UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

September 28, 2022

PC Codes: 076901, 086001, 088601, 456755, 456480, 112701, 112001, 119901, 128967, 086002, 086003, 067701, 067705, 067707
DP Barcode: 464678

MEMORANDUM

SUBJECT: **Rodenticides:** 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

FROM: Tamara Johnson, Biologist
Rebecca Lazarus, Ph.D., Biologist
Pamela Thompson, Ph.D., Biologist
Kristina Garber, Senior Science Advisor
Environmental Fate and Effects Division (7507P)

TAMARA JOHNSON Digitally signed by TAMARA JOHNSON Date: 2022.09.27 11:11:49 -04'00'
Rebecca Lazarus Digitally signed by Rebecca Lazarus Date: 2022.09.27 18:09:25 -04'00'
PAMELA THOMPSON Digitally signed by PAMELA THOMPSON Date: 2022.09.27 13:59:31 -04'00'
Digitally signed by KRISTINA GARBER Date: 2022.09.27 14:07:09 -04'00'

THRU: Ethan Harwood, M.S., Scientist Special Assistant
Thomas Steeger, Ph.D., Senior Science Advisor
William Eckel, Ph.D., Senior Science Advisor
Mark Corbin, Branch Chief
Environmental Fate and Effects Division (7507P)

DOUGLAS HARWOOD Digitally signed by DOUGLAS HARWOOD Date: 2022.09.27 14:13:54 -04'00'
THOMAS STEEGER Digitally signed by THOMAS STEEGER Date: 2022.09.28 05:51:53 -04'00'
WILLIAM ECKEL Digitally signed by WILLIAM ECKEL Date: 2022.09.28 09:08:26 -04'00'
Mark Corbin Digitally signed by Mark Corbin Date: 2022.09.28 09:21:11 -04'00'

TO: Steven R. Peterson, Chemical Review Manager
Kent Fothergill, Chemical Review Manager
Anna Senninger, Chemical Review Manager
Srijana Shrestha, Chemical Review Manager
Melissa Grable, Team Leader
Julie Javier, Team Leader
Linda Arrington, Branch Chief
Dana Friedman, Branch Chief
Pesticide Reevaluation Division (7508P)

The Environmental Fate and Effects Division (EFED) has completed DRAFT effects determinations for three Federally listed threatened and endangered species ("listed species") and one designated critical habitat for all currently registered uses of 11 rodenticide active ingredients. For these listed species and critical habitat, EFED's draft effects determinations are that many (but not necessarily all) rodenticides are likely to adversely affect one or more individuals of a species or the critical habitat. For these species and critical habitat, EFED included predictions of the likelihood for the listed species to be

jeopardized or the critical habitat to be adversely modified. These predictions help to inform the consultation process with U.S. Fish and Wildlife Service (FWS), which has authority over these three listed species. FWS makes the final determination as to jeopardy to listed species and adverse modification to designated critical habitats. EFED will consider public comments and feedback from FWS, and registrants, and determine whether changes are needed to this assessment. The three species considered in this memo were chosen to pilot the approach for identifying rodenticide mitigations and types of mitigations for listed species because they represent examples of the listed species that may be affected by rodenticides through different routes of exposure (*i.e.,* primary and secondary consumption). The assessments for three species and associated mitigations are considered pilots for other listed species that may be similarly exposed and affected by rodenticides. In November 2023, EPA intends to draft effects determinations for these 11 rodenticides for all listed species and critical habitats.

Rodenticides: 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

September 27, 2022

Prepared by:

ENVIRONMENTAL FATE AND EFFECTS DIVISION

OFFICE OF PESTICIDE PROGRAMS

U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460

Contents

List of Acronyms

ACR	Acute-Chronic Ratio
AI	Active Ingredient
BiOp	Biological Opinion
BLT	Bulletins Live Two
EFED	Environmental Fate and Effects Division
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FWS	Fish and Wildlife Service
J/AM	Jeopardy or Adverse Modification
LAA	Likely to Adversely Affect
LC_{50}	Concentration leading to 50% mortality
LOAEC	Lowest Observed Adverse Effect Concentration
LOC	Level of Concern
MA	May Affect
MRID	Master Record Identification
NE	No Effect
NLAA	Not Likely to Adversely Affect
NOAEC	No Observed Adverse Effect Concentration
OPP	Office of Pesticide Programs
PBF	Physical or Biological Feature
PID	Proposed Interim Decision
RMD	Risk Mitigation Decision
RQ	Risk Quotient
RUP	Restricted Use Pesticide
UDL	Use Data Layer

1. Executive Summary

The general ecological risk assessments for the registration review of the 11 rodenticides[1] concluded that these chemicals pose a likelihood of mortality to non-target mammals and birds that may consume treated bait (referred to as "primary consumers"). Many rodenticides also pose a risk to animals that prey upon or scavenge animals that have consumed bait (*e.g.,* birds of prey, carnivorous mammals; referred to as "secondary consumers"). Based on the ecological risk assessments for registration review of the rodenticides, OPP is proposing a suite of mitigations in the Proposed Interim Decisions (PIDs) that are general in nature and intended to reduce exposure and risk to non-target wildlife. The suite of proposed mitigations are intended to be placed on rodenticide product labels to reduce primary and secondary exposures to listed and non-listed non-target animals. For example, OPP is proposing to require use of bait stations for certain uses and carcass cleanup. OPP is also proposing to require that the majority of rodenticide uses be classified as restricted use pesticides (RUP), and that the registrants develop and implement stewardship programs associated with their use. To address spatially and temporally explicit mitigations that are identified for specific federally listed endangered and threatened ("listed") species, OPP proposes that all labels include language instructing users to check the Bulletins Live! Two website[2] (BLT) in order to understand listed species use restrictions that may apply in the future (excluding labels that are only intended for use by residential consumers, which must be applied within bait stations or directly in burrows).

For this pilot effort, OPP selected three listed species: a primary consumer mammal, a primary consumer bird, and a secondary consumer bird for which there is potential exposure from currently registered rodenticides. Specifically, the Stephens' kangaroo rat (*Dipodomys stephensi*) and Attwater's prairie-chicken (*Tympanuchus cupido attwateri; also referred to as* "Attwater's greater prairie-chicken") represent primary consumers, while the California condor (*Gymnogyps californianus*) represents a secondary consumer. One of those species, the California condor, also has a designated critical habitat. These three species were chosen to pilot the approach for identifying rodenticide mitigations and types of mitigations for listed species because they represent examples of the listed species that may be affected by rodenticides through different routes of exposure (*i.e.,* primary and secondary consumption). The assessments for three species and associated mitigations are considered pilots for other listed species that may be similarly exposed and affected by rodenticides. In November 2023, EPA intends to draft effects determinations for these 11 rodenticides for all listed species and critical habitats.

EFED completed draft effects determinations for the current registered uses of the rodenticides and made draft Likely to Adversely Affect (LAA) determinations for these three pilot species and the designated critical habitat of the California condor. EFED also predicted that the current registered uses of the rodenticides are likely to jeopardize these three species and adversely modify the critical habitat of the California condor. **Table 1** includes the draft effects determinations and jeopardy and adverse modification (J/AM) predictions for the specific rodenticide active ingredients. In the PID for the registration review of the rodenticides, OPP is proposing broad mitigations that are intended to be applied to labels so that exposures are reduced to non-target species in general (*e.g.,* birds and mammals), which also includes listed species. In addition, OPP is proposing additional mitigations that

[1] Specifically: chlorophacinone, diphacinone and its sodium salt, warfarin and its sodium salt, brodifacoum, bromadiolone, difenacoum, difethialone, bromethalin, cholecalciferol, strychnine, and zinc phosphide

[2] https://www.epa.gov/endangered-species/bulletins-live-two-view-bulletins

are specific to these three pilot species[3] intended to avoid jeopardizing the three pilot species and minimize take. The mitigations included in the PID are also intended to prevent adverse modification of the designated critical habitat of the California condor. These mitigations would be applied through BLT and would have spatially explicit use restrictions that are relevant to the location of the specific listed species or critical habitat.

For each of these three species, bulletins for species-specific mitigations are proposed to limit exposure and effects. In general, species-specific mitigations are most substantial for the Stephens' kangaroo rat because it has the greatest likelihood of exposure and adverse effects because it most closely resembles the target species for rodenticides. Thus, those rodenticides expected to be applied via broadcast, burrow, or bait station within this species' range need additional mitigations such as specially designed bait stations that limit access by this species. The main concern for the Attwater's prairie-chicken is for broadcast bait uses, which are limited to only three rodenticide active ingredients (*i.e.,* chlorophacinone, diphacinone, and zinc phosphide) and a subset of their formulated end-use products that have broadcast uses. Because the draft effects determination is NLAA for diphacinone and Attwater's prairie chicken, no mitigations are proposed for this rodenticide. Because EFED made draft LAA determinations for chlorophacinone and zinc phosphide, OPP is proposing that broadcast applications of these two rodenticides be prohibited within the pesticide sensitive area for the species. For the California condor, additional mitigations include prohibition of broadcast uses for chlorophacinone, diphacinone, and zinc phosphide, and the use prohibition of a select warfarin feral hog bait station to reduce exposures to prey and extended periods of carcass cleanup within both the range and designated critical habitat.

This memorandum includes EFED's draft effects determinations and prediction of the likelihood for the registered uses of the 11 rodenticides in registration review to jeopardize the three pilot listed species or adversely modify one designated critical habitat. **Table 1** summarizes the individual level effects determinations (NE, NLAA or LAA) for each species and rodenticide. For those rodenticides with LAA determinations, EPA also predicted the likelihood of the rodenticide to jeopardize or adversely modify the critical habitat. The effects determinations in **Table 1** are based on the current registered uses of the 11 rodenticides. In absence of the proposed mitigations of the rodenticides (including the general FIFRA mitigations and the species-specific mitigations implemented in bulletins), EFED determined that certain rodenticide uses would likely jeopardize the Stephens' kangaroo rat (broadcast, burrow and possibly bait station uses), Attwater's greater prairie-chicken (broadcast uses of zinc phosphide), and the California condor (all uses) and adversely modify the designated critical habitat of the California condor (all uses, through impacts to habitat quality caused by presence of rodenticides in prey). However, the mitigations proposed in the PID would reduce (through avoidance and minimization) potential exposures and effects such that EFED could predict there is not a likelihood of jeopardy or adverse modification for the three species and the one identified critical habitat. These mitigations would also likely reduce the potential for take of individuals.

[3] Mitigations are changes to the currently registered uses that avoid or minimize effects to listed species (and to non-listed species). Mitigations are also referred to as "conservation measures."

Table 1. Summary of draft individual level effects determinations and predictions of jeopardy and adverse modification by pilot species and rodenticide. These determinations and predictions are based on currently registered uses of the rodenticides.

Rodenticide	Stephens' kangaroo rat		Attwater's prairie-chicken		California condor	
	Effects Determination	Jeopardy prediction	Effects Determination	Jeopardy prediction	Effects Determination	Jeopardy and adverse modification prediction[2]
Brodifacoum	LAA	Likely	NE	NA	NE	NA
Bromadiolone	LAA	Likely	NE	NA	NE	NA
Bromethalin	LAA	Likely	NE	NA	NLAA	NA
Cholecalciferol	LAA	Not Likely	NE	NA	NE	NA
Chlorophacinone	LAA	Likely	LAA	Not Likely	LAA	Likely
Difenacoum	LAA	Likely	NE	NA	NE	NA
Difethialone	LAA	Likely	NE	NA	NE	NA
Diphacinone[1]	LAA	Likely	NLAA	NA	LAA	Likely
Strychnine	LAA	Likely	NE	NA	LAA	Likely
Warfarin[1]	LAA	Likely	NE	NA	LAA	Likely
Zinc phosphide	LAA	Likely	LAA	Likely	LAA	Likely

NE = no effect

NLAA = not likely to adversely affect

NA = not applicable

LAA=likely to adversely affect

[1]also including the sodium salt

[2]Adverse modification prediction applies to critical habitat.

After consideration of public comments, as appropriate, OPP may revise the analyses and mitigations. OPP intends to discuss the draft effects determinations in this pilot assessment and the proposed mitigations with FWS. OPP is using these three species as pilots to establish an approach for assessing potential effects and identifying mitigations to avoid and minimize exposure to avoid jeopardy or adverse modification to listed species for the registration review of pesticides. OPP also intends to apply approaches used for these three species in the final analyses to all listed species that may be exposed to rodenticides via primary or secondary exposure. EPA intends to make the draft effects determinations for all species available for public comment in November 2023.

2. Background

OPP is currently reevaluating the rodenticides through registration review. The 11 rodenticides being reviewed at this time are: chlorophacinone (PC Code 067707), diphacinone and its sodium salt (067701; 067705), warfarin and its sodium salt (086002; 086003), brodifacoum (112701), bromadiolone (112001), difenacoum (119901), difethialone (128967), bromethalin (112802), cholecalciferol (202901), strychnine (076901), and zinc phosphide (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"[4]); however, there are rodenticides with other modes of action, such as neurotoxicity (bromethalin and strychnine), disruption of calcium absorption (cholecalciferol) and impairment of cellular function (zinc phosphide). The target pests of rodenticides include rats, mice, squirrels, voles, moles, prairie dogs, gophers, muskrats, and feral pigs. Rodenticides may be used in a wide range of settings, including residential areas, sewers, agricultural areas, forests, rights-of-way, and rangelands. They can be formulated as baits, tracking powders, and as granules. Rodenticides are commonly applied within bait stations, placed directly in target animal burrows, or applied as a broadcast application. Each rodenticide active ingredient has its own use sites, formulations, and application methods. A summary of the uses and modes of action of the 11 rodenticides is provided in **Appendix A.**

To support the registration review of the rodenticides, EFED assessed the risks of each of the 11 rodenticides to non-target taxa (USEPA, 2020a, 2020b, 2020c, 2020d, and 2020e). The assessments concluded that non-target birds, mammals, reptiles, and terrestrial-phase amphibians may be at risk from dietary exposure (primary or secondary) to rodenticides[5]. Multiple lines of evidence support these risk conclusions, including risk quotients (RQs) for primary and secondary consumers within various taxa that exceed the acute risk levels of concern (LOCs).

In the assessments, primary exposure is defined as the direct consumption of treated bait or broadcast pellets by target or non-target organisms. Primary exposure may occur from broadcast, burrow, bait stations and tracking powder uses. When bait stations are used, primary exposure is reduced because access to bait is limited to animals that are a similar size to the target animals. Secondary exposure is defined as consumption, either through predation or scavenging, of exposed primary consumers. Secondary exposure to most registered rodenticides is also considered a risk to the taxa of concern

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

[5] Since there is a low likelihood of exposure, the compounds do not pose an appreciable risk to aquatic animals, terrestrial invertebrates, and plants.

(*i.e.,* mammals, birds, reptiles and terrestrial-phase amphibians that consume animals), with the exception of cholecalciferol (which has a low likelihood of secondary exposure). Secondary exposure can occur from the entire suite of rodenticide uses, including bait stations.

The risk assessments also summarized over a thousand rodenticide incidents involving mortality of non-target species, predominantly mammals and birds. The available incident data suggest widespread detectable levels of rodenticides in birds and mammals, including predatory animals that would be considered secondary consumers. Listed species, including the San Joaquin kit fox (*Vulpes macrotis*) and key deer (*Odocoileus virginianus clavium*), and genera that may be listed, including kangaroo rats (*Dipodomys sp.*), were among the wildlife reported.

Collectively, the lines of evidence support the conclusion that the rodenticides pose a risk to mammals, birds, reptiles, and terrestrial-phase amphibians that are primary and secondary consumers of rodenticides; however, the risks associated with the different rodenticides are not all equal (**Appendix B)**. All 11 rodenticides may pose a risk to non-target mammals that are primary consumers of bait. All 7 anticoagulant rodenticides, 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 and reptiles that consume bait[6]. In the risk assessments, OPP identified risk concerns for secondary consumers from uses of all of the rodenticides except cholecalciferol. Although not discussed in the risk assessments, secondary exposure risks are not likely to be equal among the different rodenticides. 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 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 to secondary consumers. Also, 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; this does not impact secondary consumers of carcasses (*i.e.,* scavengers; USEPA 2020a). Not all anticoagulant rodenticides pose an equivalent risk of secondary exposure. In general, second-generation anticoagulants (*i.e.,* brodifacoum, bromadiolone, difenacoum, and difethialone) pose a greater risk compared to first-generation anticoagulant rodenticides (*i.e.,* warfarin, chlorophacinone, and diphacinone), because they only require one feeding to kill the target pest (first generation anticoagulants require multiple feedings; USEPA, 2011).

To date, EFED's risk assessments for the registration review of rodenticides have been general, discussing taxa-based concerns. EFED has not yet assessed the risks of the 11 rodenticides to specific federally listed endangered and threatened species (referred to as "listed species"). As part of registration review of the rodenticides, OPP is considering potential effects to listed species and critical habitats and identifying mitigations aimed at avoiding jeopardy of listed species or adverse modification their designated critical habitats. OPP identified 91 listed species of mammals, birds, reptiles, and amphibians that may be exposed to rodenticides through primary or secondary consumption (**Appendix C**)[7]. To support the PID, OPP selected a subset of species intended to

[6] Cholecalciferol has low acute risk to birds, reptiles, and amphibians. Chronic risk to birds is unknown due to lack of chronic avian toxicity data.

[7] The species included in Appendix C were identified as primary and/or secondary consumers based on their diets or taxonomic similarity to species for which there are incident reports for rodenticides. When EPA completes a full

represent different considerations when selecting mitigations to avoid jeopardy (*i.e.,* the different exposure routes of primary and secondary consumption) and different taxa (*i.e.,* mammals and birds that are primary consumers). For this effort, OPP selected three listed species: a primary consumer mammal, a primary consumer bird, and a secondary consumer bird for which there is potential exposure from currently registered rodenticides. Specifically, the Stephens' kangaroo rat and Attwater's prairie-chicken represent primary consumers, while the California condor represents a secondary consumer. In the PID, OPP is presenting proposed mitigations for these three listed species. As part of the registration review of the rodenticides, OPP intends to expand those mitigations to reduce exposures to other listed species and designated critical habitats (**Appendix C**).

EPA and FWS have consulted on previous actions for conventional pesticides, including rodenticides. In 2012 (prior to registration review of the 11 rodenticides), EPA addressed potential effects of a limited number of rodenticide products to a subset of listed species which were predicted to be adversely affected by rodenticides. EPA consulted with FWS on the use of Rozol® Prairie Dog Bait (contains chlorophacinone; USFWS, 2012)[8]. During the consultation process, EPA, the registrant, and FWS determined appropriate mitigations to avoid jeopardy for several listed species. The mitigations included geographic and timing restrictions, carcass search and disposal. These mitigations were considered and adapted as applicable for the pilot species in this memo.

Following discussions with registrants, federal partners (including FWS), and considerations of public comments, OPP may revise the assessments and proposed mitigations for these three species. OPP also plans to use similar mitigations as those developed for these three species for other listed species that may be adversely affected by rodenticides (*e.g.,* mitigations for the California condor may be used to represent mitigations for other secondary consumers). The purpose of this memo is to describe and solicit input on the draft effects determinations for these three species and one critical habitat based on the current uses of the rodenticides, and to evaluate the effectiveness of OPP's proposed mitigations in avoiding jeopardy for these three listed species and preventing adverse modification of the designated critical habitat of the California condor.

3. Summary of Proposed Rodenticide Mitigations

The general ecological risk assessments for the rodenticides identified risks to non-target wildlife that may consume bait or be secondary consumers. Based on those assessments, for registration review of the rodenticides, OPP is proposing several mitigations in the PIDs that are general in nature and intended to reduce exposure and risk to non-target wildlife[9]. As discussed in the rodenticide PIDs, these mitigations are being proposed so that the rodenticides meet the registration standard under the Federal Insecticide, Fungicide and Rodenticide Act.

OPP is proposing to place the following mitigations on the labels for first generation anticoagulant rodenticides (*i.e.,* warfarin, chlorophacinone and diphacinone) and non-anticoagulant rodenticides

biological evaluation for the rodenticides, this species list may be revised based on changes to listing status or available information on species diet or life history.

[8] Mitigations applied to Rozol prairie dog uses were also applied to Kaput®/Kaput®-D Prairie Dog Bait (contains diphacinone).

[9] Additional mitigations are also being proposed to reduce human health risk concerns; however, those are not discussed here unless they also result in reductions of risk for non-target wildlife.

(bromethalin, cholecalciferol, strychnine, and zinc phosphide) to reduce primary and secondary exposures:

- Prohibit spot and broadcast uses in turf, lawns, golf courses, campsites, and other residential recreation areas. Applications to these use sites only allowed if bait station is used.

OPP is proposing to make some rodenticide products RUPs, meaning that they can only be applied by certified applicators. Making these products RUP is expected to decrease the likelihood of misapplication or overapplication, based on the training certified applicators receive, which is expected to result in less exposure to non-target organisms. There are some differences in how RUP designation will be assigned among the rodenticides:

- All second-generation anticoagulant rodenticide (*i.e.,* brodifacoum, bromadiolone, difenacoum and difethialone), strychnine, and zinc phosphide products will be RUPs.
- First generation anticoagulant rodenticides (*i.e.,* warfarin, chlorophacinone and diphacinone), bromethalin and cholecalciferol products will be RUPs for anything sold in packages ≥ 4 lbs.

OPP is also proposing that registrants be required to develop stewardship materials and make them available on their websites for users. Examples of stewardship may include best management practices to reduce exposures to non-target animals.

OPP proposes that all RUP labels include language instructing users to check the BLT website[10] in order to understand listed species use restrictions that may apply. As part of the registration review of the rodenticides, OPP is developing species-specific mitigations to avoid jeopardizing listed species or adversely modifying their critical habitats. When necessary for a species, bulletins may be developed to implement these mitigations. Having links to the bulletins available on the rodenticide labels will allow users to be aware of spatially explicit use restrictions that may apply to them (based on the locations, uses and products relevant to the rodenticides they intend to apply).

In addition to the mitigations indicated above that are intended to be applied to the labels and will have broad geographic applications to non-target wildlife, OPP is proposing the following mitigations specific to the three pilot listed species.

- For the Stephens' kangaroo rat, rodenticide applications within the species' range are only allowed if products are placed within specially designed bait stations with size-limited entrances and specific designs that limit likelihood of entry by this listed species (see **Appendix D** for a description of modified bait stations for control of California ground squirrels).
- For the Attwater's prairie-chicken, broadcast applications of chlorophacinone and zinc phosphide are prohibited on grassland, pasture and rights-of-way within the "pesticide sensitive area" of the species' range, as defined by FWS (see **Figure 2**). Rodenticide applications are allowed if products are placed within bait stations or directly within burrows of target pests. Applications of diphacinone would not have additional restrictions for this listed species, because the likelihood of mortality from diphacinone is considered low for adult Attwater's prairie-chickens that consume bait.
- For the California condor, broadcast and feral hog control bait station applications of rodenticides are prohibited within its range (to reduce likelihood of exposures of prey; other bait station and burrow uses are still allowed), and carcass searches and disposal must be conducted for at least two weeks after any rodenticide application (longer if carcasses are found at the application site).

[10] https://www.epa.gov/endangered-species/bulletins-live-two-view-bulletins

OPP is proposing including exemptions to the restrictions for these three species that allow for some of the above uses within the ranges or designated critical habitat of the pilot species. These exemptions would only allow for an application if the applicator consults with the local FWS field office first to establish application procedures to prevent jeopardizing the species and minimizing take. These exemptions are being considered for cases where invasive species control may be needed within the range or designated critical habitat of a species (*e.g.,* feral hog control).

The following section includes EFED's draft effects determinations for the three pilot species and critical habitat. For those cases where EFED made draft LAA determinations, we predicted the likelihood that the current registered uses of the rodenticides would lead to J/AM. This section also evaluates the impact of OPP's proposed mitigations on the likelihood of J/AM. Additional details are provided below on the proposed species-specific mitigations.

4. Species Specific Draft Effects Determinations, Predictions of Potential Jeopardy/Adverse Modification and Evaluation of Proposed Mitigations

For the analysis of rodenticides, EPA adapted the methodology used by FWS in their Biological Opinion (BiOp) of the insecticide malathion (USFWS, 2022a), which represents FWS's first national level BiOp for a pesticide. The following is a brief explanation of the method used in that BiOp. In the malathion BiOp, FWS made their species-specific determinations by considering three major factors: "overall vulnerability" of a species, "risk[11]," and "usage[12] " Each factor was assigned one of the three categories: high, medium or low. FWS based overall vulnerability on the species baseline (independent of malathion exposure) and considered factors like population size, population trajectory, habitat quality and distribution. Usage was based on the degree of overlap of the species range and pesticide use sites, including consideration of potential use sites on labels, usage data, and exclusion of federal lands. The risk to each species was based on the likelihood of direct and indirect effects to individuals that may be exposed, based on the fate and exposure information provided in the FIFRA risk assessments. Direct effects considered the magnitude of mortality and potential sublethal effects. Indirect effects considered impacts on the prey, pollination, habitat and/or dispersal relevant to the listed species. FWS determined if jeopardy was likely or not for a species by considering the high, medium, and low conclusions for overall vulnerability, risk and usage. If either usage or risk was low, there was no jeopardy to a species. If risk and/or usage were high or medium, FWS made their decision based on the weight of evidence.

Since the 91 species identified in **Appendix C** (including the three pilot species) are all under the authority of FWS, EPA adapted the FWS method incorporated in the malathion BiOp to predict whether the three pilot species are likely jeopardized by uses of rodenticides. Since the analysis below predicts that the current uses likely jeopardize the continued existence of these three species and likely

[11] In this assessment, EPA uses the term "magnitude of effect" instead of "risk" to characterize the expected effect to exposed individuals.

[12] In this assessment, EPA uses the term "overlap" instead of "usage" to represent the spatial overlap of rodenticide exposure areas and the species range or critical habitat.

adversely modify the critical habitat of the California condor, EPA also predicted the effectiveness of the proposed mitigations on the likelihood of avoiding jeopardy and adverse modification.

The sections below describe the overall vulnerability for each species, as well as the potential magnitude of effect from currently registered rodenticide uses (referred to as "risk" by FWS) and the overlap of use sites (similar to FWS's "usage"). Overlap is based on Use Data Layers (UDLs) that represent potential use sites of individual rodenticide active ingredients based on their registered uses. OPP is currently considering whether refinements to that overlap are possible, for example by identifying areas within the UDL that represent the ranges of the target pests. In addition, if rodenticide usage data are available the overlap could be adjusted accordingly.

For each listed pilot species, there is a discussion of the draft effects determination and prediction of likelihood of jeopardy (or adverse modification) based on the current registration, an evaluation of the proposed mitigations and their potential to reduce exposure to the point that EPA could predict there is not a likelihood of jeopardy or adverse modification. Finally, each section includes a discussion of how the method and mitigations may be applied to similar species (those included in **Appendix C**).

4.1 Stephens' Kangaroo Rat (*Dipodomys stephensi*)

Overall Vulnerability

The Stephens' kangaroo rat (Entity ID 39) is a small rodent that lives in warm, dry desert and grassland habitats in Southern California. The Stephens' kangaroo rat was originally listed as endangered in 1988, but was recently reclassified as threatened, due to a reduction of threats since listing and the implementation of conservation actions (USFWS, 2022b). When considering factors that impact the vulnerability of this species (*e.g.,* population size and trajectory, habitat quality, distribution), FWS considers this species to have a medium overall vulnerability (USFWS, 2022a).

Magnitude of Effect

Stephens' kangaroo rats are 9-12 inches in length and have an average weight of 65 g. Kangaroo rats are named as such due to their large hind legs and tendency to hop. The species excavates and lives in underground burrows and may also colonize older burrows previously made by pocket gophers (*Geomyidae* spp.) and California ground squirrels (*Otospermophilus beecheyi*).

Stephens' kangaroo rats primarily eat seeds from forbs and grasses (*i.e., Erodium cicutarium*, *Schismus* sp., *Bromus* sp.). The seeds are stored in their external cheek pouches for transport to their burrows, where the seeds are consumed or cached (stored for later consumption). Because adults are seed-eaters, it is assumed that they may be primary consumers of rodenticide bait, especially treated grain, if applied within the range of the species. They are also taxonomically related to commensal rodents that are the targets of rodenticides, and the design and application method of each of the rodenticides addressed in this assessment (*e.g.,* broadcast, in-burrow and bait box) makes them inherently attractive to kangaroo rats, which may mistake treated bait in each of these applications for a dietary item.

As discussed in the ecological risk assessments, another potential exposure pathway could be consumption of insects that consumed rodenticides. For the Stephens' kangaroo rat, insect parts have

been observed in fecal materials at a detection rate of about 8% (USFWS, 2020). Insects (ants, lice, beetles) may be consumed incidentally by foraging or grooming. It is possible that terrestrial invertebrates exposed to treated bait could be secondarily consumed by kangaroo rats (USFWS, 2020), but this is not expected to be a major exposure pathway. Primary exposure is expected to be through primary consumption of rodenticide treated bait.

Appendix A includes a summary of the application methods of the 11 rodenticides. Rodenticides may be broadcast as loose bait, placed directly in rodent burrows, and/or applied in bait stations. Rodenticides that are applied via broadcast include chlorophacinone, diphacinone and zinc phosphide; chlorophacinone and zinc phosphide are also applied to rodent burrows, and in tamper-resistant bait stations, whereas diphacinone is also used in tamper-resistant bait stations but is not used in burrows. Chlorophacinone, diphacinone, and zinc phosphide have acute dose-based RQs above the level of concern (acute risk to listed species LOC= 0.1) for listed medium-sized mammals (RQs are 9.5, 8.68 and 71 respectively; see **Table 2**). Chlorophacinone and diphacinone both have a 79% likelihood of mortality of exposed individuals after one day of feeding, and >99% after 6 days of feeding (based on dose-response slope of 4.5 and RQs in **Table 2**). These three rodenticides are used to target California ground squirrel pests, as well as other burrowing pests, and Stephens' kangaroo rats are known to colonize these abandoned burrows. There is some restriction in the broadcast placement of chlorophacinone in California, under a shingle or grass, but there are no such restrictions on diphacinone, and there is a recorded incident involving kangaroo rats and diphacinone (**Table 2**). Zinc phosphide has a >99% likelihood of mortality of exposed individuals and lists three species of kangaroo rats as target pests, suggesting that these baits may be attractive to this family of rodents. Each of these active ingredients used in broadcast applications has multiple incidents with small mammals ecologically similar to kangaroo rats (*e.g.,* rats, chipmunks, voles, squirrels). Based on the use patterns, toxicity, and incident information, these active ingredient rodenticides with broadcast uses will have a high magnitude of effect on the Stephens' kangaroo rat.

Rodenticides that are used in burrows (and in bait stations) include bromethalin, cholecalciferol, strychnine, and warfarin. These active ingredients have acute dose-based RQs above the listed species acute risk LOC of 0.1 (RQs are 4.3, 13.4, 328, 43.8 respectively), and each has >99% likelihood of mortality of exposed individuals (based on dose-response slope of 4.5 and RQs in **Table 2**). Stephens' kangaroo rats may be exposed to rodenticides accidentally placed in burrows (if an applicator mistakes a Stephens' kangaroo rat burrow for a pest burrow) and through their use of abandoned burrows of target species for rodenticides (*i.e.,* California ground squirrel), which may contain leftover treated bait (USFWS, 2020). Bromethalin, strychnine and warfarin have incidents with small mammals ecologically similar to kangaroo rats, but cholecalciferol does not have any small mammal wildlife incidents (**Table 2**; USEPA, 2020b, 2020c, 2020d). Each of the rodenticides with burrow uses are considered to have a high magnitude of effect on the Stephens' kangaroo rat.

Based on their risk profile, certain rodenticides are restricted to bait stations (in tamper-resistant bait stations) and can only be applied by certified applicators. These include brodifacoum, bromadiolone, difenacoum, and difethialone, which are second-generation anticoagulant rodenticides (SGARs). It is unclear if the tamper-resistant bait stations are currently designed to exclude kangaroo rats. Brodifacoum has the largest number of reported incidents with small mammals that are ecologically similar to kangaroo rats, with many occurring after the Risk Mitigation Decision (RMD) for Ten Rodenticides was published (USEPA, 2008). Bromadiolone and difethialone have incidents with small mammals as well, and each of these has a 29% likelihood of mortality of exposed individuals after one day of feeding, and >99% after 6 days of feeding (based on dose-response slope of 4.5 and RQs in **Table**

2). Difenacoum has one recorded incident involving small mammal primary consumers, and 79% likelihood of mortality of exposed individuals after one day of feeding, and >99% after 6 days of feeding (based on a dose-response slope of 4.5 and RQs in **Table 2**). Each of the rodenticides with bait station uses have a high magnitude of effect on the Stephens' kangaroo rat.

Table 2. Acute toxicity endpoints, risk quotients (RQs) and number of reported incidents for rodenticide active ingredients relevant to Stephens' kangaroo rat (*Dipodomys stephensi*), from 2008-Present.

Active Ingredient	Concentration in bait (mg a.i./kg-bait)	LD_{50} (mg a.i./kg-bw)[1]	Adjusted LD_{50} (mg/kg-bw)[2]	Acute dose-based RQs from 1-d feeding[2]	Acute dose-based RQs from 6-d feeding[2]	Magnitude of mortality of exposed individuals[3]	No. of incidents reported for small mammal primary consumers (2008-Present)[4]	Magnitude of effect
Brodifacoum	25	0.42	4.4	0.75	51	1 day= 29%; 6d >99%	45 (122)	High
Bromadiolone	25	0.6	4.4	0.75	3.68	1 day= 29%; 6d >99%	12 (78)	High
Difenacoum	50	1.8	4.4	1.5	8.86	1 day= 79%; 6d >99%	1 (1)	High
Difethialone	25	0.55	4.4	0.75	21	1 day= 29%; 6d >99%	3 (>3, notes "numerous" squirrels)	High
Chlorophacinone	50	0.8[5]	4.4	1.5	9.5	1 day= 79%; 6d >99%	9 (49)	High
Diphacinone	50	1.9	4.4	1.5	8.68	1 day= 79%; 6d >99%	6 (33) 1 kangaroo rat	High
Warfarin	50	3	4.4	7.49	43.82	1 d and 6 d >99%	4 (10)	High
Zinc phosphide	20,000	21	37.3	71	NA	>99%	3 (21)	High
Bromethalin	100- 250	2.11	3	4.3	NA	>99%	10 (unknown individuals)	High
Cholecalciferol	750	11.8	7.35	13.4	NA	>99%	0 (0)	High
Strychnine	5,000- 9,726	2.2	3.91	169- 328	NA	>99%	1 (unknown individual)	High

[1]Acute oral LD_{50} and sub-acute dietary LC_{50} values from most sensitive tested species. Test species was the laboratory rat.
[2]Average body weight of adult Stephens' kangaroo rat is 65 g. Therefore, adjusted LD_{50} values (using concentration of bait and body weight of test animal) and RQs from default 35 g BW used to represent risk for this species.
[3]Calculated using Individual Effect Chance Model (IEC; V. 1.1), highest RQ and default slope of 4.5.
[4]Number of incidents and number of individuals in parentheses. Excludes secondary consumers and large mammals (*e.g.,* deer, skunk, raccoon, fox, bobcat, mountain lion).
[5]This exposure was for 5 days, which is longer than the durations of the other LD50 values in this column.

Overlap

Current populations of the Stephens' kangaroo rat are in limited areas of western Riverside County and western-central San Diego County of California. See **Figure 1** for a general outline of the species' range.

Figure 1. Stephens' kangaroo rat (*Dipodomys stephensi*) range (USFWS, 2021a)

The Stephens' kangaroo rat is primarily associated with open, annual grassland, and can be found in sparse coastal sage scrub (with an average shrub cover around 9%). Because the species is dependent on burrows, populations are limited to well-drained soil types and open landscapes. They create burrows in dirt roads, and often are in close proximity to or have overlapping habitat in grazing and agricultural areas. The species status report (USFWS, 2021a) states that the species appears to prefer intermediate seral stage (*i.e.,* secondary succession) plant communities that are maintained by disturbance (*e.g.,* fire, grazing, and agriculture). Experimental translocation studies have found Stephens' kangaroo rats prefer fire maintained/burned habitat plots to sheep-grazed or mowed ones and restored and burned subplots had the highest rate of burrow establishment (USFWS, 2021a).

The Stephens' kangaroo rat also overlaps federal lands by 16% (notably three Department of Defense facilities including Marine Corps Base Camp Pendleton; studies there have found Stephens' kangaroo rats are relatively tolerant of moderate levels of military disturbance activities, provided a forb layer was maintained). To avoid predators and heat and water loss from diurnal activity, Stephens' kangaroo rats are nocturnal, and most active foraging is just after sundown and a few hours before sunrise. The species is active year-round.

In the malathion BiOp (USFWS, 2022a), FWS considered uses that were < 5% overlap to be low overlap, uses with 5-10% overlap to be medium overlap, and uses >10% overlap to be high overlap. OPP uses the same categories here. **Table 3** shows the percent overlap between the species range and use sites that are >5% and includes the overlap of potential use sites where the 11 rodenticides can be applied, with details on potential use sites from product labels. According to this information, Stephens' kangaroo rat has a high overlap with pasture, rangeland, developed[13], and rights-of-way uses, and a medium overlap with wheat, open space developed areas.

Broadcast applications of chlorophacinone, diphacinone and zinc phosphide may be made to areas representing the habitat of this species (*e.g.,* pastures, rangeland) and areas that may be visited by the species (*e.g.,* agricultural areas, rights-of-way). Rodenticides used in burrows (*i.e.,* bromethalin, cholecalciferol, strychnine, and warfarin) can be applied across several use sites that occur within the range of this species (*e.g.,* pastures, rangeland, rights-of-way). An evaluation of the target pest species (listed in **Appendix A**) for each rodenticide, those target pest species' ranges, and the typical use of each rodenticide that is used in burrows, would be helpful for understanding the level of overlap for listed species that also use burrows. For example, strychnine is generally used to target pocket gophers of several species, and in Nevada, there is a Special Local Need (SLN; FIFRA Section 24c) use for control of yellow-bellied marmots (*Marmota flaviventris*), jack rabbits and certain ground squirrels. The Nevada SLN use would not overlap the range of the Stephens' kangaroo rat, (which is restricted to Southern CA), but the ranges of several species of pocket gophers might overlap with the Stephens' kangaroo rat range, increasing the potential for rodenticide exposure to the listed species.

The RUP rodenticides that can only be applied in bait stations by certified applicators likely have an overlap with developed areas. These rodenticides may also have an overlap with other areas such as open space developed or agricultural areas, if they are applied in and around agricultural buildings and structures, which would be consistent with label language.

[13] The developed landcover is used to spatially represent certain non-agricultural label uses and includes areas with a mixture of constructed materials and vegetation, where impervious surfaces account for 20-100% of total cover. These areas most commonly include single-family housing units, apartment complexes, row houses and commercial/industrial areas.

Table 3. Overlap of potential agricultural and non-agricultural rodenticide use sites and range of Stephens' kangaroo rat (*Dipodomys stephensi*).

	Agricultural Uses		**Non-Agricultural Uses**			
	Wheat	*Pasture*	*Rangeland*	*Developed*	*Open Space Developed*	*Rights-of-Way*
% Overlap	5	30	27	16	9	26
Active Ingredient	*Wheat*	*Pasture*	*Rangeland*	*Developed*	*Open Space Developed*	*Rights-of-Way*
Brodifacoum	NA	NA	NA	In and around buildings	NA	NA
Bromadiolone	NA	NA	NA	In and around buildings	NA	NA
Difenacoum	NA	NA	NA	In and around buildings	NA	NA
Difethialone	NA	NA	NA	In and around buildings	NA	NA
Chlorophacinone	NA	NA	Rangeland	Homes, food processing facilities, industrial and commercial buildings, trash receptacles	Homes, food processing facilities, industrial and commercial buildings, trash receptacles	NA
Diphacinone	NA	Pasture land	Rangeland	Homes, food processing facilities, industrial and commercial buildings, trash receptacles	Homes, food processing facilities, industrial and commercial buildings, trash receptacles	Levees
Cholecalciferol	NA	NA	NA	In and around buildings, industrial and agricultural structures, transportation vehicles, and trash receptacles	In and around buildings, industrial and agricultural structures, transportation vehicles, and trash receptacles	NA
Bromethalin	NA	NA	Non-crop grassy areas	In and within 100 ft of man-made structures	Lawns, parks, golf courses	NA
Strychnine	Agricultural cropland	Pasture	Rangeland	In and around buildings	Lawns, non-agricultural areas	NA
Warfarin	NA	Pasture	Rangeland	In and around buildings	Lawns, turf areas, golf courses	NA
Zinc Phosphide	Wheat, Alfalfa	Pasture, timothy grass	Rangeland	In and around buildings	Recreational areas, airports, golf courses, residential lawns, ornamentals, and turf	Highway medians, canal, and waterway rights-of-way

[1]NA=Not Applicable

Effects Determinations and Jeopardy Predictions for Current Registrations

Table 4 summarizes the draft effects determinations for each rodenticide active ingredient for the Stephens' kangaroo rat. When considering individual level effects, draft LAA determinations are made for the current uses. EFED predicts that the current uses of 10 of the 11 rodenticides are likely to jeopardize the Stephen's kangaroo rat. For cholecalciferol, EPA predicts that jeopardy is not likely because it has a limited likelihood of exposure across the range of the species because of its use pattern (*i.e.,* inside or nearby buildings, vehicles and trash receptacles).

Table 4. Summary of draft effects determinations for the Stephens' kangaroo rat[1] (*Dipodomys stephensi*) for current registered uses of rodenticides. For all LAA determinations, EPA predicted whether jeopardy is likely or not.

Rodenticide	Draft Individual Level Determination	Predicted likelihood of jeopardy	Comments relevant to jeopardy determination
Brodifacoum	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals; high overlap with developed areas
Bromadiolone	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals; high overlap with developed areas
Bromethalin	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals; high overlap within burrow use sites
Cholecalciferol	LAA	Not Likely Jeopardy	High magnitude of effect; no incidents with small mammal primary consumers; overall usage within range anticipated to be low due to use pattern
Chlorophacinone	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals, high overlap with broadcast use sites
Difenacoum	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals; high overlap with developed areas;
Difethialone	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals; high overlap with developed areas
Diphacinone	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals, high overlap with broadcast use sites
Strychnine	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals; high overlap within burrow use sites
Warfarin	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals; high overlap within burrow use sites
Zinc phosphide	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals, high overlap with broadcast use sites

LAA=likely to adversely affect

[1]The medium vulnerability of the Stephens' kangaroo rat also factors into the jeopardy likelihood determinations.

Evaluation of Proposed Mitigations

To avoid jeopardy to the Stephens' kangaroo rat, OPP proposes to implement measures that would minimize the potential exposure of rodenticides to Stephens' kangaroo rat throughout the species' range (see **Figure 1**). Within the species' range, OPP proposes to prohibit burrow and broadcast uses. Preventing broadcast and in-burrow use within range would reduce primary exposure of the Stephens' kangaroo rat, as it would reduce the chance of applying rodenticides to areas where the listed species forages. The prohibition also reduces the chance of rodenticide application in burrows that the species

either excavates or colonizes from a target pest within its range. OPP proposes that rodenticides that are used within the range of the Stephen's kangaroo rat are placed within bait stations that are designed to exclude kangaroo rats. **Appendix D** includes a description of design elements of a bait station that would exclude the Stephens' kangaroo rat but allow entry of California ground squirrels (target pests). Additional bait station designs may be needed to control other types of pests (*e.g.,* voles). These mitigations would be required for all rodenticide active ingredients, except cholecalciferol because OPP predicted that this active ingredient is not likely to jeopardize the Stephens' kangaroo rat. These mitigations would be applied to all RUP uses of the rodenticides. OPP expects that potential rodenticide exposures to non-target species will be reduced because they will be applied by trained certified applicators. These mitigations do not apply to residential consumers/homeowners that are applying rodenticides to control commensal rodents.

The proposed mitigations for the Stephens' kangaroo rat were partially addressed in the latest FWS Species Report on Stephens' kangaroo rats (USFWS, 2021a), which concluded that recent mitigation efforts by the California Department of Pesticide Regulation (CDPR), which reference mitigation measures in the California PRESCRIBE database[14], reduced the magnitude of effects of rodenticides on this species. OPP intends to adopt the recent PRESCRIBE mitigations at the Federal level. These would involve implementation using BLT of rodenticide burrow restrictions, broadcast prohibitions, and allow use of specifically designed bait stations. OPP predicts that these mitigations are sufficient to reduce exposures such that rodenticides would not likely jeopardize the Stephens' kangaroo rat.

Consideration of Other Listed Species

The Stephens' kangaroo rat was chosen as a pilot species because it represents a mammal that is a primary consumer. **Appendix C** has details on other listed species that may be primary and secondary consumers of rodenticides. Of the 91 listed species, there are 22 other primary consumers that are small mammals (and 2 species of large mammal primary consumers). Of these 22, there are 5 other kangaroo rat species, including the Fresno kangaroo rat (*D. nitratoides*), the Giant kangaroo rat (*D. ingens*), the Morro Bay kangaroo rat (*D. heermanni morroensis*), the San Bernardino [Merriam's] kangaroo rat (*D. merriami*), and Tipton kangaroo rats (*D. nitratoides nitratoides*).

In addition, there are several listed species that are primary and secondary consumer mammals (*e.g.,* several beach mouse species); some of these are larger mammals that use burrows (*e.g.,* kit foxes). Their specific life histories and ranges should be considered when developing mitigation options. For example, the San Joaquin kit fox often uses abandoned rodent burrows and occurs within the range of California ground squirrel pest management.

The approach used here, which assesses potential adverse effects from uses of rodenticides, may be adapted when EPA assesses potential effects to these other species. Some notable differences between Stephens' kangaroo rat and these other species include:

- overlap of range with rodenticide use sites,
- overlap of range with different target pests, which may indicate specific in-burrow uses (*e.g.,* other ground squirrels, woodrats, or pest kangaroo rats),
- body weight (different default RQs may be used for smaller or larger species),
- habitat type (some of these species may use forests, or be in specific agricultural areas)

[14] https://www.cdpr.ca.gov/docs/endspec/prescint.htm

When considering the proposed mitigations, prohibition of broadcast and in-burrow uses in the species range and use of bait stations reduce exposures to a point where EPA predicts there is not a likelihood of jeopardy to the Stephens' kangaroo rat. Similar mitigations may be applied (and modified as needed) to different rodenticides and uses that are relevant to the other listed species that may be primary consumers of rodenticides. In addition, additional bait station designs may be needed for other target pests or other listed species.

4.2. Attwater's Prairie-Chicken (*Tympanchus cupido attwateri*)

Overall Vulnerability

The Attwater's prairie-chicken (also known as "Attwater's greater prairie-chicken;" Entity ID 83) is a grouse unique to the Texas coastal prairies. This species was listed as endangered in 1967 (USFWS, 2021b). When considering factors that impact the vulnerability of this species (*e.g.,* population size and trajectory, habitat quality, distribution), FWS considers this species to have a high overall vulnerability (USFWS, 2022a).

Magnitude of Effect

Adult Attwater's prairie-chickens primarily consume foliage, insects, and seeds and grains, including corn, peanuts, and rice. Adults also seasonally consume insects (*e.g.,* grasshoppers and beetles; USFWS, 2010). Because adults consume seeds and grains, they may also be primary consumers of rodenticide bait (especially those baits that are formulated as grains). The diet of juvenile Attwater's prairie-chickens is primarily insect-based (USFWS, 2010); therefore, it is assumed that juveniles are not likely to consume bait.

As discussed in the ecological risk assessments for the rodenticides, one potential exposure pathway could be consumption of insects that consumed rodenticides. It is possible that terrestrial invertebrates exposed to treated bait could be secondarily consumed by Attwater's prairie-chickens; however, this is not considered a substantial exposure route. The main exposure route of concern for this species is from primary exposure to adults consuming rodenticide bait.

Appendix A includes a summary of the application methods of the 11 rodenticides. Rodenticides may be broadcast as loose bait, placed directly in rodent burrows, and applied in bait stations. It is assumed that the Attwater's prairie-chicken may be exposed to rodenticide baits through broadcast applications. Given the life history of the Attwater's prairie-chicken, individuals are not expected to enter rodent burrows and are too large to enter bait stations designed for rodents. Therefore, those rodenticides that are only used in bait stations and/or burrows (*i.e.,* brodifacoum, bromadiolone, bromethalin, cholecalciferol, difenacoum, difethialone, strychnine, and warfarin) are not of concern for the Attwater's prairie-chicken. Currently, chlorophacinone, diphacinone and zinc phosphide baits may be applied via broadcast; therefore, these three rodenticides are considered further for the Attwater's prairie-chicken.

Acute exposures

As discussed in **Section 1** and summarized in **Appendix B**, EPA previously identified risk concerns for mortality to birds consuming bait containing chlorophacinone, diphacinone, and zinc phosphide. Acute

dose-based RQs exceed the acute risk to listed species LOC (0.1) for all three pesticides for birds consuming bait that represent the body weight of the Attwater's prairie-chicken (adult body weights range 737-1,112 g (USFWS 2010); a default body weight of 1,000 g was used to calculate RQs for this species; **Table 5**). Sub-acute dietary-based RQs also exceed the acute risk to listed species LOC (0.1) for chlorophacinone and zinc phosphide. There is some uncertainty associated with the dose-based RQs in **Table 5** because the estimated environmental concentrations (EECs) were calculated using a passerine food intake equation. As a result, EECs and RQs may be somewhat overestimated for non-passerine (*i.e.,* Galliformes) species.

Table 5. Acute toxicity endpoints and risk quotients (RQs) for rodenticides relevant to Attwater's prairie-chicken (*Tympanchus cupido attwateri*).

Parameter Description	Chlorophacinone	Diphacinone	Zinc phosphide
Concentration in bait (mg a.i./kg-bait)	50	50	20,000
LD_{50} (mg/kg-bw)[1]	258	1630	12.9
LC_{50} (mg/kg-diet)[1]	56	906	470
Acute dose-based RQs from 1 d feeding[2]	0.02	0.02	167
Acute dose-based RQs from 6 d feeding[2]	0.13	0.12	Not applicable
Sub-acute concentration-based RQs[3]	0.89	0.06	43
Maximum individual effects (magnitude of mortality of exposed individuals)[4]	41%	<0.002%	>99%
Number of incidents reported for birds (primary consumers), from 2008-present	6*	1	57
Magnitude of effect	Medium	Low	High

[1]Acute oral LD_{50} and sub-acute dietary LC_{50} values from most sensitive tested species. Test species was either mallard duck (*Anas platyrhynchos*) or bobwhite quail (*Colinus virginianus*).
[2]Body weight of adult Attwater's prairie-chicken is 737-1,112 g. Therefore, RQs from default 1000 g body weight (BW) used to represent risk for this species.
[3]Calculated by dividing concentration in bait by LC_{50}
[4]Calculated using Individual Effect Chance Model (IEC; V. 1.1), highest RQ and default dose-response slope of 4.5.
*Includes incidents on pigeon (4 individuals), wild turkey (2 individuals and 45 individuals), Canada geese (70 individuals), Western meadowlark (1 individual), and mallard ducks (# individuals unknown)

For zinc phosphide, RQs indicate that exposures are 2-3 orders of magnitude above the acute oral LD_{50}[15]. When considering the magnitude of effect, these exposures represent almost 100% mortality of exposed individuals (based on dose-response slope of 4.5 and RQs in **Table 5**). In addition, there are 57 separate incident reports with birds assumed to be primary consumers of bait. Therefore, it is assumed that zinc phosphide has a high magnitude of effect for the Attwater's prairie-chicken (and other birds that may be primary consumers of bait).

When considering chlorophacinone, RQs indicate that EECs are generally below the acute oral LD_{50} or subacute dietary LC_{50} values. Because animals may continue to consume bait even after they consume a lethal amount (due to a delay in effect), exposure was estimated in the risk assessment by assuming multiple days of feeding (USEPA, 2020a). For chlorophacinone, the concentration-based RQ suggests 41% of exposed individuals will exhibit mortality. Given the estimated levels of individual mortality and that there are 6 incident reports for birds (with multiple individuals affected in each incident; **Table 5**), the magnitude of effect is considered medium for chlorophacinone.

[15] RQs are calculated by dividing estimated exposures by the median lethal dose (LD_{50}). Therefore, an RQ represents the magnitude difference between the estimated exposure and the LD_{50}.

For diphacinone, the sub-acute dietary RQ is below the acute risk to listed species LOC. The 6-d dose-based RQ exceeds the listed species LOC (0.1), but the 1-d dose-based RQ does not. Given that a passerine food intake equation was used to estimate exposure for this larger galliform species, the RQs likely overestimate exposure, suggesting that there is limited concern for risk. This is further supported by the estimated magnitude of mortality of <0.002% of individuals exposed for 6 days. Based on this information, the magnitude of effect on the prairie-chicken is considered low for this chemical and it is not likely that an individual will be adversely affected even if exposed. As mentioned above, while EECs (body burden of an anticoagulant rodenticide in a bird or mammal) can be used to understand secondary exposure, effects from chronic exposure to diphacinone were not evaluated because a suitable method is not available for primary consumers. In addition, one incident was identified for primary avian consumers with diphacinone, indicating that diphacinone incidents are not indicative for a greater diphacinone risk to the Attwater's prairie-chicken, which supports the low magnitude of effect classification.

Chronic exposures

Across all rodenticides, there are limited chronic toxicity data for birds. The single available chronic toxicity study evaluated effects of chlorophacinone on mallard ducks (*Anas platyrhynchos*) and reported a 6% reduction in survivor weight at the lowest-observe adverse effect concentration (LOAEC) of 0.096 mg a.i./kg-diet. The reported no-observed adverse effect concentration (NOAEC) was 0.046 mg a.i./kg-diet (MRID 48994002). The study also reported significant reductions in a suite of measurement endpoints including eggs laid per pen, hatchlings per eggs set, weight gain in females at 0.096 mg a.i./kg-diet, which is also exceeded by bait concentrations. These effect levels are well below the concentration of chlorophacinone in bait (50 mg ai/kg).

No chronic toxicity data are available for other rodenticides. In the most recent anticoagulant rodenticide draft ecological risk assessment (USEPA, 2020a), due to the common mechanism of action (*i.e.,* Vitamin K antagonist), the empirical chlorophacinone chronic toxicity endpoints were used to estimate chronic toxicity endpoints for other anticoagulants, including diphacinone, through utilizing the acute-chronic ratio (ACR) method, and those ACR-estimated values were subsequently used as chronic toxicity endpoints. In EFED, the ACR approach is generally only applied to aquatic taxa; however, for this assessment, it is considered sufficiently reliable to characterize potential chronic effects. For diphacinone, the ACR-estimated NOAEC and LOAEC were 0.29/0.60 mg a.i./kg-diet, respectively. These estimated NOAEC and LOAEC values are below the concentrations in diphacinone baits (50 mg ai/kg).

Comparisons of LOAEC values to concentrations in bait for chlorophacinone and diphacinone suggests that there could be an effect from chronic exposures. Chronic exposures are considered discountable because exposures to bait over a long period of time are not expected. Bait is expected to be present on treated areas for a limited period of time. Thus, the most relevant exposure period for primary consumers is considered acute.

Summary

The magnitude of effect for zinc phosphide is high. The magnitude of effect for chlorophacinone and diphacinone are medium and low, respectively. Chlorophacinone and diphacinone are expected to have a lower magnitude of effect compared to zinc phosphide because 1) zinc phosphide is more toxic

on an acute-dose basis and 2) the concentration of zinc phosphide in bait (2%) is much higher than the concentration of first generation anticoagulants in bait (0.005%). Given the low likelihood of effect to an individual, a not likely to adversely affect (NLAA) determination is predicted for diphacinone. Chronic exposures to primary consumers are considered discountable because bait will not be present for prolonged periods of time. The overlap section below focuses on chlorophacinone and zinc phosphide.

Overlap

The Attwater's prairie-chicken is currently only known to occur in the wild at the Attwater's Prairie-Chicken National Wildlife Refuge (NWR; Colorado County, TX), the Texas City Prairie Preserve (Galveston County, TX), and a private ranch in Golidad County, TX (USFWS, 2010; range depicted in **Figure 2**). The FWS recommends restricting pesticide applications in areas within the Attwater's range where they are most vulnerable. These areas are referred to as "pesticide sensitive areas." Pesticide sensitive areas for the Attwater's prairie-chickens are located in two federally managed areas: the Attwater's Prairie-Chicken NWR and the Texas City Prairie Preserve near the Gulf of Mexico coast (USFWS, 2004). **Figure 2** includes a map generated by EPA that includes the pesticide sensitive areas created using the FWS description in USFWS 2004.

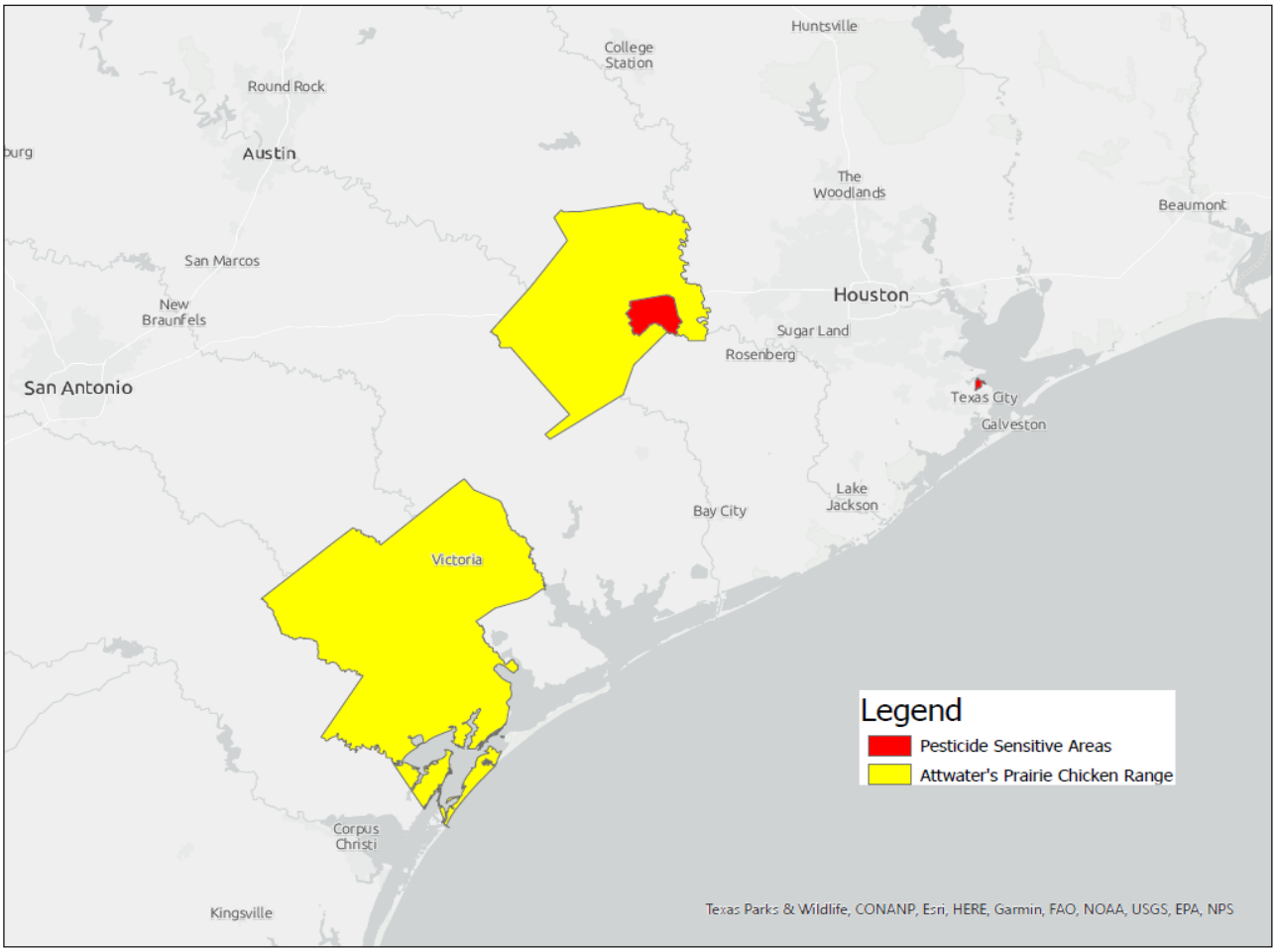

Figure 2. Attwater's Prairie-Chicken (*Tympanuchus cupido attwateri*) Range and Pesticide Sensitive Areas (Pesticide Sensitive Area Shapefile Generated by EFED using range data from FWS Environmental Conservation Online System (ECOS; https://ecos.fws.gov/ecp/), downloaded December 2020; and Pesticide Sensitive Data from USFWS, 2004).

The habitat of the Attwater's prairie-chicken includes native prairie and undisturbed grasslands which are well drained and diversified with a variety of weeds, shrubs, and grasses (USFWS, 2010; USFWS 2021b). Since this species also consumes corn, peanuts and rice, it is assumed to also visit agricultural areas. Chlorophacinone and zinc phosphide broadcast applications may be made to areas representing the habitat of this species (*e.g.,* pastures, rangeland) and areas that may be visited by the species (*e.g.,* agricultural areas, rights-of-way). **Table 6** includes the overlap of potential use sites where chlorophacinone and zinc phosphide may be broadcast with the Attwater's prairie-chicken range and the pesticide sensitive areas (**Figure 2**). Broadcast applications of bait are assumed to have insignificant drift; therefore, these overlaps represent potential use sites within the range or pesticide sensitive area. This overlap does not account for usage data; therefore, it is assumed that 100% of the potential use sites may be treated. This assumption could be refined in the future with usage data for chlorophacinone and zinc phosphide that are relevant to the uses that overlap with the range of the Attwater's prairie-chicken.

Table 6. Overlap of potential rodenticide use sites and range of Attwater's prairie-chicken (*Tympanuchus cupido attwateri*). This table also includes overlap with the pesticide sensitive area of the range.

Use Data Layer	Zinc phosphide Broadcast Uses	Chlorophacinone Broadcast Uses	% Overlap with Pesticide sensitive areas
Pasture	Pasture, timothy grass	NA	100[1]
Alfalfa	Alfalfa	NA	0
Rangeland	Rangeland	NA	100[1]
Managed forests*	Tree farms, tree plantations	Tree and forestry plantations	0
Christmas tree plantations*	Christmas tree plantations	Christmas tree plantations	0
Developed*	Residential lawns, ornamentals, ornamental lawns and turf	NA	1.4
Open space developed*	Recreational areas, airports, golf courses	NA	5.1
Other tree crops and vineyards	Orchards, tree nuts, macadamia nut, grapes, pome fruits, stone fruits, avocados	Pome and stone fruit orchards	2.6
Vegetables and ground fruit	Bushberries, caneberries, potatoes	NA	0.8
Citrus	Citrus	NA	0
Rights of way	Non agricultural	NA	8.2
Non-cultivated	Non-agricultural uncultivated areas/soils	NA	100[1]
Nurseries	Nursery stock	Commercial nurseries	0

*Attwater's prairie-chickens are not expected to visit tree plantations or developed areas.
NA = not applicable
[1]Overlap > 100%; UDL fully encompasses the pesticide sensitive area and error in Geographic Information Systems (GIS) analysis makes values > 100%; therefore, 100% is assumed.

In the malathion BiOp, FWS considered uses that were <5% to be low overlap, uses with 5-10% overlap as medium overlap and uses >10% overlap as high overlap (USFWS, 2022a). OPP is using the same categories here. Based on this overlap information, all use data layers for chlorophacinone were <5% overlap. For zinc phosphide uses, percent overlap with pesticide sensitive areas exceeded 5% for rights-of-way and open space developed (medium overlap). High (>10%) overlap was identified for pasture, rangeland and non-cultivated use data layers. For these categories, the overlap is at 100%, indicating that the use data layer fully encompassed the pesticide sensitive area. Because the Attwater's prairie chicken is not expected to use all of these use sites, exposures are not expected when rodenticides are used on developed or open space developed areas.

Effects Determination for Current Registrations

As discussed above, EPA has no evidence that Attwater's prairie-chickens would be exposed to uses that are applied through bait stations or directly to burrows. The following rodenticides are only used in bait stations and/or burrows: brodifacoum, bromadiolone, difenacoum, difethialone, bromethalin, cholecalciferol, strychnine and warfarin. Therefore, the predicted determination for these rodenticides is no effect (NE) for the Attwater's prairie-chicken.

Although diphacinone has registered uses that involve broadcast applications, a NLAA determination is predicted because the likelihood of mortality from diphacinone is considered low for adult Attwater's prairie-chickens that consume this rodenticide.

As discussed above, there is potential concern for exposures of Attwater's prairie-chickens to chlorophacinone and zinc phosphide through consumption of bait from broadcast applications. Acute dose-based RQs exceed the acute risk to listed species LOC for both rodenticides. Based on the estimated magnitude of effect (**Table 5**), chlorophacinone and zinc phosphide are predicted to likely to adversely affect (LAA) an individual Attwater's prairie-chicken if exposed through consumption of bait.

For those two chemicals with LAA determinations (*i.e.,* chlorophacinone and zinc phosphide), EPA went on to predict whether these chemicals are likely to jeopardize the Attwater's prairie-chicken. As discussed above, this species has a high vulnerability (population estimate is approximately 100-200 individuals over the last 5 years (USFWS 2021b).

Zinc phosphide has a high magnitude of effect and fell into the medium overlap for rights-of-way and the high overlap category for pasture, rangeland and non-cultivated use data layers. Chlorophacinone has a medium magnitude of effect and low (<5%) overlap for all use data layers. In combination with the species high vulnerability, EPA predicts that broadcast uses of zinc phosphide are likely to jeopardize the Attwater's prairie-chicken, if this rodenticide is used in their limited habitats. Because the overlap with chlorophacinone use sites is <5%, overlap is considered low and EFED predicted that this rodenticide is not likely to jeopardize this species.

Table 7 summarizes the effects determinations for the rodenticides for the Attwater's prairie-chicken. For broadcast uses of zinc phosphide, EPA is proposing mitigations to avoid jeopardizing this species. In addition, OPP is proposing mitigations to minimize take from chlorophacinone and zinc phosphide. The following section evaluates the proposed mitigations.

Table 7. Summary of draft effects determinations for the Attwater's prairie-chicken (*Tympanuchus cupido attwateri*)[1,2] for current registered uses of rodenticides. For all LAA determinations, EPA predicted whether jeopardy is likely or not.

Rodenticide	Draft Individual Level Determination	Predicted likelihood of jeopardy	Comments relevant to jeopardy determination
Brodifacoum	NE	NA	Exposure not expected because broadcast applications not allowed on current labels
Bromadiolone	NE	NA	Exposure not expected because broadcast applications not allowed on current labels
Bromethalin	NE	NA	Exposure not expected because broadcast applications not allowed on current labels
Cholecalciferol	NE	NA	Exposure not expected because broadcast applications not allowed on current labels
Chlorophacinone	LAA	Not Likely Jeopardy	Broadcast applications are allowed on current labels. Medium magnitude of effect to exposed individuals. Jeopardy not predicted due to low overlap.
Difenacoum	NE	NA	Exposure not expected because broadcast applications not allowed on current labels
Difethialone	NE	NA	Exposure not expected because broadcast applications not allowed on current labels
Diphacinone	NLAA	NA	Broadcast applications are allowed on current labels; however, low likelihood of mortality to an individual.
Strychnine	NE	NA	Exposure not expected because broadcast applications not allowed on current labels
Warfarin	NE	NA	Exposure not expected because broadcast applications not allowed on current labels
Zinc phosphide	LAA	Likely Jeopardy	High magnitude of effect to exposed individuals; high/medium overlap.

[1]NE = no effect; NLAA = not likely to adversely affect; LAA = Likely to Adversely Affect; NA = not applicable

[2]The high vulnerability of the Attwater's prairie-chicken also factors into the jeopardy likelihood determinations.

Evaluation of Proposed Mitigations

As discussed in Section 3, OPP is proposing to prohibit broadcast applications of chlorophacinone and zinc phosphide baits to grassland, pasture and rights-of-way areas located within the FWS defined pesticide sensitive areas of the Attwater's prairie-chicken (**Figure 2**). These mitigations are intended to reduce take for both chlorophacinone and zinc phosphide and avoid jeopardy for zinc phosphide. Broadcast applications are being limited on these use sites because they represent areas where the Attwater's prairie-chicken is expected to occur (based on its habitat). Broadcast applications of diphacinone would still be allowed in this area with no restrictions. Other rodenticide applications may still be allowed within the pesticide sensitive areas if they are applied directly to burrows or contained within tamper-resistant bait stations. The proposed mitigations restricting broadcast applications on specific use sites are consistent with those recommended by FWS for the Attwater's prairie-chicken (USFWS, 2004). Given that the prohibitions on chlorophacinone and zinc phosphide broadcast applications are spatially explicit, OPP proposes to implement these mitigations using BLT.

Once the rodenticide is contained in a tamper-resistant bait box or in burrows, it is unlikely that an individual Attwater's prairie-chicken would have access to rodenticide bait. Bait that is kicked or spilled out of the bait stations can be cleaned up to reduce exposure risk. This is expected to minimize exposures to individuals such that chlorophacinone and zinc phosphide are predicted to not likely to adversely affect an individual or jeopardize a species' population. In addition to species-specific mitigations, RUP classification of specific rodenticide products will help with implementation of these mitigations, because the applicator is more likely to be aware of Attwater's prairie-chickens in the area to avoid broadcast bait applications.

Consideration of Other Listed Species

The Attwater's prairie-chicken was chosen as a pilot species because it represents a bird that is a primary consumer. When considering the diets of endangered and threatened bird species, EPA preliminarily identified 27 additional species that may be primary consumers of rodenticide baits (**Appendix C**). The approach used here to predict potential adverse effects from broadcast uses of rodenticides may be adapted when EPA assesses potential effects to these 27 species. Some notable differences between Attwater's prairie-chicken and these other species include:

- body weight (different default RQs may be used for smaller species);
- order (many of these species are passerines, so, exposures from diphacinone may not be overestimated);
- habitat type (some of these species may use forests); and,
- overlap of range with rodenticide broadcast use sites.

When considering mitigations, use of a bait station to limit exposure of uses that have a predicted likelihood of potential jeopardy to individuals or adverse modifications their respective critical habitats are expected to be reasonable approaches to reducing exposures to other species of listed birds. In applying this mitigation, it may need to be applied to different rodenticides and uses that are relevant to different species. In addition, the size of entry holes may need to be adjusted for different sized birds. Finally, of the 27 other listed birds that are primary consumers, six may also be exposed through secondary exposure. For those species, secondary exposure can be assessed and additional mitigation measures may be needed. These analyses and mitigations can be adapted based on the approach discussed below for the California condor.

4.3. California Condor (*Gymnogyps californianus*)

Overall Vulnerability

The California condor (Entity ID 66) is the only remaining member of its genus (*Gymnogyps*) in the family Cathartidae and is one of the rarest species of birds in the world. Condors are very large birds, averaging approximately 4 feet in height with a 9.5 ft wingspan. The California condor was listed as endangered across its entire range in 1967 (USFWS, 2013) and reached near extinction in the 1980's, but due to intense conservation efforts, the population has increased in its historic range encompassing Arizona, California, Nevada, and Utah (**Figure 3**). In 2020, 504 individuals were estimated to be left in the wild (National Park Service, 2020). When considering factors that impact the vulnerability of this species (*e.g.,* population size and trajectory, habitat quality, distribution), FWS considers this species to have high overall vulnerability (USFWS 2022a).

Magnitude of Effect

California condors are obligate scavengers that primarily feed on large mammalian carcasses (*e.g.,* deer (family Cervidae), elk (*Cervus canadensis* ssp. Nannodes), feral hogs (*Sus scrofa*), livestock (domestic ungulates), horses (*Equus ferus* caballus), pinnipeds (family Otariidae); however, medium- to small-sized carrion (*e.g.,* rabbit (Family Leporidae) and squirrels (family Scuridae)) also are consumed (USFWS, 2013). Warfarin is used to control feral hog populations; therefore, the species may be directly affected by warfarin if condors consume carcasses of this target pest, as the target pest is within the typical size class of California condor prey. Because the California condor consumes small mammals, including rodents, it is assumed that, if applied within or near the range of the species, condors may be secondary consumers of other rodenticide baits. **Appendix A** includes a summary of the target species application methods of the 11 rodenticides. Rodenticides may be broadcast as loose bait, placed directly in rodent burrows, and/or applied in bait stations. Because the California condor is an obligate scavenger, it may be exposed to all rodenticides via secondary consumption through the presence of rodenticide residues in the carcasses they consume.

As indicated in **Appendix B**, EFED has previously concluded that 10 of the 11 rodenticides considered in the memo may cause effects to secondary consumers. Cholecalciferol poses a low risk to secondary consumers; therefore, an NE determination is made for this rodenticide. Bromethalin is most likely to cause secondary exposure to small mammals and birds (USEPA, 2020b), which are considered only a small part of the condor prey base as the condor prioritizes medium to large mammal carcasses to consume (USFWS, 1996). Because of the low magnitude of effect estimated for condors due to its effects on a small portion of the condor prey base and its relatively fast-acting mode of action within target pests, EPA made a draft NLAA determination on the condor for this rodenticide. Effects of the 7 anticoagulants, strychnine and zinc phosphide are summarized in Table 8 and discussed below.

Table 8. Acute and chronic toxicity endpoints and estimated exposures for rodenticides relevant to the California condor (*Gymnogyps californianus*). Incidents reported from 2008-Present.

Rodenticide	LC_{50} (mg a.i./kg-diet)	Chronic NOAEC or LOAEC (mg/kg-diet) [1]	Concentration in body of prey (mg a.i./kg-carcass)	Number of incidents reported for avian secondary consumers that are scavengers, from 2008-present	Magnitude of effect
Bromadiolone	158	0.09	1.8	46 (659 affected)	High
Brodifacoum	0.8	0.002	26	219 (1664 affected)	High
Chlorophacinone	56	0.096	4.1	6 (22 affected)	High
Difenacoum	14.1	0.008	0.74	8 (16 affected)	High
Difethialone	0.56	0.001	2.7	50 (55 affected)	High
Diphacinone	906	0.5	3.4	15 (17 affected)	High
Strychnine	212	33.2	5,000 9,700 (SLN)	57	High
Warfarin	625	0.5	3.0	6 (6 affected)	High
Zinc Phosphide	470	Not available	460	0	High

[1]Chronic no-observed adverse effect concentration (NOAEC) and lowest-observed adverse effect concentration (LOAEC) values from most sensitive tested species. Test species was either mallard duck (*Anas platyrhynchos*) or bobwhite quail (*Colinus virginianus*). The chronic toxicity endpoint and resulting RQs were derived from the empirical chronic toxicity NOAEL provided in a chlorophacinone mallard duck study and should only be used for qualitative purposes.
SLN = special local need

Acute exposures

Estimated concentrations in prey exceed sub-acute dietary LC_{50} values for brodifacoum and difethialone, which are both SGARs. For other SGARs (bromadiolone and difenacoum), exposures are 2 orders of magnitude below the LC_{50}. Although some SGARs are anticipated to pose a risk to birds on an acute basis, SGAR acute exposures are limited based on the mandatory bait station use pattern.

For the FGARs (chlorophacinone, diphacinone and warfarin), estimated exposures are 1-2 orders of magnitude below the LC_{50}. This suggests that the likelihood mortality to individuals may be limited for acute exposures to the FGARs.

Estimated exposures an order of magnitude above the LC_{50} for strychnine and similar to the LC_{50} for zinc phosphide. This suggests that these two rodenticides may cause mortality to secondary consumers from sub-acute dietary exposures.

Chronic exposures

When data are available, OPP assesses rodenticide exposure to secondary consumers on a chronic basis (USEPA, 2020a, 2020, 2020c, 2020d, 2020e). The long half-lives of some rodenticides in the environment and animal tissue (primarily SGARs) also indicate there are chronic risk concerns from

exposure to rodenticides from all applications (in-burrow, bait station and broadcast), based on the ability of a primary consumer to consume the rodenticide bait from any source and carry the active ingredient(s) from the initial use site to their place of death. The condor can be particularly vulnerable to the SGARs that persist in the environment and within the bodies of primary consumers for long periods of time, which reduces the mitigative power of bait stations to prevent rodenticide exposure for carcass consumers. Based on the potential for multiple exposure routes of rodenticides that could lead to secondary consumption, and the physicochemical properties which make some rodenticides efficacious over long periods of time, the California condor may be exposed to rodenticides on a chronic basis, regardless of use pattern of the rodenticide.

The environmental fate properties of rodenticides, especially the SGARS (*e.g.,* the long degradation half-lives in mammal livers of 29 to 318 days for the SGARs; USEPA, 2020a), suggest that condors could be exposed to them long after the deceased animal ingested the active ingredient (USEPA, 2020a). The long half-lives also increase the extent to which rodenticides could be available in their active form within the condor range and increase the likelihood that a condor could experience adverse effects from consuming a contaminated carcass. As discussed above (for the Attwater's prairie chicken), available chronic toxicity data for chlorophacinone are bridged to represent potential effects of other anticoagulant rodenticides. Table 8 presents the estimated NOAEC and LOAEC values for the anticoagulants as well as the empirically based values for chlorophacinone and strychnine. This table also presents estimated exposures in primary consumers as well as the ratio of these exposure and chronic toxicity endpoints. Chronic effects represent 6% decrease in weight of survivors at the LOAEC. As shown in this table, estimated exposures are above the toxicity values, indicating that there is a potential for chronic effects.

There is notable uncertainty in this approach because no empirical toxicity data are available for 6 of the anticoagulant rodenticides and for zinc phosphide. In addition, the LOAEC represents a relatively low magnitude of effect; however, for some rodenticides (brodifacoum, difethialone), exposures are 3-4 orders of magnitude above the chronic effect level.

The likelihood of effects from secondary exposure are not likely to be equal among the different rodenticides. Strychnine and zinc phosphide are relatively fast acting (mortality of primary consumers occurs within 24 hours; USEPA 2020b, 2020d, 2020e). The anticoagulant rodenticides can take several days to result in mortality from primary exposures. As a result, primary consumers of anticoagulants can consume larger amounts of the active ingredient, resulting in a potential higher exposure to secondary consumers. The use of rodenticides could increase the number of affected carcasses accessible to California condors, which would decrease their foraging grounds as the unaffected prey base would be reduced, and thus adversely modify the critical habitat of the species.

Incident reports

Additionally, there are incident reports which involve birds that are scavengers for all rodenticides relevant to California condor exposure, except for zinc phosphide. There are up to 219 incident reports for some rodenticides (*i.e.,* brodifacoum), which provides evidence that scavengers are impacted by rodenticides (**Table 8**).

Summary

The magnitude of effect is estimated to be high for all nine assessed rodenticides, based on the comparisons of estimated exposures and toxicity endpoints, and modes of action that take several days for the rodenticide to kill the prey and incident reports relevant to these rodenticides. Broadcast applications of chlorophacinone, diphacinone, strychnine and zinc phosphide, may increase the potential for exposure and effects of these a.i.'s on the California condor and its critical habitat.

Overlap

FWS designated approximately 570,400 acres of public and private lands as critical habitat for the California condor in six southern California counties: Ventura, Los Angeles, Santa Barbara, San Luis Obispo, Kern, and Tulare counties (**Figure 4**; USFWS, 1996). Critical habitat for the California condor was designated based on habitat components that contained physical or biological features (PBFs) that were deemed by FWS to be essential to the survival and health of the California condor populations. Those PBFs are: nest caves, roost trees, and foraging grounds necessary to the maintenance of wild condors, and expectations are that the released condors will eventually discover these habitats and utilize and use them (USFWS, 1996). The foraging ground PBF is the habitat component that is being considered relevant to rodenticide effects (**Figure 3**).

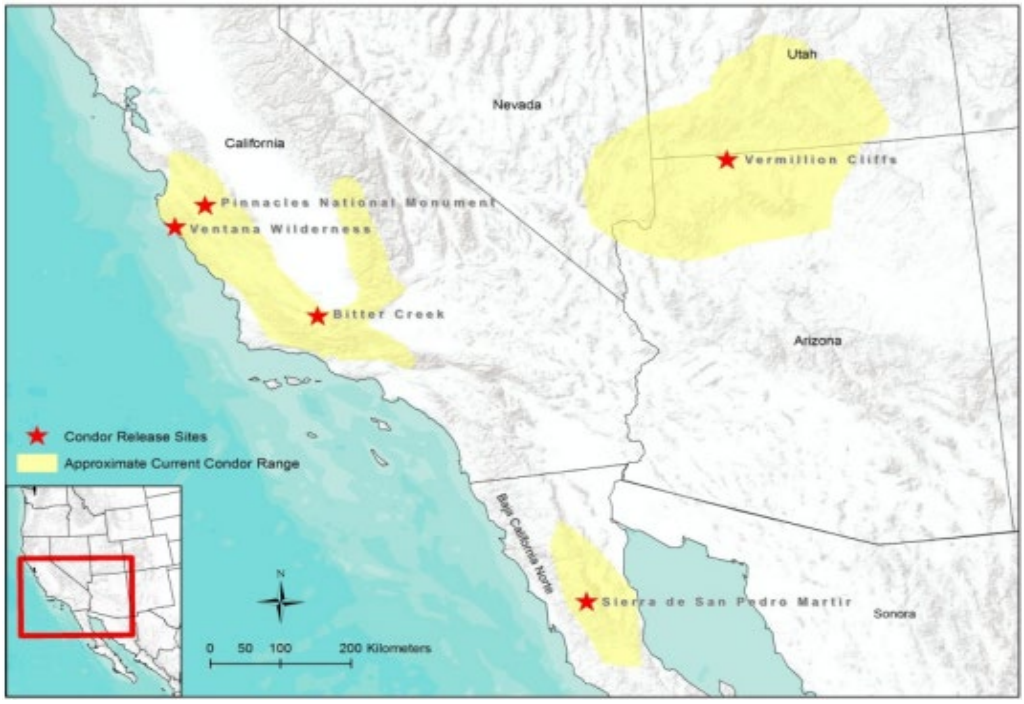

Figure 3. California condor range (*Gymnogyps californianus*) and active release sites from 2012 (USFWS, 2013)

Figure 4. California condor (*Gymnogyps californianus*) designated critical habitat, from the Environmental Conservation Online System (ECOS; retrieved April 15, 2022).

All of the assessed rodenticides could be used in areas that would be considered within the range and designated critical habitat of the California condor (*i.e.,* pasture, rangeland, rights-of-way, and managed and unmanaged forests). Specifically, chlorophacinone and zinc phosphide broadcast applications may be made to areas representing the habitat of this species (*e.g.,* pastures, rangeland), while all other rodenticides could be applied in burrows or tamper-resistant bait stations within the range or designated critical habitat. The overlap analysis (**Table 9**) only considers the rodenticides that 1) previous assessments have indicated may pose a risk to secondary consumers, which includes all rodenticides except cholecalciferol (USEPA, 2020c). Because bromethalin secondary exposure mainly affects small mammals and birds, which constitute a small portion of the condor prey base, bromethalin was also excluded from the overlap analysis.

The overlap analysis (**Table 9**) for the condor was considered for both on-field applications, and off-field (out to 1500 m from the application). The off-field consideration is based on the nature of secondary exposure to occur days after application, and it accounts for rodenticide primary consumers (that would become carcass prey) living and foraging for several days into and outside the condor range or designated critical habitat after feeding one or more times on rodenticide bait. The foraging distance of a feral hog is typically approximately 10 square kilometers (10,000,000 m; Hayes et al., 2009); therefore, the analyses included the overlap distances the furthest distance off-field to approximate the foraging distance of the target prey.

Because brodifacoum, bromadiolone, difenacoum, and difethialone uses do not overlap with the condor, secondary exposure is not expected for these rodenticides. The overlap analysis did not include

any UDLs that would overlap with SGAR use because the 2008 Risk Mitigation Decision (RMD) required that all SGAR products registered for use in residential settings be in securable bait form (*i.e.,* in a tamper-resistant bait station) within 50 ft of a building. The RMD was revised in 2012 to allow for SGARs to be used in and within 100 feet of man-made structures, including homes, in sizes >8 lbs. Above ground uses must also be made within 100 ft of structures, and fence line baiting is prohibited. Current labels have these restrictions. These uses are not included in the UDLs assessed in the overlap process, and the SGARs do not overlap with the condor range. Based on the lack of overlap, effects are not expected to the California condor from secondary exposure to SGARs.

Table 9. Overlap of potential rodenticide use sites and range and designated critical habitat of the California condor (*Gymnogyps californianus*).

	Pasture	**Rangeland**	**Managed Forests[1]**	**Forest Trees**	**Rights of Way[1]**
% Overlap	94	94	44	57	72
Active Ingredient	*Pasture*	*Rangeland*	*Managed Forests[1]*	*Forest Trees*	*Rights of Way[1]*
Brodifacoum	NA	NA	NA	NA	NA
Bromadiolone	NA	NA	NA	NA	NA
Chlorophacinone	NA	NA	Tree and Forestry Plantations	NA	NA
Difenacoum	NA	NA	NA	NA	NA
Difethialone	NA	NA	NA	NA	NA
Diphacinone	NA	Rangeland	Forestry Plantations	NA	Levees
Strychnine	Pasture	Rangeland	Forestry Land	Forestry Land	NA
Warfarin	Pasture	Rangeland	Forests	Forests	NA
Zinc Phosphide	Pasture, timothy grass	Rangeland	Tree farms, tree plantations	Tree farms, tree plantations	Highway medians, canal, and waterway rights-of-way

NA = not applicable

[1]These overlaps only apply to the range of the California condor, not the critical habitat.

In the malathion BiOp, FWS considered uses that were <5% to be low overlap, uses with 5-10% overlap to be medium overlap and uses >10% overlap to be high overlap. OPP is using the same categories in this assessment. Based on the overlap information presented in **Table 9**, all UDLs for chlorophacinone, diphacinone, warfarin, strychnine, and zinc phosphide have high overlap with the California condor. Brodifacoum, bromadiolone, difenacoum, and difethialone did not overlap with the range and critical habitat of the California condor; EPA has predicted a no effects (NE) determination from these rodenticides to the species.

Effects Determination for Current Registrations

As discussed above, California condors are expected to be potentially affected by the use of all the rodenticides mentioned in this assessment through secondary consumption. However, as mentioned above, cholecalciferol does not pose an exposure risk to secondary consumers; therefore, the predicted draft determination for this rodenticide is no effect (NE) for the California condor. Because bromethalin poses a secondary risk to mainly small mammals and birds, which constitute only a small portion of the condor prey base, an NLAA determination for condors is predicted for this rodenticide.

As discussed above, there are potential effects from secondary exposures of the California condor to 5 out of 10 rodenticides which may affect to the species, as the condor overlaps with the rodenticide uses. Chronic dose-based exposures exceed the chronic NOAEC for all rodenticides and there are incident reports associated with secondary consumers and rodenticides. Based on the estimated magnitude of effect (**Table 8**), the remaining rodenticides of concern are likely to adversely affect (LAA) an individual California condor if secondarily exposed through consumption of primary consumer carcasses.

For the rodenticide active ingredients with LAA determinations, EPA considered whether there was a likelihood of potential jeopardy for the California condor species or a likelihood of adverse modification of its designated critical habitat. As discussed above, this species has a high vulnerability (population estimate is approximately 504 individuals over the last 5 years; National Park Service, 2020).

The five rodenticides with LAA determinations have a high magnitude of effect and fell into the high overlap for all use data layers that overlap with the California condor range (pasture, rangeland, managed forests/forest trees, and rights-of-way) and designated critical habitat (pasture, rangeland, and managed forests). Therefore, EFED predicted that, based on current registrations, there is a likelihood of jeopardy for the California condor and a likelihood of adverse modification of its designated critical habitat.

Table 10 summarizes the effects determinations for the rodenticides for the California condor. For uses of the five rodenticides, EPA is proposing mitigations predicted to avoid jeopardizing this species and adversely modifying its designated critical habitat. The following section evaluates the proposed mitigations.

Table 10. Summary of draft effects determinations for the California condor (*Gymnogyps californianus*)[1,2] for current registered uses of rodenticides. For all LAA determinations, EPA predicted whether jeopardy or adverse modification (J/AM) is likely or not.

Rodenticide	Draft Individual Level Determination	Predicted likelihood of J/AM	Comments relevant to J/AM determination
Brodifacoum	NE	NA	Secondary exposure is not expected, based on no use overlap with the range or critical habitat.
Bromadiolone	NE	NA	Secondary exposure is not expected, based on no use overlap with the range or critical habitat.
Bromethalin	NLAA	NA	Secondary exposure is not expected, based on the low likelihood of the species consuming small mammals and birds.
Cholecalciferol	NE	NA	Secondary exposure is not expected, as cholecalciferol does not pose a secondary exposure risk to birds.
Chlorophacinone	LAA	Likely Jeopardy/Adverse Modification	Secondary exposure is expected; the high vulnerability of the species and the high overlap lead to a prediction of likelihood of jeopardy/adverse modification
Difenacoum	NE	NA	Secondary exposure is not expected, based on no use overlap with the range or critical habitat
Difethialone	NE	NA	Secondary exposure is not expected, based on no use overlap with the range or critical habitat
Diphacinone	LAA	Likely Jeopardy/Adverse Modification	Secondary exposure is expected; the high vulnerability of the species and the high overlap lead to a prediction of likelihood of jeopardy/adverse modification
Strychnine	LAA	Likely Jeopardy/Adverse Modification	Secondary exposure is expected; the high vulnerability of the species and the high overlap lead to a prediction of likelihood of jeopardy/adverse modification
Warfarin	LAA	Likely Jeopardy/Adverse Modification	Secondary exposure is expected; the high vulnerability of the species and the high overlap lead to a prediction of likelihood of jeopardy/adverse modification
Zinc phosphide	LAA	Likely Jeopardy/Adverse Modification	Secondary exposure is expected; the high vulnerability of the species and the high overlap lead to a prediction of likelihood of jeopardy/adverse modification

[1]NE = no effect; NLAA = not likely to adversely affect; NA = not applicable; LAA = Likely to adversely affect

[2]The high vulnerability of the California condor also factors into the jeopardy determinations.

Evaluation of Proposed Mitigations

To avoid jeopardy and adverse modification to the California condor and its respective designated critical habitat, OPP proposes measures that would mitigate effects to the California condor from secondary exposure to rodenticides. The proposed mitigations would aim to reduce the amount of condor prey affected by primary exposure to rodenticides. This would be accomplished by reducing the rodenticide footprint within the California condor range and critical habitat. The proposed mitigations would apply to the entire range and designated critical habitat of California condor, which is located

within states in the Western contiguous U.S. Currently the mitigations proposed have been recommended in California alone, as outlined in the PRESCRIBE database. OPP is proposing to incorporate the following mitigations into Bulletins Live! Two. The mitigations include:

- For broadcast or dust formulations of chlorophacinone, diphacinone, and zinc phosphide, do not make applications within 200 yards by air or 40 yards by ground upwind from California condor range and/or designated critical habitat when air currents are moving towards those areas. When air is calm or moving away from the range or designated critical habitat, apply on the side nearest those areas and proceed away. The following uses are still permitted within the use area: bait stations, burrows, bait paste, floating bait stations, and tracking powders.
- Prohibit rodenticide use for feral hog control within the range and designated critical habitat of the California condor, unless the applicator coordinates with the local FWS office to ensure that the proposed application is expected to have minor effects on the species.
- Search the treated area to collect and dispose of dead carcasses. Search for non-target organisms 3 days after first application and continue searches daily for the first 4 days of searching. After day 6, continue searches at subsequent intervals of 1 to 2 days for at least 2 weeks after the last bait application, or longer if carcasses are still being found. Wearing gloves, collect and properly dispose of visible carcasses by burial, dispose of in the trash, or dispose of according to the Pesticide Disposal instructions. All carcasses must be disposed of in a way inaccessible to wildlife.

Prohibiting broadcast applications within set distances of occupied condor range or designated critical habitat would reduce the chance of rodenticide consumption by the prey of the condor, thereby reducing the likelihood of effects in California condors that could occur from secondary exposure. This prohibition would then focus the mitigations on rodenticide bait station and burrow uses.

Prohibiting rodenticide use for feral hog control within the range and designated critical habitat of the California condor would reduce the secondary exposure a California condor would encounter from consuming this target pest, which is notable as the feral hog is a large mammal, the top prey for the California condor. Ideally, alternative methods of controlling the feral hog could be used within the range of the California condor, including hunting or the use of chemical control that is less likely to cause adverse effects to secondary consumers. If hunting, trapping, or other methods of capture are implemented, feral hog carcasses could be left within the condor range to maintain prey availability for condors that is sustainable for their survival.

Implementing carcass survey/search and disposal for treated areas by certified rodenticide applicators within condor range and designated critical habitat could reduce the chance that a condor would consume a carcass contaminated with rodenticides. Survey/search and disposal would address potential exposure from primary consumers that ingested rodenticides via broadcast applications outside of the 200-yard air/40-yard ground buffer, that may wander into the species' range and critical habitat. Carcass survey/search and disposal would consequently reduce lethal and sublethal effects to California condors from secondary exposure to rodenticides. This measure was also implemented in the Rozol™ biological opinion (USFWS, 2012), to avoid impacts to the federally listed Northern Aplomado falcon (*Falco femoralis*), a species that is also a potentially exposed to rodenticides through secondary consumption. The mitigations should be implemented so that the restrictions on use would limit the likelihood of non-target primary consumption, and therefore uncontaminated prey availability would presumably increase. This would mean that effects to the foraging grounds of California condors (a PBF of its critical habitat) would be reduced, and adverse modification of the designated critical habitat is

predicted to be avoided. Reporting the number of dead and dying animals that appear to be affected by rodenticides to respective reporting outlets (*e.g.,* the National Pesticide Information Center) would supplement this mitigation well by accounting for the volume of affected prey in the condor range.

It is recognized that carcass survey/search and disposal as a rodenticide bait box/burrow use mitigation measure only eliminates a portion of affected carcasses. In addition to species-specific mitigations, RUP classification of specific rodenticide products can provide benefit to implementation of California condor mitigations in that the applicators would be more informed, and applications are expected to be more skillful and intentional (*e.g.,* the applicator is trained in carcass survey/search techniques, or the applicator is aware of condors in the area to avoid broadcast bait applications).

Uses of many of the rodenticides are likely to adversely affect condors; however, the proposed mitigations would reduce the impact of rodenticides on California condors such that EPA can predict that the rodenticides would not likely jeopardize this species or adversely modify its designated critical habitat. (**Table 10**).

Consideration of Other Listed Species

The California condor was chosen as a pilot species because it represents a bird that is a secondary consumer. When considering the diets of endangered and threatened bird species, EPA has preliminarily identified 11 additional avian species that may be secondary consumers of rodenticide baits (**Appendix C**). The approach used here to predict potential effects from broadcast uses of rodenticides may be adapted when EPA assesses potential effects to these 11 species. Some notable differences between the California condor and these other species include:

- body weight (different default weights may be used for smaller species);
- order (many of these species are raptors (*e.g.,* Accipitriformes. Falconiformes); also, scavengers within other orders);
- diet (the species on the list might consume living prey or be exposed to rodenticides via routes other than consuming carcasses. For instance, a J/AM call could be predicted for bromethalin use on secondary consumers such as raptors for which small rodents make up a large portion of their prey base (An NLAA call was made for condors, which more often prey on medium-to-large mammal carcasses);
- habitat type (some of these species may use residential areas or other non-agricultural areas); and,
- overlap of range with rodenticide broadcast use sites.

When considering mitigations, prohibiting uses to limit exposure that result in potential jeopardy or adverse effects to individuals, and implementing carcass survey and disposal within the species range and designated critical habitat are expected to be reasonable approaches to reducing exposures to other species of listed birds. If accepted through discussions with FWS, the mitigations may need to be modified to different rodenticides and uses that are relevant to the other 90 listed species that may be adversely affected by rodenticides (**Appendix B**). Finally, of the 11 other listed birds that are secondary consumers, 4 may also be exposed through primary exposure. For those species, secondary exposure can be assessed, and additional mitigation measures may be needed. These mitigations can be adapted based on the approach discussed above for the Attwater's prairie-chicken.

5. Conclusions

For the PID for the registration review of the rodenticides, OPP is proposing mitigations intended to reduce exposures to non-target species that may be primary or secondary consumers of rodenticide bait. OPP is proposing some additional mitigations intended to avoid jeopardizing three specific listed species: Stephens' kangaroo rat, Attwater's prairie-chicken, and the California condor and the critical habitat of the California condor. These species were chosen because they represent primary and secondary consumers of rodenticides. For the three pilot listed species, OPP is proposing the following additional geographically-specific mitigations that would be implemented using BLT:

- For the Stephens' kangaroo rat, rodenticide applications are only allowed within the species range if products are placed within specially designed bait stations that allow access of the target species but limit access of the Stephens' kangaroo rat (see **Appendix D** for bait station designs for the California ground squirrel). Broadcast and in-burrow uses would be prohibited within the range of this species.
- For the Attwater's prairie-chicken, broadcast applications of chlorophacinone and zinc phosphide are prohibited on grassland, pasture, and rights-of-way areas within the "pesticide sensitive area" of the species' range, as defined by FWS (see **Figure 2**). Applications of all rodenticides are allowed if products are placed within tamper-resistant bait stations or directly within burrows of target pests. Broadcast applications of diphacinone are still allowed with no restrictions for this species.
- For the California condor, broadcast applications of rodenticides are prohibited within its range, and carcass searches must be conducted for at least two weeks after any rodenticide application. Carcasses must be collected and disposed of properly. Warfarin use to control feral hogs is prohibited within the range of the species unless the applicator coordinates with the local FWS field office.

OPP predicted that the current uses of the rodenticides (without mitigations) are likely to jeopardize these three species or adversely modify the designated critical habitat of the California condor. EPA predicts that with the proposed mitigations there is not a likelihood that the rodenticides would jeopardize the Stephens' kangaroo rat, Attwater's greater prairie-chicken, and the California condor, or adversely modify the designated critical habitat of the California condor. Draft mitigations for these three species are proposed in the PID, with the intent that OPP will use them as examples for developing mitigation for other listed species that may be primary or secondary consumers of rodenticides. All draft determinations discussed in this memo are subject to modification through new information and further discussions with FWS after the PID. These proposed mitigations may be revised after discussion with FWS, and after receiving feedback from FWS, stakeholders, and registrants.

6. References

Hayes, RA. et al. 2009. Survival and Habitat Use of Feral Hogs in Mississippi. Southeastern Naturalist, 8(3): 411-426.

National Park Service. World CA Condor Update-2020. Glen Canyon National Recreation Area, Grand Canyon National Park, Pinnacles National Park, Redwood National and State Parks, Zion National Park. Accessed September 14, 2022.

Stafford, J.M. 2012. Reproductive Toxicity Test with the Mallard (*Anas platyrhynchos*), Following FIFRA Guideline 71-4, OPPTS 850.2300 and OECD 206. Unpublished study performed by Smithers Viscient (CRC), Snow Camp, NC. Laboratory Project No. 14007.4102. Study sponsored by Liphatech, Milwaukee, WI. Study initiated February 14, 2011 and completed November 8, 2012. MRID 48994002.

U.S. Environmental Protection Agency. 2008. Risk Mitigation Decision for Ten Rodenticides. Office of Pesticide Programs. Environmental Fate and Effects Division. May 28, 2008. Docket Number: EPA-HQ-OPP-2011-0718

U.S. Environmental Protection Agency. 2011. Risks of Non-Compliant Rodenticides to Nontarget Wildlife, Background Paper for Science Advisory Panel on Notice of Intent to Cancel Non-RMD compliant Rodenticide Products. U.S. Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Office of Pesticide Programs, Environmental Fate and Effects Division.

U.S. Environmental Protection Agency. 2020a. Seven Anticoagulant Rodenticides: Draft Ecological Risk Assessment for Registration Review. Office of Pesticide Programs. Environmental Fate and Effects Division. March 17, 2020. DP 453282.

U.S. Environmental Protection Agency. 2020b. Bromethalin: Draft Ecological Risk Assessment for Registration Review. Office of Pesticide Programs. Environmental Fate and Effects Division. March 31, 2020. DP 456755.

U.S. Environmental Protection Agency. 2020c. Cholecalciferol: Draft Ecological Risk Assessment for Registration Review. Office of Pesticide Programs. Environmental Fate and Effects Division. March 31, 2020. DP 456480.

U.S. Environmental Protection Agency. 2020d. Strychnine: Draft Ecological Risk Assessment for Registration Review. Office of Pesticide Programs. Environmental Fate and Effects Division. June 23,2020. DP 453652.

U.S. Environmental Protection Agency. 2020e. Zinc Phosphide: Draft Ecological Risk Assessment for Registration Review. Office of Pesticide Programs. Environmental Fate and Effects Division. June 24, 2020. DP 455987.

U.S. Fish and Wildlife Service. 1996. Recovery Plan for the California Condor. U.S. Fish and Wildlife Service, Pacific Region. April 25, 1996. 74 pp.

U.S. Fish and Wildlife Service. 2004. Recommended Protection Measures for Pesticide Applications in Region 2 of the U.S. Fish and Wildlife Service. U.S. Fish and Wildlife Service Region 2, Environmental Contaminants Program, Austin, TX. 199 pp.

U.S. Fish and Wildlife Service. 2012. Final Biological Opinion for Rozol Use on Black-tailed Prairie Dogs Registered Under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act. U.S. Fish and Wildlife Service, Ecological Services Region 6 and Region 2. April 9, 2012. 129 pp.

U.S. Fish and Wildlife Service. 2013. California Condor (*Gymnogyps californianus*) 5 Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Pacific Southwest Region. June 2013. 64 pp.

U.S. Fish and Wildlife Service. 2010. Attwater's Prairie-Chicken Recovery Plan, Second Revision. Albuquerque, New Mexico. 107 pp.

U.S. Fish and Wildlife Service. 2020. Species Report for the Stephens' kangaroo rat (*Dipodomys stephensi*). Version 1.1, July 30, 2020. U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. xi + 125 pp.

U.S. Fish and Wildlife Service. 2021a. Species Report for the Stephens' kangaroo rat (*Dipodomys stephensi*). Version 1.2, August 2021. U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. xii + 121 pp.

U.S. Fish and Wildlife Service. 2021b. Attwater's Greater Prairie-Chicken (*Tympanuchus cupido attwateri*) Five Year Review Summary and Evaluation. Attwater's Prairie-chicken National Wildlife Refuge, Eagle Lake, Texas and Texas Coastal Ecological Services, Houston, TX. May 26, 2021.

U.S. Fish and Wildlife Service. 2022a. Final Biological and Conference Opinion on the Registration of Malathion Pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act. Ecological Services Program, Headquarters. February 28, 2022.

U.S. Fish and Wildlife Service. 2022b. Federal Register Notice: [Docket No. FWS-R8-ES-2019-0113] Reclassification of Stephens' Kangaroo Rat from Endangered to Threatened, with a 4(d) Rule, on the Federal List of Endangered and Threatened Wildlife.

Appendix A. Summary of Rodenticide Uses

Table A. Summary of Rodenticides, Current Uses, and Potentially Exposed Pilot Listed Species

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)	Potentially Exposed Pilot Listed Species[1]
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	Stephens' kangaroo rat, California condor
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	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	Stephens' kangaroo rat, California condor

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)	Potentially Exposed Pilot Listed Species[1]
				prohibited. Product can be used both in and outdoors>	mice, golden mice, Polynesian rat, meadow vole, white-throated woodrat, Southern plains and Mexican woodrat	
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	Stephens' kangaroo rat
			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	Stephens' kangaroo rat
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	Attwater's prairie-chicken, Stephens' kangaroo rat, California condor

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)	Potentially Exposed Pilot Listed Species[1]
					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	
			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	Stephens' kangaroo rat, California condor
Cholecalciferol	202901	Binds to Vitamin D receptors which leads to	Bait Stations (tamper-resistant if used above ground)	In and within 100 feet of man-made structures including homes, temporary and permanent	Bushytail woodrats, cotton rat, house mice, meadow vole, Mexican woodrat,	Stephens' kangaroo rat

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)	Potentially Exposed Pilot Listed Species[1]
		increase in serum calcium and results hypercalcemia (this chemical is Vitamin D_3)		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.	Norway rat, Polynesian rat, roof rat, Southern plains woodrat, whitethroat woodrat, meadow vole	
			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 listed above).	Norway rats, roof rats and house mice	Stephens' kangaroo rat
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	Stephens' kangaroo rat, California condor
Difethialone	128967	Anticoagulant (Vitamin K antagonist)	Bait Stations (tamper-resistant bait stations;	Can be used in and within 100 feet from manmade structures including permanent or	Bushytail woodrats, Cotton rat, Deer mouse, Harvest mice, House mouse,	Stephens' kangaroo rat, California condor

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)	Potentially Exposed Pilot Listed Species[1]
			can only be applied by certified applicators)	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.	Meadow vole, Mexican woodrat, Norway rat, Polynesian rat, Roof rat, Southern plains woodrat, White-footed mouse, Whitethroat woodrat	
Diphacinone	067701	Anticoagulant (Vitamin K antagonist)	Broadcast	CRP lands, forests	California ground squirrel	Attwater's prairie-chicken, Stephens' kangaroo rat, California condor
			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	Stephens' kangaroo rat, California condor

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)	Potentially Exposed Pilot Listed Species[1]
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)	Stephens' kangaroo rat, California condor
Warfarin	086002	Anticoagulant (Vitamin K antagonist)	Feeding station where hogs must lift the doors with their snouts in order to access bait (do not apply directly to ground)	Pastures, rangelands, forest and non-crop areas.	Feral hogs	California condor
			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	Stephens' kangaroo rat, California condor

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)	Potentially Exposed Pilot Listed Species[1]
			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	Stephens' kangaroo rat, California condor
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-tail 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	California condor, Attwater's Praire Chicken Stephens' kangaroo rat
			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	House mice, Norway rat, Roof rat, Cotton rat, Eastern harvest mice, Golden mice, Polynesian rat, Meadow vole, White-	

Rodenticide Active Ingredient	PC Code	Mode of Action	Current Application method	Current Use sites	Target Pest(s)	Potentially Exposed Pilot Listed Species[1]
				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.	throated woodrat, Southern plains woodrat, Mexican woodrat	
			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	

[1] Attwater's Greater Prairie-chicken (*Tympanuchus cupido attwateri*), Stephens' Kangaroo Rat (*Dipodomys stephensi*), and the California Condor (*Gymnogyps californianus*)

Appendix B. Summary of Risk Conclusions for Primary and Secondary Consumers Associated Incidents[1]

Rodenticide	Mode of Action	Risk to Primary Consumers (Chronic RQs Unless Otherwise Specified) Acute Listed LOC = 0.1 Chronic Listed LOC = 1.0		Risk to Secondary Consumers	
		Mammals	Birds	Mammals	Birds, Amphibians, Reptiles
Chlorophacinone	Vitamin K antagonist	Single Feeding: 0.80-**1.7** Multiple Feedings: **5.1-11**	Single Feeding: 0.02-0.07 Multiple Feedings: 0.13-0.43	Potential for Secondary	Potential for Secondary
Diphacinone		Single Feeding: 0.80-**1.7** Multiple Feedings: **4.6-10**	Single Feeding: 0.02-0.07 Multiple Feedings: 0.12-0.40	Potential for Secondary	Potential for Secondary
Warfarin		Single Feeding: **4.02-8.7** Multiple Feedings: **23-50**	Single Feeding: 0.11-0.34 Multiple Feedings: 0.62-**2**	Potential for Secondary	Potential for Secondary
Brodifacoum		Single Feeding: 0.40-0.87 Multiple Feedings: **27-59**	Single Feeding: 0.01-0.03 Multiple Feedings: **117-166**	Potential for Secondary	Potential for Secondary
Bromadiolone		Single Feeding: 0.40-0.87 Multiple Feedings: **2.66-12.81**	Single Feeding: 0.01-0.03 Multiple Feedings: 0.18-**1.49**	Potential for Secondary	Potential for Secondary
Difenacoum		Single Feeding: 0.80-**1.73** Multiple Feedings: **4.7-10.2**	Single Feeding: 0.02-0.07 Multiple Feedings: 0.12-0.40	Potential for Secondary	Potential for Secondary
Difethialone		Single Feeding: 0.4-**0.87** Multiple Feedings: **11-24**	Single Feeding: 0.01-0.03 Multiple Feedings: **52-168**	Potential for Secondary	Potential for Secondary
Bromethalin	Neurotoxicant	Acute RQs: **2.4-13**	Acute RQs: **2.4-20**	Potential for Secondary	Potential for Secondary
Cholecalciferol	Binds to Vitamin D receptors which leads to increase in serum calcium and results hypercalcemia (this chemical is Vitamin D_3)	Acute RQs: **2.3-24.4** Possible for small mammals to access bait stations or pellets in underground burrows	Acute RQs: <0.1 Likelihood of exposure for birds to treated bait low.	Low Potential for Secondary	Low Potential for Secondary
Strychnine	Neurotoxicant	Acute RQs: **90-383**	Acute RQs: **333-2094** Subacute RQs: **24-46**	Acute RQs: **64-192**	Acute RQs; **13-382** Sub-acute RQs: 0.7-**6.7**

Rodenticide	Mode of Action	Risk to Primary Consumers (Chronic RQs Unless Otherwise Specified) Acute Listed LOC = 0.1 Chronic Listed LOC = 1.0		Risk to Secondary Consumers	
		Mammals	**Birds**	**Mammals**	**Birds, Amphibians, Reptiles**
			Sublethal RQs: **150-293**		Sublethal RQs **4.6-55.9**
Zinc phosphide	MOA unclear, formation of phosphine gas in gut impairs a suite of cellular functions	Acute RQs: **38-85**	Acute RQs: **70-546** Subacute RQs: **43**	Acute RQs: **20-42**	Acute RQs: **70-100** Subacute RQs: **1.3-8.3**

[1]USEPA 2020a, USEPA, 2020b, USEPA, 2020c, USEPA, 2020d, USEPA, 2020e

Appendix C. Federally Listed Endangered and Threatened Species that Could be Exposed and Impacted by Rodenticides

As discussed in Section 2, the general ecological risk assessments for the rodenticides concluded that non-target birds, mammals, reptiles, and terrestrial-phase amphibians may be at risk from dietary exposure (primary or secondary) to rodenticides. These risk assessments were taxa-based. These assessments do not make species-specific risk conclusions. When conducting a species-specific assessment, EFED considers taxonomy and dietary requirements. EFED determined through that analysis that there are multiple listed species of birds, mammals, reptiles, and terrestrial-phase amphibians that may be exposed to rodenticides through primary or secondary exposure. EFED evaluated available listed species dietary information[16,17,18,19] to identify those listed mammals, birds, reptiles and amphibians that could be exposed as primary or secondary consumers of rodenticides. For those species that consume seeds or are omnivores, EFED assumed that they may be primary consumers of rodenticide baits. Some species were included because of available incident reports involving rodenticides and taxonomically similar species (*e.g.,* deer). For those species that consume mammals, birds or carrion, EFED assumed that they may be secondary consumers of rodenticides. EFED identified 91 listed species that may eat bait or secondarily consume mammals or birds containing rodenticide residues. Of those species, 37 have designated critical habitats (**Table C**). As part of registration review of the rodenticides, OPP is considering potential effects to listed species and identifying mitigations that are intended to avoid jeopardizing listed species or adversely modifying their critical habitats. As noted in Section 2, OPP intends to expand the approaches used for the pilot species included in this memo to assess effects of rodenticides and identify mitigations for the remaining species in **Table C**. Adjustments may be needed to account for species-specific considerations (*e.g.,* related to location, different overlap of range and use sites, different species life history). When EPA completes a full biological evaluation for the rodenticides, this species list may be revised based on changes to listing status or available information on species diet or life history.

Table C. Potential Listed Species that may be Primary or Secondary Consumers of Rodenticides

Common Name	Scientific Name	Critical Habitat?	Entity ID	Potential Rodenticide Exposure Route
Amargosa Vole	*Microtus californicus scirpensis*	Yes	28	Primary
Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*	No	83	Primary
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	Yes	85	Primary

[16] https://www3.epa.gov/pesticides/nas/final/attachment-1-16.docx
[17] https://www3.epa.gov/pesticides/nas/final/attachment-1-17.docx
[18] https://www3.epa.gov/pesticides/nas/final/attachment-1-18.docx
[19] https://www3.epa.gov/pesticides/nas/final/attachment-1-19.docx

Common Name	Scientific Name	Critical Habitat?	Entity ID	Potential Rodenticide Exposure Route
Carolina Northern Flying Squirrel	*Glaucomys sabrinus coloratus*	No	42	Primary
Columbian White-tailed Deer (Columbia River DPS)	*Odocoileus virginianus leucurus*	No	3	Primary
Florida grasshopper sparrow	*Ammodramus savannarum floridanus*	No	133	Primary
Florida Salt Marsh Vole	*Microtus pennsylvanicus dukecampbelli*	No	60	Primary
Fresno Kangaroo Rat	*Dipodomys nitratoides exilis*	Yes	37	Primary
Giant Kangaroo Rat	*Dipodomys ingens*	No	38	Primary
Hawaiian common moorhen	*Gallinula chloropus sandvicensis*	No	76	Primary
Hawaiian duck (=koloa)	*Anas wyvilliana*	No	69	Primary
Hawaiian Goose	*Branta (=Nesochen) sandvicensis*	No	73	Primary
Inyo California towhee	*Pipilo crissalis eremophilus*	Yes	137	Primary
Key Deer	*Odocoileus virginianus clavium*	No	4	Primary
Key Largo Cotton Mouse	*Peromyscus gossypinus allapaticola*	No	31	Primary
Key Largo Woodrat	*Neotoma floridana smalli*	No	32	Primary
Laysan finch (honeycreeper)	*Telespyza cantans*	No	71	Primary
Lesser prairie-chicken	*Tympanuchus pallidicinctus*	No	2691	Primary
Masked bobwhite quail	*Colinus virginianus ridgwayi*	No	89	Primary
Micronesian megapode	*Megapodius laperouse*	No	87	Primary
Morro Bay Kangaroo Rat	*Dipodomys heermanni morroensis*	Yes	16	Primary
Mount Graham Red Squirrel	*Tamiasciurus hudsonicus grahamensis*	Yes	43	Primary
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	Yes	5210	Primary
Nihoa finch (honeycreeper)	*Telespyza ultima*	No	72	Primary
Northern Idaho Ground Squirrel	*Spermophilus brunneus brunneus*	No	59	Primary
Olympia pocket gopher	*Thomomys mazama pugetensis*	Yes	8683	Primary
Pacific Pocket Mouse	*Perognathus longimembris pacificus*	No	51	Primary
Palila (honeycreeper)	*Loxioides bailleui*	Yes	79	Primary
Ponape mountain starling	Aplonis pelzelni	No	1658	Primary
Preble's Meadow Jumping Mouse	*Zapus hudsonius preblei*	Yes	52	Primary
Puerto Rican parrot	*Amazona vittata*	No	80	Primary
Puerto Rican plain pigeon	*Columba inornata wetmorei*	No	101	Primary
Red-cockaded woodpecker	*Picoides borealis*	No	107	Primary
Riparian Woodrat	*Neotoma fuscipes riparia*	No	62	Primary

Common Name	Scientific Name	Critical Habitat?	Entity ID	Potential Rodenticide Exposure Route
Rota bridled white-eye	*Zosterops rotensis*	Yes	1241	Primary
Roy Prairie pocket gopher	*Thomomys mazama glacialis*	No	3194	Primary
Salt Marsh Harvest Mouse (CA population)	*Reithrodontomys raviventris*	No	17	Primary
San Bernardino Merriam's Kangaroo Rat	*Dipodomys merriami parvus*	Yes	63	Primary
San Clemente sage sparrow	*Amphispiza belli clementeae*	No	116	Primary
Stephens' Kangaroo Rat	*Dipodomys stephensi (and D. cascus)*	No	39	Primary
Streaked Horned lark	*Eremophila alpestris strigata*	Yes	4296	Primary
Tenino pocket gopher	*Thomomys mazama tumuli*	Yes	8684	Primary
Tipton Kangaroo Rat	*Dipodomys nitratoides nitratoides*	No	40	Primary
Utah Prairie Dog	*Cynomys parvidons*	No	20	Primary
Yellow-shouldered blackbird	*Agelaius xanthomus*	Yes	117	Primary
Yelm pocket gopher	*Thomomys mazama yelmensis*	Yes	8685	Primary
Alabama Beach Mouse	*Peromyscus polionotus ammobates*	Yes	41	Primary + Secondary
Anastasia Island Beach Mouse	*Peromyscus polionotus phasma*	No	50	Primary + Secondary
Choctawhatchee Beach Mouse	*Peromyscus polionotus allophrys*	Yes	34	Primary + Secondary
Florida scrub-jay	*Aphelocoma coerulescens*	No	140	Primary + Secondary
Grizzly Bear (Cabinet-Yaak Recovery Zone Population)	*Ursus arctos horribilis*	No	7753	Primary + Secondary
Grizzly Bear (lower 48 states)	*Ursus arctos horribilis*	No	2	Primary + Secondary
Grizzly Bear (Selkirk Recovery Zone Population)	*Ursus arctos horribilis*	No	4110	Primary + Secondary
Mariana crow (=aga)	*Corvus kubaryi*	Yes	118	Primary + Secondary
Mississippi sandhill crane	*Grus canadensis pulla*	Yes	110	Primary + Secondary
Mona boa	*Epicrates monensis monensis*	Yes	164	Secondary
Perdido Key Beach Mouse	*Peromyscus polionotus trissyllepsis*	Yes	35	Primary + Secondary
San Joaquin Kit Fox (CA population)	*Vulpes macrotis mutica*	No	6	Primary + Secondary
Santa Catalina Island Fox (CA population)	*Urocyon littoralis catalinae*	No	1237	Primary + Secondary
Southeastern Beach Mouse (FL)	*Peromyscus polionotus niveiventris*	No	53	Primary + Secondary
St. Andrew Beach Mouse (FL)	*Peromyscus polionotus peninsularis*	Yes	54	Primary + Secondary
Whooping crane	*Grus americana*	Yes	67	Primary + Secondary
Yellow-billed Cuckoo (western DPS)	*Coccyzus americanus*	Yes	6901	Primary + Secondary
Audubon's crested caracara	*Polyborus plancus audubonii*	No	125	Secondary
Alameda whipsnake	*Masticophis lateralis euryxanthus*	Yes	183	Secondary

Common Name	Scientific Name	Critical Habitat?	Entity ID	Potential Rodenticide Exposure Route
American crocodile	*Crocodylus acutus*	Yes	176	Secondary
Black-footed Ferret	*Mustela nigripes*	No	5	Secondary
California condor	*Gymnogyps californianus*	Yes	66	Secondary
Canada Lynx	*Lynx canadensis*	Yes	24	Secondary
Eastern indigo snake	*Drymarchon corais couperi*	No	173	Secondary
Florida Panther	*Puma(=Felis) concolor coryi*	No	8	Secondary
Gray Wolf	*Canis lupus*	Yes	11	Secondary
Gray Wolf (MN)	*Canis lupus*	Yes	12	Secondary
Gulf Coast Jaguarundi (TX population)	*Herpailurus (=Felis) yagouaroundi cacomitli*	No	22	Secondary
Jaguar	*Panthera onca*	Yes	18	Secondary
Mexican gray wolf	*Canis lupus baileyi*	No	13	Secondary
Mexican spotted owl	*Strix occidentalis lucida*	Yes	129	Secondary
New Mexican ridge-nosed rattlesnake	*Crotalus willardi obscurus*	Yes	166	Secondary
Northern aplomado falcon	*Falco femoralis septentrionalis*	No	126	Secondary
Northern Mexican garter snake	*Thamnophis eques megalops*	Yes	1783	Secondary
Northern spotted owl	*Strix occidentalis caurina*	Yes	142	Secondary
Ocelot (AZ, TX)	*Leopardus (=Felis) pardalis*	No	30	Secondary
Puerto Rican Boa	*Epicrates inornatus*	No	156	Secondary
Puerto Rican broad-winged hawk	*Buteo platypterus brunnescens*	No	127	Secondary
Puerto Rican sharp-shinned hawk	*Accipiter striatus venator*	No	128	Secondary
Red Wolf	*Canis rufus*	No	14	Secondary
Rice rat (Lower FL Keys Population)	*Oryzomys palustris natator*	Yes	29	Secondary
San Clemente loggerhead shrike	*Lanius ludovicianus mearnsi*	No	115	Secondary
San Francisco garter snake	*Thamnophis sirtalis tetrataenia*	No	152	Secondary
Sinaloan Jaguarundi	*Herpailurus (=Felis) yagouaroundi tolteca*	No	23	Secondary
Virgin Island Tree Boa	*Epicrates monensis granti*	No	174	Secondary

Appendix D. Recommended design elements of California ground squirrel bait station to exclude Stephens' kangaroo rat

For control of California ground squirrels within the range of the range of the Stephen's kangaroo rat, OPP proposes to only use bait stations that are designed to exclude kangaroo rats. Whisson (1998)[20] conducted laboratory and field tests in order to establish bat station designs to allow entry by ground squirrels but exclude kangaroo rats, including Stephen's kangaroo rat and others that are also listed (*i.e.,* giant, fresno and tipton's kangaroo rats). Whisson proposed two designs. One involves elevating the bait stations to 12 inches or higher using a table platform. The other design allows for placement of the bait station on the ground with PVC pipes with upturned corners. Details on both designs and pictures are available through the California Department of Pesticide Regulation[21,22] . For other target pests (*e.g.,* voles), different designs may be needed to allow the target pest access.

[20] Whisson, Desley A., "Modified Bait Stations For California Ground Squirrel Control In Endangered Kangaroo Rat Habitat" (1998). Proceedings of the Eighteenth Vertebrate Pest Conference (1998). 80. http://digitalcommons.unl.edu/vpc18/80

[21] https://www.cdpr.ca.gov/docs/endspec/espdfs/elevated_bait_station.pdf

[22] https://www.cdpr.ca.gov/docs/endspec/espdfs/t_bait_station.pdf