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MEMORANDUM

SUBJECT: **Rodenticides:** Draft 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 draft 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 a future jeopardy (J) or adverse modification (AM) (collectively abbreviated as J/AM) finding by U.S. Fish and Wildlife Service (USFWS) or the National Marine and Fisheries Service (NMFS) (collectively referred to as “the Services”) for listed species and their CHs, respectively. 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 Services 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 the jurisdiction of the USFWS. However, EPA does not anticipate needing to consult with NMFS because draft No Effect (NE) determinations were made all listed species and CHs under the jurisdiction of NMFS. While EPA predicted potential likelihood of future J/AM as part of its effects determinations, the Services make the final J/AM findings in any Biological Opinion (BiOp) they issue at the end of the consultation process.

Rodenticides: Draft 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 draft BE is to make effect determinations and predict whether there is a potential likelihood that current registrations of 11 rodenticides may lead to a future jeopardy or adverse modification finding by USFWS or NMFS for listed species and their CHs. This draft BE also identifies possible mitigation measures, as part of the Rodenticide Strategy, that are intended to avoid potential jeopardy and minimize take for species that could potentially be jeopardized or adversely affected.

A BE is the United States EPA's document that includes an analysis to support EPA's effects determinations, conducted when it takes an action subject to review under the Endangered Species Act (ESA). EPA prepares a draft BE to evaluate the potential effects of the Agency's action (here defined as the Registration Review (RR) of registered uses of the 11 rodenticides) on listed species and their CHs.

The 11 rodenticides reviewed are: chlorophacinone (PC Code[1] 067707), diphacinone and its sodium salt (PC Codes 067701 and 067705, respectively), warfarin and its sodium salt (PC Codes 086002 and 086003, respectively), brodifacoum (PC Code 112701), bromadiolone (PC Code 112001), difenacoum (PC Code 119901), difethialone (PC Code 128967), bromethalin (PC Code 112802), cholecalciferol (PC Code 202901), strychnine (PC Code 076901), and zinc phosphide (ZnP; PC Code 088601). 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"[2]); 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). This 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 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) based risk assessments (USEPA, 2020a – 2020e) and analyses completed for three pilot listed species[3] (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). At that time, EPA took comment on additional proposed mitigations to protect non-target species.

In this draft BE, for every listed species and CH, EPA determined whether each of the 11 rodenticides will have NE or MA of 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. For those listed species CHs where EPA determined that rodenticides are likely to adversely affect one or more individuals or the CH, EPA also included in its effects determinations its prediction of the potential likelihood of future jeopardy (J) for a listed species or adverse modification (AM) of a CH (J/AM), consistent with 50 C.F.R. §402.40(b)(1). 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

[1] PC Code=Product Chemistry Code

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

[3] 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.

process more efficient. EPA used information and elements of the draft and final BiOp for malathion (USFWS, 2021 and USFWS, 2022), and USFWS BiOps for rodenticides (USFWS, 1993 and USFWS, 2012) as a guide in this assessment to assist EPA in predicting those species and CHs where USFWS is likely to determine that the use of any of the 11 rodenticides results in a likelihood of future J/AM. Details on the method, models, and tools used for making NE, NLAA, LAA and predictions of the potential likelihood of future J/AM are in **Section 2** of this draft BE. While EPA predicted potential likelihood of future J/AM as part of its effects determinations, the Services make the final J/AM findings in any BiOp they issue at the end of the consultation process.

Summary of Effects Determinations Including Predicted Potential Likelihood of Future Jeopardy and Adverse Modification

The general (*i.e*, non-species specific) FIFRA ecological risk assessments for the RR of the 11 rodenticides concluded that use of these pesticides may pose a likelihood of mortality to non-target mammals and birds that may consume treated bait (referred to as "primary consumers"). Many rodenticides also may pose a risk to animals that prey upon or scavenge animals that have consumed bait (*e.g.,* birds of prey and carnivorous mammals; referred to as "secondary consumers"). In general, no effects are anticipated for aquatic species (or species in the aquatic food web) that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects.

For purposes of species effects determinations, EPA first grouped each of the 11 active ingredients by mode of action (*e.g.,* anticoagulants, neurotoxins) and then further grouped by use pattern (*i.e.,* bait station, 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 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. EPA further evaluated the LAA species and made predictions about the potential likelihood of future jeopardy based on current label restrictions (*see* **Section 2** for details). The effects determinations for listed species are summarized in **Tables E-1 and E-2**.

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

Taxon	Number of Species	NE	Initial Taxon-Level NLAA Determinations across all A.I.'s
Mammals	98	24	21
Birds	95	25	28
Amphibians[3]	45	11	22
Reptiles	53	23	1
Terrestrial Invertebrates	161	161	0
Aquatic Invertebrates	187	187	0
Plants	946	946	0
Fish	199	199	0
Total	**1,784**	**1,576**	**72**

[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.**

[2] Reflects listed species current as of April 2023 and delisting of several of those species as of October 2023. 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

Table E-2. Number of Listed Species Effects Determinations Including Predictions of the Potential Likelihood of Future Jeopardy by Taxon[1,2]

Taxon	Number of Species	NE	Specific Determinations and Predictions Across Use Patterns and by A.I. or group											
			Bait Station			Burrow			Broadcast			Feral Hog Bait Station		
			NLAA	LAA, No J	LAA, J	NLAA	LAA, No J	LAA, J	NLAA	LAA, No J	LAA, J	NLAA	LAA, No J	LAA, J
First Generation Anticoagulant Rodenticides (FGARs)[3]														
Mammals	**98**	**24**	**30**	**23**	**21**	**24**	**19**	**31**	**21**	**16**	**37**	**65**	**8**	**1**
Birds	**95**	**25**	**54**	**9**	**7**	**54**	**15**	**1**	**28**	**24**	**18**	**68**	**0**	**2**
Amphibians[5]	**45**	**11**	**34**	**0**	**0**	**29**	**5**	**0**	**22**	**12**	**0**	**34**	**0**	**0**
Reptiles	**53**	**23**	**16**	**10**	**4**	**16**	**14**	**0**	**1**	**24**	**5**	**29**	**1**	**0**
Second Generation Anticoagulant Rodenticides (SGARs)[4]														
Mammals	**98**	**24**	**30**	**23**	**21**	N/A[6]	N/A[6]	N/A[6]	N/A	N/A	N/A	N/A	N/A	N/A
Birds	**95**	**25**	**54**	**9**	**7**	N/A[6]	N/A[6]	N/A[6]	N/A	N/A	N/A	N/A	N/A	N/A
Amphibians[5]	**45**	**11**	**34**	**0**	**0**	N/A[6]	N/A[6]	N/A[6]	N/A	N/A	N/A	N/A	N/A	N/A
Reptiles	**53**	**23**	**16**	**10**	**4**	N/A[6]	N/A[6]	N/A[6]	N/A	N/A	N/A	N/A	N/A	N/A
Bromethalin														
Mammals	**98**	**24**	**30**	**24**	**20**	**24**	**20**	**30**	N/A	N/A	N/A	N/A	N/A	N/A
Birds	**95**	**25**	**54**	**16**	**0**	**54**	**16**	**0**	N/A	N/A	N/A	N/A	N/A	N/A
Amphibians[5]	**45**	**11**	**34**	**0**	**0**	**29**	**5**	**0**	N/A	N/A	N/A	N/A	N/A	N/A
Reptiles	**53**	**23**	**16**	**14**	**0**	**16**	**14**	**0**	N/A	N/A	N/A	N/A	N/A	N/A
Cholecalciferol														
Mammals	**98**	**24**	**30**	**24**	**20**	N/A[6]	N/A[6]	N/A[6]	N/A	N/A	N/A	N/A	N/A	N/A
Birds	**95**	**25**	**70**	**0**	**0**	N/A[6]	N/A[6]	N/A[6]	N/A	N/A	N/A	N/A	N/A	N/A
Amphibians[5]	**45**	**11**	**34**	**0**	**0**	N/A[6]	N/A[6]	N/A[6]	N/A	N/A	N/A	N/A	N/A	N/A
Reptiles	**53**	**23**	**30**	**0**	**0**	N/A[6]	N/A[6]	N/A[6]	N/A	N/A	N/A	N/A	N/A	N/A
Strychnine														
Mammals	**98**	**24**	N/A	N/A	N/A	**24**	**20**	**30**	N/A	N/A	N/A	N/A	N/A	N/A
Birds	**95**	**25**	N/A	N/A	N/A	**58**	**12**	**0**	N/A	N/A	N/A	N/A	N/A	N/A
Amphibians[5]	**45**	**11**	N/A	N/A	N/A	**29**	**5**	**0**	N/A	N/A	N/A	N/A	N/A	N/A
Reptiles	**53**	**23**	N/A	N/A	N/A	**18**	**12**	**0**	N/A	N/A	N/A	N/A	N/A	N/A
Zinc Phosphide														
Mammals	**98**	**24**	**24**	**19**	**31**	**24**	**19**	**31**	**21**	**21**	**32**	N/A	N/A	N/A
Birds	**95**	**25**	**54**	**16**	**0**	**54**	**16**	**0**	**28**	**16**	**26**	N/A	N/A	N/A
Amphibians[5]	**45**	**11**	**34**	**0**	**0**	**29**	**5**	**0**	**22**	**12**	**0**	N/A	N/A	N/A
Reptiles	**53**	**23**	**16**	**14**	**0**	**16**	**14**	**0**	**6**	**24**	**0**	N/A	N/A	N/A

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.**

[2] Reflects listed species current as of April 2023 and delisting of several of those species as of October 2023. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction.

[3] FGARs are chlorophacinone, diphacinone (and its sodium salt), and warfarin (and its sodium salt).

[4] SGARs are brodifacoum, bromadiolone, difenacoum and difethialone.

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

[6] 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.

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

For each CH, a single effect determination was made for the 11 rodenticides collectively, without consideration of specific chemical or use pattern. EPA further evaluated the LAA CH determinations and made predictions about the potential likelihood of future adverse modification based on essential physical and biological features (PBFs) related to habitat quality for species that utilize small mammal burrows and rely on small mammal prey (*see* **Section 2.7** for details). EPA could refine the AM predictions to be pesticide or use pattern specific, if needed, in the future. The predictions of the potential likelihood of future adverse modification are summarized in **Table E-3**.

EPA considered 1,784 total species (**Table E-1**) and made NE determinations for all aquatic and terrestrial plants, aquatic and terrestrial invertebrates, and aquatic vertebrates for which no direct effects or effects on prey, pollination, habitat or dispersal (PPHD) are expected from the use of the 11 rodenticides (*see* **Section 3.1.1**). EPA made NE determinations for all species under the jurisdiction of NMFS because no consequences relevant to direct toxicity of these species or their PPHD are expected from the use of these rodenticides.

For vertebrates other than fish, EPA considered 98 mammal, 95 bird, 45 amphibian, and 53 reptile species (**Table E-1** and **E-2**). EPA determined 83 of the vertebrate species (other than fish) to be NE (24 mammals, 25 birds, 11 amphibians, and 23 reptiles) because exposure was not expected due to dietary, behavioral, or habitat factors. Therefore, EPA determined 208 non-fish vertebrate species to be MA. From those MA species, EPA then determined that 72 species were NLAA for all 11 rodenticides for various reasons detailed in **Appendix B**. Due to differential toxicity and exposure profiles of the 11 rodenticides, EPA then made refined (*i.e.,* chemical/use specific) species determinations for the remaining 136 MA species (*i.e.,* those not initially determined to be NE or NLAA for all 11 rodenticides) by considering use (bait station, broadcast, or burrow application) and the type of effects of each particular rodenticide (**Table E-2**). Therefore, the number of NLAA determinations for those species varied depending on the labeled use pattern and chemical (**Table E-2**). Specific justifications for the determination of NLAA, LAA/predictions of potential no likely future jeopardy, and LAA/predictions of potential of likely future jeopardy are found in **Appendix B**.

EPA considered 904 CH in this BE of the 11 rodenticides (**Table E-3**). EPA determined that 857 of the CH are NE (all plants, invertebrates, and fish and some mammals, birds, reptiles, and amphibians). A total of 47 species CH, all vertebrates, were determined to be MA and of those, 9 were determined to be NLAA and 38 were determined to be LAA. Specific justifications for the determination of NLAA, LAA/predictions of potential no likely future adverse modification, and LAA/predictions of potential of likely future AM are found in **Appendix B**.

In total, EPA predicted the potential likelihood of future jeopardy for 73 species and the potential likelihood of future AM for 4 CHs. EPA predicted the potential likelihood of future jeopardy for 24 mammal species for bait station use, 31 for burrow use, and 35 for broadcast applications. For birds, EPA predicted 6 species with the potential likelihood for future jeopardy from bait station use, one for burrow use, and 30 for broadcast applications. For reptiles, EPA predicted the potential likelihood of future jeopardy for 4 species from bait station use, and one species for broadcast applications. EPA predicted there is not a potential likelihood for future jeopardy for any of the listed amphibians as detailed in each of the chemical chapters and in **Appendix B**. Only warfarin is labeled for use to control feral hogs. EPA evaluated this use separately because the associated bait stations are designed to target feral hogs (rather than rodents) and to exclude smaller non-target species. As a result, the exposure pathways for this use are quite different compared with bait stations designed to control rodents.

Table E-3. Number of Critical Habitats Effect Determinations and Predictions of the Potential Likelihood of Future Adverse Modification by Taxon[1]

Taxon	Number of Species with Critical Habitat	NE	NLAA	LAA/No AM	LAA/AM
Mammals	46	30	2	14	0
Birds	33	25	3	3	2
Amphibians[2]	33	18	1	13	1
Reptiles	22	14	3	4	1
Terrestrial Invertebrates	64	64	0	0	0
Aquatic Invertebrates	102	102	0	0	0
Plants	482	482	0	0	0
Fish	122	122	0	0	0
Total	**904**	**857**	**9**	**34**	**4**

[1] Reflects species with CH as of April 2023.

[2] "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; AM = adverse modification; no AM = no adverse modification

Only species that included feral hogs as a part of their diet, either live or as carrion, have an exposure pathway to the warfarin bait station use to control feral hogs. In total, EPA predicted the potential likelihood of future jeopardy for three species for this use pattern (2 birds and 1 mammal; these counts are included in the bait station numbers above).

EPA based the species effects determinations and CH effects determinations in this draft BE solely on existing approved labels (*i.e.*, they do not consider the proposed mitigations identified in the 4 PIDs associated with the 11 rodenticides (USEPA, 2022a – 2022d) or the pilot memo (USEPA, 2022e)). EPA is proposing a Rodenticide Strategy (mitigations) as part of this draft BE that focuses on reducing exposures of listed species to 11 rodenticides[4]. This strategy focuses on reducing exposures so that EPA's predictions of the potential likelihood of future Jeopardy for listed species and potential likelihood of future Adverse Modification (AM) for CHs based on current uses and label restrictions in this draft BE would not be likely. The proposed mitigation measures are also intended to minimize take of those species where EPA made LAA determinations. This strategy proposes mitigation measures to address exposure routes of concern for bait station, in-burrow, and broadcast application methods. The proposed mitigation measures include measures to "avoid" or "minimize" exposure, as defined by the ESA Consultation Handbook[5]. No "offsets" are proposed at this time; however, EPA is open to considering proposals regarding how offsets may be utilized for rodenticides.

As noted previously, the mitigation measures proposed in the 4 PIDs and the pilot memo were available for public comment, and as the EPA continues to consider those comments, the Agency may further refine the proposed mitigations in the Rodenticide Strategy. During the public comment period on this draft BE, EPA seeks feedback on the effectiveness of the measures proposed in this BE, for reducing the potential for exposure to listed species and their CHs, feasibility, and enforceability of these measures.

Additionally, as described earlier, EPA intends to continue discussing the draft effects determinations and mitigation options in this draft BE with USFWS prior to finalizing the BE, which is scheduled for November 2024. In addition, EPA may also revise the mitigation measures proposed for the Rodenticide Strategy to protect listed species and their CH in this BE after receiving feedback from other state and federal co-regulators, and other stakeholders.

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.

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

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

1 Background

1.1 Nature of the Regulatory Action

This draft BE presents EPA's determinations for the effects of 11 rodenticides on listed species and CH in the U.S. and its territories[6]. EPA first grouped each of the 11 rodenticides and assessed them according to their modes of action. The three FGARs are chlorophacinone, diphacinone (and its sodium salt), and warfarin (and its sodium salt). The four 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, 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 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. For each CH, a single effect determination was made for the 11 rodenticides collectively, without consideration of specific chemical or use pattern.

This 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 NE and MA determinations for species and CH; the latter being further refined to NLAA or LAA. For LAA species, EPA presents its predictions of the potential likelihood of future jeopardy or not likely future jeopardy for USFWS consideration. For LAA CH, EPA presents its predictions for the potential likelihood of future AM and not likely future AM for USFWS consideration. 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 proposing a Rodenticide Strategy (mitigations) as part of this draft 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 Jeopardy for listed species and potential likelihood of future AM for CHs based on current uses and label restrictions in this draft BE would not be likely. The proposed mitigation measures are also intended to minimize take[7] of those species where EPA made LAA determinations. The proposed mitigation measures include measures to "avoid" or "minimize"

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

[7] 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]

exposure, as defined by the ESA Consultation Handbook[8]. No "offsets" are proposed at this time; however, EPA is open to considering proposals regarding how offsets may be utilized for rodenticides.

As noted previously, the mitigation measures proposed in the 4 PIDs and the pilot memo were available for public comment, and as the EPA continues to consider those comments, the Agency may further refine the proposed mitigations in the Rodenticide Strategy. Additionally, EPA intends to continue discussing the draft effects determinations and mitigation options in this draft BE with USFWS prior to finalizing the BE. EPA may also revise the mitigation measures proposed for the Rodenticide Strategy to protect listed species and their CH in this BE after receiving feedback from other state and federal co-regulators, and other stakeholders. **Section 5** describes the proposed mitigation measures.

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), bromethalin, and strychnine 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 will conduct ESA consultation with USFWS and NMFS and will present a completed BiOp to EPA before any of these projects are added to their labels; therefore, these projects are not otherwise included in this nationwide draft BE and rodenticide mitigation strategy.

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

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

Island	Specific Site
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 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 draft 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 jeopardy 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 draft 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 4 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 draft 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 for the CH of the California condor. EFED predicted the potential likelihood of future jeopardy 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 draft BE.

Table 1-2. Draft FIFRA- and ESA-based Risk Assessments for the RR of the 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 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 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 and are rather specific to states in the CONUS. Therefore, broadcast use of these FGARs is not anticipated on islands.

2 Effects Determination Methodology

2.1 Overview

In this draft BE,[9] EPA evaluated whether the registrations of the 11 rodenticides pose potential effects to listed species and CH[10] that are within the action area.[11] The 1,784 listed species and 904 CHs assessed in the draft BE were current as of April 2023 after accounting for delisting of several of those species as of October 2023.[12]

One component of making an effects determination is comparing where species are located to see if they overlap with areas where these rodenticides are used, referred to as an overlap analysis. In some cases, data were not available. First, EPA used the spatial dataset available as of February 2022[13]; therefore, overlap is not available for species and CH that were listed or proposed for listing after that date (between February 2022 and April 2023). Second, the Services have not developed a spatial file that is representative of all species ranges and CH. In both cases, EPA did not include overlap analyses to make its effects determinations or predictions of J/AM for those species and CH.

EPA used the best available information in making the effects determinations, which reflect possible effects to individuals of a species or their CH. For this analysis, EPA considered direct effects to the species and effects on PPHD. The term "direct effects" refers to decreases in the survival, growth, or

[9] 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."

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

[11] 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.

[12] https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction

[13] Spatial dataset contains range and critical habitat data 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.

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 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 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 predicted whether there is a potential likelihood of future jeopardy 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 other 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. A 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 draft BE. The primary and secondary exposure concerns for each listed species and CHs are included in **Appendix B**.

[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.

2.2 Exposure Considerations

The FIFRA-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 concern 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 FIFRA-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 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), bromethalin, strychnine, and zinc phosphide 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 FIFRA-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) take up to a week 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 require multiple feedings (USEPA, 2011). Multiple lines of evidence support these FIFRA-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 routed 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 stations 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 draft 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 many 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 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 FIFRA-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 soil dwelling invertebrates as a secondary route of exposure is extremely unlikely to cause adverse effects to individual listed species because incidental consumption of rodenticides through soil dwelling invertebrates has a low likelihood to occur, 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. 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	Yes[1]	Yes[1]	Yes	Yes	Yes	Yes
SGARs	Yes	Yes	NA	NA	NA	NA
Zinc Phosphide	Yes	No	Yes	No	Yes	No
Bromethalin	Yes	No	Yes	No	NA	NA
Cholecalciferol	Yes[2]	No	NA	NA	NA	NA
Strychnine	NA	NA	Yes	Yes	NA	NA

[1] Includes Feral Hog bait station use (warfarin)

[2] Mammals only

NA = not applicable

2.3 Action Area

The action area is inclusive of 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 US 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 (*see* **Table 2-2**) for the Rodenticide UDL Crosswalk and selection of UDLs). 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), currently 2012-2017 (*see* **Appendix D** 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 label 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 D**. 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

Use	Rodenticide	UDLs Considered
Bait Stations	FGARs SGARs Bromethalin Cholecalciferol Zinc Phosphide	Open Space Developed Developed
Broadcast	FGARs Chlorophacinone Diphacinone Zinc Phosphide	Cultivated Rangeland Pasture Right-of-Way Nurseries Managed Forest Christmas Trees Forest Trees
Burrow	FGARs Strychnine Zinc Phosphide	
Feral Hog Bait Station Use	Warfarin	Pasture Rangeland Managed Forest Forest Trees Christmas Trees

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 D**). Due to the broad scope of labeled rodenticide uses, EPA did not implement further usage refinements. For many of the uses assessed, the actual area of use is expected to be less than the entire UDL, so effects predicted in this assessment may be greater than occurs from actual use.

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.

2.4.1 Identifying Listed Species or CHs within the Action Area

EPA used spatial data representing the listed species range and CH locations provided by the USFWS and NMFS as of February 16, 2022 (USFWS, 2022). 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 where effects are reasonably expected to occur for each of the UDLs. A species 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.

[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.

Given the categorical and temporal aggregations of UDLs described in **Appendix D** (*i.e.,* the UDLs may contain more than one crop and are based on 5 years of data aggregated from 2013-2017), 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 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 since 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 D** 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[17] of the available UDLs, if the resulting maximum overlap is <1%[18] 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 the Agency. 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 RR PIDs associated with the 11 rodenticides (USEPA, 2022a – 2022d) and reflected

[17] 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%.
[18] 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%.

available incident information, as of March 2020. This draft 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 potential for take, as defined by the ESA. EPA considered each incident in the making the initial effects determinations.

2.6 Method Used for Listed Species Effects Determinations and 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 NE and MA Determination Methodology

EPA first made generic 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.[19] 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**) for species within these taxa.

There are 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 $\leq$ 1% across all UDLs,
- Species consumes aquatic-based food items or is a marine species,
- 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 NLAA and 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 generic 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

[19] 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%.

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,[20]
- 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**), then EPA then considered additional refinements. For species that could be impacted if 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[21], or
- applications are intended to be made to active target best 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,

[20] 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).
[21] 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 private. comm 8/28/2023).

- 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 1 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 >1% for at least one UDL and exposure is reasonably expected to occur and lead to a potential adverse effect.

For the species where EPA made LAA determinations, EPA completed additional analyses to predict the potential likelihood of future jeopardy. EPA's approach to predicting the potential likelihood for future jeopardy 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, the Agency then predicted the potential likelihood of future jeopardy 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 jeopardy predictions is included in this assessment to better inform any needed mitigation discussions prior to completion of a final BE and during any consultation with the USFWS. 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 jeopardy, 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; however, at this time, no mitigations above and beyond what is on current labels, including those proposed in the 4 PIDs and the pilot memo, have been agreed upon and formalized with commitment letters. 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 jeopardy 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 jeopardy for species from the registered uses of 11 rodenticides.[22] Although the USFWS malathion BiOp was finalized (USFWS, 2022), EPA used the draft BiOp because the final BiOp contained a no jeopardy opinion and the draft BiOp includes examples of species where

[22] 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.

USFWS proposed to find draft potential likelihood of future jeopardy. For purposes of the rodenticide BE, the USFWS 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 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 future jeopardy. Finally, EPA met regularly with the USFWS for informal consultation and technical assistance during the development of the draft BE, which informed the methodology and decision-making processes for species determinations and predictions of the potential likelihood of future jeopardy.

EPA predicted the potential likelihood of future jeopardy by primarily relying upon overlap[23] and MoE.[24] 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 likely future jeopardy (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 and relevant risk modifiers), EPA predicted no J. If there were no modifiers that decreased the likelihood of effects or degree of overlap, EPA predicted likely future jeopardy. 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 jeopardy for the rodenticides. EPA may revisit the impact of species vulnerability in predicting the potential likelihood of future jeopardy 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.

[23] Referred to by USFWS as "usage"
[24] Referred to by USFWS as "risk"

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

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 reproductive endpoint. In addition, species diet is made up of a large proportion of rodent prey. For mammals, single day feeding resulted in medium acute RQs (0.8 to 1.7) for chlorophacinone and diphacinone, and medium to high acute RQs (4.0 to 8.7) for warfarin. Multiple day feeding resulted in acute RQs of 5 to 11 for chlorophacinone (*i.e.*, high MoE), 4.7 to 10 for diphacinone (up to high MoE) and high MoE for warfarin (RQs 24 to 51).
	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 reproductive endpoint. For birds, multiple day feeding acute RQs for the FGARS are lower than for mammals (for ~20g passeriform birds: chlorophacinone RQ = 0.43, diphacinone RQ = 0.4, and warfarin RQ = 2.0). These RQs are based on the median lethal dose (LD_{50}) and so are not meant to be representative of population-level effects.
	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 for multiple day feedings for brodifacoum and difethialone range from 52-168 & RQs for bromadiolone and difenacoum range from 0.12-1.5 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 of 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 February 16, 2022, there are 904 species with CHs included in this assessment. Among those, there are 134 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 USFWS and NMFS.

EPA made CH determinations for the entire chemical class (*i.e.,* the 11 rodenticides) as a whole because effects to both habitat and loss of mammalian prey (details discussed below) are generally similar across all rodenticides. EPA based the CH determination on effects (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, are subject to overlap considerations specific to that CH.

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 adverse modification, 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 of a taxa basis 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 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 and 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* plant worksheet in **Appendix B**). EPA made NE determinations for the three species that rely on mammals since the first plant (Higuero de sierra, *Crescentia portoricensis*) specifically relies on bats. Since EPA made a 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 such to go unnoticed 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 plant worksheet in **Appendix B**.

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 based the 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 draft BE. NE determinations were made for all aquatic animals (USEPA, 2020a-2020e). Effects determinations for aquatic animals can be found in the fish, mammal, amphibian, reptile, and aquatic invertebrate worksheets in **Appendix B**.

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 invertebrate worksheet in **Appendix B**.

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

EPA made a 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 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 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	98	24	21
Birds	95	25	28
Amphibians[3]	45	11	22
Reptiles	53	23	1
Terrestrial Invertebrates	161	161	0
Aquatic Invertebrates	187	187	0
Plants	946	946	0
Fish	199	199	0
Total	**1,784**	**1576**	**72**

[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.**

[2] Reflects listed species current as of April 2023 and delisting of several of those species as of October 2023. 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, bioaccumulation potential as well as the use profile including where the chemical is used and 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 bird 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.[25] Effects determinations for reptiles can be found in the reptile worksheet in **Appendix B**.

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 preferential feed on live moving prey and are unlikely to eat the bait directly. In addition, it is 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 amphibian worksheet in **Appendix B**.

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 mammal worksheet in **Appendix B**.

3.1.4 Overview of Initial 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 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

[25] 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** provides a detailed justification for the NE, NLAA, LAA, and predicted likelihood of potential future jeopardy 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 jeopardy, and LAA determinations with predictions of likely future jeopardy 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[26] 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 of time 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.

[26] 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 mammals, single day feeding resulted in medium acute RQs (0.8 to 1.7) for chlorophacinone and diphacinone, and medium to high acute RQs (4.0 to 8.7) for warfarin. Multiple day feeding resulted in acute RQs of 5 to 11 for chlorophacinone, 4.7 to 10 for diphacinone, and 24 to 51 for warfarin. For birds, multiple day feeding acute RQs for the FGARS are lower than for mammals (for ~20g passeriform birds: chlorophacinone RQ = 0.43, diphacinone RQ = 0.4, and warfarin RQ = 2.0). These RQs are based on the median lethal dose (LD_{50}) and so are not meant to be representative of population-level effects. 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 and 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 2000 incidents associated with the use of rodenticides recorded in the IDS and 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 AR 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 Anticoagulant 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).

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.

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 "bird" 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 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 43 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 jeopardy for 7 listed bird species for FGAR bait station uses. These species were determined to be LAA with a prediction of likely future jeopardy 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 jeopardy 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 jeopardy 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 jeopardy 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 jeopardy for 15 listed bird species for FGAR (chlorophacinone and diphacinone) burrow uses. The reasons for the not likely future jeopardy 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 jeopardy for 18 listed bird species for the FGARs chlorophacinone and diphacinone broadcast uses. These species were determined to be LAA with likely predicted future jeopardy 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 jeopardy for 5 listed bird species.

EPA made LAA determinations but did not predict the potential likelihood of future jeopardy for 24 listed bird species for FGAR (*i.e*., chlorophacinone and diphacinone) broadcast uses. The reasons for predicted no likely future jeopardy 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 jeopardy for listed birds can be found in the bird 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 53 reptile species for exposure to FGARs from bait station, burrow, and broadcast uses. Of these, EPA determined 23 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** following methodology in **Section 2.6.2.** MoE risk modifiers used for the predictions of potential likely future jeopardy are described in **Section 2.6.3.**

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

Use Pattern	NLAA	LAA, No J	LAA, J
Bait Station	16	10	4
Feral Hog Bait Station (Warfarin)	29	1	0
Burrow (Chlorophacinone and Diphacinone)	16	14	0
Broadcast (Chlorophacinone and Diphacinone)	1	24	5

NLAA Determinations (Bait Station Use)

EPA made NLAA determinations for 16 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 29 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 16 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 29 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 jeopardy for 4 listed reptile species for FGAR bait station uses J because they had high or medium MoE from FGARs and high overlap with FGAR UDLs.

EPA made LAA determinations but did not predict the likelihood of jeopardy 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 jeopardy 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 jeopardy determinations for 14 listed reptile species for the FGARs chlorophacinone and diphacinone burrow uses. The reasons for the predicted not likely future jeopardy 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 jeopardy for 5 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 jeopardy 24 listed reptile species for the FGAR chlorophacinone and diphacinone broadcast uses. The reasons for the not likely future jeopardy 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 jeopardy for listed reptiles can be found in the bird worksheet in **Appendix B** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.1.6 Amphibians

EPA considered 45 amphibian species for exposure to FGARs from bait station, burrow, and broadcast uses. Of these, EPA determined 11 to be NE because of lack of exposure (aquatic lifestyle). **Table 3-4** summarizes the effect determinations for the FGRAs. 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** following methodology in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

Table 3-4. Summary of Draft 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	34	0	0
Feral Hog Bait Station (Warfarin)	34	0	0
Burrow (Chlorophacinone and Diphacinone)	29	5	0
Broadcast (Chlorophacinone and Diphacinone)	22	12	0

NLAA Determinations (Bait Station Use)

EPA made NLAA determinations for 34 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 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 34 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 29 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 22 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 jeopardy 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 jeopardy 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 jeopardy for listed amphibians can be found in the bird worksheet in **Appendix B** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.1.7 Mammals

EPA considered 98 mammalian species for exposure to FGARs from bait station, burrow, and broadcast uses. Of these, EPA determined 24 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** following methodology in **Section 2.5**. MoE risk modifiers followed the methods in **Section 2.6.3**.

Table 3-5. Summary of Draft 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	23	21
Feral Hog Bait Station (Warfarin)	65	8	1
Burrow (Chlorophacinone and Diphacinone)	24	19	31
Broadcast (Chlorophacinone and Diphacinone)	21	16	37

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 65 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 unlikelihood 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 44 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 because of the potential to consume feral hogs.

LAA Determinations (Chlorophacinone and Diphacinone Burrow Use)

EPA made LAA determinations for 50 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 53 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 jeopardy for 21 listed mammals for FGAR bait station uses because they had high MoE from FGARs and high or medium

overlap with FGAR UDLs. 20 of these species are rodents who are 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 jeopardy for 23 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 jeopardy for one listed mammal species from feral hog bait station use of warfarin. EPA predicted the potential likelihood of future jeopardy for the Florida Panther (*Puma (=Felis) concolor coryi*) due to a diet that consists substantially (21% of its diet) of feral hog.[27] The prediction of the potential for likely future jeopardy 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 jeopardy 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.

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

EPA made LAA determinations and predicted likely for potential future jeopardy for 31 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 jeopardy for 19 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.

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

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

EPA made LAA determinations and predicted the potential for likely future jeopardy for 37 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 jeopardy for 16 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 FGARs UDLs.

EPA's predictions of the potential likelihood of future jeopardy and justifications for listed mammals can be found in the mammal worksheet in **Appendix B** 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 jeopardy 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	**98**	**30**	**23**	**21**	**24**	**19**	**31**	**21**	**16**	**37**	**65**	**8**	**1**
Birds	**95**	**54**	**9**	**7**	**54**	**15**	**1**	**28**	**24**	**18**	**68**	**0**	**2**
Amphibians[3]	**45**	**34**	**0**	**0**	**29**	**5**	**0**	**22**	**12**	**0**	**34**	**0**	**0**
Reptiles	**53**	**16**	**10**	**4**	**16**	**14**	**0**	**1**	**24**	**5**	**29**	**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.**

[2] Reflects listed species current as of April 2023 and delisting of several of those species as of October 2023. 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 draft 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 draft 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[28] 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 (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 jeopardy 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, 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 jeopardy 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.

[28] 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 jeopardy.

EPA determined that the remaining 7 species were LAA and predicted the potential likelihood for future jeopardy 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 Draft Effects Determinations and Predictions of Potential Likelihood of Future Jeopardy for Listed Birds within the Action Area

Draft Effects Determination/Predicted Potential Likelihood of Future Jeopardy Prediction	No. Listed Species	Rationale
NE	Birds 25	Marine species, species in the aquatic food web, arboreal species, extinct species
NLAA	Birds 54	Excluded from bait stations by body size, or behaviorally unlikely to enter bait station
LAA-Predicted no likely future jeopardy	Birds 9	Not likely to consume rodents, or have varied diet
LAA – Predicted likely future jeopardy	Birds 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 53 listed reptiles for the SGAR bait station uses. Toxicity data for birds were used as a surrogate for reptiles. Of the 53 listed reptiles, EPA determined 23 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 14 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 jeopardy 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 jeopardy based on high MoE, medium or high overlap with the SGAR because of their fully aquatic life cycles.

NLAA Determinations (Amphibian)

EPA considered 45 listed amphibian species. Of these, EPA determined 11 were NE based on their fully aquatic life cycle. Thirty-four (34) 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 Draft Effects Determinations and Predictions of Potential Likelihood of Future Jeopardy for Listed Reptiles/Amphibians within the Action Area.

Draft Effects Determination/Prediction of Potential Likelihood of Future Jeopardy Prediction	No. Listed Species	Rationale
NE	Amphibians 11	Fully aquatic life cycle
	Reptiles 23	Not exposed (marine species), in aquatic food web, or terrestrial consumers of vegetation or invertebrates

Draft Effects Determination/Prediction of Potential Likelihood of Future Jeopardy Prediction	No. Listed Species	Rationale
NLAA	Amphibians 34	Only incidental consumption of bait or invertebrates
	Reptiles 16	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 jeopardy	Reptiles 10	Low Overlap
LAA – Predicted likely future jeopardy	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 98 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 74 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 44 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 44 LAA species, EPA predicted the potential likelihood for future jeopardy for 23 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 21 LAA species, EPA did not predict the potential likelihood of future jeopardy 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 jeopardy for the SGARs.

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

Draft Effects Determination/ Predictions of Potential Likelihood of Future Jeopardy Prediction	No. Listed Species	Rationale
NE	Mammals 24	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 jeopardy	Mammals 23	Mammals too large to enter a bait station or not consumers of mammals
LAA – Predicted likely future jeopardy	Mammals 21	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

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	98	24	30	23	21
Birds	95	25	54	9	7
Amphibians[3]	45	11	34	0	0
Reptiles	53	23	16	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.**

[2] Reflects listed species current as of April 2023 and delisting of several of those species as of October 2023. 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[29] 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, with the exception of 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 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).

[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.

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" 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 private. 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 jeopardy 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 jeopardy 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, with the exception of 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 16 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 34 listed amphibian species from bait station uses and made NLAA determinations for 29 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

All 14 reptile species for which EPA determined LAA from bromethalin exposure, EPA predicted to have no likely future jeopardy. EPA predicted these reptile species as unlikely to experience adverse effects from bromethalin to the point of jeopardy 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 jeopardy. EPA predicted these amphibian species as unlikely to experience adverse effects from bromethalin to the point of jeopardy 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** 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.

3.2.3.6 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 44 mammals, based on the potential for primary exposure to bromethalin through direct consumption of the ai. 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 jeopardy for 24 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 jeopardy for 20 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 jeopardy predictions for the 20 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 jeopardy determinations for 20 listed mammals for bait station uses, and for 30 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 jeopardy 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 jeopardy 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 jeopardy 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** 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.

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	98	24	75	22	53	30	24	20	24	20	30
Birds	95	25	84	41	43	54	16	0	54	16	0
Amphibians[3]	45	11	34	0	0	34	0	0	29	5	0
Reptiles[3]	53	23	30	1	29	16	14	0	16	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.**

[2] Reflects listed species current as of April 2023 and delisting of several of those species as of October 2023. 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[30] 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.

[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.

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" 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 private. comm 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 jeopardy. 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 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 jeopardy for listed birds can be found in the bird 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 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[31] to all animal taxa (birds, mammals, 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 (aquatic amphibians and reptiles were determined to be NE due to a lack of aquatic exposure).

NLAA Determinations

EPA made NLAA determinations for 18 reptile and 29 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. determined as NLAA 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 private. comm 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 jeopardy 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 jeopardy. 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.

[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.

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

3.2.4.6 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 20 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 20 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 jeopardy for 30 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 20 listed LAA mammals EPA did not predict the potential likelihood of future jeopardy 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 jeopardy and justifications for listed mammals can be found in the mammal worksheet in **Appendix B** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

Table 3-10 summarizes the number of listed species determinations and predictions of the potential likelihood of future jeopardy for all taxa from cholecalciferol.

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	98	24	24	20	30
Birds	95	25	58	12	0
Amphibians[3]	45	11	29	5	0
Reptiles	53	23	18	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.**

[2] Reflects listed species current as of April 2023 and delisting of several of those species as of October 2023. https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction

"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 the UDL layers, which cover large portions of CONUS and NL 48 (*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 jeopardy were not considered separately for burrow uses.

3.2.5.4 Birds

Based on available acute toxicity studies, cholecalciferol can be considered to essentially non-toxic to birds. In both studies with Bobwhite quail (*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 bird worksheets 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 reptile worksheets in **Appendix B** 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[32] 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 jeopardy 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 jeopardy for mammals can be found in the mammals worksheet in **Appendix B** 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 44 listed mammal species primarily based on similarity to target pest, small body size and the potential to consume mammalian prey.

[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.

Predictions of the Potential Likelihood of Future Jeopardy

Of the 44 total LAA species, EPA predicted the potential likelihood of future jeopardy for 20 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 20 LAA species EPA did not predict the potential likelihood of future jeopardy 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 jeopardy for listed mammals can be found in **Appendix B** 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 jeopardy 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	**98**	**30**	**24**	**20**
Birds	**95**	**70**	**0**	**0**
Amphibians[3]	**45**	**34**	**0**	**0**
Reptiles	**53**	**30**	**0**	**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.**

[2] Reflects listed species current as of April 2023 and delisting of several of those species as of October 2023. 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).

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). 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[33] 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

[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.

might visit the agricultural or other outdoor use sites. Such species are LAA on the basis of exposure of at least one individual.

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 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" 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 jeopardy 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 jeopardy 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 jeopardy 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 jeopardy 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 jeopardy for listed birds can be found in the bird 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[34] 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 jeopardy for listed reptiles and amphibians can be found in **Appendix B** following the methods in Section 2. MoE risk modifiers followed the methods in **Section 2.6.3**.

NLAA Determinations (Bait Stations)

EPA made 34 NLAA determinations for listed amphibian species and 16 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.
- 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 29 NLAA determinations for listed amphibians and 16 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, we anticipate that this species only use their own burrows (USFWS, 1993), and
- Species specifically consumes invertebrates and does not rely on small mammal burrows.

[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.

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 24 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 jeopardy 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 jeopardy 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 24 LAA listed reptiles and 12 LAA listed amphibians, EPA did not predict the potential likelihood of future jeopardy 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 jeopardy and justifications for listed reptiles and amphibians can be found in the reptile worksheet and amphibian worksheet in **Appendix B** following the methods in **Section 2.6**. MoE risk modifiers followed the methods in **Section 2.6.3**.

3.2.6.6 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 44 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 50 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 53 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 44 LAA mammals, EPA predicted the potential likelihood of future jeopardy for 20 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 24 LAA listed mammals, EPA did not predict the potential likelihood for future jeopardy 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 50 LAA determinations for listed mammals, EPA predicted the potential likelihood of future jeopardy for 31 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 19 LAA listed mammals, EPA did not predict the potential likelihood of future jeopardy from zinc phosphide burrow uses. This was based on either low overlap or a low MoE. Of the 19 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 (Burrow)

Of the 50 LAA listed mammals, EPA predicted the potential likelihood of future jeopardy for 31 species from zinc phosphide burrow uses. This was based on a high MoE due to similarity to target pest and a medium or high overlap.

For the remaining 19 species, EPA did not predict the potential likelihood of future jeopardy. 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**).

Predictions of the Potential Likelihood of Future Jeopardy (Broadcast)

Of the 53 LAA listed mammals, EPA predicted the potential likelihood of future jeopardy for 32 species. This was based on a high MoE due to similarity to target pest and a medium or high overlap.
For the remaining 21 listed LAA mammals EPA did not predict the potential likelihood of future jeopardy. 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 jeopardy for listed mammals can be found in **Appendix B** 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 jeopardy 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	98	24	24	19	31	24	19	31	21	21	32
Birds	95	25	54	16	0	54	16	0	28	16	26
Amphibians[3]	45	11	34	0	0	29	5	0	22	12	0
Reptiles	53	23	16	14	0	16	14	0	6	24	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.**

[2] Reflects listed species current as of April 2023 and delisting of several of those species as of October 2023. 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 904 listed species with CHs. Among those, there are 134 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 118, NMFS is responsible for 11, and both Agencies are responsible for the remaining five.

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 adverse modification made for CH are found in the Critical Habitat worksheet in **Appendix B**. 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 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 857 of the species CHs.

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

4.2 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 47 of the species CHs.

The MA determinations and justifications can be found in the Critical Habitat worksheet in **Appendix B** 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 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.** NLAA determinations followed the methodology outlined in **Section 2.7**.

4.2.2 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 38 of the MA species CHs are LAA. Thirty-two 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**. 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 4 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

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 followed the methodology in **Section 2.7**. **Table 4-1** provides a summary of the total number of CHs and the number of CHs with NE, NLAA, LAA/predictions of potential no likely future adverse modification, and LAA/predictions of potential of likely future AM.

Table 4-1. 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	46	30	2	14	0
Birds	33	25	3	3	2
Amphibians[1]	33	18	1	13	1
Reptiles	22	14	3	4	1
Terrestrial Invertebrates	64	64	0	0	0
Aquatic Invertebrates	102	102	0	0	0
Plants	482	482	0	0	0
Fish	122	122	0	0	0
Total	904	857	9	34	4

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

[2] Reflects listed species with CH as of April 2023.

NE = no effect; NLAA = not likely to adversely affect; LAA = likely to adversely affect; AM = adverse modification

5 Proposed Mitigations

5.1 Proposed Mitigation Measures to Reduce the Potential Likelihood of Future Jeopardy and Adverse Modification and to Minimize Take

EPA is proposing a strategy to reduce exposures of listed species to the 11 rodenticides.[35] This Rodenticide Strategy focuses on proposed mitigation measures that have been identified to reduce exposures where EPA made predictions of potential likelihood of future jeopardy for listed species and adverse modification for critical habitats based on current uses and label restrictions in this draft BE. The mitigation measures are also intended to minimize take of those species where EPA made LAA determinations. This strategy proposes 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.[36] 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.

Prior to issuing the draft BE and Rodenticide Strategy, EPA completed the 4 FIFRA proposed interim decisions (PIDs) for the registration review (RR) of the 11 rodenticides 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 4 PIDs are broad (*i.e.*, generally applicable wherever the labels allow their use) protective measures intended to be applied to federal pesticide labels to reduce exposures to humans and non-target species nationally. In addition, it is expected that these proposed measures may reduce exposure to listed species. The draft BE and Rodenticide Strategy reflects current labels. As a result, some of the mitigation measures in this proposed strategy are the same as those in the 4 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 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 jeopardy to these species or adverse modification of their designated critical habitat. However, with the proposed mitigation measures, EPA predicted that there is not a potential likelihood that the use of rodenticides would result in future jeopardy to these species, or adverse modification of their critical habitat. EPA also predicted that these same measures would reduce exposures to other listed species (beyond the 3

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

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

pilot species) and their designated critical habitats predicted to be J or AM by the use of rodenticides in this draft BE (**Table 5-1** below includes those mitigation measures).

The proposed mitigation measures for the three listed species were targeted in specific geographic areas most relevant to each of the species, with the intention to focus the mitigation measures where they are most needed while still retaining 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 to other species as appropriate after evaluating population level effects for all listed species and their critical habitat in the draft BE. Unlike mitigation to further EPA's FIFRA obligations, mitigation to meet its ESA obligations is governed by the ESA standard, which does not include a risk-benefit analysis, even when EPA includes that mitigation through RR.

The rodenticides' PIDs were available for public comment from November 29, 2022, through February 13, 2023, and received over 22,000 comments across the 11 rodenticide dockets. A summary of the major themes expressed in the comments is found below.

- A number of commenters were proponents for strict regulation of rodenticides due to concerns over non-target wildlife exposure, incidents, and concern that not enough is being done to protect listed species.
- Several commenters cited the potential for rodenticide misuse.
- A significant number of comments cited the numerous benefits of rodenticide use, expressing concern that the proposed measures will substantially increase costs of rodent control, access to affordable rodenticides, and users' ability to control infestations.
- The proposed mitigation measure of non-refillable bait stations for consumer products raised concerns regarding the prohibition of refillable bait stations for consumer use, and the impact of single-use plastics.
- Concerns were raised over feasibility and effectiveness of carcass search measures.
- Concerns related to proposing the restricted use designation focused on a current lack of certified applicators in the professional pest applicator and livestock sectors, and the cost of certification, record-keeping, and labor.
- Concerns regarding variability in state regulations (*e.g.*, state specific requirements for certified applicators supervising applications of RUPs and storage requirements for RUPs.
- Many stakeholders expressed concern relating to the proposed field use restrictions for chlorophacinone and diphacinone.

EPA is continuing to consider these comments as part of the ongoing registration review of the rodenticides.

EPA is proposing mitigation measures in this document that the Agency has identified to prevent the potential likelihood of future J for the 74 species predicted to receive those findings and to prevent the potential likelihood of future AM for the four critical habitats that received those findings. The mitigation measures include those proposed in the PIDs, the pilot memo for three species (USEPA 2022e), and new mitigations in this draft BE. After considering public comments on the mitigation options described in this draft BE, EPA will refine the draft mitigation options as it develops the final BE including the mitigation strategy in November 2024. The final BE and mitigation measures in the final strategy will inform relevant ESA consultations with the USFWS (which has jurisdiction over the listed

species for which EPA is proposing a MA finding in this draft BE) as they make these formal findings and should expedite the process. In addition, EPA has been discussing its proposed population-level findings and associated mitigation measures to address these findings with USFWS as it developed the draft BE. This plan will be known as the Rodenticide Strategy that the Agency described in its November 2022 update to its ESA Workplan.

5.2 Description of Mitigation Options

The mitigation measures described below are those that EPA has identified for consideration where EPA has predicted a potential likelihood of future J/AM. After considering public comments on this draft BE and draft Rodenticide Strategy, EPA will refine the mitigation measures. Where broad, national mitigation measures are identified, these measures would be on the general label, and any geographically specific, species-specific mitigation measures would be implemented through the Bulletins Live! Two (BLT) system with a reference to BLT on the product labeling. Additionally, EPA is proposing that the mitigation measures would be specific to the active ingredient, use site, and application method (*i.e.*, bait station, in-burrow, and broadcast). The following three sections outline mitigation measures that EPA is currently considering as part of this draft BE and draft Rodenticide Strategy.

5.3 Rodenticide PID Proposed Mitigation Measures

The following measures were proposed in the rodenticide PIDs as part of their FIFRA registration review. As noted previously, the Agency is currently reviewing the public comments received on these measures and engaging with registrants, federal and state co-regulators, and other stakeholders to refine these mitigation measures, that will then be considered when finalizing the Rodenticide Strategy. Mitigation measures proposed in the PID include:

1. Classifying certain rodenticide products as RUP. This measure would apply to all SGAR, zinc phosphide, and strychnine products. Additionally, this would apply to all FGAR, bromethalin, and cholecalciferol products in packages greater than four pounds. This mitigation is intended to ensure that (non-consumer/professional use) rodenticides are used by trained personnel, thus making misuse and misapplication less likely. This mitigation measure is intended to reduce the potential for both primary and secondary exposure.

2. Packaging for all FGARs, bromethalin, and cholecalciferol products for consumer use would be in quantities of one pound or less and in ready-to-use non-refillable bait stations. This measure aims to prevent the possibility of misuse (*i.e.*, using bait refills to broadcast or for spot treatments) and eliminates the ability for anyone other than certified applicators or handlers under their supervision to use bait refills. This mitigation is intended to reduce the potential for primary exposure.

3. Add Endangered Species Protection Bulletins (BLT) to all rodenticide labels except those that are consumer products. This measure would allow the implementation of any geographically specific, species-specific mitigation measures to minimize effects to listed species and their critical habitats. BLT provides a platform for mitigation instructions that are too detailed for the general label.

4. Prohibit broadcast and spot treatments for turf, lawns, golf courses, campsites, and other recreation areas. This mitigation measure would apply to FGARs and zinc phosphide products that are registered for these use sites. This mitigation measure is intended to reduce the potential for primary exposure.

5. Prohibit broadcast applications to cropped areas, rangeland, pastureland, and fallow land for chlorophacinone and diphacinone. This mitigation measure would reduce the potential for primary exposure.

6. Post-application follow-up statements for carcass search, collection, and disposal, bait-spill or bait kick-out, and dead or dying animal reporting requirements. This mitigation measure would apply to all zinc phosphide and strychnine products, as well as field uses of FGARs, SGARs, bromethalin, and cholecalciferol. Carcass search, collection, and disposal is intended to address secondary exposure by reducing rodenticide exposures of predators and scavengers with a high potential for secondary poisoning. 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. Reporting dead or dying animals to the Agency's website (https:/www.epa.gov/pesticide-incidents) as soon as possible ensures that wildlife incidents are tracked, so that adjustments to the label or bulletin instructions may be made. These mitigation measures were proposed as advisory for structural uses of rodenticides.

Work with registrants to update Terms and Conditions of Registration for all rodenticide products for registrants to develop, implement, and maintain a rodenticide stewardship plan that includes the development of education and outreach materials intended for product users that are made available on registrants' websites. The purpose of these rodenticide stewardship plans is to educate the user on proper rodenticide use and to address potential impacts from the use of these products to non-target organisms, including listed species.

5.4 ESA Pilot Memo Proposed Mitigation Measures

The following are species-specific mitigation measures from the ESA pilot memo within the rodenticide PIDs. As described above, EPA selected three species (SKR, APC, and CC) to represent different routes of exposure. These mitigation measures listed below are intended to be applied to other species for which EPA predicted, in the draft effects determinations, the potential likelihood of future J or AM within their range and/or designated critical habitat, as needed, and are currently expected to be implemented using BLT. The mitigation measures that were proposed in the ESA pilot memo include:

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 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 "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[37].

4. Additional restrictions (i.e., more frequent search intervals) for mandatory carcass searches and disposal within the species' range and/or designated critical habitat. This mitigation is intended to reduce the potential for secondary exposure.

5.5 Updated Listed Species Mitigation Measures for this Draft Rodenticide Strategy

The findings in the draft effects determinations indicate that mitigation measures would be applicable for 73 listed species and four CHs to avoid or further minimize exposure from the rodenticides. The following measures are intended to be applied in geographically specific locations to these species, as needed, depending on factors such as species size and behavior. As described above, EPA proposed to apply some of the mitigation measures in the ESA pilot memo within the species range and/or designated critical habitat. EPA expects to be able to further refine the areas where the location specific mitigation measures would apply, if appropriate, before finalizing the strategy. EPA plans to implement geographically specific mitigations in the final Rodenticide Strategy using BLT.

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 draft strategy could help increase the efficiency of future consultations and acknowledges that some of the mitigation measures may not apply to conservation uses.

The mitigation identified in this draft strategy includes changes to labeling as well as terms and conditions of registrations. EPA would work with the registrants to incorporate the following applicable updated measures that would supersede the measures proposed in the ESA pilot memo described earlier:

1. 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.

[37] 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 measure is no longer being considered as a mitigation option in this draft BE.

2. Prohibiting application directly to water. This prohibition is already included on many labels and this measure 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.

3. Mandatory carcass searches and carcass disposal for SGAR products applied in structural use sites. This mitigation measure is intended to reduce the potential for secondary exposure.

4. 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). FWS 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.

5. Users would need to cover 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 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).

6. Users would need to monitor open burrows for dead animals after below-ground in-burrow applications made in fields and other non-structural use sites. For this mitigation measure users would need to check burrows at specific times depending on the toxicity of the active ingredient. For example, users applying strychnine, zinc phosphide, and bromethalin would need to check burrows between 48 and 96 hours after application to allow for consumption of bait and death. For chlorophacinone, diphacinone, and cholecalciferol, users would need to check burrows between 96 hours and 4 weeks after application to allow for consumption of bait and death. This mitigation measure is intended to reduce exposure to secondary consumers (those that feed on carrion or tertiary consumers).

7. Update Terms and Conditions of Registration for all rodenticide products 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.

Table 5-1 specifies the proposed mitigation options for the draft Rodenticide Strategy applicable by groups of listed species for which EPA made draft “may affect” determinations (mammals, birds, reptiles) for each rodenticide active ingredient/group. The table defines mitigation measures for mammals, birds, and reptiles for which EPA predicted a potential likelihood of future J. The proposed mitigation measures are specific to active ingredient and exposure route (primary - direct consumption of rodenticide or secondary - consumption of poisoned prey) within each listed species group. A short description of each mitigation measure is given at the bottom of the table.

Table 5-1. General Summary of Mitigation Categories by Grouped Species and Rodenticide AI/Group

Rodenticide ai/group	Mammals		Birds		Reptiles	
	Primary	Secondary	Primary	Secondary	Primary	Secondary
FGAR	1, 2, 3, 4, 5, 6, 7, 8	8, 9, 10, 11	1, 3, 4, 5, 6, 7, 8	8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8	8, 9, 10, 11
SGAR	1, 2, 3, 4, 5, 6, 7, 8	8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8	8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8	8, 9, 10, 11
Bromethalin	2, 3, 5, 8, 9	8, 9, 10, 11	2, 3, 5, 8, 9	8, 9, 10, 11	2, 3, 5, 8, 9	8, 9, 10, 11
Cholecalciferol	2, 3, 5	NA	NA	NA	NA	NA
Strychnine	1, 4, 6, 7, 8	8, 9, 10, 11	1, 4, 6, 7, 8	8, 9, 10, 11	1, 4, 6, 7, 8	8, 9, 10, 11
Zinc Phosphide	1, 2, 4, 5, 6, 8	8, 9, 10, 11	1, 2, 4, 5, 6, 8	8, 9, 10, 11	1, 2, 4, 5, 6, 8	8, 9, 10, 11

1 Post-application follow-up to dispose of spilled or kicked-out bait
2 Use of bait stations that exclude listed species by size or behavior
3 Restriction of consumer products to non-refillable bait stations
4 Classification of rodenticides as RUP
5 Placement of bait stations within five feet of structures
6 Prohibition of broadcast and in-burrow uses in areas or at times of the year when listed animals have access to the treated area
7 Do not apply directly to water
8 Establishment of Endangered Species Bulletins to implement specific mitigations needed in limited geographical areas or at times of year to protect particular species
9 Post-application follow-up to report dead or dying animals to EPA's Pesticide Incident Reporting website as soon as possible (https:/www.epa.gov/pesticide-incidents)
10 Post-Application Follow-Up: Carcass Search, Collection, and Disposal statements
11 Prohibition of use in areas or at times of the year when listed secondary consumers might be exposed

NA = Not applicable

Table 5-2 below is a crosswalk that outlines the mitigation measures that were proposed in the anticoagulant, bromethalin/cholecalciferol, strychnine, and zinc phosphide PIDs under FIFRA, the rodenticides' ESA pilot memo, and those mitigation measures that are now being considered in this draft strategy. While some of these mitigations would likely be geographically specific, others would likely be needed across labels.

During the public comment period on this draft Rodenticide Strategy, EPA is interested in receiving feedback on the effectiveness of the measures proposed for reducing the potential for exposure to listed species and their designated critical habitats, as well as the feasibility and enforceability of these measures.

Additionally, as described earlier, EPA intends to continue discussing the draft effects determinations and mitigation options in this draft BE and draft Rodenticide Strategy with USFWS prior to finalizing the BE which is scheduled for November 2024. In addition, EPA may identify revisions to the mitigation measures to protect listed species and their critical habitat after receiving feedback from state and other federal co-regulators, and stakeholders.

Table 5-2. Crosswalk of Mitigation Measures from the Rodenticide PIDs (including the ESA pilot memo) and Draft Rodenticide Strategy

Mitigation Measure	Anticoagulant Rodenticides PID	Bromethalin/ Cholecalciferol PID	Zinc Phosphide PID	Strychnine PID	Draft Strategy
RUP classification	All SGAR products; all FGAR products in packages ≥ 4 lbs.	All bromethalin and cholecalciferol products in packages ≥ 4 lbs.	All ZP products	All strychnine products	Consistent with any future registration review decision, RUP classification would also apply to areas/times that relevant species have access to treated areas
General use consumer packaging size requirements ≤ 1 lb. and formulated as ready-to-use non-refillable bait stations	All FGAR products	All bromethalin and cholecalciferol products	NA	NA	For consumer use products
Restriction of broadcast use in field cropped areas, rangeland, pastureland and fallow land	Chlorophacinone and diphacinone products registered for use in these areas	NA	NA	NA	In areas/times that relevant species have access to treated areas
Restriction of broadcast and spot treatment for turf, lawns, golf courses, campsites, and other recreation areas (per RMD)	All FGAR products registered for use in these areas	NA	All ZP products registered for use in these areas	NA	In areas/times that relevant species have access to treated areas
Prohibition of broadcast and in-burrow treatment for all other uses within the species range and/or designated critical habitat	ESA pilot memo – do not apply via broadcast/in-burrow for all 7 ARs (SKR). Do not broadcast chlorophacinone (APC). Do not apply via broadcast (extended beyond range) for chlorophacinone and diphacinone (CC)	ESA pilot memo – do not apply via broadcast/in-burrow for bromethalin (SKR)	ESA pilot memo – do not apply via broadcast/ in-burrow for ZP (SKR). Do not broadcast (APC). Do not apply via broadcast (extended beyond range) for ZP (CC)	ESA pilot memo – do not apply via in-burrow (SKR)	In areas/times that relevant species have access to treated areas

Mitigation Measure	Anticoagulant Rodenticides PID	Bromethalin/ Cholecalciferol PID	Zinc Phosphide PID	Strychnine PID	Draft Strategy
Mandatory carcass search, disposal, bait-spill/kick-out, and reporting requirements	Mandatory for FGAR products registered for use in fields and other non-structural use sites; ESA – pilot memo mandatory and more restrictive than PID for chlorophacinone and diphacinone products within range (CC) and warfarin critical habitat (CC)	Mandatory for bromethalin and cholecalciferol products registered for use in fields and other non-structural use sites	Mandatory for ZP products registered for use in fields and other non-structural use sites. ESA pilot memo – mandatory and more restrictive for ZP products within range of CC	Mandatory for all strychnine products. ESA Pilot memo – mandatory and more restrictive for strychnine products within range and critical habitat	Mandatory carcass search and disposal for SGAR products. Mandatory carcass search and disposal for FGARs and non-anticoagulant products within the range of listed species
Advisory carcass search, disposal, and reporting	All SGAR and FGAR products registered for use in structural use sites and all FGAR general use products	All bromethalin and cholecalciferol products registered for use in structural use sites and all bromethalin and cholecalciferol general use products	NA	NA	General use products
Include Bulletins Live! Two on product labels (excluding homeowner/ residential use products)	All SGAR and FGAR products	All bromethalin and cholecalciferol products	All ZP products	All strychnine products	Consistent with the PIDs
Updates to Terms and Conditions of Registration for registrant stewardship programs	All SGAR and FGAR products	All bromethalin and cholecalciferol products	All ZP products	All strychnine products	Include stewardship as a Best Management Practice to support other mitigation measures and to help reduce take
Exclusionary bait stations	ESA pilot memo – chlorophacinone (SKR)	ESA pilot memo – bromethalin (SKR)	ESA pilot memo – all ZP products	NA	For species and behavior as appropriate
Buffer to the range and critical habitat in addition to prohibition of broadcast applications in those areas for species with secondary consumer exposure	ESA pilot memo – do not apply within 200 yards (air) or 40 yards (ground) of range for chlorophacinone and diphacinone (CC)	NA	ESA pilot memo – do not apply within 200 yards (air) or 40 yards (ground) of range for ZP (CC)	NA	NA. This was proposed in the ESA Pilot memo but has been reconsidered and will not be included in the BE

Mitigation Measure	Anticoagulant Rodenticides PID	Bromethalin/ Cholecalciferol PID	Zinc Phosphide PID	Strychnine PID	Draft Strategy
Do not apply directly to water	NA	NA	NA	NA	Update any labels that do not already have this language
Reduction of distance of bait station placement from man-made structures. This would apply to mammals that cannot be excluded using bait stations	NA	NA	NA	NA	For all bait station products registered for uses within the range of listed mammals with primary consumer exposure
Cover burrow hole after application for in-burrow applications in fields and other non-structural use sites	NA	NA	NA	NA	Update any labels registered for use to control target pests that maintain closed burrow systems (i.e., pocket gophers) that do not already have this language. This would not apply to products registered for use to control target pests that maintain open burrow systems (i.e., Norway rat)
Use prohibitions during certain times of year	NA	NA	NA	NA	Prohibit use within the listed species' range during certain times of year when primary or secondary consumers might be exposed (i.e., if the species is active or has migrated into the area)

NA = Not applicable

6 Overall Conclusions

This draft BE makes effect determinations and predicts whether there is a potential likelihood that current registrations of 11 rodenticides may lead to a future jeopardy or adverse modification finding by USFWS or NMFS for all listed and proposed species (1,784) and their CHs (904). 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 to discuss analytical approaches and tentative conclusions. Species that were not expected to be exposed due to habitat factors (*e.g.*, strictly arboreal birds) 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 jeopardy for 74 species because exposure could not be precluded, and current restrictions do not mitigate exposure. EPA also predicted that 4 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.

EPA is proposing a Rodenticide Strategy (mitigations) as part of this draft 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 jeopardy for listed species and potential likelihood of future AM for CHs based on current uses and label restrictions in this draft BE would not be likely. The proposed mitigation measures are also intended to minimize take of those species where EPA made LAA determinations. This strategy proposes mitigation measures to address exposure routes of concern for bait station, in-burrow, and broadcast application methods. The proposed mitigation measures include measures to "avoid" or "minimize" exposure, as defined by the ESA Consultation Handbook. No "offsets" are proposed at this time; however, EPA is open to considering proposals regarding how offsets may be utilized for rodenticides.

The previously proposed mitigation measures (*i.e.*, in the 4 PIDs and the pilot memo) were available for public comment, and as the EPA continues to consider those comments, the Agency may further refine the proposed mitigations in the Rodenticide Strategy. During the public comment period on this draft BE, EPA seeks feedback on the effectiveness of the measures proposed in this BE, for reducing the potential for exposure to listed species and their CHs, feasibility, and enforceability of these measures.

6.1 Geographic Extent of Jeopardy Species and Adverse Modification of Critical Habitat

EPA created maps showing the geographic extent of the species and CHs that it predicted as potential likely future jeopardy or AM from the currently registered use of the 11 rodenticides (**Figure 6-1** to **Figure 6-3**; 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.

Figure 6-1 presents the entire geographic ranges of bird and mammal primary consumers that EPA has predicted to be potential likely future J from one or more rodenticides and/or use patterns. **Figure 6-2** presents the entire geographic ranges of secondary consumer birds, mammals, and reptiles predicted to be potential likely future J from one or more rodenticides and/or use patterns**. Figure 6-3** presents the entire geographic ranges of the CH of two birds, one reptile, and one amphibian that EPA has predicted to be potential likely future AM from the use of all 11 rodenticides as a group. These figures indicate that proposed mitigations to protect listed species and CH will not be required in the entire United States. However, it is important to note that EPA intends for these ranges to be refined in space and time where the listed species are potentially exposed to rodenticide use and therefore, anticipates areas of mitigation to be smaller than the entire ranges presented here. In other words, any pesticide use limitation area (PULA) will likely be smaller in geographical extent than the species and CH ranges.

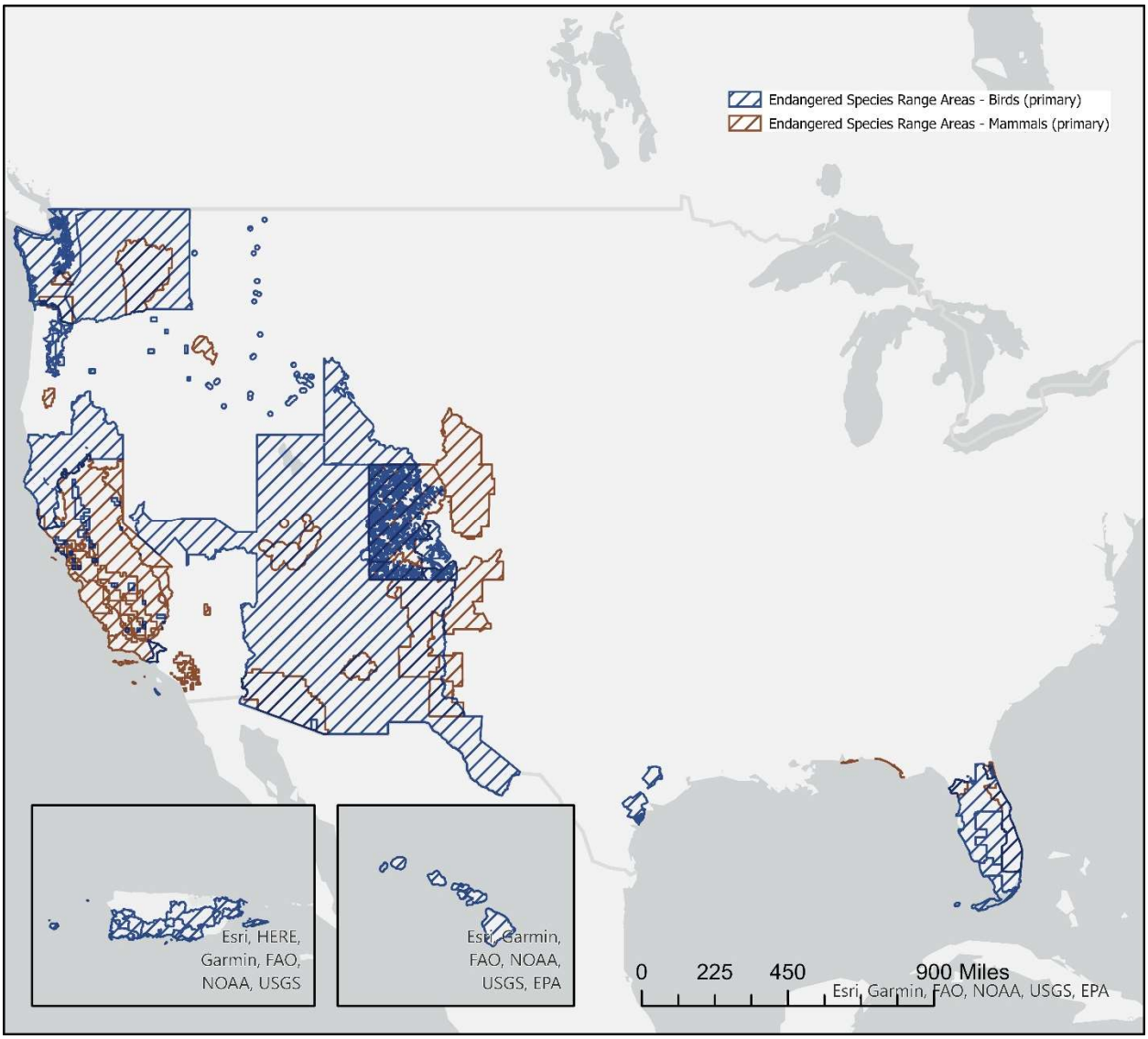

Figure 6-1. Geographic extent of primary consumers' range, that EPA Predicted as Potential Likely Future Jeopardy. Birds are blue and mammals are brown. There are no species' ranges contained in areas of the CONUS that are not displayed in the above map. Similarly, there are no ranges for species in AK.

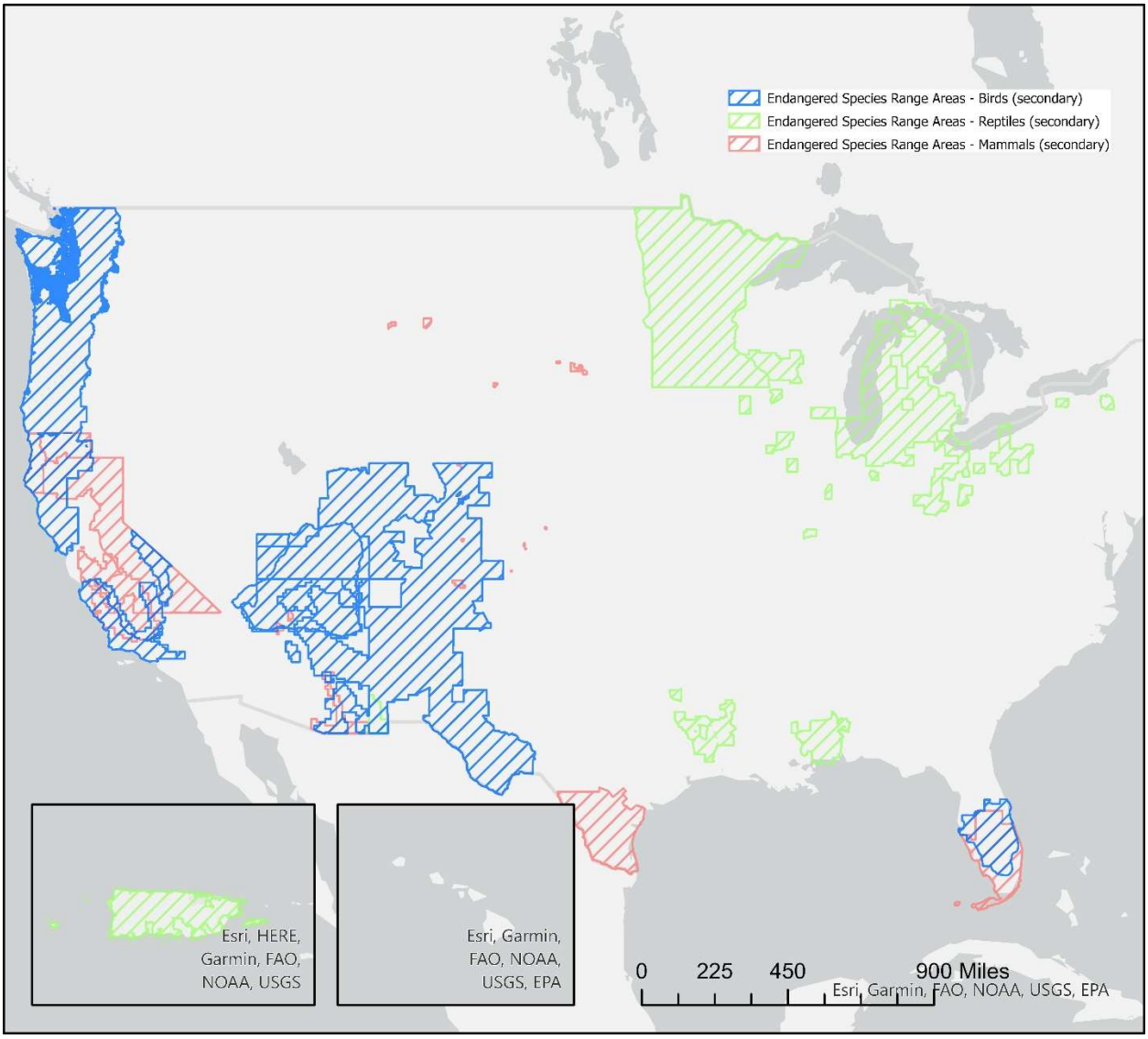

Figure 6-2. Geographic extent of secondary consumers ranges that EPA predicted as potential likely future jeopardy. Birds are blue, mammals are red, reptiles are green. There are no species' ranges contained in areas of the CONUS that are not displayed in the above map. Similarly, there are no ranges for species in AK.

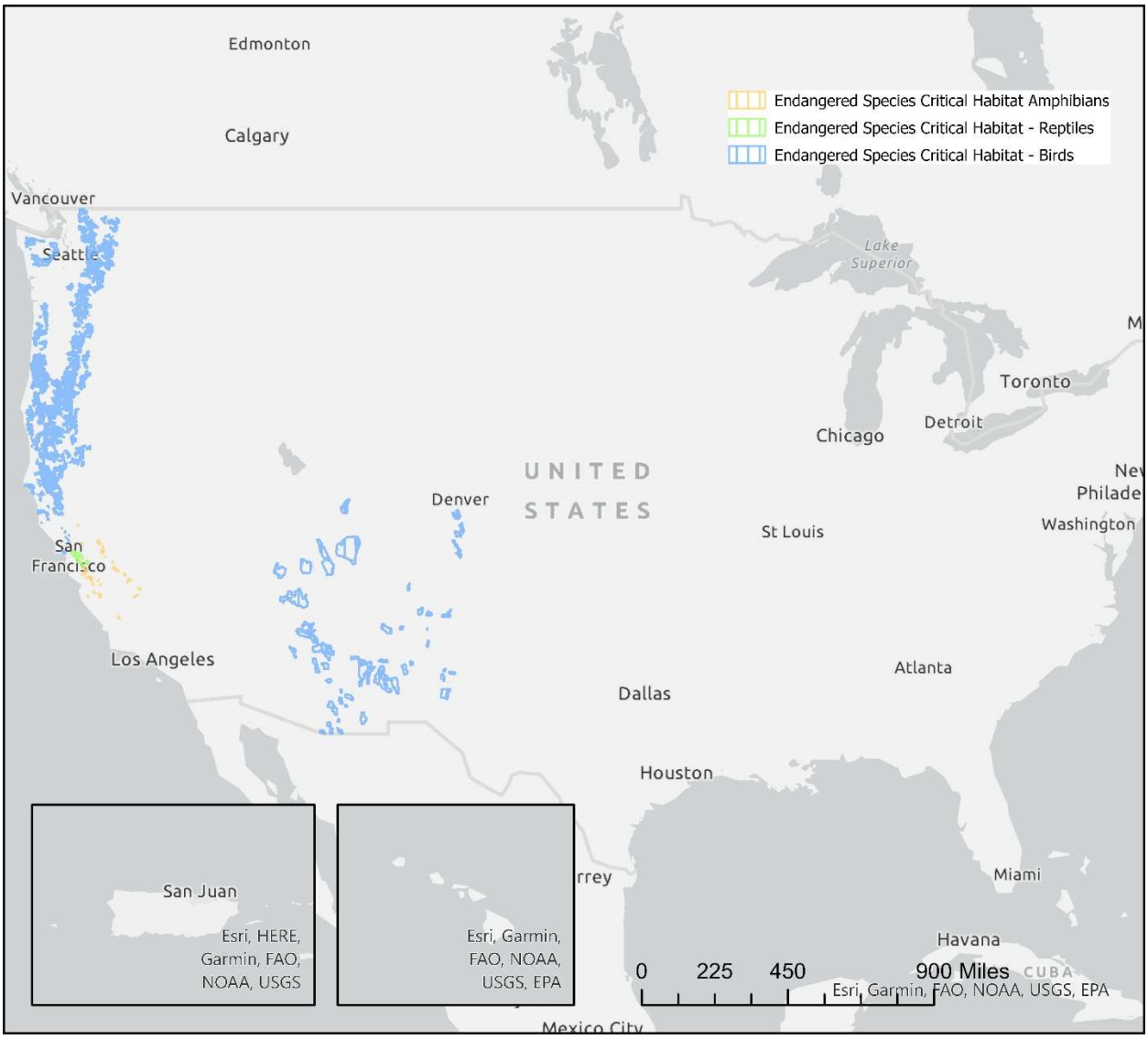

Figure 6-3. Geographic extent of critical habitat that EPA predicted as potential likely future adverse habitat modification. Birds are blue and reptiles are green (near San Francisco). There are no species' critical habitats contained in areas of the CONUS that are not displayed in the above map. Similarly, there are no critical habitats for species in AK.

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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, black-tail jack rabbit, 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
			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 (**Appendix B. Rodenticide Effects Determinations_11-28-23**) 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 jeopardy 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 adverse modification of the CH.

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

Table C-1. Summary of Jeopardy Species by Use Pattern and Active Ingredient

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)	Primary
Columbian white-tailed deer	Bait Station (FGAR and SGAR)	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, bromethalin, and ZnP) Broadcast (FGAR, ZnP)	Primary

Species	Use and A.I. Associated with J/AM	Primary or Secondary Exposure
	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) Broadcast (FGAR, ZnP) Burrow (FGARs, bromethalin, strychnine, 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
Buena Vista Lake ornate Shrew	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)	
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	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

Appendix D. 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 2017 cultivated UDL identifies cultivated land cover for the lower 48 states and is based on land cover information derived from USDA's Crop Data Layer from 2013 through 2017 (Boryan *et al*., 2011; USDA, 2017).

- **Cultivated land:** Cultivated/Fallow is spatial represented using all cultivated land as identified in USDA's Cultivated layer from Cropland Data Layer (2017). It is based on the most recent five years of CDL data. The 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 or not 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)

    1. 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 in order 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 were 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

1. 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 E. Determination of Overlap of Likely Rodenticide Exposure Area and Species Ranges and Critical Habitat

The attached appendix **(Appendix E. Overlap Files_11_28_23)** 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.