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

MEMORANDUM

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SUBJECT: Ecological Risk Assessment Evaluating Expanded Uses for Rozol Black Tailed Prairie Dog Bait (Chlorophacinone 0.005%)

FROM: Ron Dean, Biologist
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THRU: Tom Bailey, Chief
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Environmental Fate and Effects Division (7507P)

It is requested that previous 24c Special Local Needs (SLN) labels for Black Tailed Prairie Dog control in Colorado, Kansas, Nebraska, Texas and Wyoming be expanded to include Arizona, Montana, New Mexico, North Dakota, Oklahoma and South Dakota. However, although part of its historic range, the Black Tailed Prairie Dog is now extirpated in Arizona (Lomolino and Smith 2003, USFWS 1999, Hafner *et al* 1998). Accidental misuse and the potential for primary and secondary exposure to nontarget species can be greatly reduced by excluding Arizona from the label. The product is food bait containing 0.005% ai (50 ppm) of the first generation anticoagulant rodenticide chlorophacinone.

The proposed label states that the applicator must return to the site within 5 to 10 days after bait application and again at 14-21 days after application to collect and properly dispose of any dead or dying Prairie Dogs found above ground. However, earlier SLN labels state that the applicator must return to the site within 2 days after bait application and at 1- to 2-day intervals. Collection of dead and dying poisoned animals is crucial in reducing the risk of secondary exposure through predation and scavenging. The potential for secondary exposure to nontarget species will be decreased if the label instructs the applicator to return after 2 days and at 1- to 2-day intervals.

EFED believes that it is essential that applicators adhere to instructions to conduct carcass searches periodically after baiting and to properly dispose of any Prairie Dog carcasses collected. Moreover, poisoned Prairie Dogs may be more easily subject to predation before they die, as they are likely to become progressively weaker as they hemorrhage for several days before death. Any non-target species impacted by this product should be collected and turned in to proper authorities for identification and tissue-residue analysis to determine if the animal was exposed to chlorophacinone. When available, that information also should be reported to the appropriate state agencies, to EPA, and to the USFWS.

The current label also states that reapplications may be made if activity persists several weeks to months after the bait was applied. This language is vague and could result in reapplications being made before monitoring and carcass removal occurs from the original application. Reapplication before monitoring and carcass removal will likely result an increased exposure to non target species.

Of special concern is the federally listed Black-Footed Ferret, which is the most endangered mammal in the United States (USFWS 1988). The Black-Footed Ferret may consume poisoned Prairie Dogs or non-target animals that contain chlorophacinone residue in body tissues (secondary exposure). The Black-Footed Ferret depends on Prairie Dogs for food and utilizes Prairie Dog borrows for shelter. Historically, wherever Prairie Dogs were found, so were Black-Footed Ferrets (USFWS 2000). A major cause for the decline in Black-Footed Ferrets is the reduction of the range of Prairie Dogs (USFWS 1988). The U.S. Fish and wildlife Service is currently engaged in aggressive breeding and reintroduction programs for the Black-Footed Ferret in its historic range in Montana (USFWS 2000, 2003). However, this label targets the major food source of the Black Footed Ferret within much of its entire historic range, making recolonization and recovery unlikely.

Conclusions regarding the environmental fate, ecological effects and ecological risks associated with the proposed uses of the chemical can be found in the executive summary of the attached document.

Key Uncertainties and Data Gaps

Data are not available to assess potential reproductive impairment to any taxa. Because mammals are the target species, and that chlorophacinone is so acutely toxic to them, reproductive effects data are not being requested for this specific use at this time.

- No acceptable data are available to assess possible reproductive effects to avian species from primary or secondary/tertiary exposure to chlorophacinone. Due to the increased use area, reduction in monitoring and removal of dead and dying animals and the fact that poisoned and moribund Prairie Dogs are easy prey and scavenge items for raptors and other birds, avian reproduction data are needed to adequately quantify the risks this proposed use poses.

- There are no data to evaluate the risks of chlorophacinone to terrestrial or aquatic plants. However, the mode of action of chlorophacinone is specific to animals and it used routinely in agricultural settings for crop protection with no verified incidents resulting from registered uses reported in the EIIS database. In addition, a low likelihood of exposure to plants is expected from this proposed use of chlorophacinone. Furthermore, plants naturally produce similar compounds as a defense strategy from herbivory. It is therefore reasonable to assume that risks to terrestrial plants are minimal.

ENVIRONMENTAL FATE AND EFFECTS SCIENCE CHAPTER

For The Proposed Registration of

Ecological Risk Assessment for Expanded Uses for Rozol Black Tailed Prairie Dog Bait (Chlorophacinone 0.005% ai)

USEPA PC Code: 067707

ERB II Team: **Ron Dean, Biologist**
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1.0 Executive Summary

It is requested that previous 24c Special Local Needs (SLN) labels for Black Tailed Prairie Dog control in Colorado, Kansas, Nebraska, Texas and Wyoming be expanded to include Arizona, Montana, New Mexico, North Dakota, Oklahoma and South Dakota. However, although part of its historic range, the Black Tailed Prairie Dog is now extirpated in Arizona (Lomolino and Smith 2003, USFWS 1999, Hafner *et al* 1998). Accidental misuse and the potential for primary and secondary exposure to nontarget species can be greatly reduced by excluding Arizona from the label.

The proposed label states that the applicator must return to the site within 5 to 10 days after bait application and again at 14-21 days after application to collect and properly dispose of any dead or dying Prairie Dogs found above ground. However, earlier SLN labels state that the applicator must return to the site within 2 days after bait application and at 1- to 2-day intervals. Collection of dead and dying poisoned animals is crucial in reducing the risk of secondary exposure through the predation and scavenging on poisoned animals. Secondary exposure to nontarget species will be decreased if the label instructs the applicator to return after 2 days and at 1- to 2-day intervals.

EFED believes that it is essential that applicators adhere to instructions to conduct carcass searches periodically after baiting and to properly dispose of any Prairie Dog carcasses collected. Moreover, poisoned Prairie Dogs may be more easily subject to predation before they die, as they are likely to become progressively weaker as they hemorrhage for several days before death. Any non-target species impacted by this product should be collected and turned in to proper authorities for identification and tissue-residue analysis to determine if the animal was exposed to chlorophacinone. When available, that information also should be reported to the appropriate state agencies, to EPA, and to the USFWS.

The current label also states that reapplications may be made if activity persists several weeks to months after the bait was applied. This language is vague and could result in reapplications being made before monitoring and carcass removal occurs from the original application. Reapplication before monitoring and carcass removal will likely result an increased exposure to non target species.

This proposed use of chlorophacinone bait poses primary risks to non-target mammals and birds that exceed the Agency's Level of Concern (LOC). Secondary/tertiary risks to mammals are also likely, including those to Federally Listed (i.e., Endangered and Threatened) species protected under the Endangered Species Act. The proposed registration of Rozol Prairie Dog Bait would greatly expand the use area of this product.

Chlorophacinone may also pose risks to reptiles and land-based amphibians (especially predatory and scavenging species). Moreover, migratory and other wide-ranging birds and mammals exposed to chlorophacinone can harbor residue in body tissues. Even if they ingest a lethal dose, they will not die for 4 to 10 days or more due to the mode of action of chlorophacinone and the delayed time to death after ingestion of a lethal dose. Thus, lethally and sublethally exposed

animals may move considerable distances beyond treated areas and expose other predators and scavengers that feed on them.

Of special concern is the federally listed Black-Footed Ferret, which is the most endangered mammal in the United States (USFWS 1988). The Black-Footed Ferret may consume poisoned Prairie Dogs or non-target animals that contain chlorophacinone residue in body tissues (secondary exposure). The Black-Footed Ferret depends on Prairie Dogs for food and utilizes Prairie Dog borrows for shelter. Historically, wherever Prairie Dogs were found, so were Black-Footed Ferrets (USFWS 2000). A major cause for the decline in Black-Footed Ferrets is the reduction of the range of Prairie Dogs (USFWS 1988). The U.S. Fish and wildlife Service is currently engaged in aggressive breeding and reintroduction programs for the Black-Footed Ferret in its historic range in Montana (USFWS 2000, 2003). However, this label targets the major food source of the Black Footed Ferret within much of its entire historic range, making recolonization and recovery unlikely.

1.1 Nature of Chemical Stressor

Chlorophacinone is an anticoagulant rodenticide. Anticoagulants are vitamin-K antagonists that disrupt normal blood-clotting mechanisms and induce capillary damage. Typically, death is delayed for four to ten or more days after a lethal dose is ingested, and animals may continue to feed and move about until shortly before death. Death results from hemorrhage, and exposed animals may exhibit behavior that may make them more susceptible to predation (Cox and Smith 1992). This may result in secondary exposure to predatory animals. Vertebrate animals that have eaten bait metabolize chlorophacinone, but some is sequestered in various body tissues for days or weeks.

1.2 Potential Risks to Non-target Organisms

These proposed changes will greatly increase area and locations where this product will be applied and will likely result in increased exposure to both listed and non-listed nontarget species. Exposure may occur through primary exposure to nontarget species consuming bait or through secondary/tertiary exposure to avian and mammalian predators and scavengers consuming poisoned animals. These risks are summarized below:

- ***Risks to Birds and Mammals.*** Dietary RQs exceed the Agency's LOC for listed and non-listed birds and nontarget mammals that eat bait. Although the proposed label states that the bait be placed only underground in active burrows, primary exposure cannot be eliminated. Because chlorophacinone residue will be present in body tissues of target and nontarget primary consumers for days or weeks after they consume bait, and because chlorophacinone exhibits toxicity to birds and especially to mammals, secondary and tertiary risk is likely for listed and non-listed predators and scavengers.

- ***Risks to Aquatic Animals.*** Chlorophacinone is highly toxic to fish and aquatic invertebrates, but EECs in the water column are expected to be low. No acute LOC is exceeded, and risk is presumed to be minimal.

Risks to Listed Species. Of special concern is the federally listed Black-Footed Ferret, which is the most endangered mammal in the United States (USFWS 1988). The Black-Footed Ferret may consume poisoned Prairie Dogs or non-target animals that contain chlorophacinone residue in body tissues (secondary exposure). The Black-Footed Ferret depends on Prairie Dogs for food and utilizes Prairie Dog borrows for shelter. Historically, where ever Prairie Dogs were found, so to were Black-Footed Ferrets (USFWS 2000). A major cause for the decline in Black-Footed Ferrets is the reduction of the range of Prairie Dogs (USFWS 1988). The U.S. Fish and wildlife Service is currently engaged in aggressive breeding and reintroduction programs for the Black-Footed Ferret in its historic range in Montana (USFWS 2000, 2003). However, this label targets the major food source of the Black Footed Ferret within much of its entire historic range, making recolonization and recovery unlikely.

1.3 Key Uncertainties and Data Gaps

Data are not available to assess potential reproductive impairment to any taxa. Because mammals are the target species, and that chlorophacinone is so acutely toxic to them, reproductive effects data are not being requested for this specific use at this time.

- No acceptable data are available to assess possible reproductive effects to avian species from primary or secondary/tertiary exposure to chlorophacinone. Due to the increased use area, reduction in monitoring and removal of dead and dying animals and the fact that poisoned and moribund Prairie Dogs are easy prey and scavenge items for raptors and other birds, avian reproduction data are needed to adequately quantify the risks this proposed use poses.

- Effects data are not available for reptiles or terrestrial-phase amphibians. In accordance with OPP/EFED policy for risk assessment, birds are considered as surrogates for assessing risk to these taxa (EPA 2004).

- There are no data to evaluate the risks of chlorophacinone to terrestrial or aquatic plants. However, the mode of action of chlorophacinone is specific to animals and it used routinely in agricultural settings for crop protection with no verified incidents resulting from registered uses reported in the EIIS database. In addition, a low likelihood of exposure to plants is expected from this proposed use of chlorophacinone. Furthermore, plants naturally produce similar compounds as a defense strategy from herbivory. It is therefore reasonable to assume that risks to terrestrial plants are minimal.

2.0 Problem Formulation

2.1 Nature of Regulatory Action

The proposed registration for Rozol Prairie Dog Bait will greatly expand the use area of this product. It is requested that previous 24c Special Local Needs (SLN) labels for Black Tailed Prairie Dog control in Colorado, Kansas, Nebraska, Texas and Wyoming be expanded to include Arizona, Montana, New Mexico, North Dakota, Oklahoma and South Dakota. However, although part of its historic range, the Black Tailed Prairie Dog is now extirpated in Arizona

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EFED believes that it is essential that applicators adhere to instructions to conduct carcass searches periodically after baiting and to properly dispose of any Prairie Dog carcasses collected. Moreover, poisoned Prairie Dogs may be more easily subject to predation before they die, as they are likely to become progressively weaker as they hemorrhage for several days before death. Any non-target species impacted by this product should be collected and turned in to proper authorities for identification and tissue-residue analysis to determine if the animal was exposed to chlorophacinone. When available, that information also should be reported to the appropriate state agencies, to EPA, and to the USFWS.

The current label also states that reapplications may be made if activity persists several weeks to months after the bait was applied. This language is vague and could result in reapplications being made before monitoring and carcass removal occurs from the original application. Reapplication before monitoring and carcass removal will likely result an increased exposure to non target species.

EFED believes that this proposed use of chlorophacinone poses primary and secondary/tertiary risks to mammals, including Federally Listed (i.e., Endangered and Threatened) species protected under the Endangered Species Act. Chlorophacinone also may pose risks to birds, possibly reptiles and land-based amphibians (especially predatory and scavenging species). Moreover, migratory and other wide-ranging birds and mammals exposed to chlorophacinone can harbor residue in body tissues. Even if they ingest a lethal dose, they will not die for 4 to 10 days or more due to the mode of action of chlorophacinone and the delayed time to death after ingestion of a lethal dose. Thus, lethally and sublethally exposed animals may move considerable distances beyond treated areas and expose other predators and scavengers that feed on them. Some alternative baits are not stored in body tissues and thus pose minimal secondary/tertiary risks (Erickson and Urban 2004).

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the reduction of the range of Prairie Dogs (USFWS 1988). The U.S. Fish and wildlife Service is currently engaged in aggressive breeding and reintroduction programs for the Black-Footed Ferret in its historic range in Montana (USFWS 2000, 2003). However, this label targets the major food source of the Black Footed Ferret within much of its entire historic range, making recolonization and recovery unlikely.

2.1.1 Label Information

The following information is based on the label received by EFED.

Product:	ROZOL Prairie Dog Bait, EPA
Parent Product:	ROZOL Pocket Gopher Bait, EPA Reg. No. 7173-244, EPA Est. No. 7173-WI-1
Formulation:	Food bait (0.005% ai)
Classification:	Restricted use due to hazard to non-target species
Target species:	Black-tailed Prairie Dog (*Cynomys ludovicianus*)
Use sites:	Rangeland and non-crop areas
Application timing:	October 1 to March 15
Application rate:	¼ cup (53 g or nearly 2 oz.) bait per active burrow
Repeat applications:	A second application can be made several weeks after first application.
Other use restrictions:	Only active burrows can be baited Bait must be placed at least 6 inches inside the burrow opening Store product away from non-target wildlife Dead animals must be collected and buried in holes at least 18 inches deep The proposed label states that the applicator must return to the site within 5 to 10 days after bait application and again at 14-21 days after application to collect and properly dispose of any dead or dying Prairie Dogs found above ground. The current label states that reapplications may be made if activity persists several weeks to months after the bait was applied.

Listed species considerations:	Do not use this product within Prairie Dog towns in the range of the Black-Footed Ferret without first contacting U.S. Fish and Wildlife Service, Denver Regional Office.

The label provides some additional information and post-application requirements. It notes that poisoned Prairie Dogs will begin to die 4 to 5 days after eating a lethal amount. The proposed label states that the applicator must return to the site within 5 to 10 days after bait application and again at 14-21 days after application to collect and properly dispose of any dead or dying Prairie Dogs found above ground. However, earlier SLN labels state that the applicator must return to the site within 2 days after bait application and at 1- to 2-day intervals. Collection of dead and dying poisoned animals is crucial in reducing the risk of secondary exposure through predation and scavenging. The potential for secondary exposure to nontarget species will be decreased if the label instructs the applicator to return after 2 days and at 1- to 2-day intervals.

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2.2 Stressor Source and Distribution

Rozol Black Tailed Prairie Dog Bait is a food bait formulated with 0.005% (50 ppm) chlorophacinone, a first-generation anticoagulant rodenticide. It is currently registered mainly for rat and mouse control in and around buildings but also for control of pocket gophers, moles, ground squirrels, voles, and several other localized pest mammals.

2.2.1 Nature of the Chemical Stressor

Chlorophacinone is an anticoagulant rodenticide. Anticoagulants are vitamin-K antagonists that disrupt normal blood-clotting mechanisms and induce capillary damage. Typically, death is delayed for four to ten or more days after a lethal dose is ingested, and animals may continue to feed and move about until shortly before death. Death results from hemorrhage, and exposed animals may exhibit behavior that may make them more susceptible to predation (Cox and Smith

1992). This may result in secondary exposure to predatory animals. Chlorophacinone is metabolized by vertebrate animals that have eaten bait, but some is sequestered in various body tissues for days or weeks.

The likely fate of chlorophacinone in the environment, when used as Prairie Dog bait, is difficult to accurately determine, as this type of usage is not typically modeled with either the EFED *tier 1* model (GENEEC) or *tier 2* model (PRZM-EXAMS). Nevertheless, making several assumptions regarding input parameters and usage patterns allowed the Agency to run the GENEEC model and obtain adequate results. This is especially appropriate for this compound because of its physical/chemical characteristics (generally non-mobile and insoluble) and proposed application amounts/patterns (very small amounts of active ingredient per treated area).

Rozol is proposed to be used as Prairie Dog bait in rangeland and non-crop areas. The proposed label instructs that this product only be used underground (i.e., applied inside burrows at a depth of at least 6 inches). Applicators should ensure that no bait is left above ground, and that dead animals found above ground be buried at least 18 inches beneath the surface. However, it is doubtful that no bait will ever be present on the surface; aside from spillage at the time of application, it is likely that at least some of the bait will be kicked out of the burrows (either by the Prairie Dogs or other foraging animals). In addition, it may be difficult to find and dispose of all dead animals after application. A second Rozol application may be made if the first is inadequate.

A cursory examination of the fate properties of chlorophacinone indicates that this product should not present much of a risk to water supplies for this proposed usage. It is fairly insoluble, has very low leaching potential, and is not very persistent. Since it is to be placed into burrows, very little will be available at the surface, and so should not be subject to much runoff or erosion into surface water bodies. Even if significant amounts were to be found at the surface, it is most likely to be exported off-site via erosion rather than as dissolved in runoff water because of its low solubility and propensity to adsorb onto solids. Thus, any material that is exported as erosion should remain sorbed onto particles and settle to the bottom of the receiving lake or stream bed. In addition, the very low K_{OC} and low solubility mean that it is unlikely to contaminate ground water. This is especially true for this region (Plains), where the groundwater is typically deep and annual rainfall totals fairly low.

The GENEEC model was run for this compound based upon the most conservative estimates and assumptions. Input parameters used in this model are tabulated below (Table 1). Label instructions state that ¼ cup (~2 oz.) of bait should be placed into each burrow opening. If one assumes 100 burrows/A at 2 oz/burrow, then about 12.5 lbs. of product would be used per acre. The amount of active ingredient (a.i.) in Rozol is 0.005%, which yields 0.000625 lb a.i./A. Although the bait should be placed at least 6 inches underground, we assumed that some of the bait would be moved up to the surface through bioturbation, so an incorporation depth of 4 inches (instead of 6) was used. Likewise, where a range was given, the longest reported half lives were used. Despite these conservative assumptions, though, the peak concentration (EEC) predicted by GENEEC for this use of this chemical is 0.92 PPTr (0.0009 PPB). A SciGrow ground water model was also run, to assess the likely peak concentrations predicted for ground

water. Results from this are even lower, with a peak concentration of 0.0075 PPTr (0.0000075 PPB). The agency does not expect any marked surface water or ground water contamination to result from this proposed use for chlorophacinone.

A review of the chemical/physical properties of Chlorophacinone (Table 1) indicates that this product should not present an appreciable risk to water supplies. The rodenticide is fairly insoluble (34 ppm), has very low leaching potential (K_{oc} = 43,411 ml/g), and is not very persistent (photolysis half-life in water = 37 min.). While the photolysis rate is fairly rapid, photo-degradation in water may not be as effective because of sediment reducing light penetration (something that is common from runoff events). Light may not penetrate deeply into water. Without any data on aquatic metabolism, actual persistence in water/sediment is uncertain.

Table 1. Physical /Chemical Properties of Chlorophacinone, and Model Inputs

Property	Value	Source	Comment
Molecular Weight	375		
Solubility	34 ppm	1998 RED	
Hydrolysis	Stable	MRID 42205501	At pH 5, 7, and 9
Photolysis in Water	37 min. (half-life)	1998 RED	No reference given in text
Photodegradation on Soil	4 days (half-life)	MRID 42452301	
Aerobic Soil Degradation	26-45 day (half-life)	MRID 43159801	45 day value was used
K_{ads}	341	MRID 42666001	Averaged for 4 soils
K_{oc}	43,411 ml/g	MRID 42666001	Averaged for 4 soils
Vapor pressure	3.6E-6 mm Hg	1998 RED	
Henry's law	5.2E-8 m-m3/mol	1998 RED	
K_{ow}	94	1998 RED	
Incorporation depth	4 inches	Label	Label says minimum 6 inches, adjusted to account for bioturbation
Application rate	0.000625 lb a.i./A	Label	Estimated based on burrows/acre
Number of applications	2	Label	
Application interval	30 days	Label	Not specified – likely minimum interval deduced from label

2.2.2 Overview of Pesticide Usage

Use will be limited to certified applicators or persons under their supervision. Precautionary statements on the product label state that the product is toxic to fish and wildlife and that dogs and other predatory and scavenging mammals and birds may be poisoned if they feed upon animals that have eaten the bait. The proposed uses for chlorophacinone require placement of the material below the surface in active borrows by a certified applicator, limiting off-site movement of the compound. Although the bait should be placed at least 6 inches underground, some of the bait may be moved up to the surface through bioturbation.

Although chlorophacinone appears to be fairly immobile in the environment, this is partly dependant upon the compound being immobile after application. However, the specific intent that Rozol be used as bait requires that it present an appealing food target for rodents and other species. Once placed at the surface in an outdoor environment, this bait is likely to be transported from its original location either by or within a target (or non-target) animal. This type of environmental transport cannot currently be adequately modeled; attempts at quantifying this impact would be speculative. Nevertheless, there would almost certainly be far higher exposure because of the proposed new uses, particularly for open, aboveground applications.

2.3 Receptors

In order for a chemical to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. An exposure pathway is the means by which a contaminant moves in the environment from a source to an ecological receptor. For an ecological exposure pathway to be complete, it must have a source, a release mechanism, an environmental transport medium, a point of exposure for ecological receptors, and a feasible route of exposure. In addition, the potential mechanisms of transformation (i.e., which degradates may form in the environment, in which media, and how much) must be known, especially for a chemical whose metabolites/degradates are of greater toxicological concern. The assessment of ecological exposure pathways, therefore, includes an examination of the source and potential migration pathways for constituents, and the determination of potential exposure routes (e.g., ingestion, inhalation, and dermal absorption).

Ecological receptors that may potentially be exposed to chlorophacinone include terrestrial wildlife (i.e., invertebrates, mammals, birds, and reptiles), terrestrial and semi-aquatic plants, aquatic plants, aquatic invertebrates and fish. In addition to terrestrial ecological receptors, aquatic receptors (e.g., freshwater and estuarine/marine fish and invertebrates, amphibians) may also be exposed to potential migration of pesticides from the site of application to various watersheds and other aquatic environments via runoff and drift.

Consistent with the process described in the Overview Document (EPA, 2004), this risk assessment uses a surrogate species approach in its evaluation of the proposed new uses of chlorophacinone. Data generated from surrogate test species, which are intended to be representative of broad taxonomic groups, are used to extrapolate to potential effects on a variety of species (receptors) included under these taxonomic groupings.

Acute and chronic toxicity data from studies submitted by pesticide registrants are used to evaluate the potential direct effects of chlorophacinone to the aquatic and terrestrial receptors identified in this section. This includes toxicity data on the technical grade active ingredient, and when available, formulated products. The evaluation of this data can also provide insight into the direct and indirect effects of chlorophacinone on biotic communities from loss of species that are sensitive to the chemical and from changes in structure and functional characteristics of the affected communities.

The toxicity data used in this assessment are obtained from registrant-submitted guideline toxicity studies required for pesticide registration. These studies are typically performed on a number of organisms from several taxonomic groups, including birds, mammals, fish, and aquatic invertebrates (EPA 2004). The surrogate test species, assessment endpoints, and measures of effect derived from these studies used for risk assessment are presented in Appendix A. Additional information from other sources, such as public literature and incident reports, are used when relevant.

Table 2 provides a summary of the taxonomic groups and the surrogate species tested to help understand potential acute ecological effects of pesticides to these non-target taxonomic groups. In addition, the table provides a preliminary overview of the potential acute toxicity of chlorophacinone by providing the acute toxicity classifications.

Table 2 Test Species Evaluated for Assessing Potential Ecological Effects of Associated Acute Toxicity Classification

Taxonomic Group	Example(s) of Surrogate Species	Acute Toxicity Classification
Birds[1]	Mallard (*Anas platyrhynchos*)	Very Highly Toxic
Mammals	Laboratory rat (*Rattus norvegicus*)	Very Highly Toxic
Freshwater fish[2]	Rainbow trout (*Oncorhynchus mykiss*)	Highly Toxic
Freshwater invertebrates	Water flea (*Daphnia magna*)	Highly Toxic

[1] Birds represent surrogates for terrestrial-phase amphibians and reptiles.
[2] Freshwater fish may be surrogates for aquatic-phase amphibians.

2.4 Ecosystems Potentially at Risk

The ecosystems at risk are often extensive in scope, and as a result, it may not be possible to identify specific ecosystems during the development of a baseline risk assessment. However, in general terms, terrestrial ecosystems potentially at risk could include the treated field and areas immediately adjacent to the treated field that may receive drift or runoff. Areas adjacent to the treated field could include cultivated fields, fencerows and hedgerows, meadows, fallow fields or grasslands, woodlands, riparian habitats and other uncultivated areas.

Aquatic ecosystems potentially at risk include water bodies adjacent to, or down stream from, the treated field and might include impounded bodies such as ponds, lakes and reservoirs, or flowing waterways such as streams or rivers. For uses in coastal areas, aquatic habitat also includes marine ecosystems, including estuaries.

2.5 Assessment Endpoints

Assessment endpoints represent the actual environmental value that is to be protected, defined by an ecological entity (species, community, or other entity) and its attribute or characteristics (EPA, 1998). For chlorophacinone, the ecological entities may include the following: birds, mammals, reptiles, amphibians, freshwater fish and invertebrates, estuarine/marine fish and invertebrates, terrestrial plants, insects, and aquatic plants and algae. The attributes for each of these entities may include growth, reproduction, and survival.

Selection of the assessment endpoints is based on valued entities (i.e., ecological receptors), the ecosystems potentially at risk, the migration pathways of pesticides, and the routes by which ecological receptors are exposed to pesticide-related contamination. The selection of clearly defined assessment endpoints is important because they provide direction and boundaries in the risk assessment for addressing risk management issues of concern.

For both aquatic and terrestrial animal species, direct acute and direct chronic exposures are considered. In order to protect threatened and endangered species, all assessment endpoints are measured at the individual level. Although all endpoints are measured at the individual level, they provide insight about risks at higher levels of biological organization (e.g. populations and communities). For example, pesticide effects on individual survivorship have important implications for both population rates of increase and habitat carrying capacity.

For aquatic plants, the assessment endpoint is the maintenance and growth of standing crop or biomass. Measurement endpoints for this assessment endpoint focus on algal and vascular plant growth rates and biomass measurements. Although it is recognized that these endpoints may not address all plant life cycle components, it is assumed that these impacts have the potential to impact individual competitive ability and reproductive success.

The ecological relevance of selecting these assessment endpoints is as follows:

- Complete exposure pathways exist for these receptors;
- The receptors may be potentially sensitive to pesticides in affected media.
- The receptors could potentially inhabit areas where pesticides are applied, or areas where runoff and/or spray drift may impact the sites because suitable habitat is available.

2.6 Conceptual Model

A conceptual model provides a written description and visual representation of the predicted relationships between chlorophacinone, potential routes of exposure, and the predicted effects for

the assessment endpoint. A conceptual model consists of two major components: risk hypothesis and a conceptual diagram (EPA, 1998).

2.6.1 Risk Hypothesis

The objective of EFED's assessment is to identify ecological risks from use of Rozol Black Tailed Prairie Dog Bait to kill Black Tailed Prairie Dogs in various rangeland and noncrop settings. EFED's 2004 *Potential Risks of Nine Rodenticides to Birds and Nontarget Mammals: A comparative Approach* (Erickson and Urban 2004) includes an assessment of the potential primary and secondary risks of chlorophacinone bait when used in these scenarios. Based on the proposed product label for applying Rozol Black Tailed Prairie Dog Bait field to rangeland and noncrop areas, EFED formulated a conceptual model presented in terms of risk hypotheses and a flow diagram depicting potential exposure pathways and ecological receptors. These risk hypotheses are as follows:

> Chlorophacinone, when used in accordance with the label, results in potential adverse effects upon the survival, growth, and reproduction of non-target terrestrial and aquatic organisms.

2.6.2 Conceptual Diagram

The conceptual model assumes that Rozol Black Tailed Prairie Dog Bait will be available to nontarget organisms and, as toxic food bait, will adversely affect terrestrial species. Figure 1 illustrates the anticipated exposure pathways and transport routes to ecological receptors and identifies the predicted attribute changes from this exposure. The major sources of exposure of nontarget terrestrial animals are expected to be ingestion of the formulated food bait and consumption of vertebrate body tissues or invertebrates that have eaten the food bait (Erickson and Urban 2004). Exposure via these routes is expected primarily for birds and mammals, though it is likely that other terrestrial animals such as reptiles and terrestrial amphibians are at risk if they consume invertebrates or tissues of vertebrates that have eaten bait.

Bait deposited in surface waters might also be directly consumed by aquatic species (fish, invertebrates, and aquatic phase amphibians) and terrestrial species (e.g., waterfowl) that feed in water. Terrestrial species may also ingest chlorophacinone by drinking contaminated water. Aquatic species may ingest some bait and may be exposed to chlorophacinone via uptake through gills/integument. Dermal and inhalation routes of exposure occur for some pesticides (e.g., foliar sprays). However, these are not expected to be important routes of exposure for grain-based, rodenticide food bait.

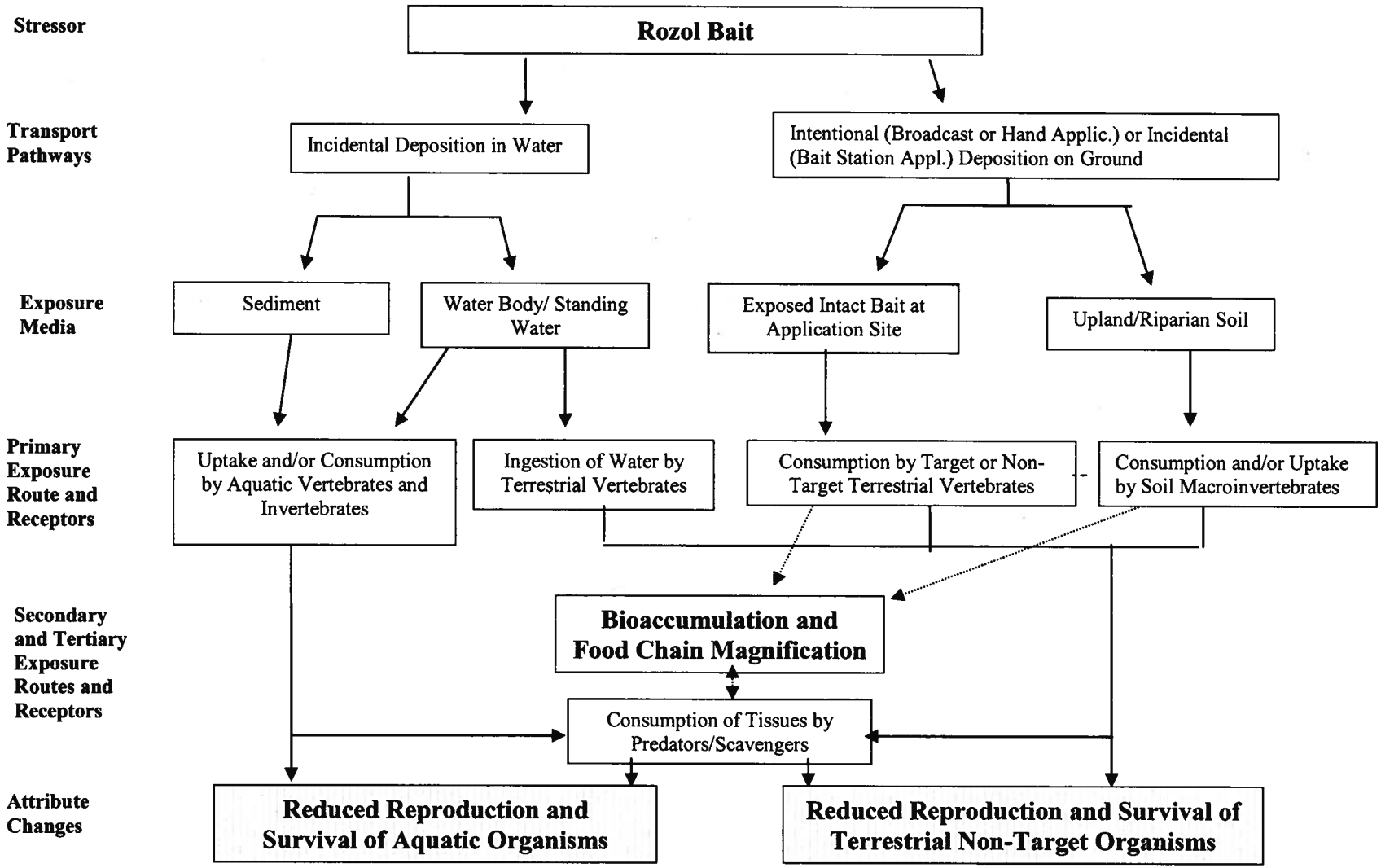

Figure 1. Conceptual Model Diagram of Chlorophacinone Exposure and Effects in Nontarget Species

2.7 Analysis Plan

This risk assessment is based on EFED's risk quotient (RQ) methodology in combination with lines of evidence (e.g., published literature, etc.) available to assess potential exposure and risks. An RQ is a ratio of an estimated environmental concentration (EEC) of a pesticide to a toxicity value (e.g., LC_{50}), where the EEC is presumed to represent a measure of exposure (EPA 2004). Acute and chronic RQs for each taxonomic group are compared to the Agency's acute and chronic Levels of Concern (LOCs). Exceedence of an LOC for a taxonomic group triggers a need for regulatory action to mitigate risk. Appendix B summarizes EFED's LOCs for the various taxa assessed.

Because non-target animal species will be attracted to Rozol bait and will actively seek it out and consume it, rather than simply being exposed through chance contact, the EEC for terrestrial exposure is based on consumption of the formulated food bait (50-ppm ai) for primary exposure. Consumption of body tissues of primary consumers is the primary route of secondary/ tertiary exposure. Pen and field studies, information from operation control programs, and incident reports are used to characterize primary and secondary/tertiary exposure. As discussed in Erickson and Urban (2004), the standard methodology (e.g., Kenaga nomogram) for assessing terrestrial exposure of pesticides formulated as liquids or granules is not appropriate for rodenticide food bait.

The EEC for aquatic exposure is based on GENEEC2, a screening-level surface water exposure model. Application amounts are based upon assumptions about the maximum number of burrows per acre.

2.7.1 Conclusions from Previous Risk Assessments

The conclusions from the five SLN assessments for chlorophacinone bait on Prairie Dogs are summarized below:

- ***Risks to Birds and Mammals.*** Dietary RQs exceed the Agency's LOC for listed and non-listed birds and nontarget mammals that eat bait. Although the proposed label states that the bait be placed only underground in active burrows, primary exposure cannot be eliminated. Because chlorophacinone residue will be present in body tissues of target and nontarget primary consumers for days or weeks after they consume bait, and because chlorophacinone exhibits toxicity to birds and especially to mammals, secondary and tertiary risk is likely for listed and non-listed predators and scavengers.

- ***Risks to Aquatic Animals.*** Chlorophacinone is highly toxic to fish and aquatic invertebrates, but EECs in the water column are expected to be low. No acute LOC is exceeded, and risk is presumed to be minimal.

- ***Risks to Listed Species.*** Of special concern is the federally listed Black-Footed Ferret, which is the most endangered mammal in the United States (USFWS 1988). The Black-Footed Ferret may consume poisoned Prairie Dogs or non-target animals that contain chlorophacinone residue in body tissues (secondary exposure). The Black-Footed Ferret depends on Prairie Dogs for food and utilizes Prairie Dog borrows for shelter. Historically, where ever Prairie Dogs were found, so to were Black-Footed Ferrets (USFWS 2000). A major cause for the decline in Black-Footed Ferrets is the reduction of the range of Prairie Dogs (USFWS 1988). The U.S. Fish and wildlife Service is currently engaged in aggressive breeding and reintroduction programs for the Black-Footed Ferret in its historic range in Montana (USFWS 2000, 2003). However, this label targets the major food source of the Black Footed Ferret within much of its entire historic range, making recolonization and recovery unlikely.

The conclusions from previous risk assessments are consistent with the current proposed applications with the exception that the use area will be expanded greatly, resulting in an increase in the availability of bait to non-target species and a likely increase of primary and secondary exposure to non-target mammals and birds.

2.7.2 Identification of Data Gaps

Data are not available to assess potential reproductive impairment to any taxa. However, because mammals are the target species, and that chlorophacinone is so acutely toxic to them, reproductive effects data are not being requested for this specific use at this time.

- No acceptable data are available to assess possible reproductive effects to avian species from primary or secondary/tertiary exposure to chlorophacinone. Due to the increased use area, reduction in monitoring and removal of dead and dying animals and the fact that poisoned and moribund Prairie Dogs are easy prey and scavenge items for raptors and other birds, avian reproduction data are needed to adequately quantify the risks this proposed use poses.

- Effects data are not available for reptiles or terrestrial-phase amphibians. In accordance with OPP/EFED policy for risk assessment, birds are considered as surrogates for assessing risk to these taxa (EPA 2004).

- There are no data to evaluate the risks of chlorophacinone to terrestrial or aquatic plants. However, the mode of action of chlorophacinone is specific to animals and it used routinely in agricultural settings for crop protection with no verified incidents resulting from registered uses reported in the EIIS database. In addition, a low likelihood of exposure to plants is expected from this proposed use of chlorophacinone. Furthermore, plants naturally produce similar compounds as a defense strategy from herbivory. It is therefore reasonable to assume that risks to terrestrial plants are minimal.

2.7.3 Measures of Effects and Exposure

This section describes the tools and methods used to conduct the analysis of the pesticide described in the analysis plan. Each assessment endpoint requires one or more measures of ecological effects, which are measurable changes in the attribute of an assessment endpoint in response to a stressor. It also requires measures of exposure, which are the measures of stressor existence and movement in the environment and their contact or co-occurrence with the assessment endpoint.

2.7.4 Measures of Effects

Each assessment endpoint requires one or more "measures of ecological effect," which are defined as changes in the attributes of an assessment endpoint itself or changes in a surrogate entity or attribute in response to exposure to a pesticide. Ecological measurement endpoints for the screening level risk assessment are based on a suite of registrant-submitted toxicity studies performed on a limited number of organisms in the following broad groupings:

- Birds (mallard duck and bobwhite quail) used as surrogate species for terrestrial- phase amphibians and reptiles,
- Mammals (laboratory rat),
- Freshwater Fish (bluegill sunfish and rainbow trout) used as a surrogate for aquatic phase amphibians
- Freshwater invertebrates (*Daphnia magna*),
- Estuarine/marine fish (Sheepshead minnow *Cyprinodon variegatus*),
- Estuarine/marine invertebrates (*Crassostrea virginica* and *Mysidopsis bahia*),
- Terrestrial plants (corn, onion, ryegrass, wheat, buckwheat, cucumber, soybean, sunflower, tomato, and turnip), and
- Aquatic plants and Algae (*Lemna gibba* and *Selenastrum capricornutum*).

Within each of these very broad taxonomic groups, an acute and chronic endpoint is selected from the available test data, as the data sets allow. A summary of the assessment and measurement endpoints selected to characterize potential ecological risks associated with exposure to chlorophacinone is provided in Appendix A.

3.0 Analysis

3.1 Exposure Characterization

Direct chlorophacinone exposure is likely to be limited to areas near application sites. Even if significant amounts of chlorophacinone are present at the surface, it is most likely to be exported off-site via erosion rather than as dissolved in runoff water because of its low solubility and propensity to adsorb onto solids. Thus, the majority of material that is exported as erosion should remain sorbed onto particles and settle to the bottom of the receiving lake or stream bed. In addition, the very low K_{oc} and low solubility suggest that it is unlikely to contaminate ground

water. Terrestrial exposure is a much more likely avenue of incidental non-target exposure than aquatic.

3.1.1 Measures of Aquatic Exposure

3.1.1.1 Aquatic Exposure Modeling

At the screening risk assessment level for aquatic organisms, such as plants, fish, aquatic-phase amphibians, and invertebrates, computer simulation models are used to estimate acute (annual instantaneous peak) and chronic (21 and 60 day weighted average annual peaks for aquatic invertebrates and fish, respectively) residue levels of the dissolved pesticide active ingredient in surface water and sediment pore water and in bulk sediment from runoff and spray drift. These models calculate EECs in surface water and sediment using environmental fate data for chlorophacinone. Monitoring data, if available, may also be used to determine EECs or to support the model's exposure estimates.

The EECs for aquatic exposure are based on GENEEC2, a screening-level surface water exposure model. Several assumptions are made for this assessment: 1) within a Prairie Dog community, there is a set maximum number of burrows per acre; 2) most of the bait will be successfully placed within the burrow openings at the minimum required depth of 6 inches; 3) some of the bait will be moved closer to the land surface through a variety of processes – leading to an assumption that the average depth of bait will be about 4 inches below surface.

3.1.1.2 Aquatic Exposure Monitoring and Field Data

Groundwater and surface water monitoring data are not available. Screening models were used to determine estimated concentrations for chlorophacinone in groundwater and surface water.

3.1.2 Measures of Terrestrial Exposure

Avian and Mammalian Exposure

Terrestrial wildlife exposure estimates are typically calculated for bird and mammals, emphasizing a dietary exposure route for uptake of pesticide active ingredients. These exposures are considered as surrogates for terrestrial-phase amphibians as well as reptiles. Birds and mammals in the field may be exposed to chlorophacinone by ingesting material directly with the diet.

This is a bait formulation; therefore, non-target birds and mammals will actively seek out Rozol bait and consume it. Primary risk to avian and non-target mammalian bait feeders is therefore evaluated for single and multiple feedings. The dietary risk quotient (RQ) is a ratio of chlorophacinone in the food bait to the dietary toxicity (LC_{50} based on 5-day dietary exposure) for the northern bobwhite and the laboratory rat. Pen and field studies, information from operation control programs, and incident reports are used to characterize primary and secondary/tertiary exposure. As discussed in Erickson and Urban (2004), the standard methodology (e.g., Kenaga nomogram) for assessing terrestrial exposure of pesticides formulated as liquids or granules is not appropriate for rodenticide food bait.

Non-target animals also may be exposed by other routes, such as incidental ingestion of contaminated soil, dermal contact with treated surfaces and soil during activities in the treated areas, preening activities, and ingestion of drinking water contaminated with pesticide. Only ingestion of treated food items was considered as a route of exposure in this assessment.

Terrestrial Plants

There are no data regarding the toxicity of chlorophacinone to terrestrial plants. However, the mode of action of chlorophacinone is specific to animals and it used routinely in agricultural settings for crop protection with no verified incidents resulting from registered uses reported in the EIIS database. In addition, a low likelihood of exposure to plants is expected from this proposed use of chlorophacinone. Furthermore, plants naturally produce similar compounds as a defense strategy from herbivory. It is therefore reasonable to assume that risks to terrestrial plants are minimal.

3.2 Ecological Effects Characterization

In screening-level ecological risk assessments, effects characterization describes the types of effects a pesticide can produce in an organism. This characterization is based on registrant-submitted studies that describe acute and chronic effects toxicity information for various aquatic and terrestrial organisms. A complete list of toxicity endpoints may be found in Appendix A.

3.2.1.1 Terrestrial Animals

Birds and Mammals

Chlorophacinone exhibits high to very high acute and dietary toxicity to small mammals (LD_{50}'s = 0.49 to 50-100 mg/kg; LC50's = 1.14 to 1.26 ppm) and moderate to high toxicity to birds (LD_{50}'s >100 to 430 mg/kg bw; LC50's = 56 to 172 ppm). However, toxicity increases if chlorophacinone is ingested even in small amounts for several days rather than in a single, large dose. The single-dose lab. rat LD_{50} is 6.2 mg ai/kg bw, whereas toxicity was enhanced (LD_{50} = 0.8 to 0.95 mg ai/kg bw) when wild and lab. rats were dosed at only 0.16 to 0.19 mg ai/kg bw daily for 5 consecutive days (Erickson and Urban 2004). The toxicity values listed below are used to assess and/or characterize primary risk to birds and mammals.

Mammals:

LC_{50} = 1.14 ppm (lab. rat)
LD_{50} (♂, single dose) = 3.1 mg ai/kg bw (lab. rat, *Rattus norvegicus*)
LD_{50} (♀, single dose) = 11.0 mg ai/kg bw (lab. rat)
LD_{50} (5-day) = 0.8 mg ai/kg bw (0.16 mg ai/kg bw/dose) (wild rat, *R. norvegicus*)
LD_{50} = 14.2 mg ai/kg bw (pine vole, *Microtus pinetorum*)
LD_{50} = 0.49 mg ai/kg bw (deer mouse, *Peromyscus maniculatus*)

Birds:

LC_{50} = 56 ppm (northern bobwhite, *Colinus virginianus*)

LD_{50} = 172 mg ai/kg bw (mallard, *Anas platyrhynchos*)

Standard toxicity values such as the LC50 and LD50 are not available for predators and scavengers. However, tests in which poisoned prey were offered to captive avian and mammalian predators and scavengers, especially mustelids and wild canids, may be killed or adversely affected (e.g., hemorrhage) if feeding on poisoned prey for several days (Erickson and Urban 2004) Table 3.

Although no captive avian predators/scavengers died from comparable exposure, a few raptors, owls, and corvids displayed signs of intoxication (e.g., increased blood-coagulation time, external bleeding, and/or internal hematoma when sacrificed and necropsied) from sublethal exposure. No effects data are available for reptiles, terrestrial-phase amphibians, or terrestrial invertebrates.

Table 3. Secondary Hazards of Chlorophacinone to Mammals and Birds in Laboratory Studies (from Erickson and Urban 2004)

Mammals:

Predator/ scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of toxicity[a]
Mongoose (*Herpestes auropunctatus*)	rats fed 0.005% bait for 5 days	1	1 3 5 6 7 9 10	1 1 2 1 1 1 1	0 1 2 1 1 1 1	nr no survivors no survivors no survivors no survivors no survivors no survivors
Coyote (*Canis latrans*)	ground squirrels fed 15 g of 0.01% bait for 6 days[b]	1	5	7	3	0
Red fox (*Vulpes vulpes*)	mice fed 0.0075% bait[c]	20 total	4	1	1[d]	no survivors
European Ferret (*Mustela putorius furo*)	rats fed 0.005% bait for 5 days	ad lib.	5	20	11	nr
	Prairie Dogs fed 25 g of 0.0025% bait daily for 6 days[c]	4 (1 every other day)	8	6	5	nr
	voles/mice fed 0.0075% bait[c]	5 total	4	2	1[e]	(ct)
	muskrats fed 0.005% bait	ad lib.	4 8	2 1	0 1	1 (bl) no survivors
	voles fed 0.0075% bait[c]	ad lib.	3	4	0	(ct)
Weasel (*Mustela* sp.)	mice fed 0.005% bait	ad lib.	90	4	3	0

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported

[b] ground squirrels were fed no-choice for 3 days followed by 3 days in which they had a choice of bait or untreated laboratory chow

[c] baits registered in the U.S. are either 0.005% or 0.01% ai

[d] individual was sacrificed but considered 'dead' based on coagulation index

[e] individual recovered from moribund state after administration of antidote, but assumed 'dead' without antidote treatment

Birds:

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of toxicity[a]
Barn owl (*Tyto alba*)	rats fed choice of 0.005% bait or untreated bait for 5 days	1-2	10	2	0	0
Black-billed magpie (*Pica pica*)	rats fed 0.005% bait for 5 days	ad lib.	5	20	0	0
American kestrel (*Falco sparverius*)	voles fed 0.01% bait until dead	1 1 every 3 days	21 61	10 10	0 0	10 (eb/ih) 10 (eb/ih)
Red-tailed hawk (*Buteo jamaicensis*)	voles fed 10 g 0.005% bait daily for up to 9 days	2	6	5	0	0
Great horned owl (*Bubo virginianus*)	voles fed 10 g 0.005% bait daily for up to 9 days	2	6	1	0	0
Red-tailed hawk	voles fed 0.005% bait for up to 9 days	2	6	5	0	0
Great horned owl	voles fed 0.005% bait for up to 9 days	2	6	1	0	0
Tawny owl (*Strix aluco*)	mice fed 0.0075% bait[b]	ad lib.	10	4	0	(ct)
Eurasian buzzard (*Buteo buteo*)	mice fed 0.0075% bait[b]	ad lib.	7 10 5+5+5[d] 40	4 6 3 3	0 0 0 0	(ct) (ct) (ct) (ct)
Eurasian buzzard	mice fed 0.0075% bait[b]	4	7	4	0	0
Carrion crow (*Corvus corone*)	mice fed 0.0075% bait[b]	ad lib.	10	4	0	(ct)
	mice fed 0.0075% bait[b]	3-4	3 5	12 12	0 0	0 0

Predator/scavenger (p/s)	Prey offered to p/s	No. prey offered daily per p/s	No. days p/s exposed	No. p/s exposed	No. p/s dead	No. survivors with signs of toxicity[a]
White stork	mice fed 0.0075% bait[b]	ad lib. (treat/ untreated[c])	3	3	0	1 or 2 (ct)
			14	3	0	1 or 2 (ct)

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported
[b] baits registered in the U.S. are either 0.005% or 0.01% ai
[c] the 3 5-day treatment periods are separated by 3 days when the birds were fed untreated mice

3.2.1.2 Terrestrial Plants

There are no data regarding the toxicity of chlorophacinone to terrestrial plants. However, the mode of action of chlorophacinone is specific to animals and it used routinely in agricultural settings for crop protection with no verified incidents resulting from registered uses reported in the EIIS database. In addition, a low likelihood of exposure to plants is expected from this proposed use of chlorophacinone. Furthermore, plants naturally produce similar compounds as a defense strategy from herbivory. It is therefore reasonable to assume that risks to terrestrial plants are minimal.

3.2.2 Aquatic Effects Characterization

3.2.2.1 Aquatic Animals

The available data indicate that chlorophacinone also is highly toxic to fish and aquatic invertebrates. The toxicity values below are used in the risk assessment.

Fish LC_{50} = 450 ppb (rainbow trout, *Oncorhynchus mykiss*)
Invertebrate EC_{50} = 640 ppb (waterflea, *Daphnia magna*)

3.2.2.2 Aquatic Plants

There are no data regarding the toxicity of chlorophacinone to aquatic plants. However, the mode of action of chlorophacinone is specific to animals and it used routinely in agricultural settings for crop protection with no verified incidents resulting from registered uses reported in the EIIS database. In addition, a low likelihood of exposure to plants is expected from this proposed use of chlorophacinone. Furthermore, plants naturally produce similar compounds as a defense strategy from herbivory. It is therefore reasonable to assume that risks to terrestrial plants are minimal.

4.0 Risk Characterization

Risk characterization is the integration of exposure and effects characterization to determine the ecological risk from the use of chlorophacinone and the likelihood of effects on aquatic life, wildlife, and plants based on varying pesticide-use scenarios. The risk characterization provides estimation and a description of the risk; articulates risk assessment assumptions, limitations, and uncertainties; synthesizes an overall conclusion; and provides the risk managers with information to make regulatory decisions.

4.1 Risk Estimation – Integration of Exposure and Effects Data

Results of the exposure and toxicity effects data are used to evaluate the likelihood of adverse ecological effects on non-target species. For the assessment of chlorophacinone risks, the risk quotient (RQ) method is used to compare exposure and measured toxicity values. Primary risk

to avian and non-target mammalian bait feeders is evaluated for single and multiple feedings. The dietary risk quotient (RQ) is a ratio of chlorophacinone in the food bait to the dietary toxicity (LC_{50} based on 5-day dietary exposure) for the northern bobwhite and the laboratory rat. The dietary RQ is compared to the level of concern (LOC) for Listed species (LOC = 0.1) and non-Listed species (LOC = 0.5). These LOCs are the Agency's interpretive policy and are used to analyze potential risk to non-target organisms and the need to consider regulatory action. These criteria are used to indicate when a pesticide's use as directed on the label has the potential to cause adverse effects on non-target organisms. Risk is presumed for any RQ exceeding an LOC.

4.1.1 Non-target Aquatic Animals and Plants

There are no data regarding the toxicity of chlorophacinone to aquatic plants. However, the mode of action of chlorophacinone is specific to animals and it used routinely in agricultural settings for crop protection with no verified incidents resulting from registered uses reported in the EIIS database. In addition, a low likelihood of exposure to plants is expected from this proposed use of chlorophacinone. Furthermore, plants naturally produce similar compounds as a defense strategy from herbivory. It is therefore reasonable to assume that risks to terrestrial plants are minimal.

EFED presumes minimal risk to aquatic species when Rozol bait is applied in accordance with the proposed label directions and precautions. Although chlorophacinone is highly toxic to fish and aquatic invertebrates, minimal contamination of surface waters seems likely from this proposed use. Based on a maximum expected EEC in the water column, RQs (<0.001) are two orders of magnitude below the LOC (0.5 for nonlisted species, 0.01 for listed species) for both fish and aquatic invertebrates.

4.1.2 Non-target Terrestrial Animals and Plants

4.1.2.1 Non-target Terrestrial and Semi-Aquatic Plants

There are no data regarding the toxicity of chlorophacinone to terrestrial and semi-aquatic plants. However, the mode of action of chlorophacinone is specific to animals and it used routinely in agricultural settings for crop protection with no verified incidents resulting from registered uses reported in the EIIS database. In addition, a low likelihood of exposure to plants is expected from this proposed use of chlorophacinone. Furthermore, plants naturally produce similar compounds as a defense strategy from herbivory. It is therefore reasonable to assume that risks to terrestrial plants are minimal.

4.1.2.2 Non-target Terrestrial Animals

Nontarget primary consumers, especially mammals, may be exposed to Rozol bait applied for Prairie Dog control. Bait applied 6 inches into entrances of open-burrow systems may be visible from the surface and may result in exposure of non-target animals, including migratory birds and Listed species. Digging by predators such as badgers, skunks, and coyotes also may bring bait to the surface.

a) Primary Exposure

Primary risk to avian and non-target mammalian bait feeders is evaluated for single and multiple feedings. The dietary risk quotient (RQ) is a ratio of chlorophacinone in the food bait to the dietary toxicity (LC_{50} based on 5-day dietary exposure) for the northern bobwhite and the laboratory rat. The dietary RQ is compared to the level of concern (LOC) for Listed species (LOC = 0.1) and non-Listed species (LOC = 0.5). Risk is presumed for any RQ exceeding an LOC. For Rozol bait, Listed and non-Listed LOCs are exceeded for both birds and non-target mammals, with the exceedences being much higher for mammals than for birds (Table 2).

Table 2. Dietary RQs and Amounts of Bait Providing an LD50 Dose for Birds and Mammals

Taxa/ size (g)	Dietary RQ	daily food intake (g)[a]	g bait providing *single-day* LD_{50} dose[b]	g bait providing *5-day* LD_{50} dose[c]
Birds:				
25	0.9	6.1	129	no data
100		9.6	516	no data
1000		53.9	5160	no data
Mammals:				
25	43.8	3.8	3.1	0.4 (0.08 g/day)
100		8.3	12.4	1.6 (0.32 g/day)
1000		68.7	124	16 (3.2 g/day)

[a] estimates of daily food-ingestion rates (g dry matter per day) were determined from allometric equations in Nagy (1987; see EPA 1993 and Erickson and Urban 2004)
[b] based on single-dose rat LD_{50} = 6.2 mg ai/kg bw
[c] based on 5-day-dose rat LD_{50} = 0.8 mg ai/kg bw (0.16 mg ai/kg bw/day

The amount of bait that birds and mammals of various sizes need to eat in single or multiple feedings to obtain a dose expected to be lethal to 50% of the individuals in the population (i.e., LD50 dose) also has been calculated (Table 2). These calculations are based on the amount of chlorophacinone in the bait (0.005% ai) and the single-dose acute-oral toxicity data for the northern bobwhite and the laboratory rat. A 5-day-dose acute-oral toxicity data value also is available for the laboratory rat.

It is unlikely that most birds could eat enough Rozol bait in a single feeding to ingest an LD_{50} dose, but a single feeding is potentially lethal to small non-target mammals. However, the available 5-day LD_{50} data for mammals indicates that risk increases by an order of magnitude if even small amounts of bait are eaten daily for several days. For example, a 100-g mammal is expected to eat approximately 8.3 g food daily. It would need to eat 12.4 g Rozol bait in a single feeding to ingest an LD_{50} dose. However, because chlorophacinone is more toxic if eaten for several days, a 100-g mammal needs to eat only about 0.32 g bait daily for 5 days to ingest an LD_{50} dose. Therefore, as also indicated by the dietary data, birds eating bait for several days, even if only in small amounts, may be at increased risk. For many individuals, this risk is actually of greater concern. The LD_{50} is the lethal dose to 50% of the test population, and no uncertainty or safety factor has been applied. In the wild, concern would be manifested when only 5% or 10% of the population has died, and that occurs at a lower dose (i.e., LD_{05} or LD_{10}) than predicted by the LD_{50}.

EFED does not have data to evaluate the potential for chronic/reproductive risks to birds and mammals from consumption of sublethal doses. The potential lethal and sublethal risks of chlorophacinone baits to birds and non-target mammals are discussed in more detail in OPP's comparative risk assessment for nine rodenticides (Erickson and Urban 2004).

b) Secondary Exposure

Secondary exposure of avian and mammalian predators and scavengers may occur. Dead and dying Prairie Dogs provide an easy food source. The USFWS reported that 300-400 dead and dying Prairie Dogs were found outside their burrows after an incident in which Rozol bait was used to illegally poison Prairie Dogs in Todd County, South Dakota in 2005. Prairie Dogs were retrieved up to 25 days after bait application and were being scavenged by various animals. Many others were likely removed by scavengers before they could be retrieved, because carcass retrieval did not begin until 12 days after bait was applied. Significant scavenging of ground squirrel carcasses also has been reported in field trials with chlorophacinone and diphacinone baits in California rangeland (studies reviewed by EFED). Dead and dying Prairie Dogs and non-target animals that have eaten bait pose a risk to predators and scavengers, because chlorophacinone is stored in body tissues of bait consumers (see Erickson and Urban 2004). Tests with captive Mustelids (domestic ferrets, mongooses, weasels) and wild Canids (coyotes, red foxes) indicate that poisoned prey pose a significant risk to mammalian predators and scavengers. Although no avian predators died in such tests, some displayed signs of intoxication; those feeding for several days on poisoned Prairie Dogs might be adversely affected. As noted, EFED has no data to evaluate the affects of sublethal exposure on behavior or reproduction of birds and mammals but recognizes that such effects might occur, particularly in combination with other environmental stressors animals face in the wild.

According to the Colorado Division of Natural Resources (2006), numerous species of predators and scavengers are associated with Prairie Dog colonies. Some of the most common of these species are listed below. Many of these mammals, birds, and reptiles may opportunistically feed on dead and dying Prairie Dogs and other small non-target mammals that eat bait and become

easy prey. For example, the burrowing owl utilizes Prairie Dog burrows for nesting and roosting and feeds extensively on the small rodents associated with Prairie Dog colonies. Golden eagles and ferruginous hawks also are closely linked with Prairie Dog colonies and known to regularly prey on Prairie Dogs and other small mammals that might eat bait. Some of these species are designated as State and/or Federal Species of Concern, and some are protected under The Migratory Bird Treaty Act.

Mammals:

Coyote (*Canis latrans*),
Badger (*Taxidea taxus*),
Red fox (*Vulpes vulpes*),
Gray fox (*Urocyon cinereoargenteus*)
Swift fox (*Vulpes velox*)
Bobcat (*Felis rufus*),
Long-tailed weasel (*Mustela frenata*)
Striped skunk (*Mephitis mepitis*)

Birds:

Bald eagle (*Haliaeetus leucocephalus*)
Golden eagle (*Aquila chrysaetos*)
Red-tailed hawk (*Buteo jamaicensis*)
Swainson's hawk (*Buteo swainsoni*)
Ferruginous hawk (*Buteo regalis*)
American peregrine falcon (*Falco peregrinus anatum*)
Turkey vulture (*Cathartes aura*)
Rough-legged hawk (*Buteo lagopus*)
Common raven (*Corvus corax*)
Common crow (*Corvus brachyrhynchos*)
Black-billed magpie (*Pica hudsonia*)
Burrowing owl (*Athene cunicularia*)

Reptiles:

Massasauga (*Sistrurus catenatus*)
Common king snake (*Lampropeltis getula*)
Common garter snake (*Thamnophis sirtalis*)

The amount of bait that birds and mammals of various sizes need to eat in single or multiple feedings to obtain a dose expected to be lethal to 50% of the individuals in the population (i.e., LD_{50} dose) also has been calculated (Table 4). These calculations are based on the amount of chlorophacinone in the bait (0.005% ai) and the single-dose acute-oral toxicity data for the northern bobwhite and the laboratory rat. A 5-day-dose acute-oral toxicity data value also is available for the laboratory rat.

Table 4. Amount of Bait Providing a 5-day LD_{50} Dose for Nontarget Mammals

Taxa/ size (g)	g bait providing *5-day* LD_{50} dose[a]		no. bait pellets[b]	
	total	per day	5 days	per day
25	0.4	0.08	2	0.4
100	1.6	0.32	8	1.6
1000	16	3.2	80	16

[a] based on 5-day-dose rat LD_{50} = 0.8 mg ai/kg bw (0.16 mg ai/kg bw/day)
[b] based on a pellet wt of 0.2 g (Erickson and Urban 2004)

Based on food consumption and acute-oral toxicity, small mammals might ingest an LD_{50} dose in a single feeding, but larger mammals and birds are not likely to do so. However, small, medium-sized, and larger mammals are at much higher risk if consuming bait for several days, even in small quantities. Small and medium-sized mammals can ingest an LD_{50} dose by eating fewer than two 0.2-g pellets per day for five days. A 1-kg mammal would need to eat only 16 pellets (3.2 g) per day, which is only about 5% of its daily food intake. This analysis is in agreement with the dietary RQ, based on a 5-day dietary exposure. Comparable data are not available for birds.

4.2 Risk Description

The results of this risk assessment indicate that there are potential effects to listed and non-listed birds and mammals through primary exposure. Additionally, because chlorophacinone residue will be present in body tissues of target and nontarget primary consumers for days or weeks after they consume bait, and because chlorophacinone exhibits toxicity to birds and especially to mammals, secondary and tertiary risk is likely for listed and nonlisted predators and scavengers, even when bait is applied underground. The expanded proposed use area for this product will greatly increase the availability of chlorophacinone to non-target listed and non-listed birds and mammals and result in increased exposure to these organisms.

4.2.1 Risks to Aquatic Organisms

EFED presumes minimal risk to aquatic species when Rozol bait is applied in accordance with the proposed SLN label directions and precautions. Although chlorophacinone is highly toxic to fish and aquatic invertebrates, minimal contamination of surface waters seems likely from this proposed use. Based on a maximum expected EEC in the water column, RQs (<0.001) are at least two orders of magnitude below the LOC (0.5 for non-Listed species, 0.01 for Listed species) for both fish and aquatic invertebrates.

4.2.2 Risks to Terrestrial Organisms

4.2.2.1 Terrestrial Animals

Birds and Nontarget Mammals

The Agency's LOC is exceeded for birds and nontarget mammals when chlorophacinone is applied according to the proposed product-label application directions. The proposed new uses expand the use area of this product to all states where Prairie Dogs occur. This increased usage are will result in more chlorophacinone bait available to non-target vertebrate species, and will increase the likelihood of both primary exposure through ingestion and secondary exposure through consumption of dead or poisoned animals.

It is unlikely that most birds could eat enough Rozol bait in a single feeding to ingest an LD_{50} dose, but a single feeding is potentially lethal to small non-target mammals. However, the available 5-day LD_{50} data for mammals indicates that risk increases by an order of magnitude if even small amounts of bait are eaten daily for several days. For example, a 100-g mammal is expected to eat approximately 8.3 g food daily. It would need to eat 12.4 g Rozol bait in a single feeding to ingest an LD_{50} dose. However, because chlorophacinone is more toxic if eaten for several days, a 100-g mammal needs to eat only about 0.32 g bait daily for 5 days to ingest an LD_{50} dose. Therefore, as also indicated by the dietary data, birds eating bait for several days, even if only in small amounts, may be at increased risk. For many individuals, this risk is actually of greater concern. The LD_{50} is the lethal dose to 50% of the test population, and no uncertainty or safety factor has been applied. In the wild, concern would be manifested when only 5% or 10% of the population has died, and that occurs at a lower dose (i.e., LD_{05} or LD_{10}) than predicted by the LD_{50}.

New uses require that bait be placed below ground in active burrows. While this will limit exposure, some primary exposure of small nontarget mammals may occur. Avian and mammalian predators and scavengers also may be exposed, because target species and smaller nontarget mammals containing chlorophacinone residue will be available as prey.

Removal of bait by invertebrates (e.g., crickets, ants) and their subsequent consumption by birds and mammals also has been documented as a route of exposure to anticoagulant rodenticides (Erickson and Urban 2004). Birds and mammals, including insectivorous species that might not directly eat bait, may be at risk.

The proposed usage areas also harbor a diverse variety of avian and mammalian predators and scavengers that will feed on target and nontarget species that have eaten bait. Noncrop areas include important wildlife habitat, including fence lines and border areas and buffer strips adjacent to crops as well as in forestry. Wildlife utilize areas adjacent to crop fields, such as hedgerows, unmowed ditch banks, and field borders, for food and cover[1],[2],[3].

[1] NC Wildlife Resources Commission
http://www.ces.ncsu.edu/nreos/wild/wildlife/habitat/index.html

Animals that eat chlorophacinone bait contain residues in various body tissues (Erickson and Urban 2004). Predators and scavengers that eat exposed animals are at risk from such exposure. Such risk seems to be much higher for mammals than for birds; wild canids (e.g., foxes, coyotes) and mustelids (e.g., weasels, skunks) seem to be most at risk (Erickson and Urban 2004).

Data are not available to assess potential reproductive impairment to any taxa. However, because mammals are the target species, and that chlorophacinone is so acutely toxic to them, reproductive effects data are not being requested for this specific use at this time. The potential lethal and sublethal risks of chlorophacinone baits to birds and non-target mammals are discussed in more detail in OPP's comparative risk assessment for nine rodenticides (Erickson and Urban 2004).

Reptiles and Amphibians

Reptiles and amphibians feeding on small mammals that have eaten bait may be exposed to chlorophacinone present in body tissues. EFED has no data to assess those potential risks but acknowledges that they likely exist.

4.2.2.2 Terrestrial Plants

There are no data regarding the toxicity of chlorophacinone to terrestrial and semi-aquatic plants. However, the mode of action of chlorophacinone is specific to animals and it used routinely in agricultural settings for crop protection with no verified incidents resulting from registered uses reported in the EIIS database. In addition, a low likelihood of exposure to plants is expected from this proposed use of chlorophacinone. Furthermore, plants naturally produce similar compounds as a defense strategy from herbivory. It is therefore reasonable to assume that risks to terrestrial plants are minimal.

4.2.3 Review of Incident Data

Dozens of incidents of both primary and secondary poisoning of both listed and non-listed wildlife from chlorophacinone have been reported to EFED's Ecological Incident Information System (EIIS) database. It is very likely that these reported incidents underestimate the percentage of wildlife populations exposed to chlorophacinone due to the fact that the vast majority of wildlife that have consumed lethal doses of Rozol bait or poisoned prey items remain undiscovered where they died[4]. Furthermore, the incidents reported here are only from verified registered uses where the certainty of chlorophacinone causing the incident was "probable" or better. It is important to note that it is often impossible to determine whether other incidents are due to misuse or approved use of chlorophacinone. This assessment does not include incidents

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[2] USDA, Natural Resourtces Conservation Sevice, Wildlife Habitat Management Institute, Fish and Wildlife Habitat Management Leaflets Nos 4 and 10

[3] Managing Michigan's Wildlife: A landowner's guide http://www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/index.htm

[4] 1999 Empirical evidence of side effects of rodenticides on some predatory birds and mammals. Advances in vertebrate pest management. Filander verlag. Pp. 347-367. Eds. D. O. Cowan and C. J. Feare

from deliberate misuse or where the certainty of chlorophacinone causing the incident was unknown.

4.2.3.1 Incidents Involving Terrestrial Organisms

a) <u>Incidents from Registered Uses</u>

I019311-001
Use of the product Rozol Pocket Bait Burrow Builder Formula with active ingredient chlorophacinone caused mortality of a badger in Kansas. A necropsy by the National Fish and Wildlife Forensics Lab determined that anticoagulant poisoning was the cause of death. Chlorophacinone was measured at 320 ppb in the stomach and 2 ppm in the liver. Route of exposure was listed as "unknown" because no Prairie Dog remains were found inside the badger, but being a strict carnivore, it almost certainly was affected through secondary poisoning.

I016476-018 1992
This incident can be found in detail on page 1824 of a report entitled "Field Evidence of Secondary Poisoning of Foxes and Buzzards by Bromadiolone, a 4-Year Study" which can be found appended to I016476-001 which is filed under Bromadiolone, PC 112001. Fletcher and Grave (Brighton Crop Protection Conference - Pets and Diseases - 793-798, 1992) reported six recent incidents involving rodenticides in Great Britain. They mentioned that birds and mammals found dead after rodenticide use always had direct access to the bait source. Fletcher also investigated 763 suspected poisoning incidents in animals in Great Britain in 1993, and pesticides were cited as the cause in 212 cases, with anti-coagulants accounting for poisoning in 20 cases (four of Brodifacoum, eight of Bromadiolone, and eight of Chlorophacinone). Foxes, little owls, mallards, cats and dogs were the victims.

I016476-001
An article in Chemosphere (Vol. 35, pgs 1817-1829, 1997) describes the results of a 4-year study in France based on the activity of a wildlife disease surveillance network (SAGIR). Its purpose was to evaluate the detrimental effects of anti-coagulant (AC) rodenticides in non-target wild animals. Such poisoning accounted for only 1-3% of the identified causes in most species. Predators (mainly foxes and buzzards) were potentially exposed to AC compounds, especially chlorophacinone, via contaminated prey in most species. The liver concentrations of bromadiolone residues were elevated and species-specific diagnostic values were determined.

AC rodenticides are used in major field-treatments in France during fall and winter. Bromadiolone is used extensively against field vole and coypu in the form of baits (carrots, apples, dry cereals). Wet baits are buried in holes or by means of a special plough, 15 cm below ground. Chlorophacinone is widely distributed and used against rats, mice, voles, and other rodents. It is less strictly regulated than bromadiolone. Chlorophacinone baits can be prepared by farmers and are usually not buried.

I016476-002
For full details of this incident, see I016476-001 filed under Bromadiolone, PC 112001. Sixteen buzzards were suspected as victims of the rodenticides, and 15 were confirmed. Of those, all 15 contained Bromadiolone and six contained Chlorophacinone.

I016476-014
For details of this incident see I016476-001 filed under Bromadiolone, PC 112001. This particular incident concerned a barn owl. There were seven suspected of dying of anti-coagulant poisoning but only one was submitted for necropsy and it contained Chlorophacinone in its liver at 0. 3 ppm.

I016476-003
For details of this incident, see I016476-001 filed under bromadiolone, PC 112001. There were 59 hares suspected of being affected. Of that number, 15 were submitted for analysis and Bromadiolone was found in two while Chlorophacinone was found in 12.

I016476-012
For details of this incident see I016476-001 filed under Bromadiolone, PC 112001. The subject of this particular incident was an eagle and it was found to have 6.2 ppm Chlorophacinone in its liver.

I016476-010
For details of this incident see I016476-001 filed under Bromadiolone, PC 112001. This particular incident concerned pigeons. Twenty two were suspected of being victims of anticoagulants, four were sent for analysis, and all four were found to contain anti-coagulants. Three were found to have Chlorophacinone in their livers.

I016476-005
For details of this incident see I016476-001 filed under bromadiolone, PC 112001. In this incident the subject was boars. Eight were suspected of being victims of anti-coagulants, and six were confirmed; there were three each due to Bromadiolone and Chlorophacinone.

b) <u>Incidents Resulting from Applications of Unknown Legality</u>

I009118-001
An adult male gray squirrel was found dead, head-first in the split of a tree stump in Central Park, on February 14, 1999. A bacterial infection with pus was present over the skull, and several large tan necrotic areas were present in the liver. An analysis of the liver showed the presence of chlorophacinone at 0.29 ppm. In the opinion of the technical investigator, the squirrel may have died from the infection alone, but the pale musculature indicates blood loss had occurred from the anti-coagulant. For further information contact Ward Stone at 108 Game Farm Road, Delmar, NY 12054.

I009063-001
A dead gray squirrel (wt. 613g) in fair flesh was found dead in Manhattan, N.Y. (Central Park at Locust Grove W. of the Great Lawn) and submitted to the Pathology Unit. It had puncture wounds over the lumbar spine and on the left Hind limb. It had fresh fractured ribs with extensive associated hemorrhage. A Lab report found the anticoagulant rodenticide. Chlorophacinone (0.44ppm) present in the liver. Though no amounts were submitted, diagnosis also indicated the presence of Diphacinone. The Pathologist surmised that predation seemed to be the cause of death. However, the squirrels' minimum health aspect was compromised by the anticoagulant and Diphacinone.

I009111-001
A gray squirrel was found dead in Gramercy Park in Manhattan, on January 18, 1999. The squirrel was in good flesh and had abundant fat supplies but the skeletal muscle and liver appeared to be very anemic. A hemorrhage was present. An analysis of the liver was conducted by the Illinois Dept. of Agriculture and a screen of 15 potential anticoagulants revealed the presence of 0.465 ppm chlorophacinone in the liver.

For further information contact Ward Stone at 108 Game Farm Road, Delmar, NY 12054.

I012972-001
A Southeastern Cooperative Wildlife Disease Study report concerned two turkeys that were found dead approximately 100 yards from a Prairie Dog town that had been baited with poisoned grain 2 1/2 to 3 weeks earlier. The suspected poison was Rozol pocket gopher poison. The turkeys were transferred to the Kansas Department of Wildlife and Parks, and ultimately to SCWDS. Both birds had symptoms typical of animals that have ingested rodenticides, and the livers of both birds were found to contain chlorophacinone at concentrations of 0.40- and 0.69-ppm chlorophacinone.

I013810-013
This is part of the Contaminant Exposure and Effects - Terrestrial Vertebrates (CEE-TV) Database, Version 3.3, October 2002 report. A Red-tailed Hawk was found on Manhattan. The necropsy showed .018 ug/g Chlorophacinone in the liver. It was also reported that trichomoniasis was present and we have not found any information on its possible relationship with this product.

R000-02-003
This incident is among those in a table entitled California Wildlife Submitted for Anticoagulant residue Analysis Between 1994-2000. A bobcat was found dead in Marin County. Its liver contained 0.4 ppm chlorophacinone and in the pathologist's judgment it was the likely cause of death.

R000-02-005
This incident is among those in a table entitled California Wildlife Submitted for Anticoagulant Residue Analysis Between 1994-2000. A coyote was found dead in Los Angeles County and

chlorophacinone was found in its liver at 1.2 ppm; in its blood at 0.04 ppm; and in its gut at 0.24 ppm. Chlorophacinone was judged to be the Highly Likely Cause of death.

I016100-001
At a technical meeting (site and sponsor not shown) personnel of the CA Dept. of Fish and Game gave the results of a study conducted in California, 1999 to 2003, to show the prevalence of Kit Fox deaths resulting from the use of anticoagulant rodenticides. Kit Foxes were trapped and then equipped with transponders by which their movements and, ultimately, their carcasses, could be traced. Necropsies provided evidence of the causes of death (hemorrhage, vehicle impacts, predator, suffocation, disease, antifreeze, and unknown). Those concerning hemorrhages were subjected to chemical analyses and the numbers associated with rodenticides were chlorophacinone (1), pindone (1), bromadiolone (2), coumatetralyl (5), and brodifacoum (27). In the slide attached to this report, the number of incidents cited with brodifacoum was 25 but Bill Erickson pointed out that number was incorrect - - should have been 27. There was an error in the 2001 reporting (should have been 4 rather than the 2 shown on the slide).

4.2.4 Federally Threatened and Endangered (Listed) Species Concerns

4.2.4.1 Taxonomic Groups potentially at Risk

The proposed expanded use and the new uses will expand the geographical area where Rozol Black Tailed Prairie Dog Bait will be applied (i.e., many more states, new and expanded uses), which may result in the exposure of many more listed species. The assessment uses the LOCs and other available information to identify concerns for adverse affects to listed species. For those taxa or measurement endpoints for which guideline studies are not available, EFED uses any relevant data from the literature to make a qualitative assessment of potential exposures pathways and risks. Taxa identified as being at potential risk from the proposed use of chlorophacinone as a food bait to kill Black Tailed Prairie Dogs include the following:

- birds, acute primary and secondary/tertiary and possibly reproductive/chronic
- mammals, acute primary and secondary/tertiary and possibly reproductive/chronic
- reptiles, acute secondary and possibly reproductive/chronic
- land-based amphibians, possible

EFED's Location of Crops and Threatened and Endangered Species (LOCATES) database was employed to identify possible listed species that may be exposed to chlorophacinone due to this proposed use. Special concern exists for the Endangered Black-Footed Ferret (*Mustela nigripes*). The Black-Footed Ferret may consume poisoned Prairie Dogs or non-target animals that contain chlorophacinone residue in body tissues (secondary exposure). If present, Black-Footed Ferrets depend on Prairie Dogs for food and utilize their burrows for shelter. Historically, where ever Prairie Dogs were found, so to were Black-Footed Ferrets (USFWS 2000). Anywhere Prairie Dogs occur should be considered possible habitat for the Black-Footed Ferret.

Listed species that are likely to be exposed to chlorophacinone either direct or secondary/tertiary exposure in states where the Black Tailed Prairie Dog occurs are listed below. A complete list of these species for all states is attached in Appendix C. Again, although the Black Tailed Prairie Dog only occurs in ten states, the label does not express this. Exposure to Listed species through accidental misuse of this product in states where the target species does not occur can be limited through label language limiting its use to the appropriate states.

Arizona

Amphibian	
Frog, Chiricahua Leopard (*Rana chiricahuensis)*	Threatened
Bird	
Condor, California (*Gymnogyps californianus*)	Endangered
Eagle, Bald (*Haliaeetus leucocephalus*)	Threatened
Falcon, Northern Aplomado (*Falco femoralis septentrionalis)*	Endangered
Owl,Mexican Spotted (*Strix occidentalis lucida)*	Threatened
Pygmy-owl, Cactus Ferruginous (*Glaucidium brasilianum cactorum*)	Endangered
Mammal	
Ferret, Black-Footed (*Mustela nigripesi)*	Endangered
Jaguar (*Panthera onca*)	Endangered
Jaguarundi, Sinaloan (*Herpailurus (=Felis) yagouaroundi Tolteca*)	Endangered
Ocelot (*Leopardus (=Felis) pardalis*)	Endangered
Squirrel, Mount Graham Red (*Tamiasciurus hudsonicus Grahamensis*)	Endangered
Vole, Hualapai Mexican (*Microtus mexicanus hualpaiensis*)	Endangered

Colorado

Bird	
Crane, Whooping (*Grus Americana)*	Endangered
Owl, Mexican Spotted (*Strix occidentalis lucida)*	Threatened
Mammal	
Ferret, Black-Footed (*Mustela nigripes)*	Endangered
Mouse, Preble's Meadow Jumping (*Zapus hudsonius preblei)*	Threatened
Wolf, Gray (*Canis lupus)*	Endangered

Kansas

Bird

Crane, Whooping (*Grus Americana)*	Endangered
Plover, Piping (*Charadrius melodus)*	Endangered

Mammal

Ferret, Black-Footed (*Mustela nigripes)*	Endangered

Montana

Bird

Crane, Whooping (*Grus Americana)*	Endangered

Mammal

Ferret, Black-Footed (*Mustela nigripes)*	Endangered

Nebraska

Bird

Crane, Whooping (*Grus americana)*	Endangered

Mammal

Ferret, Black-Footed (*Mustela nigripes)*	Endangered

New Mexico

Amphibian

Frog, Chiricahua Leopard (*Rana chiricahuensis)*	Threatened

Bird

Crane, Whooping (*Grus Americana)*	Endangered
Falcon, Northern Aplomado (*Falco femoralis septentrionalis)*	
Owl,Mexican Spotted (*Strix occidentalis lucida)*	Threatened

Mammal

Ferret, Black-Footed (*Mustela nigripes)*	Endangered
Jaguar (*Panthera onca)*	Endangered

Reptile

Rattlesnake, New Mexican Ridge-nosed(*Crotalus willardi obscurus)*	Threatened

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North Dakota

Bird

Crane, Whooping (*Grus Americana)*	Endangered

Mammal	
Wolf, Gray (*Canis lupus)*	Endangered

Oklahoma

Bird	
Crane, Whooping (*Grus Americana)*	Endangered

South Dakota

Bird	
Crane, Whooping (*Grus Americana)*	Endangered
Mammal	
Ferret, Black-Footed (*Mustela nigripes)*	Endangered
Wolf, Gray (*Canis lupus)*	Endangered

Texas

Amphibian	
Toad, Houston (*Bufo houstonensis)*	Endangered
Bird	
Crane, Whooping (*Grus Americana)*	Endangered
Falcon, Northern Aplomado (*Falco femoralis septentrionalis)*	Endangered
Owl, Mexican Spotted (*Strix occidentalis lucida)*	Threatened
Prairie-chicken, Attwater's Greater (*Tympanuchus cupido attwateri)*	Endangered
Mammal	
Jaguarundi, Gulf Coast (*Herpailurus yagouaroundi cacomitli)*	Endangered
Jaguarundi, Sinaloan (*Herpailurus yagouaroundi tolteca)*	Endangered
Ocelot (*Leopardus pardalis)*	Endangered
Reptile	
Snake, Concho Water (*Nerodia paucimaculata)*	Threatened

Wyoming

Amphibian	
Toad, Wyoming (*Bufo baxteri (=hemiophrys))*	Endangered
Mammal	
Ferret, Black-Footed (*Mustela nigripes)*	Endangered
Mouse, Preble's Meadow Jumping (*Zapus hudsonius preblei)*	Threatened

4.2.4.2 Indirect Effects Analysis

Chlorophacinone has the potential to exert both direct and indirect effects upon the listed organisms by, for example, causing mortality or impacting prey availability. Direct and indirect effects expected from the proposed new and expanded uses of Rozol Bait are described below (Table 5).

Table 5. Listed Species Risks Associated With Direct or Indirect Effects Due to Applications of Rozol Bait

Listed Taxon	Direct Effects	Indirect Effects
Terrestrial and semi-aquatic plants - monocots	No	No
Terrestrial and semi-aquatic plants - dicots	No	No
Terrestrial invertebrates	No	No
Birds	**Yes** (primary and secondary/ tertiary exposure)	**Yes** (loss of small mammal prey base)
Terrestrial phase amphibians	**Yes** (consumption of invertebrates transporting bait)	No
Reptiles	**Yes** (secondary exposure)	**Yes** (loss of small mammal prey base)
Mammals	**Yes** (primary and secondary/ tertiary exposure)	**Yes** (loss of small mammal prey base)
Aquatic non-vascular plants	No	No
Aquatic vascular plants	No	No
Freshwater fish	No	No
Aquatic phase amphibians	No	No

Listed Taxon	Direct Effects	Indirect Effects
Freshwater crustaceans	No	No
Mollusks	No	No
Marine/estuarine fish	No	No
Marine/estuarine crustaceans	No	No

4.2.4.3 Critical Habitat

In the evaluation of pesticide effects on designated critical habitat, consideration is given to the physical and biological features (constituent elements) of a critical habitat identified by the U.S Fish and Wildlife and National Marine Fisheries Services as essential to the conservation of a listed species and which may require special management considerations or protection. The evaluation of impacts for a screening level pesticide risk assessment focuses on the biological features that are constituent elements and is accomplished using the screening-level taxonomic analysis (risk quotients, RQ's) and listed species levels of concern (LOCs) that are used to evaluate direct and indirect effects to listed organisms.

The screening-level risk assessment has identified potential concerns for indirect effects on listed species for those organisms dependant upon aquatic organisms and mammals. In light of the potential for indirect effects, the next step for EPA and the Service(s) is to identify which listed species and critical habitat are potentially implicated. Analytically, the identification of such species and critical habitat can occur in either of two ways. First, the agencies could determine whether the action area overlaps critical habitat or the occupied range of any listed species. If so, EPA would examine whether the pesticide's potential impacts on non-endangered species would affect the listed species indirectly or directly affect a constituent element of the critical habitat. Alternatively, the agencies could determine which listed species depend on biological resources, or have constituent elements that fall into, the taxa that may be directly or indirectly impacted by the pesticide. Then EPA would determine whether use of the pesticide overlaps the critical habitat or the occupied range of those listed species. At present, the information reviewed by EPA does not permit use of either analytical approach to make a definitive identification of species that are potentially impacted indirectly or critical habitats that is potentially impacted directly by the use of the pesticide. EPA and the Service(s) are working together to conduct the necessary analysis.

This screening-level risk assessment for critical habitat provides a listing of potential biological features that, if they are constituent elements of one or more critical habitats, would be of

potential concern. These correspond to the taxa identified above as being of potential concern for indirect effects and include the following aquatic organisms, birds, amphibians, reptiles, and insects. This list should serve as an initial step in problem formulation for further assessment of critical habitat impacts outlined above, should additional work be necessary.

4.2.4.4 Co-occurrence Analysis

The goal of the co-location evaluation is to determine whether potential use sites of Rozol Black Tailed Prairie Dog Bait are geographically associated with known locations of listed species that might be exposed. At the screening level, this analysis is typically done using EFED's LOCATES database, which contains state and county-level data for listed species. Appendix C provides a synopsis of listed terrestrial species by State and taxa (birds, mammals, reptiles, amphibians) for the various use sites listed on the Rozol Black Tailed Prairie Dog Bait label. The lists include only terrestrial species and have been further refined to remove a number of bird and mammal species not expected to be impacted due to food habits and/or body size. For example, although ground-dwelling invertebrates may be exposed to bait, flying insects are not likely to be exposed. Therefore, listed bats, flycatchers, and vireos were removed from the lists, because they feed exclusively on flying insects. Fish-eating species such as eiders, petrels, shearwaters, and murrelets also were removed, based on their piscivorous food habits. Larger mammals, including grizzly bear, pronghorn, and caribou were removed due to food habits (e.g., caribou feed on lichens) and large body size.

4.3 Description of Assumptions, Limitations, Uncertainties and Data Gaps.

Data are not available to assess potential reproductive impairment to any taxa. However, because mammals are the target species, and that chlorophacinone is so acutely toxic to them, reproductive effects data are not being requested for this specific use at this time. Effects data are not available for reptiles or terrestrial-phase amphibians. In accordance with OPP/EFED policy for risk assessment, birds are considered as surrogates for assessing risk to these taxa (EPA 2004). There are no data to evaluate the risks of chlorophacinone to terrestrial or aquatic plants. However, the mode of action of chlorophacinone is specific to animals and it used routinely in agricultural settings for crop protection with no verified incidents resulting from registered uses reported in the EIIS database. In addition, a low likelihood of exposure to plants is expected from this proposed use of chlorophacinone. Furthermore, plants naturally produce similar compounds as a defense strategy from herbivory. It is therefore reasonable to assume that risks to terrestrial plants are minimal.

4.3.1 Related to Exposure for All Species

This screening-level risk assessment relies on labeled statements of the maximum rate of chlorophacinone application. This assumption constitutes a maximum use scenario. The frequency at which actual uses approach these maximums is dependant on resistance to the product, timing of applications, and market forces.

4.3.2 Related to Exposure for Aquatic Species

For an acute risk assessment, there is no averaging time for exposure. An instantaneous peak concentration, with a 1 in 10 year return frequency, is assumed. The use of the instantaneous peak assumes that instantaneous exposure is of sufficient duration to elicit acute effects comparable to those observed over more protracted exposure periods tested in the laboratory, typically 48 to 96 hours. In the absence of data regarding time-to-toxic event analyses and latent responses to instantaneous exposure, the degree to which risk is overestimated cannot be quantified.

4.3.3 Related to Exposure for Terrestrial Species

Screening-level risk assessments for applications of pesticides consider dietary exposure alone. Other routes of exposure, not considered in this assessment, are discussed below:

Incidental soil ingestion exposure - This risk assessment does not consider incidental soil ingestion. Available data suggests that up to 15% of the diet can consist of incidentally ingested soil depending on the species and feeding strategy (Beyer et al., 1994). Being that the proposed new use is a granular formulation, significant exposure via this scenario is not expected.

Inhalation Exposure - The screening risk assessment does not consider inhalation exposure. Such exposure may occur through three potential sources: (1) spray material in droplet form at the time of application (2) vapor phase pesticide volatilizing from treated surfaces, and (3) airborne particulate (soil, vegetative material, and pesticide dusts). Being that the proposed new use is a granular formulation, significant inhalation exposure is not expected.

Dermal Exposure - The screening assessment does not consider dermal exposure, except as it is indirectly included in calculations of RQ's based on lethal doses per unit of pesticide treated area. Dermal exposure may occur through three potential sources: (1) direct application of spray to terrestrial wildlife in the treated area or within the drift footprint, (2) incidental contact with contaminated vegetation, or (3) contact with contaminated water or soil. Being that the proposed new use is a use is a granular formulation, significant exposure via these scenarios is not expected.

Drinking Water Exposure - Drinking water exposure to a pesticide active ingredient may be the result of consumption of surface water or consumption of the pesticide in dew or other water on the surfaces of treated vegetation. For pesticide active ingredients with a potential to dissolve in runoff, puddles on the treated field may contain the chemical.

4.3.4 Related to Effects Assessment

4.3.4.1 Age class and sensitivity of effects thresholds

It is generally recognized that test organism age may have a significant impact on the observed sensitivity to a toxicant. The screening risk assessment acute toxicity data for fish are collected on juvenile fish between 0.1 and 5 grams. Aquatic invertebrate acute testing is performed on recommended immature age classes (e.g., first instar for daphids, second instar for amphipods,

stoneflies and mayflies, and third instar for midges). Similarly, acute dietary testing with birds is also performed on juveniles, with mallard being 5-10 days old and quail 10-14 days old.

Testing of juveniles may overestimate toxicity at older age classes for active ingredients, such as chlorophacinone, that act directly (without metabolic transformation) because younger age classes may not have the enzymatic systems associated with detoxifying xenobiotics. The screening risk assessment has no current provisions for a generally applied method that accounts for this uncertainty. Insofar as the available toxicity data may provide ranges of sensitivity information with respect to age class, the risk assessment uses the most sensitive life-stage information as the conservative screening endpoint.

4.3.4.2 Use of the Most Sensitive Species Tested

Although the screening risk assessment relies on a selected toxicity endpoint from the most sensitive species tested, it does not necessarily mean that the selected toxicity endpoints reflect sensitivity of the most sensitive species existing in a given environment. The relative position of the most sensitive species tested in the distribution of all possible species is a function of the overall variability among species to a particular chemical. In the case of listed species, there is uncertainty regarding the relationship of the listed species' sensitivity and the most sensitive species tested.

4.4 Recommendations

Use of Rozol bait to control Prairie Dogs may pose primary and secondary risks to birds and non-target mammals, including federally Listed and migratory species. Other bait options, currently registered for Prairie Dog control should be encouraged in areas potentially inhabited by Black-Footed Ferrets and other predacious and scavenging birds and mammals that may be opportunistically attracted to dead or dying Prairie Dogs and other rodents that have eaten bait.

Although part of its historic range, the Black Tailed Prairie Dog is now extirpated in Arizona (Lomolino and Smith 2003, USFWS 1999, Hafner *et al* 1998). Accidental misuse and the potential for primary and secondary exposure to nontarget species can be greatly reduced by excluding Arizona from the label.

The proposed label states that the applicator must return to the site within 5 to 10 days after bait application and again at 14-21 days after application to collect and properly dispose of any dead or dying Prairie Dogs found above ground. However, earlier SLN labels state that the applicator must return to the site within 2 days after bait application and at 1- to 2-day intervals. Collection of dead and dying poisoned animals is crucial in reducing the risk of secondary exposure through predation and scavenging. The potential for secondary exposure to nontarget species will be decreased if the label instructs the applicator to return after 2 days and at 1- to 2-day intervals.

EFED believes that it is essential that applicators adhere to instructions to conduct carcass searches periodically after baiting and to properly dispose of any Prairie Dog carcasses collected. Moreover, poisoned Prairie Dogs may be more easily subject to predation before they die, as they are likely to become progressively weaker as they hemorrhage for several days before death. Any non-target species impacted by this product should be collected and turned in to proper authorities for identification and tissue-residue analysis to determine if the animal was exposed to chlorophacinone. When available, that information also should be reported to the appropriate state agencies, to EPA, and to the USFWS.

The current label also states that reapplications may be made if activity persists several weeks to months after the bait was applied. This language is vague and could result in reapplications being made before monitoring and carcass removal occurs from the original application. Reapplication before monitoring and carcass removal will likely result an increased exposure to non target species.

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APPENDIX A. **Acute-oral and Dietary Toxicity of Chlorophacinone to Mammals and Birds (from Erickson and Urban 2004)**

Species	LD_{50}, mg/kg (95% CI)	LC_{50}, ppm (95% CI)
Mammals:		
Laboratory rat (*Rattus norvegicus*)	6.2 3.1 ♂ (1.5-6.7) 11.0 ♀ (6.5-18.5) 0.95 (5-day dose @ 0.19/day)	1.14 (1.02-1.36) 1.14 (0.98-1.35) 1.26 (1.11-1.47) 1.26 (0.97-1.64)
Norway rat (wild) (*R. norvegicus*)	0.80 (5-day dose @ 0.16/day)	
Roof rat (*Rattus rattus*)	15.0	
House mouse (*Mus musculus*)	1.0 6	
Laboratory mouse (*M. musculus*)	1.90 ♂ 17.40 ♀	
Deer mouse (*Peromyscus maniculatus*)	0.49 1.0-3.75	
Pine vole (*Microtus pinetorum*)	14.2 (11.4-17.6)	
Dog (domestic)	50-100	
Birds:		
Mallard (*Anas platyrhynchos*)		172 (75-498)
Northern bobwhite (*Colinus virginianus*)	258 (167-356)	56 (22-105)
Ring-necked pheasant (*Phasianus colchicus*)	>100	
Red-winged blackbird (*Agelaius phoenicius*)	430	

APPENDIX B. Risk Quotient Method and Levels of Concern

Risk characterization integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects. The means of this integration is the quotient method. Risk quotients (RQs) are calculated by dividing exposure estimates (EECs) by acute and chronic ecotoxicity values.

RQ = EXPOSURE/TOXICITY

RQs are then compared to OPP's levels of concern (LOCs). LOCs are used by OPP to determine potential risk to non-target organisms and identify the need to consider regulatory action to mitigate risk. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on non-target organisms. LOCs currently address the following risk presumption categories:

- acute risks - regulatory action may be warranted in addition to restricted use classification
- acute restricted use - the potential for acute risk is high, but may be mitigated through restricted use classification
- acute endangered species - endangered species may be adversely affected, and
- reproductive/chronic risk - the potential for chronic risk is high regulatory action may be warranted.

EFED does not perform assessments for chronic risk to plants, acute or chronic risks to insects or chronic risk from granular/bait formulations to birds or mammals.

The ecotoxicity test values (measurement endpoints) used in the acute and reproductive/chronic RQs are derived from required studies. Examples of ecotoxicity values derived from short-term laboratory studies that assess acute effects are:

- LC50 (fish and birds)
- LD50 (birds and mammals)
- EC50 (aquatic plants and aquatic invertebrates), and
- EC25 (terrestrial plants - nonlisted species)
- NOAEC or EC05 (terrestrial plants - listed species)

Examples of toxicity test effect levels derived from the results of longer-term laboratory studies that assess reproductive/chronic effects are:

- LOAEC (birds, fish, and aquatic invertebrates)
- NOAEC (birds, fish and aquatic invertebrates)

Other toxicity values may be used when justified.

Risk presumptions and the corresponding RQs and LOCs, are tabulated below.

Risk presumptions for terrestrial animals based on risk quotients (RQ) and levels of concern (LOC)

Risk Presumption	RQ	LOC
Birds:		
Acute Risk	EEC[1]/LC_{50} or LD_{50}/ft^2 or LD_{50}/day[3]	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
Wild Mammals:		
Acute Risk	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1

[1] Estimated Environmental Concentration (EEC, ppm) on avian and mammalian food items
[2] mg/ft^2
[3] mg of toxicant consumed/day
LD_{50} * wt. of bird
LD_{50} * wt. of bird

Risk presumptions for aquatic animals based on risk quotients (RQ) and levels of concern (LOC)

Risk Presumption	RQ	LOC
Acute Risk	EEC[1]/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Endangered Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/NOAEC	1

[1] EEC = (ppm or ppb) in water

Risk presumptions for plants based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
Terrestrial and Semi-Aquatic Plants:		
Acute Risk	EEC^{1}/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOAEC	1
Aquatic Plants:		
Acute Risk	EEC^{2}/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOAEC	1

[1] EEC = lbs ai/A
[2] EEC = (ppb/ppm) in water

APPENDIX C. Listed Species Occurrence in All States for Selected Terrestrial Taxa: Mammal, Bird, Amphibian, Reptile by Use Site

Species Occurrence in Selected States and Selected Taxa

No species were excluded
All Medium Types Reported

Mammal, Bird, Amphibian, Reptile

AL, AK, AZ, AR, CA, CO, CT, DE, DC, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, PR, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY

Alabama				CH
Bird				
Stork, Wood	*Mycteria americana*	Endangered	Terrestrial	No
Mammal				
Mouse, Alabama Beach Yes	*Peromyscus polionotus ammobates*	Endangered	Terrestrial, Coastal (neritic)	
Mouse, Perdido Key Beach	*Peromyscus polionotus trissyllepsis*	Endangered	Coastal (neritic)	Yes
Reptile				
Snake, Eastern Indigo	*Drymarchon corais couperi*	Threatened	Terrestrial	No
Arizona				CH
Amphibian				
Frog, Chiricahua Leopard	*Rana chiricahuensis*	Threatened	Freshwater, Terrestrial	No
Bird				
Condor, California	*Gymnogyps californianus*	Endangered	Terrestrial	Yes
Eagle, Bald	*Haliaeetus leucocephalus*	Threatened	Terrestrial	No
Falcon, Northern Aplomado	*Falco femoralis septentrionalis*	Endangered	Terrestrial	No
Owl, Mexican Spotted	*Strix occidentalis lucida*	Threatened	Terrestrial	Yes
Pygmy-owl, Cactus Ferruginous	*Glaucidium brasilianum cactorum*	Endangered	Terrestrial	No
Mammal				
Ferret, Black-Footed	*Mustela nigripes*	Endangered	Terrestrial	No
Jaguar	*Panthera onca*	Endangered	Terrestrial	No
Jaguarundi, Sinaloan	*Herpailurus (=Felis) yagouaroundi tolteca*	Endangered	Terrestrial	No
Ocelot	*Leopardus (=Felis) pardalis*	Endangered	Terrestrial	No
Squirrel, Mount Graham Red	*Tamiasciurus hudsonicus grahamensis*	Endangered	Terrestrial	Yes

Vole, Hualapai Mexican	*Microtus mexicanus hualpaiensis*	Endangered	Terrestrial	No
Reptile				
Rattlesnake, New Mexican Ridge-nosed	*Crotalus willardi obscurus*	Threatened	Terrestrial	Yes
California				CH
Amphibian				
Frog, California Red-legged	*Rana aurora draytonii*	Threatened	Terrestrial, Freshwater	Yes
Frog, Mountain Yellow-legged	*Gopherus agassizii*	Endangered	Terrestrial, Freshwater	No
Toad, Arroyo Southwestern	*Bufo californicus (=microscaphus)*	Endangered	Freshwater, Terrestrial	Yes
Bird				
Condor, California	*Gymnogyps californianus marmoratus*	Endangered	Terrestrial Saltwater	Yes
Owl, Northern Spotted	*Strix occidentalis caurina*	Threatened	Terrestrial	Yes
Shrike, San Clemente Loggerhead	*Lanius ludovicianus mearnsi*	Endangered	Terrestrial	No
Sparrow, San Clemente Sage	*Amphispiza belli clementeae*	Threatened	Terrestrial	No
Towhee, Inyo Brown	*Pipilo crissalis eremophilus*	Threatened	Terrestrial	Yes
Mammal				
Fox, San Joaquin Kit	*Vulpes macrotis mutica*	Endangered	Terrestrial	No
Fox, San Miguel Island	*Urocyon littoralis littoralis*	Endangered	Terrestrial	Yes
Fox, Santa Catalina Island	*Urocyon littoralis catalinae*	Endangered	Terrestrial	Yes
Fox, Santa Cruz Island	*Urocyon littoralis santacruzae*	Endangered	Terrestrial	Yes
Fox, Santa Rosa Island	*Urocyon littoralis santarosae*	Endangered	Terrestrial	Yes
Kangaroo Rat, Fresno	*Dipodomys nitratoides exilis*	Endangered	Terrestrial	Yes
Kangaroo Rat, Giant	*Dipodomys ingens*	Endangered	Terrestrial	No
Kangaroo Rat, Morro Bay	*Dipodomys heermanni morroensis*	Endangered	Terrestrial	Yes
Kangaroo Rat, San Bernardino Merriam's	*Dipodomys merriami parvus*			
Endangered	Terrestrial	Yes		
Kangaroo Rat, Stephens'	*Dipodomys stephensi (incl. D. cascus)*	Endangered	Terrestrial	No
Kangaroo Rat, Tipton	*Dipodomys nitratoides nitratoides*	Endangered	Terrestrial	No
Mountain Beaver, Point Arena	*Aplodontia rufa nigra*	Endangered	Freshwater, Terrestrial	No
Mouse, Pacific Pocket	*Perognathus longimembris pacificus*	Endangered	Terrestrial	No
Mouse, Salt Marsh Harvest	*Reithrodontomys raviventris*	Endangered	Terrestrial	No
Rabbit, Riparian Brush	*Sylvilagus bachmani riparius*	Endangered	Terrestrial	No
Sheep, Peninsular Bighorn	*Ovis canadensis*	Endangered	Terrestrial	Yes
Sheep, Sierra Nevada Bighorn	*Ovis canadensis californiana*	Endangered	Terrestrial	No
Shrew, Buena Vista Lake Ornate	*Sorex ornatus relictus*	Endangered	Terrestrial	Yes
Vole, Amargosa	*Microtus californicus scirpensis*	Endangered	Terrestrial	Yes
Woodrat, Riparian	*Neotoma fuscipes riparia*	Endangered	Terrestrial	No
Reptile				
Lizard, Blunt-nosed Leopard	*Gambelia silus*	Endangered	Terrestrial	No
Lizard, Coachella Valley Fringe-toed	*Uma inornata*	Threatened	Terrestrial	Yes
Lizard, Island Night	*Xantusia riversiana*	Threatened	Terrestrial	No

Snake, Giant Garter	*Thamnophis gigas*	Threatened	Freshwater, Terrestrial	No
Snake, San Francisco Garter	*Thamnophis sirtalis tetrataenia*	Endangered	Freshwater, Terrestrial	No
Whipsnake (=Striped Racer), Alameda	*Masticophis lateralis euryxanthus*	Threatened	Terrestrial	Yes

Colorado CH

Bird

Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes
Owl, Mexican Spotted	*Strix occidentalis lucida*	Threatened	Terrestrial	Yes

Mammal

Ferret, Black-Footed	*Mustela nigripes*	Endangered	Terrestrial	No
Mouse, Preble's Meadow Jumping	*Zapus hudsonius preblei*	Threatened	Terrestrial	Yes
Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes

Delaware CH

Mammal

Squirrel, Delmarva Peninsula Fox	*Sciurus niger cinereus*	Endangered	Terrestrial	No

Florida CH

Bird

Caracara, Audubon's Crested	*Polyborus plancus audubonii*	Threatened	Terrestrial	No
Kite, Everglade Snail	*Rostrhamus sociabilis plumbeus*	Endangered	Terrestrial	Yes
Scrub-Jay, Florida	*Aphelocoma coerulescens*	Threatened	Terrestrial	No
Sparrow, Cape Sable Seaside	*Ammodramus maritimus mirabilis*	Endangered	Terrestrial	Yes
Sparrow, Florida Grasshopper	*Ammodramus savannarum floridanus*	Endangered	Terrestrial	No
Stork, Wood	*Mycteria americana*	Endangered	Terrestrial	No

Mammal

Deer, Key	*Odocoileus virginianus clavium*	Endangered	Terrestrial	No
Mouse, Anastasia Island Beach No	*Peromyscus polionotus phasma*	Endangered	Terrestrial, Coastal (neritic)	
Mouse, Choctawhatchee Beach Yes	*Peromyscus polionotus allophrys*	Endangered	Coastal (neritic), Terrestrial	
Mouse, Key Largo Cotton	*Peromyscus gossypinus allapaticola*	Endangered	Terrestrial	No
Mouse, Perdido Key Beach	*Peromyscus polionotus trissyllepsis*	Endangered	Coastal (neritic)	Yes
Mouse, Southeastern Beach No	*Peromyscus polionotus niveiventris*	Threatened	Coastal (neritic), Terrestrial	
Mouse, St. Andrew Beach No	*Peromyscus polionotus peninsularis*	Endangered	Terrestrial, Coastal (neritic)	
Panther, Florida	*Puma (=Felis) concolor coryi*	Endangered	Terrestrial	No
Rabbit, Lower Keys Marsh	*Sylvilagus palustris hefneri*	Endangered	Terrestrial	No

Rice Rat (=Silver Rice Rat)	*Oryzomys palustris natator*	Endangered	Terrestrial	Yes
Vole, Florida Salt Marsh	*Microtus pennsylvanicus dukecampbelli*	Endangered	Terrestrial, Brackish	No
Woodrat, Key Largo	*Neotoma floridana smalli*	Endangered	Terrestrial	No
Reptile				
Skink, Blue-tailed Mole	*Eumeces egregius lividus*	Threatened	Terrestrial	No
Skink, Sand	*Neoseps reynoldsi*	Threatened	Terrestrial	No
Snake, Atlantic Salt Marsh	*Nerodia clarkii taeniata*	Threatened	Saltwater, Terrestrial, Brackish	No
Snake, Eastern Indigo	*Drymarchon corais couperi*	Threatened	Terrestrial	No
Georgia				CH
Bird				
Stork, Wood	*Mycteria americana*	Endangered	Terrestrial	No
Warbler (=Wood), Kirtland's	*Dendroica kirtlandii*	Endangered	Terrestrial	No
Reptile				
Snake, Eastern Indigo	*Drymarchon corais couperi*	Threatened	Terrestrial	No
Hawaii				CH
Bird				
'Akepa, Hawaii	*Loxops coccineus coccineus*	Endangered	Terrestrial	No
'Akepa, Maui	*Loxops coccineus ochraceus*	Endangered	Terrestrial	No
'Akia Loa, Kauai (Hemignathus procerus)		*Hemignathus procerus*		
Endangered	Terrestrial	No		
'Akia Pola'au (Hemignathus munroi)	*Hemignathus munroi*	Endangered	Terrestrial	No
Albatross, Short-tailed	*Phoebastria (=Diomedea) albatrus*	Endangered	Terrestrial, Saltwater	No
Coot, Hawaiian (=Alae keo keo)	*Fulica americana alai*	Endangered	Terrestrial	No
Creeper, Hawaii	*Oreomystis mana*	Endangered	Terrestrial	No
Creeper, Molokai (Kakawahie)	*Paroreomyza flammea*	Endangered	Terrestrial	No
Creeper, Oahu (Alauwahio)	*Paroreomyza maculata*	Endangered	Terrestrial	No
Crow, Hawaiian ('Alala)	*Corvus hawaiiensis*	Endangered	Terrestrial	No
Duck, Hawaiian (Koloa)	*Anas wyvilliana*	Endangered	Freshwater, Terrestrial	No
Duck, Laysan	*Anas laysanensis*	Endangered	Terrestrial, Freshwater	No
Elepaio, Oahu	*Chasiempis sandwichensis ibidis*	Endangered	Terrestrial	Yes
Finch, Laysan	*Telespyza cantans*	Endangered	Terrestrial	No
Finch, Nihoa	*Telespyza ultima*	Endangered	Terrestrial	No
Goose, Hawaiian (Nene)	*Branta (=Nesochen) sandvicensis*	Endangered	Terrestrial, Freshwater	No
Hawk, Hawaiian (Io)	*Buteo solitarius*	Endangered	Terrestrial	No
Honeycreeper, Crested ('Akohekohe)	*Palmeria dolei*	Endangered	Terrestrial	No
Millerbird, Nihoa	*Acrocephalus familiaris kingi*	Endangered	Terrestrial	No
Moorhen, Hawaiian Common	*Gallinula chloropus sandvicensis*	Endangered	Terrestrial	No
Nuku Pu'u	*Hemignathus lucidus*	Endangered	Terrestrial	No

'O'o, Kauai (='A'a)	*Moho braccatus*	Endangered	Terrestrial	No
'O'u (Honeycreeper)	*Psittirostra psittacea*	Endangered	Terrestrial	No
Palila	*Loxioides bailleui*	Endangered	Terrestrial	Yes
Parrotbill, Maui	*Pseudonestor xanthophrys*	Endangered	Terrestrial	No
Petrel, Hawaiian Dark-rumped	*Pterodroma phaeopygia sandwichensis*		Endangered	
Terrestrial	No			
Po'ouli	*Melamprosops phaeosoma*	Endangered	Terrestrial	No
Shearwater, Newell's Townsend's	*Puffinus auricularis newelli*	Threatened	Terrestrial, Saltwater	No
Stilt, Hawaiian (=Ae'o)	*Himantopus mexicanus knudseni*	Endangered	Terrestrial	No
Thrush, Large Kauai	*Myadestes myadestinus*	Endangered	Terrestrial	No
Thrush, Molokai (Oloma'o)	*Myadestes lanaiensis rutha*	Endangered	Terrestrial	No
Thrush, Small Kauai (Puaiohi)	*Myadestes palmeri*	Endangered	Terrestrial	No

Idaho CH

Bird

Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes

Mammal

Squirrel, Northern Idaho Ground	*Spermophilus brunneus brunneus*	Threatened	Terrestrial	No

Illinois CH

Bird

Tern, Interior (population) Least	*Sterna antillarum*	Endangered	Terrestrial	No

Mammal

Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes

Indiana CH

Bird

Plover, Piping	*Charadrius melodus*	Endangered	Terrestrial	Yes
Tern, Interior (population) Least	*Sterna antillarum*	Endangered	Terrestrial	No

Mammal

Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes

Reptile

Snake, Northern Copperbelly Water	*Nerodia erythrogaster neglecta*	Threatened	Freshwater, Terrestrial	No

Iowa CH

Mammal

Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes

Kansas CH

Bird				
Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes
Mammal				
Ferret, Black-Footed	*Mustela nigripes*	Endangered	Terrestrial	No
Kentucky (9) species:				CH
Bird				
Warbler (=Wood), Kirtland's	*Dendroica kirtlandii*	Endangered	Terrestrial	No
Warbler, Bachman's	*Vermivora bachmanii*	Endangered	Terrestrial	No
Maine				CH
Mammal				
Lynx, Canada	*Lynx canadensis*	Threatened	Terrestrial	No
Maryland				CH
Mammal				
Squirrel, Delmarva Peninsula Fox	*Sciurus niger cinereus*	Endangered	Terrestrial	No
Michigan				CH
Bird				
Warbler (=Wood), Kirtland's	*Dendroica kirtlandii*	Endangered	Terrestrial	No
Mammal				
Lynx, Canada	*Lynx canadensis*	Threatened	Terrestrial	No
Reptile				
Snake, Northern Copperbelly Water	*Nerodia erythrogaster neglecta*	Threatened	Freshwater, Terrestrial	No
Minnesota				CH
Mammal				
Lynx, Canada	*Lynx canadensis*	Threatened	Terrestrial	No
Mississippi				CH
Amphibian				
Frog, Dusky Gopher (Mississippi DPS)	*Rana capito sevosa*	Endangered	Terrestrial, Freshwater	No
Bird				
Crane, Mississippi Sandhill	*Grus canadensis pulla*	Endangered	Terrestrial, Freshwater	Yes

Reptile

Snake, Eastern Indigo	*Drymarchon corais couperi*	Threatened	Terrestrial	No

Missouri CH

Mammal

Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes

Montana CH

Bird

Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes

Mammal

Ferret, Black-Footed	*Mustela nigripes*	Endangered	Terrestrial	No

Nebraska CH

Bird

Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes

Mammal

Ferret, Black-Footed	*Mustela nigripes*	Endangered	Terrestrial	No

New Mexico CH

Amphibian

Frog, Chiricahua Leopard	*Rana chiricahuensis*	Threatened	Freshwater, Terrestrial	No

Bird

Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes
Falcon, Northern Aplomado	*Falco femoralis septentrionalis*	Endangered	Terrestrial	No
Owl, Mexican Spotted	*Strix occidentalis lucida*	Threatened	Terrestrial	Yes

Mammal

Ferret, Black-Footed	*Mustela nigripes*	Endangered	Terrestrial	No
Jaguar	*Panthera onca*	Endangered	Terrestrial	No

Reptile

Rattlesnake, New Mexican Ridge-nosed	*Crotalus willardi obscurus*	Threatened	Terrestrial	Yes

North Carolina CH

Bird

Stork, Wood	*Mycteria americana*	Endangered	Terrestrial	No

Mammal

Squirrel, Carolina Northern Flying	*Glaucomys sabrinus coloratus*	Endangered	Terrestrial	No

North Dakota				CH
Bird				
Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes
Mammal				
Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes
Ohio				CH
Mammal				
Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes
Reptile				
Snake, Lake Erie Water	*Nerodia sipedon insularum*	Threatened	Terrestrial, Freshwater	No
Snake, Northern Copperbelly Water	*Nerodia erythrogaster neglecta*	Threatened	Freshwater, Terrestrial	No
Oklahoma				CH
Bird				
Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes
Oregon				CH
Bird				
Owl, Northern Spotted	*Strix occidentalis caurina*	Threatened	Terrestrial	Yes
Mammal				
Deer, Columbian White-tailed	*Odocoileus virginianus leucurus*	Endangered	Terrestrial	No
Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes
Pennsylvania				CH
Mammal				
Squirrel, Delmarva Peninsula Fox	*Sciurus niger cinereus*	Endangered	Terrestrial	No
Puerto Rico				CH
Amphibian				
Coqui, Golden	*Eleutherodactylus jasperi*	Threatened	Freshwater, Terrestrial	Yes
Guajon	*Eleutherodactylus cooki*	Threatened	Freshwater, Terrestrial	No
Toad, Puerto Rican Crested	*Peltophryne lemur*	Threatened	Terrestrial, Freshwater	No
Bird				
Blackbird, Yellow-shouldered	*Agelaius xanthomus*	Endangered	Terrestrial	Yes
Hawk, Puerto Rican Broad-winged	*Buteo platypterus brunnescens*	Endangered	Terrestrial	No
Hawk, Puerto Rican Sharp-shinned	*Accipiter striatus venator*	Endangered	Terrestrial	No
Nightjar, Puerto Rico	*Caprimulgus noctitherus*	Endangered	Terrestrial	No

Pigeon, Puerto Rican Plain	*Columba inornata wetmorei*	Endangered	Terrestrial	No
Plover, Piping	*Charadrius melodus*	Endangered	Terrestrial	Yes

Reptile

Anole, Culebra Island Giant	*Anolis roosevelti*	Endangered	Terrestrial	Yes
Boa, Mona	*Epicrates monensis monensis*	Threatened	Terrestrial	Yes
Boa, Puerto Rican	*Epicrates inornatus*	Endangered	Terrestrial	No
Gecko, Monito	*Sphaerodactylus micropithecus*	Endangered	Terrestrial	Yes
Iguana, Mona Ground	*Cyclura stejnegeri*	Threatened	Terrestrial	Yes

South Carolina CH

Bird

Stork, Wood	*Mycteria americana*	Endangered	Terrestrial	No
Warbler, Bachman's	*Vermivora bachmanii*	Endangered	Terrestrial	No

Reptile

Snake, Eastern Indigo	*Drymarchon corais couperi*	Threatened	Terrestrial	No

South Dakota CH

Bird

Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes

Mammal

Ferret, Black-Footed	*Mustela nigripes*	Endangered	Terrestrial	No
Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes

Tennessee CH

Bird

Stork, Wood	*Mycteria americana*	Endangered	Terrestrial	No

Mammal

Squirrel, Carolina Northern Flying	*Glaucomys sabrinus coloratus*	Endangered	Terrestrial	No

Texas CH

Amphibian

Toad, Houston	*Bufo houstonensis*	Endangered	Terrestrial, Freshwater	Yes

Bird

Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes
Falcon, Northern Aplomado	*Falco femoralis septentrionalis*	Endangered	Terrestrial	No
Owl, Mexican Spotted	*Strix occidentalis lucida*	Threatened	Terrestrial	Yes
Prairie-chicken, Attwater's Greater	*Tympanuchus cupido attwateri*	Endangered	Terrestrial	No
Warbler (=Wood), Golden-cheeked	*Dendroica chrysoparia*	Endangered	Terrestrial	No

Mammal

Jaguarundi, Gulf Coast	*Herpailurus (=Felis) yagouaroundi cacomitli*	Endangered	Terrestrial	No
Jaguarundi, Sinaloan	*Herpailurus (=Felis) yagouaroundi tolteca*	Endangered	Terrestrial	No
Ocelot	*Leopardus (=Felis) pardalis*	Endangered	Terrestrial	No

Reptile

Snake, Concho Water	*Nerodia paucimaculata*	Threatened	Freshwater, Terrestrial	Yes

Utah CH

Bird

Owl, Mexican Spotted	*Strix occidentalis lucida*	Threatened	Terrestrial	Yes

Mammal

Ferret, Black-Footed	*Mustela nigripes*	Endangered	Terrestrial	No
Prairie Dog, Utah	*Cynomys parvidens*	Threatened	Terrestrial, Subterraneous	No
Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes

CH

Virginia CH

Mammal

Squirrel, Delmarva Peninsula Fox	*Sciurus niger cinereus*	Endangered	Terrestrial	No
Squirrel, Virginia Northern Flying	*Glaucomys sabrinus fuscus*	Endangered	Terrestrial	No

Washington CH

Bird

Murrelet, Marbled	*Brachyramphus marmoratus marmoratus*	Threatened	Freshwater, Terrestrial, Saltwater	Yes
Owl, Northern Spotted	*Strix occidentalis caurina*	Threatened	Terrestrial	Yes
Pelican, Brown	*Pelecanus occidentalis*	Endangered	Terrestrial	No

Mammal

Caribou, Woodland	*Rangifer tarandus caribou*	Endangered	Terrestrial	No
Deer, Columbian White-tailed	*Odocoileus virginianus leucurus*	Endangered	Terrestrial	No
Rabbit, Pygmy	*Brachylagus idahoensis*	Endangered	Terrestrial	No
Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes

West Virginia CH

Mammal

Squirrel, Carolina Northern Flying	*Glaucomys sabrinus coloratus*	Endangered	Terrestrial	No
Squirrel, Virginia Northern Flying	*Glaucomys sabrinus fuscus*	Endangered	Terrestrial	No

Wisconsin				CH
Bird				
Crane, Whooping	*Grus americana*	Endangered	Terrestrial, Freshwater	Yes
Plover, Piping	*Charadrius melodus*	Endangered	Terrestrial	Yes
Warbler (=Wood), Kirtland's	*Dendroica kirtlandii*	Endangered	Terrestrial	No
Mammal				
Lynx, Canada	*Lynx canadensis*	Threatened	Terrestrial	No
Wolf, Gray	*Canis lupus*	Endangered	Terrestrial	Yes
Wyoming				CH
Amphibian				
Toad, Wyoming	*Bufo baxteri (=hemiophrys)*	Endangered	Freshwater, Terrestrial	No
Mammal				
Ferret, Black-Footed	*Mustela nigripes*	Endangered	Terrestrial	No
Mouse, Preble's Meadow Jumping	*Zapus hudsonius preblei*	Threatened	Terrestrial	Yes