there were instances in which the Services have not developed a spatial file for some species' ranges or CH. Where data was not available, EPA did not include a quantitative overlap analysis to make its effects determinations, including any predictions of potential likelihood of future J/AM for those species and any AM of CH. Instead, EPA assumed overlap and exposure occurred, and made its determinations based on biological, and not spatial, factors.

EPA similarly used the best available information in making the effects determinations, which reflect potential effects to individuals of a species or their CH. For this analysis, EPA considered direct effects to the species and effects on prey, pollination, habitat, or dispersal (PPHD). The term "direct effects" refers to decreases in the survival, growth, or reproduction of individuals of a listed species due to exposure to one of the rodenticides. EPA also considered impacts on the listed species that may be the result of the effects of one of the rodenticides on organisms for which the listed species depends for PPHD. When making effects determinations for CHs, EPA considered whether there may be potential effects to the physical and biological features (PBFs) of the CH.

EPA determined whether currently registered rodenticide uses will have "no effect" (NE) on a given listed species or CH (*e.g.*, species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects) or "may affect" (MA) the species or CH. For those species and CH that EPA determined MA, EPA further determined whether the action (*i.e.*, RR of the 11 rodenticides): "may affect but is not likely to adversely affect" the listed species or CH (NLAA); or "may affect and is likely to adversely affect" the listed species or CH (LAA). EPA made NLAA determinations when exposure was extremely unlikely to occur or if an effect was insignificant or wholly beneficial. If EPA determined that an effect could not be discounted as extremely unlikely, then EPA made a LAA determination. LAA

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[12] Spatial dataset contains range and critical habitat data for species listed under ESA. Updated routinely, this snapshot represents the data currently used in US EPA's OPP endangered species evaluations. Delineated by the USFWS and NOAA/NMFS, the associated spatial dataset are enhanced with field attributes supporting ESA section 7 implementation by the EPA. Ranges represent anywhere an individual could be found based on the best available information at the time of delineation. Critical habitat represents specific habitat areas essential to conservation and continued existence of a listed species. When multiple files are associated with a species, individual files are converted to polygons, when necessary, and merged into a single file to represent the species as a whole. The last snapshot of the species locations occurred in February 2022.

[13] Range files - https://services.arcgis.com/cJ9YHowT8TU7DUyn/arcgis/rest/services/Species_Ranges_Static/FeatureServer
Critical habitat - https://services.arcgis.com/cJ9YHowT8TU7DUyn/arcgis/rest/services/Critical_Habitat_Static/FeatureServer

determinations mean that an effect from an exposure to one or more individuals of a species is reasonably certain to occur and that the effect is discernible and adverse. To inform consultation with the USFWS, for those species and CHs with LAA determinations, EPA also included in its effects determinations predictions of whether there is a potential likelihood of future J to a listed species or AM of their CH from the use of one or more of the 11 rodenticides.[14]

As previously mentioned, this assessment uses the best available scientific information on the rodenticides, including but not limited to use, environmental fate and transport, ecological effects, incident data, and monitoring data. EPA used that information and the taxa-based risk assessments (*see* FIFRA-based DRAs for each rodenticide summarized in **Table 1-2**) as the starting point for the effects determinations for the listed species and CHs. The taxa-based methodology identifies the types of species that may be affected by labeled uses of the 11 rodenticides and the important exposure routes associated with potential adverse effects. As needed, EPA refined the taxa-based methodology and considered species-specific information to determine if there are potential effects to any individual of a species or its CH. The taxa-based method is not spatially explicit.

EPA used the taxa-based assessment to focus the species-specific analysis on types of direct effects (*e.g.*, mortality) or effects to PPHD that may be relevant to listed species or CHs. When EPA's FIFRA-based assessment (**Table 1-2**) showed that a RQ exceeded a listed species LOC, it does not automatically mean that the action may affect a specific species or CH. Instead, it means further species-specific review was needed to determine whether rodenticide use may affect a listed species or its CH. An RQ that does not exceed the listed species LOC does not necessarily mean that the species or CH determination is NE because potential effects to PPHD also need consideration. Therefore, EPA considered the life history, distribution of the species, and effects of the 11 rodenticides on organisms on which the listed species depends for PPHD before making the effects determinations. The sections below discuss the approach EPA used to make effects determinations for listed species and CHs.

The FIFRA-based risk conclusions of the rodenticides and the exposure considerations described below form the starting point for the effects determinations made for each listed species and the rationales for the effects determinations that are detailed in this final BE. The primary and secondary exposure concerns for each listed species and CHs are included in **Appendix B** and **Appendix C**.

2.2 Exposure Considerations

The taxa-based risk assessments for the 11 rodenticides (USEPA, 2020a-2020e) concluded that rodenticides do not pose a concern to non-target taxa via drift or runoff, as they are used primarily in bait stations, applied within burrows, or in granular form via broadcast. They do not pose a concern for inhalation or off-field movement via transport through the air because they are all non-volatile. Application of these pesticides incorporated into baits essentially eliminates off-site transport via runoff or drift and thus eliminates runoff and drift exposure concerns.

EPA considered off-site concerns for the 11 rodenticides from exposure to rodenticides through secondary exposure, that is, an animal consuming another animal that had directly consumed one of the rodenticides. Previous taxa-based risk assessments on these rodenticides concluded that non-target birds, mammals, reptiles, and terrestrial-phase amphibians may be at risk from dietary exposure to

[14] 50 CFR 402.40(b)(1) provides that EPA may describe in its effects determination a conclusion whether jeopardy to a listed species or adverse modification of any designated critical habitat is likely.

rodenticides, though the exposure concerns differ by chemical and use type (USEPA, 2020a-2020e). More specifically, those assessments concluded that all 11 rodenticides may pose a risk to non-target mammals that are primary consumers of bait whereas seven anticoagulant rodenticides (FGARs and SGARs), pose a risk to birds, terrestrial-phase amphibians, and reptiles that directly eat bait. Cholecalciferol does not pose an acute risk to birds, terrestrial-phase amphibians or reptiles that consume bait.

In the taxa-based risk assessments, EPA identified potential risk concerns for secondary consumers from all the rodenticides except cholecalciferol, but that potential secondary exposure risks are not equal among the rodenticides. One consideration is that bromethalin, strychnine, and zinc phosphide are all relatively fast acting (*i.e.,* mortality of primary consumers occurs within 1 and 24 hours), while the anticoagulant rodenticides (FGARs and SGARs) may take longer to result in mortality of the target pest. As a result, primary consumers of anticoagulants can accumulate larger amounts of the active ingredient (based on their fate properties), resulting in potentially higher exposure and likelihood of effects to secondary consumers. Another consideration is that there may be a longer period where anticoagulant-contaminated prey may be active, leading to a greater likelihood that secondary consumers that only eat live prey will be exposed; although this feature of the anticoagulants does not impact secondary consumers of carcasses (*i.e.,* scavengers; USEPA 2020a). However, not all anticoagulant rodenticides pose an equivalent potential risk of secondary exposure. In general, SGARs (*i.e.,* brodifacoum, bromadiolone, difenacoum, and difethialone) pose a greater potential risk compared to FGARs (*i.e.,* warfarin, chlorophacinone, and diphacinone) because they only require one feeding to kill the target pest whereas FGARs may require multiple feedings (USEPA, 2011). Multiple lines of evidence support these taxa-based risk conclusions, including RQs for primary and secondary consumers within various taxa that exceed the acute risk LOCs. The following section describes dietary exposure in terms of primary and secondary exposure and potential for effects.

For broadcast uses, the relevant exposure routes are by consumption of bait or treated grain found on the ground (primary consumer), or by consumption of a primary consumer (secondary consumer). For in-burrow uses, the relevant exposure route is by consumption of bait or treated grain found within treated burrows (primary consumer) or by consumption of a primary consumer (secondary consumer). For bait station uses, the relevant exposure routes are by consumption of bait within the bait station (primary consumer), or by consumption of a primary consumer (secondary consumer).

2.2.1 Primary Exposure

Primary exposure is defined as the direct consumption of rodenticide by a targeted rodent, or by non-targeted mammal, bird, reptile, or amphibian. Primary consumption may occur within a bait station, or on the landscape because of broadcast and in-burrow uses. Animals that feed on the ground or live in burrows are most likely to be exposed to rodenticides from primary exposure.

Primary exposure from in-burrow uses is more likely than from bait stations for a wider variety of non-target species given the restricted entrance to bait stations and placement near structures. For burrow uses, labels typically require bait to be placed several inches down into the burrow and cleanup of bait on the soil surface, which limits incidental exposure at the ground surface. Non-target animals that also utilize burrows have the highest likelihood of exposure, as they may enter the burrows of target pests, or their burrows may be treated by mistake. Secondary exposure from in-burrow treatments is limited by the tendency of burrow-dwelling pest species to die in their burrows rather than on the surface (Baldwin, *et al*., 2021).

The main mechanism for the prevention of primary exposure to non-target animals is use of tamper-resistant bait stations, which is required for all commensal rodent control in residential settings. Bait stations exclude animals that are too large to enter the station, or which are behaviorally unlikely to enter an enclosed space on the ground and next to a structure. Bait stations are attractive to rodents and are usually placed in areas of high rodent activity within the required 100-foot distance of a structure.

In general, there is a greater likelihood of exposure to non-target primary consumers from broadcast uses than burrow use or bait station uses given that the bait is scattered across the surface of the landscape. Rodenticides with broadcast use patterns are two of the FGARs (*i.e.*, chlorophacinone and diphacinone) and zinc phosphide. Non-target animals may be exposed by eating baits or pellets while foraging in agricultural fields.

Animals that are extremely unlikely to be exposed to rodenticides via primary consumption include but are not limited to fully aquatic species and terrestrial species whose habitat and feeding patterns suggest exposure is not reasonably certain to occur (*e.g.,* birds whose diet is entirely from the aquatic food web) (*see* **Section 2.6.1**).

2.2.2 Secondary Exposure

Secondary exposure refers to the consumption of rodenticide via predation/scavenging of primary consumer animals (*i.e.*, direct consumption of bait) by predators (*i.e.*, omnivores, carnivores, and scavengers). Examples of these types of species include but are not limited to vultures, owls, foxes, and large cats. EFED assumed that species that consume live animals or carrion may be secondary consumers of rodenticides.

In some cases, top predators or scavengers may consume animals that are themselves secondary consumers of rodenticide-poisoned mammals. This includes listed birds of prey, scavengers, and larger omnivores (*e.g.*, cranes and storks) as well as snakes and carnivorous mammals due to possible secondary and tertiary exposure from consumption of poisoned mammals. This is termed tertiary exposure and may occur in apex species such as the California Condor. For purposes of this final BE, tertiary exposure is treated as functionally equivalent to secondary exposure, with the main difference being that the spatial footprint of tertiary exposure may be greater than the spatial footprint for secondary exposure.

Secondary exposure can occur from all types of rodenticide uses, including bait stations, though secondary exposure from consumption of burrow-dwelling animals is limited by the tendency of burrow-dwelling pest species to die in their burrows rather than on the surface (Baldwin, *et al*., 2021). This exposure pathway is a possibility for all 11 of the rodenticides, but the likelihood of effects due to secondary exposure varies among them due to differences among the chemicals in terms of fate, metabolic, and toxicity properties.

Secondary exposure may include consumption of rodenticide contaminated terrestrial invertebrates because soil-dwelling invertebrates may encounter rodenticides through bait station, in-burrow, or broadcast uses; thus, becoming potential vectors of rodenticides to listed species that consume terrestrial invertebrates. For secondary exposure, it is unlikely that invertebrates represent a significant exposure pathway (*i.e.*, a listed species is unlikely to consume enough exposed invertebrates to elicit effects). In past taxa-based risk assessments, EPA concluded that predators of the target organisms (*i.e.*, rodents) are at significant risk of exposure as secondary consumers of the rodenticides, but predators of non-target organisms were not because of a lower likelihood of sufficient numbers of non-target prey items being contaminated with the rodenticides. EPA determined that consumption of soil dwelling invertebrates (or incidental consumption of soil containing baits) as a secondary route of exposure is extremely unlikely to cause adverse effects to individual listed species and the exposure is unlikely to lead to adverse effects on individual or population levels.

2.2.3 Chemical Specific Exposure Considerations

EPA addressed the differential toxicity, label use patterns, and exposure profiles of the 11 rodenticides by conducting a screen of each taxon of concern (*i.e.*, mammals, birds, reptiles, and amphibians). This screen identified potential for effects to primary and secondary consumers, by active ingredient and use (**Table 2-1**). The initial screen assumes that animals have access to bait (through primary or secondary consumption). EPA determined that exposure is not reasonably expected to occur at levels that could cause effects to listed species because they do not reasonably have access to the bait when applied indoors; therefore, EPA made an NE determination for all listed species and all designated CH for indoor uses and these uses are not considered further. When needed, EPA refined the high-level screen presented in **Table 2-1** with life history data and other considerations to make effects determinations for each listed species.

Table 2-1. Potential for Effects to Primary and Secondary Consumers from Exposure to the 11 Rodenticides by Application Method

Chemical	Bait Station		Burrow		Broadcast	
	Primary	Secondary	Primary	Secondary	Primary	Secondary
FGARs[1,2,3]	Yes[5]	Yes[5]	Yes	Yes	Yes	Yes
SGARs[4]	Yes	Yes	Yes[7]	Yes[7]	NA	NA
Zinc Phosphide[2,3]	Yes	No	Yes	No	Yes	No
Bromethalin	Yes	No	Yes	No	NA	NA
Cholecalciferol	Yes[6]	No	Yes[6,7]	No	NA	NA
Strychnine	NA	NA	Yes	Yes	NA	NA

[1] FGARs are chlorophacinone, diphacinone (and its sodium salt), and warfarin (and its sodium salt).
[2] EPA considers the effects determinations for broadcast use of zinc phosphide, chlorophacinone and diphacinone to be representative of those for the scatter/spot treatments.
3 EPA considers the effects determinations for broadcast use of zinc phosphide, chlorophacinone and diphacinone to be inclusive of those for the agricultural bait station uses. See 3.2.1 and 3.2.6 for information on potential impacts on effects determination for primary consumers.
[4] SGARs are brodifacoum, bromadiolone, difenacoum, and difethialone.
[5] Includes Feral Hog bait station use (warfarin).
[6] Mammals only
[7] For cholecalciferol and two of the SGARs (bromadiolone and difethialone), the only registered burrow uses are structural applications within 100 ft of a building and the bait station effects determinations for these chemicals are considered protective of this use.
NA = not applicable

2.3 Action Area

The action area includes all potential pesticide use sites (represented by Use Data Layers or UDLs[15]) or exposure areas at which effects on listed species or CH are reasonably expected to occur. The action area sets the geographic extent of the Federal action. The 11 rodenticides are primarily used in bait stations, within burrows, and on-field, all in bait formulations. EPA qualitatively considered off-site concerns for the 11 rodenticides mainly from secondary exposure to rodenticides through an animal consuming another animal that directly consumed rodenticides by estimating the size of the range of the secondary consumer or tertiary consumer. The use patterns of the 11 rodenticides preclude spray drift and runoff exposure concerns; thus, EPA did not need to add a buffer to the UDLs to account for these transport mechanisms.

EPA defined the action area as the area encompassing the use of the 11 rodenticides. The action area for this assessment includes the 48 contiguous Unites States (CONUS), Alaska, Hawaii and U.S. Territories including Puerto Rico (PR), Guam (GU), Commonwealth of the Northern Mariana Islands (CMNI), U.S. Virgin Islands (VI), and American Samoa (AS). Collectively, Alaska, Hawaii, PR, GU, CMNI, VI, and AS are referred to as the non-lower 48 [states] (*i.e.*, NL48). To define the action areas spatially, EPA conducted an overlap analysis assuming that the exposure area was limited to the use sites (*i.e.*, areas consistent with allowable rodenticide use).

EPA used the registered uses of rodenticides (**Appendix A**) to identify spatial data that represent potential application sites of rodenticides. The UDLs represent the potential locations of rodenticide applications in the CONUS and NL-48. The CONUS agricultural UDLs are based on 5 years of USDA's Cropland Data Layer (CDL). The draft BE used data from 2012-2017, whereas the final BE used data from 2018-2022, as new data became available since the draft BE (*see* **Appendix E** for additional information on the generation of the UDLs).

Given the widespread list of agricultural uses that are registered for the 11 rodenticides being considered, the Cultivated Layer UDL was used as opposed to the grouped UDLs that are more specific to individual crop groups.

For non-agricultural uses, EPA used UDLs derived from several other sources including the U.S. Geological Survey (USGS) National Land Cover Database (NLCD), and the National Oceanic and Atmospheric Administration (NOAA) Coastal Change Analysis Program (C-CAP) data layers. EPA represented developed areas using NLCD Developed or Open Space Developed land use categories (*i.e.*, where developed areas describe areas with man-made impervious cover, like urban or suburban areas. EPA used these Developed and Open Space Developed (OSD) UDLs to represent several rodenticide labeled uses that included structures or urban areas. EPA captured other non-agricultural uses in the UDLs for Ornamentals, Pastureland, Rangeland, Managed Forests, Forest Trees, Christmas Tree Plantations, Nurseries, and Rights-of-Ways. For descriptions about the development and underlying datasets in these Agricultural and Non-Agricultural UDLs see **Appendix E**. A crosswalk of UDLs with rodenticide use patterns is presented in **Table 2-2**.

[15] UDLs are spatial representations of where a pesticide may be used and is often grown out to reflect additional adjacent areas that may be exposed to the pesticide such as from run-off and/or spray drift.

Table 2-2. Crosswalk of UDLs with Rodenticide Use Patterns

<table>
<tr><th>Use</th><th>Rodenticide</th><th>UDLs Considered</th></tr>
<tr><td>Bait Stations</td><td>FGARs
SGARs
Bromethalin
Cholecalciferol
Zinc Phosphide</td><td>Open Space Developed
Developed</td></tr>
<tr><td>Broadcast</td><td>FGARs
Zinc Phosphide</td><td rowspan="2">Cultivated
Rangeland
Pasture
Right-of-Way
Nurseries
Managed Forest
Christmas Trees
Forest Trees</td></tr>
<tr><td>Burrow</td><td>FGARs
Bromethalin
Strychnine
Zinc Phosphide</td></tr>
<tr><td>Feral Hog Bait Station Use</td><td>Warfarin</td><td>Pasture
Rangeland
Managed Forest
Forest Trees
Christmas Trees</td></tr>
</table>

2.4 Overlap Analysis

The extent of overlap for the 11 rodenticides between likely exposure areas and the species' range or CH integrates information on potential use sites with the species locations. This approach considers overlap of the species range or CH with areas of potential use. The potential pesticide use sites are represented using Geographic Information System (GIS) layers developed from several data sources (*see* **Appendix E**). Due to the broad scope of labeled rodenticide uses, EPA did not implement further usage refinements as EPA does not have typical agricultural usage data for rodenticides. For many of the uses assessed, the actual area of use is expected to be less than the entire UDL, so the spatial extent of potential effects predicted in this assessment may be overstated.

This section describes the approach EPA used to determine the extent of overlap and the action area to support the effects determinations and overall potential impacts of the spatial analysis. The full inputs and outputs of the overlap analysis describing the determination of overlap of likely rodenticide exposure area and species ranges and critical habitat can be found in **Appendix F**.

2.4.1 Identifying Listed Species or CHs within the Action Area

For the draft BE, EPA used spatial data representing the listed species range and CH locations from the USFWS and NMFS as of February 16, 2022 (USFWS, 2022). The final BE used species ranges and CH from Dec. 2023. These updates impacted EPA's predictions of the potential likelihood of future J/AM in the draft BE for seven species and no CHs. To identify species or CHs within the action area, EPA looked across the maximum overlap for the individual UDLs and representative exposure areas.[16] This analysis captures the full geographic footprint of the action area by considering the potential exposure area

[16] The Use Data Layer Overlap Tool can be found at: https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological

where effects are reasonably expected to occur for each of the UDLs. A species range or CH is within the action area if it is found within one or more of the UDL exposure areas identified using the maximum overlap across all UDLs.

This overlap analysis was updated between the draft and final BE to account for both updated UDLs as well as updated species ranges and critical habitat. The draft BE used spatial files from February 2022. For the final BE, EPA updated its species list to include all listed species as of Oct. 2024. EPA excluded species that were delisted since the draft BE. The most up to date species range and critical habitat spatial files were from December 2023.[17]

The summary of important changes that were a result of this update are contained in **Appendix C**. However, changes to the final numbers of J/AM calls or individual calls themselves have already been updated in the final BE. Some new species and CH were listed as part of this update and resulted in new ranges and CH being assessed. For the species where EPA already made effects determinations in the draft BE, the updated overlap was compared to the old overlap for species and CH where the overlap was determinative in the predictions of potential likelihood of J/AM (*see* **Appendix C** for more details).

Given the categorical and temporal aggregations of UDLs described in **Appendix E** (*i.e.,* the UDLs may contain more than one crop and are based on 5 years of data), a single location could be accounted for in several UDLs. In the UDL method, this is referred to as "redundancy" in the UDLs. Typically, because of this redundancy, EPA does not add overlaps for a species or CH generated from multiple UDLs. The only exception in this analysis was for the Open Space Developed (OSD) UDL and Developed UDL, since they were meant to be representative of structural uses (*e.g.*, a bait station placed near a building). EPA made a more conservative assumption that looks at the sum of percent overlap from open space developed and developed UDLs to ensure that it did not exceed the overlap thresholds set within the scope of this analysis. Given the resolution of the data, this conservative approach accounts for the possible inaccuracies associated with representing structural uses with a single UDL, either Open Space Developed or Developed. Additionally, EPA had less of a concern with redundancy for both the OSD and Developed layer, since these UDLs are derived from the same base data, but separate categories that are mutually exclusive spatially (*see* **Appendix E** for additional details). For the other UDLs used as part of this analysis, there is spatial redundancy between layers. Given the redundancy across these UDLs, the sum of the individual UDLs would dramatically overestimate the total percent overlap. For this reason, EPA used the maximum value across UDLs at the maximum off-site distance to determine if a species is within the action area. While the use of maximum overlap across exposure areas for the UDLs does not represent the total overlap across all uses, given the existing redundancy of the use site and exposure areas, EPA considers this protective.

Given the known spatial relationship and correlation across the landscape, the general conservativeness of the spatial overlap analysis, and the accuracy[18] of the available UDLs, if the resulting maximum

[17] Range files - https://services.arcgis.com/cJ9YHowT8TU7DUyn/arcgis/rest/services/Species_Ranges_Static/FeatureServer
Critical habitat - https://services.arcgis.com/cJ9YHowT8TU7DUyn/arcgis/rest/services/Critical_Habitat_Static/FeatureServer

[18] EPA has used this 1% overlap criterion because a known source of error within spatial datasets is positional accuracy and precision. To prevent false precision when calculating area and the percent overlap it rounded to whole number to account for significant digits, where <0.44% is represented as 0 and 0.45% is represented as 1%.

overlap is <1%[19] for a species or CH, EPA made NE determinations for the species or CHs. For any NE determination, no additional analyses are needed (*see* **Section 2.6** below).

2.5 Consideration of Incident Data in the Weight of Evidence

The Incident Data System (IDS) is an Office of Pesticide Programs (OPP) database containing ecological incidents that have been reported to EPA. When available, IDS includes the date and location of an incident, type and magnitude of effects observed in various species, use(s) of pesticides known or suspected of contributing to the incident, and results of any chemical residue analysis or other analyses conducted during incident investigation. The IDS includes reports submitted to the EPA from sources such as state and federal agencies, registrants, members of the public, and other stakeholders.

In the process of making effects determinations, EPA included incidents as a part of the weight of evidence when estimating rodenticide impacts on listed species. EPA considered reported deaths and reported residues as evidence of exposure, and evidence of the potential for take, as defined by the ESA. EPA considered incidents in the making the initial effects determinations.

EPA has conducted numerous comprehensive evaluations of the available incident data, which show thousands of rodenticide related incidents reported since 1968. EPA presented the most recent evaluation in the 4 PIDs associated with the 11 rodenticides (USEPA, 2022a – 2022d) and reflected available incident information, as of March 2020. This final BE utilized the incident analyses from the RR DRAs. The 2020 DRA incident analyses also included open literature reviews of incidents that were not reported to the IDS (USEPA, 2020a - 2020e).

EPA categorizes the IDS incidents according to the certainty that the incident resulted from pesticide exposure. The recent evaluation described above excluded incidents classified as 'unlikely', 'unspecified', or 'unrelated' and only includes incidents with the certainty categories of 'exposure only', 'possible', 'probable', and 'highly probable.' The number of actual incidents associated with rodenticides is potentially much higher than what is reported to EPA. Incidents may go unreported since side effects may not be immediately apparent or readily attributed to the use of a chemical. Additionally, there is low likelihood of an animal being found by an individual and reported to EPA, the registrant, or a state agency even in cases where an incident occurs. Although FIFRA Section 6(a)(2) requires registrants to report incidents, incident reports from other sources are largely voluntary. The absence of incident reports does not indicate that the chemical has no effects on wildlife; rather, it is possible that incidents are unnoticed and unreported.

The FIFRA-based risk assessments for the rodenticides summarized over a thousand incidents involving mortality of non-target species, predominantly mammals and birds (USEPA, 2020a - 2020e). The available incident data indicate detectable levels of rodenticides in birds and mammals, including predatory animals that would be considered secondary consumers (*as defined in* **Section 2.2.2**). Listed species, including the San Joaquin kit fox (*Vulpes macrotis*) and Key deer (*Odocoileus virginianus clavium*), and genera proposed for listing, including kangaroo rats (*Dipodomys sp.*), were among the wildlife reported. In the process of making effects determinations, EPA included incidents as a part of the weight of evidence when estimating rodenticide impacts on listed species. EPA considered reported deaths and reported residues within animal tissues as evidence of exposure, and evidence of the

[19] The overlap is rounded to whole numbers due to the precision of the remotely sensed data; therefore <1% represents <0.44% with anything over 0.44% rounding up to 1%.

potential for take, as defined by the ESA. EPA considered each incident in making the initial effects determinations.

The incident data for this final BE is among the most robust data for any group of pesticides, with multiple mortalities associated with multiple active ingredients, demonstrating that the risk hypothesis has been confirmed for non-target effects.

2.6 Method Used for Listed Species Effects Determinations Including Predictions of the Potential Likelihood of Future Jeopardy

In the species-specific assessment, EPA first made generic, taxa-based effects determinations (*i.e.,* NE, MA/NLAA, and MA/LAA determinations) for the 11 rodenticides and use patterns based on the potential for effects to an individual of a listed species. One of the main factors when distinguishing between NE and MA is the potential for direct effects and effects to PPHD, which are based on estimated environmental concentrations (EECs), toxicity endpoints, exposure-to-effect ratios, species life history, and location of the species or CH. As described above, EPA also considers the degree of overlap of the species range and potential exposure areas. For MA determinations, EPA refined assumptions related to overlap and considered the potential likelihood of effects to an individual (considering whether life history may impact this potential likelihood). Additional information is provided below on the overlap analysis and the determinations.

2.6.1 No Effect (NE) and May Affect (MA) Determination Methodology

EPA first made taxa-based NE and MA determinations. For any species that does not have direct effects or effects when considering their PPHD (*i.e.,* when all relevant exposure-to-effect ratios are less than listed species LOCs) or the species is found outside of the action area, EPA made a NE determination. For any species where the taxa-based exposure-to-effect ratios indicate potential direct and/or effects to PPHD, EPA considered the overlap of the species range and each rodenticides' potential exposure area. EPA made NE determinations for species with <1% overlap of the entire range and each individual UDL.[20] For any NE determination, no additional analyses are needed. Since direct effects are not reasonably certain to occur to aquatic and terrestrial plants, aquatic and terrestrial invertebrates, and aquatic vertebrates, EPA made taxa level NE determinations (**Appendix B** and **Appendix C**) for species within these taxa.

There is a potential for effects to mammals, birds, reptiles, and terrestrial amphibians from dietary exposures or if one of these taxa depends on mammals for PPHD. In considering if a species is NE or MA, EPA first considered if any of the species from these taxa are not expected to consume rodenticide baits or are in the aquatic food web. For these species the major considerations for NE included:

- Overlap < 1% across all UDLs,
- Species consumes aquatic-based food items or is a marine species,

[20] EPA has used this 1% overlap criteria because a known source of error within spatial datasets is positional accuracy and precision. To prevent false precision when calculating area and the percent overlap it rounded to whole number to account for significant digits, where <0.44% is represented as 0 and 0.45% is represented as 1%.

- Species consumes insects found within the bark of the trees or wood boring beetles for which exposure is not expected to occur (*e.g.,* ivory-billed and red-cockaded woodpeckers or the akipaloaau),
- Species is fully aquatic (*e.g.,* aquatic amphibians),
- Species is restricted to experimental populations or uninhabited islands (*e.g.,* Guam kingfisher, Slevins skink)

EPA made MA determinations for species that did not meet one of the above considerations. For all species with MA determinations, EPA completed additional analyses to determine if each rodenticide is likely or not to adversely affect at least one individual of a species. EPA's process for NE/MA and MA/NLAA and MA/LAA determinations is outlined in the Key worksheet of **Appendix B.**

2.6.2 Not Likely to Adversely Affect (NLAA) and Likely to Adversely Affect (LAA) Determination Methodology

EPA made NLAA and LAA determinations by incorporating species life history considerations in determining the likelihood that rodenticide use will adversely affect an individual of a listed species (as described in the following sections).

2.6.2.1 Taxa-Level NLAA Determinations

After EPA made high-level taxa-level exposure NLAA determinations for some species (*i.e.*, generic to all chemicals and use patterns and described in the following paragraph), the remainder of the MA species were determined to be NLAA/LAA based on chemical and use pattern specific considerations due to the differential toxicity, labeled use patterns, and exposure profiles of each of the 11 rodenticides (*see* **Section 2.6.2.2**).

For the MA species, EPA made NLAA determinations for species in which exposure is considered discountable or insignificant due to their habitats (*e.g.,* forests, caves, remote habitats) or feeding preferences (*e.g.,* species is not expected to feed on bait or on primary consumers). For these species the major considerations for NLAA included:

- Species does not forage on ground (*e.g.,* fruit-eating or nectivorous species),
- Species consumes flying terrestrial invertebrates which are extremely unlikely to be in contact with the bait (*e.g.,* listed bats),
- Species is presumed extinct (and recommended for delisting) by the Services,[21]
- Species is semi-aquatic or restricted to specific wetland habitats, or riparian zones,
- Species is found in ravines, caves, crevices, slopes, sub-humid forests, restricted to mountaintops, high elevation, or tundra habitats where exposure is extremely unlikely to occur.

2.6.2.2 Refinements to NLAA Determinations

If the species did not pass the initial NLAA determinations (*i.e.*, applicable to all chemicals and used; *see* **Section 2.6.2.1**), EPA then considered additional refinements. For species that could be impacted if

[21] All the species that are presumed extinct are under the authority of USFWS. Species identified as presumed extinct are consistent with the USFWS's most recent national level BiOp (*i.e.,* for malathion; USFWS, 2022).

exposed and that were in the action area, EPA evaluated, on a chemical and use-specific basis, the likelihood and significance of potential effects to differentiate LAA and NLAA determinations based on major considerations including the chemical's toxicity, bioaccumulation potential, as well as the use profile including where the chemical is used and how it can be applied (*i.e.*, bait station, within a burrow, or broadcast). Lastly EPA made NLAA determinations if the use pattern is not expected in the species range or the species is not anticipated to be in the range of the target pest (*i.e.***,** FGAR broadcast applications are only made in the CONUS and strychnine target pests including the Northern pocket gopher (*Thomomys talpoides*) and Camas pocket gopher (*Thomomys bulbivorus*) are assumed to only occur in CONUS).

For burrow applications located away from a structure (*i.e.*, FGARs, bromethalin, strychnine, and zinc phosphide), EPA made NLAA determinations if:

- the species is not expected to enter the burrow due to its size and foraging behavior (*i.e.,* it is unlikely their dietary items will be contaminated by the bait since it is contained to the burrow),
- bait must be placed 6" into the entrance of the burrow, as it is not expected for birds to enter burrow or kick out bait and exposure is not expected to occur[22], or
- applications are intended to be made to active target pest burrows only rather than an inactive burrow- It is unlikely exposure would occur to non-target species if the burrow is already occupied by target pest.

For bait station applications (*i.e.*, FGARs, SGARs, cholecalciferol, bromethalin, and zinc phosphide), EPA made NLAA determinations if:

- the species is a primary consumer and the species' main dietary items are extremely unlikely to be contaminated with bait because the bait is specifically contained within the bait station,
- the species is a primary consumer, and its size precludes its entry into the bait station opening, and
- the species consumes invertebrates and since the bait is contained within the station, invertebrates are not expected to represent a significant exposure.

For broadcast applications (two of the FGARs (chlorophacinone and diphacinone) and zinc phosphide), no additional refined chemical-specific modifiers were applied due to the nature of the application across the surface of the landscape and all species were LAA that were identified in the taxa-based evaluation.

For the remaining MA species, that did not receive an NLAA determination, EPA made LAA determinations on a chemical and use pattern specific basis to take into account the differential toxicity and exposure profiles across the 11 rodenticides. EPA made LAA determinations when the rodenticide can be used within a species' range (overlap $\geq$ 1% for at least one UDL), exposure is reasonably expected to occur, and could lead to a potential adverse effect. Similarly, EPA made LAA determinations for listed species that depend upon mammals and overlap is $\geq$ 1% for at least one UDL and exposure is reasonably expected to occur and lead to a potential adverse effect.

[22] There is likely little chance for any significant non-target exposure because the target pest (pocket gopher) quickly wall-off disturbed sections of the burrow (Gene Benbow pers. comms 8/28/2023).

For the species where EPA made LAA determinations, EPA completed additional analyses to predict the potential likelihood of future J. EPA's approach to predicting the potential likelihood for future J is described below. This process is further outlined in the Key Worksheet of **Appendix B**.

2.6.3 Methodology Used to Predict the Potential Likelihood of Future Jeopardy

For those species and CH where EPA made LAA determinations, EPA then predicted the potential likelihood of future J to the species (*i.e.*, population level effects as opposed to effects to an individual as described above) or future AM to the CH. The potential likelihood of future J predictions is included in this assessment to better inform the USFWS consultation process and whether any additional mitigation may be necessary. The USFWS will make the final J/AM findings in any BiOp they issue at the end of the consultation process. When EPA assesses whether there is the potential likelihood of future J, it considers exposures and potential effects across the population. EPA considers life history information that may modify the magnitude of effects (MoEs). EPA would also consider any label changes or mitigations agreed upon by the registrants but not yet incorporated onto labels. Additionally, EPA identified mitigations in this biological evaluation that may be necessary to address predictions of potential likelihood of J/AM. The rest of this section explains in more detail the approach to making population-level effects determinations and predictions of the potential likelihood of future J to listed species for each of the 11 rodenticides.

EPA used the USFWS's draft BiOp for malathion (USFWS, 2021) as a guide in this assessment to predict the potential likelihood of future J for species from the registered uses of 11 rodenticides.[23] Although the USFWS malathion BiOp was finalized (USFWS, 2022), EPA used the draft BiOp because the final BiOp contained a no J opinion, whereas the draft BiOp included examples of species where USFWS proposed to find potential likelihood of future J. For purposes of the rodenticide BE, the USFWS malathion BiOp is representative of a national-level assessment for listed species because USFWS has authority for the majority of listed species and CHs within the action area of each rodenticide. Furthermore, in this final BE, EPA only made LAA determinations for listed species under USFWS's authority. EPA also used prior USFWS BiOps on some of the 11 rodenticides (*see* **Section 1.1**; USFWS, 1993 and USFWS, 2012) to serve as a guide for predicting the combination of potential exposure and species life history characteristics that would likely lead to potential likelihood of future J. Finally, EPA met regularly with the USFWS technical assistance during the development of the final BE, which informed the methodology and decision-making processes for species determinations and predictions of the potential likelihood of future J.

EPA predicted the potential likelihood of future J by primarily relying upon overlap[24] and MoE.[25] EPA integrated concepts similar to USFWS "risk modifiers" into the determinations. For each species, EPA assigned a high, medium, or low classification to both overlap and MoE. Like USFWS, if overlap was considered low (<5%), EPA predicted no potential likelihood of future J (no J). If overlap was medium (≥ 5 to ≤ 10 %) or high (> 10%) and MoE was considered low (based on both direct effects and effects to PPHD and relevant risk modifiers), EPA predicted no J. If there were no modifiers that decreased the

[23] Because all species and CH for which EPA made LAA determinations are under the authority of USFWS, EPA primarily relied upon USFWS' approach when predicting the potential likelihood of jeopardy and AM. During consultation, EPA will consider adjusting the approach as needed for those species and CH under the authority of NMFS.

[24] Referred to by USFWS as "usage"

[25] Referred to by USFWS as "risk"

likelihood of effects or degree of overlap, EPA predicted a potential likelihood of future J (predicted J). If overlap was medium or high and MoE was medium or high, EPA predicted J. Although USFWS incorporated species vulnerability into its malathion determinations, EPA did not consider this factor when predicting the potential likelihood of future J for the rodenticides. EPA may revisit the impact of species vulnerability in predicting the potential likelihood of future J for a species from this action.

For MoE, EPA assigned an initial low or high classification to each species based on the species taxonomy, life history, and other weight of evidence. For example, for mammals or a species which depends upon mammals for PPHD, or had LOC exceedances for direct effects, EPA determined that the initial MoE for population-level effects was high (because the screening-level assessment indicated that exposures are orders of magnitude above effects levels). EPA determined effects to listed non-target species of concern through assessing rodenticide levels in non-target taxa via the consumption of bait, based on both one-day consumption and consumption over multiple days. These effects are divided by the exposure of the rodenticides and used to estimate the MoE for each rodenticide. In addition, EPA then applied various effect modifiers for population-level effects that may influence the initial MoE (*see* **Table 2-3**). **Section 3** provides further detail on chemical and use pattern considerations used by EPA to refine the MoE determinations.

Table 2-3. Magnitude of Effect (MoE) Categories and Effect Modifiers for Predictions of Potential Future Jeopardy[1]

Chemical Class	MoE Classification	MoE Justification
FGARs	High	**Bait Station and Broadcast exposures to mammal and non-mammal secondary consumers:** High MoE based on LOC exceedances at the mortality-based acute dietary No Observed Adverse Effect Concentration (NOAEC) & reproductive effects in the birds that survived (ACR estimated). In addition, species diet is made up of a large proportion of rodent prey.
	High	**Bait Station and Broadcast exposures to non-mammal primary consumers:** High MoE based on LOC exceedances at the mortality-based acute dietary NOAEC & reproductive effects in the birds that survived (ACR estimated).
	High	**Bait Station, Burrow & Broadcast exposures to mammal primary consumers:** Similarity to target pests (direct effects to mammals).
	Low	**Bait Station and Broadcast, exposures to mammal and non-mammal secondary consumers:** Species is an omnivore and consumes other terrestrial vertebrate prey. Since FGARs take multiple feedings to result in mortality and since this species is an omnivore and occasionally only consumes small mammals (eating a wide variety of plant and animal matter) it is not as likely that the target pest will constitute a large proportion of their diet.
	Low	**Burrow, exposures to mammal and non-mammal secondary consumers:** The MoE is low because the vast majority of mortalities are expected to occur belowground (82–91%), likely reducing the extent of secondary exposure to occur at the population level (Baldwin et al., 2021). Since FGARs require multiple feedings to achieve a lethal dose, there is the potential for prey to be available on the surface with less than lethal concentrations and the capacity to evade predators is the same as before exposure.

Chemical Class	MoE Classification	MoE Justification
SGARs	High	**Bait Station, exposures to mammal and non-mammal secondary consumers:** Collectively, the MoE for SGARs is high, since RQs exceed the LOC for mortality-based endpoints and species diet is made up of a large proportion of rodent prey.
	High	**Bait Station, exposures to non-mammal primary consumers:** Similarity to target pests (direct effects to mammals).
	Low	**Bait Station, exposures to mammal and non-mammal secondary consumers:** Species is an omnivore and consumes other terrestrial vertebrate prey and it is not as likely that the target pest will constitute a large proportion of their diet.
Bromethalin	High	**Bait Station exposures to mammal primary consumers**: Species is a primary consumer and similar to the target pest (mammals).
	Low	**Bait Station exposures to mammal and non-mammal secondary consumers:** Species is a secondary consumer and since bromethalin has low persistence in gut it will not bioaccumulate to high enough concentrations to cause effects.
Cholecalciferol	High	**Bait Station, exposures to mammal primary consumers:** High because of similarity to target pests (direct effects to mammals).
	Low	**Bait Station, exposures to mammal secondary consumers:** MoE is low because cholecalciferol has a low risk of secondary poisoning.
Strychnine	High	**Burrow exposures to mammal primary consumers**: Species is a primary consumer and similar to the target pest (mammals).
	Low	**Burrow exposures to mammal and non-mammal secondary consumers:** The MoE is low because the vast majority of mortalities are expected to occur belowground (82–91%), likely reducing the extent of secondary exposure to occur at the population level (Baldwin et al., 2021).
Zinc Phosphide	High	**Bait Station and Broadcast exposures to mammal primary consumers:** Similarity to target pests (direct effects to mammals).
	High	**Bait Station and Broadcast exposures to non-mammal primary consumers:** RQs for primary consumers range from 43-546. ZnP is applied as a broadcast application and is available for primary consumers.
	Low	**Bait Station, Burrow & Broadcast exposures to mammal and non-mammal secondary consumers**: Species is a secondary consumer and likelihood of effect is dependent in part on the consumption of the GI tract of the poisoned animal by the predator or scavenger and secondary poisoning from ZnP is uncommon and is not as persistent compared other rodenticide classes

[1]Only applies to species with LAA effect determinations (*see* **Appendix B** for further detail).

2.7 Method Used for Critical Habitat Effects Determinations and Predictions of the Potential Likelihood of Future Adverse Modification

As of Oct. 2024, there are 927 species with CHs included in this assessment. Among those, there are 147 CHs for the taxonomic groups with potential direct effects or effects to PPHD; that is, birds, reptiles, amphibians, and mammals. There are many similarities between the species analysis and the CH analysis. For example, EPA also used the overlap approach described above to determine the extent of overlap between the action area and CHs. EPA obtained spatial locations of CHs from the USFWS and NMFS.

For each CH, EPA made single overall CH determination that was based on the entire chemical class (*i.e.,* the 11 rodenticides) and all use patterns because effects to both habitat and loss of mammalian prey (details discussed below) are generally similar across all rodenticides and use patterns. EPA based the CH determination on effects to PBFs requiring mammal prey or burrow use, not direct effects (*i.e.,* from primary consumption of bait or secondary consumption of the rodenticide through contaminated prey). EPA accounted for direct effects to species within the CH in species effects determinations and to avoid redundancy, they were subject to overlap considerations specific to that CH. EPA then made rodenticide MOA group/use pattern specific refinements to CHs with predictions of potential likelihood of future AM based on all chemical classes and use patterns. This refinement was based on overlap specific to the use pattern.

EPA made NE determinations for CH if the species and its PPHD are not expected to be impacted within the CH (*i.e.,* if all relevant taxa-based RQs are < LOCs; based on life history information for the species) following the same reasons described in **Section 2.6.1**. This included CH for all plants, fish, and invertebrates. EPA also made NE determinations if all UDLs that are associated with potential rodenticide uses collectively had < 1% overlap.

One key difference between the CH and species analyses is that the Services define PBFs that are necessary for the CH to support the species for which it was designated. EPA concluded that two PBFs are relevant to the use of rodenticides. The first PBF is the availability of mammalian prey because rodenticides are intended to reduce or eliminate rodent populations in local areas. Therefore, EPA considered rodenticide use a potential modification of CH for listed species, in particular predatory mammals, birds, and reptiles that may consume rodents as a large part of their diet. For this analysis, EPA made a distinction between rodent and non-rodent mammalian prey populations. EPA considered it unlikely that the overall availability of non-rodent prey would be substantially impacted within the CH because they are not the target species of the rodenticides. The second PBF is the availability of animal burrows for shelter or other purposes because one of the primary uses of the rodenticides is to reduce or eliminate burrowing rodents. Therefore, EPA considered rodenticide use for burrowing rodents could lead to reductions in rodent populations, which would subsequently lead to a potential decrease in the availability of burrows.

EPA made a NE determination if a species does not consume terrestrial mammalian prey, use burrows, or have a PBF associated with those. Therefore, a MA determination was made if a species consumes terrestrial mammalian prey, uses burrows, or has a PBF associated with those. EPA made a NLAA determination for CH if the availability of mammalian prey and burrow use were part of the species PPHD (based on the EFED life history database), but the USFWS did not indicate that availability of small mammal prey or burrow use were relevant (*i.e.,* based on methodology in Appendix L of the malathion BiOp). For species where PBFs are not defined for a CH, EPA used the best available information on the species life history from the USFWS and the EFED life history database to make NLAA and LAA determinations for critical habitat.

EPA made LAA determinations for species CH with PBFs that include the availability of mammalian prey or burrow use (terrestrial habitat quality) and ≥ 1% spatial overlap of rodenticide use and CH. In some cases, PBF's have not been defined for CH. In those instances, EPA made LAA determinations when there is ≥ 1% spatial overlap and best available information indicates that the species consumes mammal prey or uses burrows. Using similar methods as described in **Section 2.6.3**, EPA then predicted the potential likelihood of future AM, primarily relying upon the extent of spatial overlap between the CH and various UDLs and various effects modifiers that can influence the likelihood of exposure. EPA applied additional modifiers including if the species is an omnivore (*i.e.,* not an obligate to mammal prey) and considered if the species makes their own burrow or inhabits that of another species (*see* further detail in **Section 4**).

3 Species Effects Determination Results

3.1 General Effects Determinations at a Taxa-Based Level

EPA first made effects determinations for listed species at a taxa-based level, considering all 11 rodenticides and routes of exposure following the methods described in **Section 2.6**. The effects determinations include NE determinations for all aquatic and terrestrial plants, aquatic and terrestrial invertebrates, and aquatic vertebrates. The next section describes the taxa-based determinations in more detail.

3.1.1 Overview of No Effect (NE) Determinations

EPA made NE determinations following methods described in **Section 2.6.1** for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects. EPA based NE determinations on low overlap, no direct toxicity and/or no dependence on mammalian or other terrestrial vertebrate prey items for PPHD. Primarily, EPA's NE determinations included the terrestrial and aquatic plants, aquatic and terrestrial invertebrates, aquatic vertebrates, and those mammals, birds, terrestrial-phase amphibians, and reptiles in the aquatic food web for which no direct effects or effects to PPHD were identified. Collectively, these taxa were determined to be NE (see **Section 2.6.1)**. The USFWS 1993 BiOp, which included 8 of the 11 rodenticides, includes similar evidence for NE determinations, and includes such determinations for plants (USFWS, 1993).

Species and CHs with <1% overlap for all UDLs

For any remaining species or CHs after the first step, EPA made NE determinations for all species or CHs with <1% overlap with all UDLs. If a species or CH had 1% or more overlap with at least one UDL and that species may be a primary consumer of bait, a secondary consumer of prey that consumed the bait, or have effects due to loss of PPHD (*e.g.,* species relies on mammal burrows), then EPA made an MA determination. MA determinations are discussed below.

3.1.1.1 Terrestrial, Wetland and Aquatic Plants

EPA made NE determinations based on species where exposure is extremely unlikely to occur at a level that could cause effects and considered species habitat and diet. EPA made NE determinations for all listed plants because direct effects and exposure to this taxon are not expected to occur. This is because the modes of action of the rodenticides (*e.g.*, anticoagulants and neurotoxins) apply to vertebrate animals only, not to plants. To evaluate potential effects to PPHD from the loss of mammal pollinators, EPA evaluated the pollinator vectors for each listed species of plant. Of the listed species of plants, only three rely on pollination from mammals (*see* "Plants" worksheet in **Appendix B**). EPA made NE determinations for the three plant species that rely on mammals. One listed plant (Higuero de sierra, *Crescentia portoricensis*) specifically relies on bats for pollination. Since EPA made an NLAA determination for bats (*see* **Appendix B**), no effects to the Higuero de sierra are expected. The second two species are pollinated by multiple taxa including mammals, birds, and invertebrates. EPA made NE determinations for these two listed plants (Chupacallos and Ufa-halomtan), because the plants have a variety of pollination options; therefore, any effects to mammal or bird pollinators would be negligible in the environment in the context of all potential pollinators in the range of these plants. Effects determinations for plants can be found in the "Plants" worksheet in **Appendix B** and **Appendix C**.

3.1.1.2 Aquatic Animals

EPA made NE determinations for all freshwater and marine fish, aquatic mammals, aquatic amphibians, aquatic reptiles, and aquatic invertebrates. EPA made NE determinations for aquatic animals as exposure is not reasonably certain to occur because the application sites of rodenticides (bait stations and burrows on terrestrial sites) and the formulations of the bait (granules) are unlikely used near aquatic habitats. Pesticide labels generally require that pesticides not be applied to water or below the mean high-water mark in tidal areas unless specifically intended for aquatic use. Also, the target pests (mice, rats, voles, prairie dogs, etc.) are terrestrial species, so application of rodenticides is expected to be only in terrestrial areas. Of the use patterns, only broadcast is subject to exposure to the weather, and this is limited to a few agricultural crops, and to rodenticides that are either immobile or non-persistent, making potential exposure discountable. Furthermore, the DRAs determined that only terrestrial vertebrates have potentially significant exposure, therefore, aquatic organisms are not further considered in this final BE. NE determinations were made for all aquatic animals (USEPA, 2020a-2020e). Effects determinations for aquatic animals can be found in the "Fish", "Mammals", "Amphibians", "Reptiles", and "Aquatic invertebrates" worksheets in **Appendix B** and **Appendix C**.

3.1.1.3 Terrestrial Invertebrates

EPA made NE determinations for all terrestrial invertebrates, as direct effects to the taxa were not reasonably certain to occur. The EPA evaluated the toxicity of terrestrial invertebrates for each rodenticide, with limited data in the FIFRA-based 2020 DRAs, and concluded that rodenticides exhibit low toxicity (USEPA, 2020a-2020e) to terrestrial invertebrates. The low toxicity means effects from exposure are unlikely for ground-nesting bee species that may be exposed to rodenticides through using rodent burrows. Since there is a low likelihood of exposure on-site, and offsite exposures to non-target areas (via spray drift, volatilization and runoff) are not reasonably certain to occur, rodenticides do not pose an appreciable risk to terrestrial invertebrates. The Rozol BiOp (USFWS, 2014) similarly noted that chlorophacinone adverse effects are unlikely for the American burying beetle (*Nicrophorus americanus*), which consumes carrion (USFWS, 2014).

EPA considered the potential for soil-dwelling invertebrates that may encounter rodenticides through burrow, bait station or broadcast uses to be potential vectors for rodenticides to listed species that consume them, thus making terrestrial invertebrate consumption a potential method of secondary exposure. For secondary exposure, it is unlikely that invertebrates represent a significant exposure pathway (*i.e.*, listed species is unlikely to consume enough exposed invertebrates for toxicity). This rationale is further characterized in the following chemical-specific effects determinations sections. Effects determinations for terrestrial invertebrates can be found in the "Terrestrial invertebrates" worksheet in **Appendix B** and **Appendix C**.

3.1.2 Overview of May Affect (MA) Not Likely to Adversely Affect (NLAA) and Likely to Adversely Affect (LAA) Determinations

EPA made an MA determination because of the potential for direct effects from primary exposure to rodenticides from the consumption of bait. Species with MA determinations may also incidentally consume bait while foraging for soil-dwelling invertebrates, which would be considered primary exposure. In addition, EPA anticipates effects for some MA species from secondary exposure from the consumption of birds, mammals, terrestrial-phase amphibians, or reptiles and exposed soil-dwelling invertebrates. Primary exposure could occur for birds that consume bait. EPA assumed that birds that primarily consume seeds are also likely to consume rodenticide bait. This assumption is due to the similarity of some rodenticide use formulations (*e.g.,* broadcast pellets) that may resemble seeds as dietary items. Some mammalian species (*e.g.*, the San Joaquin kit fox) received MA determinations based on the possibility of consumption of rodenticides through consumption of herbivores.
MA determinations were also made for species that have the potential for secondary exposure due to effects to PPHD and from consumption of contaminated prey. At this stage EPA narrowed down the taxa that have the potential for direct effects to include bird, mammals, reptiles and terrestrial-phase amphibians.

3.1.3 Overview of Initial Not Likely to Adversely Affect (NLAA) Determinations

The NLAA determinations are driven by an assumption that rodenticide exposure leads to discountable effects, (*i.e.*, effects are extremely unlikely to occur), insignificant effects, or wholly beneficial effects. These determinations are based on the likelihood of direct effects and exposure occurring based on different habitat characteristics, diet and feeding behaviors, and effects to PPHD. Overall, across taxa, EPA made NLAA determinations if a species was presumed extinct by USFWS. NLAA determinations can be found in **Appendix B** and **Appendix C** and followed the method outlined in **Section 2.6.2**. **Table 3-1** summarizes the initial effects determinations considering all routes of exposure.

Table 3-1. Number of Initial Listed Species Effects Determinations Across All A.I.'s by Taxon[1,2]

Taxon	Number of Species	NE	Initial NLAA Determinations across all A.I.'s
Mammals	100	25	21
Birds	95	25	28
Amphibians[3]	47	12	23
Reptiles	59	25	4
Terrestrial Invertebrates	164	164	0
Aquatic Invertebrates	209	209	0
Plants	946	946	0
Fish	207	207	0
Total	**1,827**	**1,613**	**76**

[1] EPA made effects determinations and predictions of the potential likelihood of future jeopardy for listed species and the details on these can be found in **Appendix B** and **Appendix C**.
[2] Reflects listed species current as of Oct. 2024. This includes accounting for delisted species. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction
[3] "Amphibians" include those species that have both a terrestrial and aquatic phase.
A.I.s=active ingredients; NE = no effect; NLAA = not likely to adversely affect

3.1.3.1 Birds

Initial NLAA determinations for birds included species which inhabit areas or have feeding behaviors which would suggest exposure is extremely unlikely to occur. The main modifiers used for NLAA determinations included:

- species found at high elevations,
- species is presumed extinct (*i.e.,* Palila, thick-billed parrot and white-necked crow),
- species is found on remote uninhabited islands (*e.g.,* Nioha and Laysan finches),
- species gleans insects off foliage or consumes flying terrestrial invertebrates (aerial insectivores) which are less likely to be in contact with the bait,
- species forages in the canopy or subcanopy, or,
- species is nectivorous.

EPA evaluated the remaining species on a chemical and use-specific basis to be NLAA when exposure is not reasonably expected to occur based on major considerations including the chemical's toxicity and bioaccumulation potential, as well as the use profile, including where the chemical is used and if it can be applied as a bait station, in a burrow, or as a broadcast application. Effects determinations for birds can be found in the "Birds" worksheet in **Appendix B**.

3.1.3.2 Reptiles

EPA made an initial NLAA determination for one listed species of reptile (Culebra Island giant anole; *Anolis roosevelti*) because the best scientific and commercial information lead USFWS to conclude that the Culebra Island giant anole is extinct.[26] Effects determinations for reptiles can be found in the "Reptiles" worksheet in **Appendix B** and **Appendix C**.

3.1.3.3 Amphibians

As discussed above, EPA made NE determinations for those amphibians that are fully aquatic (*i.e.,* spends its entire life submersed in water) and/or in the aquatic food web. NLAA determinations for listed amphibians included species which inhabit areas in which exposure is extremely unlikely to occur. In addition to habitat modifiers (*e.g.,* elevation, sub-humid tropical forests, rock crevices/caves, steep ravines), amphibians preferentially feed on live moving prey and are unlikely to eat the bait directly. It is also unlikely the species' main dietary items (live invertebrates) represent a significant exposure pathway. Amphibians did not rise to LAA in the USFWS 1993 BiOp of 8 of the 11 rodenticides (USFWS, 1993), which further supports EPA's effects determinations in this assessment. Effects determinations for amphibians can be found in the "Amphibians" worksheet in **Appendix B** and **Appendix C**.

3.1.3.4 Mammals

Initial NLAA determinations for mammals included species which have feeding behaviors that would suggest exposure is extremely unlikely to occur. EPA made NLAA determinations for all listed bats. Bats mainly prey on flying terrestrial invertebrates, insects that crawl on trees, or other dietary items that are extremely unlikely to be in contact with rodenticide bait (compared to soil-dwelling invertebrates) and exposure is not reasonably expected to occur. EPA made NLAA determinations for mammals, including bighorn sheep and the woodland caribou, that inhabited areas in which rodenticide exposure is extremely unlikely to occur, including remote areas where commensal rodenticide uses were unlikely. EPA made NLAA determinations for mammals that were likely extinct. Effects determinations for mammals can be found in the "Mammals" worksheet in **Appendix B** and **Appendix C**.

3.1.4 Overview of Initial Likely to Adversely Affect (LAA) Determinations

In general, LAA species effects determinations are driven by an assessment of the likelihood of effects from primary exposure to bait; that is, from being attracted to the bait, from incidental consumption foraging for invertebrates (soil-dwelling) and other food items (*e.g.,* seeds) on the ground, or the species might utilize mammal burrows. In addition, LAA determinations were also driven by the potential for secondary and tertiary exposure from the consumption of mammals, birds, terrestrial-phase amphibians, and/or reptiles (*see* **Section 2.2.1** and **2.2.2**) due to the potential for rodenticides to bioaccumulate and persist in tissues of animals that had consumed the bait through primary or secondary exposure (*see* **Section 2.2**). See **Appendix B** and **Appendix C** and the following sections on the specific active ingredients for details on species-specific LAA determinations.

3.2 Overview of Refined Use Pattern and Rodenticide-Specific Effects Determinations

For the remaining species with MA determinations that did not receive an initial NLAA determination (*see* **Section 2.6.2.1**), EPA considered refinements to make chemical and use-specific NLAA/LAA

[26] USFWS. 2023. Culebra Island Giant Anole 5-Year Review. USFWS Southeast Region. https://ecosphere-documents-production public.s3.amazonaws.com/sams/public_docs/species_nonpublish/4087.pdf

determinations due to the differential toxicity, use patterns, and nuances with exposure profiles of each of the 11 rodenticides. For each species-rodenticide/use combination, **Appendix B** and **Appendix C** provides a detailed justification for the NE, NLAA, LAA, and predicted likelihood of potential future J determinations. The following sections begin with an introductory section that goes over previous regulatory decisions, provides background on the chemical risk profile (primarily from FIFRA-based risk assessments), chemical fate information, and the labeled uses of the chemical(s). The next section presents information on incidents involving the chemicals. That is followed by a description of the spatial overlap of labeled uses for the chemicals. Finally, EPA presents the NE, MA, NLAA, LAA determinations with predictions of no likely future J, and LAA determinations with predictions of likely future J made for each labeled-use pattern (*i.e.,* bait station, burrow, broadcast) by taxa (birds, reptiles, amphibians, and mammals).

3.2.1 First-Generation Anticoagulant Rodenticides (FGARs)

3.2.1.1 Introductory Information on FGARs

EPA signed the FIFRA-based draft environmental risk assessment (USEPA, 2020a) for seven anticoagulant rodenticides (AR) for the RR program on March 17, 2020. These include three first-generation ARs (FGARs; warfarin, chlorophacinone, diphacinone). EPA has completed ESA consultation for diphacinone and chlorophacinone for the control of the Black-tailed prairie dog for the formulated products called Rozol and Kaput (respectively). The 1993 USFWS BiOp for vertebrate control agents (USFWS, 1993) included all 3 FGARs (*see* **Section 1.2**).

The potential impact to mammals and birds from FGARs is well-established (USEPA, 2020a) and includes mortality from primary and secondary exposure, as well as longer-term effects on growth and reproduction. Primary exposure is defined as consumption of treated bait by target or non-target organisms. Secondary exposure is defined as predation/scavenging and consumption of exposed primary consumers (*see* **Section 2.2**). Target and non-target taxa that consume ARs via bait boxes bioaccumulate residues of the ARs that are persistent in biological tissues moving from bait boxes into the environment, sometimes far from the treatment area because FGARs do not result in immediate toxicity and may take multiple feedings to result in toxicosis.

The FGARs present an acute hazard[27] to mammals, birds, amphibians, and reptiles. Generally, the likelihood of secondary poisoning of carnivores and scavengers is less for FGARS than for SGARs because FGARs are less persistent in the environment and in the bodies of primarily exposed animals. While reproductive effects in mammals due to exposure to FGARs may be presumed, exposed individuals are more likely to die before having the chance to reproduce. Thus, mortality rather than reproduction will likely drive population-level effects. EPA has evaluated several repeat-dose or extended exposure duration studies. These studies demonstrated that exposure to low doses over an extended period can impact birds and mammals and that chronic exposures to low doses of AR rodenticides may be a concern for all 7 ARs. This analysis (USEPA, 2020a) indicated that toxicity of FGARs is substantially enhanced in studies that utilize repeated exposures, such as reproductive toxicity assays and subacute repeated dose dietary toxicity studies.

[27] Hazard only reflects relative toxicity. The hazard is not synonymous with likely effects to individuals or populations because it does not consider the likelihood or magnitude of exposure.

EPA made effects determinations for warfarin from feral hog bait station use on a nationwide basis because there are not geographic restrictions on the product label; however, EPA notes that the product is currently only approved for use at a local/state level in Texas and Oklahoma.

EPA made effects determinations for chlorophacinone and diphacinone based on bait station, burrow, and broadcast uses. EPA considers the effects determinations for broadcast use of those two chemicals to be representative of those for the scatter/spot treatments because the amount of bait put on the landscape surface during a scatter/spot treatment should be equally as lethal to non-target primary consumers as that for a broadcast application and the bait should be equally accessible to those species for both types of application. EPA expects to further discuss this with USFWS during consultation.

Furthermore, bait station uses of chlorophacinone and diphacinone are permitted in some agricultural areas. Although, EPA made effects determinations for bait station use with chlorophacinone and diphacinone for non-agricultural areas, the effects determination for broadcast use and/or scatter/spot treatments is inclusive of bait station uses in the same location. That said, bait stations use instead of broadcast use in these locations would reduce the exposure to primary consumer terrestrial vertebrates that cannot access the bait within the stations, meaning that there is potentially no J for those species that EPA predicted to have potential likelihood of J for broadcast uses at the same locations. EPA believes effects determinations for secondary consumers are the same in agricultural field settings whether the bait is applied by broadcast or in a bait station. EPA expects to further discuss this with USFWS during consultation.

For mammals, single day feeding and multiple day feedings resulted in acute LOC exceedances. Further information on endpoints used to calculate RQs for the FGARs is available in the FIFRA-based draft environmental risk assessment of seven anticoagulant rodenticides (USEPA, 2020a).

Chlorophacinone and diphacinone have agricultural uses that involve broadcast and rodent burrow application and therefore may cause exposure to a wide variety of animals. The FGARs are also used in bait stations for commensal rodent control. Diphacinone is used in island rodent eradication projects, both as broadcast and in bait stations, under the supervision of federal agencies such as APHIS and USFWS. Warfarin is used in specialized bait stations for the control of feral hogs. In EPA's FIFRA-based risk assessment of broadcast and floating bait station uses for two FGARs (*i.e.*, chlorophacinone and diphacinone) found the uses not to be of concern for aquatic taxa (USEPA, 2020a). However, the FIFRA-based risk assessment concluded that there was a risk concern for terrestrial vertebrates.
FGARs are considered non-persistent to slightly persistent, and moderately mobile to hardly mobile. They are not considered bio-concentrating in aquatic organisms, with the possible exception of diphacinone (LogP = 4.85). The potential for secondary poisoning is influenced by the half-life of the FGAR in the body of the primarily exposed animal. Persistence of AR residues in the bodies of primary consumers is often sufficient to cause mortality in secondary consumers. The first-generation anticoagulants require several days of consecutive feedings to deliver a lethal dose, and death does not occur until 5-7 days after the feeding. Exposure in water is considered negligible because of the use of bait stations. Even in cases where rodenticide bait may be broadcast on the surface, their formulation into baits, low mobility, and/or low persistence and low toxicity to aquatic organisms make aquatic exposures unlikely and potential effects negligible even if exposure did occur (*see* **Section 2.2**). The residue of concern for the FGARs is the parent compound only, due to degradation to non-toxic residues. Because the half-life of diphacinone in rat liver is 35 days (USEPA, 2020a), secondary poisoning by diphacinone is more likely than for the less persistent chlorophacinone (12 days half-life in rat liver).

Additionally, warfarin is less likely to represent a threat to secondary consumers due to lower persistence and lower exposure, respectively.

3.2.1.2 General Conclusions from the Incident Analysis

Since 1971, there are over 2,000 incidents associated with the use of rodenticides recorded in the IDS. 63% of these incidents (804 total) occurred between 2010 and 2018, indicating that exposure and wildlife incidents have continued in recent years. With regards to listed species, incidents have been reported for listed species such as San Joaquin kit fox, bald eagle (*Haliaeetus leucocephalus*), and Key deer. The San Joaquin kit fox has had several recent incidents related to anticoagulant rodenticides.

Due to their robust reporting systems relative to other states, the states of California and New York account for 58 and 21% of reported incidents for the evaluated rodenticides. Open literature studies (Murray, 2017; Serieys et al., 2015; Slankard et al., 2019) on rodenticide incidents suggest that ARs have a significant likelihood to impact non-target wildlife. Anticoagulant rodenticide incidents are generally based on detection of residues in liver tissue and corroborating evidence from carcass necropsy. Analysis of incident reports in the AR DRA (USEPA, 2020a) indicates that secondary exposure to FGARs is occurring and causing mortality, although to a much lesser extent than SGARs. Recent FGAR incidents have been noted in great horned owl (*Bubo virginianus*), barn owl (*Tyto alba*), red-tailed hawk (*Buteo jamaicensis*), bald eagle, and other species. In mammals, FGAR incidents in coyote (*Canis latrans*), mountain lion (*Puma concolor*), bobcat (*Lynx rufus*) and other species confirm the potential for secondary effects. Of the three FGARs, diphacinone had the most reported overall incidents (122) followed by chlorophacinone (54) and warfarin (23; USEPA, 2020a).

Overall, it appears that SGARs rather than FGARs are the drivers of secondary poisoning in wildlife, however diphacinone appears to rank with the SGARs (122 incidents). Of 656 total applicable bird incidents in IDS since 1971, SGARs were involved in 90% and FGARs in 10%. Of 607 total incidents involving mammals in IDS since 1971, 78% were due to SGARs and 22% to FGARS. EPA counted incidents with multiple AR residues separately for each rodenticide (USEPA, 2020a).

The reported incident data show an apparent increase in wildlife exposure and deaths since 1971. This may be attributed to greater effort in seeking out incidents, especially in California. The data presented in this assessment therefore do not necessarily represent an increase in incidents, but instead show that upon closer examination, incidents continue and have apparently not decreased despite the introduction of bait box uses. The available incidents are consistent with the established FIFRA-based risk profile and exposure concerns described in this evaluation.

3.2.1.3 Defining Spatial Overlap

Diphacinone and chlorophacinone may be used in commensal rodent control, agricultural broadcast, and in-burrow uses. Warfarin is used in commensal rodent control, although not as widely today because of the development of resistance in rodent populations. Warfarin is also registered for the control of feral hogs with the use of special hog bait stations.

Overall, the action area for FGARs will be represented by Developed and Open Space Developed UDLs for the commensal rodent control uses, and by agricultural UDLs (cropped land) for diphacinone and chlorophacinone. Overlap analysis of listed species ranges with these UDLs indicates that none of the species has less than 1% overlap. The feral hog bait station use is represented by UDLs for rangeland and managed forest (*see* **Section 2.4**).

3.2.1.4 Birds

EPA considered 95 bird species for exposure to FGARs from bait station, burrow, and broadcast uses. Of these, EPA determined 25 to be NE because of lack of exposure (marine species) or dietary considerations (aquatic food web or insects within the bark of trees) (*see* **Section 2.6.1)**.

Table 3-2 summarizes the effects determinations for birds from FGARs. All NLAA, LAA/No J and LAA/J determinations and justifications for listed birds can be found in the "Birds" worksheet in **Appendix B** following methodology in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**. Conclusions from **Appendix B** are summarized in the following sections; however, the reader is directed to **Appendix B** for additional information.

Table 3-2. Summary of Effects Determinations and Predictions of Potential Likelihood of Future Jeopardy for Listed Birds within the Action Area

Use Pattern	NLAA	LAA, No J	LAA, J
Bait Station	54	9	7
Feral Hog Bait Station (Warfarin)	68	0	2
Burrow (Chlorophacinone and Diphacinone)	54	15	1
Broadcast (Chlorophacinone and Diphacinone)	28	24	18

NLAA = not likely to adversely affect; LAA = likely to adversely affect; J = jeopardy

NLAA Determinations (Bait Station Use)

EPA made NLAA determinations for 54 listed bird species for bait station uses. The reason for the NLAA determination for these species is that these species are primary consumers that are extremely unlikely to enter the bait station opening for behavioral reasons. For those species that consume invertebrates, since the bait is contained within the station, invertebrates containing residues of FGAR are not expected to represent a significant exposure pathway.

NLAA Determinations (Feral Hog Warfarin Bait Station Use)

EPA made NLAA determinations for 68 listed bird species for FGAR (warfarin) feral hog bait station uses. These species are NLAA because the only exposure route is through the consumption of either live poisoned feral hogs or poisoned feral hog carcasses and none of the bird species found within the use area consume them.

NLAA Determinations (Chlorophacinone and Diphacinone Burrow Use)

EPA made NLAA determinations for 54 listed bird species for FGAR (*i.e.*, chlorophacinone and diphacinone) burrow uses. The reason for the NLAA determination for these species is that bait must be placed 6 inches into the entrance of the burrow, and EPA does not expect birds to enter the burrow and/or kick out bait on to the surface; therefore, exposure is highly unlikely to occur.

NLAA Determinations (Chlorophacinone and Diphacinone Broadcast Use)

EPA made NLAA determinations for 28 listed bird species for the broadcast uses of the FGARs because these species only consume dietary items, such as fruit, nectar, aquatic organisms, or terrestrial invertebrates, that are unlikely to come into contact with bait.

LAA Determinations (Bait Station Use)

EPA made LAA determinations for 16 listed bird species (secondary consumers) for bait station uses primarily based on the potential for consumption of poisoned mammals.

LAA Determinations (Feral Hog Warfarin Bait Station Use)

EPA made LAA determinations for 2 listed bird species for feral hog warfarin bait station uses because of the potential for secondary exposure from consumption of feral hogs.

LAA Determinations (Chlorophacinone and Diphacinone Burrow Use)

EPA made LAA determinations for 16 listed bird species for FGAR burrow uses primarily based on the potential for consumption of poisoned mammals.

***LAA Determinations* (*Chlorophacinone and Diphacinone Broadcast Use*)**

EPA made LAA determinations for 42 listed bird species. For secondary consumers this is primarily based on their potential to consume small mammals. For primary consumers this is primarily based on the potential for incidental exposure while the species is foraging on the ground for seeds and other food items.

Predictions of the Potential Likelihood of Future Jeopardy (Bait Station Use)

Of the 16 LAA listed bird species, EPA made LAA determinations and predicted the potential likely future J for 7 listed bird species for FGAR bait station uses. These species were determined to be LAA with a prediction of likely future J because FGARs have a high MoE on these species because these species tend to consume mammals on a regular basis and thus have an increased likelihood of secondary exposure to rodenticides.

For the remaining 9 LAA listed bird species, EPA did not predict the potential likelihood of future J for 9 listed LAA bird species for FGAR bait station uses. The Mississippi Sandhill crane (*Grus canadensis*), California clapper rail (*Rallus longirostris obsoletus*), Wood stork (*Mycteria americana*), and Mariana crow (*Corvus kubaryi*) were determined to be LAA with predicted not likely potential future J because despite the fact that they had high overlap (and in the Mississippi Sandhill Crane's case, a high MoE as well), their exposure pathway is through secondary consumption and FGARs take multiple feedings to result in mortality. Furthermore, these species are omnivores (consuming a wide variety of plant and animal matter) and only occasionally consume small mammals; therefore, it is extremely unlikely that the target pest will constitute a large enough proportion of their diet sufficient to reach exposure levels that would cause effects on a population level.

Predictions of the Potential Likelihood of Future Jeopardy (Feral Hog Warfarin Bait Station Use)

EPA made LAA determinations and predicted the potential for likely future J for 2 listed bird species (California Condor and Audubon's crested caracara) for the FGAR warfarin feral hog bait station use. The reason for the predicted J determinations was a high MoE because both species eat carrion. These predicted J determinations are because this use is labeled nationally even though it may only be used locally at this time so there is potential for warfarin use to control feral hogs in the range of California Condor and Audubon's crested caracara.

Predictions of the Potential Likelihood of Future Jeopardy (Chlorophacinone and Diphacinone Burrow Use)

EPA made LAA determinations but did not predict the potential likelihood of future J for 15 listed bird species for FGAR (chlorophacinone and diphacinone) burrow uses. The reasons for the not likely future J predictions were low MoE of FGARs on these species. Additionally, FGARs take multiple feedings to result in mortality and since the omnivorous species only occasionally consume small mammals (eating a wide variety of plant and animal matter) it is not as likely that the target pest will constitute a large proportion of their diet. For secondary consumers who hunt the target pest (rodents), while there is the potential for prey to be available on the surface with less than lethal concentrations, their capacity to evade predators is the same as before exposure. Furthermore, a significant majority of reported mortalities occurred belowground (82–91%), likely reducing the extent of secondary exposure to occur at the population level (Baldwin *et al*., 2021).

Predictions of the Potential Likelihood of Future Jeopardy (Chlorophacinone and Diphacinone Broadcast Use)

EPA made LAA determinations and predicted the potential for likely future J for 18 listed bird species for the FGARs chlorophacinone and diphacinone broadcast uses. These species were determined to be LAA with likely predicted future J because of high overlap and high MoE. Additionally, some of the species consume prey comprised of rodenticide target species, increasing their adverse effects through secondary exposure.

Broadcast applications pose a chance of exposure to avian primary bird consumers (LAA) and to secondary consumers (LAA). Because of a high MoE for FGARs, EPA predicts the potential likelihood of future J for 18 listed bird species.

EPA made LAA determinations but did not predict the potential likelihood of future J for 24 listed bird species for FGAR (*i.e.*, chlorophacinone and diphacinone) broadcast uses. The reasons for predicted no likely future J were that these species were not from the lower 48 states. Use in these areas is not anticipated since broadcast uses are specific to target species not located on islands and specific to states in the CONUS; therefore, use is not anticipated. Although there are two APHIS labels for target pests found on islands, use will not be allowed until APHIS completes ESA consultation.
EPA's rationales for effect determinations and predictions of future J for listed birds can be found in the "Birds" worksheet in **Appendix B** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.1.5 Reptiles

EPA considered 59 reptile species for exposure to FGARs from bait station, burrow, and broadcast uses. Of these, EPA determined 25 to be NE because of lack of exposure (marine species), diet (aquatic food web), or low overlap with the FGAR action area.

Table 3-3 summarizes the effects determinations for reptiles from FGARs. All NLAA/LAA determinations and predictions of no J/J and justifications for listed reptiles can be found in the "Reptiles" worksheet in **Appendix B** and the "New species" worksheet in **Appendix C** following methodology in **Section 2.6.2.** MoE risk modifiers used for the predictions of potential likely future J are described in **Section 2.6.3.**

Table 3-3. Summary of Final Effects Determinations and Predictions of Potential Likelihood of Future Jeopardy for Listed Reptiles within the Action Area

Use Pattern	NLAA	LAA, No J	LAA, J
Bait Station	20	10	4
Feral Hog Bait Station (Warfarin)	33	1	0
Burrow (Chlorophacinone and Diphacinone)	20	14	0
Broadcast (Chlorophacinone and Diphacinone)	3	24	6

NLAA = not likely to adversely affect; LAA = likely to adversely affect; J = jeopardy

NLAA Determinations (Bait Station Use)

EPA made NLAA determinations for 20 listed reptile species for bait station uses. Reasons for the NLAA determinations included:

- Exposure of an individual is extremely unlikely due to behavioral foraging preferences of consuming live moving prey (*i.e.*, unlikely to enter the bait station and eat bait directly),
- It is unlikely that the species' main dietary items (invertebrates) represent a significant exposure pathway (*i.e.*, unlikely to consume enough exposed invertebrates),
- Although the species consumes other non-mammalian terrestrial vertebrate prey (*e.g.*, birds, amphibians and reptiles), the main exposure route is from the consumption of poisoned target mammals. Since the main dietary item is non-mammalian prey, it is unlikely the species would enter the bait station in search of prey, and
- For listed turtles, it is extremely unlikely that a turtle will enter the bait station opening due to the shape and rigidity of its shell.

NLAA Determinations (Feral Hog Warfarin Bait Station Use)

EPA made NLAA determinations for 33 listed reptile species for warfarin feral hog bait station uses. The reason for the NLAA determinations for these species is that the only exposure route is through the consumption of either live poisoned feral hogs or poisoned feral hog carcasses and these species do not consume feral hog.

NLAA Determinations (Chlorophacinone and Diphacinone Burrow Use)

EPA made NLAA determinations for 20 listed reptile species for chlorophacinone and diphacinone burrow uses. The reasons for the NLAA determinations included:

- Although the species' diet is comprised primarily of insects, so while they do consume some terrestrial vertebrates, they are not a large part of their diet and it is unlikely that invertebrates

represent a significant exposure pathway (*i.e.*, unlikely to consume enough exposed invertebrates),
- For burrowing species, applications are intended to be made to active target pest burrows only, therefore, bait is more likely to go into an active pest target burrow rather than an inactive burrow that might be inhabited by a non-target species,
- FGARs take multiple exposures and it is unlikely that this would occur if the burrow is already occupied by the target pest, and
- The main dietary item of the species is non-mammalian terrestrial vertebrate prey (*e.g.*, birds, amphibians and reptiles), and the main exposure route is from the consumption of poisoned target mammals, it is unlikely the species would enter the mammal burrow in search of prey.

NLAA Determinations (Chlorophacinone and Diphacinone Broadcast Use)

EPA made a NLAA determination for one listed reptile species for chlorophacinone and diphacinone broadcast uses. The species is the Culebra Island Giant Anole (*Anolis roosevelti*) and it is NLAA because the best scientific and commercial information lead the Service to conclude this the species is extinct.

LAA Determinations (Bait Station Use)

EPA made LAA determinations for 14 listed reptile species based on the potential consumption of poisoned mammals.

LAA Determinations (Feral Hog Warfarin Bait Station Use)

EPA made LAA determinations for 1 listed reptile species for FGAR warfarin bait station uses because of the potential for secondary exposure from consumption of feral hogs.

LAA Determinations (Chlorophacinone and Diphacinone Burrow Use)

EPA made LAA determinations for 14 listed reptile species for FGAR burrow uses primarily based on the potential for consumption of poisoned mammals.

***LAA Determinations* (*Chlorophacinone and Diphacinone Broadcast Use*)**

EPA made LAA determinations for 30 listed reptile species primarily based on the potential to consume small mammals and the potential for incidental exposure while the species is foraging on the ground for seeds and other food items.

Predictions of the Potential Likelihood of Future Jeopardy (Bait Station Use)

Of the 14 listed LAA reptiles, EPA predicted the potential for likely future J for 4 listed reptile species for FGAR bait station uses J because they had high MoE from FGARs and high overlap with FGAR UDLs.

EPA made LAA determinations but did not predict the likelihood of J for 10 listed reptile species for FGAR bait station uses. EPA determined the New Mexican ridge-nosed rattlesnake (*Crotalus willardi obscurus*) and Northern Mexican garter snake (*Thamnophis eques megalops*) to be LAA and predicts no J because of low overlap. EPA determined the Virgin Islands tree boa (*Epicrates monensis granti*), Alligator snapping turtle (*Macrochelys temmincki*), San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), Giant garter snake (*Thamnophis gigas*), Eastern indigo snake (*Drymarchon corais couperi*), American crocodile (Crocodylus acutus), Alameda whipsnake (*Masticophis lateralis euryxanthus*), and the Suwannee alligator snapping turtle (*Macrochelys suwanniensis*) to be LAA and predicts no J because FGARs require multiple feedings to result in mortality and since these species have varied diets consisting of many types of organisms it is extremely unlikely that the target pest (rodents) will constitute a large proportion of their diet.

Predictions of the Potential Likelihood of Future Jeopardy (Feral Hog Warfarin Bait Station Use)

EPA made an LAA determination but did not predict the potential likelihood of future J for one listed reptile species (American Crocodile, *Crocodylus acutus*) for the FGAR warfarin feral hog bait station uses because although the MoE of FGARs used to control feral hogs is high for this species because it consumes feral hogs, its overlap with this use is low.

Predictions of the Potential Likelihood of Future Jeopardy (Chlorophacinone and Diphacinone Burrow Use)

EPA made LAA determinations but did not predict the likelihood of future J determinations for 14 listed reptile species for the FGARs chlorophacinone and diphacinone burrow uses. The reasons for the predicted not likely future J were because despite high and (in one case) medium overlap there is low MoE. Since FGARs require multiple feedings to achieve a lethal dose, there is the potential for prey to be available on the surface with less than lethal concentrations, and the capacity to evade predators is the same as before exposure. However, the majority of mortalities occur below ground (82–91%), likely reducing the extent of secondary exposure to occur at the population level (Baldwin *et al*., 2021).

Predictions of the Potential Likelihood of Future Jeopardy (Chlorophacinone and Diphacinone Broadcast Use)

EPA made LAA determinations and predicted likely potential future J for 6 listed reptile species for the broadcast uses of the FGARs chlorophacinone and diphacinone because of high MoE and high overlap, as well as several of the species having diets which consist predominantly of mammals.
EPA made LAA determinations but did not predict the potential likelihood of future J for 24 listed reptile species for the FGAR chlorophacinone and diphacinone broadcast uses. The reasons for the not likely future J predictions were because of a low MoE of FGARs on those species, low overlap with FGAR use, or both. For species in the non-lower 48 states, no FGAR use is anticipated since broadcast uses are specific to certain target species which are geographically exclusive to states in CONUS. There are 2 APHIS labels for target pests found on islands; however, use will not be allowed until APHIS completes ESA consultation.

EPA's rationales for effect determinations and predictions of future J for listed reptiles can be found in the "Reptiles" worksheet in **Appendix B** and the "New species" worksheet in **Appendix C** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.1.6 Amphibians

EPA considered 47 amphibian species for exposure to FGARs from bait station, burrow, and broadcast uses. Of these, EPA determined 12 to be NE because of lack of exposure (fully aquatic lifestyle and lives in caves). **Table 3-4** summarizes the effect determinations for the FGARs. All NLAA/LAA determinations and predictions of likely future no J/J and justifications for listed reptiles and amphibians can be found in the "Amphibians" worksheet in **Appendix B** and the "New species" worksheet in **Appendix C** following methodology in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

Table 3-4. Summary of Final Effects Determinations and Predictions of Potential Likelihood of Future Jeopardy for Listed Amphibians within the Action Area

Use Pattern	NLAA	LAA, No J	LAA, J
Bait Station	35	0	0
Feral Hog Bait Station (Warfarin)	35	0	0
Burrow (Chlorophacinone and Diphacinone)	30	5	0
Broadcast (Chlorophacinone and Diphacinone)	23	12	0

NLAA = not likely to adversely affect; LAA = likely to adversely affect; J = jeopardy

NLAA Determinations (Bait Station Use)

EPA made NLAA determinations for 35 listed amphibian species for FGAR bait station uses. Reasons for the NLAA determinations included:

- because they primarily consume live prey so exposure to rodenticide bait is unlikely.
- because exposure of an individual is extremely unlikely due to a behavioral foraging preference for consumption of live moving prey (*i.e.*, unlikely to eat bait directly).
- because amphibians considered did not rise to LAA in the 1993 USFWS BiOp and therefore remain NLAA.
- because it is unlikely that the species' main dietary items (invertebrates) represent a significant exposure pathway (*i.e.*, unlikely to consume enough exposed invertebrates).
- because species is typically found in an isolated, highly unique, or aquatic/semi-aquatic habitat where exposure to rodenticides is unlikely to occur.

NLAA Determinations (Feral Hog Warfarin Bait Station Use)

EPA made NLAA determinations for 35 listed amphibians based primarily on reasons described in the previous section for bait station uses.

NLAA Determinations (Chlorophacinone and Diphacinone Burrow Use)

EPA made NLAA determinations for 30 listed amphibian species for FGAR burrow uses for the same reasons discussed above in the 'Bait Station Use' section.

NLAA Determinations (Chlorophacinone and Diphacinone Broadcast Use)

EPA made NLAA determinations for 23 listed amphibian species for FGAR broadcast uses for the same reasons discussed above in the 'Bait Station Use' section.

LAA Determinations (Bait Station Use)

EPA did not make any LAA determinations for listed amphibian species from FGAR bait station use and no further analyses are needed.

LAA Determinations (Feral Hog Warfarin Bait Station Use)

EPA did not make any LAA determinations for listed amphibian species from FGAR feral hog warfarin bait station use and no further analyses are needed.

LAA Determinations (Chlorophacinone and Diphacinone Burrow Use)

EPA made LAA determinations for 5 listed amphibian species for FGAR burrow uses primarily because the species utilizes small mammal burrows.

***LAA Determinations* (*Chlorophacinone and Diphacinone Broadcast Use*)**

EPA made LAA determinations for 12 listed amphibian species primarily based on the potential to for incidental exposure while the species is foraging on the ground for seeds and other food items.

Predictions of the Potential Likelihood of Future Jeopardy (Chlorophacinone and Diphacinone Burrow Use)

EPA made LAA determinations and did not predict the likelihood for potential future J for 5 of the listed amphibian species for the burrow uses of the FGARs. These species had high overlap with this use but had a low MoE.

Predictions of the Potential Likelihood of Future Jeopardy (Chlorophacinone and Diphacinone Broadcast Use)

EPA made LAA determinations and did not predict the likelihood of potential future J for 12 of the listed amphibian species for the bait station uses of the FGARs. These species had either high or medium overlap with this use but had a low MoE.

EPA's rationales for effect determinations and predictions of future J for listed amphibians can be found in the "Amphibians" worksheet in **Appendix B** and the "New species" worksheet in **Appendix C** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.1.7 Mammals

EPA considered 100 mammalian species for exposure to FGARs from bait station, burrow, and broadcast uses. Of these, EPA determined 25 to be NE because of lack of exposure (marine mammals) or diet (aquatic food web).

Table 3-5 summarizes the effect determinations for mammals from FGARs. All NLAA/LAA determinations and predictions of no J/J and justifications for listed mammals can be found in the "Mammals" worksheet in **Appendix B** and the "New species" and "UDL_update (species)" worksheets in **Appendix C** following methodology in **Section 2.5**. MoE risk modifiers followed the methods in **Section 2.6.3**.

Table 3-5. Summary of Final Effects Determinations and Predictions of Potential Likelihood of Future Jeopardy for Listed Mammals within the Action Area

Use Pattern	NLAA	LAA, No J	LAA, J
Bait Station	30	18	27
Feral Hog Bait Station (Warfarin)	66	8	1
Burrow (Chlorophacinone and Diphacinone)	24	17	34
Broadcast (Chlorophacinone and Diphacinone)	21	14	40

NLAA = not likely to adversely affect; LAA = likely to adversely affect; J = jeopardy

NLAA Determinations (Bait Station Use)

EPA made NLAA determinations for 30 listed mammal species for FGAR bait station uses. These species were NLAA because they are unlikely to enter bait station due to their body size. All of these species are >400 g which is equivalent to size of a standard laboratory rat.

NLAA Determinations (Feral Hog Bait Station Use)

EPA made NLAA determinations for 66 listed mammal species for the feral hog bait station use of the FGAR warfarin. These species are NLAA because the only exposure route is through the consumption of either live poisoned feral hogs or poisoned feral hog carcasses and these species do not consume feral hog.

NLAA Determinations (Chlorophacinone and Diphacinone Burrow Use)

EPA made NLAA determinations for 24 listed mammal species for the burrow uses of the FGARs chlorophacinone and diphacinone. These species include the Key deer (*Odocoileus virginianus clavium*), Columbian white-tailed deer (*Odocoileus virginianus leucurus*), and Sonoran pronghorn (*Antilocapra americana sonoriensis*) which are NLAA because they are unlikely to enter burrows due to their size (species >400 g). Several listed bat and flying squirrel species are also included because of the low likelihood that they would access a burrow. In addition, these species do not consume other mammals (no secondary exposure pathway).

NLAA Determinations (Chlorophacinone and Diphacinone Broadcast Use)

EPA made NLAA determinations for 21 of the listed mammal species for the broadcast uses of the FGARs chlorophacinone and diphacinone. These species are NLAA due to remote habitats or diets which preclude the consumption of bait (*i.e.,* only consume flying terrestrial invertebrates).

LAA Determinations (Bait Station Use)

EPA made 45 LAA determinations for listed mammals based primarily on similarity to target pest, small body size (that would allow entry into bait station), and from the potential consumption of mammal prey.

LAA Determinations (Feral Hog Warfarin Bait Station Use)

EPA made 9 LAA determinations for listed mammal species from FGAR feral hog warfarin bait station uses because of the potential to consume feral hogs.

LAA Determinations (Chlorophacinone and Diphacinone Burrow Use)

EPA made LAA determinations for 51 listed mammal species for FGAR burrow uses primarily based on small body size, similarity to target pest and the potential consumption of mammalian prey.

***LAA Determinations* (*Chlorophacinone and Diphacinone Broadcast Use*)**

EPA made LAA determinations for 54 listed mammal species primarily based on the potential to for incidental exposure while the species is foraging on the ground for seeds and other food items and from the consumption of mammal prey.

Predictions of the Potential Likelihood of Future Jeopardy (Bait Station Use)

EPA made LAA determinations and predicted the potential for likely future J for 27 listed mammals for FGAR bait station uses because they had high MoE from FGARs and high or medium overlap with FGAR UDLs. Twenty-six of these species are rodents who are likely small enough to access bait stations. The San Joaquin kit fox is also in this group because it feeds primarily on rodents and lives in residential areas where concentrations of bait stations are likely to be higher, so secondary exposure is more likely. EPA made LAA determinations and did not predict the potential for likely future J for 18 listed mammal species for FGAR bait station uses because despite a high MoE of FGARs to these species, there is a low overlap between FGAR usage and the range of these species.

Predictions of the Potential Likelihood of Future Jeopardy (Feral Hog Warfarin Bait Station Use)

EPA made LAA determinations and predicted the potential for likely future J for one listed mammal species from feral hog bait station use of warfarin. EPA predicted the potential likelihood of future J for the Florida panther (*Puma (=Felis) concolor coryi*) due to a diet that consists substantially (21% of its diet) of feral hog.[28] The prediction of the potential for likely future J for the Florida panther is since this use is labeled nationally even though it may only be used locally at this time so there is potential for warfarin use to control feral hogs in the range of California condor and Audubon's crested caracara.

EPA made LAA determinations and did not predict the potential for likely future J for 8 listed mammals from the feral hog bait station use of warfarin because despite a high overlap with this use, the MoE is low for these species. These are species which may eat feral hogs, but which have varied diets so that exposure through their regular consumption of feral hogs is extremely unlikely to lead to population level effects.

[28] https://myfwc.com/wildlifehabitats/wildlife/panther/biology/

Predictions of the Potential Likelihood of Future Jeopardy (Chlorophacinone and Diphacinone Burrow Use)

EPA made LAA determinations and predicted likely for potential future J for 34 listed mammals for the burrow use of the FGARs chlorophacinone and diphacinone because of a high MoE of FGARs on these species and a high or medium overlap of these species' ranges with FGAR UDLs. These species are similar to the target species and have the potential to be in a burrow where they could be exposed to bait through primary exposure.

EPA made LAA determinations but did not predict the potential for likely future J for 17 listed mammal species for the burrow uses of the FGARs chlorophacinone and diphacinone. Since FGARs require multiple feedings to achieve a lethal dose, there is the potential for prey to be available on the surface with less than lethal concentrations. EPA does not anticipate that FGAR contaminated primary consumers would have a reduced capacity to evade predators due to the need for multiple feedings of the FGAR bait before mortality. However, despite the potential availability of exposed prey, a significant majority of mortalities may occur below ground (82–91%), likely reducing the extent of secondary exposure to occur at the population level (Baldwin *et al*., 2021). One additional reason for the no J predictions for some of the species was low overlap with FGAR usage.

Predictions of the Potential Likelihood of Future Jeopardy (Chlorophacinone and Diphacinone Broadcast)

EPA made LAA determinations and predicted the potential for likely future J for 40 listed mammals from the broadcast uses of the FGARs chlorophacinone and diphacinone because of high MoE of FGARs on these species and high overlap of these species with FGAR UDLs.

EPA made LAA determinations but did not predict the potential for likely future J for 14 listed mammal species for the broadcast uses of the FGARs chlorophacinone and diphacinone because despite a high MoE of FGARs on these species, there is low overlap between the species' range and FGAR UDLs.

EPA's predictions of the potential likelihood of future J and justifications for listed mammals can be found in the "Mammals" worksheet in **Appendix B** and the "New species" and "UDL_update (species)" worksheets in **Appendix C** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

Table 3-6 summarizes the number of listed species determinations and predictions of the potential likelihood of future J for all taxa from FGARs.

Table 3-6. Number of Listed Species Effects Determinations and Predictions of the Potential Likelihood of Future Jeopardy for First Generation Anticoagulant Rodenticides (FGARs)[1,2]

Taxon	Number of Species	Specific Determinations Across Use Patterns and by A.I.											
		Bait Station			Burrow			Broadcast			Feral Hog		
		NLAA	LAA, No J	LAA, J	NLAA	LAA, No J	LAA, J	NLAA	LAA, No J	LAA, J	NLAA	LAA, No J	LAA, J
Mammals	**100**	**30**	**18**	**27**	**24**	**17**	**34**	**21**	**14**	**40**	**66**	**8**	**1**
Birds	**95**	**54**	**9**	**7**	**54**	**15**	**1**	**28**	**24**	**18**	**68**	**0**	**2**
Amphibians[3]	**47**	**35**	**0**	**0**	**30**	**5**	**0**	**23**	**12**	**0**	**35**	**0**	**0**
Reptiles	**59**	**20**	**10**	**4**	**20**	**14**	**0**	**4**	**25**	**5**	**33**	**1**	**0**

[1] EPA made effects determinations and predictions of the potential likelihood of future jeopardy for listed species and the details on these can be found in **Appendix B** and **Appendix C**.

[2] Reflects listed species current as of Oct. 2024. This includes accounting for delisted species. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction

[3] "Amphibians" includes those species that have both a terrestrial and aquatic phase.

NE = no effect; NLAA = not likely to adversely affect; LAA = likely to adversely affect; J = jeopardy

3.2.2 Second-Generation Anticoagulant Rodenticides (SGARs)

3.2.2.1 Introductory Information on SGARs

EPA signed the DRA (USEPA, 2020a) for seven anticoagulant rodenticides (AR) for the RR program on March 17, 2020. These AR include three FGARs (*i.e.*, warfarin, chlorophacinone, diphacinone) and four SGARs (*i.e.*, bromadiolone, brodifacoum, difenacoum, and difethialone). Based on previous FIFRA-based draft risk assessments, and the 2008 RMD (USEPA, 2008), for each of the 7 ARs, this final BE has been focused on risks to mammals and birds (as well as reptiles and terrestrial amphibians, for which birds serve as a proxy).

The effects to mammals and birds from ARs is well-established (USEPA, 2020a) and include mortality from primary and secondary exposure, as well as longer-term growth and reproductive effects. Primary exposure in this assessment is defined as consumption of treated bait by target or non-target organisms. Secondary exposure is defined as predation/scavenging and consumption of exposed primary consumers. Previous assessments (USEPA, 2020a) have concluded that SGARs present greater secondary exposure concerns than FGARs do, supported by numerous incidents in which animals too large to enter bait boxes are found to contain significant levels of AR residues in liver or other tissues. Target and non-target taxa that consume ARs via bait boxes carry residues of the persistent ARs from bait boxes into the environment, sometimes far from the treatment area because ARs do not kill immediately and some SGARs have persistent biological half-lives, creating secondary exposure opportunities for predators and scavengers (see **Section 2.2.2** for more information).

An acute-to-chronic ratio qualitative assessment of chlorophacinone and difenacoum indicates reproduction concerns for all 7 ARs (USEPA, 2020a). These data show that AR toxicity is substantially enhanced in studies that utilize repeated exposures, such as reproductive toxicity assays and subacute repeated dietary exposure toxicity studies.

The FIFRA-based 2020 DRA also conducted an analysis of wildlife incidents involving the 7 ARs to determine if there are any trends in recent years. Since the 2008 RMD imposed mitigations within the United States (USEPA, 2008), this final BE focuses on reports from the US because the mitigation decision applied only to the US, although there is scientific literature on the effectiveness of similar AR mitigations from several European countries. Data sources include EPA's IDS and scientific reports that specifically addressed the question of wildlife incident trends. EPA obtained literature reports from California, Kentucky and Massachusetts (USEPA, 2020a). The Department of Pesticide Regulation completed the California report in response to a citizen petition.

3.2.2.2 General Conclusions from the Incident Analysis

EPA identified 804 incidents (63% of incidents reported since 1971 in the IDS) between 2010 and 2018, indicating that exposure and wildlife incidents have continued in recent years. Two rodenticides – brodifacoum and bromadiolone – were the primary drivers of incidents, accounting together for roughly 69% of the incidents reported between 2010 and 2018. Brodifacoum and bromadiolone are both SGARs and are expected to be persistent. Based on autopsy reports of poisoned animals, exposure to two or more second-generation ARs is common (*see* USEPA, 2020a). With regards to listed species, incidents have been reported for listed species such as San Joaquin kit fox, bald eagle, and key deer. The San Joaquin kit fox (*Vulpes macrotis*) has had several recent incidents related to anticoagulant rodenticides.

Due to their robust reporting systems relative to other states, the states of California and New York account for 58 and 21% of reported incidents for the evaluated rodenticides. Open literature studies on rodenticide incidents suggest that anticoagulant rodenticides have a significant likelihood to impact non-target wildlife; exposure rates to wild animals in these studies was high, even in remote densely forested regions with no legal uses of SGARs. Anticoagulant rodenticide incidents are generally based on detection of residues in liver tissue and corroborating evidence from carcass necropsy. the reported incident data show an apparent increase in wildlife exposure and deaths from 2010 to 2018. This may be attributed to greater effort in seeking out incidents, especially in California. The California report cited herein was the result of a formal petition by a non-government organization (NGO). The data presented in this assessment therefore do not necessarily represent an increase in incidents, but instead show that upon closer examination, incidents continue and have apparently not decreased.

The SGARs include bromadiolone, brodifacoum, difethialone, and difenacoum. The SGARs represent an acute hazard[29] to all animal taxa (mammals, birds, amphibians, and reptiles) by direct consumption. Due to their persistence in animal tissues, these rodenticides also pose an acute hazard to carnivores (secondary consumers) that eat directly exposed animals. The hazard to secondary consumers is supported by analysis of numerous incidents. Brodifacoum is used in island eradication projects for invasive rodents by APHIS and USFWS.

3.2.2.3 Defining Spatial Overlap

SGARs may be used for commensal rodent control associated with structures. The action area for SGARs will be represented by Developed and Open Space Developed UDLs (see **Section 2.4**). Lastly, for the purposes of this assessment, bait box uses are assumed to be protective of burrow uses as all SGAR labels require outdoor applications to be within 100 feet of man-made structures; therefore, species effects determinations and predictions of potential likelihood of future J determinations were not considered separately for burrow uses.

3.2.2.4 Birds

EPA considered 95 (including species with multiple entity IDs) listed bird species for effects from SGAR bait station uses. Of these, EPA determined 25 to be NE because they are marine species, or because they consumed food items from the aquatic food web, or because they are strictly arboreal (*i.e.,* species that chiefly live and feed in trees), and so are not expected to be exposed (*see* **Section 2.6.1**). EPA then made NLAA determinations for 54 species. For the remaining 16 LAA species EPA predicted the potential for likely future J because the species were likely to consume exposed rodent prey. These include birds of prey and scavengers such as hawks, owls, falcons, crows, cranes, and storks.

[29] Hazard only reflects relative toxicity. The hazard is not synonymous with likely effects to individuals or populations because it does not consider the likelihood or magnitude of exposure.

NLAA Determinations

The remaining 70 species EPA determined to be MA based on possible consumption of bait, or consumption of exposed rodents. Of these, EPA determined 54 to be NLAA because they are unlikely to be exposed, due either to size or behavior (too large or behaviorally unlikely to enter bait station).

LAA Determinations

EPA made LAA determinations for 16 listed bird species primarily based on primary route of exposure being consumption of poisoned target mammals.

Predictions of the Potential Likelihood of Future Jeopardy

For 9 of the species with LAA determinations, EPA did not predict the potential for likely future J.

EPA determined that the remaining 7 species were LAA and predicted the potential likelihood for future J because they were likely exposed through consumption of rodent prey. These include birds of prey and scavengers such as hawks, owls, falcons, crows, cranes, and storks.

Table 3-7. Summary of Final Effects Determinations and Predictions of Potential Likelihood of Future Jeopardy for Listed Birds within the Action Area

Final Effects Determination/Predicted Potential Likelihood of Future Jeopardy Prediction	No. Listed Species	Rationale
NE	25	Marine species, species in the aquatic food web, arboreal species (*i.e.,* species that chiefly live and feed in trees), extinct species
NLAA	54	Excluded from bait stations by body size, or behaviorally unlikely to enter bait station
LAA-Predicted no likely future J	9	Not likely to consume rodents, or have varied diet
LAA – Predicted likely future J	7	Likely to consume exposed rodents or in broadcast use area on islands

NE = No Effect; NLAA = Not Likely to Adversely Affect; LAA = Likely to Adversely Affect; J = Jeopardy

3.2.2.5 Reptiles and Amphibians

NLAA Determinations (Reptiles)

EPA considered 59 listed reptiles for the SGAR bait station uses. Toxicity data for birds were used as a surrogate for reptiles. Of the 59 listed reptiles, EPA determined 25 to be NE, either because no exposure was expected (marine species), because they were terrestrial species in the aquatic food web, or they were terrestrial species that eat vegetation or invertebrates (*see* **Section 2.6.1**). EPA determined 20 reptiles to be MA/NLAA based on the following reasons:

- Exposure of an individual is extremely unlikely due to behavioral foraging preferences of consuming live moving prey (*i.e.*, unlikely to enter the bait station and eat bait directly),
- It is unlikely that the species' main dietary items (invertebrates) represent a significant exposure pathway (*i.e.*, unlikely to consume enough exposed invertebrates),
- Although the species consumes other non-mammalian terrestrial vertebrate prey (*e.g.*, birds, amphibians and reptiles), the main exposure route is from the consumption of poisoned target mammals. Since the main dietary item is non-mammalian prey, it is unlikely the species would enter the bait station in search of prey, and
- For listed turtles, it is extremely unlikely that a turtle will enter the bait station opening due to the shape and rigidity of its shell.

LAA Determinations (Reptiles)

EPA made LAA determinations for 14 listed reptile species primarily based on primary route of exposure being consumption of poisoned target mammals.

Prediction of Potential Likely Future Jeopardy (Reptiles)

EPA predicts that 10 of the LAA reptiles to be no likely future J because, despite a high MoE, they have low overlap with the SGAR action area. These were the New Mexican Ridge-nose rattlesnake and the Northern Mexican garter snake.

EPA predicts that 4 reptiles, all snakes, are likely future J based on high MoE and medium or high overlap with the SGAR action area.

NLAA Determinations (Amphibian)

EPA considered effects to 47 listed amphibian species. Of these, EPA determined 12 were NE based on their fully aquatic life cycle or that they lives in caves. Thirty-five species were considered MA but NLAA for reasons described in **Section 2.6.2** based on only incidental consumption of bait or invertebrates; therefore, no further analyses were conducted.

Table 3-8. Summary of Final Effects Determinations and Predictions of Potential Likelihood of Future Jeopardy for Listed Reptiles/Amphibians within the Action Area.

Final Effects Determination/Prediction of Potential Likelihood of Future Jeopardy Prediction	No. Listed Species	Rationale
NE	Amphibians 12	Fully aquatic life cycle or live in caves
	Reptiles 25	Not exposed (marine species), in aquatic food web, or terrestrial consumers of vegetation or invertebrates

Final Effects Determination/Prediction of Potential Likelihood of Future Jeopardy Prediction	No. Listed Species	Rationale
NLAA	Amphibians 35	Only incidental consumption of bait or invertebrates
	Reptiles 20	Species consumes invertebrates and since bait is confined to the station, it is not likely for species to accidentally consume bait while feeding and invertebrates do not represent a significant exposure pathway
LAA – Predicted no likely future J	Reptiles 10	Low Overlap
LAA – Predicted likely future J	Reptiles 4	Secondary consumers likely to have exposed rodents in their diet, or island species in areas of broadcast application

NE = No Effect; NLAA = Not Likely to Adversely Affect; LAA = Likely to Adversely Affect; J = Jeopardy

3.2.2.6 Mammals

EPA considered 100 mammalian species for exposure to SGARs from bait stations. Of these, EPA determined 24 to be NE because of lack of exposure (marine mammals), diet (aquatic food web or strictly flying insects, all bats) or low overlap with the SGAR action area.

NLAA Determinations

EPA made MA determinations for 75 species because SGARs are intended to kill mammals, but 30 of these EPA determined to be NLAA because the species do not consume rodents and are too large to fit into a bait station.

LAA Determinations

EPA made LAA determinations for 45 listed mammals based on the consumption of poisoned target prey, small body size and/or similarity to target pest.

Predictions of Potential Likelihood Future Jeopardy

Of the 45 LAA species, EPA predicted the potential likelihood for future J for 27 species either because they were small mammals able to enter a bait station (mice, gophers, ground squirrels, voles kangaroo rats, *etc*.) or secondary consumers with rodents in their diet (wolves, foxes, marten, ocelot, panthers, *etc*.).

For the remaining 18 LAA species, EPA did not predict the potential likelihood of future J due to low overlap despite a high MoE, meaning that exposure is discountable.

Table 3-9 presents the effects determinations and predictions of the potential likelihood of future J for the SGARs.

Table 3-9. Summary of Final Effects Determinations and Predictions of Potential Likelihood of Future Jeopardy for Listed Mammals within the Action Area

Final Effects Determination/ Predictions of Potential Likelihood of Future Jeopardy Prediction	No. Listed Species	Rationale
NE	Mammals 25	Lack of exposure (marine mammals), diet (aquatic food web or strictly flying insects, all bats) or low overlap with the SGAR action area
NLAA	Mammals 30	Non-rodent consumers too large to access bait stations
LAA –Predicted no likely future J	Mammals 18	Mammals too large to enter a bait station or not consumers of mammals
LAA – Predicted likely future J	Mammals 27	Small mammals able to enter a bait station or secondary consumers with rodents in their diet

NE = No Effect; NLAA = Not Likely to Adversely Affect; LAA = Likely to Adversely Affect; J = Jeopardy

Table 3-10. Number of Listed Species Effects Determinations and Predictions of the Potential Likelihood of Future Jeopardy for SGARs (Bait Station Use)[1,2]

Taxon	Number of Species	NE	NLAA	LAA, No J	LAA, J
Mammals	100	25	30	18	27
Birds	95	25	54	9	7
Amphibians[3]	47	12	35	0	0
Reptiles	59	25	20	10	4

[1] EPA made effects determinations and predictions of the potential likelihood of future jeopardy for listed species and the details on these can be found in **Appendix B** and **Appendix C**.
[2] Reflects listed species current as of Oct. 2024. This includes accounting for delisted species. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction
[3] "Amphibians" include those species that have both a terrestrial and aquatic phase.
NE = No Effect; NLAA = Not Likely to Adversely Affect; LAA = Likely to Adversely Affect; J = Jeopardy

3.2.3 Bromethalin

3.2.3.1 Introductory Information on Bromethalin

EPA signed the FIFRA-based bromethalin DRA on March 31, 2020. Bromethalin is a neurotoxicant that causes adverse effects and histological changes to the central nervous system of the target mammal pests. The 2020 DRA noted that acute toxicity is caused by the uncoupling of mitochondrial oxidative phosphorylation leading to respiratory failure (USEPA, 2020b). Bromethalin is used to control various types of rats and moles. As required by the 2008 RMD (USEPA, 2008), all above ground uses of bromethalin must be in tamper-resistant bait boxes. The bromethalin burrow uses are used within 100 feet of manmade structures, or on open space developed areas. Bromethalin bait must also be placed six inches inside animal burrows. Broadcast uses of bromethalin are not registered.

The bait station exposure analysis is considered protective of bromethalin burrow uses (with the exception of the impregnated artificial worm/grub use, as described below), as listed species are less likely to fit into burrows or be attracted to the bait within the burrows. Animals that cannot fit into the opening of the bait station are not considered to be exposed via direct (primary) consumption of the treated bait. Bromethalin poses an acute hazard[30] to all terrestrial vertebrate taxa (mammals, birds, reptiles, and amphibians). The likelihood of effects from secondary exposure of carnivores is anticipated to be lower than that of the anticoagulant rodenticides, based on the short half-life and rapid elimination from primary consumers. However, there are secondary consumer incidents that are addressed in the FIFRA-based 2020 DRA (USEPA, 2020). EPA thus considers that bromethalin secondary exposure is still possible. In the 1993 USFWS BiOp for vertebrate control agents, the USFWS considered bromethalin and did not determine it to jeopardize any listed species (USFWS, 1993).

The FIFRA-based 2020 DRA summarized that bromethalin poses an acute hazard to all vertebrates that might consume it (aquatic vertebrates are not likely to be exposed to bromethalin). According to the DRA, primary exposure RQ values for mammals consuming bait range from 2.4 to 13, depending on body weight (USEPA, 2020b). For birds, primary exposure RQ values ranged from 2.4 to 20.

According to the FIFRA-based DRA, effects to secondarily exposed mammals are possible, though there are no secondary mammal incident reports. Secondary effects in birds are also possible – three secondary bird incidents have been reported. Bromethalin is fast acting and is rapidly eliminated in the gut of the primary consumer, which could potentially lead to lower chances for secondary exposure than the anticoagulant rodenticides. Overall, effects to secondary and tertiary consumers are considered possible.

3.2.3.2 General Conclusions from the Incident Analysis

Since 1996, 56 wildlife incidents associated with the use of bromethalin were reported in the IDS. There were 52 incidents (93% of the total) reported between 2010 and 2018, indicating that exposure and wildlife incidents have continued in recent years. The bromethalin incidents were mainly of primary consumers, except for five secondary consumer bird incidents. In general, the number of incident reports increased after the implementation of the 2008 RMD (USEPA, 2008) but have begun to decrease since 2016, when the stores of non-compliant products would have been removed from circulation. The

[30] Hazard only reflects relative toxicity. The hazard is not synonymous with likely effects to individuals or populations because it does not consider the likelihood or magnitude of exposure.

states of California and New York account for 67 and 25% of reported incidents for bromethalin. Bromethalin incidents are generally based on detection of residues in tissues and corroborating evidence from carcass necropsy. However, many incidents are not reported either because most animal carcasses are never found by humans, and those that are found may not be reported, let alone analyzed for rodenticides. Additionally, reported incidents will not account for the animals for which exposure to bromethalin was a factor in their death through means such as increased vulnerability to predation, starvation, or accidental death (*e.g.,* hit by a car).

3.2.3.3 Defining Spatial Overlap

Bromethalin may be used in commensal rodent control in bait stations. The action area for bromethalin commensal rodent uses will be represented by Developed and Open Space Developed UDLs. Bromethalin is also used to control burrowing rodents in a variety of settings, including residential lawns, other "non-agricultural areas", agricultural cropland, pastures, forestry land, and rangeland. The in-burrow uses are only applied via below-ground, burrow insertion. The burrow uses include the limited artificial impregnated worm/grub use. The action area for bromethalin burrow uses is represented by the UDL layers Open Space Developed and agricultural lands for commensal rodent uses, and Other Orchards, Managed Forest, Forest Trees, Rangeland, Cultivated Land, Rights-of-Way, and Pasture (*see* **Section 2.4**).

3.2.3.4 Birds

NLAA Determinations

Multiple birds are deemed unlikely to enter burrows because applicators are required to place bait 6 inches below the surface, reducing exposure potential. EPA made NLAA determinations for bird species that overlap only with bromethalin burrow uses other than the limited impregnated artificial worm/grub bromethalin burrow use. Exposures to bromethalin of birds are considered unlikely either on because of behavior (unlikely to enter bait station) or body size (too large to enter bait station).

EPA made NLAA determinations for 54 listed bird species from bromethalin use. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects (see **Section 2.6.2**). In addition, EPA determined as NLAA those species that are likely extinct. Overall, the most impactful modifiers that resulted in NLAA determinations included:

- Bait must be placed 6 inches into the entrance of the burrow and it is not expected for birds to enter the burrow and/or kick out bait therefore exposure is not reasonably expected to occur. There is likely little chance for any significant non-target exposure because the target pest (pocket gopher) quickly wall off disturbed sections of the burrow (Gene Benbow, pers. comm., 8/28/2023),
- Species is unlikely to enter into burrow due to size and foraging behavior,
- All above-ground application of these products is prohibited, and
- Species is not in the CONUS and not expected to overlap with the range for the target pests.
- Species overlaps only with bromethalin burrow uses other than the limited impregnated artificial worm/grub bromethalin burrow use.

There are also species that EPA determined as NLAA because the species consumes fruits or gleans insects and snails off the tree foliage or ingests flying insects instead of dietary items on the ground; therefore, these birds are unlikely to be exposed to rodenticides via primary or secondary exposure. Finally, several species, including the bridled white-eye (*Zosterops conspicillatus*), EPA determined as NLAA because they are presumed extinct.

LAA Determinations

EPA made LAA determinations for bromethalin for 16 birds, based on the potential for secondary exposure to bromethalin through the consumption of mammals, birds, terrestrial amphibians, and reptiles containing bromethalin residues, along with potential for direct consumption through consuming carrion. Some of these species are ground feeders that eat grains or seeds, so there is potential for incidental consumption of bait while feeding. Several bird species with LAA determinations were considered omnivorous and opportunistic foragers, which decreased the likelihood of rodenticide exposure.

Predictions of the Potential Likelihood of Future Jeopardy

EPA did not predict the potential likelihood of future J for listed bird species for the limited burrow uses that target moles via impregnated artificial worms/grubs. However, despite the potential availability of exposed prey, a significant majority of mortalities occurred below ground (82–91%), likely reducing the extent of secondary exposure to occur at the population level (Baldwin *et al*., 2021). There is also lower potential for secondary exposure from these burrow uses because of the shorter half-life of bromethalin, relative to other rodenticides. EPA also took into consideration that many of the birds with LAA determinations had diverse diets, which would reduce the chance that bromethalin exposure would lead to population level effects. EPA did not predict the potential likelihood of future J for species with low overlap with the limited bromethalin impregnated artificial worm/grub burrow use (*see* **Section 3.2.3.3**).

All NLAA/LAA and no J/J determinations and justifications for listed birds can be found in the "Birds" worksheet in **Appendix B** following methodology in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**. Conclusions from **Appendix B** are summarized here; however, the reader is directed to **Appendix B** for additional information.

3.2.3.5 Amphibians and Reptiles

NLAA Determinations

EPA considered reptiles and amphibians unlikely to enter burrows because applicators are required to place bait within open space developed areas where listed species are extremely unlikely to be found, or six inches below the surface, thereby reducing exposure potential. Based on this consideration, EPA made NLAA determinations for amphibian and reptile species that overlap only with bromethalin burrow uses, except for reptiles and amphibians that overlap with the impregnated artificial worm/grub burrow uses. EPA considers exposures of reptiles and amphibians to bromethalin unlikely either because of:

- behavior (unlikely to enter bait station) or
- body size (too large to enter bait station).

Reptiles

EPA made NLAA determinations for bromethalin bait station and burrow uses for 20 reptiles, including turtles and snakes, because exposure is extremely unlikely to occur.

- The species are unlikely to fit into the bait stations or unlikely to be found in most burrow uses where bromethalin is placed because applicators are required to place bait within open space developed areas where listed reptile species are extremely unlikely to occur, or six inches below the surface, making exposure unlikely.
- The species are unlikely to be exposed to bromethalin based on their dietary patterns, as the species are unlikely to eat bait located within bait stations or burrows and are unlikely to eat species that consume the bait in those locations.

One species, the Culebra Island giant anole (*Anolis roosevelti*), is located on a nature preserve managed by the Commonwealth of Puerto Rico Department of Natural and Environmental Resources. However, consultation with the Services is required for potential future rodent eradication projects on the island.

Amphibians

EPA made NLAA determinations for 35 listed amphibian species from bait station uses and made NLAA determinations for 30 amphibians from burrow uses, because exposure is extremely unlikely to occur.

- The listed amphibians partially reside in aquatic or riparian habitats where rodenticide exposure is extremely unlikely to occur.
- The amphibians are also unlikely to encounter bromethalin in the terrestrial phase of their life history, based on the bait station and most burrow use patterns of bromethalin.
- Certain listed amphibians were found in high elevation, remote locations, where rodenticide exposure is unlikely to occur.
- Several amphibian species primarily feed on aquatic invertebrates and zooplankton that are unlikely to be exposed to rodenticides.

LAA Determinations

Reptiles

EPA made LAA determinations for 14 reptiles, based on the potential for secondary exposure through the consumption of mammals, birds, terrestrial amphibians and reptiles exposed to bromethalin.

- Along with potential for direct consumption through consuming or carrion, some of these species are ground feeders that eat grains or seeds, so there is potential for incidental consumption of bait while feeding.
- EPA made LAA determinations for listed reptiles that may be exposed to bromethalin via the limited burrow use via impregnated artificial worms/grubs.

Amphibians

EPA made LAA determinations for 5 amphibians, based on the potential for secondary exposure through the consumption of mammals, birds, terrestrial amphibians and reptiles exposed to bromethalin. EPA made LAA determinations for listed reptiles that may be exposed to bromethalin via the limited burrow use via impregnated artificial worms/grubs.

Predictions of the Potential Likelihood of Future Jeopardy

Reptiles

For all 14 reptile species which EPA determined LAA from bromethalin exposure, EPA predicted to have no likely future J. EPA predicted these reptile species as unlikely to experience adverse effects from bromethalin to the point of J to their population based on one or more of the following factors: low overlap, low MoE, and a diverse diet.

Amphibians

All 5 amphibian species for which EPA determined LAA from bromethalin exposure, EPA predicted to have no likely future J. EPA predicted these amphibian species as unlikely to experience adverse effects from bromethalin to the point of J to their population based on one or more of the following factors: low overlap, low MoE, and a diverse diet.

All NLAA/LAA and no J/J determinations and justifications for listed reptiles and amphibians can be found in the respective species worksheet in **Appendix B** and **Appendix C** following methodology in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.3.6 Mammals

NLAA Determinations

EPA made 30 NLAA determinations for listed mammals for bromethalin bait station uses and 24 NLAA determinations for burrow uses (specifically determining effects from the limited artificial impregnated worm/grub use). Several mammals reside at high elevation or remote locations such as cliffside or rocky slope habitat where rodenticide exposure is unlikely to occur. Several mammalian species primarily feed on aquatic invertebrates and zooplankton, or only live in aquatic habitats such as salt marshes (*e.g.*, the salt marsh harvest mouse; *Reithrodontomys raviventris*) and are thus unlikely to be exposed to rodenticides within their habitat. EPA made NLAA determinations for mammals that lived in uninhabited island locations within the non-lower 48 areas of the United States, including within Hawaii and Puerto Rico, as bromethalin uses are only approved for open spaced developed commensal uses in these locations. Several species live within interior forests or other areas where rodenticide usage is unlikely and exposure potential is low. Several mammalian species, including all listed bats, EPA determined as NLAA because the species consumes fruits and glean insects and snails off the tree foliage, or flying insects instead of dietary items on the ground; therefore, EPA considers these species as unlikely to be exposed to rodenticides via primary or secondary exposure.

LAA Determinations

EPA made LAA determinations for bromethalin for 45 mammals, based on the potential for primary exposure to bromethalin through direct consumption of bromethalin. There is also potential for secondary exposure through the consumption of mammals, birds, terrestrial amphibians and reptiles. Along with potential for direct consumption through consuming carrion, some of these mammalian species are ground feeders that eat grains and seeds, so there is potential for incidental consumption of bait while feeding. Several mammalian species with LAA determinations were considered omnivorous and opportunistic foragers, which decreased the likelihood of rodenticide exposure. Several mammals inhabit the same burrows of target pests, which means they are vulnerable to rodenticide exposure from direct application.

Predictions of the Potential Likelihood of Future Jeopardy

EPA did not predict the potential likelihood of future J for 21 listed mammalian species because there was either low to medium overlap with uses (with the exception of the limited artificial impregnated worm/grub burrow use), or there was high overlap but low likelihood of effects. Therefore, there was low likelihood that the exposure would cause population-level effects.

EPA made LAA determinations and did not predict the potential likelihood of future J for 18 listed mammal species for the limited burrow uses which targeted moles via impregnated artificial worms/grubs. Despite the potential availability of exposed prey, a significant majority of mortalities occurred below ground (82–91%), likely reducing the extent of secondary exposure to occur at the population level (Baldwin *et al*., 2021). There is also lower potential for secondary exposure from these burrow uses because of the shorter half-life of bromethalin, relative to other rodenticides. One additional reason for the no likely future J predictions for the 18 listed mammal species was low overlap with the limited bromethalin impregnated artificial worm/grub burrow use.

EPA made LAA determinations and predicted potential likely future J determinations for 45 listed mammals for bait station uses, and for 30 of those listed mammals from the limited impregnated artificial worm/grub burrow use. The listed mammals exhibited both high MoE and high overlap from bromethalin exposure from bait station uses and the limited impregnated artificial worm/grub burrow use – primary exposure is possible for the predicted J species. Several listed mammalian species are similar to target species, including the deer mice (*Peromyscus* spp.) or pocket gophers (*Thomomys* spp.) and have the potential to enter a bait station or burrow due to size. EPA made LAA determinations for bromethalin with predicted likely J determinations for the Stephens' kangaroo rat (*Dipodomys stephensi)*, which is consistent with the effects determinations EPA made in the pilot memo (USEPA, 2022e).

Table 3-11 presented the listed species effects determinations and predictions of the potential likelihood of future J for bromethalin.

All NLAA/LAA and no J/J determinations and justifications for listed mammals can be found in the listed "Mammals" worksheet in **Appendix B** and **Appendix C** following methodology in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

Table 3-11. Number of Listed Species Effects Determinations and Predictions of the Potential Likelihood of Future Jeopardy for Bromethalin[1,2]

Taxon	Number of Species	Initial Determinations across all A.I.'s				Specific Determinations and Predictions Across Use Patterns and by A.I.					
						Bait Station			Burrow		
		NE	MA	NLAA	LAA	NLAA	LAA, No J	LAA, J	NLAA	LAA, No J	LAA, J
Mammals	100	25	75	22	53	30	21	24	24	18	33
Birds	95	25	70	28	42	54	16	0	54	16	0
Amphibians[3]	47	12	35	0	0	35	0	0	30	5	0
Reptiles[3]	59	25	34	1	29	20	14	0	20	14	0

[1] EPA made effects determinations and predictions of the potential likelihood of future jeopardy for listed species and the details on these can be found in **Appendix B** and **Appendix C**.
[2] Reflects listed species current as of Oct. 2024. This includes accounting for delisted species. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction
[3] "Amphibians" include those species that have both a terrestrial and aquatic phase.
NE = No Effect; NLAA = Not Likely to Adversely Affect; LAA = Likely to Adversely Affect; J = Jeopardy

3.2.4 Strychnine

3.2.4.1 Introductory Information on Strychnine

EPA signed the FIFRA-based strychnine DRA on June 30, 2020 (USEPA, 2020d). The United States first registered strychnine, an alkaloid compound, in 1947. The sole target pests registered in the U.S. for strychnine are gophers (*Geomyidae* spp.), except in the state of Nevada where a Special Local Need (SLN) registration (also referred to as a Section 24(c) registration) currently allows its use to control the yellow-bellied marmot (*Marmota flaviventris*) and three species of ground squirrel (*Spermophilus* spp.). Strychnine is also sometimes used for the control of invasive animals other than rodents (*e.g.*, feral cats, rabbits) in island eradication projects by federal agencies such as APHIS or USFWS. The federal agencies initiate ESA consultation for each new project (island) under their EPA registrations.

All registered Section 3 strychnine products are formulated as a solid bait. The bait products must be placed either inside underground runways of existing gopher burrows, or into artificial burrows that the gophers are expected to enter. The Section 24(c) product in Nevada is formulated as a paste, which is mixed with bait material (*e.g.,* chopped cabbage or alfalfa) and then placed at least 8 inches in the animal burrow. Baits may be applied in various settings, including residential lawns, other "non-agricultural areas", agricultural cropland, pastures, forestry land, and rangeland. Strychnine does not have any above-ground uses.

Strychnine is a convulsant that acts as a selective competitive antagonist to block post-synaptic glycine receptors predominantly in the central nervous system (USEPA, 2020d). Tetanic convulsions caused by strychnine can lead to rapid asphyxiation and death. Symptoms in mammals can occur within 5 to 30 minutes after ingestion (Borges et al., 1989), with death able to occur within an hour after a lethal exposure (USEPA, 2020).

Based on available toxicity data, strychnine is classified as very highly toxic to birds and mammals on an acute oral exposure basis and highly toxic to birds on a subacute dietary exposure basis. These same data indicate that a broad range of birds and mammals are highly sensitive to strychnine, including passerines, waterfowl, corvids, raptors, rodents, canids, and mustelids, whereas quail (Galliformes) appear to be less sensitive. Therefore, strychnine poses an acute hazard[31] to all terrestrial vertebrate taxa (birds, mammals, reptiles, and amphibians). Chronic effects (*e.g.*, reduced egg production) have also been observed in birds.

The nature of risk to non-target mammals and birds from rodenticides is well-established in the FIFRA-based risk assessments and includes mortality from primary and secondary exposure (*e.g.,* USEPA, 2020d). As strychnine is used for the control of burrowing rodents, which can form a significant proportion of the diet for a number of species, and since the compound is persistent in animal tissues and the environment, it has the potential to be a secondary exposure route for predators that may consume the target species carcasses. Exposure of predators through invertebrates that accumulate strychnine is also possible.

3.2.4.2 General Conclusions from the Incident Analysis

Since 1968, there are 170 strychnine-related wildlife incidents reported in the IDS, with 3 incidents reported as recently as 2020. This indicates that exposure and wildlife incidents have continued to occur even though above-ground uses of strychnine were prohibited by a U.S. Court injunction in 1988 and remain temporarily cancelled. Strychnine incidents are generally based on detection of residues in tissues and corroborating evidence from carcass necropsy or observed tremors in the field. Incident reports include numerous bird and mammal species, primary (*e.g.,* Eastern Bluebird [*Sialia sialis*], American Coot [*Fulica americana*], Eastern Meadowlark [*Sturnella magna*], Blue-winged Teal [*Spatula discors*], Killdeer [Charadrius vociferus], deer, and jack rabbit) and secondary consumers (*e.g.*, Rough-legged hawk [*Buteo lagopus*], Peregrine falcon [*Falco peregrinus*], San Joaquin Kit Fox, eagles, and bear). Collectively, these incidents involve a wide range of species, most of which are primary consumers. Given the large number of unrelated target species involved in some incidents (*e.g.,* 30 blackbirds, 20 mallards), a significant amount of bait was likely applied above-ground, which would represent a misapplication or misuse. For a complete list of affected non-target animals, see the FIFRA-based 2020 DRA (USEPA, 2020d).

3.2.4.3 Defining Spatial Overlap

Strychnine is used to control burrowing rodents in a variety of settings, including residential lawns, other “non-agricultural areas”, agricultural cropland, pastures, forestry land, and rangeland. It is only applied via below-ground, burrow insertion. The action area for strychnine is thus represented by the UDL layers Open Space Developed, Other Orchards, Managed Forest, Forest Trees, Rangeland, Cultivated Land, Rights-of-Way, and Pasture (*see* **Section 2.4**).

3.2.4.4 Birds

Toxicity data classifies strychnine as very highly toxic to birds on an acute oral exposure basis and highly toxic on a subacute dietary exposure basis (USEPA, 2020d). A broad range of birds are highly sensitive to strychnine, including passerines, waterfowl, corvids, and raptors, whereas quail (Galliformes spp.) appear to be less sensitive. On a chronic exposure basis, reduced growth and egg production were detected in toxicity tests at concentrations as low as 68.9 mg a.i./kg-diet. Therefore, there is the potential of adverse effects from the use of strychnine for birds.

[31] Hazard only reflects relative toxicity. The hazard is not synonymous with likely effects to individuals or populations because it does not consider the likelihood or magnitude of exposure.

NLAA Determinations

EPA made NLAA determinations for 58 bird species from strychnine use. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects (*see* **Section 2.6.2**). In addition, EPA determined as NLAA those species that are likely extinct. Overall, the most impactful modifiers that resulted in NLAA determinations included:

- Since all above ground use is prohibited and bait must be placed 6 inches into the entrance of the burrow and it is not expected for birds to enter the burrow and/or kick out bait therefore exposure is not reasonably expected to occur. There is likely little chance for any significant non-target exposure because the target pest (pocket gopher) quickly wall-off disturbed sections of the burrow (Gene Benbow pers. comms 8/28/2023),
- Species is unlikely to enter into burrow due to size and foraging behavior, and
- Species is not in the CONUS and not expected to overlap with the range for the target pests.

LAA Determinations

EPA made LAA determinations for 12 listed bird species due to the potential for consumption of poisoned target mammals. These species included secondary consumers such as the Northern aplomado falcon (*Falco femoralis septentrionalis*) and the Mexican spotted owl (*Strix occidentalis lucida*).

Predictions of the Potential Likelihood of Future Jeopardy

For the 12 listed bird species identified as LAA, EPA did not predict that any would rise to the potential for likely future J. Despite overlap classifications, EPA made a low MoE classification for these species (*see* **Section 2.6.3**) because although the assessed birds would likely consume just a fraction of a mammal that has consumed its daily diet as strychnine bait or tracking powder, they could receive a dose equivalent to the dose leading to 50% mortality (LD_{50}) and one that exceeds the LOC (0.5) from the consumption of just one mammal. However, the vast majority of mortalities from rodenticide-treated bait burrow uses tend to occur belowground (Baldwin *et al.,* 2021)., likely reducing the extent of secondary exposure that could occur at the population level.

EPA's rationales for effect determinations and predictions of future J for listed birds can be found in the "Birds" worksheet in **Appendix B** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.4.5 Reptiles and Amphibians

Avian toxicity data is used as a surrogate for reptiles and terrestrial-phase amphibians. As mentioned above, strychnine is classified as very highly toxic to birds on an acute oral exposure basis and highly toxic to birds on a subacute dietary exposure basis. These same data indicate that a broad range of birds and mammals are highly sensitive to strychnine, including passerines, waterfowl, corvids, raptors, rodents, canids, and mustelids, whereas quail appear to be less sensitive. Mortality can occur from primary and secondary exposure and strychnine is persistent in animal tissues and the environment (USEPA, 2020d). Therefore, strychnine poses an acute hazard[32] to all animal taxa (birds, mammals,

[32] Hazard only reflects relative toxicity. The hazard is not synonymous with likely effects to individuals or populations because it does not consider the likelihood or magnitude of exposure.

reptiles and amphibians). Chronic effects (*e.g.*, reduced egg production) have also been observed in birds. Potential effects to reptiles and terrestrial-phase amphibians were determined by referencing toxicity data for birds as surrogate data (aquatic amphibians and reptiles were determined to be NE due to a lack of aquatic exposure).

NLAA Determinations

EPA made NLAA determinations for 22 reptile and 30 amphibian species from strychnine use. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects (*see* **Section 2.6.2**). In addition, EPA also made NLAA determinations for species that are likely extinct. Overall, the most impactful modifiers that resulted in NLAA determinations included:

- Species specifically consumes invertebrates and does not rely on small mammal burrows (invertebrates do not represent a significant exposure pathway),
- Species is not found in CONUS and not expected to overlap with the range of the target pest,
- Applications are intended to be made to active target pest burrows only; therefore, EPA expected that the species is more likely to go into an active pest target burrow rather than an inactive burrow that might be inhabited by a nontarget species,
- Non-target exposure would not be significant because the primary target pests (*e.g.*, gopher species) can wall off disturbed sections of the burrow (Gene Benbow pers. comms 8/28/2023, Schalau, 2023 and Werner *et al.,* 2005), and
- Species only consumes only other non-mammalian terrestrial vertebrate prey (*e.g.*, birds, amphibians, and reptiles). Since the main dietary item is non-mammalian prey, it is unlikely the species would enter the mammal burrow in search of prey or consume the target species.

LAA Determinations

EPA made LAA determinations for 12 listed reptiles and 5 listed amphibian species from strychnine use because species have the potential to inhabit small mammal burrows and may accidentally consume bait while foraging for invertebrates or the species has the potential to consume poisoned target mammals.

Predictions of the Potential Likelihood of Future Jeopardy

For the 12 listed reptiles classified as LAA, EPA did not predict the potential likelihood for future J for any of the species. Despite overlap classifications, EPA made a low MoE classification for these 12 reptiles because a majority (82–91% per Baldwin *et al.,* 2021) of target species mortalities occur below ground, likely reducing the extent of secondary exposure to occur at the population level. For the 5 listed amphibians classified as LAA, EPA did not predict the potential likelihood for future J. Despite the overlap classifications, EPA made a low MoE determination because invertebrates are not expected to represent a significant exposure route to translate to population level effects and it is unlikely that enough burrows will be treated to result in population level effects.

EPA's predictions of the potential likelihood of future J and justifications for listed reptiles and amphibians can be found in the "Amphibians" and "Reptiles" worksheets in **Appendix B** and the "New species" worksheet in **Appendix C** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.4.6 Mammals

Strychnine is classified as very highly toxic to mammals on an acute oral exposure basis. FIFRA-based risk assessments indicate that mammals are at risk of mortality from the use of strychnine (acute RQs ranging from 64-192). The FIFRA-based 2020 DRA shows that for mammals ranging from 50-3000 g, consuming just a fraction of their daily diet as mammalian prey affected by strychnine would be enough to impart a dose equivalent to the mammal LD_{50} for strychnine and one that exceeds the acute LOC (0.5). There are no 2-generation rat or other chronic toxicity studies available for strychnine to evaluate effects on reproduction or growth in mammals. Although there are no sublethal effects data available, this data gap is not impactful because mortality is the major concern for strychnine.

NLAA Determinations

EPA made NLAA determinations for 24 mammal species from strychnine use. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects (*see* **Section 2.6.2**). In addition, EPA also determined species that are likely extinct as NLAA. In addition to the reasons for NLAA described in **Section 2.6.2**, EPA also made NLAA determinations for larger species (*e.g.,* Sonoran pronghorn, *Antilocapra americana sonoriensis* and other listed deer species) that are unlikely to enter a burrow due to their body size (species more than 400 g, approximately the equivalent size of a standard laboratory rat). Additionally, these species are herbivorous; therefore, secondary exposure is not a pathway for these species.

LAA Determinations

EPA made LAA determinations for 51 listed mammals because of similarity to the target species, potential to be in a burrow, or exposure from the consumption of mammalian prey.

Predictions of the Potential Likelihood of Future Jeopardy

EPA predicted the potential likelihood for future J for 33 mammal species from strychnine use based primarily on high overlap with the UDLs selected and high MoE because of similarity to target pest and potential to be in a burrow (*see* **Sections 2.4** and **2.6.3**). These include several species of gophers, kangaroo rats, ground squirrels, beach mice, rabbits, voles, one chipmunk (*i.e.*, Penasco least chipmunk; *Tamias minimus atristriatus*), and one prairie dog (Utah prairie dog; *Cynomys parvidons*).
For the remaining 18 listed LAA mammals EPA did not predict the potential likelihood of future J because of either low overlap or a low MoE (primarily based on the reasoning that the vast majority of mortalities occurred below ground which significantly reduced the extent of secondary exposure at the population level).

EPA's predictions of the potential likelihood of future J and justifications for listed mammals can be found in the "Mammals" worksheet in **Appendix B** and the "New species" and "UDL_update (species)" worksheets in **Appendix C** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

Table 3-12 summarizes the number of listed species determinations and predictions of the potential likelihood of future J for all taxa from strychnine.

Table 3-12. Number of Listed Species Effects Determinations and Predictions of the Potential Likelihood of Future Jeopardy for Strychnine (Burrow)[1,2]

Taxon	Number of Species	NE	NLAA	LAA, No J	LAA, J
Mammals	100	25	24	18	33
Birds	95	25	58	12	0
Amphibians[3]	47	12	30	5	0
Reptiles	59	25	22	12	0

[1] EPA made effects determinations and predictions of the potential likelihood of future jeopardy for listed species and the details on these can be found in **Appendix B** and **Appendix C**.
[2] Reflects listed species current as of Oct. 2024. This includes accounting for delisted species. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction
[3] "Amphibians" include those species that have both a terrestrial and aquatic phase.
NE = No Effect; NLAA = Not Likely to Adversely Affect; LAA = Likely to Adversely Affect; J = Jeopardy

3.2.5 Cholecalciferol

3.2.5.1 Introductory Information on Cholecalciferol

EPA signed the FIFRA-based DRA for cholecalciferol on March 31, 2020 (USEPA, 2020c). In 1984, the United States first registered cholecalciferol (3β,5*Z*,7*E*)-9,10-secocholesta-5,7,10(19)-trien-3-ol), a sterol also known as vitamin D3 that is used as a rodenticide. Based on the FIFRA-based DRA, the parent compound cholecalciferol is the sole residue of concern for assessing risk. Cholecalciferol may be applied as pellets or bait blocks, which must be placed inside tamper-proof bait stations if used above-ground. Below-ground, cholecalciferol can be placed in rat burrows in pellet-form. Labeled target species for cholecalciferol are Norway rats (*Rattus norvegicus*), roof rats (*Rattus rattus*), and house mice (*Mus musculus*). Ingestion results in hypercalcemia due to mobilization of calcium from bone matrix into blood plasma (Pelfrene, 1991) leading to metastatic calcification of soft tissues (Fraser, 1995).

Based on available toxicity data, cholecalciferol may be considered practically non-toxic to birds on an acute oral exposure basis but is slightly to highly toxic to birds on a subacute dietary exposure basis. Additionally, according to the Wildlife Exposure Factors Handbook (USEPA, 1993), the daily food intake for birds ranges from 5.1 to 141 g/day. In comparison, the concentration leading to 50% mortality (LC_{50}) from the acute dietary toxicity study with bobwhite quail was 495 mg a.i./kg-diet (USEPA, 2020) and is well above levels of daily food intake, indicating low likelihood of toxicity to birds on a subacute dietary exposure basis. The compound is highly toxic to mammals on an acute oral exposure basis (USEPA 2020). Exposure to non-target birds and mammals is expected to be minimal when cholecalciferol is used according to label instructions (*i.e.*, mandatory placement of pellets or bait blocks inside tamper-proof bait stations or below-ground placement of pellets inside rodent burrows with mandatory retrieval of unconsumed bait). However, although label language may help to reduce the likelihood of exposure for non-target organisms, it is not precluded by label statements. Since chronic toxicity data are not available, the likelihood of adverse effects from repeated exposure to cholecalciferol cannot be fully characterized.

Acute RQs for cholecalciferol exceed the acute LOC of 0.5 for mammals. However, acute RQs for birds, which serve as surrogates for reptiles and terrestrial-phase amphibians, do not exceed the acute risk LOC. Chronic toxicity data are not available for terrestrial vertebrates; therefore, the likelihood of adverse effects from chronic exposure has not been quantified. Additionally, secondary exposure from consumption of cholecalciferol-affected target species is uncertain but expected to be low (USEPA, 2020c). Non-target plants and animals other than birds and mammals, including aquatic organisms, terrestrial plants and terrestrial invertebrates are not expected to be at risk from use of cholecalciferol due to a lack of exposure (USEPA, 2020c).

3.2.5.2 General Conclusions from the Incident Analysis

Registrants of cholecalciferol have reported a substantial number of incidents of domestic animal poisoning for cholecalciferol. As of the FIFRA-based 2020 DRA, there was one wildlife incident for cholecalciferol in the IDS database in which a juvenile female striped skunk was found in a dumpster in Corte Madera, California (Incident# I029093) on May 22, 2016. A rehabilitation center treated the affected animal with fluids and antibiotics; however, due to the severity of its condition (lethargic and inability to stand), they later euthanized the animal. The liver showed detection of cholecalciferol at >2.6 mg/kg. As of the 2020 DRA, there were no reported aggregate incidents for wildlife or plants.

3.2.5.3 Defining Spatial Overlap

Cholecalciferol is used to control commensal rodents in and around human-made structures. It has no agricultural uses. It is sold in bait stations and is available to the public; therefore, the action area for cholecalciferol is understood to be areas of human habitation. This is represented by Developed and Open Space Developed UDL layers, which cover large portions of CONUS and NL48 (*see* **Section 2.4**). Lastly, for the purposes of this assessment, bait box uses are assumed to be protective of burrow uses as all cholecalciferol labels require outdoor applications to be within 100 feet of man-made structures; therefore, species effects determinations and predictions of the potential likelihood of future J were not considered separately for burrow uses.

3.2.5.4 Birds

In both studies with bobwhite quails (*Colinus virginianus*) and mallard ducks (*Anas platyrhynchos*), the 14-d LD_{50} values are >2,000 mg/kg bw and would classify cholecalciferol as practically non-toxic on an acute oral exposure basis (USEPA, 2020). On a sub-acute dietary exposure basis, cholecalciferol may be classified as slightly to highly toxic to birds. In an acute dietary study with the Mallard, the LC_{50} value was 1,178 mg a.i/kg diet (slightly toxic), whereas in a sub-acute dietary study with the Bobwhite, the LC_{50} value was 495 mg a.i./kg-diet (highly toxic). No data are available to assess avian chronic toxicity from exposure to cholecalciferol. EPA generally considers exposure of birds to current uses of cholecalciferol as unlikely based either on bird behavior (unlikely to enter bait station) or body size (too large to enter bait station).

NLAA Determinations

Due to low toxicity of cholecalciferol to birds on a dose-basis and a low likelihood of consuming enough bait on a daily basis to meet dietary levels of effect, EPA made NLAA determinations for this taxon for cholecalciferol. The cholecalciferol NE and NLAA determinations for birds can be found in the “Birds” worksheet in **Appendix B** and are summarized in **Table 3-13**.

3.2.5.5 Reptiles and Amphibians

As discussed in **Section 2.6.1**, EPA made NE determinations for all fully aquatic species or those in the aquatic-based food web. For the remaining species, since birds are surrogates for terrestrial-phase amphibians and reptiles and cholecalciferol is of relatively low toxicity to birds (*see* **Section 3.2.5.4**), EPA made NLAA determinations for all reptiles and terrestrial-phase amphibians. The cholecalciferol NE and NLAA determinations for reptiles and amphibians can be found in the "Amphibians" and "Reptiles" worksheets in **Appendix B** and the "New species" worksheet in **Appendix C** and are summarized in **Table 3-13**.

3.2.5.6 Mammals

With a rat LD_{50} of 11.8 mg a.i./kg bw, cholecalciferol is classified highly toxic to mammals on an acute oral exposure basis. Therefore, cholecalciferol poses an acute hazard[33] to all mammals that might consume it. According to the FIFRA-based 2020 DRA, primary exposure RQ values for mammals consuming bait range from 1.34 to 24, depending on body weight. According to the DRA, effects to secondarily exposed mammals are possible, but the data to support this route of exposure are limited.

EPA predicted the potential likelihood of future J for mammal species whose range includes Developed or Open Space Developed UDLs, and which are small enough to enter bait stations (house mouse size or smaller) or burrows. This prediction rests on the assumption that a significant number of individuals of a given listed species and size could enter bait stations and/or burrows and consume cholecalciferol to cause population-level effects.

EPA's rationales for effect determinations and predictions of the potential likelihood of future J for mammals can be found in in **Appendix B** and **Appendix C** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

NLAA Determinations

EPA made NLAA determinations for 30 mammal species from cholecalciferol use (*see* **Table 3-13**). An assessment of the likelihood of direct effects and exposure occurring based on different habitat characteristics drove EPA's NLAA determinations. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects (*see* **Section 2.6.2**). In addition, EPA also determined species that are likely extinct as NLAA. NLAA determinations resulted from a low likelihood that species will be exposed in multiple feedings on rodent prey.

LAA Determinations

EPA made LAA determinations for a total of 45 listed mammal species primarily based on similarity to target pest, small body size and the potential to consume mammalian prey.

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[33] Hazard only reflects relative toxicity. The hazard is not synonymous with likely effects to individuals or populations because it does not consider the likelihood or magnitude of exposure.

Predictions of the Potential Likelihood of Future Jeopardy

Of the 45 total LAA species, EPA predicted the potential likelihood of future J for 24 mammal species from cholecalciferol use due to a high MoE (similarity to target pest; *see* **Section 2.6.3**) and high or medium overlap with the UDLs selected to represent cholecalciferol use (*see* **Sections 2.4** and **3.2.5.3)**. These species include several species of pocket gophers, kangaroo rats, beach mice, and one shrew (Buena Vista Lake ornate shrew; *Sorex ornatus relictus*).

For the remaining 21 LAA species, EPA did not predict the potential likelihood of future J due to either low overlap or a low MoE due to cholecalciferol having a low likelihood of effect from secondary poisoning (*see* **Sections 2.4** and **2.6.3**).

EPA's rationales for effect determinations and predictions of future J for listed mammals can be found in **Appendix B** and **Appendix C** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

Table 3-13 summarizes the number of listed species determinations and predictions of the potential likelihood of future J for all taxa from cholecalciferol.

Table 3-13. Number of Listed Species Effects Determinations and Predictions of the Potential Likelihood of Future Jeopardy for Cholecalciferol (Bait Station)[1,2]

Taxon	Number of Species	NLAA	LAA, No J	LAA, J
Mammals	100	30	21	24
Birds	95	70	0	0
Amphibians[3]	47	35	0	0
Reptiles	59	34	0	0

[1] EPA made effects determinations and predictions of the potential likelihood of future jeopardy for listed species. The details on these can be found in **Appendix B** and **Appendix C**.
[2] Reflects listed species current as of Oct. 2024. This includes accounting for delisted species. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction
[3] "Amphibians" include those species that have both a terrestrial and aquatic phase.
NLAA = Not Likely to Adversely Affect; LAA = Likely to Adversely Affect; J = Jeopardy

3.2.6 Zinc Phosphide

3.2.6.1 Introductory Information on Zinc Phosphide

EPA signed the FIFRA-based zinc phosphide (ZnP) DRA in June 24, 2020 (USEPA, 2020e). Zinc phosphide is an inorganic rodenticide used to control gophers, mice, rats, lagomorphs (*e.g.*, jack rabbits), prairie dogs, and squirrels. The USDA first registered zinc phosphide as a pesticide in the U.S. in 1947. Zinc phosphide formulations include dusts intended for mixing into baits, solid baits, and tracking powders, which may be applied as a ground or aerial broadcast treatment. Registered uses include: indoor and outdoor residential and agricultural areas (including in and around homes, lawns, bulbs, in and around outside buildings/barns, and rights-of-ways/fencerows/ hedgerows), indoor and outdoor commercial or institutional premises and equipment, golf courses, and reforestation areas. To minimize exposure of children to rodenticide products used in homes, EPA requires that all rodenticide bait products marketed to general and residential consumers be sold only with bait stations (USEPA, 2008). All zinc phosphide products labeled for field use (except those limited to underground baiting for pocket gophers and moles) are restricted use pesticides (RUP) and may only be applied by certified applicators (USEPA, 2008).

EPA made effects determinations for chlorophacinone and diphacinone based on bait station, burrow, and broadcast uses. EPA considers the effects determinations for broadcast use of those two chemicals to be representative of those for the scatter/spot treatments because the amount of bait put on the landscape surface during a scatter/spot treatment should be equally as lethal to non-target primary consumers as that for a broadcast application and the bait should be equally accessible to those species for both types of application. EPA expects to further discuss this with USFWS during consultation.

Furthermore, bait station uses are permitted in some agricultural areas. Although, EPA made effects determinations for bait station use for non-agricultural areas, the effects determinations for broadcast use and/or scatter/spot treatments are inclusive of bait station uses in the same location. That said, bait stations use instead of broadcast use in these locations would reduce the exposure to primary consumer terrestrial vertebrates that cannot access the bait within the stations, meaning that there is potentially no J for those species that EPA predicted to have potential likelihood of J for broadcast uses at the same locations. EPA believes effects determinations for secondary consumers are the same in agricultural field settings whether the bait is applied by broadcast or in a bait station. EPA expects to further discuss this with USFWS during consultation.

Zinc phosphide's mode of pesticidal action is via an acid hydrolysis reaction that produces phosphine (PH_3), a toxic gas. After ingestion, reactions in the gut result in PH_3 release and absorption into the digestive tract (USEPA, 2020e). The residues of concern for zinc phosphide are the parent compound and phosphine gas (particularly within the gut of an animal). Phosphine is expected to form once zinc phosphide is ingested; therefore, exposures and toxicity are assessed by considering consumption of zinc phosphide formulated products. Zinc phosphide that is not ingested by target or non-target organisms would be slowly converted into phosphine gas by hydrolysis under environmentally relevant pH conditions where zinc phosphide is applied. Phosphine gas released slowly in the environment under relatively neutral pH conditions is expected to dissipate in the atmosphere or adsorb to soils before it can reach levels of toxicological concern.

Based on available toxicity data, zinc phosphide is highly toxic to birds and mammals on an acute oral and sub-acute dietary exposure basis. Other than acute and sub-acute toxicity data for birds and mammals, no other toxicity data are available for zinc phosphide. The FIFRA-based 2020 DRA assessed risk to birds and mammals from zinc phosphide exposure by considering primary (via direct consumption by non-target animals of formulated products containing zinc phosphide) and secondary exposure (via consumption of target mammals that have consumed zinc phosphide formulated products).

The main effects from zinc phosphide are generally from direct primary consumption. Secondary effects due to consumption of target species by predators and scavengers is less of a concern than with other rodenticides because zinc phosphide decomposes readily in the digestive tract and does not accumulate in muscles. Furthermore, zinc phosphide's emetic effect (useful since most rodent species are less capable of vomiting) and a tendency for predators to avoid digestive tracts containing this pesticide may reduce both primary and secondary exposure. Lastly, mortality in target species occurs soon after consumption (less than one day; USEPA, 2020e). Labels for the outdoor broadcast uses of zinc phosphide held by the APHIS generally require that zinc phosphide not be used near occupied ranges of numerous listed species to reduce exposure to non-target species.

The FIFRA-based DRA presents multiple lines of evidence to indicate that zinc phosphide poses a risk of mortality to birds, terrestrial-phase amphibians, reptiles and mammals from both primary and secondary exposure to zinc phosphide, including; 1) bait formulations of zinc phosphide (*e.g.*, treated oats) are expected to be attractive to birds and mammals and possibly some reptiles, 2) zinc phosphide is broadcast in agricultural areas where non-target wildlife, including where birds, terrestrial-phase amphibians, reptiles and mammals are likely to visit, 3) dietary (RQ=43) and dose-based (RQ range: 70-546) screening-level risk estimates for birds consuming bait (RQ = 43) exceed the acute risk LOC of 0.5 by orders of magnitude, 4) dose-based RQs (range: 38-85) exceed the acute risk LOC by orders of magnitude for mammals, and 5) only a small fraction of a daily diet is needed to reach the LD_{50} for birds and mammals (>1.4%-2.6%).

3.2.6.2 General Conclusions from the Incident Analysis

Fifty-seven incident reports are available in the IDS for zinc phosphide documenting bird mortalities, which are assumed to be from consuming bait (USEPA, 2020e). In total, the reported incidents involve mortalities of thousands of birds associated with bait. More than half of those incidents have been reported since the RED in 1998, with six incidents occurring within the last five years. Separate incidents reported in 2015 and 2016 involved the deaths of thousands and hundreds of snow geese (respectively). Three incident reports are available documenting mortalities of non-target mammals which are assumed to be from consuming bait. Two additional incidents may be associated with primary or secondary consumption. Most of the incident reports have a certainty index of highly probable or probable, indicating a high degree of confidence that they were associated with zinc phosphide exposure. 2008 is the date of the most recent mammalian mortality incident. Sixty-three incident reports of registered use or unknown legality (39 highly probable) for zinc phosphide indicate that affected birds were likely exposed by primary consumption, as none of the species affected were predators of mammals (USEPA, 2020e). The majority of the mortalities were turkeys (hundreds) and geese (thousands). These reports confirm primary exposure and adverse effects in birds. There were fewer (six) incident reports for mammals, including raccoon, red fox and gray squirrel. Of the 25 reported mortalities, 20 were gray squirrels. The incident report confirmed that the single red fox incident resulted from secondary exposure from consumption of dead mice. Overall, these incidents do not provide strong support of effects to mammals from secondary exposure; however, evidence of effects from primary exposure to non-target mammals is more evident by the squirrel incidents.

3.2.6.3 Defining Spatial Overlap

Zinc phosphide is used to control commensal rodents in and around human-made structures. It is applied using bait stations, as well as broadcast and burrow insertion in agricultural areas. The action area for zinc phosphide is thus understood to be areas of human habitation, cropland, managed forest, rangeland, rights-of-way, *etc*. Zinc phosphide use is represented by the UDL layers Developed, Open Space Developed, Nurseries, Managed Forest, Christmas Trees, Forest Trees, Rangeland, Cultivated Land, Rights-of-Way, and Pasture. Bait station uses are represented by Open Space Developed and Developed UDLs (*see* **Section 2.4**).

3.2.6.4 Birds

The FIFRA-based DRA concluded that zinc phosphide poses an acute hazard[34] to all terrestrial vertebrates that might consume it (USEPA, 2020e). Primary exposure RQs for mammals calculated on dose-basis ranged from 38 to 85 (USEPA, 2020e). For birds, primary exposure RQs calculated on a dose- and dietary-basis ranged from 43 to 546.

Effects to secondarily exposed birds are possible (dietary-based RQs 1.3-8.3), but only if 1) the entire carcass including gut contents is consumed and 2) too little time (<1 hour) has passed for the zinc phosphide to have completely reacted in the gut. Overall, effects to secondary and tertiary consumers are considered unlikely due to the reactive nature and non-persistence of zinc phosphide. However, secondary consumers that often consume some prey items whole (*e.g.,* owls and some other raptors) or whose diet is significantly composed of target species (*e.g.,* species that are obligate consumers of target species) may be exposed.

Exposures to zinc phosphide used in bait stations is considered likely only for small mammals, since the bait stations are designed to be attractive to rodents. Exposure of birds to zinc phosphide used in bait stations is considered unlikely either on behavioral (unlikely to enter bait station) or body size (too large to enter bait station). Exposures from broadcast or in-burrow uses are possible for all vertebrates that might visit the agricultural or other outdoor use sites. Such species are LAA on the basis of exposure of at least one individual.

Burrow baiting with zinc phosphide can include the placement of bait at or near the surface of the burrow and the exposure potential has elements of both the broader bins of broadcast and burrow. For birds, EPA only made predictions of the potential likelihood of future J for broadcast use. EPA considered it unlikely that a primary consumer bird would enter a burrow and routinely feed around the openings of active burrows to rise to the level of a population-level effect.

NLAA Determinations (Bait Stations)

EPA made NLAA determinations for 54 listed bird species from zinc phosphide bait station use. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects (*see* **Section 2.6.2**). In addition, EPA determined species that are likely extinct as NLAA. Overall, the most impactful modifiers that drove EPA NLAA determinations included:

- Species is a primary consumer and the species' main dietary items are extremely unlikely to be contaminated with bait because the bait is specifically contained within the bait station,
- Species is extremely unlikely to enter the bait station opening, and
- For those species that consume invertebrates, since the bait is contained within the station, invertebrates are not expected to represent a significant exposure pathway.

NLAA Determinations (Burrow Applications)

EPA made NLAA determinations for 54 listed bird species from zinc phosphide as a burrow application. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably

[34] Hazard only reflects relative toxicity. The hazard is not synonymous with likely effects to individuals or populations because it does not consider the likelihood or magnitude of exposure.

expected to occur at levels that could cause effects (*see* **Section 2.6.2**). In addition, EPA determined species that are likely extinct as NLAA. Overall, the most impactful modifiers that drove EPA NLAA determinations included:

- Bait must be placed 6 inches into the entrance of the burrow and it is not expected for birds to enter the burrow and/or kick out bait; therefore, exposure is not reasonably expected to occur, and
- Species is unlikely to enter the burrow due to its size and foraging behavior.

NLAA Determinations (Broadcast Applications)

EPA made NLAA determinations for 28 listed bird species for broadcast uses of zinc phosphide following the modifiers described in **Section 2.6.2**. Overall, the most impactful modifiers that drove these NLAA determinations included:

- Species endemic to an island/island system where exposure is unlikely to occur; and/or,
- Species' diet primarily composed of non-mammal food items such as flying invertebrates which are unlikely to be found on the ground where bait is located.

LAA Determinations (Bait Station)

EPA made LAA determinations for 16 listed bird species for bait station uses primarily based on the consumption of poisoned mammals.

LAA Determinations (Burrow)

EPA made LAA determinations for 16 listed bird species for bait station uses primarily based on the consumption of poisoned mammals.

LAA Determinations (Broadcast)

EPA made LAA determinations for 42 listed bird species primarily based on the potential to consume small mammals and the potential for incidental exposure while the species is foraging on the ground for seeds and other food items.

Predictions of the Potential Likelihood of Future Jeopardy (Bait Station)

Of the 16 LAA listed bird species, EPA did not predict the potential likelihood of J for any of the species. Despite overlap classifications, these 16 birds had a low MoE because RQs range from 1.3-8.3 based on consumption contaminated prey (100% of diet). However, for secondary poisoning, is the likelihood of effect is dependent in part on the consumption of the GI tract of the poisoned animal by the predator or scavenger and secondary poisoning from of zinc phosphide is uncommon given that the compound is not as persistent compared to other rodenticide classes.

Predictions of the Potential Likelihood of Future Jeopardy (Burrow)

Similar to bait station conclusions, of the 16 LAA listed bird species, EPA did not predict the potential likelihood of J for any of the species. Despite overlap classifications, these 16 birds had a low MoE because RQs range from 1.3-8.3 based on consumption contaminated prey (100% of diet) and EPA determined that the species being considered were unlikely to enter the burrows of target species. However, for secondary poisoning, the likelihood of effect is dependent in part on the consumption of the GI tract of the poisoned animal by the predator or scavenger and secondary poisoning from of zinc phosphide is uncommon given that the compound is not as persistent compared to other rodenticide classes.

Predictions of the Potential Likelihood of Future Jeopardy (Broadcast)

Of the 42 LAA listed bird species, EPA predicted the potential likelihood of J for 26 of these species from broadcast applications of zinc phosphide primarily based on a high MoE for primary consumers and either a high or medium overlap with the species range and UDLs selected to represent zinc phosphide broadcast use (*see* **Sections 2.4** and **2.6.3**).

For the remaining 16 LAA species, EPA did not predict the potential likelihood of J because of either low overlap or a low MoE. EPA made a low MoE classification for all secondary consumers because the likelihood of effect is dependent in part on the consumption of the GI tract of the poisoned animal by the predator or scavenger and secondary poisoning from of zinc phosphide is uncommon given that the compound is not as persistent compared to other rodenticide classes (*see* **Section 2.6.3**).

EPA's rationales for effect determinations and predictions of future J for listed birds can be found in the "Birds" worksheet in **Appendix B** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.6.5 Reptiles and Amphibians

As mentioned above, zinc phosphide poses an acute hazard[35] to all vertebrates by which it may be consumed. There is a high MoE for birds, and thus for taxa represented by birds (*i.e.*, reptiles and terrestrial-phase amphibians) as well. Exposures from broadcast or in-burrow uses are possible for all vertebrates that might visit the agricultural or other outdoor use sites. EPA determinations for reptiles and terrestrial-phase amphibians referenced toxicity data for birds as surrogate (aquatic amphibians and reptiles were determined to be NE due to a lack of aquatic exposure).

EPA's rationales for effect determinations and predictions of future J for listed reptiles and amphibians can be found in **Appendix B** and **Appendix C** following the methods in **Section 2**. MoE risk modifiers followed the methods in **Section 2.6.3**.

NLAA Determinations (Bait Stations)

EPA made 35 NLAA determinations for listed amphibian species and 20 NLAA determinations for listed reptile species from zinc phosphide use in bait stations. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects (*see* **Section 2.6.2**). Overall, the most impactful modifiers that drove EPA NLAA determinations were:

- Species only consumes only other non-mammalian terrestrial vertebrate prey (*e.g.*, birds, amphibians, and reptiles). Since the main dietary item is non-mammalian prey, it is unlikely the species would enter the mammal burrow in search of prey or consume the target species.

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[35] Hazard only reflects relative toxicity. The hazard is not synonymous with likely effects to individuals or populations because it does not consider the likelihood or magnitude of exposure.

- For those species that consume invertebrates, since the bait is contained within the station, invertebrates are not expected to represent a significant route of exposure.

NLAA Determinations (Burrow Application)

EPA made 30 NLAA determinations for listed amphibians and 20 NLAA determinations for listed reptiles for zinc phosphide use in burrows. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects (*see* **Section 2.6.2**) or if the species is presumed to be extinct (*i.e.,* Culebra Island giant anole; *Anolis roosevelti*). Overall, the most impactful modifiers that drove EPA NLAA determinations were similar to those for bait station use and included:

- Species only consumes only other non-mammalian terrestrial vertebrate prey (*e.g.*, birds, amphibians, and reptiles). Since the main dietary item is non-mammalian prey, it is unlikely the species would enter the mammal burrow in search of prey or consume the target species,
- Applications are intended to be made to active target pest burrows only, it is more likely to go into an active pest target burrow rather than an inactive burrow that might be inhabited by a nontarget species. In addition, EPA anticipated that this species only use their own burrows (USFWS, 1993), and
- Species specifically consumes invertebrates and does not rely on small mammal burrows.

LAA Determinations (Bait Station)

EPA made 14 LAA determinations for listed reptiles and 0 LAA determinations for listed amphibians for zinc phosphide bait station use. LAA determinations in reptiles are based on the potential for a species to consume poisoned mammals.

LAA Determinations (Burrow)

EPA made 14 LAA determinations for listed reptiles and 5 LAA determinations for listed amphibians for zinc phosphide use in burrows. LAA determinations are based on the potential for a species to consume poisoned mammals and/or the potential for a species to utilize a small mammal burrow.

LAA Determinations (Broadcast)

EPA made 25 LAA determinations for listed reptiles and 12 LAA determinations for listed amphibians for zinc phosphide use in burrows. The LAA determinations are based on the potential for a species to consume poisoned mammals and/or potential for incidental exposure to the bait while foraging on the ground for seeds and other food items.

Predictions of the Potential Likelihood of Future Jeopardy (Bait Station)

Of the 14 LAA listed reptiles, EPA did not predict the potential likelihood of future J for any of the species. Despite overlap, EPA made a low MoE classification because:

- Zinc phosphide is rapidly converted to phosphine gas in the GI tract and by the time the reptile completely digests its prey, it is extremely unlikely that there would be enough phosphine gas available to cause effects at a population level,
- Species consumes a wide variety of non-mammalian prey (*e.g.,* Alligator snapping turtle, *Macrochelys temmincki* and the American crocodile, *Crocodylus acutus*),

Since EPA did not make any LAA determinations for amphibians from zinc phosphide bait station use no further analysis was conducted.

Predictions of the Potential Likelihood of Future Jeopardy (Burrow)

Of the 14 LAA listed reptiles and 5 LAA listed amphibians EPA did not predict the potential likelihood of future J for any of the species. Despite overlap, EPA made a low MoE classification for the similar reasons described for bait box use. However, for the 5 amphibians classified as LAA, EPA also made a low MoE classification because they all consume invertebrates, and they are not expected to be a significant exposure route and it is highly unlikely enough burrows will be treated to result in an effect at the population level.

Predictions of the Potential Likelihood of Future Jeopardy (Broadcast)

Of the 25 LAA listed reptiles and 12 LAA listed amphibians, EPA did not predict the potential likelihood of future J for any of the species from broadcast applications of zinc phosphide. Despite overlap, EPA made a low MoE classification (*see* **Section 2.6.3**) because:

- Secondary poisoning from of zinc phosphide is uncommon given that the compound is not as persistent compared to other rodenticide classes,
- Species consumes a wide variety of non-mammalian prey (*e.g.,* Alligator snapping turtle, *Macrochelys temmincki* and the American crocodile, *Crocodylus acutus*), and
- Species mainly feeds on foliage, seeds, and fruits of grasses and forbs in an area of about 150 feet surrounding burrows and because it is herbivorous is less likely to directly consume bait that has been broadcast on the ground and translate into a population-level effect (*i.e.,* Gopher tortoise, *Gopherus agassizi*); and/or,
- Species consumes invertebrates (*i.e.,* amphibians) and invertebrates are not expected to represent a significant exposure route and translate to population level effects; therefore, accidental ingestion of bait while foraging is not expected to result in population-level effects.

EPA's predictions of the potential likelihood of future J and justifications for listed reptiles and amphibians can be found in **Appendix B** and **Appendix C** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.6.6 Mammals

Screening-level dose-based RQ values for mammals for zinc phosphide (38-85) exceed the acute LOC by orders of magnitude. Additionally, only a small fraction of a daily diet for a mammal is needed to reach a median lethal dose (>2.6% would exceed the LD_{50}) or to exceed the LOC (>1.3% would exceed the LOC). Exposures to zinc phosphide used in bait stations is considered likely only for small mammals, since the bait stations are designed to be attractive to small rodents. Exposures from broadcast or in-burrow uses are possible for all vertebrates that might visit the agricultural or other outdoor use sites. As with birds, effects to secondarily exposed mammals are possible; however, this again this depends on consumption of the poisoned animal before all the consumed zinc phosphide has dissipated as a gas as a result of hydrolysis. Overall, EPA considers effects to secondary and tertiary consumers improbable due to the reactive nature and non-persistence of zinc phosphide. However, secondary consumers that consume their prey whole or whose diet is significantly composed of target species (*e.g.*, species that are obligate consumers of target species) may be exposed.

NLAA Determinations (Bait Stations)

EPA made 30 NLAA determinations for listed mammals for zinc phosphide use in bait stations. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects (*see* **Section 2.6.2**). In addition to the reasons for NLAA described in **Section 2.6.2**, EPA also made NLAA determinations for larger species (*e.g.,* Sonoran pronghorn, *Antilocapra americana sonoriensis* and other listed deer species) that unlikely to enter a bait station due to their body size (species more than 400 g, approximately the equivalent size of a standard laboratory rat). Additionally, these species are herbivorous; therefore, EPA does not anticipate secondary exposure to the rodenticides.

NLAA Determinations (Burrow)

EPA made 24 NLAA determinations for zinc phosphide use in burrows. In addition to the reasons for NLAA described in **Section 2.6.2**, EPA also made NLAA determinations for larger species (*e.g.,* Sonoran pronghorn, *Antilocapra americana sonoriensis* and other listed deer species) that unlikely to enter a burrow due to their body size (species more than 400 g, approximately the equivalent size of a standard laboratory rat). Additionally, these species are herbivorous; therefore, EPA does not anticipate secondary exposure to the rodenticides.

NLAA Determinations (Broadcast)

EPA made 21 NLAA determinations for zinc phosphide broadcast for species where exposure is not reasonably expected to occur based on the reasons for NLAA described in **Section 2.6.2**.

LAA Determinations (Bait Station)

EPA made 45 LAA determinations for listed mammals from zinc phosphide use in bait stations primarily based on similarity to target pest, small body size (that would allow entry into the bait station), and species consumes mammals.

LAA Determinations (Burrow)

EPA made 51 LAA determinations for listed mammals from zinc phosphide use in burrows primarily based on similarity to target pest, the species has a potential to be in a burrow, or the species consumes mammals.

LAA Determinations (Broadcast)

EPA made 54 LAA determinations for listed mammals from zinc phosphide use in burrows. The LAA determinations are based on the potential for a species to consume poisoned mammals and/or potential for incidental exposure to the bait while foraging on the ground for seeds and other food items, and similarity to the target pest.

Predictions of the Potential Likelihood of Future Jeopardy (Bait Station)

Of the 45 LAA mammals, EPA predicted the potential likelihood of future J for 24 listed mammals from zinc phosphide use in bait stations. These species had a high MoE due to similarity to target pest and a high overlap and included listed gophers, kangaroo rats and beach mice.

For the remaining 21 LAA listed mammals, EPA did not predict the potential likelihood for future J because of a low overlap or low MoE (*see* **Section 2.4** and **2.6.3**). EPA made a low MoE classification for all secondary consumers because secondary poisoning from zinc phosphide is uncommon and it is not as persistent as other chemical classes.

Predictions of the Potential Likelihood of Future Jeopardy (Burrow)

Of the 51 LAA determinations for listed mammals, EPA predicted the potential likelihood of future J for 33 species from zinc phosphide burrow uses. This was based on a high MoE due to similarity to target pest and potential for species to be in a burrow and a medium or high overlap.

For the remaining 18 LAA listed mammals, EPA did not predict the potential likelihood of future J from zinc phosphide burrow uses. This was based on either low overlap or a low MoE. Of the 18 species, 15 are secondary consumers and EPA made a low MoE classification for all secondary consumers because the likelihood of effect is dependent in part on the consumption of the GI tract of the poisoned animal by the predator or scavenger and secondary poisoning from of zinc phosphide is uncommon given that the compound is not as persistent compared to other rodenticide classes (*see* **Section 2.6.3**).

Predictions of the Potential Likelihood of Future Jeopardy (Broadcast)

Of the 54 LAA listed mammals, EPA predicted the potential likelihood of future J for 35 species. This was based on a high MoE due to similarity to target pest and a medium or high overlap.
For the remaining 19 listed LAA mammals EPA did not predict the potential likelihood of future J. This was based on low overlap or a low MoE. EPA made a low MoE classification for all secondary consumers because the likelihood of effect is dependent in part on the consumption of the GI tract of the poisoned animal by the predator or scavenger and secondary poisoning from of zinc phosphide is uncommon given that the compound is not as persistent compared to other rodenticide classes (*see* **Section 2.6.3**).

EPA's rationales for effect determinations and predictions of future J for listed mammals can be found in **Appendix B** and **Appendix C** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

Table 3-14 summarizes the number of listed species determinations and predictions of the potential likelihood of future J for all taxa from zinc phosphide.

Table 3-14. Number of Listed Species Effects Determinations and Predictions of the Potential Likelihood of Future Jeopardy for Zinc Phosphide[1,2]

Taxon	Number of Species	NE	Bait Station			Burrow			Broadcast		
			NLAA	LAA, No J	LAA, J	NLAA	LAA, No J	LAA, J	NLAA	LAA, No J	LAA, J
Mammals	100	25	30	21	24	24	18	33	21	19	35
Birds	95	25	54	16	0	54	16	0	28	16	26
Amphibians[3]	47	12	35	0	0	30	5	0	23	12	0
Reptiles	59	25	20	14	0	20	14	0	9	25	0

N/A = Not a Registered Use Pattern

[1] EPA made effects determinations and predictions of the potential likelihood of future jeopardy for listed species and the details on these can be found in **Appendix B** and **Appendix C**.

[2] Reflects listed species current as of Oct. 2024. This includes accounting for delisted species. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction

[3] "Amphibians" and "Reptiles" include those species that have both a terrestrial and aquatic phase.

NE = No Effect; NLAA = Not Likely to Adversely Affect; LAA = Likely to Adversely Affect; J = Jeopardy

4 Critical Habitat Effects Determinations Results

This assessment includes 927 listed species with CHs. Among those, there are 147 CHs for the taxonomic groups with potential direct effects or effects to PPHD; that is, birds, reptiles, amphibians, and mammals. For those CH, USFWS is responsible for 124, NMFS is responsible for 13, and both Agencies are responsible for the remaining ten.

Section 2.7 of this assessment explains the method used to make effects determinations for CHs. The rationales for the NE, MA, NLAA and LAA determinations and predictions of potential likelihood of future AM made for CH are found in the "Critical Habitat" worksheet in **Appendix B** and **Appendix C**. The major considerations included:

- overlap of the CH and exposure area by the UDLs that represent rodenticide use areas,
- availability of mammalian prey, and
- terrestrial habitat quality (availability of burrows).

4.1 No Effect (NE) Determinations

NE determinations for CH are based on areas where exposure is not reasonably expected to occur at levels that could cause effects. Habitat modification and effects on PPHD are not expected to occur for plants, fish, or invertebrates; therefore, these taxa received NE determinations.

The most common risk modifiers for NE determinations included:

- CH with < 1% overlap with all UDLs and
- CH areas where exposure is not reasonably expected to occur at levels that could cause effects (*e.g.,* estuarine/marine habitats or habitats of species in the aquatic food web).

In total, EPA made a NE determination for 878 of the species CHs.

The NE determinations and justifications for CH can be found in the “Critical Habitat” worksheet in **Appendix B** and **Appendix C**.

4.2 May Affect (MA) Determinations

For all CHs with MA determinations, overlap was >1%. EPA made a MA determination if a species consumes terrestrial mammalian prey, uses burrows, or has a PBF associated with either of those. EPA used best available information for six species (three mammals, two birds, and one reptile) with undefined PBFs.

In total, EPA made a MA determination for 49 of the species CHs.

The MA determinations and justifications can be found in the “Critical Habitat” worksheet in **Appendix B** and **Appendix C** and follows the methodology described in **Section 2.7**. For all CH determined by EPA as MA, risk modifiers were applied, and CHs were then determined as NLAA or LAA.

4.2.1 Not Likely to Adversely Affect (NLAA) Determinations

EPA’s NLAA determinations were driven by an assessment of the likelihood of effects to PPHD and exposure occurring based on different habitat characteristics. EPA made a NLAA determination for CH if the availability of mammalian prey and burrow use were part of the species PPHD (based on the EFED life history database), but the USFWS did not indicate that availability of small mammal prey or burrow use were relevant (*i.e.,* based on methodology in Appendix L of the malathion BiOp) EPA used best available information about mammal prey and burrow use for the CH of six species determined to be MA (three mammals, two birds, and one reptile) with undefined PBFs.

In total, EPA determined that 9 of the MA species CHs are NLAA, all lacking PBFs for mammal prey or burrow use or information suggesting their importance in cases where PBF’s were undefined.
NLAA determinations and justifications can be found in the “Critical Habitat” worksheet in **Appendix B** and **Appendix C**. NLAA determinations followed the methodology outlined in **Section 2.7**.

4.2.2 Likely to Adversely Affect (LAA) Determinations

EPA’s LAA determinations were based on a CH having a PBF for mammal prey or burrow use and >1% spatial overlap of UDLs and CH. EPA used best available information about mammal prey and burrow use for the CH of six species determined to be MA (three mammals, two birds, and one reptile) with undefined PBFs.

In total, EPA determined that 40 of the MA species CHs are LAA. Thirty-four of those species had a PBF for either mammal prey or burrow use. The other six did not have PBF’s defined by USFWS; however best available information indicated that those species either consume mammal prey or use burrows.

EPA’s LAA determinations and justifications for CH can be found in the “Critical Habitat” worksheet in **Appendix B** and **Appendix C**. LAA determinations followed the methodology outlined in **Section 2.7**.

4.3 Critical Habitats with Predictions of Potential Likelihood of Future Adverse Modification Determinations

EPA's predictions for the potential likelihood of future AM of CH are based on the MoEs described previously, the extent of spatial overlap between the CH and various UDLs, various effects modifiers that can influence the likelihood of exposure, and if mammals or burrows are identified as an essential PBF for the species CH. The main effect modifiers for CH included:

- the CH's species relies on making its own burrow (*e.g.,* Choctawhatchee beach mouse; *Peromyscus polionotus allophrys),*
- the CH's species uses structural features including but not exclusive to small mammal burrows for shelter or other reasons (non-obligate relationship, *e.g.*, several listed frogs and salamanders), and
- the CH's species does not exclusively rely on mammalian prey (*e.g.*, Whooping crane; *Grus americana*), or its diet includes large herbivorous mammal prey, which are not affected by rodent prey availability (*e.g.*, Canada Lynx (*Lynx canadensis*) and Jaguar (*Panthera onca*)).

EPA predicted the potential likelihood of future AM for five CHs after considering effects modifiers, including those described above. Those CH species with the potential likelihood of future AM are:

- California tiger salamander (*Ambystoma californiense*)
  - Small mammal burrows are an essential PBF for this species
- Alameda whipsnake (*Masticophis lateralis euryxanthus*)
  - Small mammal burrows are an essential PBF for this species
- Mexican spotted owl (*Strix occidentalis lucida*)
  - Mammals are a main dietary item and the maintenance of available prey species is an essential PBF
- Northern spotted owl (*Strix occidentalis caurina*)
  - Mammals are a main dietary item and the maintenance of available prey species is an essential PBF
- Louisiana pinesnake (*Pitouphis ruthveni*)
  - Mammals are a main dietary item and the maintenance of available prey species is an essential PBF

EPAs predictions of potential likelihood of future AM of the CH of each of the five species is shown by chemical group and use type in **Table 4-1**.

Table 4-1. Critical Habitat Effects Determinations and Predictions of the Potential Likelihood of Future Adverse Modification by CH species and Use Pattern[1]

CH species	Bait Station[2]		Burrow[3]		Broadcast[4,5,6]		Feral Hog Bait Station[7]	
	LAA/No AM	LAA/AM	LAA/No AM	LAA/AM	LAA/No AM	LAA/AM	LAA/No AM	LAA/AM
California tiger salamander	NA	Yes	NA	Yes	NA	Yes	Yes	NA
Alameda whipsnake	Yes	NA	NA	Yes	NA	Yes	Yes	NA
Mexican spotted owl	Yes	NA	NA	Yes	NA	Yes	Yes	NA
Northern spotted owl	Yes	NA	NA	Yes	NA	Yes	Yes	NA
Louisiana pinesnake	Yes	NA	NA	Yes	NA	Yes	Yes	NA

[1] Reflects species with CH as of Oct. 2024.
[2] FGARs, SGARs (inclusive of burrow use of chlorophacinone and diphacinone next to structures), zinc phosphide, bromethalin, and cholecalciferol
[3] FGARs, zinc phosphide, strychnine, and bromethalin
[4] FGARs and zinc phosphide
[5] EPA considers the effects determinations for broadcast use of zinc phosphide, chlorophacinone and diphacinone to be representative of those for the scatter/spot treatments.
[6] EPA considers the effects determinations for broadcast use of zinc phosphide, chlorophacinone and diphacinone to be inclusive of those for the agricultural bait station uses. See 3.2.1 and 3.2.6 for information on potential impacts on effects determination for primary consumers.
[7] Warfarin
NA = Not applicable; AM = Adverse Modification

EPAs predictions of the potential likelihood of future AM for CH and justifications can be found in the "Critical Habitat" worksheet in **Appendix B** and **Appendix C** and followed the methodology in **Section 2.7**. **Table 4-2** provides a summary of the total number of CHs and the number of CHs with NE, NLAA, LAA/predictions of potential no likely future AM, and LAA/predictions of potential of likely future AM.

Table 4-2. Number of Critical Habitat Effects Determinations and Predictions of the Potential Likelihood of Future Adverse Modification by Taxon[1,2]

Taxon	Number of Species with Critical Habitat	NE	NLAA	LAA/No AM	LAA/AM
Mammals	49	32	2	15	0
Birds	34	26	3	3	2
Amphibians[1]	35	20	1	13	1
Reptiles	29	20	3	4	2
Terrestrial Invertebrates	64	64	0	0	0
Aquatic Invertebrates	111	111	0	0	0
Plants	484	484	0	0	0
Fish	121	121	0	0	0
Total	**927**	**878**	**9**	**35**	**5**

[1] "Amphibians" include those species that have both a terrestrial and aquatic phase.

[2] Reflects species with CH as of Oct. 2024.

NE = No Effect; NLAA = Not Likely to Adversely Affect; LAA = Likely to Adversely Affect; AM = Adverse Modification

5 Final Rodenticide Strategy

In addition to the effects determinations that include predictions of the potential likelihood of future J/AM contained in the final BE, EPA also included the final Rodenticide Strategy. Prior to finalizing this strategy, EPA issued a draft strategy for public comment that include measures designed to reduce exposures of listed species to the 11 rodenticides.[36] After considering the public comments on the draft strategy, EPA has made refinements in the final strategy.

The final Rodenticide Strategy includes the mitigation measures that EPA identified to address the predictions of potential likelihood of future J/AM for 78 listed species and five critical habitats. These identified mitigation measures would reduce the potential for exposure to listed species from these rodenticides and may be implemented during registration review and prior to completion of the USFWS BiOp. The mitigation measures are also intended to minimize take of those species where EPA made LAA determinations.

It is important to note that certain identified mitigation measures are applicable to a specific species-chemical-use combination. The identified mitigation measures are presented in Table 5-1. This strategy identifies mitigation measures to address exposure routes of concern for bait station, in-burrow, and broadcast application methods. The measures “avoid” or “minimize” exposure, as defined by the ESA Consultation Handbook.[37] No “offsets” are proposed at this time, but EPA is open to considering proposals on how the Agency may be able to use offsets for rodenticides.

At the end of the consultation, the USFWS will make their conclusions on J/AM and determine whether there are additional measures necessary to avoid J/AM for each listed species and critical habitat, and the USFWS will issue their BiOp. After the BiOp is issued, EPA will implement any additional measures identified in the BiOp.

5.1 Background on Registration Review of Rodenticides

EPA completed four FIFRA proposed interim decisions (PIDs) for the registration review of the 11 rodenticides within the scope of this BE in November 2022 (USEPA, 2022a-2022d), which included proposing measures to protect human health and the environment from those rodenticides. Most of the mitigation measures proposed in the four PIDs are broad (*i.e.*, generally applicable wherever the labels allow their use) protective measures intended to be applied through pesticide labeling to reduce exposures to humans and non-target species nationally. In addition, EPA expects that these proposed measures may reduce exposure to listed species. The final BE and Rodenticide Strategy reflect current labels, which do not yet include mitigation proposed in the PIDs. As a result, some of the mitigation measures in the final strategy are the same as those proposed in the four PIDs.

The November 2022 PIDs also proposed targeted ESA mitigation to protect certain listed species. This work furthered the goals outlined in EPA’s April 2022 Endangered Species Act (ESA) Workplan by including protections for ESA species earlier in its FIFRA registration review process. The rodenticide early mitigation Pilots described in its November 2022 update specified EPA’s focus on addressing

[36] Brodifacoum, Bromadiolone, Bromethalin, Cholecalciferol, Chlorophacinone, Difenacoum, Difethialone, Diphacinone, Strychnine, Warfarin, and Zinc Phosphide

[37] https://www.fws.gov/media/endangered-species-consultation-handbook

effects to mammals and birds that consume rodenticide bait (*i.e.*, primary consumers) and to birds, mammals, and reptiles that consume primary consumers (*i.e.*, secondary consumers).

Consistent with that goal, EPA proposed mitigation measures in the PIDs for the three species evaluated in the pilot memo (USEPA, 2022e). EPA evaluated each of the 11 rodenticides' potential effects on individuals and populations of the Stephens' kangaroo rat (SKR), Attwater's prairie chicken (APC), and the California condor (CC) and their designated critical habitat. EPA chose these three species because they represent listed species that may be affected by rodenticides through different routes of exposure, like primary consumption, by the SKR and APC, and secondary consumption, by the CC. EPA predicted that the currently labeled uses of the rodenticides have the potential likelihood for future J to these species or AM of their designated critical habitat. However, including the appropriate mitigation measure(s) for a particular use in its BE, EPA predicted that there is not a potential likelihood that the use of rodenticides would result in future J to these species, or AM of their critical habitat if these measures are implemented. EPA also predicted that these same measures would reduce exposures to other listed species (beyond the three pilot species) and their designated critical habitats predicted to be J/AM by the use of rodenticides in this final BE.

The proposed mitigation measures for the three listed species in the Pilot were targeted for specific geographic areas most relevant to each of the species, with the intention of implementing mitigation measures where they are most needed while still retaining use options for rodenticide users. Additionally, because EPA selected the three pilot species to be largely representative of other species that have similar exposure routes and therefore, similar effects, these mitigation measures were proposed in the PIDs with the intention of considering extending them to other listed species as appropriate after evaluating population level effects for all listed species and their critical habitat in the final BE.

In comments on the draft BE and strategy, EPA received comments that additional clarity was needed in finalizing the mitigation strategy, particularly regarding the applicability of each mitigation measure to each rodenticide product and use. Commenters expressed concern that some mitigation measures may not be effective or feasible depending on the listed species, scenario, or use pattern. EPA wishes to clarify that the intent of the rodenticide strategy is to outline the known mitigation measures identified to reduce endangered species exposure, and therefore reduce the potential likelihood of future J/AM. Unlike the Herbicide Strategy, these mitigation measures are not a mitigation menu for rodenticide users. Rather, these are the suite of measures that EPA has identified from which EPA expects to choose when identifying measures to reduce exposure to listed species and their CH from the 11 rodenticides for a specific active ingredient, use site, and application method (*i.e.*, bait station, in-burrow, and broadcast). Section 5.2.2 provides some examples of how EPA envisions implementing the strategy.

EPA continues to assess human health and ecological risks of concern as well as benefits of the use of rodenticides in the ongoing registration review for these pesticides.

5.2 Description of Mitigation Measures to Reduce the Potential Likelihood of Future Jeopardy and Adverse Modification and to Minimize Take

The mitigation measures described below are those that EPA has identified for consideration where EPA has predicted a potential likelihood of future J/AM. Having considered public comments, EPA has made several updates to the strategy. The following section outlines the mitigation measures that EPA has identified to address the predictions of potential likelihood of future J/AM.

5.2.1 Changes Since the Draft BE

In the mitigation strategy in the draft BE, there were three sections: *Rodenticide PID Proposed Mitigation Measures, ESA Pilot Memo Proposed Mitigation Measures,* and *Updated Listed Species Mitigation Measures for this Draft Rodenticide Strategy.* The Agency outlined mitigation measures it was considering to reduce exposure to listed species and their CH side-by-side with the mitigation measures that EPA was considering in the PIDs to protect human health and non-listed non-target species under registration review activities. However, in this final BE and strategy, EPA is only identifying measures to avoid predicted J/AM to listed species. Any mitigation proposed to address ecological risk concerns identified through the registration review process under FIFRA will be addressed in registration review. There were multiple comments received related to PID mitigation measures. Those comments will be addressed in a response to comments document that is anticipated with the next registration review milestone.

For clarity, the following mitigation measures were removed from this final BE because they were proposed in conjunction with the PID for implementation nationally through product labeling updates and will therefore be addressed in registration review instead of this final strategy:

- Restricted use classification
- Packaging FGARs, bromethalin, and cholecalciferol products for consumer use in quantities of one pound or less in ready-to-use non-refillable bait stations
- Broad national product labeling updates to prohibit broadcast and spot for turf, lawns, golf courses, campsites, and other recreation areas.

5.2.2 Listed Species Mitigation Measures for this Final Rodenticide Strategy

The final effects determinations indicate that mitigation measures would be applicable for 78 listed species and five CHs to avoid or further minimize exposure from this group of 11 rodenticides collectively. In other words, not all rodenticides and uses have the same predictions of the potential likelihood of future J/AM determinations. The following is a suite of measures that EPA has identified from which it expects to choose when identifying measures to reduce exposure to listed species and their CH for a specific active ingredient, use site, and application method (*i.e.*, bait station, in-burrow, and broadcast).

1. Restrict the use of bait stations to only those that exclude listed species by size or behavior. Beyond the standard bait stations now in use, custom bait stations for the exclusion of listed species (primarily mammals) could be used within their ranges. An example is the bait station recommended by the state of California in PRESCRIBE for use within the range of the SKR. This mitigation is intended to reduce the potential for primary exposure.

2. Prohibition of broadcast and below-ground in-burrow applications in locations where needed to protect listed species such as a “pesticide sensitive area” within the USFWS designated range of listed species. This mitigation is intended to reduce the potential for primary exposure to specific listed species.

3. Prohibition of broadcast and below-ground in-burrow application within and beyond the range and/or critical habitat for species that have the potential to consume rodenticides via secondary consumption. This mitigation is intended to reduce the potential for secondary exposure.[38]

4. Restricting bait station placement to within five feet of man-made structures in areas with listed mammals that are small enough to enter bait stations. This mitigation measure would reduce the likelihood that bait stations will be placed in the species habitat. This mitigation measure is intended to reduce the potential for primary exposure.

5. Prohibiting application directly to water. This prohibition is already included on many labels[39] and would not apply to conservation uses (*i.e.*, island eradication). This measure would ensure that rodenticides do not enter water bodies, which are not an approved use site. This mitigation measure is intended to reduce the potential for primary exposure.

6. Mandatory or advisory post-application follow-up statements for carcass search, collection, and disposal within the species' range and/or designated critical habitat. This mitigation measure could be used for all active ingredients and use patterns. For below-ground in-burrow applications made in fields and other non-structural use sites, users would need to monitor open burrows at specific times depending on the toxicity characteristics of the active ingredient (*e.g.,* how quickly the rodenticide causes mortality could be considered). This mitigation measure is intended to address secondary exposure by reducing rodenticide exposures of predators and scavengers with a high potential for secondary poisoning.

7. Post-application follow-up statements for bait-spill or bait kick-out. Removing spilled bait or bait that has been ejected from a burrow or disturbed by an animal is intended to reduce primary exposure by removing rodenticide bait at the soil surface.

8. Prohibiting use in areas or at times of the year when listed secondary consumers might be exposed (*i.e.*, if species are active or in the area). USFWS determined this measure was needed to protect listed species in the previous biological opinions for the rodenticide products Rozol Prairie Dog Bait and Kaput-D Prairie Dog Bait. This measure would reduce exposure to predators and scavengers and is intended to reduce the potential for secondary exposure.

9. Covering the burrow hole after applications made in fields and other non-structural use sites for appropriate species that live in closed burrow systems (*i.e.*, pocket gopher). This mitigation measure is intended to reduce exposure to primary consumers that might enter the burrow. This would not apply to all target species and would depend on their behavior. This measure would not apply to target species that live in open burrow systems (*i.e.*, Norway rat).

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[38] Following the PID, EPA has reconsidered the Pilot mitigation measure prohibiting application outside the range and or critical habitat (i.e., "*do not apply via broadcast application within 200 yards by air or 40 yards by ground from range and critical habitat when air currents are moving toward those areas. When air is calm or moving away from the range or critical habitat, apply on the side nearest those areas and proceed away"*) since drift of rodenticide product is not anticipated. Therefore, this is no longer being considered as a mitigation measure.
[39] The water prohibition is in alignment with currently registered use patterns of the rodenticides and for consistency, this statement will be added to all national labels during the registration review process.

10. Updating the Terms and Conditions of Registration to include a clause that EPA will notify registrants upon issuance of the Biological Opinion if additional measures would be necessary and that the registrants agree to amend their product labeling or cancel their registrations as EPA determines are necessary based on any applicable final Biological Opinion.

11. Require the applicator to report dead or dying non-target animals to EPA's website (https:/www.epa.gov/pesticide-incidents) as soon as possible. This helps monitor take and ensures that wildlife incidents are tracked, so that adjustments to the label or bulletin instructions may be made.

As explained previously, EPA expects most of the measures would apply in geographically specific areas only (referred to as Pesticide Use Limitation Areas or PULAs) through Bulletins using its web-based system, Bulletins Live! Two (BLT). PULAs focus on areas where pesticide exposures are likely to impact the continued existence of a listed species, which may include a reduction in survival or recovery of the species and designated critical habitat. EPA is refining the species maps that it will use for PULAs and does not plan to implement mitigations in those areas until those maps are refined. The eleven mitigation measures identified above are summarized in Table 5-1 by applicability to address primary or secondary exposure, as well as whether the EPA has identified implementation through BLT or a general label statement.

Table 5-1. Summary of Recommended Mitigation Measures[40]

Mitigation Measures	Primary	Secondary	Routes of Implementation
1. Restrict the use of bait stations to only those that exclude listed species by size or behavior.	Yes	NA	PULA
2. Prohibition of broadcast and below-ground in-burrow applications in locations where needed to protect listed species such as "pesticide sensitive area" within the USFWS designated range of listed species.	Yes	NA	PULA
3. Prohibition of broadcast and below-ground in-burrow application within and beyond the range and/or CH for species that have the potential to consume rodenticides via secondary consumption.	NA	Yes	PULA
4. Restricting bait station placement to within five feet of man-made structures in areas with listed mammals that are small enough to enter bait stations.	Yes	NA	PULA

[40] Registrants have inquired if these mitigation measures are applicable if they were to amend consumer product labels to indoor-only bait stations. Indoor use will not reasonably result in exposure to listed species or CH; therefore, those use patterns are NE for all species. Accordingly, EPA has not identified J/AM for indoor uses and none of the listed species' mitigation in this strategy is relevant for indoor uses.

Mitigation Measures	Primary	Secondary	Routes of Implementation
5. Prohibiting application directly to water.	NA	NA	Label Statement
6. Mandatory or advisory post-application follow-up statements for carcass search, collection, and disposal within the species' range and/or designated critical habitat.[41]	NA	Yes	PULA (Mandatory); Label Statement (Advisory)
7. Post-application follow-up statements for bait-spill or bait kick-out.	Yes	NA	Label Statement (bait spill); PULA (kick out)
8. Prohibiting use in areas or at times of the year when listed secondary consumers might be exposed.	NA	Yes	PULA
9. Covering the burrow hole after applications made in fields and other non-structural use sites for appropriate species that live in closed burrow systems.	Yes	NA	PULA
10. Updating the Terms and Conditions of Registration to include a clause that EPA will notify registrants upon issuance of the Biological Opinion, if additional mitigation measures are required.	Yes	Yes	Terms and Conditions of Registration
11. Mandatory or Advisory reporting of dead or dying non-target animals to the Agency's website as soon as possible.	Yes	Yes	PULA (Mandatory); Label Statement (Advisory)

In addition, EPA understands that island eradication programs are currently underway (led by USDA APHIS) and that consultation with USFWS has occurred for these uses on certain registered rodenticides. EPA anticipates the mitigation measures being considered in this final strategy could help increase the efficiency of future consultations on rodenticide use for species conservation. EPA acknowledges that some mitigation measures may not apply to conservation uses because they will be handled under a separate consultation.

Application of Measures to Species and Chemicals:

It is important to note that certain mitigation measures are applicable to a specific species-chemical combination only. The following section provides examples of EPA's thinking on how it envisions selecting which measures from Table 5-1 to implement for a specific use.

[41] EPA anticipates the carcass search measure will only be selected when other mitigation measures are not practical or feasible. The Agency does not expect this mitigation measure to be widely used.

Example Mitigation Implementation Measures:

In this strategy, EPA identified the above mitigation measures to address the predictions of potential likelihood of future J/AM for the rodenticides. EPA recognizes that not every mitigation measure is applicable for every species, location, and use pattern, and these factors are being taken into consideration during the implementation of this strategy through registration review. In addition, EPA recognizes that not every mitigation measure is feasible for all users and that the effectiveness of the mitigation measures varies. Below are some practical examples of how EPA envisions implementing the strategy:

1. Restricting the use of bait stations to only those that exclude listed species by size or behavior would not work to address J/AM for all listed species. If a listed species has a similar size or behavior to the target pest (for example, Alabama Beach Mouse) this would not be a feasible measure and therefore another mitigation measure should be implemented. As an alternative, EPA would consider implementing a five-foot placement restriction for residential use or a geographic area.
2. Limiting bait station placement to within five feet of structures is not feasible for facilities that must comply with stringent phytosanitary requirements, such as food processing facilities. In such cases, post-application follow-up statements such as bait spill/kickout or carcass search may be the mitigation measure EPA identifies as the preferred measure for this particular use pattern. For example, this measure may be identified as appropriate for the Pacific Pocket Mouse.
3. A prohibition of broadcast and below-ground in-burrow applications in locations where needed to protect listed species could be implemented via a PULA or could be limited to a clearly defined area needed for a particular listed species. For example, to address potential likelihood of J for the Salt Marsh Harvest Mouse, a restriction of use on or near sand dunes may be identified as the preferred measure for this species.
4. Timing restrictions prohibiting use in areas or at times of the year when listed primary or secondary consumers might be exposed can be adjusted on a species-specific basis. For example, if a species hibernates or migrates, the timing restriction can be adjusted accordingly. This measure may be identified as appropriate for the Preble's Meadow Jumping Mouse, which is a is a true hibernator. The listed mice usually enter underground hibernacula (hibernation nests) in September or October and emerge the following May after a potential hibernation period of 7 or 8 months. If the product label were to instruct users to apply rodenticide from October 1 to March 15, then the timing overlap with the listed mouse activity would be the month of October. In this scenario, an application timing restriction could be put in place for the month of October only where overlap with the listed mouse occurs, limiting application from November 1 to March 15th**.**

EPA plans to implement the strategy through registration review with the intent of avoiding predicted potential likelihood of J/AM for listed species and AM of critical habitat. EPA will continue its current practice of providing opportunities for public input on proposed decisions, including mitigation that may come from this strategy. Should alternative mitigation measures be identified that are effective, practical, and feasible, EPA would similarly consider them during registration review and there would also be opportunities for the registrants ("applicants") to raise these during formal consultation with

USFWS. Ultimately, during consultation, the USFWS will make their conclusions on potential for J/AM and determine if any further measures are needed to avoid the potential for future J/AM for each use, species, and critical habitat.

6 Overall Conclusions

This final BE makes effect determinations including predictions of potential likelihood that current registrations of 11 rodenticides may lead to a future J or AM. EPA considered all registered use patterns (*i.e.*, bait station, broadcast, and in-burrow) and the landscapes where the rodenticides are used: urban structures, agriculture, and other contexts (forest, rangeland, etc.).

The analysis focused on vertebrate species because of their sensitivity to rodenticides and their potential exposure in the terrestrial environment. EPA held regular meetings with USFWS for technical assistance. Species that were not expected to be exposed due to habitat factors (*e.g.*, strictly arboreal birds/species that chiefly live and feed in trees) or dietary factors (*e.g.*, bats) were judged to be NE or NLAA. Terrestrial species that live or feed on the ground were carefully examined to determine if their habitat, feeding habits, or behaviors made their exposure less likely (and therefore NLAA) or whether they were likely to consume rodenticides on the ground, in burrows or to enter bait stations. Those species for which exposure could not be discounted by habitat, behavior, or diet were found to be LAA. After making effect determinations, EPA predicted a potential likelihood of future J for 78 species because exposure could not be precluded, and current restrictions do not mitigate exposure. EPA also predicted that five species whose critical habitat PBFs were adversely affected by rodenticide use (*i.e.*, requirement of rodents in the diet or use of target species' burrows) have a potential likelihood of future AM of their critical habitat. **Appendix D** provides a summary of species that EPA predicted the potential likelihood of J by exposure route (primary or secondary exposure), use pattern, and active ingredient. **Appendix G** shows the geographic area of the species range and CH for those that EPA predicted the potential likelihood of J/AM.

EPA included a Rodenticide Strategy (mitigation measures) as part of this final BE that focuses on reducing exposures of listed species to the 11 rodenticides. This strategy focuses on reducing exposures so that EPA's predictions of the potential likelihood of future J for listed species and potential likelihood of future AM for CHs based on current uses and label restrictions in this final BE would not be likely. The mitigation measures are also intended to minimize take of those species where EPA made LAA determinations. This strategy describes mitigation measures to address exposure routes of concern for bait station, in-burrow, and broadcast application methods. The mitigation measures include measures to "avoid" or "minimize" exposure, as defined by the ESA Consultation Handbook.

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8 List of Acronyms

AM	Adverse Modification
APHIS	Animal and Plant Health Inspection Service
BE	Biological Evaluation
BiOp	Biological Opinion
BLT	Bulletins Live! Two
C-CAP	Coastal Change Analysis Program
CDL	Cropland Data Layer
CH	Critical Habitat
CONUS	Contiguous United States
EECs	Estimated Environmental Concentrations
EFED	Environmental Fate and Effects Division
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FGAR	First Generation Anticoagulant Rodenticides
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GIS	Geographic Information System
IDS	Incident Data System
J	Jeopardy
LAA	Likely to Adversely Affect
LC_{50}	Concentration leading to 50% mortality
LD_{50}	Dose leading to 50% mortality
LOC	Level of Concern
MA	May Affect
MoE	Magnitude of Effect
NE	No Effect
NGO	Non-government organization
NL48	No lower 48 [states]
NLAA	Not Likely to Adversely Affect
NLCD	National Land Cover Database
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAEC	No Observed Adverse Effect Concentration
OSD	Open Space Developed
OPP	Office of Pesticide Programs
PBF	Physical or Biological Features
PID	Proposed Interim Decision
PPHD	Prey, Pollination, Habitat and/or Dispersal
RED	Re-Registration Eligibility Decision
RQ	Risk Quotient
RMD	Risk Mitigation Decision
RR	Registration Review
RUP	Restricted Use Pesticide

SAP	Science Advisory Panel
SGAR	Second Generation Anticoagulant Rodenticides
UDL	Use Data Layer
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

Appendix A. Summary of Rodenticide Uses

Table A-1. Summary of Rodenticides and Current Uses

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)
Brodifacoum	112701	Anticoagulant (Vitamin K antagonist)	Bait Stations (tamper-resistant bait stations; can only be applied by certified applicators).	In and within 100 feet from manmade structures including permanent or temporary residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public buildings, transport vehicles (ships, trains, aircraft), docks and port or terminal buildings and related structures. Fence and perimeter baiting beyond 100 feet from structure is prohibited. Product can be used both in and outdoors in a bait station.	Various mouse, vole and rat species including house mice, harvest mice, Norway rat, roof rat, cotton rat, Mexican woodrat, Polynesian rat, Southern plains woodrat, whitethroat woodrat & meadow vole
Bromadiolone	112001	Anticoagulant (Vitamin K antagonist)	Bait Stations (tamper-resistant bait stations are mandatory for above ground uses; can only be applied by certified applicators). Do not broadcast bait; burrow baiting with this a.i. is prohibited. Used outdoors in a bait station.	Can be used in and within 100 feet from manmade structures including permanent or temporary residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public buildings, transport vehicles (ships, trains, aircraft), docks and port or terminal buildings and related structures. Fence and perimeter baiting beyond 100 feet from structure is prohibited. Product can be used both in and outdoors>	Various mouse and rat species including house mice, harvest mice, deer mice, white-footed mice, Norway rat, roof rat, cotton rat, Mexican woodrat Polynesian rat, Southern plains woodrat, whitethroat woodrat, bushytail woodrat & meadow vole *In CA cannot be used on cotton rat, Eastern harvest mice, golden mice, Polynesian rat, meadow vole, white-throated woodrat, Southern plains and Mexican woodrat

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)
Bromethalin	112802	Neurotoxicant (Uncouples mitochondrial oxidative phosphorylation leading to respiratory failure)	Bait Stations (tamper-resistant bait stations are mandatory for above ground uses)	Can be used in and within 100 feet from manmade structures including permanent or temporary residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public buildings, transport vehicles (ships, trains, aircraft), docks and port or terminal buildings and related structures. Fence and perimeter baiting beyond 100 feet from structure is prohibited.	Various mouse and rat species, including harvest mice, house mice, white-footed mice, deer mice, cotton rat, Norway rat, Polynesian rat, roof rat, Southern plains woodrat, whitethroat woodrat, Mexican woodrat, bushytail woodrat
			Burrow Use (apply 6” in burrow)	Lawns, parks, around homes, golf courses, ornamental gardens, nurseries, and other non-crop grassy areas.	Mole species including the Eastern mole, starnose mole, meadow vole
Chlorophacinone	067707	Anticoagulant (Vitamin K antagonist)	Broadcast (except in CA; any applications in CA must be covered by a shingle or grass to prevent exposure to non-target species)	Orchards and groves, vineyards, non-crop areas, nurseries, tree/forestry plantations, rangeland, and fallow agricultural land	Bushytail woodrats, cotton rat, house mice, meadow vole, Mexican woodrat, Mountain vole, Norway rat, pine vole, Polynesian rat, roof rat, Southern plains woodrat, whitethroat woodrat, California and Richardson ground squirrels, Columbian ground squirrel
			Burrow Use (apply 6” in burrow)	Rangeland and adjacent non-crop areas (CO, KS, MT, NE, NM, MD, OK, SD, TX, WY)	Black-tailed Prairie Dogs, Pocket Gophers

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)
Chlorophacinone	067707	Anticoagulant (Vitamin K antagonist)	Bait Stations (tamper-resistant, tracking powder & floating (CA only))	Can be used in and within 100 feet from manmade structures including permanent or temporary residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public buildings, transport vehicles (ships, trains, aircraft), docks and port or terminal buildings and related structures. Fence and perimeter baiting beyond 100 feet from structure is prohibited.	California ground squirrel, chipmunks, various mouse, vole and rat species including white-footed mice, house mice, deer mice, cotton rat, Mexican woodrat, Norway rat, Polynesian rat, roof rat, Southern plains woodrat, white-throated woodrat, bushytail woodrat, meadow vole, pine vole, black-tail jack rabbit, Golden mantled ground squirrel, ground squirrels, jack rabbits, meadow mice, muskrats, mountain vole, California vole *In CA cannot be used on cotton rat, Eastern harvest mice, golden mice, Polynesian rat, meadow vole, white-throated woodrat, Southern plains and Mexican woodrat
Cholecalciferol	202901	Binds to Vitamin D receptors which leads to increase in serum calcium and results hypercalcemia (this chemical is Vitamin D_3)	Bait Stations (tamper-resistant if used above ground)	In and within 100 feet of man-made structures including homes, temporary and permanent residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public building, transport vehicles (ships, trains, aircraft), docks and ports of terminal and related structures. Fence and perimeter baiting beyond 100 feet of a structure is prohibited.	Bushytail woodrats, cotton rat, house mice, meadow vole, Mexican woodrat, Norway rat, Polynesian rat, roof rat, Southern plains woodrat, whitethroat woodrat, meadow vole

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)
Cholecalciferol	202901	Binds to Vitamin D receptors which leads to increase in serum calcium and results hypercalcemia (this chemical is Vitamin D_3)	Pellet applications to burrows (of target rodents) no less than 6 inches into active Norway/roof rat burrows. Do not broadcast bait.	Apply to active rodent burrows within or beyond 100 feet of buildings and man-made structures (including those described above).	Norway rats, roof rats and house mice
Difenacoum	119901	Anticoagulant (Vitamin K antagonist)	Bait Stations (tamper-resistant bait stations; can only be applied by certified applicators)	In and within 100 feet of man-made structures including homes, permanent and temporary residences, food processing facilities, industrial and commercial buildings, trash receptables, agricultural and public buildings, transport vehicles, docks and port of terminal and related structures. Fence and perimeter baiting beyond 100 feet, burrow and broadcast baiting are prohibited.	Norway rat, roof rat, house mice, cotton rat, Eastern harvest mice, golden mice, meadow vole, Mexican woodrat, Polynesian rat, Southern plains woodrat and white-throated woodrat
Difethialone	128967	Anticoagulant (Vitamin K antagonist)	Bait Stations (tamper-resistant bait stations; can only be applied by certified applicators)	Can be used in and within 100 feet from manmade structures including permanent or temporary residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public buildings, transport vehicles (ships, trains, aircraft), docks and port or terminal buildings and related structures. Fence and perimeter baiting beyond 100 feet from structure is prohibited.	Bushytail woodrats, Cotton rat, Deer mouse, Harvest mice, House mouse, Meadow vole, Mexican woodrat, Norway rat, Polynesian rat, Roof rat, Southern plains woodrat, White-footed mouse, Whitethroat woodrat

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)
Diphacinone	067701	Anticoagulant (Vitamin K antagonist)	Broadcast	CRP lands, forests	California ground squirrel
			Bait Stations (tamper-resistant bait stations)	Can be used in and within 100 feet from manmade structures including permanent or temporary residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public buildings, transport vehicles (ships, trains, aircraft), docks and port or terminal buildings and related structures. Fence and perimeter baiting beyond 100 feet from structure is prohibited.	Norway rats, roof rats, house mice
Strychnine	076901	Neurotoxicant (Inhibits post synaptic glycine receptors in spinal cord and causes involuntary skeletal muscle contraction)	Applications to burrows (of target rodents) and both agricultural and non-agricultural areas. Strychnine cannot be applied on geographic ranges of any Federally protected pocket gopher subspecies or populations.	Below ground applications to artificial burrows in rangelands, pastures, croplands, forests and non-agricultural areas to control pocket gophers. Also used in orchards, alfalfa fields, hay fields, pastures, rangelands, and other non-crop areas.	Mazama pocket gopher, Northern pocket gopher, plains pocket gopher, Southern pocket gopher, yellow-faced pocket gopher, botta pocket gopher, camas pocket gopher, mountain gopher, Towsend's pocket gopher, valley pocket gopher and other *Thomomys* and Geomys *sp.* (Special Local Needs Use in NV specifically for yellow-bellied marmots, Richardson, Beldin's and Piute ground squirrels)
Warfarin	086002	Anticoagulant (Vitamin K antagonist)	Feeding station where hogs must lift the doors with their snouts to access bait (do not apply directly to ground)	Pastures, rangelands, forest and non-crop areas.	Feral hogs
			Applications to burrows (of target rodents)	Active burrow systems on lawns, turf areas, golf courses, and other non-food grassy areas	Various mole species including Eastern mole, starnose mole, and Townsend's mole

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)
Warfarin	086002	Anticoagulant (Vitamin K antagonist)	Bait Stations (tamper-resistant)	Can be used in and within 100 feet from manmade structures including permanent or temporary residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public buildings, transport vehicles (ships, trains, aircraft), docks and port or terminal buildings and related structures. Fence and perimeter baiting beyond 100 feet from structure is prohibited.	Cotton rat, harvest mice, house mice, meadow vole, Norway rat, Polynesian rat, roof rat, deer mice, pine vole, mountain vole, white-footed mice, Mexican woodrat, Southern plains woodrat
Zinc phosphide	088601	Mechanism of Action is unclear; Possibly acts through gut hydrolysis of zinc phosphide, which produces toxic phosphine gas (PH_3) which impairs a suite of cellular functions	Broadcast (Ground & Aerial)	Used in and outdoor residential and agricultural areas (including in and around homes, lawns, bulbs, in and around outside buildings/barns, and rights-of-ways/ fencerows/ hedgerows), indoor and outdoor commercial or institutional premises and equipment, golf courses, and reforestation areas.	Banner-tailed kangaroo rat, Belding ground squirrel, black tail jack rabbit, black-tailed prairie dog, California ground squirrel, California vole, Columbia ground squirrel, Cotton rat, Desert woodrat, Dusky-footed woodrat, Eastern woodrat, Florida woodrat, Franklin's ground squirrel, Golden-mantled ground squirrel, Ground squirrels, Gunnison's prairie dog, house mouse, prairie dog, house mouse
			Bait Stations (tamper-resistant)	Can be used in and within 100 feet from manmade structures including permanent or temporary residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public buildings, transport vehicles (ships, trains, aircraft), docks and port or terminal buildings and related structures. Fence and perimeter baiting beyond 100 feet from structure is prohibited.	House mice, Norway rat, Roof rat, Cotton rat, Eastern harvest mice, Golden mice, Polynesian rat, Meadow vole, White-throated woodrat, Southern plains woodrat, Mexican woodrat

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)
Zinc phosphide	088601	Mechanism of Action is unclear; Possibly acts through gut hydrolysis of zinc phosphide, which produces toxic phosphine gas (PH_3) which impairs a suite of cellular functions	Applications to burrows (of target rodents can be applied 6" in burrow and around mouth of holes leading to burrow system)	Active burrows in non-crop areas, non-feed crop areas, ornamental lawns, ornamental turf (golf courses), residential lawns; also for use between tree rows, drainage ditches, rock walls, rock outcrops, fence rows and low spots in tree orchard at surface of trail or mouth of hold leading to burrow system.	Moles, pocket gophers (*Thomomys sp.*), and various rat, mouse and vole species

Appendix B. Endangered and Threatened Species Effects Determinations and Predictions of the Potential Likelihood of Future Jeopardy and Critical Habitat Effects Determinations and Predictions of the Potential Likelihood of Adverse Modification

The attached Excel spreadsheet (**067701+_NoTGCode_Final BE_Appendix B_11-21-2024**) includes the species-specific and CH effects determinations. For species with LAA determinations based on potential effects to an individual, **Appendix B** also includes EPA's predictions of the likelihood that rodenticide use will result in potential future J of the species. For CHs with LAA determinations, **Appendix B** also includes EPA's predictions of the likelihood that rodenticide use will result in potential future AM of the CH.

Appendix C. November 2024 Updates: Endangered and Threatened Species Effects Determinations and Predictions of the Potential Likelihood of Future Jeopardy and Critical Habitat Effects Determinations and Predictions of the Potential Likelihood of Adverse Modification

EPA recognizes that UDL and Listed species/CH designations are frequently updated and may change during the process of conducting at BE and during the BiOp process. Therefore, EPA has updated both the underlying agricultural data used in the overlap analysis (*i.e.* Use Data Layers), the listed species range and critical habitat GIS files, as well the listed species considered in the BE to the most current information at the time of the final BE.

The attached Excel spreadsheet (**067701+_NoTGCode_Final BE_Appendix C_11-21-2024**) includes the species-specific and CH effects determinations for those listed by the Services between the draft BE (*i.e.*, April 2023) and November 2024. EPA used the most recent (Dec. 2023) spatial files for range and critical habitat for the effects determinations of (1) the new species and CH and (2) to re-evaluate the effects determinations made in the draft BE for the species and CH listed prior to April 2023. For the existing species where EPA already made effect determinizations in the draft BE, the updated overlap was compared to the old overlap for species and CH where overlap was determinative in EPA's predictions of potential likelihood of J/AM (*see* **Appendix C** for more details).

Appendix C identifies species and critical habitats that were listed or designated during the interval between draft and final BE. Those new species and CH are incorporated into the final BE. It also identifies species and CH that have been delisted since October 2023 and that were included in the draft BE, but now are excluded in the final BE.

Finally, **Appendix C** also presents the updated overlap results (Dec. 2023).

Updated Use Data Layers (UDLs):

In terms of the UDL, EPA updated the agricultural Use Data Layers to account for the more up to date USDA Cropland Data Layer. These UDLs represent data from the 2018-2022 CDL. When necessary multiple land cover classes are combined into a single layer; see data sources for additional details. The agricultural classes were further refined by comparing county level National Agricultural Statistics Service (NASS) 2017 Census of Agriculture (CoA) acreage reports to county level UDL acreages. However this analysis for the final BE just used the cultivated layer, which is derived directly from the 2021 CDL. The NL48 UDLs and non-Ag UDLs (*i.e.*, Open space developed and Developed) were not updated in the interval between the draft and final BE.

Updated Species Ranges and Critical Habitats:

The draft BE used spatial files from February 2022. For the final BE, EPA updated its species list to include all listed species as of Oct. 2024. The most up to date species range and critical habitat spatial files were from Dec. 2023[42]

[42] Range files - https://services.arcgis.com/cJ9YHowT8TU7DUyn/arcgis/rest/services/Species_Ranges_Static/FeatureServer
Critical habitat - https://services.arcgis.com/cJ9YHowT8TU7DUyn/arcgis/rest/services/Critical_Habitat_Static/FeatureServer

Appendix D. Summary of Jeopardy Species by Use Pattern and Active Ingredient

Table D-1. Summary of Jeopardy Species by Use Pattern and Active Ingredient[1]

Species	Use and A.I. Associated with J/AM	Primary or Secondary Exposure
Reptiles		
Puerto Rican boa	Bait Station (FGAR and SGAR) Broadcast (FGAR)	Secondary
Louisiana pine snake	Bait Station (FGAR and SGAR) Broadcast (FGAR)	Secondary
Eastern Massasauga (rattlesnake)	Bait Station (FGAR and SGAR) Broadcast (FGAR)	Secondary
Black pine snake	Bait Station (FGAR and SGAR) Broadcast (FGAR)	Secondary
New Mexican ridge-nosed rattlesnake	Broadcast (FGAR)	Secondary
Birds		
California condor	Bait Station (FGAR and SGAR) Feral Hog bait station (warfarin) Broadcast (FGAR)	Secondary
Hawaiian (alala) Crow	Bait Station (FGAR and SGAR) Broadcast (ZnP) Burrow (FGAR)	Primary/Secondary
Audubon's crested caracara	Bait Station (FGAR and SGAR) Feral Hog bait station (warfarin) Broadcast (FGAR)	Secondary
Mexican spotted owl	Bait Station (FGAR and SGAR) Broadcast (FGAR)	Secondary
Northern spotted owl	Bait Station (FGAR and SGAR) Broadcast (FGAR)	Secondary
California spotted owl	Bait Station (FGAR and SGAR) Broadcast (FGAR)	Secondary
Hawaiian (koloa) duck	Broadcast (ZnP)	Primary
Hawaiian goose	Broadcast (ZnP)	Primary
Hawaiian common gallinule	Broadcast (ZnP)	Primary
Micronesian megapode	Broadcast (ZnP)	Primary
Puerto Rican plain pigeon	Broadcast (ZnP)	Primary
Hawaiian coot	Broadcast (ZnP)	Primary
Puerto Rican nightjar	Broadcast (ZnP)	Primary
Yellow-shouldered blackbird	Broadcast (ZnP)	Primary
Guam rail	Broadcast (ZnP)	Primary
Nightingale reed warbler (old world warbler)	Broadcast (ZnP)	Primary
Elfin-woods warbler	Broadcast (ZnP)	Primary
Friendly ground-dove	Broadcast (ZnP)	Primary
Mao (= maomao) (honeyeater)	Broadcast (ZnP)	Primary
Attwater's greater prairie-chicken	Broadcast (FGAR, ZnP)	Primary
Lesser prairie-chicken	Broadcast (FGAR, ZnP)	Primary

Species	Use and A.I. Associated with J/AM	Primary or Secondary Exposure
Cape Sable seaside sparrow	Broadcast (FGAR, ZnP)	Primary
Masked bobwhite (quail)	Broadcast (FGAR, ZnP)	Primary
San Clemente loggerhead shrike	Broadcast (FGAR, ZnP)	Primary
Florida grasshopper sparrow	Broadcast (FGAR, ZnP)	Primary
Florida scrub-jay	Broadcast (FGAR, ZnP)	Primary
Gunnison sage-grouse	Broadcast (FGAR, ZnP)	Primary
Greater sage-grouse	Broadcast (FGAR, ZnP)	Primary
Yellow-billed Cuckoo	Broadcast (FGAR, ZnP)	Primary
Streaked horned lark	Broadcast (FGAR, ZnP)	Primary
Mammals		
Pacific Marten, Coastal Distinct Population Segment prev. Humboldt Marten	Broadcast (FGAR)	Secondary
Florida Panther	Feral Hog bait station (warfarin)	Secondary
Ocelot	Broadcast (FGAR)	Secondary
San Joaquin kit fox	Bait Station (FGAR and SGAR) Broadcast (FGAR)	Secondary
Black-footed ferret	Burrow (FGARs and ZnP) Broadcast (FGAR)	Secondary
Sierra Nevada red fox	Broadcast (FGAR)	Secondary
Sonoran pronghorn	Bait Station (FGAR and SGAR) Broadcast (FGAR, ZnP)	Primary
Columbian white-tailed deer	Bait Station (FGAR and SGAR) Broadcast (FGAR, ZnP)	Primary
Roy Prairie pocket gopher	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Olympia pocket gopher	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Tenino pocket gopher	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Yelm pocket gopher	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Stephens kangaroo rat	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
San Bernardino Merriam's kangaroo rat	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Choctawhatchee beach mouse	Bait Station (FGAR, SGAR, cholecalciferol,	Primary

Species	Use and A.I. Associated with J/AM	Primary or Secondary Exposure
	bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	
Perdido Key beach mouse	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Alabama beach mouse	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP)	Primary
St. Andrew beach mouse	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Anastasia Island beach mouse	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Southeastern beach mouse	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Salt marsh harvest mouse	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Pacific pocket mouse	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Giant kangaroo rat	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Morro Bay kangaroo rat	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Tipton kangaroo rat	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Fresno kangaroo rat	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Prebles meadow jumping mouse	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary

Species	Use and A.I. Associated with J/AM	Primary or Secondary Exposure
Buena Vista Lake Ornate Shrew	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP)	Primary
Utah Prairie Dog	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Riparian Bush Rabbit	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Point Arena Mountain Beaver	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Riparian Woodrat	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Pygmy Rabbit (prey Columbia basic pygmy rabbit)	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Northern Idaho Ground Squirrel	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Amargosa vole	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
New Mexico meadow jumping mouse	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Penasco least chipmunk	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Florida salt marsh vole	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Silver rice rat	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP)	Primary
Key Largo cotton mouse	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Key Largo woodrat	Bait Station (FGAR, SGAR, cholecalciferol, bromethalin, and ZnP) Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Texas kangaroo rat	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary
Lower Keys marsh rabbit	Burrow (FGARs, bromethalin, strychnine, and ZnP) Broadcast (FGAR, ZnP)	Primary

[1]This evaluation did not include 10(j) species which are plants or animal populations that have been designated as an experimental under the Endangered Species Act (ESA) (*e.g.,* some populations of Black footed ferret, *Mustela nigripes*, are considered a non-essential experimental population; therefore, regulatory and take prohibitions, and consultation requirements of the ESA are relaxed). Any adjustments to 10(j) species will be resolved during consultation with the USFWS.

Appendix E. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)

1. Agriculture Uses

Use site footprint layers represent the application sites for agricultural and non-agricultural label uses. The best available data to spatially characterize specific agricultural crops in the continuous United States (CONUS) is the Cropland Data Layer (CDL), produced by the U.S. Department of Agriculture. Several methods have been employed to minimize data errors within the CDL. The CDL is a landcover dataset that has over 100 cultivated classes that were grouped into 13 general classes. Lumping classes reduces the likelihood of errors of omission and commission between similar crop categories. In selecting how to group crops from the CDL, EPA referred to the grouping used by the U.S. Geological Survey (Baker and Capel, 2011) and the Generic Endangered Species Task Force. This information considers environmental factors that influence the location of crops and the error matrices provided by USDA with the original CDL data.

The draft BE used the 2017 cultivated UDL identifies cultivated land cover for the lower 48 states and based on land cover information derived from USDA's Crop Data Layer from 2013 through 2017 (Boryan *et al*., 2011; USDA, 2017). The final BE used the Cultivated layer from the 2021 CDL (updated analysis presented in **Appendix C**).

- **Cultivated land:** Cultivated/Fallow is spatial represented using all cultivated land as identified in USDA's Cultivated layer from Cropland Data Layer. It is based on the most recent five years of CDL data. Generally speaking, a pixel is identified as "Cultivated" if in at least two out of the five years of CDL data it has been previously identified as growing a crop. The exception is that all pixels identified as cultivated in the most recent year are assigned to the 'Cultivated' category regardless of whether they were cultivated in the previous four years of CDL data. The Cultivated Layer is a raster, geo-referenced data layer that has a ground resolution of 30 meters (Boryan, Claire, Yang, Z., and Di, L., IGRSS, 2012)

    a. Agricultural UDL Data Sources for the Non-lower 48 contiguous United States (NL48)

The Cultivated Layer UDL just covers CONUS so additional datasets were needed to create a similar agricultural layer for the NL48. EPA primarily used the 2011 National Land Cover Dataset (NLCD) to represent many agricultural uses in the NL48. Where NLCD wasn't available, the National Oceanic and Atmospheric Administration (NOAA) Coastal Change Analysis Program (C-CAP) dataset and corresponding landcover classes were used. Details on the data sources NL48 agricultural UDL are below:

- **Alaska (AK)**
    - National Land Cover Dataset (NLCD) Cultivated Class (82)
- **Hawaii (HI)**
    - National Oceanic & Atmospheric Administration (NOAA) Coastal Change Analysis Program (CCAP), Cultivated Class (6)
- **Puerto Rico (PR)**
    - NLCD Cultivated Class (82)
- **Guam (GU)**
    - CCAP Cultivated Class (6)

    - Current CoA is not available for GU
- **Marianas (CNMI)**
    - CCAP Cultivated Class (6)
    - Current CoA is not available for CNMI
- **American Samoa (AS)**
    - CCAP Cultivated Class (6)
    - Current CoA is not available for AS
- **Virgin Islands (VI)**
    - CCAP Cultivated Class (6)
    - Current CoA is not available for VI

Additional agricultural use was captured in UDLs that represent uses beyond typical cultivation, which include Pasture and Rangeland:

Pasture: The CDL and NLCD map a pasture class, that is primarily grassland pastures.
CONUS

- The Pasture UDL includes a group of CDL classes that include categories for Alfalfa, Other Hay/Non-Alfalfa, Switchgrass, Pasture/Grass, Pasture/Hay, Pasture/Hay, and Vetch.

- Additionally, this includes NLCD 2016 pasture class.

Alaska:

- NLCD 2016 pasture class everywhere

Hawaii:
- CCAP 2011 pasture class 7

Puerto Rico:
• NLCD 2001 pasture class 81

Guam:
• CCAP 2011 pasture class 7

Marianas:
• CCAP 2004 pasture class 7 42 Version 1.1 Last updated January 2023

American Samoa:
•CCAP 2010 pasture class 7

Virgin Islands:
•CCAP 2012 pasture class 7

Rangeland: The grazing cattle land use is added to additional land cover types, such as forests, shrublands, wetlands, etc.
CONUS:

•CDL (2013-2017) and NLCD 2016 pasture classes everywhere

•Excludes the cultivated agricultural grasses (captured in the alfalfa layer described above)

•Undeveloped NLCD classes within Bureau of Land Management (BLM) and United States Forest Service (USFS) grazing allotment boundaries

•Exclude NLCD developed, water, and cultivated

Alaska:
•NLCD 2016 pasture class everywhere
•Undeveloped NLCD classes within BLM grazing allotment boundaries
•No USFS grazing allotment boundaries available for AK

Hawaii:
• CCAP 2011 pasture class 7
• No BLM or USFS grazing allotment boundaries available for HI

Puerto Rico:
• NLCD 2001 pasture class 81
•No BLM or USFS grazing allotment boundaries available for PR

Guam:
• CCAP 2011 pasture class 7
•No BLM or USFS grazing allotment boundaries available for GU

Marianas:
• CCAP 2004 pasture class 7 42 Version 1.1 Last updated January 2023
• No BLM or USFS grazing allotment boundaries available for CNMI

American Samoa:
•CCAP 2010 pasture class 7
•No BLM or USFS grazing allotment boundaries available for AS

Virgin Islands:
•CCAP 2012 pasture class 7
•No BLM or USFS grazing allotment boundaries available for VI

2. Non-Agricultural UDL Data Sources CONUS and NL48

Non-agricultural label uses include a wide range of landcover and land use categories. Each label use was carefully considered and cross-walked with the best available land cover data. Where available, EPA used the 2011 National Land Cover Dataset (NLCD) to represent many non-agricultural labeled uses (see below). Where NLCD wasn't available, EPA used the NOAA C-CAP and other datasets outlined below.

- **Developed**

Developed land cover is used to spatially represent certain non-agricultural label uses

- **CONUS**
    - NLCD class 22-24
- **Alaska**
    - NLCD class 22-24
- **Hawaii**
    - CCAP class 2-4
- **Puerto Rico**
    - NLCD class 22-24
- **Guam**
    - CCAP class 2
- **Marianas**
    - CCAP class 2
- **American Samoa**
    - CCAP class 2
- **Virgin Islands**
    - CCAP class 2

- **Open Space Developed**

Open Space Developed (OSD) is used to spatially represent certain non-agricultural label uses

- **CONUS**
    - NLCD class 21
- **Alaska**
    - NLCD class 21
- **Hawaii**
    - CCAP class 5
- **Puerto Rico**
    - NLCD class 21
- **Guam**
    - CCAP class 5
- **Marianas**
    - CCAP class 5
- **American Samoa**
    - CCAP class 5
- **Virgin Islands**
    - CCAP class 5

- **Noncultivated**
    - **CONUS**
        - Spatially represented as the inverse of all cultivated land as identified in USDA's Cropland Data Layer (2017).
    - **Alaska (AK)**
        - Spatially represented as the inverse of the National Land Cover Dataset (NLCD) Cultivated Class (82)
    - **Hawaii (HI)**

        - Spatially represented as the inverse of the National Oceanic & Atmospheric Administration (NOAA) Coastal Change Analysis Program (CCAP), Cultivated Class (6)
    - **Puerto Rico (PR)**
        - Spatially represented as the inverse of the NLCD Cultivated Class (82)
    - **Guam (GU)**
        - Spatially represented as the inverse of the CCAP Cultivated Class (6)
    - **Marianas (CNMI)**
        - Spatially represented as the inverse of the CCAP Cultivated Class (6)
    - **American Samoa (AS)**
        - Spatially represented as the inverse of the CCAP Cultivated Class (6)
    - **Virgin Islands (VI)**
        - Spatially represented as the inverse of the CCAP Cultivated Class (6)
- **Forest Trees**

Forested areas managed for timber extraction, forested areas, forest tree plantations

- **CONUS**
    - Cropland Data Layer (CDL) class 70, Christmas Trees
    - Include all the following LandFire Existing Vegetation Type (EVT) classes; "Recently Logged-Herb and Grass Cover", "Recently Logged-Shrub Cover", "Recently Logged-Tree Cover", "Managed Tree Plantation-Northern and Central Hardwood and Conifer Plantation Group", or "Managed Tree Plantation-Southeast Conifer and Hardwood Plantation Group"
    - Include any of the following United States Geologic Survey (USGS) National Gap Analysis Program (GAP) Public Model Ready Events; "Thinning", "Other Mechanical", "Clearcut", "Harvest", or "Reforestation"
    - Include any of the following USGS GAP Land Cover classes; "Recently Logged Areas", "Harvested Forest - Grass/Forb Regeneration", "Harvested Forest-Shrub Regeneration", "Harvested Forest - Northwestern Conifer Regeneration", "Managed Tree Plantation", "Evergreen Plantation or Managed Pine", "Deciduous Plantations"
    - Include either of the following USGS GAP Protected Areas Database classes where NLCD indicates "Forest" (41-43); "3 - managed for multiple uses - subject to extractive (*e.g.*, mining or logging) or Off Highway Vehicles (OHV) use" and "4 - no known mandate for protection"
- **Alaska**
    - Include either of the following USGS GAP Protected Areas Database classes where NLCD indicates "Forest" (41-43); "3 - managed for multiple uses - subject to extractive (*e.g.*, mining or logging) or OHV use" and "4 - no known mandate for protection"

- Include any of the following USGS GAP Public Model Ready Events; "Thinning", "Other Mechanical", "Clearcut", "Harvest", or "Reforestation"
- AK LandFire EVT and GAP land cover do not have classes indicative of forest management

- **Hawaii**
  - Include the following LandFire EVT class; “Hawai'i Managed Tree Plantation”
  - Include either of the following USGS GAP Protected Areas Database classes where CCAP indicates "Forest" (9-11); "3 - managed for multiple uses - subject to extractive (*e.g.*, mining or logging) or OHV use" and "4 - no known mandate for protection"
  - HI GAP land cover and USGS GAP Public Model Ready Events for HI do not have classes indicative of forest management
- **Puerto Rico**
  - Include the following GAP land cover classes; “Abandoned dry forest plantation”, “Woody agriculture and plantations: Palm plantations”
  - Include either of the following USGS GAP Protected Areas Database classes where CCAP indicates "Forest" (9-11); "3 - managed for multiple uses - subject to extractive (*e.g.*, mining or logging) or OHV use" and "4 - no known mandate for protection"
  - PR LandFire EVT is not available
- **Guam**
  - Include either of the following USGS GAP Protected Areas Database classes where CCAP indicates "Forest" (9-11); "3 - managed for multiple uses - subject to extractive (*e.g.*, mining or logging) or OHV use" and "4 - no known mandate for protection"
  - LandFire EVT, GAP land cover, and USGS GAP Public Model Ready Events are not available for Guam
- **Marianas**
  - Include either of the following USGS GAP Protected Areas Database classes where CCAP indicates "Forest" (9-11); "3 - managed for multiple uses - subject to extractive (*e.g.*, mining or logging) or OHV use" and "4 - no known mandate for protection"
  - LandFire EVT, GAP land cover, and USGS GAP Public Model Ready Events are not available for the Marianas
- **American Samoa**
  - LandFire EVT, GAP land cover, and USGS GAP Public Model Ready Events are not available for the Marianas
  - USGS GAP Protected Areas Database does not indicate areas indicative of forest management
- **Virgin Islands**
  - Include either of the following USGS GAP Protected Areas Database classes where CCAP indicates "Forest" (9-11); "3 - managed for multiple

uses - subject to extractive (*e.g.*, mining or logging) or OHV use" and "4 - no known mandate for protection"
            - LandFire EVT, GAP land cover, and USGS GAP Public Model Ready Events are not available for the Marianas

- **Christmas Trees**

Cropland Data Layer (CDL) class 70, Christmas Trees, are used for CONUS. These are not characterized anywhere else.

    - **CONUS**
        - Cropland Data Layer (CDL) class 70, Christmas Trees
    - **Alaska**
        - No Christmas Tree land cover data are available
    - **Hawaii**
        - No Christmas Tree land cover data are available
    - **Puerto Rico**
        - No Christmas Tree land cover data are available
    - **Guam**
        - No Christmas Tree land cover data are available
    - **Marianas**
        - No Christmas Tree land cover data are available
    - **American Samoa**
        - No Christmas Tree land cover data are available
    - **Virgin Islands**
        - No Christmas Tree land cover data are available

- **Nurseries**

Non-agricultural Nurseries represent a land use that is not exclusive to any nationwide land cover class. Nurseries are mapped by using geocoded Dun and Bradstreet (D&B) business database addresses. Label uses that are covered by this UDL found on ornamentals, shrubs/vines, and non-food trees, grown in a non-agricultural setting (*e.g.* Retail Nurseries, Garden supple stores or retail horticultural locations). This UDL does not include labels represented by agricultural nursery uses such as trees grown for food, tree plantations or transplanted trees, shrubs, and ornamentals. These agricultural nurseries are captured in the agricultural UDLs described above.

  - **CONUS**
    - Using the Dun and Bradstreet business database, select all records with any SIC Codes starting with “018” (Horticultural Specialties) or “526” (Retail Nurseries, Lawn and Garden Supply Stores)
    - Selected points are then buffered by their facility size attribute. Where facility size is absent, substitute the Census of Agriculture’s average acreage by county, calculated using Nursery Totals. If a county’s nursery acreages are undisclosed, then an average of all county averages is used. A circular buffer is applied, where radius is solved for using the areas previously described. In an effort to

map production facilities only and not business offices, use the 'Location Type' attribute to categorize locations.

- **Alaska**
  - EPA used Dun and Bradstreet business database in the same method as applied to CONUS.
- **Hawaii**
  - EPA used Dun and Bradstreet business database in the same method as applied to CONUS.
- **Puerto Rico**
  - EPA used Dun and Bradstreet business database in the same method as applied to CONUS.
- **Guam**
  - No Dun and Bradstreet business data were available for Guam.
- **Marianas**
  - No Dun and Bradstreet business data were available for Marianas.
- **American Samoa**
  - No Dun and Bradstreet business data were available for American Samoa.
- **Virgin Islands**
  - EPA used Dun and Bradstreet business database in the same method as applied to CONUS.

- **Right-of-Ways**

NLCD developed classes are sufficient for most scenarios. NLCD developed classes are insufficient in cases of rural minor roads, rural transmission lines, and rural pipelines.

- **CONUS**
  - All NLCD developed classes everywhere (21-24)
    - *** For generating Euclidean distance for CONUS Right-of-Ways (ROW), NLCD Developed classes do not have Euclidean distance algorithms applied. NLCD Developed classes are included in the footprint as a zero value in the final Euclidean distance file. The other component ROW classes do have Euclidean distance algorithms applied.*
  - ESRI Railroads
  - United States Census Bureau's Master Address File (MAF) Topologically Integrated Geographic Encoding and Referencing database (TIGER) transmission (MAF/TIGER Feature Class Code (MTFCC) code L4020) and pipeline (MTFCC code L4010) data
  - Bonneville Power Administration's (BPA) Right-of-Way data
  - Navteq roads
- **Alaska**
  - See ConUS method (without BPA data)
- **Hawaii**
  - All National Oceanic & Atmospheric Administration (NOAA) Coastal Change Analysis Program (CCAP) developed classes everywhere (2-5)
  - ESRI Railroads

        - TIGER transmission (MTFCC code L4020) and pipeline (MTFCC code L4010) data
        - NAVTEQ roads
    - **Puerto Rico**
        - See ConUS method (without BPA data)
    - **Guam**
        - All CCAP developed classes everywhere (2-5)
        - No ESRI Railroads data available for Guam
        - TIGER transmission (MTFCC code L4020) and pipeline (MTFCC code L4010) data
        - No NAVTEQ roads data available for Guam

    - **Marianas**
        - All CCAP developed classes everywhere (2-5)
        - No ESRI Railroads data available for Marianas
        - TIGER transmission (MTFCC code L4020) and pipeline (MTFCC code L4010) data
        - No NAVTEQ roads data available for Marianas
    - **American Samoa**
        - All CCAP developed classes everywhere (2-5)
        - No ESRI Railroads data available for American Samoa
        - No TIGER data available for American Samoa
        - No NAVTEQ roads data available for American Samoa
    - **Virgin Islands**
        - All CCAP developed classes everywhere (2-5)
        - No ESRI Railroads data available for Virgin Islands
        - No TIGER data available for Virgin Islands
        - No NAVTEQ roads data available for Virgin Islands

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Appendix F. Determination of Overlap of Likely Rodenticide Exposure Area and Species Ranges and Critical Habitat

The attached appendix **(067701+_NoTGCode_Final BE_Appendix F_11-21-2024)** is a compressed file (.zip) and contains the codes as well the input and output folders associated with the spatial overlap analysis for this Rodenticides effort.

Appendix G. Geographic Extent of Jeopardy Species and Adverse Modification of Critical Habitat. Determination of Overlap of Likely Rodenticide Exposure Area and Species Ranges and Critical Habitat

EPA created maps showing the geographic extent of the species and CHs that it predicted as potential likely future J or AM from the currently registered use of the 11 rodenticides (**Figure G-1** to **Figure G-3**; inclusive of all applicable taxon). The entire range of each species and CH is presented, not accounting for overlap with areas that represent rodenticide use areas. EPA notes that **Figure G-1** to **G-3** represent the maximum spatial extent because, as described earlier, it is currently developing a process to refine PULAs, and EPA expects the result will be that many PULAs will be smaller than the species ranges.

Figure G-1 presents the entire geographic ranges of primary consumer bird and mammal species that EPA has predicted to be potential likely future J from one or more rodenticides and/or use patterns. **Figure G-2** presents the entire geographic ranges of secondary consumer bird, mammal, and reptile species that EPA has predicted to be potential likely future J from one or more rodenticides and/or use patterns**. Figure G-3** presents the entire geographic ranges of the CH of two birds, two reptiles, and one amphibian that EPA has predicted to be potential likely future AM from one or more rodenticides and/or use patterns. These figures indicate that mitigations to protect listed species and CH will not be required in the entire United States.

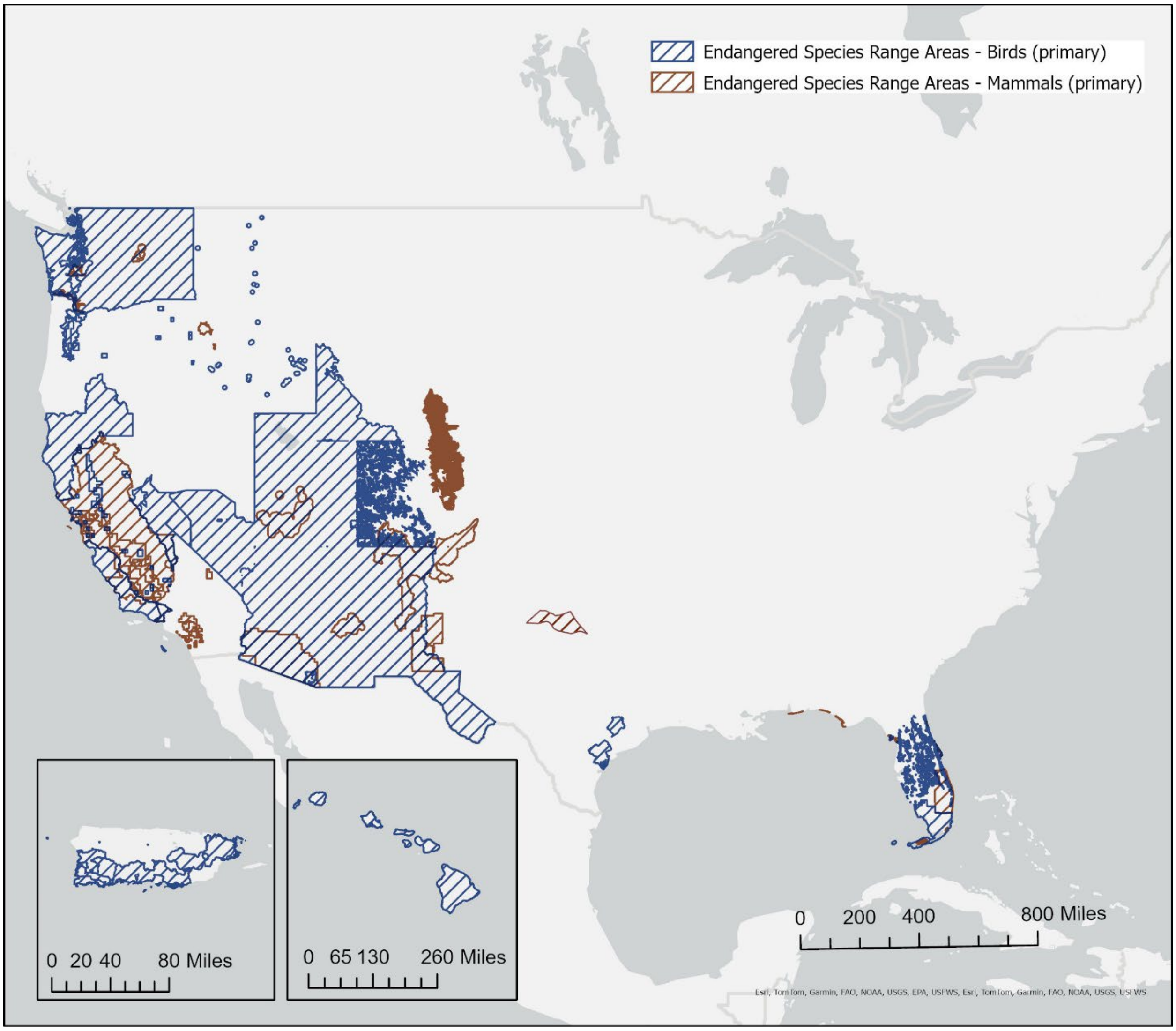

Figure G-1 Geographic extent of species range, for primary consumers that EPA predicted as potential likely future J. Birds are blue and mammals are brown. There are no species' ranges contained in areas of the CONUS that are not displayed in the above map. Similarly, there are no ranges for species in AK.

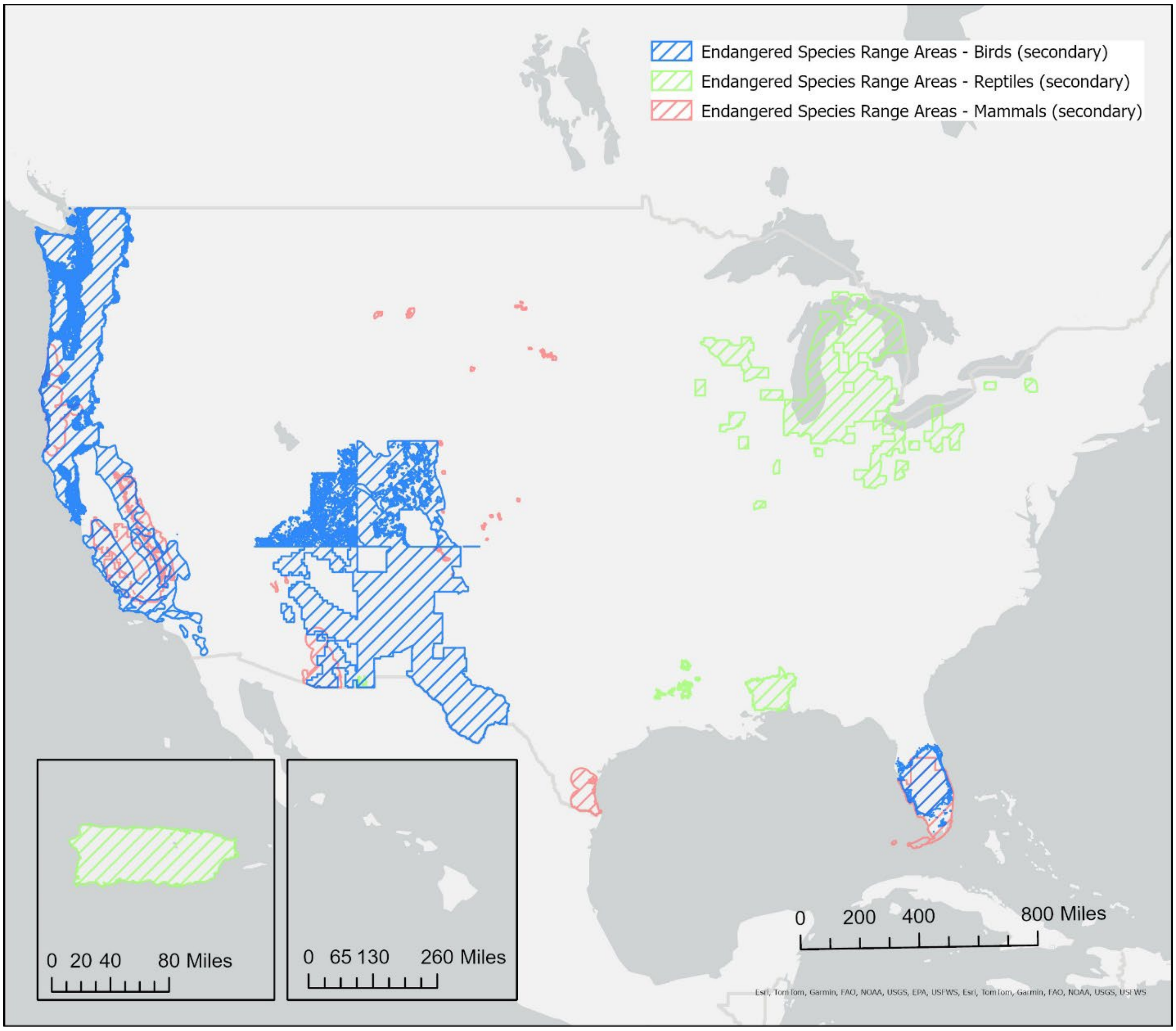

Figure G-2. Geographic extent of species range, for secondary consumers that EPA predicted as potential likely future J. Birds are blue, mammals are red, reptiles are green. There are no species' ranges contained in areas of the CONUS that are not displayed in the above map. Similarly, there are no ranges for species in AK.

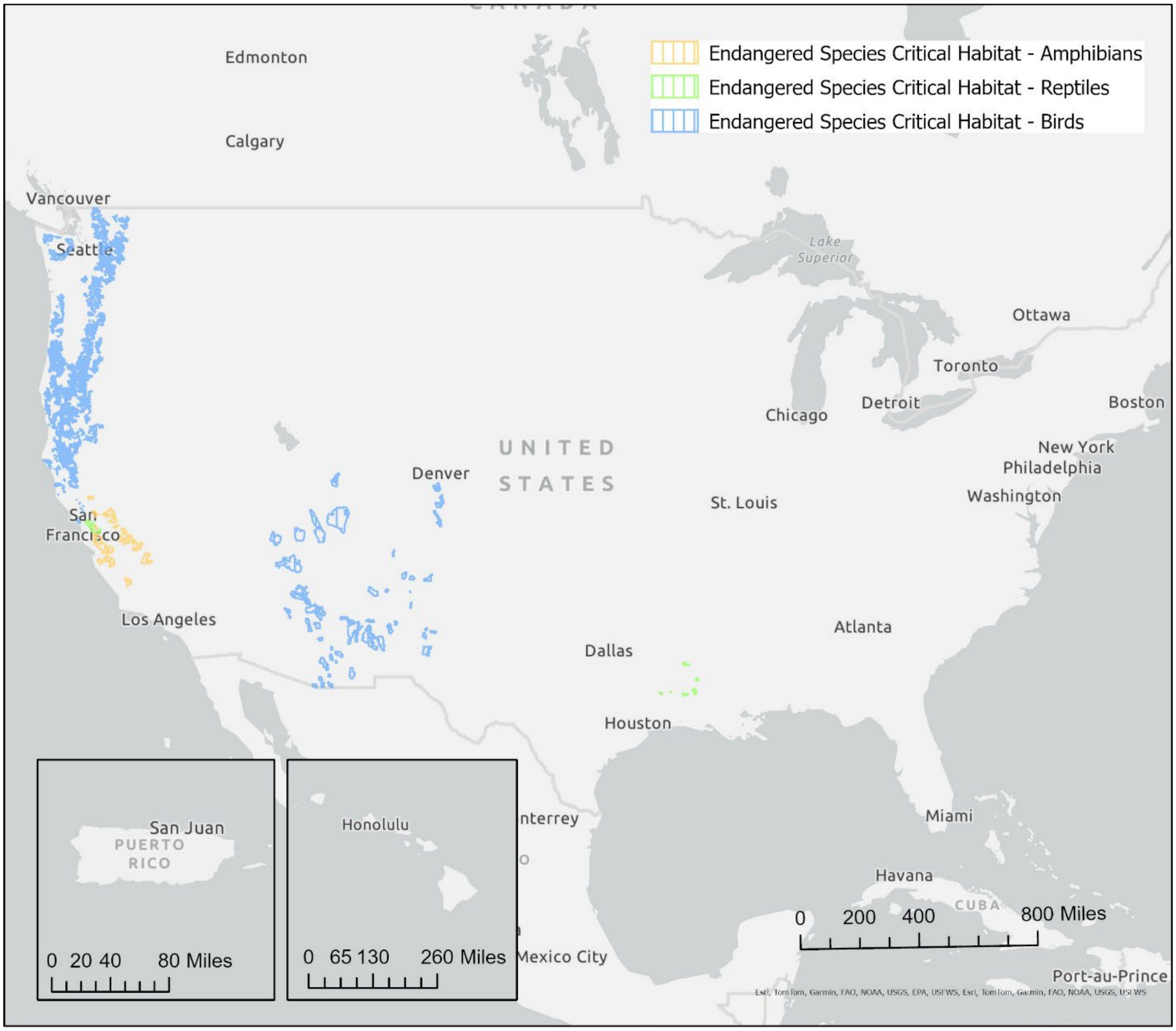

Figure G-3 Geographic extent of CH for species that EPA predicted as potential likely future AM. Birds are blue, amphibians are yellow, and reptiles are green. There are no species' critical habitats contained in areas of the CONUS that are not displayed in the above map. Similarly, there are no critical habitats for species in AK.