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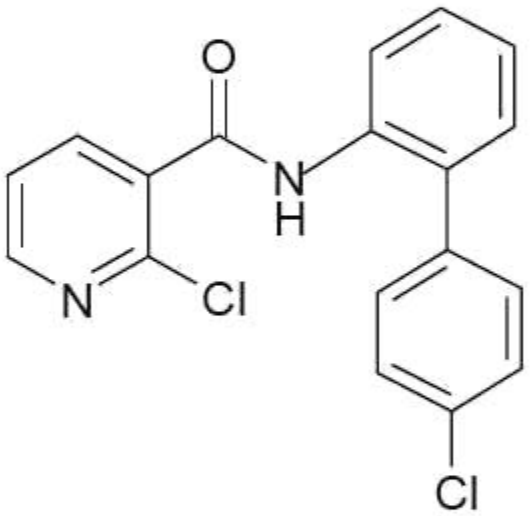
Environmental Fate and Ecological Risk Assessment for Boscalid New Uses on Alfalfa and Citrus (Group 10)



Boscalid
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Prepared by
Catherine Aubee, Biologist
David Lieu, Chemist

Reviewed by
Anita Pease, Senior Biologist
Thomas Steeger, Ph.D., Senior Biologist
R. David Jones, Ph.D., Senior Agronomist
Elizabeth Behl, Branch Chief

U.S. Environmental Protection Agency
Office of Pesticide Programs
Environmental Fate and Effects Division (EFED)
Environmental Risk Branch IV
1200 Pennsylvania Ave., NW
Mail Code 7507P
Washington, DC 20460

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1. Executive Summary

1.1. Nature of Chemical Stressor

Boscalid [2-chloro-N-(4'-chlorobiphenyl-2-yl)-nicotinamide] is a systemic carboxamide fungicide that acts by inhibiting mitochondrial respiration and the subsequent production of ATP in fungal cells. Boscalid is currently registered for food uses, including beans, berries, canola, carrots, fruiting vegetables, grapes, bulb vegetables, lettuce, peanuts, potatoes, strawberries, stone fruit, tree nuts, and pistachios, and for use on cotton, ornamentals, and turf. The highest single and seasonal application rates for currently registered uses are 0.55 lbs a.i./A on fruiting vegetables and 2.1 lbs a.i./A on turf, respectively. The new uses proposed for boscalid are for the prevention and control of fungal diseases on alfalfa (Pristine and Endura formulations) and on citrus (Group 10, hereafter referred to as "citrus"; Pristine formulation). The maximum single and seasonal application rates proposed for alfalfa are 0.48 lbs a.i./A and 1.44 lbs a.i./A, respectively. The maximum single and seasonal application rates proposed for citrus are 0.29 lbs a.i./A and 1.17 lbs a.i./A, respectively.

The known degradates of boscalid include 2-chloronicotinic acid (M510F47), 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (M510F49), *p*-chloro-benzoic acid (M510F64), an unknown (M510F50) and carbon dioxide. Data regarding the comparable toxicity of boscalid degradates on non-target organisms are not available. See **Appendix A** for further description of the degradates.

For the purposes of this assessment, residues of concern in aquatic exposure modeling are the unidentified, unextracted residues in the soil and water metabolism studies and the parent compound (see **Section 3.2.1**). The degradates were all classified as minor degradates except for M510F49, which was classified as major in only one soil sample. The major degradate M510F49 was determined to have an aerobic soil metabolism of 1.7 days. Known degradates are not included in the aquatic exposure calculations because they occur in minute amounts and are not expected to significantly alter estimated environmental concentrations (EECs). Comparative toxicity data for degradates and the parent boscalid are unavailable, although the known degradates M510F49 and M510F50 retain a high degree of structural similarity with the parent compound. Terrestrial modeling is based upon residues of parent boscalid that are expected to accumulate via runoff and spray drift, given the proposed new use patterns, and does not consider degradates or the unidentified, unextracted residues from the metabolism studies.

1.2. Potential Risks to Non-target Organisms

The results of this assessment indicate that the proposed new uses of boscalid on alfalfa and citrus pose a potential for direct acute and/or chronic risk to aquatic taxa. The Agency's Level of Concern (LOC) is exceeded for direct, acute risk of mortality to Federally-listed threatened and endangered (hereafter referred to only as "listed") species of freshwater fish and, based on the surrogate taxa approach, to listed aquatic-phase amphibians. Chronic risk is expected for both listed and non-listed species of freshwater fish and aquatic-phase amphibians. Risk quotients (RQs) are not calculated for acute and chronic risks to freshwater and estuarine/marine invertebrates (non-molluscan) and for estuarine/marine fish because definitive toxicity endpoints

are unavailable [from acute studies with the freshwater amphipod (*Hyalella azteca*), estuarine/marine mysid shrimp (*Mysidopsis bahia*), and the estuarine/marine sheepshead minnow (*Cyprinidon variegatus*)] or because appropriate data have not been submitted [for acute toxicity to the freshwater waterflea (*Daphnia magna*) and chronic sediment toxicity to the freshwater midge (*Chironomus riparius*). In the absence of definitive toxicity endpoints, acute risk is presumed for freshwater invertebrates and acute and chronic risks are presumed for estuarine/marine fish and non-molluscan invertebrates. For taxonomic groups where data were submitted but were insufficient to preclude risk to listed species, a comparison of treatment-related effects concentrations with aquatic estimated environmental concentrations (EECs) of boscalid is provided in the Risk Description of the assessment. In addition, acute listed species LOCs are exceeded for estuarine/marine molluscs.

Terrestrial organisms will also be exposed to boscalid based on the proposed new use patterns. Estimates of potential acute and chronic risks to birds and acute risks to mammals are lower than the Agency's LOCs, based on a comparison of estimated exposure with non-definitive toxicity endpoints; no adverse effects were observed at the highest test concentrations in acute studies. However, the proposed uses on alfalfa and citrus may pose chronic risk to mammals. To achieve dietary-based risk quotients (RQs) that do not exceed the chronic risk LOC for any of the given categories of mammals, the single application rates of boscalid to alfalfa and citrus would have to be reduced to approximately 0.175 lbs a.i./A and 0.135 lbs a.i./A, respectively. To achieve dose-based RQs that do not exceed the chronic LOC for any mammal size class, the single application rates of boscalid to alfalfa and citrus would have to be reduced to approximately 0.045 lbs a.i./A and 0.035 lbs a.i./A, respectively. Although oral and contact exposure studies with boscalid indicate that acute effects are not expected for terrestrial invertebrates, reports of incidents with honey bees (*Apis mellifera*) have associated adverse effects on honey bee brood (developing larvae and pupae) with application of the Pristine formulation. Given that both citrus and alfalfa are attractive to honey bees and native insect pollinators, there is a high likelihood that beneficial terrestrial invertebrates will be exposed by the proposed uses of boscalid. Therefore, potential risks to terrestrial invertebrates, including pollinators, cannot be precluded. For terrestrial and semi-aquatic plants, risk to listed and non-listed dicotyledonous plants (dicots) is presumed because the concentrations tested, while within the range of application rates permitted by the label, were too high to establish a dose-response relationship or a concentration where no adverse effects were observed (*i.e.*, NOAEC) in cabbage. Based on available ecotoxicity data and estimated exposures, risks to listed and non-listed species of terrestrial dicot plants are most likely to result from spray drift, particularly from aerial application to alfalfa.

Potential "may affect" determinations to listed species based on LOC excedances require an in-depth listed species evaluation of the potential co-occurrence of listed species and areas in which alfalfa and citrus are grown. For the purposes of this assessment, it is assumed that boscalid may be used nationwide for both uses. Identified potential direct and indirect risks to listed species that may result from the proposed new uses of boscalid on alfalfa and citrus are summarized in **Table 1.1.**

Table 1.1. Potential Effects to Federally Listed Taxa Associated with Direct or Indirect Effects from the Proposed New Uses of Boscalid.

Listed Taxon	Direct Effects	Uses of Concern	Indirect Effects	Uses of Concern
Terrestrial and semi-aquatic plants - monocots	No	None	Yes[1,2,3]	Alfalfa and citrus
Terrestrial and semi-aquatic plants - dicots	Yes	Alfalfa and citrus	Yes[2,3]	Alfalfa and citrus
Terrestrial invertebrates	Yes	Alfalfa and citrus	Yes[1,2]	Alfalfa and citrus
Birds	No	None	Yes[1,2,3]	Alfalfa and citrus
Terrestrial-phase amphibians	No	None	Yes[1,2,3]	Alfalfa and citrus
Reptiles	No	None	Yes[1,2,3]	Alfalfa and citrus
Mammals	Yes	Alfalfa and citrus	Yes[1,3]	Alfalfa and citrus
Aquatic plants	No	None	Yes[1]	Alfalfa and citrus
Freshwater fish	Yes	Citrus	Yes[1, 5]	Alfalfa and citrus
Aquatic-phase amphibians	Yes	Citrus	Yes[1, 5]	Alfalfa and citrus
Freshwater invertebrates	Yes	Alfalfa and citrus	Yes[1]	Alfalfa and citrus
Mollusks	Yes	Alfalfa and citrus	Yes[1,4]	Alfalfa and citrus
Marine/estuarine fish	Yes	Citrus	Yes[1, 5]	Alfalfa and citrus
Marine/estuarine invertebrates	Yes	Alfalfa and citrus	Yes[1]	Alfalfa and citrus

Potential indirect effects on a taxon attributable to
[1] direct effects on terrestrial dicot plants
[2] direct chronic effects on mammals
[3] potential direct effects to terrestrial invertebrates (*i.e.* honey bees) based on incident data
[4] direct acute effects on freshwater fish
[5] presumed risk to freshwater and estuarine/marine invertebrates

1.3. Conclusions - Exposure Characterization

Boscalid is a synthetic carboxamide that has a moderate potential to reach aquatic environments via runoff for several months or more following application. Its major route of degradation is aerobic soil metabolism, which proceeds slowly, with estimated aerobic soil-metabolism half-lives ranging from 848 to 2,553 days. Because boscalid degrades slowly in soil and aquatic systems, the compound may persist in soil, surface water, and benthic sediment.

The moderate mobility of boscalid, K_d values ranging from 3.3 to 28 mL/g, suggests that the parent compound is less likely to accumulate in soil. However, uncertainty exists as to whether unextracted residues in aerobic soil metabolism studies are parent boscalid or unidentified degradates, or if the residues have been incorporated into the soil humic material. When these unidentified, unextracted residues are factored into aerobic soil metabolism calculations, the resulting half-lives are more than four times greater than the half-lives for extracted boscalid alone. The aerobic soil metabolism half-lives from the combined approach for parent boscalid and unidentified, unextracted residues are used for aquatic exposure modeling in this assessment and strongly influence the aquatic estimated environmental concentrations (EECs); as a result, aquatic EECs are higher than those derived for uses with similar application rates in previous boscalid assessments, which considered only boscalid parent. The anaerobic aquatic metabolism

half-life calculations from the combined approach showed no significant signs of degradation. Therefore, boscalid was classified as stable to anaerobic degradation. In addition, the solubility and vapor pressure of boscalid are understood to be slightly lower than previously reported; however, these changes have a negligible impact on exposure estimates. Changes in the Agency's understanding of the physiochemical characteristics of boscalid and the resulting impact on predicted aquatic EECs for the proposed new use patterns are described further in **Section 3.2.1.**

1.4. Conclusions - Effects Characterization

Boscalid is moderately toxic to freshwater fish. Non-definitive toxicity endpoints indicate that the compound is no more than moderately toxic to estuarine/marine fish and to non-molluscan estuarine/marine invertebrates on an acute exposure basis. However, it is highly toxic to estuarine/marine molluscs. Based on available data, boscalid is practically non-toxic to terrestrial invertebrates (*e.g.*, honey bees), birds, and mammals under acute exposure conditions. However, adverse "brood effects" in honey bees have been reported in incident data following application of boscalid, specifically as the Pristine formulation, to almonds and other unspecified crops.

Chronic toxicity has been demonstrated for freshwater fish based on survival and for freshwater invertebrates (*i.e.*, waterflea) based on survival, reductions in growth (length and dry weight), and impaired reproduction (reduced number of young). Acceptable chronic toxicity data for other aquatic animals, including benthic freshwater invertebrates and estuarine/marine fish and invertebrates, are unavailable. Specifically, the chronic study for benthic freshwater invertebrates (*i.e.*, midge) was inadequate because sediment was not spiked. No chronic studies were submitted for estuarine/marine fish or invertebrates.

In birds and mammals, chronic boscalid exposure was associated with reproductive and growth effects, including reduced number of eggs and embryo mortality in bobwhite quail (*Colinus virginianus*) and reduced F_2 body weight in rats. Based on the results of the Tier II terrestrial plant studies, cabbage appears to be particularly sensitive to boscalid exposure, while other dicot species and all tested monocots are relatively insensitive to boscalid exposure.

1.5. Uncertainties and Data Gaps

1.5.1. Environmental Fate and Transport

The largest uncertainty in the environmental fate data for boscalid regards the unidentified, unextractable residues in the aerobic soil metabolism and anaerobic aquatic metabolism studies. In two aerobic soil metabolism studies (MRID 454052-08 and 454052-09) and in the anaerobic aquatic metabolism study (MRID 45405214), the concentration of unextracted residues exceeds 50% of radioactively applied pesticide. The efficiency of the extraction method and the extent to which these residues are actually partitioned to the sediment is unclear. It is also unknown what proportion of the residues reflect degradates and/or parent boscalid. Under these circumstances, the unidentified, unextracted residues are conservatively assumed to be the parent compound partitioned to the soil and sediment. The new calculated half-lives, using the both known parent

and unidentified unextracted residues, in some cases quadrupled the aerobic soil metabolism half-life values calculated with parent compound only and yielded no significant signs of degradation by anaerobic aquatic metabolism. For modeling purposes, this resulted in the classification of boscalid as stable to anaerobic aquatic degradation. Revision of the aerobic soil metabolism half-life values resulted in higher aquatic PRZM/EXAMS modeling EECs, as compared to previous assessments where aquatic EECs were based on parent-only half-life values.

The Agency's understanding of the chemical fate of boscalid relative to vapor pressure and solubility has changed since previous assessments. The secondary product chemistry review of boscalid (DP Barcode D285692) was used to determine the final vapor pressure and solubility values used in the fate characterization. The final accepted vapor pressure was 1.5×10^{-8} torr and the accepted value for solubility was determined to be 4.64 mg/L.

With respect to data gaps in evaluation of the chemical fate of boscalid, uncertainty surrounds the data available for aerobic and anaerobic aquatic metabolism because the submitted studies are classified as supplemental.

1.5.2. Ecological Effects

Ecological toxicity data gaps, which are discussed in further detail below, are associated with acute and chronic toxicity of dissolved boscalid residues to freshwater invertebrates, chronic toxicity to estuarine/marine fish and invertebrates, toxicity of sediment-bound boscalid to benthic invertebrates, and toxicity to terrestrial dicot plants (*e.g.*, cabbage) resulting from foliar application of boscalid. In addition, incident reports regarding adverse effects on honey bee brood development following application of boscalid as Pristine, at rates less than the maximum for proposed new uses, suggest the need for additional testing of the Pristine formulation on pollinators.

No comparative toxicity data for the boscalid parent compound and its degradates have been submitted.

1.5.2.1. Aquatic Organisms

The Agency's requirements for acute and/or chronic toxicity testing of fish and aquatic invertebrates, using the technical grade active ingredient (TGAI), are codified in part 158 of Title 40 in the U.S. Code of Federal Regulations (2009) for the registration of conventional pesticide products. For freshwater and estuarine/marine fish and invertebrates, acute toxicity tests are required for the registration of terrestrial uses, including but not limited to the use on food crops. Chronic toxicity tests are also required for freshwater fish and invertebrates.

Based on the current review of ecotoxicity data for boscalid, a determination has been made that an acute toxicity study for pelagic freshwater invertebrates (*i.e.*, daphnid), classified as supplemental and previously used as a measurement endpoint in boscalid risk assessments, cannot be used in risk estimation. Measured concentrations of boscalid overestimate the bioavailable fraction of dissolved pesticide because precipitate in water samples was not

removed prior to analysis. As a result, toxicity is underestimated. Results of the study may be used qualitatively in the characterization of potential risks to freshwater invertebrates. Submittal of an acute freshwater invertebrate toxicity test (*e.g.*, daphnid, per OPPTS 850.1010) would reduce the uncertainties associated with the lack of scientifically acceptable acute data for freshwater invertebrates. Additionally, because data were insufficient to establish a definitive endpoint for estuarine/marine invertebrates, despite treatment-related mortality across the range of concentrations tested with mysid shrimp, submittal of an acute test (*e.g.*, mysid shrimp, per OPPTS 850.1035) using concentrations of boscalid closer to the chemical's limit of solubility in water (see **Table 3.2**) would reduce the uncertainties associated with the non-definitive endpoint for estuarine/marine invertebrates.

Chronic data for estuarine/marine fish and invertebrates are not available. The conditional requirements for chronic data for estuarine/marine fish and invertebrates are based upon the predicted use and mobility patterns of the chemical (40 CFR 158.630). The proposed new uses of boscalid on alfalfa (*e.g.*, Jordan *et al.* 1997, Domagalski and Kuivila 1993) and especially on citrus (*e.g.*, Wilson *et al.* 2006, Scott *et al.* 2002), coupled with the pesticide's moderate mobility and persistence in water (see **Table 3.2**), indicate that exposure to estuarine/marine organisms may occur. Submittal of chronic tests for estuarine/marine fish and invertebrates per OPPTS 850.1400 and 850.1350, respectively, would reduce uncertainties associated with risks presumed for these taxa in the absence of acceptable guideline studies.

The absence of definitive acute and chronic spiked sediment data results in high uncertainty regarding the sensitivity of benthic invertebrates to boscalid. Although an acute spiked sediment toxicity study for freshwater invertebrates was submitted, it yielded inconclusive results. The endpoint was non-definitive (EC_{50} > 1.066 mg ^{14}C /L pore water), boscalid recoveries varied substantially based on analytical method, and results in solvent controls were significantly different from those in negative controls (see **Section 3.3.1**). In addition, a chronic spiked sediment study was not submitted. Although chronic sediment toxicity data for freshwater invertebrates were provided, boscalid was spiked into overlying water instead of directly into sediment. Neither acute nor chronic spiked sediment toxicity data were submitted for estuarine/marine invertebrates. Given the persistence of boscalid in aquatic systems (aerobic soil metabolism half-life of 848 – 2,553 days, see **Table 3.2**), submittal of chronic (*i.e.*, 28-day) spiked sediment study with freshwater invertebrates (per OPPTS 850.1735) would reduce uncertainties associated with presumed risk to freshwater and estuarine/marine benthic invertebrates.

1.5.2.2. Terrestrial Organisms

Risks to terrestrial plants based on the proposed new uses of boscalid on alfalfa and citrus cannot be precluded because Tier II vegetative vigor testing failed to establish definitive toxicity endpoints at the lowest test concentrations for the most sensitive dicot species tested, cabbage. A Tier II vegetative vigor test with cabbage (per OPPTS 850.4250) using test concentrations that provide a definitive NOAEC and EC_{25} would reduce the uncertainty associated with the level of risk presumed for exposure of non-target terrestrial plants to boscalid.

Finally, reports of incidents with honey bees associated with the use of boscalid (especially as Pristine) suggest a potential hazard to pollinators that is not captured by currently available acute contact toxicity studies (with young adult foraging bees) using the TGAI. Submittal of an acute contact toxicity test for honey bees using the Pristine formulation, per OPPTS Guideline 850.3020 (40 CFR 158.630), would reduce uncertainties regarding potential toxicity of the end-use product to honey bees. Additional submittal of a honey bee larval (*i.e.*, up to pupation) toxicity test, using the TGAI, would further reduce uncertainty about potential adverse developmental effects of boscalid to honey bees.

2. Problem Formulation

The purpose of problem formulation is to provide the foundation for the environmental fate and ecological risk assessment being conducted for new uses of boscalid on alfalfa and citrus (Group 10; hereafter referred to as citrus). It sets the objectives for the risk assessment, evaluates the nature of the problem, and provides a plan for analyzing the data and characterizing the risk (USEPA 1998a).

2.1. Nature of Regulatory Action

Boscalid, a carboxamide fungicide, was first registered in 2003 for a variety of agricultural uses, including beans, berries, canola, carrots, fruiting vegetables, grapes, bulb vegetables, lettuce, peanuts, potatoes, strawberries, stone fruit, tree nuts, and pistachios, and for use on turf (DP Barcode 278387). Under the authority of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), BASF Corporation is seeking a Section 3 registration for the new uses of boscalid on alfalfa (as Endura, 70% a.i., and Pristine multi-a.i. with 25.2% boscalid) and citrus, Group 10 (as Pristine). Section 18 emergency use exemptions have previously been granted for the use of boscalid (as Pristine) on mandarin oranges in California.

The highest single and seasonal application rates for currently registered uses are 0.55 lbs a.i./A on fruiting vegetables and 2.1 lbs a.i./A on turf, respectively. The new uses proposed for boscalid are for the prevention and control of fungal diseases on alfalfa (Pristine and Endura formulations) and on citrus (Group 10, hereafter referred to as "citrus"; Pristine formulation). The maximum single and seasonal application rates proposed for alfalfa are 0.48 lbs a.i./A and 1.44 lbs a.i./A, respectively. The maximum single and seasonal application rates proposed for citrus are 0.29 lbs a.i./A and 1.17 lbs a.i./A, respectively.

2.2. Stressor Source and Distribution

2.2.1. Nature of the Chemical Stressor

Boscalid is in the carboxamide family of fungicides (Group 7). The chemical's mode of action is the inhibition of mitochondrial respiration and the subsequent production of ATP in fungal cells, which inhibits spore germination as well as mycelial growth and sporulation of the fungus on the surface of leaves. Specifically, boscalid inhibits the succinate-ubiquinone oxidoreductase system in Complex II of the mitochondrial electron transfer chain. This mode of action is shared with the pesticide active ingredients carboxin and flutolanil.

2.2.2. Overview of Pesticide Usage

Boscalid is a fungicide consisting of seven formulated end-use products intended for use on food crops, cotton, ornamentals, and turf. Outside of the registered uses, boscalid has been used sporadically in California, Minnesota, and South Dakota under Section 18 emergency exemptions. Estimates of the total current usage of boscalid are unavailable.

For the proposed uses on alfalfa and citrus, boscalid may be applied via aerial spray, ground spray, or chemigation. For application to alfalfa, the maximum single and seasonal rates are 0.48 and 1.44 lbs a.i./A, respectively, with a minimum interval of 14 days between applications. Boscalid may be applied to alfalfa twice per cutting and no more than three times per season. For application to citrus, the maximum single and seasonal application rates are 0.29 and 1.17 lbs a.i./A, respectively, with a minimum interval of 10 days between application. Boscalid may be applied to citrus up to four times per season. However, the label requires that a fungicide with an alternative mode of action (*i.e.*, non-carboxamide and non-QoI fungicide) be applied between the second and third applications of boscalid to citrus, presumably to manage resistance.

2.3. Receptors

2.3.1. Aquatic and Terrestrial Effects

The receptor is the biological entity that is exposed to the stressor (USEPA 1998). Consistent with the process described in the Overview Document (USEPA 2004), this risk assessment uses a surrogate species approach in its evaluation of boscalid. Toxicological data generated from surrogate test species, which are intended to be representative of broad taxonomic groups, are used to extrapolate potential effects on a variety of species (receptors) included under these taxonomic groupings.

Acute and chronic toxicity data from studies submitted by pesticide registrants along with the available open literature are used to evaluate potential direct effects of boscalid to aquatic and terrestrial receptors. The open literature studies are located through EPA's database ECOTOX (http://cfpub.epa.gov/ecotox/), which provides a source for locating single chemical toxicity data for aquatic life, terrestrial plants, and wildlife.

Table 2.1. provides examples of taxonomic groups and the surrogate species tested to evaluate the potential ecological effects of pesticides to these non-target taxonomic groups. Based on a preliminary review of the ecological effects data, boscalid is highly toxic to estuarine/marine molluscs, moderately toxic to freshwater and estuarine/marine fish and invertebrates, and practically non-toxic to terrestrial birds, mammals, and invertebrates under acute exposure conditions.

The available toxicity data are not sufficient to characterize the chronic toxicity of boscalid to benthic invertebrates because the study sediment was not spiked and effects determinations were based only on nominal concentrations of boscalid in overlying water. Under chronic exposure conditions, the parent material resulted in mortality in rainbow trout (*Oncorhynchus mykiss*),

reduced dry weight and production of young in the waterflea (*Daphnia magna*), and reduced emergence in the freshwater midge (*Chironomus riparius*). Chronic exposure also resulted in adverse reproductive effects in bobwhite quail (*Colinus virginianus*), including reductions in the number of eggs laid, fertility rate, number of 14-day survivors, and increase in embryo mortality. Chronic effects in F2 offspring of Norway rats (*Rattus norvegicus*) included decreased body weight and pup viability as compared to controls.

Table 2.1. Taxonomic Groups and Test Species Evaluated for Assessing Potential Ecological Effects of Boscalid.

Taxonomic Group	Example(s) of Surrogate Species
Birds[1]	Mallard duck (*Anas platyrhynchos*) Bobwhite quail (*Colinus virginianus*)
Mammals	Laboratory rat (*Rattus norvegicus*)
Insects	Honey bee (*Apis mellifera L.*)
Freshwater fish[2]	Bluegill sunfish (*Lepomis macrochirus*) Rainbow trout (*Oncorhynchus mykiss*)
Freshwater invertebrates	Waterflea (*Daphnia magna*)
Estuarine/marine fish	Sheepshead minnow (*Cyprinodon variegatus*)
Estuarine/marine invertebrates	Mysid (*Americamysis bahia*) Eastern oyster (*Crassostrea virginica*)
Terrestrial plants[3]	Monocots – corn (*Zea mays*) Dicots – soybean (*Glycine max*)
Aquatic plants and algae	Duckweed (*Lemna gibba*) Freshwater (*Pseudokirchneriella subcapita*)

[1] Birds represent surrogates for terrestrial-phase amphibians and reptiles.
[2] Freshwater fish may be surrogates for aquatic-phase amphibians.
[3] Four species of two families of monocots, of which one is corn; six species of at least four dicot families, of which one is soybeans.

2.3.2. Ecosystems Potentially at Risk

The ecosystems at risk are often extensive in scope; therefore, it may not be possible to identify specific ecosystems at the screening level. In general terms, terrestrial ecosystems potentially at risk could include the treated site and areas immediately adjacent to the treated site that may receive drift or runoff. These areas could include the site itself, other 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 area 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.

2.4. 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 (USEPA 1998). For boscalid, the ecological entities include the following: birds, amphibians, reptiles, mammals, 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, survival, and reproduction. (See **Table 2.2** in **Section 2.6.2**, the Analysis Plan, for further discussion).

2.5. Conceptual Model

For a pesticide to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. An exposure pathway is the means by which a pesticide moves in the environment from a source to an ecological receptor. For an ecological 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.

The conceptual model is intended to provide a written description and visual representation of the predicted relationships between boscalid, potential routes of exposure, and the predicted effects for the assessment endpoint. The conceptual model consists of two major components: risk hypotheses and a conceptual diagram (USEPA 1998).

Based on previous risk assessments for boscalid, the compound is expected to persist in the environment. Previously estimated environmental concentrations, in combination with documented toxicity of boscalid to aquatic and terrestrial organisms, indicate potential risks to non-target organisms in both aquatic and terrestrial environments as a result of direct applications, spray drift, and runoff (**Figure 1.1**).

2.5.1. Risk Hypotheses

For boscalid, the following ecological risk hypothesis is based on the results of previous assessments, in addition to new information regarding the Agency's understanding of the fate properties of the chemical. The aerobic soil metabolism and anaerobic aquatic metabolism half-life values for boscalid have been recalculated to reflect parent boscalid plus unidentified, unextracted residues; aerobic soil metabolism half-life values have increased substantially from a range of 182 – 578 days to 858 – 2,553 days, and anaerobic aquatic metabolism half-life values remain classified as stable. Although water solubility and vapor pressure values are slightly lower than previously reported, this is expected to have a negligible impact on the risk hypothesis. Changes to information regarding the chemical fate and transport of boscalid are described in detail in **Section 3.2.1**.

> *Although boscalid has no more than moderate mobility in soil, it can move to surface water through spray drift, runoff, and in eroded soil. Based on previous assessments and the compound's persistence, boscalid is expected to pose a chronic risk to small birds, terrestrial-phase amphibians and reptiles and to all size classes of mammals. In addition, boscalid may result in adverse effects on survival, growth, and/or fecundity of aquatic animals. There is also uncertainty regarding the potential risk to benthic invertebrates, given boscalid's persistence in water and sediment. Although not expected to pose a risk to aquatic plants, there is uncertainty regarding its potential effects on terrestrial and semi-aquatic plants.*

The conceptual model used to depict the potential ecological risk associated with the proposed

foliar uses of boscalid relies on previous assessments and the Agency's current understanding of the environmental fate and ecological effects of the chemical. The model assumes that boscalid is capable of affecting terrestrial and aquatic plants and animals, provided environmental concentrations are sufficiently elevated as a result of proposed uses on alfalfa, including alfalfa grown for seed, and citrus crop Group 10 (**Figure 1.1**). The results from the previous risk assessments (DP Barcodes: D278387-D278390, D278418, D293435, D293436, D313814, D316736, D316735, D342975) indicate acute risk to molluscs and chronic risk to birds and mammals, but to no other non-target species tested, at application rates equal to the proposed rates.

2.5.2. Conceptual Diagram

The potential exposure pathways and effects of the proposed new uses of boscalid on citrus and alfalfa are depicted in **Figure 1.1**. Solid arrows depict the most likely routes of exposure and effects; dashed lines depict potential routes of exposure that are not considered likely for boscalid. Due to the low partial vapor pressure and no more than moderate estimated soil mobility of boscalid, it is not expected to significantly volatilize or leach into ground water.

Proposed application methods for the new uses of boscalid involve ground and aerial sprays, as well as chemigation. Ecological receptors that may be exposed to boscalid following such applications include terrestrial and semi-aquatic wildlife (*i.e.*, mammals, birds, terrestrial-phase amphibians, terrestrial invertebrates, and reptiles) and plants. In addition, aquatic receptors (*e.g.*, freshwater and estuarine/marine fish and invertebrates, aquatic-phase amphibians, and plants) may be exposed as a result of movement of boscalid via spray drift and/or runoff of sediment-bound residues from the site of application. The conceptual framework for assessment of potential ecological risk associated with boscalid use is depicted in **Figure 1.1**; potential endpoints, stressors, and ecological effects are identified based on this model.

For terrestrial organisms, the major route of exposure is the dietary route via consumption of food items such as plant leaves or insects that have boscalid residues as a result of spraying. The risk assessment does not account for possible ingestion of boscalid residues by terrestrial animals via drinking water, contaminated grit, or preening activities; nor does it consider uptake through inhalation or dermal absorption. Because of the low volatility of boscalid (see **Table 3.2** for physio-chemical characteristics), atmospheric transport is not considered in estimating environmental concentrations. Non-target terrestrial invertebrates may be exposed to boscalid via direct deposition and/or spray drift. Direct contact and/or root uptake is the major route of exposure for terrestrial and wetland (riparian) plants.

For aquatic assessments, all expected major pathways of direct exposure are incorporated. The major routes of exposure for aquatic animal species are considered to be via the respiratory surface (gills) or the integument. Similar to terrestrial organisms, exposure of aquatic organisms to boscalid may also occur through ingestion of residues in sediment/forage. However, the available data indicate that boscalid is not likely to bioconcentrate in aquatic food items, with fish bioconcentration factors (BCFs) ranging from 36-44X, 84-105X, and 57-70X in edible, non-edible, and whole fish tissues, respectively (log K_{ow} = 2.96+/- 0.16). Benthic organisms maintain a close relationship with the sediment layer and therefore may be exposed to boscalid

adsorbed to sediment through contact and/or ingestion. Aquatic plants may be exposed via direct uptake and adsorption.

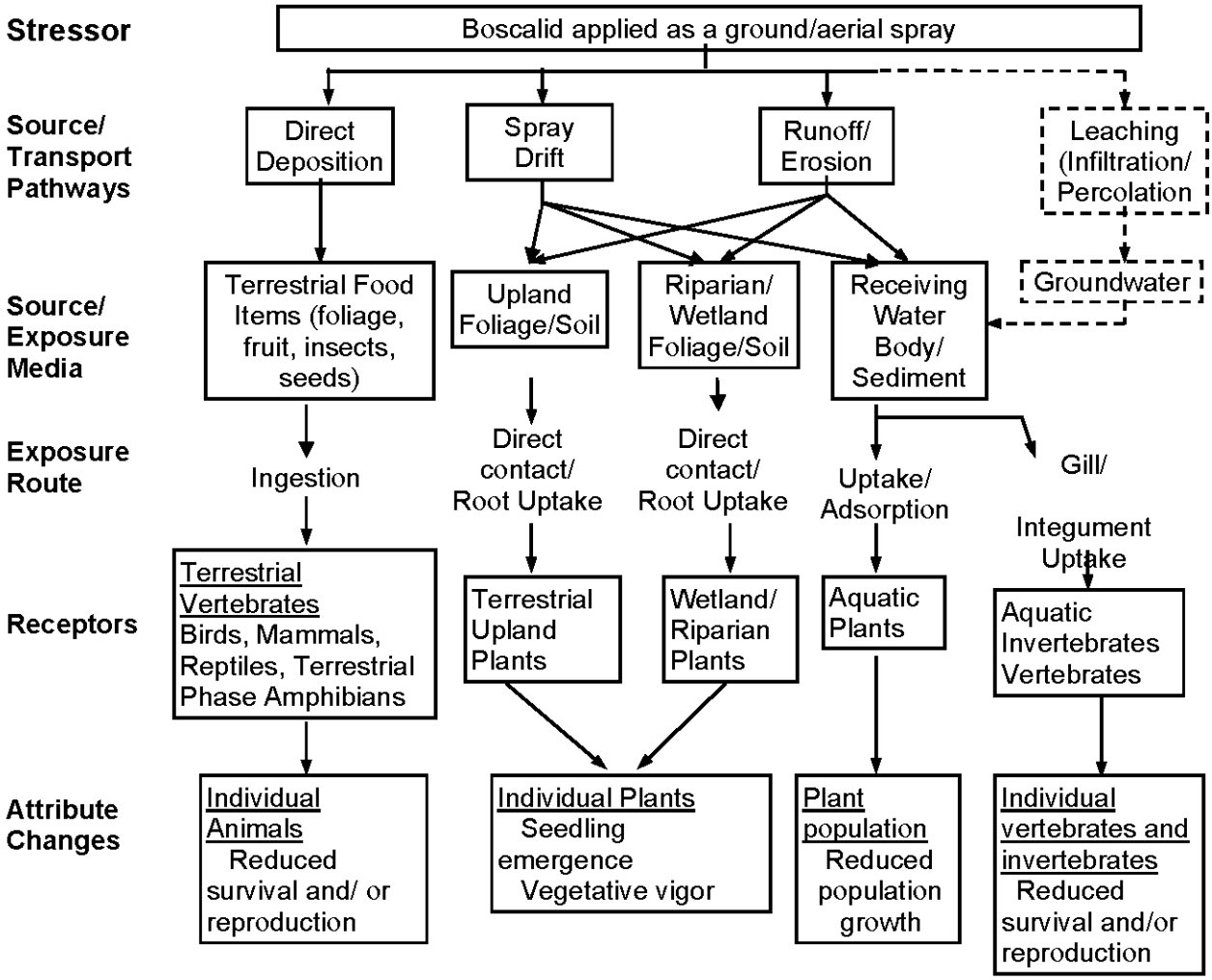

Figure 1.1. Conceptual Model Depicting Potential Risks to Non-target Species From the Proposed Use of Boscalid on Alfalfa and Citrus.

2.6. Analysis Plan

2.6.1. Measures of Exposure

2.6.1.1. Measures of Aquatic Exposure

Measures of exposure to aquatic animals and plants are concentrations in surface water and pore water simulated by the Pesticide Root Zone Model (PRZM v3.12.2, May 12, 2005) and Exposure Analysis Modeling System (EXAMS v2.98.04.06, Apr. 2005), coupled with the input shell pe5v0 (Nov 15, 2006), to generate estimated environmental concentrations (EECs) of boscalid (including parent compound and unidentified, unextracted residues) that may occur from use on adjacent crops at maximum use rates. The EECs used in risk assessment are 1-in-10 year peaks (acute assessments) and means of a specified duration (chronic assessments) generated at the

modeled site, which is selected to represent a site more vulnerable than most locations used to grow the simulated crop. Ground water concentration was simulated using SCIGROW (Screening Concentration in Ground Water) to generate estimated drinking water concentrations (EDWCs) of boscalid, incorporating the same method of calculation used in the PRZM and EXAMS modeling.

2.6.1.2. Measures of Terrestrial Exposure

Terrestrial wildlife are exposed to boscalid via consumption of boscalid residues on food items via spray applications for use on alfalfa and citrus. For spray applications, the T-REX model (Terrestrial Residue EXposure model; v. 1.4.1; October 9, 2008) is used to predict dietary exposure to boscalid residues on foliar surfaces and insects using the Kenaga nomogram as modified by Fletcher (Hoerger and Kenaga 1972, Fletcher *et al.* 1994). Estimated exposures of terrestrial insects to boscalid are qualitatively evaluated.

The TerrPlant (v. 1.2.2; December 26, 2006) model is used to derive EECs relevant to terrestrial and wetland plants for the proposed new uses of boscalid on alfalfa and citrus. This model assumes that default fractions of the intended application will be transported to an adjacent field through runoff and spray drift. Measures of exposure to terrestrial plants are expressed as a fraction of the mass of the boscalid applied to a treated field.

2.6.2. Measures of Effect

Measures of effect are obtained from a suite of registrant-submitted guideline studies which were conducted with a limited number of surrogate test species (**Table 2.1.**). The test species are not intended to be representative of the most sensitive species but rather were selected based on their ability to thrive under laboratory conditions. Toxicity testing reported in this risk assessment utilizes surrogate species to represent all freshwater fish (2000+) and bird (680+) species in the U.S. In addition, the ECOTOXicology database (ECOTOX), was searched in November 2009 in order to provide more ecological effects data for boscalid; however, no additional data were available (USEPA 2009c).

The acute measures of effect used in this screening-level assessment are the LD_{50} (Lethal Dose), LC_{50} (Lethal Concentration) or EC_{50} (Effects Concentration). These are measures of acute toxicity which result in 50% of the respective effect in tested organisms. The endpoints for chronic measures of exposure are the NOAEC (No Observed Adverse Effects Concentration) and the NOAEL (No Observed Adverse Effects Level). Toxicity studies were submitted for freshwater fish and invertebrates, estuarine/marine fish and invertebrates, aquatic plants, birds, mammals, bees, and other terrestrial invertebrates. The endpoints used for risk characterization were derived from studies which underwent review and were classified as "acceptable" (conducted under guideline conditions and considered to be scientifically valid) or "supplemental" (conditions deviated from guidelines but the results are considered to be scientifically valid).

Table 2.2 lists the measures of environmental exposure and ecological effects used to assess the potential risks of boscalid to non-target organisms. The methods used to assess the risk are

consistent with those outlined in the document "Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs" (USEPA 2004).

Table 2.2. Measures of Exposure and Measures of Effect Used in Assessing Potential Risks Associated with the Proposed Use of Boscalid on Alfalfa and Citrus (Group 10).

Assessment Endpoint		Surrogate Species and Measures of Ecological Effect[1]	Measures of Exposure
Birds[2]	Survival	Bobwhite quail acute oral LD_{50} >2000 mg a.i./kg bw Bobwhite quail/mallard duck acute dietary LC_{50} > 5000 mg a.i./kg diet	Upper-bound residues on food items
	Reproduction and Growth	Bobwhite quail chronic reproduction NOAEC = 300 mg a.i./kg diet	Upper-bound residues on food items
Mammals	Survival	Norway rat acute oral LD_{50} > 5,000 mg a.i./kg bw	Upper-bound residues on food items
	Reproduction and Growth	Norway rat oral reproduction chronic NOAEC = 100 mg a.i. /kg diet	Upper-bound residues on food items
Freshwater fish[3]	Survival	Rainbow trout acute 96-hour LC_{50} = 2.7 mg a.i./L	Peak EEC for surface water[4]
	Reproduction and Growth	Rainbow trout NOAEC = 0.116 mg a.i./L	60-day average EEC for surface water[4]
Freshwater invertebrates	Survival	No acute data for freshwater invertebrates (waterflea) Amphipod acute 10-day EC_{50} > 1.066 mg a.i./L	Peak EEC for surface water[4] Peak EEC for pore water[4]
	Reproduction and Growth	Waterflea chronic reproduction (full life cycle) NOAEC = 0.79 mg a.i./L Chironomid (14-day) NOAEC = 2.0 mg a.i./L (nominal, based on spiked overlying water)	21-day average EEC for surface water[4] 21-day average EEC for pore water[4]
Estuarine/marine fish	Survival	Sheepshead minnow acute 96-hour LC_{50} >3.86 mg a.i./L	Peak EEC for surface water[4]
	Reproduction and Growth	No chronic data for estuarine/marine fish	60-day average EEC for surface water[4]
Estuarine/marine invertebrates	Survival	Mysid acute 96-hour LC_{50} > 3.81g a.i./L	Peak EEC for surface water[4]
		Eastern oyster 96-hour shell deposition EC_{50} = 1.02 mg a.i./L	
	Reproduction and Growth	No chronic data for pelagic estuarine/marine invertebrates	21-day average EEC for surface water[4]
		No chronic data for benthic estuarine/marine invertebrates	21-day average EEC for pore water[4]
Terrestrial plants[5]	Survival	Monocot seedling emergence EC_{25} > 0.576 lbs a.i./A and NOAEC = 0.275 lbs a.i./A Dicot seedling emergence EC_{25} = 0.44 lbs a.i./A and NOAEC = 0.275 lbs a.i./A	Estimates of runoff and spray drift to non-target areas

Assessment Endpoint		Surrogate Species and Measures of Ecological Effect[1]	Measures of Exposure
	Growth	Monocot vegetative vigor EC_{25} > 0.626 lbs a.i./A and NOAEC = 0.0351 lbs a.i./A Dicot vegetative vigor EC_{25} < 0.0351 and NOAEC < 0.0351 lbs a.i./A	Estimates of runoff and spray drift to non-target areas
Terrestrial invertebrates[6]	Survival	Honey bee acute oral LD_{50} > 165.96 µg a.i./bee Honey bee acute contact LD_{50} > 200 µg a.i./bee	Upper-bound estimates of foliar residues based on maximum application rates
	Growth	Earthworm 14-day acute growth LC_{50} > 1000 mg a.i./kg soil	Upper-bound estimates of residues in soil
Aquatic plants	Survival and growth	Duckweed (vascular plant) 7-day frond number IC_{50} > 3.9 mg a.i./L and NOAEC = 0.99 mg a.i./L	Peak EEC for surface water[4]
		Algae (non-vascular plant) 96-hour EC_{50} = 1.34 mg a.i./L and NOAEC = 0.49 mg a.i./L	Peak EEC for surface water[4]

[1] The most sensitive species tested within taxonomic groups is used for screening-level risk assessments.
[2] Birds represent surrogates for amphibians (terrestrial-phase) and reptiles.
[3] Freshwater fish represent surrogates for amphibians (aquatic-phase).
[4] Aquatic EECs for citrus and alfalfa are based on the modeling described in **Sections 2.6.1 and 3.2.2**.
[5] Four species of two families of monocots - one is corn, six species of at least four dicot families, of which one is soybeans.
[6] Not quantitatively assessed in risk estimation.

2.6.3. Integration of Exposure and Effects

The exposure and toxicity effects data are integrated in order to evaluate the risks of adverse ecological effects on non-target species. For the risk assessment of boscalid, the risk quotient (RQ) method is used to compare estimated exposure and measured toxicity values. The RQ method involves dividing estimated environmental concentrations (EEC) by acute and chronic toxicity values. The resulting RQs are then compared to the Agency's Levels of Concern (LOC) (USEPA 2004) (**Table 2.3**). These criteria are used to indicate when applications of boscalid, as directed on the label, have the potential to cause adverse effects to non-target organisms.

Table 2.3. Agency Risk Quotient (RQ) Metrics and Levels of Concern (LOC) Per Risk Class.

RISK CLASS	RISK DESCRIPTION	RQ	LOC
Aquatic Animals (fish and invertebrates)			
Acute	Potential for effects to non-listed animals from acute exposures	Peak EEC/LC_{50}[1]	0.5
Acute Restricted Use	Potential for effects to animals from acute exposures Risks may be mitigated through restricted use classification	Peak EEC/LC_{50}[1]	0.1
Acute Listed Species	Listed species may be potentially affected by acute exposures	Peak EEC/LC_{50}[1]	0.05
Chronic	Potential for effects to non-listed and listed animals from chronic exposures	60-day EEC/NOAEC (fish)	1
		21-day EEC/NOAEC (invertebrates)	
Aquatic Plants			

RISK CLASS	RISK DESCRIPTION	RQ	LOC
Non-Listed	Potential for effects to non-listed plants from exposures	Peak EEC/LC_{50}[1]	1
Listed	Potential for effects to listed plants from exposures	Peak EEC/NOAEC	1
Terrestrial Animals (mammals and birds)[2]			
Acute	Potential for effects to non-listed animals from acute exposures	EEC/LC_{50} (Dietary)	0.5
		EEC/LD_{50} (Dose)	
Acute Restricted Use	Potential for effects to animals from acute exposures Risks may be mitigated through restricted use classification	EEC/LC_{50} (Dietary)	0.2
		EEC/LD_{50} (Dose)	
Acute Listed Species	Listed species may be potentially affected by acute exposures	EEC/LC_{50} (Dietary)	0.1
		EEC/LD_{50} (Dose)	
Chronic	Potential for effects to non-listed and listed animals from chronic exposures	EEC/NOAEC	1
Terrestrial and Semi-Aquatic Plants			
Non-Listed	Potential for effects to non-target, non-listed plants from exposures	EEC/ EC_{25}	1
Listed Plant	Potential for effects to non-target, listed plants from exposures	EEC/ NOAEC	1
		EEC/ EC_{05}	

[1] LC_{50} or EC_{50}.
[2] EEC based on upper bound Kenaga values (for foliar exposure).

3. Analysis

3.1 Use Characterization

Boscalid is a fungicide consisting of multiple formulated end-use products and is intended for use on food crops, cotton, ornamentals and turf. It was first registered by USEPA in 2003. The wettable granule (WG) Endura Fungicide contains 70% active ingredient, and the wettable granule (WG) Pristine contains a mixture of boscalid (25.2% active) and pyraclostrobin (12.8% active). Endura is registered for use on beans, berries, bulb vegetables, canola, carrots, fruiting vegetables, grapes, lettuce, peanuts, pistachios, potatoes, stone fruit, strawberries, tree nuts, *Brassica* sp. vegetables (subgroups 5A and 5B), cucurbit vegetables, mint, edible peas, certain root vegetables, and sunflower. Pristine is registered for use on berries, bulb vegetables, carrots, grapes, pistachios, stone fruit, strawberries, tree nuts, cotton, tropical fruits and fresh herbs. Application is via multiple, foliar, broadcast sprays at a seasonal rate of 0.9 – 1.8 lbs a.i./A, depending on crop and target disease. Typically, retreatment intervals are 1-3 weeks. There is also a formulated 70% wettable granule end-use product named Boscalid Turf Fungicide for use on golf course turf grass, which represents the highest seasonal application rate (2.1 lbs a.i./A).

This ecological risk assessment evaluates the use of boscalid as a fungicide (Pristine and Endura) to control fungal diseases of alfalfa (*e.g.*, anthracnose, common leaf spot, downy mildew, leaf spot, rust, yellow leaf blotch) and of citrus (*e.g.*,alternaria brown spot, greasy spot, scab, and melanose) on citrus fruit. Pristine (25.2% boscalid and 12.8% pyraclostrobin) is proposed for use as aerial, ground spray, or chemigation at a maximum single rate of 0.29 lbs a.i./A. A maximum of 4 applications per season is proposed with a minimum reapplication interval of 10 days; the maximum proposed seasonal application rate is 1.17 lbs a.i./A/season. Endura is

proposed for use as an aerial spray, ground spray or through chemigation at a maximum single application rate of 0.48 lbs a.i./A; the maximum proposed number of applications is 3, with a minimum reapplication interval of 14 days. The label requires a pre-harvest interval of at least 14 days for alfalfa. The maximum proposed seasonal application rate is1.44 lb a.i./A. A summary of the proposed application rates can be seen in **Table 3.1**.

Both new uses have special instructions. Alfalfa has a restriction of two applications per cutting with a total of three applications per season. Refer to **Table 3.1** for maximum application rate and minimum reapplication interval. Citrus fruit is only allowed two sequential applications of Pristine before an alternative mode of action fungicide, non-Group 11 (Quinone outside Inhibitor, or QoI) and non-Group 7 (carboxamide), must be applied. After this alternative fungicide is applied, the 3rd and 4th applications of Pristine may be applied for the season. The label is unclear as to what, if any, interval is required before and after application of the alternative mode of action fungicide.

Table 3.1. Boscalid maximum proposed application rates for Pristine and Endura formulations for new uses on alfalfa and citrus.

Crop		EPA Reg Number	Max Single App Rate lbs a.i./A	Max Number of Apps	Max Seasonal App Rate lbs.a.i./A	Minimal Interval Between Apps (days)	App Method
Alfalfa (inclnding hay, forage, and alfalfa grown for seed)	Pristine	7969-199	0.28	3[1]	0.85	14	Aerial/ ground spray or chemigation
	Endura	7969-197	0.48	3[1]	1.44	14	Aerial/ ground spray or chemigation
Citrus, Group 10	Pristine	7969-199	0.29	4[2]	1.17	10	Aerial/ ground spray or chemigation

1. Maximum of 2 applications per cutting and 3 applications per season.
2. No more than 2 sequential applications of Pristine before alternating to a fungicide with a different mode of action (neither Group 7 – carboxamide, which targets succinatedehydrogenase, nor Group 11 – Quinone outside Inhibitor (QoI), which targets the cytochrome bc_1 protein complex in cellular respiration).

3.2. Exposure Characterization

3.2.1. Environmental Fate and Transport Characterization

Boscalid is a slowly biodegradable compound with slight to moderate mobility in most soils (mean K_{oc} = 772 mL/g). The primary degradation pathway is aerobic soil metabolism, which, when calculated for parent compound only, ranges from 182 to 578 days over four soils (MRID 45643802). However, large amounts of unextracted, unidentified residues in these metabolism studies result in major uncertainty and suggest that the half-lives may be as high as 848 to 2,553 days. There is no evidence of significant degradation by other routes (aquatic metabolism, photolysis, or hydrolysis). **Table 3.2** summarizes the physio-chemical properties of boscalid, and a more thorough discussion of environmental fate can be found in the environmental fate and ecological risk assessment for the original registration of boscalid (USEPA 2003; DP Barcodes D278387, D278390, D278418).

The degradation pathway for aerobic soil metabolism results in the formation of intermediates which are quickly transformed into CO_2 or perhaps partitioned to soil residues. Degradates of the compound include 2-chloronicotinic acid (M510F47), 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (M510F49), and an unknown metabolite (M510F50). M510F47 and M510F50 are classified as minor degradates. M510F49 is classified as a major degradate but was only observed at proportions greater than 10%, relative to the applied parent, in one soil; it was a minor degradate in the rest (MRID 45405208 and 45643802). An additional study provided on the degradate M510F49 showed an aerobic soil metabolism half-life of 1.7 days.

Boscalid is not expected to volatilize. K_d values that range from 3.3 to 28 mL/g suggest that it is not expected to bioaccumulate in sediment, and the mean K_{oc} of 772 ml/g indicates that it is probably not mobile enough to frequently reach ground water. However, the persistence of the compound leads to uncertainty of its transport to and fate in aquatic systems. For example, even if they are not extremely mobile, persistent compounds are available in the unsaturated zone for longer and have the potential to reach ground water before degrading.

Previous assessments (DP Barcode D342975, D337648 and D336599) classify the anaerobic aquatic metabolism half-life of boscalid as stable. However, the assessments reference a study for a different pesticide (MRID 44346731). The anaerobic aquatic metabolism study for boscalid reports the half-lives as 385 and 408 days, when only the parent compound is included in the calculation (MRID 45405213). However, to maintain consistency with respect to the evaluation of unidentified, unextracted residues, as discussed for the aerobic soil metabolism studies, the anaerobic aquatic metabolism half-lives were recalculated using the combined method (parent boscalid plus unidentified, unextracted residues). This analysis showed no significant anaerobic aquatic degradation; therefore, boscalid remains classified as stable to anaerobic aquatic degradation.

It is also important to mention that inconsistencies were found in the Data Evaluation Records (DERs) for several fate studies. The solubility of boscalid has been listed at 6 mg/L in previous assessments (DP Barcode D342975, D337648, and D336599); however, a secondary product chemistry review analysis of the available data indicates the correct solubility value is 4.64 mg/L at 20°C (DP Barcode D285692). The four DERs citing the solubility as 6 mg/L do not list any sources or references for these values. This change in solubility did not substantively affect the EECs. Future assessments should use 4.64 mg/L as the solubility of boscalid at 20°C.

Another inconsistency in the fate evaluation for boscalid is the vapor pressure value, which has been listed as 7.5×10^{-8} torr at 25°C in previous assessments (DP Barcode D342975, D337648, and D336599). According to a secondary product chemistry review (DP Barcode D285692), the correct value should have been reported as 1.5×10^{-8} torr at 25°C. In the case of boscalid, this change in vapr pressure values resulted in no observable difference in EECs.

Table 3.2. General Chemical Properties and Environmental Fate Parameters of Boscalid.

Parameter	Value	Reference
Nomenclature		
Chemical name	Boscalid	-
IUPAC	2-chloro-N-(4'-chlorobiphenyl-2-yl)nicotinamide	-
CAS RN	188425-85-6	-
Selected Physical/Chemical Parameters		
Molecular mass	343.2 g/mol	-
Vapor pressure (25°C)[1]	$1.5x10^{-8}$	DP 285692
Water solubility (20°C)[2]	4.64 mg/L	DP 285692
Octanol-water partition coefficient (log K_{OW})	2.96+/- 0.16	DP 285692
Persistence		
Hydrolysis half-life pH 5 (25°C) pH 7 pH 9	No significant degradation No significant degradation No significant degradation	MRID 45405205
Aqueous photolysis half-life	No significant degradation	MRID 45405206
Soil photolysis half-life	No significant degradation	MRID 45405207
Aerobic soil metabolism half-life[3]	848 days (clay loam) 1,000 days (silt loam) 1,609 days (clay loam) 2,553 days (loam)	MRID 45643802
Aerobic aquatic metabolism half-life	No significant degradation	MRID 45405214
Anaerobic aquatic metabolism half-life	No significant degradation	MRID 45405213
Mobility		
Organic carbon partitioning coefficient (K_{OC})	507 – 1,110 mL/g_{OC} 772 mL/g_{OC} (mean)	MRID 45405216 MRID 45405217

[1] Vapor pressure value referenced from product chemistry. The value differs slightly from the value ($7.5X10^{-8}$ Torr at 25°C) used in previous assessments and for exposure modeling in this assessment. However, the impact of the change on assessment outcomes is negligible.

[2] Boscalid solubility in water, as reported in ecological fate and toxicity studies, ranges from ~3 mg/L to 6 mg/L at 20°C. To maintain consistency with previous risk assessments, aquatic exposure modeling in this assessment uses a solubility value of 6 mg/L. Terrestrial plant exposure modeling is based on a range of solubility values (*e.g.*, 1-10 mg/L) and therefore is unaffected.

[3] Note that values for aerobic soil metabolism half-life have increased from previously estimated range of 182 – 578 days, based on re-evaluation of an aerobic soil metabolism study (DER amendment, DP barcode 369674).

[4] Boscalid remains classified as stable to anaerobic aquatic degradation (MRID 45405213), although previous assessments cited an incorrect study (MRID 44346731). The current analysis and classification is based upon the assumption that unidentified, unextracted residues in the anaerobic aquatic metabolism study are parent boscalid.

3.2.1.1. Transport and Mobility

Boscalid has moderate mobility in most soils, as it tends to sorb to the organic matter (K_{oc} ranges from 507 to 1,110 mL/g). Boscalid was not detected below a depth of 7.5 cm. in terrestrial field dissipation studies (MRIDs 454052-19, -20, -21, -22). These data support results from batch equilibrium studies that indicate slight to moderate mobility in soil. A higher potential for leaching exists for the compound in soils which are lower in organic matter. Given its persistence and moderate mobility, transport of boscalid to surface water is probable. The slow biodegradation of boscalid in most soils will increase the potential for surface water contamination. Boscalid has a moderate potential to reach surface water following runoff of soil-bound residues and to partition to aquatic sediments. Based on aerobic soil metabolism half-life values, this may occur for several months or years following application. Boscalid may also reach surface water through spray drift when applied using ground and aerial spray. Because boscalid does not biodegrade appreciably in aquatic systems, the compound is likely to persist in static water bodies, until removed by advection, and in benthic sediment once partitioned from the water phase (MRIDs 454052-13 and -14). Boscalid may reach ground water through leaching, primarily due to the persistence of the compound; however, the K_d value suggests that this may occur only infrequently.

The boscalid degradate 2-chloronicotinic acid is very mobile in soil. It is metabolized rapidly in aerobic soil and is mineralized to CO_2 or partitioned to bound residues. The degradate is not expected to bind to aquatic sediments.

3.2.1.2. Degradation

Boscalid biodegrades in about 2.5-7 years in aerobic soil (half-lives of 848 to 2,553 days, based on parent compound and unidentified, unextracted residues) and there is no evidence of degradation in aerobic and anaerobic aquatic environments. Boscalid is also stable to hydrolysis and photodegradation. Therefore, the primary pathway is aerobic soil metabolism, which occurs very slowly.

Aerobic soil metabolism, when calculated for parent compound only, ranged from 182 to 578 days for five soils (MRID 45643802). However, a substantial amount (> 50%) of residues remained unextracted and unidentified at the conclusion of these studies. The nature of the studies was such that it was not possible to determine with any certainty whether these residues were bound into the soil matrix or were unbound, but poorly extracted, parent and/or degradate. To account for uncertainties caused by the unknown nature of these unextractable, unidentified residues, they were assumed to be parent, and the Total Toxic Residues (TTR) method was used to estimate aerobic soil metabolism half-lives, based on the summation of these residues with the identified parent compound at each time point in the studies (see USEPA 2008). The resulting half-lives range from 848 to 2,553 days and are more than four times longer than those which consider the parent alone (MRID 45643802; **Table 3.2**). The use of half-lives based on parent plus unidentified, unextracted residues is a significant departure from the previous assessment.

3.2.1.3. Field Studies

Based on terrestrial field dissipation studies, boscalid is generally persistent in the field, both in bare ground and cropped plots. The terrestrial field dissipation of boscalid was studied at several U.S. sites on various cropped and bare ground plots, and on bare ground plots in Canada. Field study information and results are presented in **Appendix G**. The DT_{50} values for dissipation of the parent boscalid compound from the surface soil applied to bare ground plots (U.S. and Canada) ranged from 27 to 372 days (with the exception of a DT_{50} of 1 day which was of questionable validity due to data variability), and were generally greater than 100 days and frequently greater than 200 days (MRIDs 45405218, 45405219, 45405220, 45405221, 45405222). The residue carryover as a percentage of the total application was a range of 11.9-52.3% for the bare ground plots. The DT_{50} values for dissipation of the parent compound from the surface soil for boscalid applied to cropped plots (U.S. only; turf, peach, almond) ranged from 44 to >360 days and were generally greater than 100 days. The residue carryover as a percentage of the total application was a range of 6.2-20.1% for the cropped plots. The maximum mean concentrations of the degradate M510F49 ranged from 0.01 mg/kg to 0.04 mg/kg across all studies. The maximum mean concentrations of the degradate M510F47 ranged from 0.003 mg/kg to 0.04 mg/kg across all studies. The results of the terrestrial field and dissipation studies are generally consistent with fate and transport properties of boscalid as observed in the submitted laboratory studies.

3.2.1.4. Degradates

The known degradates of boscalid include 2-chloronicotinic acid (M510F47), 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (M510F49), *p*-chloro-benzoic acid (M510F64), an unknown (M510F50) and carbon dioxide. M510F47 and M510F50 are classified as minor degradates. M510F49 is classified as a major degradate but was only observed at recoveries greater than 10% of the applied parent in one soil; it was a minor degradate in the rest (MRID 45405208 and 45643802). An additional study provided for the degradate M510F49 reported an aerobic soil metabolism half-life of 1.7 days. See **Appendix A** for additional information regarding degradates.

3.2.1.5. Bioaccumulation in Fish

Boscalid is expected to accumulate in fish tissues at moderate levels; bioaccumulation factors (BCF) from two studies were 36-44X, 84-105X, and 57-70X for the edible, non-edible, and whole fish tissues, respectively. It depurates rapidly from the tissues when the fish are no longer exposed to the compound. Boscalid is metabolized in fish tissues to form the metabolite M510F01, the oxygenated form of the compound, and is conjugated with cysteine to form the metabolite M510F05.

Some adverse physiological effects (such as enlarged and darkened livers and gall bladders and a discolored gastrointestinal tract) were noted in fish tissues upon sacrifice, and some behavioral effects, including loss of equilibrium, lethargy, and/or a loss of appetite, were noted during the study, particularly during exposure at 200 µg/L. The accumulation of boscalid in rainbow trout was studied using flow-through systems treated with radiolabeled (*i.e.*, [^{14}C] or [^{15}N, 2-^{13}C]) boscalid at either 20 or 200 µg/L; 35-day exposure and 14-day depuration periods were used. In both studies, mean total radiolabeled residues at steady state (1.4-3.3 days) were highest in the non-edible tissue compared with the edible and whole fish tissues. For the low and high exposure level studies, respectively, maximum total, radiolabeled residues (in parent equivalents) at steady state were 0.86 and 10.23 µg/g for the edible tissue, 2.07 and 27.51 µg/g for the non-edible tissue, and 1.40 and 17.12 µg/g for the whole fish tissue. Most of the radiolabeled residues in the tissue were the parent compound.

The metabolite M510F01 was present at respective maximums of 0.35 and 2.0 µg/g in non-edible tissues and 0.073 and 0.57 µg/g in edible tissues. The conjugated metabolite M510F05 was present at respective maximums of 0.093 and 0.96 (both in non-edible tissues) in the two studies.

Depuration was rapid at both exposure levels, with radiolabeled residues accumulated in non-edible tissues eliminated with model-derived half-lives of 0.8-1.0 days. Mean total radiolabeled residues in non-edible tissues on day 14 of the depuration period were 0.068 and 0.76 µg/g for the respective studies. Given the rapid depuration of boscalid in available fish BCF studies, exposures to non-target organisms associated with bioaccumulation are described only briefly in the Risk Characterization.

3.2.2. Measures of Aquatic Exposure

3.2.2.1. Aquatic Exposure Modeling

Because boscalid may be transported from crop sites to adjacent surface water and persists once partitioned to sediment (mean K_{oc} = 772 mL/g), estimated environmental concentrations (EECs) in both surface water and pore water were generated based on maximum labeled use rates (**Table 3.3**). Simulations were conducted using the Pesticide Root Zone Model (PRZM v3.12, 2001) and Exposure Analysis Modeling System (EXAMS v2.98.04.06, 2005), in tandem with the input shell pe5v0 (Nov 15, 2006). The PRZM model simulates pesticide movement and transformation from crop application through soil residue processes. The EXAMS model simulates pesticide loading into an adjacent pond from runoff and spray drift. When coupled, the PRZM/EXAMS model assumes a standard pond scenario in which a 10-hectare field drains into an adjacent 1-hectare pond of 2-meter depth (USEPA 2009b). A list of PRZM/EXAMS input files and sample input and output are included in **Appendix B**.

Accounting for the persistence of parent boscalid is very important in aquatic exposure modeling. Because the PRZM/EXAMS scenario is based upon a standard pond with no outflow of water, resulting EECs likely overestimate exposure over time for persistent compounds when used to estimate risk to organisms in flow-through environments, such as streams, rivers, and larger bodies of water with current or tidal flow. Exposure values calculated by the standard pond scenario are expected to be closer to actual exposures in static water bodies, such as ponds

and small lakes; therefore, these EECs remain especially relevant for inhabitants of these ecosystems and particularly to amphibians. The standard pond scenario continues to provide a conservative upper-bound estimate of exposure in aquatic environments and is used as the basis for risk estimation for aquatic organisms described in this assessment. However, to better characterize the potential for different levels of exposure to boscalid in static versus flow-through environments, EECs generated using a flow-through scenario in PRZM/EXAMS are presented in **Section 3.2.2.4**.

SCIGROW (Screening Concentration in Ground Water) is a regression model used as a screening tool to estimate pesticide concentrations found in ground water to be used as drinking water. SCIGROW was developed by fitting a linear model to groundwater concentrations with the Relative Index of Leaching Potential (RILP) as the independent variable. Groundwater concentrations are taken from 90-day average high concentrations from Prospective Ground Water studies; the RILP is a function of aerobic soil metabolism and the soil-water partition coefficient (K_{ow}). The output of SCIGROW represents the concentrations that might be expected in shallow, unconfined aquifers under sandy soils, which represent the ground water most vulnerable to pesticide contamination and likely to serve as a drinking water source. Inclusion of the unidentified, unextracted boscalid residues into the calculation (as compared to identified parent compound only), the estimated drinking water concentration increased from 0.59 ppb to 1.51 ppb.

3.2.2.2. Agricultural Practices and Selection of Crop Scenarios

The scenarios listed are those currently approved for Tier II modeling which most closely represent the proposed new uses for boscalid. For alfalfa, the Minnesota scenario was selected because it reflects the national average of three cuttings per year and it incorporates moderate natural rainfall as a driver of runoff. For citrus (Group 10), the Florida scenario was chosen as a conservative representation of exposure because high rainfall and soil characteristics increase susceptibility to runoff of sediment-bound residues.

Alfalfa can be grown year–round, depending on location. A single alfalfa crop can grow in a field for many years before reseeding is necessary. The crop is harvested by cutting from three (typically) to twelve times per season. Pest pressure is expected to be of most concern mid-season, and thus an application date of June 14th was selected for modeling simulations. The second treatment can be applied 14 days later (*e.g.*, June 28th), adhering to the minimum interval between applications. The label permits no more than two applications per cutting; therefore, the third application was set to 4 weeks later (July 26th), to observe the minimum 14 day pre-harvest interval and to allow the growth of new alfalfa shoots. (USDA 2002 and 2000)..

Citrus is grown year-round, and the fruit ripens year-round, depending on species and variety (USDA 2006). Therefore, weather conditions (*e.g.*, precipitation) were the primary consideration in selection of the timeframe of treatment for modeling. Sept. 1st was selected as the initial pesticide application date, as August, September and October were documented as the months with the greatest rainfall for the scenario location (West Palm Beach, FL; US Dept. of State 2008). Runoff is expected to be higher with greater rainfall. Thus, resulting estimated environmental concentrations should be conservative. The second application date was set for

ten days later to observe the minimum required ten-day interval between treatments. The proposed label then requires that an alternative mode of action fungicide be used following two sequential applications of Pristine, but the interval before and after this treatment is not specified. Therefore, the third application of Pristine in the simulation was set for Sept. 24th, assuming the usual ten days interval and then an additional three days following application of the alternative fungicide. Although fungicides are usually applied at a minimum of 1 to 2 weeks the 3 days allow for a more conservative estimation. It can be assumed that the alternative fungicide was applied and then is left to sit for 1 or 2 days before a scouting group can check for further fungal infections and if present the application of the fungicide on the next day. The fourth and final application was set for ten days later, on Oct. 3rd.

3.2.2.3. Chemical Fate and Transport Assumptions

Estimates of pesticide residue concentrations in surface water are driven by degradation rates, mechanisms of environmental transport, and characteristics of the receiving water body. For ecological risk assessment, the standard pond modeled with EXAMS is a static water body of fixed volume, with no outlet. Boscalid is not transformed to any significant extent in either aerobic or anaerobic aquatic systems, but it has a moderate potential to reach sediment via partitioning (mean K_{oc} = 772 mL/g) from the water phase to the sediment phase.

Table 3.3. Aquatic Exposure Inputs in Boscalid Ecological Exposure Assessment (PRZM/EXAMS).

Input Parameter	Value	Source	Comment
Application rate	Alfalfa: 0.48 lbs a.i./A Citrus: 0.29 lbs a.i./A	Proposed labels, Reg. 7969-199, 7969-197	Label maximum
Applications per season	Alfalfa: 3 Citrus: 4	Proposed labels, Reg. 7969-199, 7969-197	Label maximum
Date of first application	Alfalfa: June 14th Citrus: September 1st	USDA agricultural crop profiles information[1], label directions, and scenario parameters	Application dates were determined based upon all sources listed.
Reapplication interval	Alfalfa: 14 days, 28 days[2] Citrus: 10 days, 13 days[3]		
Chemical application method (CAM)	2- aerial, onto foliage 2- ground spray, foliar	Proposed labels, Input Parameter Guidance[4]	
Disposition of foliar residues	Alfalfa: 2 Citrus: 3	USDA agricultural crop profiles information[1]	Alfalfa is harvested through cuttings and most foliage is removed. Foliar residues remain on citrus foliage.
Spray drift fraction	0.05- aerial 0.01- ground spray	Input Parameter Guidance[4]	Aerial spray drift fraction is higher than that of ground spray.
Application efficiency	0.95- aerial, onto foliage 0.99- ground spray, foliar	Input Parameter Guidance[4]	Default values for aerial spray and ground spray.

Input Parameter	Value	Source	Comment
[1] USDA Crop Profiles information is located at: http://www.ipmcenters.org/cropprofiles/CP_form.cfm. [2] The 14 day interval is the minimum listed on proposed label. The 28 day interval is assumed after the 2nd application to allow alfalfa to re-grow after cutting. [3] The 10 day interval is the minimum listed on the proposed label. The 13 day interval is used after the 2nd application to allow for the use of a non-group 7, non-group 11 fungicide. [4] EFED input parameter guidance is located at: http://www.epa.gov/oppefed1/models/water/input_guidance2_28_02.htm			

Modeling inputs were selected according to EFED's Input Parameter Guidance (USEPA 2002). Each scenario was run based on aerial and ground methods of application at the maximum application rate and minimum interval timing as indicated in the proposed label instructions (Reg. 7969-199 and 7969-197). Chemical property and model input values were chosen according to the current Input Parameter Guidance (**Table 3.3** and **Table 3.4**, USEPA 2002). Aerial spray is expected to have 95% efficiency and 5% spray drift, and ground spray is expected to have 99% efficiency and 1% spray drift.

Values representing the disposition of foliar residues were assigned to both crop groups: Alfalfa was assigned a value of 2, because the majority of foliage is removed during harvest, and citrus was assigned a value of 3 because most foliar residue remains on the foliage after harvest. The Chemical Application Method (CAM) value for both aerial and ground spray applications was 2. Ground spray was not modeled for applications to citrus; although it is listed as a potential application method on the proposed supplemental label for this use, it is more likely to be applied via aerial blast. Therefore, estimates of exposure via aerial spray are considered to be more representative of the upper bound of exposure.

Table 3.4. Environmental Fate Data Used for Aquatic Exposure Inputs in Boscalid Ecological Exposure Assessment.

Input Parameter	Value	Source	Comment
Vapor pressure (25°C)	1.5×10^{-8} Torr	DP Barcode D285692	Product Chemistry lists a different value (see DP285692Error! Reference source not found.)
Henry's law constant	-	Not determined	Did not use as a input parameter
Water solubility	4.64 mg/L	DP Barcode D285692	pH 5-7, 20°C
Organic carbon partitioning coefficient (K_{oc})	772 mL/g_{oc}	MRID 45405216 MRID 45405217	Calculated mean K_{oc}
Aerobic soil metabolism ($t_{1/2}$)	2,073[1] days	MRID 45405208 MRID 45405209 MRID 45643802	90th percentile of the upper confidence bound on the mean half-life of four soils.
Aerobic aquatic metabolism ($t_{1/2}$)	4,146 days	Input Parameter Guidance[2]	Double the aerobic soil metabolism half-life
Anaerobic aquatic metabolism ($t_{1/2}$)	0 days[3]	MRID 45405213	No significant degradation

Input Parameter	Value	Source	Comment
Hydrolysis ($t_{1/2}$)	0 days	MRID 45405205	No significant degradation
Photolysis ($t_{1/2}$)	0 days	MRID 45405206	No significant degradation
Foliar degradation rate	0 d^{-1}	Input Parameter Guidance[2]	Default
Foliar washoff rate	0.5 cm^{-1}	Input Parameter Guidance[2]	Default

[1] Aerobic soil metabolism half-life value was recalculated in DP Barcode 367184 to include unidentified, unextractable residues (See Fate Characterization section for explanation).
[2] EFED input parameter guidance is located at:
http://www.epa.gov/oppefed1/models/water/input_guidance2_28_02.htm
[3] Anaerobic aquatic metabolism half-life value was recalculated to include the unidentified, unextracted residues (See Fate Characterization section for explanation); no statistically significant degradation was observed.

Exposure endpoints in this assessment are based on yearly peak concentrations. However, in the case of persistent compounds such as boscalid, the yearly peaks are not independent; they are correlated to the previous year's peak concentration. Therefore, a 1-in-10 year water column EEC does not necessarily or exclusively reflect varying meteorological conditions that are expected once every 10 years. The EECs are accumulating year after year because of the slow degradation rate.

3.2.2.4. Estimated Environmental Concentrations in Surface Water

The EECs listed in **Table 3.5** reflect maximum 1-in-10 year surface water concentrations, based on parent boscalid and unidentified, unextracted residues, from maximum proposed application rates for aerial and ground spray applications to alfalfa and aerial spray to citrus. Because the standard pond has no outlet, there is an accumulation of boscalid in the pond throughout the 30 year simulations.

To characterize the potential for variability in exposure concentrations resulting from the differences in outflow of environmentally relevant aquatic systems, EECs for aerial spray applications to alfalfa and citrus were generated using a scenario in PRZM/EXAMS that models advection of an amount of water equivalent to the total inflow from rainfall in a given month. The peak, 21-day average, and 60-day average concentrations with outflow were approximately 43 µg/L, 41 µg/L, and 41 µg/L for alfalfa and 25 µg/L, 20 µg/L, and 18 µg/L for citrus, respectively. The EECs range from 8 to 36% of the predicted exposure concentrations in the standard pond scenario; this noteworthy difference highlights the influence of weather patterns and hydrologic regimes on the potential for exposure to boscalid in aquatic environments.

Table 3.5. Tier II Surface Water Estimated Exposure Concentrations (EECs) of Boscalid Applied to Alfalfa and Citrus.

Proposed Use	Application Rate (lbs a.i./A) (Formulation)	Filename: Scenario (Weather)	Application Method	Peak (µg/L)	1-in-10-year 21-day average (µg/L)	1-in-10-year 60-day average (µg/L)
Alfalfa	0.48 (Endura)	MNalfalfaOP (w14914)	Aerial Spray	118.7	117.7	117.7
		MNalfalfaOP (w14914)	Ground Spray	84.87	84.35	83.74
Citrus	0.29 (Pristine)	FlcitrusST (w12844)	Aerial Spray	234.9	233.9	233.8

3.2.2.5. Estimated Environmental Concentrations in Pore Water

Pore water EECs represent the estimated concentration of boscalid that is present in the pore water of the sediment phase of a static water body (*e.g.*, pond), where benthic organisms are expected to inhabit. The EECs listed in **Table 3.6** reflect maximum 1-in-10 year peak and 21-day mean pore water concentrations, based on parent boscalid and unidentified, unextracted residues, for the maximum proposed application rates for aerial and ground spray applications to alfalfa and aerial spray to citrus. As with surface water residues, since the standard pond has no outlet, there was an accumulation of boscalid in the pond throughout the 30 year simulations.

Table 3.6. Estimated Exposure Concentrations (EECs) of Boscalid in Pore Water From Proposed Uses on Alfalfa and Citrus.

Proposed Use	Application Rate (lbs a.i./A) (Formulation)	Filename: Scenario (Weather)	Application Method	Peak	1-in-10-year 21-day average (µg/L)	1-in-10-year 60-day average (µg/L)
Alfalfa	0.48 (Endura)	MNalfalfaOP (w14914)	Aerial Spray	115.7	115.7	114.8
		MNalfalfaOP (w14914)	Ground Spray	82.13	82.11	82.02
Citrus	0.29 (Pristine)	FlcitrusC (w12842)	Aerial Spray	230.0	229.9	229.8

3.2.2.6. Estimated Drinking Water Concentrations in Ground Water

The estimated ground water concentrations reported in **Table 3.7** are EDWCs calculated by SCIGROW and are expected to represent concentrations of boscalid in ground water systems most vulnerable to pesticide contamination. The use on turf represents the maximum single application rate permitted for previous registrations of boscalid.

Table 3. 7. Summary of Tier 1 Groundwater EDWCs, Based on Application of Boscalid to Turf and Proposed New Uses on Alfalfa and Citrus (SCIGROW).

Use (Formulation)	Use/Rate (lbs a.i./A)	Estimated Drinking Water Concentration (EDWC, ppb) Acute and Chronic
Alfalfa (Endura)	Aerial Spray/0.48 x 3 applications; annual total of 1.44	1.04
Citrus (Pristine)	Aerial Spray/0.29 x 4 applications; annual total of 1.17	0.84
Turf	Ground Spray/0.35 x 6 applications; annual total of 2.1	1.51

3.2.3. Measures of Terrestrial Exposure

3.2.3.1. Ingestion of Foliar Residues by Birds and Mammals

Terrestrial wildlife exposure estimates are typically calculated for birds 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. For exposure to terrestrial organisms, such as birds and mammals, pesticide residues on food items are estimated, based on the assumption that organisms are exposed to pesticide residues in a given exposure use pattern. For boscalid, application methods for the proposed new uses on alfalfa and citrus include aerial spray, ground spray, and sprinkler irrigation. In this assessment, potential dietary exposure for terrestrial wildlife is based on consumption of boscalid residues on food items via spray applications.

T-REX (v. 1.4.1) is used to calculate dietary and dose-based EECs of boscalid residues on food items via proposed spray applications for alfalfa and citrus for mammals and birds. Input values for deriving EECs in T-REX are located in **Table 3.8**. Upper-bound Kenaga nomogram values are used to derive EECs for boscalid exposures to terrestrial mammals and birds (**Table 3.9**), based on 1-year time period. Consideration is given to different types of feeding strategies for mammals, including herbivores, insectivores and granivores. Dose-based exposures are estimated for three weight classes of birds (20 g, 100 g, and 1000 g) and three weight classes of mammals (15 g, 35 g, and 1000 g).

Table 3.8. Input Parameters for Deriving Terrestrial EECs for Boscalid Use on Alfalfa and Citrus Using T-REX.

Parameter Description	Values
Alfalfa	
Boscalid Application Rate (lbs a.i./A)	0.48
Foliar Dissipation Half-life (days)	35[1]
Minimum Application Interval (days)	14
Number of Applications	3
Citrus	
Boscalid Application Rate (lbs a.i./A)	0.29
Foliar Dissipation Half-life (days)	35[1]

Minimum Application Interval (days)	10
Number of Applications	4
[1] Default value	

Differences in exposures between ground and aerial applications cannot be assessed with the current model. Therefore, terrestrial risk conclusions for the proposed new uses on alfalfa and citrus apply to both ground and aerial exposures resulting from application of boscalid. Uncertainties in the terrestrial EECs are primarily associated with a lack of data on interception and subsequent dissipation from foliar surfaces. When data are absent, as in this case, EFED assumes a 35-day foliar dissipation half life, based on the work of Willis and McDowell (1987). An example output from the T-REX model is provided in **Appendix C**.

Table 3.9. T-REX Calculated EECs as Food Residues for Terrestrial Animals from Boscalid Use on Alfalfa and Citrus.

Alfalfa							
Food Type	**Dietary Based (ppm) (mammals and birds)**	**Dose Based (mg/kg-bw) (birds)**			**Dose Based (mg/kg-bw) (mammals)**		
	All Size Classes	**Small (20 g)**	**Medium (100 g)**	**Large (1000 g)**	**Small (15 g)**	**Medium (35 g)**	**Large (1000 g)**
Herbivores/Insectivores							
Short grass	268.67	305.99	174.49	78.12	256.16	177.04	41.05
Tall grass	123.14	140.24	79.97	35.81	117.41	81.14	18.81
Broadleaf plants/sm insects	151.13	172.12	98.15	43.94	144.09	99.58	23.09
Fruits/pods/lg insects	16.79	19.12	10.91	4.88	16.01	11.06	2.57
Granivores							
Seeds	16.79	4.25	2.42	1.09	3.56	2.46	0.57
Citrus							
Food Type	**Dietary Based (ppm) (mammals and birds)**	**Dose Based (mg/kg-bw) (birds)**			**Dose Based (mg/kg-bw) (mammals)**		
	All Size Classes	**Small (20 g)**	**Medium (100 g)**	**Large (1000 g)**	**All Size Classes**	**Small (20 g)**	**Medium (100 g)**
Herbivores/Insectivores							
Short grass	211.95	241.40	137.65	61.63	202.08	139.67	32.38
Tall grass	97.15	110.64	63.09	28.25	92.62	64.01	14.84
Broadleaf plants/sm insects	119.22	135.78	77.43	34.67	113.67	78.56	18.21
Fruits/pods/lg insects	13.25	15.09	8.60	3.85	12.63	8.73	2.02
Granivores							
Seeds	13.25	3.35	1.91	0.86	2.81	1.94	0.45

3.2.3.2. Runoff and Spray Drift to Terrestrial and Semi-Aquatic Plants

Exposure of naturally-occurring terrestrial and semi-aquatic (wetland) plant species is typically estimated using OPP's TerrPlant (v1.2.2) model and is assumed to encompass areas outside the immediate use site. The TerrPlant model is used to derive EECs for terrestrial and semi-aquatic plants near areas where boscalid has been applied for use on alfalfa and citrus. For non-wetland areas, exposure calculations are based on the amount of pesticide present in soil as a function of drift.

Loading via drift to dry, non-target, adjacent areas is assumed to occur from one acre of treatment to one acre of the non-target area. Spray drift is also a source of pesticide loading to non-target areas. The default spray drift assumptions are 1% for ground spray applications and 5% for aerial spray applications. TerrPlant estimates EECs based on application rate, solubility factor and default assumptions of drift. The EECs for terrestrial and semi-aquatic plants for a single application of boscalid at the maximum label rates for proposed boscalid uses on alfalfa and citrus are presented in **Table 3.10** (see example output in **Appendix D**). The EEC for loading to terrestrial plants is conservatively assumed to be equal to the maximum application rates for boscalid uses on alfalfa and citrus, or 0.48 and 0.29 lbs a.i./A, respectively.

Table 3.10. EECs for Terrestrial and Semi-Aquatic Plants Near Boscalid New Use Areas.

Crop	Single Max. Application Rate (lbs a.i./A)	EECs (lbs a.i./A)					
		Semi-Aquatic Areas (Total)		Spray Drift		Dry Areas (Total)	
		Ground spray	Aerial spray	Ground spray	Aerial spray	Ground spray	Aerial spray
Alfalfa	0.48	0.0528	0.072	0.0048	0.024	0.0096	0.0288
Citrus	0.29	NA	0.0435	NA	0.0145	NA	0.0174

[NA] Not applicable.

3.3. Ecological Effects Characterization

The ecological effects characterization for boscalid is based upon registrant-submitted toxicity data for the parent compound. **Appendix F** lists these studies, their review classifications, and associated deficiencies. A description of available aquatic and terrestrial toxicity data for boscalid is provided in **Sections 3.3.1 and 3.3.2.** No toxicity data are currently available for boscalid degradates.

The results of an October 2009 review of the Ecological Incident Information System (EIIS) are described in **Section 3.3.3** (USEPA 2009d). A search of the ECOTOXicology database (USEPA 2009c) on November 17, 2009, yielded no additional ecological effects data on boscalid from the open literature.

3.3.1. Aquatic Toxicity Assessment

A summary of the most sensitive aquatic toxicity data for boscalid, based on a current Agency review of all submitted data, is provided in **Table 3.11** and discussed further in **Sections 3.3.1.1** through **3.3.1.5**. Precipitate was observed in the acute freshwater invertebrate study and in the acute estuarine/marine fish study, at nominal concentrations between 3 and 4 mg a.i./L, despite the use of a solvent. The acute freshwater invertebrate daphnid study remains classified as supplemental but is not used in risk estimation because of uncertainty regarding measured concentrations of boscalid. There was no attempt to centrifuge and/or filter water samples prior to analysis; therefore, the bioavailable fraction of boscalid may have been over-reported, and toxicity may be underestimated. Although precipitate was observed in the acute estuarine/marine fish study, the data are useable for risk assessment purposes because samples were filtered prior to analysis. No solubility issues were reported in aquatic toxicity studies using freshwater fish, estuarine/marine invertebrates, or aquatic plants.

Table 3.11. Summary of Acute and Chronic Toxicity Data for Aquatic Organisms Exposed to Boscalid.

Aquatic Animals					
Species	**Study Type**	**Acute Toxicity**		**Chronic Toxicity**	
		LC_{50}/EC_{50} (mg a.i./L)[1,2]	**Toxicity Classification (MRID)**	**NOAEC & LOAEC (mg a.i./L)[2]**	**Endpoints (MRID)**
Rainbow trout (*Oncorhynchus mykiss*)	Freshwater fish acute & early life-stage (chronic)	**LC_{50} = 2.7**	Moderately toxic (454049-27)	**0.116** & 0.241	Mortality (454050-06)
Bluegill sunfish (*Lepomis macrochirus*)	Freshwater fish acute	LC_{50} > 3.7	Moderately toxic (454049-28)	NA	NA
Waterflea[3] (*Daphnia magna*)	Freshwater invertebrate chronic	EC_{50} = 5.33 (2.60)	Moderately toxic (454050-01)	**0.79** & 1.54	Reduced number of young (463514-06)
Freshwater amphipod (*Hyalella azteca*)	Invertebrate spiked sediment acute toxicity test	**EC_{50} > 1.066** (pore water)	Moderately toxic (454050-09)	NA	NA
Freshwater midge (*Chironomus riparius*)	Invertebrate sediment chronic toxicity test (spiked water)	NA	NA	**2.0** & 4.0 nominal (overlying water)	Reduced emergence (454050-08)
Sheepshead minnow (*Cyprinidon variegatus*)	Estuarine/marine fish acute	**LC_{50} > 3.86**	Moderately toxic (454050-04)	NA	NA
Mysid shrimp (*Mysidopsis bahia*)	Estuarine/marine invert. acute	**LC_{50} > 3.81**	Moderately toxic (454050-02)	NA	NA
Eastern oyster (*Crassostrea*	Oyster shell	**EC_{50} = 1.02** (2.14,	Highly toxic (454050-03)	NA	NA

virginica)	deposition	0.89 - 3.39)			

Aquatic Plants		
Species	**Endpoint (mg a.i./L)**	**Effect (MRID)**
Duckweed (*Lemna gibba*)	Vascular aquatic plant acute (IC_{50} >3.9 frond number, NOAEC 0.99 mg a.i./L)	Frond number, necrosis (454050-13)
Freshwater alga (*Pseudokirchneriella subcapitata*)	Non-vascular aquatic plant acute (EC_{50} = 1.34, NOAEC = 0.49)	Growth rate, biomass (454050-17)

[NA]Not available.
[1] Slope data from the acute aquatic studies are indicated in parentheses (value, 95% confidence interval). Where slope data are not available, the default value of 4.5 (with 95% confidence intervals of 2.0 and 9.0) is used to derive the probability of an individual effect (Urban and Cook 1986).
[2] **Bolded** values represent the most sensitive toxicity endpoints for freshwater and estuarine/marine taxa.
[3] The endpoint from the acute freshwater invertebrate study (MRID 454050-01) is not used in risk estimation because it may underestimate toxicity. Further discussion is provided in **Section 3.3.1.2**.

3.3.1.1. Toxicity to Freshwater Fish

Two freshwater fish acute toxicity studies using the technical grade active ingredient (TGAI) are available to evaluate the toxicity of boscalid to fish in support of registration for the new proposed food uses (*i.e.*, alfalfa and citrus). Results from two submitted static acute toxicity tests and one flow-through chronic toxicity test with freshwater fish are listed in **Table 3.11** above. The LC_{50} values fall in the range of 1 - 10 mg a.i./L; therefore, boscalid is classified as moderately toxic to freshwater fish on an acute exposure basis. All three studies were classified as supplemental because of uncertainties regarding the impact of elevated dilution water hardness and pH on the solubility of the chemical. Although precipitate was not reported in the freshwater fish studies, similar boscalid exposure concentrations resulted in precipitate in the freshwater invertebrate and estuarine/marine fish toxicity studies (see **Section 3.3.1.2**). Nominal concentrations in the freshwater fish studies approached the solubility limit of boscalid in water (4.64 mg/L, see **Table 3.2**). No solvent was used, and recoveries decreased with increasing concentration. Therefore, water samples should have been centrifuged and/or filtered prior to analysis. Additional details and deficiencies of the studies are addressed below.

In the 96-hour acute toxicity study with rainbow trout, 5% mortality occurred after 24 hours in fish exposed to the highest test concentration (2.98 mg a.i./L, measured) of boscalid (95.3% purity) under static conditions. Mortality for this treatment then increased with time to a maximum of 75% at 96 hours. The LC_{50} was estimated to be 2.7 mg a.i./L. Survival was not affected at any other concentration. Sublethal effects, such as lethargy, tumbling (disorientation), and convulsions, were likewise observed only in groups exposed to the highest concentration of boscalid (2.98 mg a.i./L).

An equivalent freshwater fish acute toxicity study was performed with bluegill sunfish (*Lepomis macrochirus*). The 96-hour LC_{50} was estimated to be greater than the highest test concentration (>3.7 mg a.i./L, measured). No mortality greater than 10% or sublethal effects were observed at any treatment level. However, based on length, the test species used were approximately twice as large as those recommended by EPA guidelines.

To assess the potential for chronic effects associated with boscalid exposure to freshwater fish, an early life cycle study with rainbow trout was submitted. In a 97-day toxicity study under flow-through conditions, fertilized eggs were exposed to concentrations of boscalid (95.3% purity) up to 1.667 mg a.i./L (measured). Sublethal effects (*e.g.*, lethargy, narcosis, and extended yolk sacs) and significantly higher mortality as compared to the control were observed in all but the lowest treatment level (NOAEC = 0.116 mg a.i./L; LOAEC = 0.241 mg a.i./L measured). Mortality was 28.3% at the LOAEC (compared to 15% in the control) and increased with concentration, up to 100% at the highest concentration tested. Mortality occurred primarily between days 27 and 35. Similar sublethal effects and additional physiological abnormalities were observed in the rainbow trout bioaccumulation study at roughly the same exposure concentration (approximately 200 µg a.i./L; see **Section 3.2.1.5**).

3.3.1.2. Toxicity to Freshwater Invertebrates

First instar waterfleas were exposed to boscalid (TGAI, 94.4% purity) concentrations in dilution water up to 5.13 mg a.i./L (measured), under static conditions, in a 48-hour toxicity study. Mortality occurred in all but the lowest treatment level (0.49 mg a.i./L) and controls. However, mortality was considered treatment-related only for the two highest concentrations (3.57 mg a.i./L and 5.13 mg a.i./L), where it exceeded 10% (EC_{50} = 5.33 mg a.i./L). Notably, the two highest measured concentrations were only 62.8% (of 4.3 mg a.i./L) and 42.3% (of 7.5 mg a.i./L) of the nominal concentrations, and precipitate was observed in all treatments but was not removed prior to analysis. Therefore, solubility was a limiting factor despite the use of a solvent, and toxicity was likely underestimated. The study was classified as supplemental.

Although data from the acute daphnid study were used in prior boscalid assessments, given the high uncertainty surrounding the measured boscalid concentrations and associated toxicity endpoints, the endpoint is not used for risk estimation purposes in this assessment. because precipitate was observed in all treatments and was not removed prior to analysis. Specifically, measured concentrations do not accurately represent the bioavailable (dissolved) fraction of boscalid. Submittal of an acute test for freshwater invertebrates that follows guidelines OPPTS 850.1010 and takes into consideration OPPTS 850.1000 for guidance on testing with poorly soluble materials and methods for solubility enhancement would reduce uncertainties associated with the acute data gap for freshwater invertebrates.

Chronic effects of boscalid exposure to freshwater invertebrates inhabiting the water column were assessed using first instar waterflea larvae, exposed to concentrations up to 3.06 mg a.i./L (TGAI, 94.3% purity) under static renewal conditions, for a period of 21 days. Sublethal effects occurred with respect to production of young, survival of young, and length and dry weight of offspring. The most sensitive endpoint was production of young (NOAEC = 0.79 mg a.i./L, LOAEC = 1.54 mg a.i./L), which was significantly reduced (77% of control) at the second highest treatment level. No precipitate was reported, even though the use of a solvent was not described in the study report. The study was classified as acceptable despite minor deviations from OPPTS guidelines.

With respect to benthic freshwater invertebrates, acute spiked sediment toxicity data were submitted for the amphipod (*Hyalella azteca*). First instar larvae were exposed to concentrations

of boscalid (TGAI, 96.9% purity) up to 97 mg a.i./kg dry sediment (measured), with a corresponding mean pore water concentration of 1.066 mg a.i./L (measured). Mortality at the second highest treatment level (0.664 mg a.i./L pore water) equaled 19% and was significantly higher than the 5-6% mortality in controls (NOAEC = 0.298 mg a.i./L pore water). In addition, amphipod dry weight was significantly lower at the highest two test concentrations, yielding a 10-day dry weight NOAEC of 0.298 mg a.i./L pore water. Based on the empirically determined EC_{50} > 1.066 mg a.i./L pore water, boscalid is classified as moderately toxic to the freshwater amphipod. However, mean HPLC recoveries, reported only for the highest treatment level, were approximately 66% of mean radiolabeled boscalid recoveries. Therefore, use of the concentrations based on total radiolabeled activity may overestimate exposure and underestimate toxicity to the test organism. Additionally, acetone solvent controls produced significantly different results than solvent-free (negative) controls, and it is unclear whether equal concentrations of solvent were applied across all treatments. Based on these deficiencies and the use of a non-guideline species, the study was classified as supplemental.

Chronic effects of boscalid exposure on benthic freshwater invertebrates were assessed based on first instar freshwater midge larvae exposure to nominal concentrations of boscalid (TGAI, 94.4%) up to 4.0 mg a.i./L in a 28-day study under static conditions. Boscalid was spiked into the water column. Acetone (0.1 mL/L) was used as a solvent. Both solvent and solvent-free (negative) controls were run concurrently with the study. Measured concentrations in sediment samples, provided only for the two highest treatment levels, were almost double the nominal concentrations, suggesting that boscalid residues were distributed unevenly throughout the sediment. A dose-response pattern was observed for nominal concentrations of 2.0 mg a.i./L and higher; however, the effects were statistically significant only for emergence and emergence rate (i.e., development) at the highest treatment level (62.2 % at 4.0 mg a.i./L, compared to 92-97.8% in controls). The most sensitive endpoints were reported for emergence and rate of emergence (NOAEC = 2.0 mg a.i./L, LOAEC = 4.0 mg a.i./L). The study was classified as non-guideline and supplemental. However, because boscalid was spiked into overlying water instead of directly into sediment, the endpoints, which are based on nominal overlying water concentrations, do not accurately reflect chronic exposure for sediment-dwelling freshwater invertebrates. Submittal of a chronic spiked sediment study per OPPTS 850.1735 would reduce uncertainties associated with the bioavailability of boscalid to benthic invertebrates under chronic exposure conditions.

3.3.1.3. Toxicity to Estuarine/Marine Fish

One estuarine/marine fish acute toxicity study with the TGAI (96.9% purity) is available to evaluate the toxicity of boscalid to estuarine/marine fish. Results from the 96-hour acute toxicity test with the sheepshead minnow (*Cyprinidon variegatus*), under flow-through conditions, are listed in **Table 3.11** above**.** Based on 10% mortality at the highest treatment level (3.86 mg a.i./L, the LC_{50} was determined to be > 3.86 mg a.i./L. The NOAEC was 2.33 mg a.i./L, based on mortality and sublethal effects including lethargy and loss of equilibrium. As a result, boscalid is considered no more than moderately toxic (LC_{50} [>1 – 10] mg a.i./L) to estuarine/marine fish under acute exposure conditions. Although precipitate was observed in all treatment vessels, despite a high concentration of solvent (0.5 mL acetone/L), samples were filtered prior to analysis. The study was classified as acceptable.

Chronic toxicity data for estuarine/marine fish are not available. Based on the freshwater fish acute-to-chronic ratio (ACR = 23.3, rainbow trout) and the nondefinitive acute toxicity endpoint for sheepshead minnow (LC_{50} > 3.860 mg a.i./L), a nondefinitive chronic toxicity endpoint for estuarine/marine fish is estimated as NOAEC > 0.17 mg a.i./L.

3.3.1.4. Toxicity to Estuarine/Marine Invertebrates

In acute studies with mysid shrimp (*Americamysis bahia*) and the Eastern oyster (*Crassostrea virginica*), boscalid was found to be moderately to highly toxic to marine/estuarine invertebrates. Unlike freshwater invertebrate toxicity studies with the TGAI, no solubility issues were observed at any of the concentrations tested. Acetone solvent concentrations (0.5 ml/L) exceeded the maximum recommended by the Agency for both studies; however, no solvent-related effects were observed in control vessels. Both studies were classified as acceptable.

In the 96-hour flow-through toxicity study for estuarine/marine invertebrates, mysid shrimp were exposed to boscalid (TGAI, 96.9% purity) at mean measured concentrations up to 3.81 mg a.i./L. The LC_{50} was >3.81 mg a.i./L. The NOAEC was <0.419 mg a.i./L , the lowest mean measured concentration tested. Mortality occurred at all treatment levels and ranged from 5% (*i.e.*, one specimen) to 15% (*i.e.*, three specimens). Equal and statistically significant mortality occurred at the lowest (0.419 mg a.i./L, measured) , median (1.38 mg a.i./L), and highest (3.81 mg a.i./L) concentrations, suggesting that the range of concentrations applied was not adequate to capture a dose-response. No mortality occurred in either solvent or solvent-free controls. Based on the LC_{50}, boscalid is considered moderately toxic to estuarine/marine invertebrates. Confidence in this toxicity determination would be increased if the study were repeated with a broader range of concentrations.

Juvenile Eastern oysters were exposed to boscalid (TGAI, 95.41% purity) at concentrations up to 3.9 mg a.i./L (measured), in a 96-hour flow-through shell deposition study. Based on the EC_{50} value for shell deposition (EC_{50} = 1.02 mg a.i./L), boscalid is classified as highly toxic to marine/estuarine molluscs. Shell deposition was significantly inhibited (25% - 100% inhibition compared to negative controls), in a dose-dependent manner, for all test concentrations (0.42 – 3.9 mg a.i./L, measured); therefore, the NOAEC was <0.42 mg a.i./L. No other sublethal effects were reported, and no mortality occurred in the controls or at any treatment level.

Chronic toxicity data for pelagic estuarine/marine invertebrates (*e.g.*, mysid shrimp) are not available, and neither acute nor chronic spiked sediment studies with non-molluscan estuarine/marine invertebrates were submitted. Given that boscalid may be applied within proximity to estuarine/marine environments year-round for the proposed new uses, especially for the use on citrus (see **Section 3.2.2.**), it is likely that both acute and chronic exposure of estuarine/marine invertebrates will occur. This likelihood is increased by the relatively long aerobic soil and aquatic half-lives of boscalid (> 10 days, see **Table 3.2**). In addition, the available aquatic toxicity data indicate that boscalid is moderately to highly toxic to estuarine/marine invertebrates on an acute exposure basis. Per 40 CFR 158.630, submission of a mysid full life cycle test (OPPTS 850.1350) would reduce uncertainties associated with boscalid toxicity to estuarine/marine invertebrates.

3.3.1.5. Toxicity to Aquatic Plants

In a 7-day toxicity study, the freshwater floating vascular plant, duckweed (*Lemna gibba*), was exposed to boscalid (TGAI, 96.9%) at measured concentrations up to 3.9 mg a.i./L. Frond growth inhibition occurred at all test concentrations and ranged from 6.7% - 11%, but was not statistically significant as compared to controls. The IC_{50}, based on frond number, was determined to be greater than the highest concentration tested (3.9 mg a.i./L). The NOAEC value, based on necrosis, was 0.99 mg a.i./L. The study was classified as acceptable.

The toxicity of boscalid to non-vascular aquatic plants was assessed based on a 96-hour study with a green alga (*Pseudokirchneriella subcapitata*), under static conditions. Algae were exposed to boscalid (TGAI, 94.4% purity) at mean measured concentrations up to 2.45 mg a.i./L. Inhibitions of growth rate (0.5% - 48.3% relative to controls) and biomass (3.0% - 94.8% relative to controls) were seen at all treatment levels and occurred in a dose-dependent manner (EC_{50} = 1.34 mg a.i./L, NOAEC = 0.49 mg a.i./L). The study was classified as supplemental because water quality information was not provided and because it was uncertain whether elevated pH and water hardness affected the solubility or toxicity of boscalid. Interestingly, solubility problems were not reported by the authors, even though other studies with similar test concentrations yielded precipitate despite the use of a solvent.

3.3.2. Terrestrial Effects Characterization

A summary of the most sensitive terrestrial animal toxicity data for boscalid, based on a current Agency review of all submitted data, is provided in **Table 3.12** through **Table 3.14** and is discussed further in **Sections 3.3.2.1** through **3.3.2.3**. The available data indicate that boscalid is practically non-toxic to birds, mammals, and honey bees on an acute exposure basis.

The available data for terrestrial plants, which are provided in **Section 3.3.2.4**, indicate that boscalid exposure in Tier II testing adversely affected seedling emergence endpoints in corn, oat, and cabbage, and vegetative vigor endpoints in corn, ryegrass, cabbage, lettuce, and oilseed rape (see **Table 3.15**). Cabbage appears to be particularly sensitive to boscalid, whereas other dicot species and all tested monocot species appear less sensitive to boscalid exposure. Tier II vegetative vigor tests failed to establish definitive toxicity endpoints (*i.e.*, NOAEC and EC_{25}) for the most sensitive dicot, cabbage.

3.3.2.1. Toxicity to Birds

Avian toxicity data are summarized in **Table 3.12** below. Based on results of toxicity testing with upland game and waterfowl species, bobwhite quail and mallard duck *(Anas platyrhynchos*), respectively, boscalid is categorized as practically non-toxic to birds under acute oral and subacute dietary exposure conditions. Chronic exposure to boscalid at concentrations greater than 300 mg a.i./kg diet adversely affected reproduction in bobwhite quail. No chronic effects occurred in the mallard duck.

One avian acute oral study using the TGAI is available. Bobwhite quail were exposed to boscalid via dietary intake at dose-based concentrations up to 2000 mg a.i./kg body weight (bw).

The LD_{50} was > 2,000 mg a.i./kg body weight (bw), and the corresponding NOAEL was 2000 mg a.i./kg bw. No treatment-related clinical signs of toxicity or effects on body weight or feed consumption were observed. The study was classified as acceptable.

In separate avian subacute dietary toxicity tests with boscalid, the LC_{50} values for both bobwhite quail and the mallard duck were greater than the highest treatment level of 5000 mg a.i./kg diet. No treatment-related sublethal effects related to body weight changes or clinical signs of toxicity were observed in either study. Both studies were classified as supplemental because of deviations from guideline study protocols, including sample sizes and cages that were smaller than recommended.

Two avian reproduction tests using the TGAI were submitted to establish the chronic toxicity of boscalid to birds. Significant effects on the number of eggs laid, fertility rate, embryo mortality, and number of 14-day survivors were observed in bobwhite quail at 1,000 mg a.i./kg diet. The NOAEC for this study was 300 mg a.i./kg diet, which corresponded to a dose-based exposure of 25 mg a.i./kg bw/d (NOAEL) as calculated from dietary consumption and body weight data. There was an approximate 13% reduction in the number of eggs laid per female and a 37% reduction in the number of 14-day survivors in the 1,000 mg a.i./kg diet group, as compared to the control over the whole study period. Under a similar boscalid exposure regime (concentration and duration), mallard ducks showed no adverse effects on reproductive parameters or adult health (NOAEC > 1,000 mg a.i./kg diet). Both studies were classified as acceptable.

Table 3.12. Summary of Acute and Chronic Toxicity Data for Birds Exposed to Boscalid.

Species	Study Type	Acute Toxicity		Chronic Toxicity	
		LD_{50} (mg a.i./kg bw) LC_{50} (mg a.i./kg diet)	**Toxicity Classification (MRID)**	**NOAEC (mg a.i./kg diet) NOAEL (mg a.i./kg bw)**	**Endpoints (MRID)**
Bobwhite quail (*Colinus virginianus*)	14-day acute oral	LD_{50} > 2000	Practically non-toxic (454049-22)	NA	NA
Bobwhite quail (*Colinus virginianus*)	Avian repro.	NA	NA	NOAEC = 300 NOAEL = 25	Number of eggs laid, fertility rate, embryo mortality, and number of 14-day survivors (454049-25)
Bobwhite quail (*Colinus virginianus*)	8-day subacute avian dietary	LC_{50} > 5000	Practically non-toxic (454049-23)	NA	NA
Mallard duck (*Anas platyrhynchos*)	Avian repro.	NA	NA	NOAEC > 1000	No effect (454049-26)
Mallard duck (*Anas platyrhynchos*)	8-day subacute avian dietary	LC_{50} > 5000	Practically non-toxic (454049-24)	NA	NA

3.3.2.2. Toxicity to Mammals

Acute oral and 2-generation reproductive toxicity studies with the Norway rat were submitted to establish the toxicity of boscalid to mammals. Results of the tests are presented in **Table 3.13.** Based on these results, boscalid is classified as practically non-toxic to mammalian species on an acute oral exposure basis. Statistically significant chronic effects on F2 body weight were observed at boscalid concentrations greater than 100 mg a.i./kg diet.

In the acute toxicity study, no mortality or other toxic effects were observed in Norway rats exposed to concentrations of boscalid up to 5,000 mg a.i./kg bw via dietary intake (LD_{50} > 5,000 mg a.i./kg bw). The study was classified as acceptable.

Table 3.13. Summary of Acute and Chronic Mammalian Toxicity Data for Rats Exposed to Boscalid.

		Acute		Chronic	
Species	**Study Type**	**LD_{50} or ED_{50} (mg a.i./kg bw)**	**Toxicity Classification (MRID)**	**NOAEC (mg a.i./kg diet) NOAEL (mg a.i./kg bw/d)**	**Endpoints (MRID)**
Norway rat (*Rattus norvegicus*)	Acute oral	LD_{50} > 5000	Practically non-toxic (454048-14)	NA	NA
Norway rat (*Rattus norvegicus*)	2-generation reproduction	NA	NA	NOAEC = 100 NOAEL = 11.2	Decreased F2 body weight (454049-06)
[1]Mammalian toxicity data provided and reviewed by EPA Health Effects Division.					

A 2-generation rat reproduction study using the TGAI was submitted to establish the toxicity of boscalid to mammals over prolonged periods. Boscalid exposure decreased body weight and body weight gain in F2 male pups (NOAEC = 100 mg a.i./kg diet) at the 1000 mg a.i./kg diet treatment level, which was equivalent to a dose-based exposure of 114 mg a.i./kg bw/d. At 1000 mg a.i./kg diet, F2 pups of both sexes showed a 7% lower body weight on postpartum day 21 and impaired body weight gains (7%) from postpartum day 4 up to weaning. At 10,000 mg a.i./kg diet, which was equivalent to a dose-based exposure of 1173 mg a.i./kg bw/d, there were slightly greater effects with F2 pups showing a 10-12% lower body weight at weaning compared to control and reduced viability index (as indicator of perinatal pup mortality) from postpartum day 0 - 4. Pup viability in the F2 generation was 93% for control and 86% for the 10,000 mg a.i./kg diet treatment. The study authors stated that while the viability of the high treatment group was within the range of historical control data (83-99%), the effects may have been treatment related given that there were other signs of toxicity at this treatment level. The 9% reduction in pup viability combined with the 12% reduction in growth rate may cause effects that have an impact at the population-level. Taken as a whole, these data indicate that while there were statistically significant effects at the 1000 mg a.i./kg diet treatment level, biologically significant, population-level effects may only have occurred in the 10,000 mg a.i./kg diet treatment level. The study was classified as acceptable.

3.3.2.3. Toxicity to Beneficial Insects

A 72-hr acute contact toxicity study using the TGAI was submitted to establish the toxicity of boscalid to honey bees. Based on the results of this study, boscalid is practically nontoxic to young adult (foraging) honey bees via both contact (LD_{50} > 200 µg/bee) and oral (LD_{50} > 165.96 µg/bee) exposure routes (see **Table 3.14**) This study was scientifically sound and was classified as acceptable.

Although no acute toxicity to honey bees has been demonstrated in experimental studies with boscalid, individual beekeepers have reported honey bee "brood effects" following the application of boscalid, specifically as the Pristine formulated product (25.2% boscalid and 12.8% pyraclostrobin), to nearby crops (BASF 2008). For example, a California beekeeper reported that "brood effects" were observed within ten days of the application of Pristine (application rate and target crop unspecified; BASF 2008; USEPA 2009d). Other beekeepers reported concerns to the registrant regarding "improper [brood] development" 17 days after application of Pristine to almonds (BASF 2008). Maximum rates for use on almonds are lower than the maximum rates proposed for the new uses on alfalfa and citrus. Additionally, "adverse effects" on larval development were noted after queen bees were fed almond pollen from Pristine treated crops, but the nature and magnitude of these effects were not reported (BASF 2008). The mechanism of these alleged effects is likewise unknown. Some data have been presented to suggest that carboxamide pesticides, including boscalid, may interfere with hormonally-regulated development in juvenile honey bees (*eg.* Mussen 2009, Frazier *et al.* 2008, Ladurner *et al.* 2005, Mussen *et al.* 2004, Atkins and Kellum 1986). However, this hypothesis has not been rigorously tested. Submittal of an acute contact study (per OPPTS 850.3020) with the Pristine formulation would reduce uncertainties associated with the toxicity of this formulation to honey bees. Also, submittal of a honey bee larval (*i.e.*, up to pupation) toxicity test using the TGAI would further reduce associated uncertainties with exposure to sensitive life stages.

Earthworms (*Eisenia foetida*) acutely exposed to boscalid (TGAI, 99.7% purity) at concentrations up to 1000 mg a.i./kg soil presented no significant adverse effects on survival or body weight (**Table 3.14**). The LC_{50} exceeded the highest concentration tested (LC_{50} > 1000 mg a.i./kg soil). The study was classified as supplemental because of guideline deviations, including failure to measure boscalid concentrations in soil, shorter than recommended study duration, insufficient acclimation of test organisms, and lower than recommended temperatures.

Table 3.14. Summary of Acute Toxicity Data for Terrestrial Invertebrates Exposed to Boscalid.

		Acute		Chronic	
Species	**Study Type**	**LD_{50} or LC_{50}**	**Toxicity Classification (MRID)**	**NOAEL**	**Endpoint (MRID)**
Honey bee (*Apis mellifera*)	Acute (oral, contact)	> 165.96 µg/bee (oral) > 200 µg/bee (contact)	Practically non-toxic (454050-19)	NA	NA
Earthworm (*Eisenia foetida*)	14-day acute toxicity	> 1000 mg a.i./kg dry weight soil (nominal)	NA (454050-20)	NA	NA

3.3.2.4. Toxicity to Terrestrial Plants

Terrestrial plant toxicity studies are required for pesticides that have terrestrial use patterns and/or may move off of the application site via drift or volatilization. NOAEC and EC_{25} (concentration that causes an effect in 25% of the population for the monitored endpoint) values are established for markers of seedling emergence and vegetative vigor. For boscalid, results of the Tier I studies using the Emerald formulation of boscalid (69.9% a.i.) indicated that none of the tested plant species exhibited effects greater than a 25% difference compared to controls. However, tomato plants showed a 24.1% reduction and a 22.7% reduction in shoot weight in the seedling emergence and vegetative vigor studies, respectively. Given that a 25% effect level could not be established at the highest test concentration of 0.55 lbs a.i./A, definitive EC_{25} values were not available for the Tier I tests.

Tier II testing with Emerald (69.9% a.i.) revealed significant effects on seedling emergence and vegetative vigor endpoints for some species, but no dose-response relationships were identified (**Table 3.15**). Corn and cabbage were the most sensitive monocot and dicot species, respectively. Corn emergence was significantly inhibited at the highest treatment level (0.576 lbs a.i./A), with NOAEC and EC_{25} values of 0.275 and >0.576 lbs a.i./A, respectively. In the vegetative vigor study, corn experienced a low but significant inhibition of shoot length at the second lowest treatment level (0.0726 lbs a.i./A). For seedling emergence, cabbage dry weight and shoot length were significantly reduced at the highest treatment level (0.576 lbs a.i./A). Inhibition of dry weight (22-32%) was observed at all treatment levels in the vegetative vigor study. Lettuce was similarly affected in the vegetative vigor study, although to a lesser degree. Compared to controls, lettuce dry weight was significantly lower at the two highest treatment levels (0.300 and 0.626 lbs a.i./A), and shoot length was 39% lower at the second highest dosage. Onion and oat were also affected by boscalid exposure: Onion dry weight was significantly reduced at the lowest treatment level for seedling emergence (0.0376 lbs a.i./A), and oat shoot length was significantly reduced at the three lowest levels (0.0376, 0.0726, and 0.153 lbs a.i./A).

Definitive EC_{25} values could not be established for any of the monocot species in either the Tier II seedling emergence or vegetative vigor tests within the range of concentrations tested; adverse effects to monocots did not reach or exceed 25% for any given species. However, two dicot species showed > 25% effect levels: cabbage (in both seedling emergence and vegetative vigor studies) and lettuce (only in the vegetative vigor study). The boscalid concentrations tested were too high to establish a dose-response relationship for the most sensitive dicot, cabbage. Based on the available data, it appears that terrestrial dicot plants are more sensitive to boscalid in foliar spray applications than via runoff exposure to emerged seedlings. Unlike the Tier I tests, tomato plants showed no statistically significant adverse effects in either of the Tier II studies.

Table 3.15. Summary of Tier II Toxicity of Boscalid (Emerald, 69.9% a.i.) to Non-target Terrestrial Plants.

Crop	Type of Study Species	EC_{25}* (lb a.i./A)	NOAEC* (lb a.i./A)	Endpoint Affected	MRID
Seedling Emergence					
Monocots	**Corn**	**>0.576[2]**	**0.275**	**Emergence**	47627401
	Oat	>0.551[2]	<0.04	Shoot length	
	Onion	>0.576[2]	0.576	None	
	Ryegrass	>0.576[2]	0.576	None	
Dicots	**Cabbage**	**0.44**	**0.275**	**Dry weight**	
	Lettuce	>0.576[2]	0.576	None	
	Oilseed rape	>0.576[2]	0.576	None	
	Tomato	>0.576[2]	0.576	None	
	Cucumber	>0.576[2]	0.576	None	
	Soybean	>0.576[2]	0.576	None	
Vegetative Vigor					
Monocots	**Corn**	**>0.626[2]**	**0.0351**	**Shoot length**	47627402
	Oat	>0.626[2]	0.626	None	
	Onion	>0.626[2]	0.626	None	
	Ryegrass	>0.626[2]	0.147	Shoot length	
Dicots	**Cabbage**	**<0.0351[3]**	**<0.0351[3]**	**Dry weight**	
	Lettuce	0.10	<0.0351[3]	Shoot length	
	Oilseed rape	>0.626[2]	<0.0351[3]	Dry weight	
	Tomato	>0.626[2]	0.626	None	
	Cucumber	>0.626[2]	0.626	None	
	Soybean	>0.626[2]	0.626	None	

* Based on measured application rates. **Bolded** values are the most sensitive endpoints.
[1] The vegetative vigor toxicity tests are classified as Supplemental because the Tier II test concentrations of boscalid were too high to determine definitive EC_{25} and NOAEC values for cabbage.
[2]Greater than the highest concentration of boscalid tested.
[3]Less than the lowest concentration of boscalid tested.

Although the Tier I and Tier II studies were scientifically sound, definitive toxicity endpoints for terrestrial dicot plants could not be established based on the Tier II vegetative vigor study. The range of concentrations tested in the vegetative vigor study was not sufficiently low to establish NOAEC and EC_{25} values for cabbage. Submittal of a Tier II vegetative vigor test with cabbage per OPPTS 850.4250, at a range of treatment levels sufficient to derive definitive endpoints, would reduce uncertainties to terrestrial dicot plants.

3.3.3. Review of Incident Data

The Ecological Incident Information System (EIIS), which is maintained by the Agency's Office of Pesticide Programs, was searched to determine if ecological incidents have been reported for boscalid. Based on a search of EIIS conducted in October 2009, only one ecological incident on honey bees was reported for boscalid (USEPA 2009d). Further discussion of the honey bee incident associated with boscalid exposure is found in **Section 3.3.2.3.** Because of limitations in the incident reporting system, the lack of additional incident reports cannot be construed as the absence of incidents from the registered use of boscalid. At the time of the search, EIIS contained information on incidents reported through December 2008.

4. Risk Characterization

4.1. Risk Estimation

Toxicity data and exposure estimates are used to evaluate the potential for adverse ecological effects on non-target species. This screening-level assessment of the proposed new used of boscalid on alfalfa and citrus relies on the deterministic RQ method to provide a metric of potential risks. The RQ provides a comparison of exposure estimates to toxicity endpoints (*i.e.*, the estimated exposure concentrations are divided by acute and chronic toxicity values). The resulting unitless RQs are compared to the Agency's LOCs, as shown in **Table 4.1 through Table 4.6**. LOCs are used by the Agency to indicate when the use of a pesticide, as directed by the label, has the potential to cause adverse effects to non-target organisms. For endangered species, LOC excedances require an additional in-depth listed species evaluation of the potential co-occurrence of listed species and areas in which alfalfa and citrus are grown to characterize risks. In this assessment, RQs that exceed the non-listed species LOC also exceed the listed species LOC.

4.1.1. Aquatic Organisms

Surface water EECs for the proposed new uses of boscalid on alfalfa and citrus are based on the PRZM/EXAMS model. Peak EECs are used to represent acute exposure to fish, aquatic invertebrates, and aquatic plants. The highest 21-day and 60-day average EECs represent chronic exposure to aquatic invertebrates and fish, respectively. Both alfalfa and citrus EECs used in aquatic RQ derivation are based the mean estimated K_{OC} value of 772 L/kg_{OC} (**Table 3.2**).

4.1.1.1. Freshwater Fish and Invertebrates

Acute and chronic RQs are calculated for freshwater fish that may be exposed to surface water following aerial and ground applications of boscalid for use on alfalfa and aerial application to citrus. As shown in **Table 4.1**, although acute RQs are not exceeded for non-listed species, the proposed new use of boscalid on citrus results in an RQ that exceeds the acute listed species LOC ($RQ \geq 0.05$). The chronic LOC ($RQ \geq 1.0$) for freshwater fish is exceeded by approximately 100% (RQ = 2.02) for the use on citrus and slightly (RQ = 1.01) for the aerial application of boscalid to alfalfa.

Given the re-classification of the freshwater invertebrate (*i.e.*, waterflea) acute data as inappropriate for risk estimation, acute endpoints for pelagic freshwater invertebrates are not available. Chronic RQs for pelagic freshwater invertebrates do not exceed the Agency's LOC for any of the proposed new boscalid use patterns. It is not possible to derive acute RQs for freshwater benthic invertebrates because a definitive acute toxicity endpoint has not been established. Further characterization of the potential for adverse effects to freshwater invertebrates, based on the proposed new boscalid uses for alfalfa and citrus, is provided as part of the Risk Description in **Section 4.2.1.1.**

Table 4.1. Acute and Chronic RQs for Freshwater Fish and Invertebrates Exposed to Boscalid in Surface Water Following Use on Alfalfa and Citrus.

Use	Application Rate lbs a.i./A (#app / interval in days)	Application Method	EECs (µg/L)			Fish and Amphibian RQs LC_{50} = 2.7 mg/L NOAEC = 0.116 mg/L		Invertebrate RQs EC_{50} = NA[3] NOAEC = 0.79 mg/L	
			Peak	21-day	60-day	Acute	Chronic	Acute	Chronic
Alfalfa	0.48 (3/14)	Aerial	118.7	117.7	117.7	0.044	**1.01**[2]	NA	0.15
		Ground	84.87	84.35	83.74	0.031	0.722	NA	0.11
Citrus	0.29 (4/10)	Aerial	234.9	233.9	233.8	**0.087**[1]	**2.02**[2]	NA	0.30

[1] RQ ≥ the acute listed species LOC (0.05).
[2] RQ ≥ the chronic risk LOC (1.0).
[3] The acute endpoint for freshwater invertebrates is not used in risk estimation because high uncertainty surrounds the measured concentrations associated with effects on survival. Potential acute risks to freshwater invertebrates are discussed as part of the Risk Description (Section 4.2).
[NA] Not available.

4.1.1.2. Estuarine/Marine Fish and Invertebrates

Acute toxicity studies with the sheepshead minnow and mysid shrimp indicate that boscalid is moderately toxic to estuarine/marine fish and invertebrates, respectively (**Section 3.3.1.3** and **3.3.1.4**). However, RQs are not derived for these taxa because definitive EC_{50} values could not be established based on the available toxicity data and chronic toxicity tests were not submitted. Further characterization of non-definitive toxicity values relative to EECs for the proposed new uses of boscalid is provided in the Risk Description (**Section 4.2.1.2**). Based on the available acute data for estuarine/marine molluscs, the proposed new uses of boscalid on alfalfa and citrus yield RQs that do not exceed the acute LOC for non-listed species. They do exceed the acute risk to listed species LOC (RQ ≥ 0.05) (**Table 4.2**).

Table 4.2. Acute RQs for Estuarine/Marine Invertebrates (Molluscs) Exposed to Boscalid in Surface Water Following Use on Alfalfa and Citrus.

Use	Application Rate lbs a.i./A (#app / interval in days)	Application Method	EECs (µg/L)	Invertebrate RQs EC_{50} = 1.02 mg/L
			Peak	Acute
Alfalfa	0.48 (3/14)	Aerial	118.7	**0.116**[1]
		Ground	84.87	**0.083**[1]
Citrus	0.29 (4/10)	Aerial	234.9	**0.230**[1]

[1] RQ ≥ the acute listed species LOC (0.05).

4.1.1.3. Aquatic Plants

For aquatic vascular and non-vascular plants, all RQ values are ≤ 0.5 based on a peak exposure concentration of 234.9 µg/L. Therefore, LOCs (RQ ≥ 1.0) are not exceeded for aquatic vascular or nonvascular plants.

4.1.2. Terrestrial Organisms

4.1.2.1. Birds and Mammals

Birds and mammals may be exposed to boscalid via consumption of residues on food items via spray applications. However, mammalian and avian RQs are not calculated for this exposure pathway because only non-definitive acute toxicity endpoints are available; no mortality was observed at the highest treatment levels tested in the acute avian and mammalian studies. Further discussions of predicted exposure values relative to levels at which no mortality or other sublethal effects are observed in birds and mammals are provided within the Risk Description in **Section 4.2.2.**

As shown in **Table 4.3**, chronic dietary RQs for birds do not exceed the Agency's LOC based on the maximum application rates of the proposed new uses of boscalid on alfalfa and citrus.

Table 4.3. Chronic RQs for Birds of Different Feeding Classes.

Food Type	Chronic Dietary-Based RQs[1]	
	Alfalfa (Endura: 0.48 lbs a.i./A; 3 apps; 14-day interval)	Citrus (0.29 lbs a.i./A; 4 apps; 10-day interval)
Short Grass	0.90	0.71
Tall Grass	0.41	0.32
Broadleaf plants/sm insects	0.50	0.40
Fruits/pods/lg insects	0.06	0.04
Seeds (granivore)	NA	NA

[1] Dietary-based RQ values are based on the NOAEC value of 300 ppm.
NA = Not applicable.

Based on the proposed new uses of boscalid on alfalfa, chronic dietary- and dose-based RQs exceed the chronic risk LOC (RQ $\geq$ 1.0) for all size classes of mammals that consume short grass, tall grass, broadleaf plants, and small insects (see **Table 4.4**). In addition dose-based chronic RQs for all mammalian size classes and similar feeding groups and dietary-based RQs for short grass, broadleaf plants, and small insects exceed the chronic mammalian risk LOC for the proposed use on citrus.

Table 4.4. Chronic RQs for Mammals of Different Size and Feeding Classes.

Food Type	Dietary-Based RQs[1]	Dose-Based RQs [2]		
	All Size Classes	Small (15 g)	Medium (35 g)	Large (1000 g)
Alfalfa (Endura: 0.48 lbs a.i./A; 3 apps; 14-day interval)				
Short Grass	**2.69**[3]	**10.41**[3]	**8.89**[3]	**4.76**[3]
Tall Grass	**1.23**[3]	**4.77**[3]	**4.07**[3]	**2.18**[3]
Broadleaf Plants/Sm Insects	**1.51**[3]	**5.85**[3]	**5.00**[3]	**2.68**[3]
Fruits/Pods/Lg Insects	0.17	0.65	0.56	0.30
Seeds (Granivore)	NA	0.14	0.12	0.07
Citrus (0.29 lbs a.i./A; 4 apps; 10-day interval)				
Short Grass	**2.12**[3]	**8.21**[3]	**7.01**[3]	**3.76**[3]
Tall Grass	0.97	**3.76**[3]	**3.21**[3]	**1.72**[3]

Broadleaf Plants/Sm Insects	**1.19**[3]	**4.62**[3]	**3.94**[3]	**2.11**[3]
Fruits/Pods/Lg Insects	0.13	0.51	0.44	0.23
Seeds (Granivore)	NA	0.11	0.10	0.05

[1] Dietary-based RQ values are based on the NOAEC value of 100 ppm.
[2] Dose-based RQ values are based on the NOAEL value of 11.2 mg/kg/day.
[3] Exceeds chronic risk LOC (RQ ≥ 1) for chronic exposures to non-listed and listed terrestrial mammals.
NA = Not applicable.

4.1.2.2. Terrestrial Invertebrates

Based on the available data for honey bees, boscalid TGAI is classified as practically nontoxic to non-target terrestrial invertebrates on an acute contact and oral exposure basis. The results of the acute studies show no significant mortality to yound adult (foraging) bees at any treatment level, with corresponding LD_{50} values of > 200 µg a.i./bee for contact exposure and > 165.96 µg a.i./bee for oral exposure.

Although boscalid is not shown to be toxic to young adult foraging bees in the submitted acute oral and contact toxicity studies, multiple reports of honey bee "brood effects" associated with the application of boscalid (as Pristine) have been communicated by the registrant (**Sections 3.3.2.3** and **3.3.3**). Additional characterization of the potential risks of boscalid to honey bees is provided as part of the Risk Description in **Section 4.2.2.3**.

4.1.2.3. Terrestrial Plants

Tier II terrestrial plant toxicity studies produced statistically significant effects in specific monocots (*i.e.*, corn, onion, and oat) and dicots (*i.e.* cabbage, lettuce, and oilseed rape). Of the ten non-target species tested, definitive EC_{25} values were obtained only for cabbage (seedling emergence, EC_{25} = 0.44 lbs a.i./A based on dry weight) and lettuce (vegetative vigor, EC_{25} = 0.10 lbs a.i./A based on shoot length). A dose-response relationship could not be determined for cabbage. For all monocots and most dicots (except lettuce and cabbage), the EC_{25} was greater than the highest concentration tested. Effects greater than 25%, as compared to controls, were seen in cabbage and lettuce at boscalid concentrations up to 0.576 lbs a.i./A and 0.626 lbs a.i./A, respectively.

RQs do not exceed the risk to listed and non-listed species LOCs for monocot plants (**Table 4.5**), nor do they exceed listed and non-listed LOCs for dicot plants exposed to runoff in dry and semi-aquatic areas (**Table 4.6**). Given the non-definitive NOAEC value for dicots in the vegetative vigor study, there is uncertainty associated with the derived spray drift RQ values for dicots shown in **Table 4.6**. Uncertainties regarding non-definitive toxicity endpoint for dicots and risks associated with spray drift from the new uses of boscalid on alfalfa and citrus are discussed in the Risk Description (**Section 4.2.2.4**).

Table 4.5. RQs for Monocots Inhabiting Dry and Semi-Aquatic Areas Exposed to Boscalid via Runoff and Drift.

Use	Application Rate (lbs a.i./A)	Application Method	Drift Value (%)	Spray drift RQ[1]	Dry area RQ[1]	Semi-aquatic area RQ[1]
Alfalfa	0.48	Aerial	5	<0.1 (<0.1)	<0.1 (0.10)	0.13 (0.26)
		Ground	1	<0.1.(<0.1)	<0.1 (<0.1)	<0.1 (0.19)
Citrus	0.29	Aerial	5	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (0.16)

[1] Listed species RQs are provided in parentheses.

Table 4.6. RQs for Dicots Inhabiting Dry and Semi-Aquatic Areas Exposed to Boscalid via Runoff and Drift.

Use	Application rate (lbs a.i./A)	Application Method	Drift Value (%)	Spray drift RQ[1, 2]	Dry area RQ[1]	Semi-aquatic area RQ[1]
Alfalfa	0.48	Aerial	5	**>0.68 (>0.68)**	<0.1 (0.10)	0.16 (0.26)
		Ground	1	**>0.14 (>0.14)**	0.27 (0.27)	0.12 (0.19)
Citrus	0.29	Aerial	5	**>0.41 (>0.41)**	<0.1 (<0.1)	0.10 (0.16)

[1] Listed species RQs are provided in parentheses.

[2] Given the non-definitive NOAEC value for dicots in the vegetative vigor study, there is uncertainty associated with the **bolded** spray drift RQ values. Further characterization of risks to terrestrial dicot plants based on exposure to boscalid spray drift is provided in the Risk Description.

4.2. Risk Description

The results of this screening-level risk assessment indicate that the proposed new use of boscalid on citrus has the potential for direct adverse acute effects to listed freshwater fish, based on excedance of the acute listed species LOC; neither the proposed use on alfalfa nor on citrus exceeds the LOC for acute risk to non-listed freshwater fish. However, chronic risk LOCs are exceeded for freshwater fish for both proposed uses. Given the lack of acceptable acute data for pelagic freshwater invertebrates, acute risk to freshwater invertebrates cannot be precluded; however, the chronic risk LOC is not exceeded for either use. RQs for estuarine/marine molluscs (invertebrates) exceed the acute listed species LOC, but not the non-listed species LOC, for both uses on alfalfa and citrus. RQs for acute risk to non-molluscan estuarine/marine invertebrates and to estuarine/marine fish are not calculated because definitive endpoints are unavailable. Risks to vascular and non-vascular aquatic plants are estimated to be low. Further characterization of potential risk to aquatic organisms, based on non-definitive endpoints and available toxicity data, is provided as part of this Risk Description.

With respect to terrestrial risks, the proposed new uses of boscalid on alfalfa and citrus may result in chronic risk to mammals of all size classes. Based on available data, there is uncertainty regarding the potential risk to beneficial insects such as pollinators. Although boscalid is classified as practically nontoxic to honey bees on both an acute oral and contact exposure basis, these studies are conducted using young adult foraging bees and do not provide information on the potential toxicity of compounds to developing larval and pupal honeybees. While the available toxicity tests with bees are typically viewed as representative of all life stages, there are anecdotal data indicating that exposure of developing brood to formulated boscalid (specifically as Pristine, pyraclostrobin plus boscalid) adversely affects larval survival (see **Section 4.1**). In addition, risks to listed and non-listed terrestrial dicot plants, based on spray drift from the

proposed new uses of boscalid, cannot be precluded. Therefore, the following risk hypothesis is not rejected:

> *... boscalid is expected to pose a chronic risk to small birds, terrestrial-phase amphibians and reptiles and to all size classes of mammals. In addition, boscalid may result in adverse effects on survival, growth, and/or fecundity of aquatic animals ... Although not expected to pose a risk to aquatic plants, there is uncertainty regarding its potential effects on terrestrial and semi-aquatic plants.*

These results are based on the maximum application rates for the proposed new boscalid uses.

4.2.1. Risks to Aquatic Organisms

4.2.1.1. Freshwater Fish and Invertebrates

Unlike previous assessments, acute listed species (for citrus only) and chronic (for alfalfa and citrus) LOC excedances for freshwater fish are triggered by the proposed new uses. Although the proposed application rates are within the range of those currently registered for use on food crops, an improved understanding of the chemical fate of boscalid (**Section 3.2.1**), coupled with unique use patterns for alfalfa and citrus (**Section 3.2.2.**), results in estimated environmental concentrations in surface water that are greater than those previously reported. It should be noted, however, that exposure and resulting risk to aquatic animals may increase over time, given that the chemical's stability and persistence in static water bodies.

Based on the maximum proposed application rates of boscalid to citrus, acute listed species and chronic LOCs are exceeded for freshwater fish. Acute RQs range from 0.081 to 0.087 and chronic RQs range from 1.88 to 2.02. The proposed aerial application of boscalid to alfalfa likewise results in a slight excedance of the Agency's LOC for chronic risk to freshwater fish (RQ = 1.01). According to the Agency's surrogate taxa approach, the potential for risk to freshwater fish presumably indicates a similar potential for risk to aquatic-phase amphibians.

Chronic risk to freshwater fish following the proposed use of boscalid on citrus is illustrated further by a comparison of effects concentrations and timing of effects to the maximum 60-day EEC (233.8 µg a.i./L, based on aerial spray). The chronic NOAEC and LOAEC for rainbow trout, based on mortality, are 116 µg a.i./L and 241 µg a.i./L, respectively. The level at which statistically significant mortality was observed (28.3% at 241 µg a.i./L) was similar to the predicted 60-day EEC. Embryo mortality occurred primarily between days 27-35 of the study. Sublethal effects included lethargy, narcosis, and extended yolk sacs and were observed at the same effect level (241 µg a.i./L), beginning approximately one week after termination of hatch (day 35). Sublethal effects were observed at similar exposure concentrations (approximately 200 µg a.i./L) in the rainbow trout bioaccumulation study. Therefore, both mortality and sublethal effects are expected to occur at predicted exposure concentrations for citrus. The maximum predicted EEC for alfalfa (approximately 118 µg a.i./L) is slightly higher than the NOAEC and is approximately half of the concentration where 28% mortality and sublethal effects occurred.

Uncertainties regarding the nature and comparable toxicity of unextracted residues in aquatic ecosystems following the application of boscalid to alfalfa and citrus strongly influence the risk conclusions in this assessment. As noted in **Section 3.2.1,** RQs for aquatic organisms are based upon an approach that assumes that both extracted parent boscalid and unextracted residues found in the aerobic soil metabolism studies are parent compound. However, EECs based upon measured parent compound alone are approximately 50% of those using the combined approach. For example, comparison of parent only EECs (peak 45.4 – 103 µg a.i./L, 1-in-60 day average 44.3 – 101 µg a.i./L) with the toxicity endpoints for freshwater fish result in derived RQs that are below the Agency's LOC for both aerial and ground applications to alfalfa and citrus. Nonetheless, unless further data regarding the nature and bioavailability of unextracted residues are provided, the conservative approach (assuming that unextracted, unidentified residues are parent) will be used to derive EECs for aquatic organisms following the proposed new uses of boscalid; this is necessary to account for the substantial uncertainties caused by the unknown nature of these residues.

Substantial reductions in EECs would be necessary to result in RQs that are less than LOCs for freshwater fish and aquatic-phase amphibians, based on the application to citrus. Peak EECs would have to be reduced to 134 µg/L to result in no excedances of the acute risk to listed species LOC; this equates to a 43% reduction from an adjusted rate of aerial application to citrus. Similarly, 60-day EECs would have to be reduced to 115 µg/L (or approximately a 2% reduction in EECs for alfalfa and a 50% reduction for citrus).

Acute risk to pelagic freshwater invertebrates cannot be precluded because the available acute waterflea endpoint is based upon highly uncertain measured boscalid concentrations; precipitate in water samples was not removed prior to analysis. When the waterflea endpoint (EC_{50} = 5.33 mg a.i./L) is compared to peak surface water EECs, the resulting values do not exceed the LOC. However, the use on citrus yields an estimated RQ (0.04) that approaches the listed species LOC (RQ $\geq$ 0.05). Given that variation in the solubility of boscalid may be associated with pH, which also may affect the sensitivity of aquatic organisms to boscalid exposure (*e.g.,* in dissolved versus precipitated fractions), the available data are insufficient to preclude risk to listed species of freshwater invertebrates. Based on the available ecotoxicity data, with consideration to the uncertainties described above, risks to non-listed species of freshwater invertebrates are estimated to be low. Submittal of an acute study for freshwater invertebrates, that follows OPPTS guideline 850.1010 and adheres to the guidance specified in OPPTS 850.1000 for testing with poorly soluble materials, would reduce these uncertainties. The proposed uses of boscalid on alfalfa and citrus are not expected to pose chronic risk of adverse effects to pelagic freshwater invertebrates, based on a comparison of surface water EECs to chronic toxicity endpoints from the waterflea reproduction study (RQs < 1.0).

As with freshwater invertebrates that inhabit the water column, the available data do not preclude risk to listed and non-listed species of benthic freshwater and estuarine/marine invertebrates. Risk Quotients (RQs) are not presented in the Risk Estimation because (1) the acute study with the amphipod did not yield a definitive acute toxicity endpoint, and (2) chronic toxicity was not established by a guideline spiked sediment study. While the bioavailable fraction of boscalid in the sediment matrix is uncertain, predicted concentrations of residues in pore water over time suggest that repeated use will eventually result in exposure to benthic organisms that exceeds the

Agency's concern levels. Moreover, the proposed uses of boscalid involve food crops (*i.e.*, alfalfa and citrus) associated with a single planting that often lasts multiple years (**Section 3.2.2.**). Assuming that the use of boscalid in a given location continues during this time, accumulation in water bodies, as a result of runoff and erosion, is likely.

To gain a better understanding of how the EECs for the maximum proposed boscalid application rates for the proposed new uses relate to the toxicity data currently available for benthic freshwater invertebrates, RQs were calculated based on pore water EECs, using the conservative assumption that the highest concentration tested in the amphipod study represents the endpoint (*i.e.*, acute: EC_{50} = 1.066 mg a.i./L pore water; **Table 4.7**). In this estimation, all of the RQs exceed the Agency's LOC for listed species. The peak pore water EEC (230 µg a.i./L) results from the use on citrus and is approximately 77% of the NOAEC (298 µg a.i./L) and 35% of the LOAEC (664 µg a.i./L) for mortality and reduction in dry weight in the amphipod.

Table 4.7. RQs Calculated from Non-Definitive Endpoints for Benthic Freshwater Invertebrates, Based on Mean Measured Pore Water Concentrations in a Spiked Sediment Study with the Amphipod.

Use	Application Rate lbs a.i./A (#app / interval in days)	Application Method	EECs (µg/L)	Benthic Invertebrate Acute RQs EC_{50} > 1.066 mg a.i./L
			Peak	Acute
Alfalfa	0.48 (3/14)	Aerial	115.7	**<0.1085**[1,2]
		Ground	82.13	**<0.0770**[1]
Citrus	0.29 (4/10)	Aerial	230.0	**<0.2158**[1,2]

[1] RQ ≥ the acute listed species LOC (0.05).

Because boscalid is a persistent compound with a moderate mobility, estimated concentrations in shallow ground water for the proposed uses were compared to the most sensitive, definitive endpoint available for freshwater organisms. Concentrations represent a 90-day average (1.04 µg/L for alfalfa and 0.84 µg/L for citrus); acute and chronic ground-water exposure values are equivalent. These concentrations are less than one percent of the NOAEC for chronic effects in freshwater fish. Therefore, based on this screening level assessment, risk to freshwater organisms as a result of exposure to boscalid from ground water discharged from aquifers into streams is presumed to be low.

Finally, given that acute RQs exceed listed species LOCs for estuarine/marine molluscs for the proposed new uses of boscalid on alfalfa and citrus (see **Section 4.2.1.2** below), risk to freshwater molluscs is presumed.

4.2.1.2. Estuarine/Marine Fish and Invertebrates

The persistence and moderate mobility of boscalid, coupled with documented patterns of pesticide transport to estuarine/marine environments following applications to alfalfa and citrus (*e.g.*, Wilson *et al.* 2006, Scott *et al.* 2002, Jordan *et al.* 1997, Domagalski and Kuivila 1993), indicate that boscalid may enter estuarine/marine environments as a result of the proposed new uses. To characterize the potential risks associated with exposure of estuarine/marine organisms

to boscalid, this screening level assessment compares boscalid EECs in surface water to available toxicity endpoints for estuarine/marine fish and invertebrates. These exposure concentrations are not intended to be representative of all estuarine/marine environments; instead, they provide an upper-bound estimate of exposure that is most representative of relatively enclosed environments, *e.g.*, tidal pools, small lakes, lagoons, etc., where transport of the pesticide out of the environment may be minimal. Other differences between freshwater and estuarine/marine habitats, such as a presumed decrease in solubility (and in corresponding exposure levels) of the chemical in saline environments, should also be considered when interpreting results.

For estuarine/marine fish, the range of boscalid concentrations tested with sheepshead minnow was not sufficient to capture the upper bound of exposure that would rule out rule out acute risk to listed species (see **Table 3.11).** However, it is likely that the upper bound of possible exposure was limited by boscalid's solubility in water under the conditions of the test. Given the uncertainties associated with solubility issues in the acute estuarine/marine fish study, observed mortality (10%) at the highest test concentration, and excedance of the acute listed species LOC based on the non-definitive endpoint, acute risks to estuarine/marine fish cannot be precluded.

To gain a better understanding of how the EECs for the maximum proposed boscalid application rates for the proposed new uses relate to toxicity data currently available for estuarine/marine fish, RQs were calculated for listed species (1) based on the highest concentration where no treatment-related mortality or sublethal effects occurred (NOAEC = 2.330 mg a.i./L) and (2) using the conservative assumption that the highest concentration in the toxicity test (3.860 mg a.i./L) represented the acute endpoint for estuarine/marine fish (*i.e.*, LC_{50}). These conservative endpoints were compared to the peak EECs from the aerial application scenarios for citrus and alfalfa (approximately 235 µg a.i./L and 119 µg a.i./L). For the use on citrus, the estimated acute RQs of 0.10 and 0.06, respectively, would exceed the listed species LOC. For the use on alfalfa, the NOAEC-derived RQ triggers the listed species LOC (119 µg a.i./L / 2.330 mg a.i./L = RQ of 0.05) The RQ derived for alfalfa uses based on the highest concentration tested would be less than the listed species LOC (119 µg a.i./L / 3.860 mg a.i./L = RQ of 0.03). The actual RQs for both citrus and alfalfa uses are expected to be lower.

Although chronic toxicity data for estuarine/marine fish were not submitted, based on the freshwater fish acute-to-chronic ratio (ACR = 23.3, rainbow trout) and the nondefinitive acute toxicity endpoint for sheepshead minnow (LC_{50} > 3.860 mg a.i./L), a nondefinitive chronic toxicity endpoint for estuarine/marine fish is estimated as NOAEC > 0.17 mg a.i./L. The ACR-derived endpoint should be interpreted cautiously, given that the acute and chronic freshwater fish studies were conducted under different conditions (*eg.*, static versus flow-through), and with consideration to potential differences in the physiology and ecology of freshwater versus estuarine/marine species. Nonetheless, when the estimated chronic toxicity endpoint is compared to 60-day average surface water EECs for the proposed new uses of boscalid, the resulting RQ values range from 0.49 to 1.38 and the chronic risk LOC is exceeded only for the use on citrus. Given these results, chronic risk to estuarine/marine fish from the proposed use on alfalfa is considered unlikely, but chronic risk associated with the use on citrus cannot be precluded. Submittal of a early-life stage chronic study with estuarine/marine fish per OPPTS 850.1400 would reduce uncertainties associated with presumed chronic risk to estuarine/marine fish associated with the use on citrus.

A definitive acute toxicity endpoint was not established for estuarine/marine invertebrates that inhabit the water column. Based on the highest concentration of boscalid tested with mysid shrimp, acute risk to listed species cannot be ruled out for the proposed use on citrus. Mortality occurred in all boscalid treatments (0.419 – 3.81 mg a.i./L) and ranged from 5 - 15%. The range of concentrations tested was inadequate to capture dose-response patterns. When compared to the highest concentration tested, peak EECs in surface water (**Table 3.5**) based on application to citrus, may result in risk to listed estuarine/marine invertebrates. Chronic risk to pelagic estuarine/marine invertebrates cannot be precluded because toxicity data were not submitted.

As in assessments for previously registered used of boscalid, the proposed new uses on alfalfa and citrus yield estimated exposure concentrations (EECs) and corresponding RQ values that exceed acute listed species LOCs for estuarine/marine molluscs (**Table 4.2**). Based on the risk conclusions for estuarine/marine molluscs, risks to freshwater molluscs are presumed.

Acute and chronic risks to non-molluscan, benthic estuarine/marine invertebrates cannot be precluded because toxicity data were not submitted.

4.2.1.3. Aquatic Plants

Based on available ecotoxicity data and modeling of surface water peak EECs, adverse effects to vascular and non-vascular aquatic plants are unlikely to occur. To exceed the Agency's LOC for aquatic plants, the peak surface water EEC would need to be at least 5 times higher than the current maximum concentration.

4.2.2. Terrestrial Organisms

The proposed uses of boscalid on alfalfa and citrus may result in exposure to non-target terrestrial organisms, including birds, mammals, invertebrates, and plants (**Figure 1.1**). The potential exposure to and acute risks associated with boscalid ingestion through dietary intake of residues on food items are assessed for herbivorous and insectivorous birds and mammals and for terrestrial invertebrates. Risk to invertebrates is not quantitatively assessed in the Risk Estimation (**Section 4.1.2.2**), but it is characterized based on oral and contact toxicity data, predicted residues, and available incident reports. The relationship between toxicity endpoints – definitive and non-definitive – and estimated environmental concentrations (EECs) of boscalid is characterized for each of the representative taxa. Where only non-definitive endpoints are available, RQs are not presented in the Risk Estimation (**Section 4.1**).

4.2.2.1. Birds

Because no mortality or sublethal effects were observed at the highest treatment levels tested in the avian acute oral and sub-acute dietary studies, RQ values for acute and sub-acute exposures were not calculated in the Risk Estimation section of this assessment. In order to gain a better understanding of how the EECs for the maximum proposed boscalid application rates for the proposed new use relate to the toxicity data currently available for birds, dietary- and dose-based EECs from the T-REX model are compared to the highest treatment concentrations in the avian

acute and sub-acute toxicity tests where no mortality and/or sublethal effects were observed. The maximum avian dietary- and dose-based EECs of 269 mg a.i./kg-diet and 306 mg a.i./kg-bw, respectively, are approximately 6.5 to 18.6 times lower than treatment levels where no mortality and/or sublethal effects were observed in sub-acute dietary (LC_{50} > 2000 mg a.i./kg-diet) and acute oral (LD_{50} > 5000 mg a.i./kg-bw) avian studies. Therefore, risks to birds from acute exposure to boscalid following the proposed new uses on alfalfa and citrus are assumed to be low.

Chronic dietary-based RQ values are calculated using the bobwhite quail NOAEC value of 300 mg a.i./kg diet. As shown in **Figure 4.2**, chronic RQs range from 0.06 to 0.90 for the use on alfalfa and from 0.04 to 0.71 for the use on citrus; the RQs do not exceed the chronic LOC of 1.0. These estimates are conservative in that they assume no additional interval between the second and third applications of boscalid, when the alternative mode of action fungicide should be applied according to the proposed labels. Nonetheless, for the proposed use on alfalfa, the chronic RQ (0.90) for avian consumers of short grass approaches the LOC (**Figure 4.2**). In addition, the decline in exposure values over time is shaped by an assumed foliar dissipation half-life of 35 days, because foliar dissipation data specific to boscalid are unavailable.

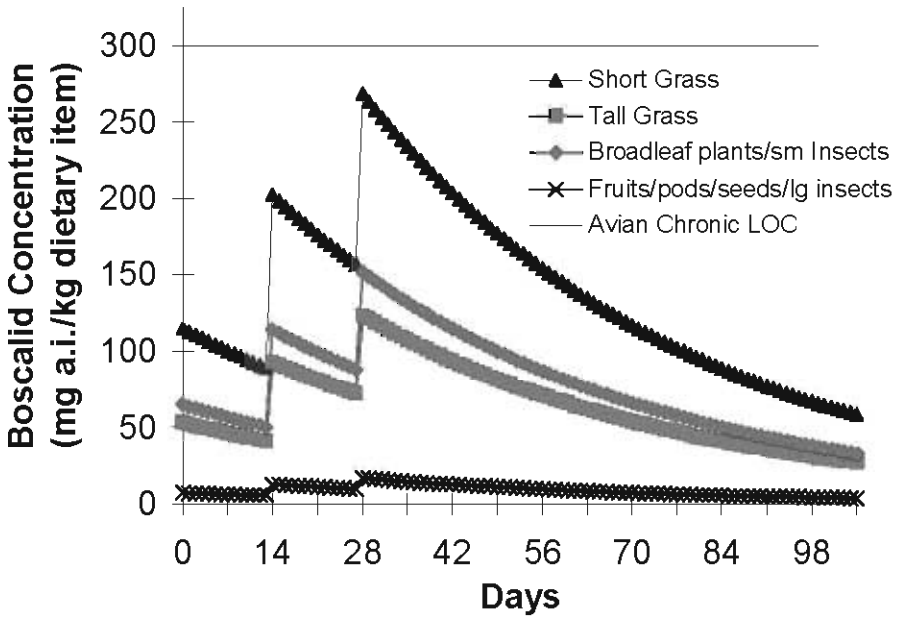

Figure 4.2: Upper Bound Kenaga Estimates of Terrestrial Residues from Maximum Proposed Use of Boscalid on Alfalfa, as Dietary Concentrations, Compared to Avian Herbivore/insectivore Chronic Level of Concern (LOC). T-REX v. 1.4.1.

To further characterize the relationship between EECs and the available chronic toxicity data for birds, RQs were derived based on the chronic LOAEC (1,000 mg a.i./kg diet). Statistically significant effects on reproductive parameters, including the number of eggs laid, fertility rate, embryo mortality, and number of 14-day survivors, were observed for bobwhite quail exposed to 1000 mg a.i./kg diet.. When compared to the maximum dose-based EECs for the uses on alfalfa and citrus (approximately 269 mg a.i./kg diet and 212 mg a.i./kg diet, respectively), predicted EECs are approximately 3 to 5 times less than the dietary avian concentrations shown to cause adverse effects. Additionally, boscalid exposure caused no adverse effects on reproduction in a

chronic toxicity study with the mallard duck. Based on these findings, potential adverse effects in birds, following chronic dietary-based exposure to boscalid from the proposed uses on alfalfa and citrus, are considered unlikely.

4.2.2.2. Mammals

Similar to birds, acute RQs are not calculated for mammals because only non-definitive acute oral toxicity data are available. In an acute toxicity study with the Norway rat, no mortality or other sublethal effects were observed up to the highest dose administered (5000 mg a.i./kg-bw). Based on the available acute mammalian data and maximum predicted dose-based EECs for boscalid residues on food items of 256 mg a.i./kg-bw, predicted exposure concentrations are approximately 19.5 times lower than the dose where no mortality or sublethal effects occurred in the acute oral mammalian study. Therefore, the potential for acute mortality in mammals following the proposed uses of boscalid on alfalfa and citrus are assumed to be low.

In a two-generation study with the Norway rat, chronic exposure to boscalid negatively impacted body weight in F2 male rat pups at concentrations > 100 mg a.i./kg diet and pup viability at 10,000 mg a.i./kg diet. Based on the NOAEC (100 mg a.i./kg diet), the chronic risk LOC for mammals that eat short grass is exceeded for the proposed new uses of boscalid following the first application to alfalfa (**Figure 4.3**) and the second application to citrus (**Figure 4.4**). In addition, LOCs are exceeded for alfalfa and citrus following the second and third applications of boscalid. For alfalfa, dietary RQs for alfalfa range from 0.17 to 2.69 (**Table 4.4**), and dose-based RQs range from 0.07 to 10.41. Specifically, consumers of food items such as short grass, tall grass, and broadleaf plants and small insects may be exposed to concentrations of boscalid that exceed the established NOAEC for adverse effects to F2 rats (*e.g.*, reduction in body weight).

Approximately seven days after the first application of boscalid to alfalfa, EECs drop below the chronic LOC and then again exceed the LOC with the second application (day 14) until day 77, approximately nine weeks following the third and final application for the season (**Figure 4.3**). The estimates of chronic risk are somewhat conservative because only two applications of boscalid are permitted per cutting of alfalfa, and for modeling purposes, no additional interval was assumed following the first cutting (*i.e.*, second application). However, the risk conclusions are not substantively impacted by this assumption. Although RQs would decline toward the chronic risk LOC if a 28-day interval were assumed between the second and third applications of boscalid, the third application would again result in EECs at approximately twice the level that would trigger the chronic risk LOC. An example output of mammalian chronic RQs derived from the T-REX model is provided in **Appendix C**.

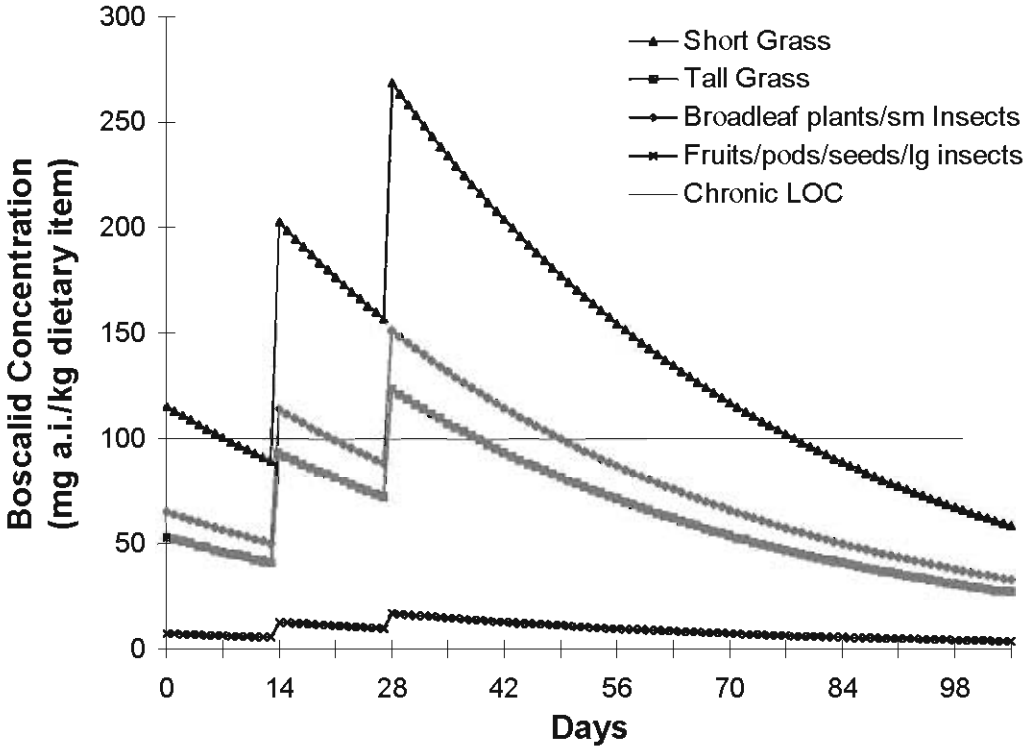

Figure 4.3: Upper Bound Kenaga Estimates of Terrestrial Residues from Maximum Proposed Use of Boscalid on Alfalfa, as Dietary Concentrations, Compared to Mammalian Herbivore/insectivore Chronic Level of Concern (LOC). T-REX v. 1.4.1.

The proposed use of boscalid on citrus results in chronic dietary-based RQs for mammals that range from 0.13 to 2.12 and dose-based RQs that range from 0.05 to 8.21 (**Table 4.4**). As with the use on alfalfa, mammals foraging on food items such as short grass, tall grass, and broadleaf plants and small insects may be exposed to concentrations of boscalid that exceed the established NOAEC. The second application of boscalid to citrus (day 10) yields RQs that exceed the chronic risk LOC and remain elevated above the LOC until day 70, almost six weeks following the fourth and final application for the season (**Figure 4.4**). The EECs for the third and fourth applications to citrus may be conservative, because the proposed label requires application of an alternative mode-of-action fungicide between the second and third applications of boscalid to citrus. An additional interval was not incorporated when modeling the EECs. However, risk conclusions are unlikely to be strongly impacted; RQs following the third application would closely approach or exceed the chronic risk LOC even if an additional 10-day interval were incorporated. In addition, the T-REX exposure values illustrated in **Figure 4.3** and **Figure 4.4** may slightly underestimate risk to mammals from the proposed uses of boscalid, because they were calculated based on a default foliar dissipation half-life assumption of 35 days; the persistence of boscalid residues in aerobic soil metabolism studies suggests that the actual foliar dissipation half-life is unknown.

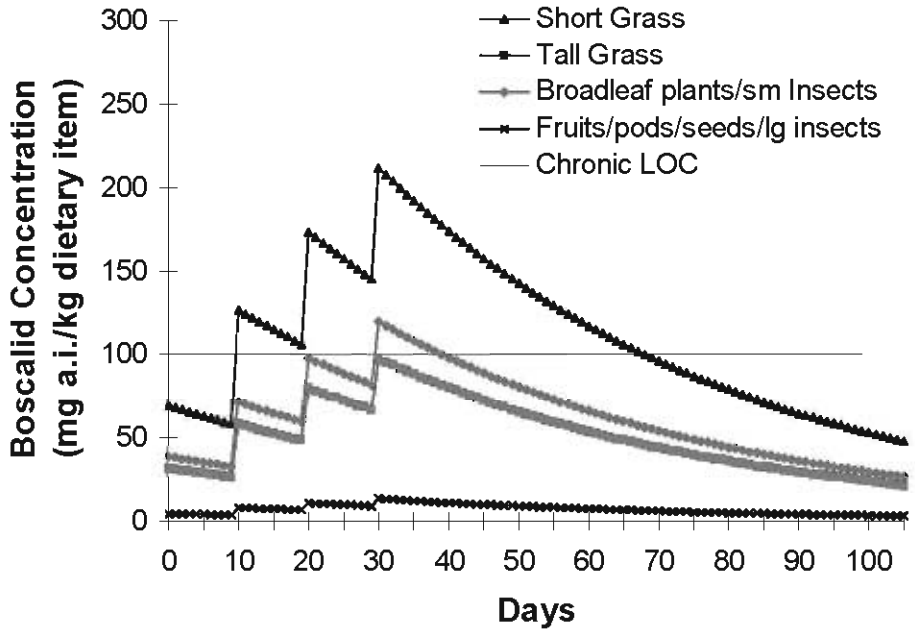

Figure 4.4: Upper Bound Kenaga Estimates of Terrestrial Residues from Maximum Proposed Use of Boscalid on Citrus, as Dietary Concentrations, Compared to Mammalian Herbivore/insectivore Chronic Level of Concern (LOC). T-REX v. 1.4.1.

To further characterize the potential for chronic risk to mammals from boscalid use on alfalfa and citrus, EECs were compared to the NOAEC (100 mg a.i./kg diet) and LOAEC (1,000 mg a.i./kg diet). Peak dietary EECs for the uses on alfalfa and citrus, respectively, were approximately 269 mg a.i./kg diet and 212 mg a.i./kg diet; these values were 2 to 2.5 times the NOAEC (*i.e.,* 212-269%) but 21-27% of the LOAEC. As a result, chronic risk to mammals based on the proposed new uses on alfalfa and citrus cannot be precluded because treatment-related effects may occur at concentrations between the NOAEC (100 mg a.i./kg diet) and the LOAEC (1,000 mg a.i./kg diet).

To achieve dietary-based risk quotients (RQs) that do not exceed the chronic LOC for any of the given categories of mammals, the single application rates of boscalid to alfalfa and citrus would have to be reduced to approximately 0.175 lbs a.i./A and 0.135 lbs a.i./A, respectively. To achieve dose-based RQs that do not exceed the chronic LOC for any mammal size class, the single application rates of boscalid to alfalfa and citrus would have to be reduced to approximately 0.045 lbs a.i./A and 0.035 lbs a.i./A, respectively. Alternatively, the NOAEC would have to be approximately an order of magnitude greater than the established value of 100 mg a.i./kg diet, based on chronic toxicity studies with the Norway rat.

4.2.2.3. Terrestrial Invertebrates

For soil invertebrates, an earthworm toxicity test indicated a chronic No Adverse Effects Level (NOAEL) of 100 ppm (**Table 3.14**). For soil concentrations of boscalid to equal 100 ppm, the total application rate for boscalid based on (1) application to 1 acre, (2) homogeneous mixing to a depth of 1 cm, and (3) soil density equal to 2.6 g/cm^3 is about 23 lbs a.i./A. This application rate exceeds all currently proposed maximum seasonal rates (highest is 1.44 lbs a.i./A for

alfalfa). Hence, based on the available earthworm data, the proposed new uses of boscalid on alfalfa and citrus are not likely to result in adverse effects to terrestrial soil invertebrates.

Boscalid is similarly classified as practically non-toxic to honey bees on both an acute oral and contact exposure basis. No evidence of toxicity was observed at an acute contact exposure concentration of 200 ppm or at an acute oral exposure concentration of 165.96 ppm (**Table 3.14**). While young adult foraging bees do not appear to be particularly sensitive to boscalid, there is uncertainty regarding the chemical's potential effects on honey bee larvae and pupae. There is also uncertainty regarding the extent to which bees foraging on treated plans may translocate residues in pollen and nectar back to colonies where they may in turn be feed to brood and the queen as royal jelly..

Based on the available acute oral and contact data, it appears that yound adult foraging bees are not acutely sensitive to the technical grade of boscalid. However, reported incidents indicate that honey bee brood may be sensitive to formulated products that include boscalid. Evidence of "brood effects" following boscalid application, especially when formulated as Pristine, has been reported. However, the mechanism of these alleged effects is unknown (Mussen 2009). For example, a California beekeeper reported that "brood effects" were observed within ten days of the application of boscalid as Pristine (application rate and target crop unspecified; BASF 2008). Other beekeepers have reported concerns regarding "improper [brood] development" 17 days after application of Pristine to almonds. Additionally, "adverse effects" on larval development were noted after queen bees were fed almond pollen from Pristine treated crops, but the nature and magnitude of these effects were not reported (BASF 2008). The maximum application rate for use of Pristine on almonds is 0.232 lbs a.i./A up to four times per season at a minimum interval of 7 to 14 days, a minimum pre-harvest interval of five weeks after petal fall, and a maximum seasonal application of 1.2 lbs a.i./A. The maximum rates for the proposed new uses on alfalfa and citrus exceed the maximum rates for almonds, and both native and introduced honey bees are likely to be attracted to these proposed uses..

The ecological and agricultural importance of pollinators makes honey bee health an issue of particular public and regulatory concern. Colony failure due to multiple (often unknown) factors, termed Colony Collapse Disorder (CCD), and pollinator declines in general have been widely reported in the United States and elsewhere (van Engelsdorp et al. 2009; van Engelsdorp and Meixner 2010). Pesticide exposure is proposed as a possible contributor to these phenomena, through direct, indirect, and/or synergistic effects. Current understanding of these events is limited primarily to epidemiological characterization; however, research is being conducted to determine what role, if any, pesticides (including boscalid) may play in pollinator declines.

Most explanations of general pollinator declines and CCD suggest that multiple factors are associated with these declines. However, the widespread loss of honey bee colonies is documented, and the potential for adverse effects of exposure to pesticides (including boscalid) has not been discounted. For this reason, submittal of additional honey bee toxicity data, including an acute contact toxicity test with the Pristine formulation per OPPTS guideline 850.3020 and a larval (*i.e.*, until pupation) toxicity test with the TGAI, would help reduce uncertainties regarding risk to honey bees from the use of boscalid and the Pristine formulation .

4.2.2.4. Terrestrial Plants

To provide a conservative estimation of risk to listed species of terrestrial plants, RQs are calculated using the highest concentration where no adverse effects were observed, based on the most sensitive endpoint for monocots and dicots (NOAEC; **Section 4.1**). RQs for non-listed species of terrestrial plants are calculated using the EC_{25}. Where toxicity tests are unable to capture the lower bound of toxicity (*i.e.,* NOAEC or EC_{25} < lowest concentration tested), the RQ is assumed to be greater than the value obtained by dividing the environmentally relevant concentration by the non-definitive endpoint.

Terrestrial dicot plants appear to be particularly sensitive to foliar application of boscalid, as demonstrated by phytotoxicity in the Tier II vegetative vigor study (see **Table 3.15**). Based on available ecotoxicity data and estimated exposures, risks to listed and non-listed species of terrestrial dicot plants are most likely to result from spray drift, particularly from aerial application to alfalfa (see **Table 4.6**). Risks to monocot plants and to terrestrial dicots following exposure via runoff/erosion are presumed to be low. Additional testing of vegetative vigor endpoints for cabbage (per OPPTS 850.4250), with a range of treatment levels that allow derivation of definitive endpoints, would eliminate much of the uncertainty regarding risk to dicot plants.

5. Federally Threatened and Endangered (Listed) Species of Concern

Section 7 of the Endangered Species Act, 16 U.S.C. Section 1536(a)(2), requires all federal agencies to consult with the National Marine Fisheries Service (NMFS) for marine and anadromous listed species, and/or the United States Fish and Wildlife Service (USFWS) for listed wildlife and freshwater organisms, if they are proposing an "action" that may affect listed species or their designated critical habitat. Each federal agency is required under the Act to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. To jeopardize the continued existence of a listed species means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species" (50 C.F.R. § 402.02).

To facilitate compliance with the requirements of the Endangered Species Act (subsection (a)(2)), the Office of Pesticide Programs has established procedures to evaluate whether a proposed registration action may directly or indirectly appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of any listed species (USEPA 2004). After the Agency's screening level risk assessment is conducted, if any of the Agency's listed species LOCs are exceeded for either direct or indirect effects, an analysis is conducted to determine if any listed or candidate species may co-occur in the area of the proposed pesticide use or areas downstream or downwind that could be contaminated from drift or runoff/erosion. If listed or candidate species may be present in the proposed action area, further biological assessment is undertaken. The extent to which

listed species may be at risk is considered, which then determines the need for the development of a more comprehensive consultation package, as required by the Endangered Species Act.

The federal action addressed herein is the proposed registration of two new uses for boscalid on alfalfa and citrus (Group 10). It is expected that the new uses of boscalid could occur nationwide; however, according to the USDA National Agricultural Statistics Service (NASS) 2007 census, the proposed new citrus uses are likely to predominately occur in the states of California, Florida, Hawaii, and Texas (USDA 2009; www.agcensus.usda.gov; searched on 4 December 2009). According to the NASS (2007) census, citrus is also grown, to a lesser extent, in other states including Arizona, Louisiana, Alabama, Mississippi, Georgia, South Carolina, and New Mexico.

5.1. Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by boscalid use and not merely the immediate area where boscalid is applied. At the initial screening-level, the risk assessment considers broadly described taxonomic groups and conservatively assumes that listed species within those broad groups are co-located with the pesticide treatment area. This means that terrestrial plants and wildlife are assumed to be located on or adjacent to the treated site and aquatic organisms are assumed to be located in a surface water body adjacent to the treated site. The assessment also assumes that the listed species are located within an assumed area, which has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area. **Section 5.2** of this risk assessment presents the proposed pesticide use sites that are used to establish initial co-location of species with treatment areas.

5.2. Taxonomic Groups Potentially at Risk

If the assumptions associated with the screening-level action area result in RQs that are below the listed species LOCs, a "no effect" determination conclusion is made with respect to listed species in that taxa, and no further refinement of the action area is necessary. Furthermore, RQs below the listed species LOCs for a given taxonomic group indicate no concern for indirect effects on listed species that depend upon the taxonomic group for which the RQ was calculated. However, in situations where the screening assumptions lead to RQs in excess of the listed species LOCs for a given taxonomic group, a potential for a "may affect" conclusion exists and may be associated with direct effects on listed species belonging to that taxonomic group or may extend to indirect effects upon listed species that depend upon that taxonomic group as a resource. In such cases, additional information on the biology of listed species, the locations of these species, and the locations of use sites are considered to determine the extent to which screening assumptions regarding an action area apply to a particular listed organism. These subsequent refinement steps will consider how this information would impact the action area for a particular listed organism and potentially include areas of exposure that are downwind and downstream of the pesticide use site.

Assessment endpoints, exposure pathways, the conceptual models addressing proposed new boscalid uses, and the associated exposure and effects analyses conducted for the boscalid

screening-level risk assessment are in **Sections 2** to **3**. The assessment endpoints used in the screening-level risk assessment include those defined operationally as reduced survival and reproductive impairment for both aquatic and terrestrial animal species and survival, reproduction, and growth of aquatic and terrestrial plant species from both direct acute and chronic exposures. These assessment endpoints address the standard set forth in the Endangered Species Act requiring federal agencies to ensure that any action they authorize does not appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species. Risk estimates (RQs) which, integrating exposure and effects, are calculated for broad based taxonomic groups in the screening-level risk assessment presented in **Section 4.**

Both acute listed species and chronic risk LOCs are considered in the screening-level risk assessment to identify direct and indirect effects to taxa of listed species. This section identifies direct effect concerns, by taxa, that are triggered by exceeding listed LOCs in the screening-level risk assessment (**Table 5.1**), with an evaluation of the potential probability of individual effects for exposures that may occur at the established listed species LOC (**Table 5.1)**. Data on exposure and effects collected under field and laboratory conditions are evaluated to make determinations on the predictive utility of the direct effect screening assessment findings to listed species. Additionally, the results of the screen for indirect effects to listed species, using direct effect acute and chronic LOCs for each taxonomic group, is presented and evaluated.

Table 5.1. Potential Effects to Federally Listed Taxa Associated with Direct or Indirect Effects from the Proposed New Uses of Boscalid.

Listed Taxon	Direct Effects	Uses of Concern	Indirect Effects	Uses of Concern
Terrestrial and semi-aquatic plants - monocots	No	None	Yes[1,2,3]	Alfalfa and citrus
Terrestrial and semi-aquatic plants - dicots	Yes	Alfalfa and citrus	Yes[2,3]	Alfalfa and citrus
Terrestrial invertebrates	Yes	Alfalfa and citrus	Yes[1,2]	Alfalfa and citrus
Birds	No	None	Yes[1,2,3]	Alfalfa and citrus
Terrestrial-phase amphibians	No	None	Yes[1,2,3]	Alfalfa and citrus
Reptiles	No	None	Yes[1,2,3]	Alfalfa and citrus
Mammals	Yes	Alfalfa and citrus	Yes[1,3]	Alfalfa and citrus
Aquatic plants	No	None	Yes[1]	Alfalfa and citrus
Freshwater fish	Yes	Citrus	Yes[1, 5]	Alfalfa and citrus
Aquatic-phase amphibians	Yes	Citrus	Yes[1, 5]	Alfalfa and citrus
Freshwater invertebrates	Yes	Alfalfa and citrus	Yes[1]	Alfalfa and citrus
Mollusks	Yes	Alfalfa and citrus	Yes[1,4]	Alfalfa and citrus
Marine/estuarine fish	Yes	Citrus	Yes[1, 5]	Alfalfa and citrus
Marine/estuarine invertebrates	Yes	Alfalfa and citrus	Yes[1]	Alfalfa and citrus

Listed Taxon	Direct Effects	Uses of Concern	Indirect Effects	Uses of Concern
Potential indirect effects on a taxon attributable to: [1] direct effects on terrestrial dicot plants [2] direct chronic effects on mammals [3] potential direct effects to terrestrial invertebrates (i.e. honey bees) based on incident data [4] direct acute effects on freshwater fish [5] presumed risk to freshwater and estuarine/marine invertebrates				

5.2.1. Probit Dose-Response Analysis

The Agency uses the probit dose-response relationship as a tool for providing additional information on the potential for acute direct effects to individual listed species and aquatic animals that may indirectly affect the listed species of concern (USEPA 2004). As part of this evaluation, the acute RQ for listed species is presented in terms of the chance of an individual event (*i.e.*, mortality or immobilization) should exposure at the EEC actually occur for a species with sensitivity to boscalid on par with the acute toxicity endpoint selected for RQ calculation. To accomplish this interpretation, the Agency uses the slope of the dose-response relationship available from the toxicity study used to establish the acute toxicity measures of effect for each taxonomic group that is relevant to this assessment. The individual effects probability associated with the acute RQ is based on the mean estimate of the slope and an assumption of a probit dose-response relationship. In addition to a single effects probability estimate based on the mean, upper and lower estimates of the effects probability are also provided to account for variance in the slope, if available. Based on the available acute toxicity for boscalid, a summary of the probit dose-response analysis is provided in **Table 5.2**. If no dose response information is available to estimate a slope for this analysis, a default slope assumption of 4.5 (with lower and upper bounds of 2 to 9) is used (Urban and Cook 1986).

Individual effect probabilities are calculated based on an Excel spreadsheet tool IECV1.1 (Individual Effect Chance Model Version 1.1) developed by the U.S. EPA, OPP, Environmental Fate and Effects Division (June 22, 2004). The model allows for such calculations by entering the mean slope estimate (and the 95% confidence bounds of that estimate) as the slope parameter for the spreadsheet. The desired threshold for the probability of an individual effect is entered as the listed species LOC. In addition, the probability of an individual effect is also derived based on the calculated acute RQ, if available.

As shown in **Table 5.2**, the probability for acute direct effects (*i.e.*, mortality or immobilization) to individual listed fish and invertebrates at the listed species LOC ranges from 1 in 373 (2.68E-03%) for estuarine/marine molluscs to 1 in 4.18E+8 (2.39E-09%) for freshwater fish, estuarine/marine fish, and estuarine/marine invertebrates. However, at the highest derived RQ values for the proposed new uses of boscalid, the chances of an individual effect increase for estuarine/marine molluscs to approximately 8% and for freshwater fish to 9.11E-07%. RQs are not available for freshwater invertebrates, estuarine/marine fish, or estuarine/marine invertebrates.

Table 5.2. Summary of Boscalid Probit Dose Response Analysis for Listed Species.

Taxa (study type)	Acute Effect Slope (95% C.I.)	Chance of Individual Effect at Listed Species LOC (95% C.I.)	Chance of Individual Effect at Derived Acute RQ[1] (95% C.I.)
Bird oral dose	No mortality observed	Not calculated; no mortality observed	Not calculated; no mortality observed
Bird dietary	No mortality observed	Not calculated; no mortality observed	Not calculated; no mortality observed
Mammal oral dose	No mortality observed	Not calculated; no mortality observed	Not calculated; no mortality observed
Freshwater fish	Mortality, Lethargy, Convulsions Slope NA = 4.5 (2 – 9)	1 in 4.18E+08 (1 in 216 to 1 in 1.75E+31)	1 in 1.10E+06 (1 in 59 to 1 in 1.46E+21)
Freshwater invertebrate	NA	NA	Not calculated; RQs not derived
Estuarine/marine fish	Mortality Slope NA = 4.5 (2 – 9)	1 in 4.18E+08 (1 in 216 to 1 in 1.75E+31)	Not calculated; RQs not derived
Estuarine/marine invertebrate (non-mollusc)	Mortality Slope NA = 4.5 (2 – 9)	1 in 4.18E+08 (1 in 216 to 1 in 1.75E+31)	Not calculated; RQs not derived
Estuarine/marine mollusc	Shell deposition Slope = 2.14 (0.89 – 3.39)	1 in 373 (1 in 8.10 to 1 in 1.94E+05)	1 in 11.6 (1 in 3.51 to 1 in 65.6)

[1] Maximum Acute RQs = 0.087 (for freshwater fish); 0.044 (for freshwater invertebrates); and 0.230 (for estuarine/marine molluscs).
[NA] Not available.

5.2.2. Listed Species Occurrence Associated with New Boscalid Uses

A preliminary analysis of the co-occurrence of listed species and the proposed new uses of boscalid was conducted using OPP's LOCATES database (v. 2.10.4). The goal of the analysis for co-location is to determine whether sites of pesticide use are geographically associated with known locations of listed species. The objective is to provide insight into the potential for exposure of listed species and to identify those areas, crop uses, and listed species that warrant further attention. The LOCATES database uses location information for listed species at the county level and compares it to agricultural census data (from 2002) for crop production at the same county level of resolution. The product is a listing of federally-listed species that are located within counties known to produce the crops upon which the pesticide will be used. **Appendix H** provides a species listing by State for those listed species that may potentially be impacted by the proposed new uses of boscalid.

A tabulation of the number of unique listed species in each state that may co-occur with the proposed new uses of boscalid on alfalfa and citrus is provided in **Table 5.3**. With respect to predicted risks for terrestrial invertebrates, it is assumed that indirect effects could occur to insectivorous mammals and birds as well as terrestrial plants (monocots and dicots) that require terrestrial insects for pollination and/or seed dispersal. In addition piscivorous mammals and birds may be indirectly affected based on direct effects to freshwater fish and invertebrates and estuarine/marine invertebrates. However, LOCATES does not currently differentiate between different feeding guilds of mammals and birds and/or identify those plant species that require terrestrial insects for pollination. Therefore, the number of potentially affected listed mammals,

birds, dicots, and monocots may be overestimated and include species that are not likely to be indirectly affected because they do not rely on terrestrial invertebrates or aquatic food items and/or require terrestrial insects for pollination or seed dispersal.

Based the results of the LOCATES database query, there are a total of 1,851 listed species from all taxa associated with counties where boscalid may potentially be used nationwide for alfalfa and citrus. It is expected that the actual total number of potentially affected listed species would be less than 1,851 because there are redundancies where a given species is listed in more than one state. A total of 50 states have listed species associated with alfalfa and citrus crops where boscalid may be used. Hawaii has the highest number (307) of listed species that may co-occur with the proposed boscalid uses on alfalfa and citrus, followed by California (282), Florida (93) and Texas (86).

This preliminary analysis indicates that there is a potential for boscalid use to overlap with listed species and that a more refined assessment is warranted. The more refined assessment should involve clear delineation of the action area associated with proposed uses of boscalid and the best available information on the temporal and spatial co-location of listed species with respect to the action area. This analysis has not been conducted for this assessment.

Table 5.3. Tabulation by State and Taxonomic Group of Listed Species that Occur in Boscalid Use Areas for Alfalfa and Citrus.

State	Amphibians	Aquatic Mammal	Birds	Bivalve	Crustacean	Dicot	Ferns	Fish	Invertebrates	Mammal	Monocot	Reptiles	Total per State
Alabama	2	-	3	30	1	10	3	15	-	4	3	4	75
Alaska	-	1	-	-	-	-	1	-	-	-	-	-	2
Arizona	2	-	6	-	-	16	-	19	1	8	2	2	56
Arkansas	-	-	2	6	2	4	-	3	2	3	-	-	22
California	6	2	15	-	8	159	-	23	24	20	17	8	282
Colorado	-	-	2	-	-	12	-	5	1	1	1	1	23
Connecticut	-	-	2	1	-	1	-	1	1	1	1	1	9
Delaware	-	-	1	-	-	-	-	1	-	1	2	1	6
Florida	1	1	8	7	1	47	4	-	1	10	3	10	93
Georgia	1	1	4	16	-	11	2	11	1	3	6	2	58
Hawaii	-	-	32	-	1	233	12	-	4	1	22	2	307
Idaho	-	-	1	-	-	3	-	4	5	3	-	-	16
Illinois	-	-	2	7	1	7	-	1	3	2	2	-	25
Indiana	-	-	2	11	-	4	-	-	2	2	2	1	24
Iowa	-	-	2	2	-	3	1	2	1	1	2	-	14
Kansas	-	-	3	-	-	1	-	4	1	2	1	-	12
Kentucky	-	-	6	22	1	10	-	5	1	4	-	-	49
Louisiana	-	1	5	4	-	2	1	2	-	1	-	7	23
Maine	-	-	2	-	-	1	-	2	-	1	2	-	8
Maryland	-	-	1	1	-	4	-	2	2	2	2	1	15
Massachusetts	-	-	2	-	-	1	-	1	3	1	2	2	12
Michigan	-	-	2	2	-	4	1	-	4	2	3	1	19
Minnesota	-	-	1	2	-	2	-	1	1	1	2	-	10

State	Amphibians	Aquatic Mammal	Birds	Bivalve	Crustacean	Dicot	Ferns	Fish	Invertebrates	Mammal	Monocot	Reptiles	Total per State
Mississippi	1	-	5	9	-	2	1	3	-	3	-	7	31
Missouri	-	-	2	6	1	7	-	7	3	2	1	-	29
Montana	-	-	3	-	-	2	-	3	-	2	-	-	10
Nebraska	-	-	3	-	-	2	-	2	1	1	1	-	10
Nevada	-	-	2	-	-	8	-	-	1	1	1	-	13
New Hampshire	-	-	-	1	-	1	-	-	1	1	1	-	5
New Jersey	-	-	2	-	-	2	-	1	-	1	1	1	8
New Mexico	1	-	6	-	2	13	-	13	5	4	-	1	45
New York	-	-	2	1	-	4	1	1	2	1	1	1	14
North Carolina	-	1	4	8	-	21	4	-	6	5	5	5	59
North Dakota	-	-	3	-	-	-	-	1			1	-	5
Ohio	-	-	1	6	-	4	-	1	4	2	2	2	22
Oklahoma	-	-	6	2	-	-	-	4	1	3	2	-	18
Oregon	-	-	4	-	1	12	-	12	2	1	2	-	34
Pennsylvania	-	-	1	2	-	-	-	-	-	2	2	1	8
Rhode Island	-	-	1	-	-	1	-	1	1	1	1	-	6
South Carolina	1	3	4	1	-	12	1	1	-	2	6	5	36
South Dakota	-	-	3	-	-	-	-	2	1	1	1	-	8
Tennessee	-	-	3	38	1	17	1	16	4	4	2	-	86
Texas	4	-	12	-	1	27	-	9	20	5	3	6	87
Utah	-	-	2	-	-	22	-	8	-	2	2	1	37
Vermont	-	-	-	1	-	1	-	-	-	1	1	-	4
Virginia	1	-	2	21	2	13	-	7	3	4	4	1	58
Washington	-	-	4	-	-	7	-	4	1	4	-	-	20
West Virginia	1	-	-	5	-	4	-	-	1	4	1	-	16
Wisconsin	-	-	3	2	-	4	-	-	2	1	2	-	14
Wyoming	1	-	-	-	-	2	-	2	-	3	-	-	8
Total Number of Species	22	10	182	214	23	723	33	200	117	135	118	74	1851

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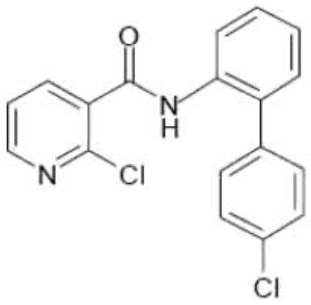
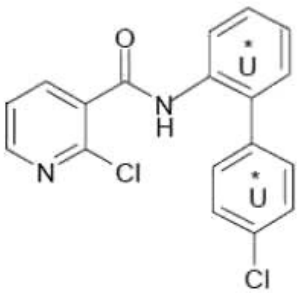
Appendix A. Chemical Names and Structures of Boscalid and its Degradates

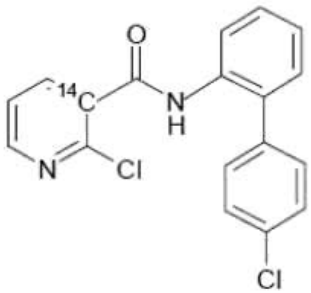
IUPAC Name: **2-chloro-N-(4'-chlorobiphenyl-2-yl)-nicotinamide**
CAS Name: **2-chloro-N-(4'-chloro[1,1-biphenyl-2-yl)-3-pyradinecarboxamide**
CAS Number: **188425-85-6**
Synonyms: **2-chloro-N-(4'-chlorobiphenyl-2-yl)-nicotinamide, BAS 510 F, boscalid, nicobifen**



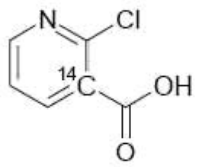
[Diphenyl-U-^{14}C]-labeled BAS 510 F



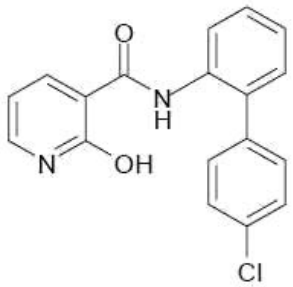
[Pyridine-3-^{14}C]-labeled BAS 510 F



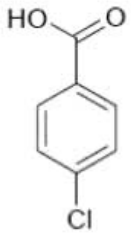
M510F47 2-chloronicotinic acid-[pyridine-3-^{14}C]



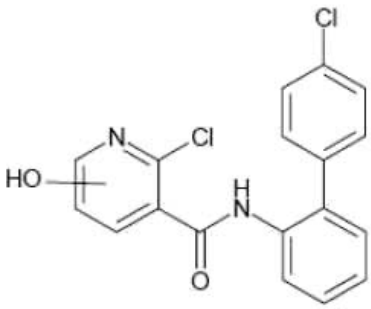
M510F49 (2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotonamide)



M510F64 (*p*-chloro-benzoic acid)



M510F50 Unknown 2



Appendix B. PRZM/EXAMS Input Files and Sample Input/Output Data

PRZM/EXAMS Input Filenames

Electronic files available as a compressed attachment.

Pristine Alfalfa	**Endura Alfalfa**	**Pristine Citrus**
Surface Water	*Surface Water*	*Surface Water*
MNalfaA1	MNalfaA2	FLcitrAR
MNalfaG1	MNalfaG2	FLcitrGR
Benthic Segment	*Benthic Segment*	*Benthic Segment*
MNalfaA1ben	MNalfaA2ben	FLcitrARben
MNalfaG1ben	MNalfaG2ben	FLcitrGRben

PRZM and EXAMS Sample Input/Output Data for Aerial Application Adjacent to the Standard Farm Pond.

stored as MNalfaA1.out
Chemical: Boscalid
PRZM environment: MNalfalfaOP.txt modified Tueday, 26 August 2008 at 06:16:46
EXAMS environment: pond298.exv modified Tueday, 26 August 2008 at 06:14:08
Metfile: w14914.dvf modified Tueday, 26 August 2008 at 06:15:16
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	2.664	2.62	2.489	2.315	2.225	1.014
1962	5.489	5.431	5.227	5.068	4.963	3.516
1963	8.644	8.553	8.235	7.785	7.588	5.956
1964	11.25	11.19	10.98	10.710.63	8.976	
1965	13.81	13.75	13.56	13.35	13.34	12.09
1966	16.03	15.98	15.88	15.715.57	14.28	
1967	17.19	17.15	17	16.78	16.72	15.98
1968	18.58	18.53	18.38	18.15	18.1	17.35
1969	24.04	23.91	23.52	22.94	22.69	20.41
1970	27.16	27.05	26.67	26.12	25.89	23.62
1971	29.15	29.1	28.99	28.81	28.71	26.68
1972	30.54	30.49	30.34	30.16	30.07	29.23
1973	34.18	34.09	33.8	33.39	33.2	31.12
1974	39.6	39.43	38.85	38.03	37.75	34.98
1975	42.13	42.03	41.54	41.240.99	38.88	
1976	41.6	41.56	41.39	41.18	41.1	40.53
1977	47.46	47.31	46.79	46.46	46.26	44.08
1978	49.37	49.3	49.04	48.67	48.54	47.25
1979	51.81	51.76	51.59	51.34	50.98	49.72
1980	54.57	54.48	54.18	53.77	53.59	51.99

1981	55.62	55.56	55.33	55.07	54.96	53.99
1982	61.13	60.96	60.37	59.54	59.04	55.98
1983	60.53	60.46	60.21	59.99	59.9	58.94
1984	63.58	63.49	63.22	62.78	62.37	60.54
1985	64.52	64.46	64.25	63.96	63.8	62.84
1986	66.41	66.36	66.17	65.94	65.89	64.67
1987	67.53	67.46	67.22	66.97	66.82	66.01
1988	69.33	69.25	68.99	68.59	68.42	67.08
1989	72.22	72.12	71.79	71.31	71.09	69.36
1990	72.24	72.18	71.97	71.82	71.71	70.99

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	72.24	72.18	71.97	71.82	71.71	70.99
0.0645161290322581	72.22	72.12	71.79	71.31	71.09	69.36
0.0967741935483871	69.33	69.25	68.99	68.59	68.42	67.08
0.129032258064516	67.53	67.46	67.22	66.97	66.82	66.01
0.161290322580645	66.41	66.36	66.17	65.94	65.89	64.67
0.193548387096774	64.52	64.46	64.25	63.96	63.8	62.84
0.225806451612903	63.58	63.49	63.22	62.78	62.37	60.54
0.258064516129032	61.13	60.96	60.37	59.99	59.9	58.94
0.290322580645161	60.53	60.46	60.21	59.54	59.04	55.98
0.32258064516129	55.62	55.56	55.33	55.07	54.96	53.99
0.354838709677419	54.57	54.48	54.18	53.77	53.59	51.99
0.387096774193548	51.81	51.76	51.59	51.34	50.98	49.72
0.419354838709677	49.37	49.3	49.04	48.67	48.54	47.25
0.451612903225806	47.46	47.31	46.79	46.46	46.26	44.08
0.483870967741936	42.13	42.03	41.54	41.241.1	40.53	
0.516129032258065	41.6	41.56	41.39	41.18	40.99	38.88
0.548387096774194	39.6	39.43	38.85	38.03	37.75	34.98
0.580645161290323	34.18	34.09	33.8	33.39	33.2	31.12
0.612903225806452	30.54	30.49	30.34	30.16	30.07	29.23
0.645161290322581	29.15	29.1	28.99	28.81	28.71	26.68
0.67741935483871	27.16	27.05	26.67	26.12	25.89	23.62
0.709677419354839	24.04	23.91	23.52	22.94	22.69	20.41
0.741935483870968	18.58	18.53	18.38	18.15	18.1	17.35
0.774193548387097	17.19	17.15	17	16.78	16.72	15.98
0.806451612903226	16.03	15.98	15.88	15.715.57	14.28	
0.838709677419355	13.81	13.75	13.56	13.35	13.34	12.09
0.870967741935484	11.25	11.19	10.98	10.710.63	8.976	
0.903225806451613	8.644	8.553	8.235	7.785	7.588	5.956
0.935483870967742	5.489	5.431	5.227	5.068	4.963	3.516
0.967741935483871	2.664	2.62	2.489	2.315	2.225	1.014
0.1	69.15	69.071	68.813	68.428	68.26	66.973

Average of yearly averages: 38.2684

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:
Output File: MNalfaA1

Metfile:	w14914.dvf			
PRZM scenario:	MNalfalfaOP.txt			
EXAMS environment file:	pond298.exv			
Chemical Name:	Boscalid			
Description	Variable Name	Value	Units	Comments

Molecular weight	mwt	343.2	g/mol	
Henry's Law Const.	henry		atm-m^3/mol	
Vapor Pressure	vapr	7.5E-8	Torr	
Solubility	sol	6	mg/L	
Kd	Kd		mg/L	
Koc	Koc	772	mg/L	
Photolysis half-life	kdp	0	days	Half-life
Aerobic Aquatic Metabolism	kbacw	4146	days	Halfife
Anaerobic Aquatic Metabolism	kbacs	0	days	Halfife
Aerobic Soil Metabolism	asm	2073	days	Halfife
Hydrolysis:	pH 5	0	days	Half-life
Hydrolysis:	pH 7	0	days	Half-life
Hydrolysis:	pH 9	0	days	Half-life
Method:	CAM	2	integer	See PRZM manual
Incorporation Depth:	DEPI		cm	
Application Rate:	TAPP	0.314	kg/ha	
Application Efficiency:	APPEFF	0.95	fraction	
Spray Drift	DRFT	0.05	fraction of application rate applied to pond	
Application Date	Date	14-06	dd/mm or dd/mmm or dd-mm or dd-mmm	
Interval 1	interval	14	days	Set to 0 or delete line for single app.
app. rate 1	apprate	0.314	kg/ha	
Interval 2	interval	28	days	Set to 0 or delete line for single app.
app. rate 2	apprate	0.314	kg/ha	
Record 17:	FILTRA			
	IPSCND	2		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0.5		
Flag for Index Res. Run	IR	EPA Pond		
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)	

Appendix C. Example T-REX Input and Output for Boscalid

Table C.1. Avian Dose- and Dietary-based Upper Bound Kenaga EECs Based on the Proposed New Use of Boscalid (Endura) for Alfalfa. Acute RQs were not calculated [NC] because non-definitive toxicity endpoints exist for birds.

Summary of Risk Quotient Calculations Based on Upper Bound Kenaga EECs

Table X. Upper Bound Kenaga, Acute Avian Dose-Based Risk Quotients

Size Class (grams)	Adjusted LD50	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
20	1440.86	305.99	0.21	140.24	0.10	172.12	0.12	19.12	0.01	4.25	0.00
100	1834.29	174.49	0.10	79.97	0.04	98.15	0.05	10.91	0.01	2.42	0.00
1000	2591.00	78.12	0.03	35.81	0.01	43.94	0.02	4.88	0.00	1.09	0.00

Table X. Upper Bound Kenaga, Subacute Avian Dietary Based Risk Quotients

	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
LC50	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
.	268.67	#####	123.14	#####	151.13	######	16.79	#####

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Avian Dietary Based Risk Quotients

	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
NOAEC (ppm)	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
300	268.67	0.90	123.14	0.41	151.13	0.50	16.79	0.06

Size class not used for dietary risk quotients

Table C.2. Mammalian Dose- and Dietary-based Upper Bound Kenaga EECs Based on the Proposed New Use of Boscalid (Endura) for Alfalfa. Acute RQs were not calculated [NC] because non-definitive toxicity endpoints exist for mammals.

Table X. Upper Bound Kenaga, Acute Mammalian Dose-Based Risk Quotients

Size Class (grams)	Adjusted LD50	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	10989.15	256.16	0.02	117.41	0.01	144.09	0.01	16.01	0.00	3.56	0.00
35	8891.40	177.04	0.02	81.14	0.01	99.58	0.01	11.06	0.00	2.46	0.00
1000	3845.80	41.05	0.01	18.81	0.00	23.09	0.01	2.57	0.00	0.57	0.00

Table X. Upper Bound Kenaga, Acute Mammalian Dietary Based Risk Quotients

LC50 (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
.	268.67	######	123.14	######	151.13	#######	16.79	######

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dietary Based Risk Quotients

NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
100	268.67	2.69	123.14	1.23	151.13	1.51	16.79	0.17

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dose-Based Risk Quotients

Size Class (grams)	Adjusted NOAEL	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	24.62	256.16	10.41	117.41	4.77	144.09	5.85	16.01	0.65	3.56	0.14
35	19.92	177.04	8.89	81.14	4.07	99.58	5.00	11.06	0.56	2.46	0.12
1000	8.61	41.05	4.76	18.81	2.18	23.09	2.68	2.57	0.30	0.57	0.07

Appendix D. Example Terrplant (v. 1.2.2) Input and Output for Boscalid

TerrPlant v. 1.2.2
Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	**Boscalid**
PC code	**128008**
Use	**Fungicide**
Application Method	**Aerial spray**
Application Form	**Wettable granule**
Solubility in Water (ppm)	**4.64**

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**0.28**	**lbs a.i./A**
Incorporation	I	**1**	none
Runoff Fraction	R	**0.01**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for Boscalid. Units in lb a.i./A.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.0028
Runoff to semi-aquatic areas	(A/I)*R*10	0.028
Spray drift	**A*D**	**0.014**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.0168**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.042**

Table 4. Plant survival and growth data used for RQ derivation. Units are in lb a.i./A.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**0.576**	**0.275**	**0.626**	**0.0351**
Dicot	**0.44**	**0.275**	**x**	**x**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Boscalid through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.1	<0.1	<0.1
Monocot	listed	<0.1	0.15	<0.1
Dicot	non-listed	<0.1	<0.1	<0.1
Dicot	listed	<0.1	0.15	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Appendix E. Classifications of Environmental Fate Studies Submitted for Boscalid

MRID	Study Type	Review Classification	Classification Justifications (for Supplemental and Unacceptable Studies)
45405205	161-1	Acceptable	
45405206	161-2	Acceptable	
45405207	161-3	Acceptable	
45405208	162-1	Supplemental	Foreign soil, high moisture content, no replicates for degradates, combined data from 2 radiolabel studies to determine half-life of parent compound.
45405209	162-1	Supplemental	Info on degradate, 2-chloronicotinic acid only
45405210	162-1	Unacceptable	Half-lives were extrapolated beyond range of data and no replicates. Interim report samples will be up to 360 days post treatment.
45643802	162-1	Acceptable	Replicate data not obtained for all sampling intervals to determine variability
46715226	162-1	Supplemental	Not stated that samples incubated in darkness and material balance decreased steadily during study. Info on deg chloronicotinic acid and not parent
45405211	162-2	Unacceptable	Half-lives were extrapolated beyond range of data and no replicates. Incorrect application prep protocol. Foreign soil, not analyzed by phase but whole system. Study not required because acceptable anaerobic aquatic metabolism study has been submitted (MRID 45405213)
45405212	162-2	Unacceptable	Half-lives were extrapolated beyond range of data and no replicates. Incorrect application prep protocol. Foreign soil, not analyzed by phase but whole system. Study not required because acceptable anaerobic aquatic metabolism study has been submitted (MRID 45405213)
45405213	162-3	Acceptable	
45405214	162-4	Supplemental	System was flooded and incubated prior to treatment with parent. Should be done simultaneously. Foreign soil. Compound was stable and provides useful info. Additional study was not required at that time.
45405216	163-1	Supplemental	Material balances not reported for all test concentrations.
45405217	163-1	Supplemental	Material balances not reported for all test concentrations.
45405218	164-1	Supplemental	Major degradate from aerobic metabolism study not monitored
45405219	164-1	Acceptable	
45405220	164-1	Acceptable	
45405221	164-1	Acceptable	Note data variability at both sites makes reported DT50s of questionable value
45405222	164-1	Supplemental	Foreign study site. Half-lives at all 3 sites are questionable due to temporal and inter-replicate data variability at all sites and insufficient sampling intervals.
45405215	164-2	Unacceptable	Experimental design flaws. No mass balance at several intervals. Foreign soil.
45405007	165-4	Acceptable	

Appendix F. Classifications of Ecological Effects Studies Cited in the New Use Assessment for Boscalid

Guideline	MRID	Study Title	Issues	Study Classification
72-1c	454049-27	BAS 510 F, Acute Toxicity Study on the Rainbow Trout (*Oncorhynchus mykiss* Walbaum 1792) in a Static System (96 hours).	No measured concentrations.	Supplemental
72-1a	454049-28	Acute toxicity Study on the bluegill, (Lepomis macrochirus RAF) in a static system (96 hours).	Water quality; uncertainty with measured concentrations.	Supplemental
72-4a	454050-06	BAS 510 F - Early Life-Stage Toxicity Test on the Rainbow Trout (*Oncorhynchus mykiss* WALBAUM 1792)	Water quality; uncertainty with measured concentrations.	Supplemental
72-2	454050-01	Effect of BAS 510 F on the Immobility of *Daphnia magna* STRAUS In a 48 Hour Static, Acute Toxicity Test.	Precipitate not filtered/centrifuged; water quality; uncertainty with measured concentrations.	Supplemental
72-4b (850.1300)	463514-06	Determination of the Chronic Effect on the Reproduction of the Waterflea *Daphnia magna* STRAUS.	Use of a solvent and treatment of water samples not specified.	Acceptable
N/A	454050-09	Acute Toxicity of BAS 510 F in Whole Sediment to the Amphipod, *Hyalella azteca*.	Non-guideline species; boscalid recoveries varied susbtantially based on analytical method; solvent controls sig. different from negative controls.	Supplemental
850.1735	454050-08	Effects of BAS 510 F on the Development of Sediment Dwelling Larvae *Chironomus riparius* in a Water-Sediment System.	Non-guideline species; sediment not spiked; measured concentrations not provided.	Supplemental
72-3	454050-04	Flow-Through Acute Toxicity of BAS 510 F to the Sheepshead Minnow, *Cyprinodon variegatus*.	Ratio of highest concentration tested to EEC not high enough to evaluate risk to listed species.	Acceptable
72-3b	454050-02	Flow-Through Acute Toxicity of BAS 510 F to the Mysid, *Americamysis bahia*.	Ratio of highest concentration tested to EEC not high enough to evaluate risk to listed species.	Acceptable
72-3c	454050-03	Flow-Through Mollusc Shell Deposition Test with BAS 510 F.	NA	Acceptable
123-2	454050-13	BAS 510 F: A 7-Day Toxicity Test with Duckweed (*Lemna gibba* G3).	NA	Acceptable

Guideline	MRID	Study Title	Issues	Study Classification
123-2	454050-17	Effect of BAS 510 F on the Growth of the Green Alga *Pseudokirchneriella subcapitata.*	Study conditions poorly described.	Supplemental
71-1a	454049-22	BAS 510 F - Avian Single-Dose Oral LDS0 On the Bobwhite Quail *(Colinus virginianus).*	NA	Acceptable
71-2a	454049-23	BAS 510 F – Avian Dietary LC50 Test In Chicks of the Bobwhite Quail *(Colinus virginianus).*	Poor rearing conditions; small sample size.	Supplemental
71-2b	454049-24	BAS 510 F - Avian Dietary LC50 Test in Chicks of the Mallard Duck *(Anas platyrhynchos L.).*	Poor rearing conditions; small sample size.	Supplemental
71-4	454049-25	BAS 510 F - I-Generation Reproduction Study On the Bobwhite quail (*Colinus virginianus*) By Administration in the Diet.	NA	Acceptable
71-4	454049-26	BAS 510 F - I-Generation Reproduction Study On the Mallard Duck *(Anas platyrhynchos L.)* By Administration in the Diet.	NA	Acceptable
81-1 (870.1100)	454048-14	BAS 510 F: Acute Oral Toxicity in Rats.	NA	Acceptable
83-4 (870.3800)	454049-06	BAS 510 F Two Generation Toxicity Study in Wistar Rats Continuous Dietary Administration.	NA	Acceptable
Non-Guideline (141-1 oral or 850.3020 contact)	454050-19	Effect of Reg. No. 300 355 (BAS 510 F) on the Honeybee (*Apis mellifera* L.) in Laboratory Trials.	NA	Acceptable
850.6200	454050-20	Acute Toxicity (14 Days) of BASF 510F to the Earthworm *Eisenia fetida* (Savigny 1826) in Artificial Soil.	Insufficient acclimation period; measured concentrations and stability unreported; 28-day study recommended.	Supplemental
850.4225	476274-01	BAS 510 04 F - Seedling Emergence Test Following U.S. EPA OPPTS Draft Guidelines 850.4100 and 850.4225.	No measured concentrations.	Acceptable
850.4250	476274-02	BAS 510 04 F – Vegetative Vigor Test Following U.S. EPA OPPTS Draft Guidelines 850.4150 and 850.4250.	Concentrations too high to establish definitive endpoints for cabbage (dicot).	Supplemental

Appendix G. Results of Terrestrial Field Dissipation Studies for Boscalid

MRID	Soil Textnre	Target App. Rate[1]	Site	Plot type	DT_{50} in days	Max. Leaching Depth (Parent)	Major Degradates & Max. Leaching Depth	Residne Carryover (as % of applied)	App. Type/ Formnlation
45405218	sandy loam	label rate[1]	GA	bare gronnd	264	15–30 cm	none detected[3]	18.5	broadcast/WG
45405218	sandy loam	label rate[1]	GA	peach	282	7.5–15 cm	none detected[3]	6.2	airblast/WG
45405218	sandy loam	label rate[1]	CA	bare gronnd	150	30–45 cm	none detected[3]	20.2	broadcast/WG
45405218	sandy loam	label rate[1]	CA	almond	>360	15–30 cm[2]	none detected[3]	16.9	airblast/WG
45405218	loamy sand	label rate[1]	NY	bare gronnd (in grape orchard)	356	7.5–15 cm	none detected[3]	33.1	broadcast/WG
45405219	loam	label rate[4]	NJ	bare gronnd	108; 300[5]	30–45 cm	M510F49[6] (0–7.5 cm)	15.6	broadcast/WG
45405219	loam	label rate[4]	NJ	tnrf	44	0–15 cm	M510F49[6] (0–7.5 cm); M510F47[6] (0–7.5 cm)	11.8	broadcast/WG
45405219	silty loam	label rate[4]	IL	bare gronnd	244; 307[5]	7.5–15 cm	M510F49[6] (0–7.5 cm); M510F47[6] (0–7.5 cm[2])	16.7	broadcast/WG
45405219	silty loam	label rate[4]	IL	tnrf	155	15–30 cm	M510F49[6] (0–7.5 cm); M510F47[6] (0–7.5 cm)	20.1	broadcast/WG
45405219	sandy loam	label rate[4]	TX	bare gronnd	143	7.5–15 cm	M510F49[6] (0–7.5 cm); M510F47[6] (0–7.5 cm)	21	broadcast/WG
45405219	sandy loam	label rate[4]	TX	tnrf	108; 194[5]	0–15 cm	M510F49[6] (0–7.5 cm); M510F47[6] (0–7.5 cm)	9.1	broadcast/WG
45405220	fine sandy loam	label rate[7]	CA	bare gronnd	289[8] (half-life)	7.5–15 cm	M510F49[6] (0–7.5 cm); M510F47[6] (7.5–15 cm[2])	19.9	broadcast/WG
45405220	loam	label rate[7]	ID	bare gronnd	333	7.5–15 cm	M510F49[6] (0–7.5 cm); M510F47 (0–7.5 cm)	52.3	broadcast/WG

MRID	Soil Textnre	Target App. Rate[1]	Site	Plot type	DT_{50} in days	Max. Leaching Depth (Parent)	Major Degradates & Max. Leaching Depth	Residne Carryover (as % of applied)	App. Type/ Formnlation
45405220	fine sand	label rate[7]	FL	bare gronnd	27	30–45 cm	M510F49[6] (0–7.5 cm)	11.9	broadcast/WG
45405221	silty clay loam	label rate[10]	ND	bare gronnd	19	0–7.5 cm (single detect. at 7.5–15 cm)	M510F47[6] (0–7.5 cm)	13.4	broadcast/WG
45405220	fine sand	label rate[7]	FL	bare gronnd	27	30–45 cm	M510F49[6] (0–7.5 cm)	11.9	broadcast/WG
45405221	silty clay loam	label rate[10]	ND	bare gronnd	19	0–7.5 cm (single detect. at 7.5–15 cm)	M510F47[6] (0–7.5 cm)	13.4	broadcast/WG
45405221	loam	label rate[10]	CO	bare gronnd	119	7.5–15 cm	M510F49[6] (7.5–15 cm); M510F47 (7.5–15 cm)	24.2	broadcast/WG
45405222	loam[11]	label rate[10]	CAN Ont.	bare gronnd	30	7.5–15 cm	M510F49[6] (0–7.5 cm); M510F47 (0–7.5 cm)	19.8	broadcast/WG
45405222	silt loam[11]	label rate[10]	CAN Man.	bare gronnd	316	7.5–15 cm	M510F47[6] (7.5–15 cm[12])	31.4	broadcast/WG
45405222	loam[11]	label rate[10]	CAN Alb.	bare gronnd	372	0–7.5 cm	M510F49[6] (0–7.5 cm); M510F47 (0–7.5 cm)	48.8	broadcast/WG

[1]Reported label rate = 0.26 kg a.i/ha (applic. 1-3) and 0.40 kg a.i./ha (applic. 4-6); 7-day application intervals. [2]Only detected at this depth at a single sampling interval. [3]The degradate 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (M510F49; BAS No. 391572) was not monitored in these field stndies. [4]Reported label rate = 0.30 kg a.i/ha (applications 1-3) and 0.39 kg a.i./ha (applications 4-6); 14-day application intervals. [5]Respective DT_{50}'s determined nsing non-linear and polynomial models. [6] M510F49 = 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)nicotinamide; M510F47 = 2-chloronicotinic acid. [7] Reported label rate = 0.41 kg a.i/ha (applications 1-4) and 0.62 kg a.i./ha (applications 5-6); 7-day application intervals. [8]The DT_{50} of 76.5 days is qnestionable dne to data variability; the half-life is considered more representative of the observed dissipation. [9]The DT_{50} is of qnestionable valne dne to data variability. [10]Reported label rate = 0.56 kg a.i/ha (2 applic.); 5- to 7-day application intervals. [11]Reported textnral class is for the top 0-15 cm layer. [12]Was only detected at a single sampling interval in each of the top two depths.

Appendix H. LOCATES Output of Listed Species

THREATENED AND ENDANGERED SPECIES LISTING BY STATE WITH USE CRITERIA

No species were excluded
Minimum of 1 Acre.
Alfalfa, alfalfa hay and forage, and citrus crop Group 10

Alabama (86) species:		**Taxa**	Critical Habitat
Salamander, Flatwoods	T	Amphibian	No
(Ambystoma cingulatum)		Terrestrial, Freshwater, Vernal pool	
Salamander, Red Hills	T	Amphibian	No
(Phaeognathus hubrichti)		Terrestrial, Freshwater	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Stork, Wood	E	Bird	No
(Mycteria americana)		Terrestrial	
Woodpecker, Red-cockaded	E	Bird	No
(Picoides borealis)		Terrestrial	
Combshell, Southern (=Penitent mussel)	E	Bivalve	No
(Epioblasma penita)		Freshwater	
Combshell, Upland	E	Bivalve	Yes
(Epioblasma metastriata)		Freshwater	
Kidneyshell, Triangular	E	Bivalve	Yes
(Ptychobranchus greenii)		Freshwater	
Mucket, Orangenacre	T	Bivalve	Yes
(Lampsilis perovalis)		Freshwater	
Mucket, Pink (Pearlymussel)	E	Bivalve	No
(Lampsilis abrupta)		Freshwater	
Mussel, Acornshell Southern	E	Bivalve	Yes
(Epioblasma othcaloogensis)		Freshwater	
Mussel, Alabama Moccasinshell	T	Bivalve	Yes
(Medionidus acutissimus)		Freshwater	
Mussel, Coosa Moccasinshell	E	Bivalve	Yes
(Medionidus parvulus)		Freshwater	
Mussel, Cumberland Combshell	E	Bivalve	Yes
(Epioblasma brevidens)		Freshwater	
Mussel, Dark Pigtoe	E	Bivalve	Yes
(Pleurobema furvum)		Freshwater	
Mussel, Fine-lined Pocketbook	T	Bivalve	Yes
(Lampsilis altilis)		Freshwater	
Mussel, Fine-rayed Pigtoe	E	Bivalve	No
(Fusconaia cuneolus)		Freshwater	
Mussel, Flat Pigtoe (=Marshall's Mussel)	E	Bivalve	No
(Pleurobema marshalli)		Freshwater	
Mussel, Heavy Pigtoe (=Judge Tait's Mussel)	E	Bivalve	No
(Pleurobema taitianum)		Freshwater	
Mussel, Heelsplitter Inflated	T	Bivalve	No
(Potamilus inflatus)		Freshwater	
Mussel, Ovate Clubshell	E	Bivalve	Yes
(Pleurobema perovatum)		Freshwater	
Mussel, Ring Pink (=Golf Stick Pearly)	E	Bivalve	No
(Obovaria retusa)		Freshwater	

Alabama (86) species:		**Taxa**	Critical Habitat
Mussel, Rough Pigtoe	E	Bivalve	No
(Pleurobema plenum)		Freshwater	
Mussel, Shiny Pigtoe	E	Bivalve	No
(Fusconaia cor)		Freshwater	
Mussel, Shiny-rayed Pocketbook	E	Bivalve	No
(Lampsilis subangulata)		Freshwater	
Mussel, Southern Clubshell	E	Bivalve	Yes
(Pleurobema decisum)		Freshwater	
Mussel, Southern Pigtoe	E	Bivalve	Yes
(Pleurobema georgianum)		Freshwater	
Pearlymussel, Alabama Lamp	E	Bivalve	No
(Lampsilis virescens)		Freshwater	
Pearlymussel, Cracking	E	Bivalve	No
(Hemistena lata)		Freshwater	
Pearlymussel, Cumberland Monkeyface	E	Bivalve	No
(Quadrula intermedia)		Freshwater	
Pearlymussel, Orange-footed	E	Bivalve	No
(Plethobasus cooperianus)		Freshwater	
Pearlymussel, Pale Lilliput	E	Bivalve	No
(Toxolasma cylindrellus)		Freshwater	
Pearlymussel, Turgid-blossom	E	Bivalve	No
(Epioblasma turgidula)		Freshwater	
Pearlymussel, White Wartyback	E	Bivalve	No
(Plethobasus cicatricosus)		Freshwater	
Stirrupshell	E	Bivalve	No
(Quadrula stapes)		Freshwater	
Shrimp, Alabama Cave	E	Crustacean	No
(Palaemonias alabamae)		Freshwater	
Amphianthus, Little	T	Dicot	No
(Amphianthus pusillus)		Freshwater	
Barbara Buttons, Mohr's	T	Dicot	No
(Marshallia mohrii)		Terrestrial	
Bladderpod, Lyrate	T	Dicot	No
(Lesquerella lyrata)		Terrestrial	
Clover, Leafy Prairie	E	Dicot	No
(Dalea foliosa)		Terrestrial	
Harperella	E	Dicot	No
(Ptilimnium nodosum)		Freshwater	
Leather-flower, Alabama	E	Dicot	No
(Clematis socialis)		Terrestrial	
Leather-flower, Morefield's	E	Dicot	No
(Clematis morefieldii)		Terrestrial	
Pitcher-plant, Alabama Canebrake	E	Dicot	No
(Sarracenia rubra alabamensis)		Terrestrial, Freshwater	
Pitcher-plant, Green	E	Dicot	No
(Sarracenia oreophila)		Terrestrial, Freshwater	
Potato-bean, Price's	T	Dicot	No
(Apios priceana)		Terrestrial	
Fern, Alabama Streak-sorus	T	Ferns	No
(Thelypteris pilosa var. alabamensis)		Terrestrial	

Alabama (86) species:		**Taxa**	Critical Habitat
Fern, American hart's-tongue	T	Ferns	No
(Asplenium scolopendrium var. americanum)		Terrestrial	
Quillwort, Louisiana	E	Ferns	No
(Isoetes louisianensis)		Terrestrial, Freshwater	
Cavefish, Alabama	E	Fish	Yes
(Speoplatyrhinus poulsoni)		Freshwater	
Chub, Spotfin	T	Fish	Yes
(Erimonax monachus)		Freshwater	
Darter, Boulder	E	Fish	No
(Etheostoma wapiti)		Freshwater	
Darter, Goldline	T	Fish	No
(Percina aurolineata)		Freshwater	
Darter, Slackwater	T	Fish	Yes
(Etheostoma boschungi)		Freshwater	
Darter, Snail	T	Fish	No
(Percina tanasi)		Freshwater	
Darter, Vermilion	E	Fish	No
(Etheostoma chermocki)		Freshwater	
Darter, Watercress	E	Fish	No
(Etheostoma nuchale)		Freshwater	
Madtom, Yellowfin	T	Fish	Yes
(Noturus flavipinnis)		Freshwater	
Sculpin, Pygmy	T	Fish	No
(Cottus paulus (=pygmaeus))		Freshwater	
Shiner, Blue	T	Fish	No
(Cyprinella caerulea)		Freshwater	
Shiner, Cahaba	E	Fish	No
(Notropis cahabae)		Freshwater	
Shiner, Palezone	E	Fish	No
(Notropis albizonatus)		Freshwater	
Sturgeon, Alabama	E	Fish	No
(Scaphirhynchus suttkusi)		Freshwater	
Sturgeon, Gulf	T	Fish	Yes
(Acipenser oxyrinchus desotoi)		Freshwater, Saltwater	
Campeloma, Slender	E	Gastropod	No
(Campeloma decampi)		Freshwater	
Elimia, Lacy	T	Gastropod	No
(Elimia crenatella)		Freshwater	
Pebblesnail, Flat	E	Gastropod	No
(Lepyrium showalteri)		Freshwater	
Riversnail, Anthony's	E	Gastropod	No
(Athearnia anthonyi)		Freshwater	
Rocksnail, Painted	T	Gastropod	No
(Leptoxis taeniata)		Freshwater	
Rocksnail, Plicate	E	Gastropod	No
(Leptoxis plicata)		Freshwater	
Rocksnail, Round	T	Gastropod	No
(Leptoxis ampla)		Freshwater	
Snail, Armored	E	Gastropod	No
(Pyrgulopsis (=Marstonia) pachyta)		Freshwater	

Alabama (86) species:

		Taxa	Critical Habitat
Snail, Lioplax Cylindrical *(Lioplax cyclostomaformis)*	E	Gastropod Freshwater	No
Snail, Tulotoma *(Tulotoma magnifica)*	E	Gastropod Terrestrial	No
Bat, Gray *(Myotis grisescens)*	E	Mammal Terrestrial, Subterraneous	No
Bat, Indiana *(Myotis sodalis)*	E	Mammal Terrestrial, Subterraneous	Yes
Mouse, Alabama Beach *(Peromyscus polionotus ammobates)*	E	Mammal Terrestrial, Coastal	Yes
Mouse, Perdido Key Beach *(Peromyscus polionotus trissyllepsis)*	E	Mammal Coastal	Yes
Grass, Tennessee Yellow-eyed *(Xyris tennesseensis)*	E	Monocot Terrestrial	No
Trillium, Relict *(Trillium reliquum)*	E	Monocot Terrestrial	No
Water-plantain, Kral's *(Sagittaria secundifolia)*	T	Monocot Freshwater	No
Sea turtle, loggerhead *(Caretta caretta)*	T	Reptile Saltwater, Coastal	No
Snake, Eastern Indigo *(Drymarchon corais couperi)*	T	Reptile Terrestrial	Yes
Tortoise, Gopher *(Gopherus polyphemus)*	T	Reptile Terrestrial	No
Turtle, Alabama Red-bellied *(Pseudemys alabamensis)*	E	Reptile Terrestrial, Freshwater	No
Turtle, Flattened Musk *(Sternotherus depressus)*	T	Reptile Terrestrial, Freshwater	No

Alaska (2) species:

		Taxa	Critical Habitat
Fern, Aleutian Shield *(Polystichum aleuticum)*	E	Ferns Terrestrial	No
Otter, Northern Sea *(Enhydra lutris kenyoni)*	T	Marine mml Saltwater	No

Arizona (56) species:

		Taxa	Critical Habitat
Frog, Chiricahua Leopard *(Rana chiricahuensis)*	T	Amphibian Terrestrial, Freshwater	No
Salamander, Sonora Tiger *(Ambystoma tigrinum stebbinsi)*	E	Amphibian Terrestrial, Freshwater, Vernal pool	No
Bobwhite, Masked *(Colinus virginianus ridgwayi)*	E	Bird Terrestrial	No
Eagle, Bald *(Haliaeetus leucocephalus)*	T	Bird Terrestrial	No
Falcon, Northern Aplomado *(Falco femoralis septentrionalis)*	E	Bird Terrestrial	No
Flycatcher, Southwestern Willow *(Empidonax traillii extimus)*	E	Bird Terrestrial	Yes
Owl, Mexican Spotted *(Strix occidentalis lucida)*	T	Bird Terrestrial	Yes
Rail, Yuma Clapper *(Rallus longirostris yumanensis)*	E	Bird Terrestrial	No

Arizona	(56) species:		**Taxa**	Critical Habitat
Blue-star, Kearney's		E	Dicot	No
(Amsonia kearneyana)			Terrestrial	
Cactus, Arizona Hedgehog		E	Dicot	No
(Echinocereus triglochidiatus var. arizonicus)			Terrestrial	
Cactus, Brady Pincushion		E	Dicot	No
(Pediocactus bradyi)			Terrestrial	
Cactus, Cochise Pincushion		T	Dicot	No
(Coryphantha robbinsorum)			Terrestrial	
Cactus, Nichol's Turk's Head		E	Dicot	No
(Echinocactus horizonthalonius var. nicholii)			Terrestrial	
Cactus, Peebles Navajo		E	Dicot	No
(Pediocactus peeblesianus peeblesianus)			Terrestrial	
Cactus, Pima Pineapple		E	Dicot	No
(Coryphantha scheeri var. robustispina)			Terrestrial	
Cactus, Siler Pincushion		T	Dicot	No
(Pediocactus (=Echinocactus,=Utahia) sileri)			Terrestrial	
Cliffrose, Arizona		E	Dicot	No
(Purshia (=cowania) subintegra)			Terrestrial	
Cycladenia, Jones		T	Dicot	No
(Cycladenia jonesii (=humilis))			Terrestrial	
Fleabane, Zuni		T	Dicot	No
(Erigeron rhizomatus)			Terrestrial	
Groundsel, San Francisco Peaks		T	Dicot	Yes
(Senecio franciscanus)			Terrestrial	
Milk-vetch, Holmgren		E	Dicot	No
(Astragalus holmgreniorum)			Terrestrial	
Milk-vetch, Sentry		E	Dicot	No
(Astragalus cremnophylax var. cremnophylax)			Terrestrial	
Milkweed, Welsh's		T	Dicot	Yes
(Asclepias welshii)			Terrestrial	
Umbel, Huachuca Water		E	Dicot	Yes
(Lilaeopsis schaffneriana var. recurva)			Terrestrial, Freshwater	
Catfish, Yaqui		T	Fish	Yes
(Ictalurus pricei)			Freshwater	
Chub, Bonytail		E	Fish	Yes
(Gila elegans)			Freshwater	
Chub, Gila		E	Fish	Yes
(Gila intermedia)			Freshwater	
Chub, Humpback		E	Fish	Yes
(Gila cypha)			Freshwater	
Chub, Sonora		T	Fish	Yes
(Gila ditaenia)			Freshwater	
Chub, Virgin River		E	Fish	Yes
(Gila seminuda (=robusta))			Freshwater	
Chub, Yaqui		E	Fish	Yes
(Gila purpurea)			Freshwater	
Minnow, Loach		T	Fish	Yes
(Tiaroga cobitis)			Freshwater	
Pupfish, Desert		E	Fish	Yes
(Cyprinodon macularius)			Freshwater	

Arizona (56) species:

		Taxa	Critical Habitat
Shiner, Beautiful	T	Fish	Yes
(Cyprinella formosa)		Freshwater	
Spikedace	T	Fish	Yes
(Meda fulgida)		Freshwater	
Spinedace, Little Colorado	T	Fish	Yes
(Lepidomeda vittata)		Freshwater	
Squawfish, Colorado	E	Fish	Yes
(Ptychocheilus lucius)		Freshwater	
Steelhead	E	Fish	Yes
(Oncorhynchus (=Salmo) mykiss)		Freshwater, Brackish, Saltwater	
Sucker, Razorback	E	Fish	Yes
(Xyrauchen texanus)		Freshwater	
Topminnow, Gila (Yaqui)	E	Fish	No
(Poeciliopsis occidentalis)		Freshwater	
Trout, Apache	T	Fish	No
(Oncorhynchus apache)		Freshwater	
Trout, Gila	E	Fish	No
(Oncorhynchus gilae)		Freshwater	
Woundfin	E	Fish	Yes
(Plagopterus argentissimus)		Freshwater	
Ambersnail, Kanab	E	Gastropod	No
(Oxyloma haydeni kanabensis)		Terrestrial, Freshwater	
Bat, Lesser (=Sanborn's) Long-nosed	E	Mammal	No
(Leptonycteris curasoae yerbabuenae)		Terrestrial, Subterraneous	
Ferret, Black-footed	E	Mammal	No
(Mustela nigripes)		Terrestrial	
Jaguar	E	Mammal	No
(Panthera onca)		Terrestrial	
Jaguarundi, Sinaloan	E	Mammal	No
(Herpailurus (=Felis) yagouaroundi tolteca)		Terrestrial	
Ocelot	E	Mammal	No
(Leopardus (=Felis) pardalis)		Terrestrial	
Pronghorn, Sonoran	E	Mammal	No
(Antilocapra americana sonoriensis)		Terrestrial	
Squirrel, Mount Graham Red	E	Mammal	Yes
(Tamiasciurus hudsonicus grahamensis)		Terrestrial	
Vole, Hualapai Mexican	E	Mammal	No
(Microtus mexicanus hualpaiensis)		Terrestrial	
Ladies'-tresses, Canelo Hills	E	Monocot	No
(Spiranthes delitescens)		Terrestrial	
Sedge, Navajo	T	Monocot	Yes
(Carex specuicola)		Terrestrial	
Rattlesnake, New Mexican Ridge-nosed	T	Reptile	Yes
(Crotalus willardi obscurus)		Terrestrial	
Tortoise, Desert	T	Reptile	Yes
(Gopherus agassizii)		Terrestrial	

Arkansas (22) species:

		Taxa	Critical Habitat
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Woodpecker, Red-cockaded	E	Bird	No
(Picoides borealis)		Terrestrial	

Arkansas (22) species:

		Taxa	Critical Habitat
Fatmucket, Arkansas *(Lampsilis powelli)*	T	Bivalve Freshwater	No
Mucket, Pink (Pearlymussel) *(Lampsilis abrupta)*	E	Bivalve Freshwater	No
Mussel, Scaleshell *(Leptodea leptodon)*	E	Bivalve Freshwater	No
Mussel, Speckled Pocketbook *(Lampsilis streckeri)*	E	Bivalve Freshwater	No
Pearlymussel, Fat Pocketbook *(Potamilus capax)*	E	Bivalve Freshwater	No
Rock-pocketbook, Ouachita (=Wheeler's pm) *(Arkansia wheeleri)*	E	Bivalve Freshwater	No
Crayfish, Cave (Cambarus aculabrum) *(Cambarus aculabrum)*	E	Crustacean Freshwater	No
Crayfish, Cave (Cambarus zophonastes) *(Cambarus zophonastes)*	E	Crustacean Freshwater	No
Bladderpod, Missouri *(Lesquerella filiformis)*	T	Dicot Terrestrial	No
Fruit, Earth (=geocarpon) *(Geocarpon minimum)*	T	Dicot Terrestrial	No
Harperella *(Ptilimnium nodosum)*	E	Dicot Freshwater	No
Pondberry *(Lindera melissifolia)*	E	Dicot Terrestrial	No
Cavefish, Ozark *(Amblyopsis rosae)*	T	Fish Freshwater	No
Darter, Leopard *(Percina pantherina)*	T	Fish Freshwater	Yes
Sturgeon, Pallid *(Scaphirhynchus albus)*	E	Fish Freshwater	No
Shagreen, Magazine Mountain *(Mesodon magazinensis)*	T	Gastropod Terrestrial	No
Beetle, American Burying *(Nicrophorus americanus)*	E	Insect Terrestrial	No
Bat, Gray *(Myotis grisescens)*	E	Mammal Terrestrial, Subterraneous	No
Bat, Indiana *(Myotis sodalis)*	E	Mammal Terrestrial, Subterraneous	Yes
Bat, Ozark Big-eared *(Corynorhinus (=Plecotus) townsendii ingens)*	E	Mammal Terrestrial, Subterraneous	No

California (284) species:

		Taxa	Critical Habitat
Frog, California Red-legged *(Rana aurora draytonii)*	T	Amphibian Terrestrial, Freshwater	Yes
Frog, Mountain Yellow-legged *(Rana muscosa)*	E	Amphibian Terrestrial, Freshwater	No
Salamander, California Tiger *(Ambystoma californiense)*	E	Amphibian Terrestrial, Vernal pool	No
Salamander, Desert Slender *(Batrachoseps aridus)*	E	Amphibian Terrestrial, Freshwater	No
Salamander, Santa Cruz Long-toed *(Ambystoma macrodactylum croceum)*	E	Amphibian Terrestrial, Freshwater, Vernal pool	No

California (284) species:		**Taxa**	Critical Habitat
Toad, Arroyo Southwestern	E	Amphibian	Yes
(Bufo californicus (=microscaphus))		Terrestrial, Freshwater	
Condor, California	E	Bird	Yes
(Gymnogyps californianus)		Terrestrial	
Flycatcher, Southwestern Willow	E	Bird	Yes
(Empidonax traillii extimus)		Terrestrial	
Gnatcatcher, Coastal California	T	Bird	Yes
(Polioptila californica californica)		Terrestrial	
Murrelet, Marbled	T	Bird	Yes
(Brachyramphus marmoratus)		Terrestrial, Freshwater, Saltwater	
Owl, Northern Spotted	T	Bird	Yes
(Strix occidentalis caurina)		Terrestrial	
Pelican, Brown	E	Bird	No
(Pelecanus occidentalis)		Terrestrial	
Plover, Western Snowy	T	Bird	Yes
(Charadrius alexandrinus nivosus)		Terrestrial	
Rail, California Clapper	E	Bird	No
(Rallus longirostris obsoletus)		Terrestrial	
Rail, Light-footed Clapper	E	Bird	No
(Rallus longirostris levipes)		Terrestrial	
Rail, Yuma Clapper	E	Bird	No
(Rallus longirostris yumanensis)		Terrestrial	
Shrike, San Clemente Loggerhead	E	Bird	No
(Lanius ludovicianus mearnsi)		Terrestrial	
Sparrow, San Clemente Sage	T	Bird	No
(Amphispiza belli clementeae)		Terrestrial	
Tern, California Least	E	Bird	No
(Sterna antillarum browni)		Terrestrial	
Towhee, Inyo Brown	T	Bird	Yes
(Pipilo crissalis eremophilus)		Terrestrial	
Vireo, Least Bell's	E	Bird	Yes
(Vireo bellii pusillus)		Terrestrial	
Cypress, Gowen	T	Conf/cycds	No
(Cupressus goveniana ssp. goveniana)		Terrestrial	
Cypress, Santa Cruz	E	Conf/cycds	No
(Cupressus abramsiana)		Terrestrial	
Crayfish, Shasta	E	Crustacean	No
(Pacifastacus fortis)		Freshwater	
Fairy Shrimp, Conservancy Fairy	E	Crustacean	Yes
(Branchinecta conservatio)		Vernal pool	
Fairy Shrimp, Longhorn	E	Crustacean	Yes
(Branchinecta longiantenna)		Vernal pool	
Fairy Shrimp, Riverside	E	Crustacean	Yes
(Streptocephalus woottoni)		Vernal pool	
Fairy Shrimp, San Diego	E	Crustacean	Yes
(Branchinecta sandiegonensis)		Vernal pool	
Fairy Shrimp, Vernal Pool	T	Crustacean	Yes
(Branchinecta lynchi)		Vernal pool	
Shrimp, California Freshwater	E	Crustacean	No
(Syncaris pacifica)		Freshwater	

California (284) species:		**Taxa**	Critical Habitat
Tadpole Shrimp, Vernal Pool	E	Crustacean	Yes
(Lepidurus packardi)		Vernal pool	
Adobe Sunburst, San Joaquin	T	Dicot	No
(Pseudobahia peirsonii)		Terrestrial	
Allocarya, Calistoga	E	Dicot	No
(Plagiobothrys strictus)		Vernal pool	
Ambrosia, San Diego	E	Dicot	No
(Ambrosia pumila)		Terrestrial	
Baccharis, Encinitas	T	Dicot	No
(Baccharis vanessae)		Terrestrial	
Barberry, Island	E	Dicot	No
(Berberis pinnata ssp. insularis)		Terrestrial	
Barberry, Nevin's	E	Dicot	No
(Berberis nevinii)		Terrestrial	
Bedstraw, El Dorado	E	Dicot	No
(Galium californicum ssp. sierrae)		Terrestrial	
Bedstraw, Island	E	Dicot	No
(Galium buxifolium)		Terrestrial	
Bird's-beak, Palmate-bracted	E	Dicot	No
(Cordylanthus palmatus)		Terrestrial	
Bird's-beak, Pennell's	E	Dicot	No
(Cordylanthus tenuis ssp. capillaris)		Terrestrial	
Bird's-beak, salt marsh	E	Dicot	No
(Cordylanthus maritimus ssp. maritimus)		Saltwater	
Bird's-beak, Soft	E	Dicot	No
(Cordylanthus mollis ssp. mollis)		Brackish, Saltwater	
Bladderpod, San Bernardino Mountains	E	Dicot	Yes
(Lesquerella kingii ssp. bernardina)		Terrestrial	
Bluecurls, Hidden Lake	T	Dicot	No
(Trichostema austromontanum ssp. compactum)		Terrestrial	
Broom, San Clemente Island	E	Dicot	No
(Lotus dendroideus ssp. traskiae)		Terrestrial	
Buckwheat, Cushenbury	E	Dicot	Yes
(Eriogonum ovalifolium var. vineum)		Terrestrial	
Buckwheat, Ione (incl. Irish Hill)	E	Dicot	No
(Eriogonum apricum (incl. var. prostratum))		Terrestrial	
Buckwheat, Southern Mountain Wild	T	Dicot	Yes
(Eriogonum kennedyi var. austromontanum)		Terrestrial	
Bush-mallow, San Clemente Island	E	Dicot	No
(Malacothamnus clementinus)		Terrestrial	
Bush-mallow, Santa Cruz Island	E	Dicot	No
(Malacothamnus fasciculatus var. nesioticus)		Terrestrial	
Butterweed, Layne's	T	Dicot	No
(Senecio layneae)		Terrestrial	
Button-celery, San Diego	E	Dicot	No
(Eryngium aristulatum var. parishii)		Terrestrial	
Cactus, Bakersfield	E	Dicot	No
(Opuntia treleasei)		Terrestrial	
Ceanothus, Coyote	E	Dicot	No
(Ceanothus ferrisae)		Terrestrial	

California (284) species:		**Taxa**	Critical Habitat
Ceanothus, Pine Hill	E	Dicot	No
(Ceanothus roderickii)		Terrestrial	
Ceanothus, Vail Lake	T	Dicot	Yes
(Ceanothus ophiochilus)		Terrestrial	
Centaury, Spring-loving	T	Dicot	Yes
(Centaurium namophilum)		Terrestrial	
Checker-mallow, Keck's	E	Dicot	Yes
(Sidalcea keckii)		Terrestrial	
Checker-mallow, Kenwood Marsh	E	Dicot	No
(Sidalcea oregana ssp. valida)		Terrestrial	
Checker-mallow, Pedate	E	Dicot	No
(Sidalcea pedata)		Terrestrial	
Clarkia, Pismo	E	Dicot	No
(Clarkia speciosa ssp. immaculata)		Terrestrial	
Clarkia, Presidio	E	Dicot	No
(Clarkia franciscana)		Terrestrial	
Clarkia, Springville	T	Dicot	No
(Clarkia springvillensis)		Terrestrial	
Clarkia, Vine Hill	E	Dicot	No
(Clarkia imbricata)		Terrestrial	
Clover, Fleshy Owl's	T	Dicot	Yes
(Castilleja campestris ssp. succulenta)		Vernal pool	
Clover, Monterey	E	Dicot	No
(Trifolium trichocalyx)		Terrestrial	
Clover, Showy Indian	E	Dicot	No
(Trifolium amoenum)		Terrestrial	
Coyote-thistle, Loch Lomond	E	Dicot	No
(Eryngium constancei)		Terrestrial	
Crownbeard, Big-leaved	T	Dicot	No
(Verbesina dissita)		Terrestrial	
Crownscale, San Jacinto Valley	E	Dicot	No
(Atriplex coronata var. notatior)		Terrestrial	
Daisy, Parish's	T	Dicot	Yes
(Erigeron parishii)		Freshwater	
Dudleya, Conejo	T	Dicot	No
(Dudleya abramsii ssp. parva)		Terrestrial	
Dudleya, Marcescent	T	Dicot	No
(Dudleya cymosa ssp. marcescens)		Terrestrial	
Dudleya, Santa Clara Valley	E	Dicot	No
(Dudleya setchellii)		Terrestrial	
Dudleya, Santa Cruz Island	T	Dicot	No
(Dudleya nesiotica)		Terrestrial	
Dudleya, Santa Monica Mountains	T	Dicot	No
(Dudleya cymosa ssp. ovatifolia)		Terrestrial	
Dudleya, Verity's	T	Dicot	No
(Dudleya verityi)		Terrestrial	
Dwarf-flax, Marin	T	Dicot	No
(Hesperolinon congestum)		Terrestrial	
Evening-primrose, Antioch Dunes	E	Dicot	Yes
(Oenothera deltoides ssp. howellii)		Terrestrial	

California (284) species:		**Taxa**	Critical Habitat
Evening-primrose, Eureka Valley	E	Dicot	No
(Oenothera avita ssp. eurekensis)		Terrestrial	
Evening-primrose, San Benito	T	Dicot	No
(Camissonia benitensis)		Terrestrial	
Fiddleneck, Large-flowered	E	Dicot	Yes
(Amsinckia grandiflora)		Terrestrial	
Flannelbush, Mexican	E	Dicot	Yes
(Fremontodendron mexicanum)		Terrestrial	
Flannelbush, Pine Hill	E	Dicot	No
(Fremontodendron californicum ssp. decumbens)		Terrestrial	
Fringepod, Santa Cruz Island	E	Dicot	No
(Thysanocarpus conchuliferus)		Terrestrial	
Gilia, Hoffmann's Slender-flowered	E	Dicot	No
(Gilia tenuiflora ssp. hoffmannii)		Terrestrial	
Gilia, Monterey	E	Dicot	No
(Gilia tenuiflora ssp. arenaria)		Terrestrial	
Golden Sunburst, Hartweg's	E	Dicot	No
(Pseudobahia bahiifolia)		Terrestrial	
Goldfields, Burke's	E	Dicot	No
(Lasthenia burkei)		Terrestrial	
Goldfields, Contra Costa	E	Dicot	Yes
(Lasthenia conjugens)		Terrestrial	
Grass, Hairy Orcutt	E	Dicot	Yes
(Orcuttia pilosa)		Vernal pool	
Grass, Sacramento Orcutt	E	Dicot	Yes
(Orcuttia viscida)		Vernal pool	
Grass, Slender Orcutt	T	Dicot	Yes
(Orcuttia tenuis)		Vernal pool	
Gumplant, Ash Meadows	T	Dicot	Yes
(Grindelia fraxino-pratensis)		Terrestrial	
Ivesia, Ash Meadows	T	Dicot	Yes
(Ivesia kingii var. eremica)		Terrestrial	
Jewelflower, California	E	Dicot	No
(Caulanthus californicus)		Terrestrial	
Jewelflower, Tiburon	E	Dicot	No
(Streptanthus niger)		Terrestrial	
Larkspur, Baker's	E	Dicot	Yes
(Delphinium bakeri)		Terrestrial	
Larkspur, San Clemente Island	E	Dicot	No
(Delphinium variegatum ssp. kinkiense)		Terrestrial	
Larkspur, Yellow	E	Dicot	Yes
(Delphinium luteum)		Terrestrial	
Layia, Beach	E	Dicot	No
(Layia carnosa)		Terrestrial, Coastal	
Lessingia, San Francisco	E	Dicot	No
(Lessingia germanorum (=L.g. var. germanorum))		Terrestrial	
Liveforever, Laguna Beach	T	Dicot	No
(Dudleya stolonifera)		Terrestrial	
Liveforever, Santa Barbara Island	E	Dicot	No
(Dudleya traskiae)		Terrestrial	

California	(284) species:		**Taxa**	Critical Habitat
Lupine, Clover		E	Dicot	No
(Lupinus tidestromii)		Coastal		
Lupine, Nipomo Mesa		E	Dicot	No
(Lupinus nipomensis)		Coastal		
Malacothrix, Island		E	Dicot	No
(Malacothrix squalida)		Terrestrial		
Malacothrix, Santa Cruz Island		E	Dicot	No
(Malacothrix indecora)		Terrestrial		
Mallow, Kern		E	Dicot	No
(Eremalche kernensis)		Terrestrial		
Manzanita, Del Mar		E	Dicot	No
(Arctostaphylos glandulosa ssp. crassifolia)		Terrestrial		
Manzanita, Ione		T	Dicot	No
(Arctostaphylos myrtifolia)		Terrestrial		
Manzanita, Morro		T	Dicot	No
(Arctostaphylos morroensis)		Terrestrial		
Manzanita, Pallid		T	Dicot	No
(Arctostaphylos pallida)		Terrestrial		
Manzanita, Santa Rosa Island		E	Dicot	No
(Arctostaphylos confertiflora)		Terrestrial		
Meadowfoam, Butte County		E	Dicot	Yes
(Limnanthes floccosa ssp. californica)		Vernal pool		
Meadowfoam, Sebastopol		E	Dicot	No
(Limnanthes vinculans)		Terrestrial, Freshwater		
Milk-vetch, Braunton's		E	Dicot	No
(Astragalus brauntonii)		Terrestrial		
Milk-vetch, Clara Hunt's		E	Dicot	No
(Astragalus clarianus)		Terrestrial		
Milk-vetch, Coachella Valley		E	Dicot	Yes
(Astragalus lentiginosus var. coachellae)		Terrestrial		
Milk-vetch, Coastal Dunes		E	Dicot	No
(Astragalus tener var. titi)		Terrestrial		
Milk-vetch, Cushenbury		E	Dicot	Yes
(Astragalus albens)		Terrestrial		
Milk-vetch, Fish Slough		T	Dicot	No
(Astragalus lentiginosus var. piscinensis)		Terrestrial		
Milk-vetch, Lane Mountain		E	Dicot	Yes
(Astragalus jaegerianus)		Terrestrial		
Milk-vetch, Pierson's		T	Dicot	Yes
(Astragalus magdalenae var. peirsonii)		Terrestrial		
Milk-vetch, Triple-ribbed		E	Dicot	No
(Astragalus tricarinatus)		Terrestrial		
Milk-vetch, Ventura Marsh		E	Dicot	Yes
(Astragalus pycnostachyus var. lanosissimus)		Terrestrial, Freshwater		
Mint, Otay Mesa		E	Dicot	No
(Pogogyne nudiuscula)		Terrestrial		
Mint, San Diego Mesa		E	Dicot	No
(Pogogyne abramsii)		Terrestrial		
Monardella, Willowy		E	Dicot	No
(Monardella linoides ssp. viminea)		Terrestrial		

California (284) species:		**Taxa**	Critical Habitat
Morning-glory, Stebbins	E	Dicot	No
(Calystegia stebbinsii)		Terrestrial	
Mountainbalm, Indian Knob	E	Dicot	No
(Eriodictyon altissimum)		Terrestrial	
Mountain-mahogany, Catalina Island	E	Dicot	No
(Cercocarpus traskiae)		Terrestrial	
Mustard, Slender-petaled	E	Dicot	No
(Thelypodium stenopetalum)		Terrestrial	
Navarretia, Few-flowered	E	Dicot	No
(Navarretia leucocephala ssp. Pauciflora)		Terrestrial, Vernal pool	
Navarretia, Many-flowered	E	Dicot	No
(Navarretia leucocephala ssp. plieantha)		Terrestrial, Vernal pool	
Navarretia, Spreading	T	Dicot	No
(Navarretia fossalis)		Vernal pool	
Niterwort, Amargosa	E	Dicot	Yes
(Nitrophila mohavensis)		Terrestrial	
Oxytheca, Cushenbury	E	Dicot	Yes
(Oxytheca parishii var. goodmaniana)		Terrestrial	
Paintbrush, Ash-grey Indian	T	Dicot	Yes
(Castilleja cinerea)		Terrestrial	
Paintbrush, San Clemente Island Indian	E	Dicot	No
(Castilleja grisea)		Terrestrial	
Paintbrush, Soft-leaved	E	Dicot	No
(Castilleja mollis)		Terrestrial	
Paintbrush, Tiburon	E	Dicot	No
(Castilleja affinis ssp. neglecta)		Terrestrial	
Penny-cress, Kneeland Prairie	E	Dicot	Yes
(Thlaspi californicum)		Terrestrial	
Pentachaeta, Lyon's	E	Dicot	No
(Pentachaeta lyonii)		Terrestrial	
Pentachaeta, White-rayed	E	Dicot	No
(Pentachaeta bellidiflora)		Terrestrial	
Phacelia, Island	E	Dicot	No
(Phacelia insularis ssp. insularis)		Terrestrial	
Phlox, Yreka	E	Dicot	No
(Phlox hirsuta)		Terrestrial	
Polygonum, Scott's Valley	E	Dicot	Yes
(Polygonum hickmanii)		Terrestrial	
Potentilla, Hickman's	E	Dicot	No
(Potentilla hickmanii)		Terrestrial	
Pussypaws, Mariposa	T	Dicot	No
(Calyptridium pulchellum)		Terrestrial	
Rock-cress, Hoffmann's	E	Dicot	No
(Arabis hoffmannii)		Terrestrial	
Rock-cress, McDonald's	E	Dicot	No
(Arabis mcdonaldiana)		Terrestrial	
Rock-cress, Santa Cruz Island	E	Dicot	No
(Sibara filifolia)		Terrestrial	
Rush-rose, Island	T	Dicot	No
(Helianthemum greenei)		Terrestrial	

California (284) species:		**Taxa**	Critical Habitat
Sandwort, Bear Valley	T	Dicot	Yes
(Arenaria ursina)		Terrestrial	
Sandwort, Marsh	E	Dicot	No
(Arenaria paludicola)		Terrestrial, Freshwater	
Sea-blite, California	E	Dicot	No
(Suaeda californica)		Terrestrial	
Spineflower, Ben Lomond	E	Dicot	No
(Chorizanthe pungens var. hartwegiana)		Terrestrial	
Spineflower, Howell's	E	Dicot	No
(Chorizanthe howellii)		Terrestrial	
Spineflower, Monterey	T	Dicot	Yes
(Chorizanthe pungens var. pungens)		Terrestrial	
Spineflower, Orcutt's	E	Dicot	No
(Chorizanthe orcuttiana)		Terrestrial	
Spineflower, Robust	E	Dicot	Yes
(Chorizanthe robusta var. robusta)		Terrestrial	
Spineflower, Scotts Valley	E	Dicot	Yes
(Chorizanthe robusta var. hartwegii)		Terrestrial	
Spineflower, Slender-horned	E	Dicot	No
(Dodecahema leptoceras)		Terrestrial	
Spineflower, Sonoma	E	Dicot	No
(Chorizanthe valida)		Terrestrial	
Spurge, Hoover's	T	Dicot	Yes
(Chamaesyce hooveri)		Vernal pool	
Stickyseed, Baker's	E	Dicot	No
(Blennosperma bakeri)		Vernal pool	
Stonecrop, Lake County	E	Dicot	No
(Parvisedum leiocarpum)		Vernal pool	
Sunflower, San Mateo Woolly	E	Dicot	No
(Eriophyllum latilobum)		Terrestrial	
Taraxacum, California	E	Dicot	No
(Taraxacum californicum)		Terrestrial	
Tarplant, Gaviota	E	Dicot	Yes
(Deinandra increscens ssp. villosa)		Terrestrial	
Tarplant, Otay	T	Dicot	Yes
(Deinandra (=Hemizonia) conjugens)		Terrestrial	
Tarplant, Santa Cruz	T	Dicot	Yes
(Holocarpha macradenia)		Terrestrial	
Thistle, Chorro creek Bog	E	Dicot	No
(Cirsium fontinale var. obispoense)		Terrestrial, Freshwater	
Thistle, Fountain	E	Dicot	No
(Cirsium fontinale var. fontinale)		Terrestrial	
Thistle, La Graciosa	E	Dicot	Yes
(Cirsium loncholepis)		Freshwater, Brackish, Saltwater,	
Thistle, Suisun	E	Dicot	No
(Cirsium hydrophilum var. hydrophilum)		Terrestrial, Brackish	
Thornmint, San Diego	T	Dicot	No
(Acanthomintha ilicifolia)		Terrestrial	
Thornmint, San Mateo	E	Dicot	No
(Acanthomintha obovata ssp. duttonii)		Terrestrial	

California (284) species:		**Taxa**	Critical Habitat
Tuctoria, Green's	E	Dicot	Yes
(Tuctoria greenei)		Vernal pool	
Vervain, California	T	Dicot	No
(Verbena californica)		Terrestrial	
Wallflower, Ben Lomond	E	Dicot	No
(Erysimum teretifolium)		Terrestrial	
Wallflower, Contra Costa	E	Dicot	Yes
(Erysimum capitatum var. angustatum)		Terrestrial	
Wallflower, Menzie's	E	Dicot	No
(Erysimum menziesii)		Terrestrial	
Watercress, Gambel's	E	Dicot	No
(Rorippa gambellii)		Terrestrial, Freshwater, Brackish	
Woodland-star, San Clemente Island	E	Dicot	No
(Lithophragma maximum)		Terrestrial	
Woolly-star, Santa Ana River	E	Dicot	No
(Eriastrum densifolium ssp. sanctorum)		Terrestrial	
Woolly-threads, San Joaquin	E	Dicot	No
(Monolopia (=Lembertia) congdonii)		Terrestrial	
Yerba Santa, Lompoc	E	Dicot	Yes
(Eriodictyon capitatum)		Terrestrial	
Chub, Bonytail	E	Fish	Yes
(Gila elegans)		Freshwater	
Chub, Hutton Tui	T	Fish	No
(Gila bicolor ssp.)		Freshwater	
Chub, Mohave Tui	E	Fish	No
(Gila bicolor mohavensis)		Freshwater	
Chub, Owens Tui	E	Fish	Yes
(Gila bicolor snyderi)		Freshwater	
Dace, Ash Meadows Speckled	E	Fish	Yes
(Rhinichthys osculus nevadensis)		Freshwater	
Goby, Tidewater	E	Fish	Yes
(Eucyclogobius newberryi)		Freshwater	
Pupfish, Desert	E	Fish	Yes
(Cyprinodon macularius)		Freshwater	
Pupfish, Owens	E	Fish	No
(Cyprinodon radiosus)		Freshwater	
Salmon, Chinook	E/T	Fish	Yes
(Oncorhynchus (=Salmo) tshawytscha)		Freshwater, Brackish, Saltwater	
Salmon, Coho	E	Fish	No
(Oncorhynchus (=Salmo) kisutch)		Freshwater, Brackish, Saltwater	
Smelt, Delta	T	Fish	Yes
(Hypomesus transpacificus)		Freshwater, Brackish	
Squawfish, Colorado	E	Fish	Yes
(Ptychocheilus lucius)		Freshwater	
Steelhead	E	Fish	Yes
(Oncorhynchus (=Salmo) mykiss)		Freshwater, Brackish, Saltwater	
Stickleback, Unarmored Threespine	E	Fish	Yes
(Gasterosteus aculeatus williamsoni)		Freshwater	
Sturgeon, North American green	T	Fish	No
(Acipenser medirostris)		Freshwater, Saltwater	

California (284) species:		**Taxa**	Critical Habitat
Sucker, Lost River	E	Fish	No
(Deltistes luxatus)		Freshwater	
Sucker, Modoc	E	Fish	Yes
(Catostomus microps)		Freshwater	
Sucker, Razorback	E	Fish	Yes
(Xyrauchen texanus)		Freshwater	
Sucker, Santa Ana	T	Fish	Yes
(Catostomus santaanae)		Freshwater	
Sucker, Shortnose	E	Fish	No
(Chasmistes brevirostris)		Freshwater	
Trout, Lahontan Cutthroat	T	Fish	No
(Oncorhynchus clarki henshawi)		Freshwater	
Trout, Little Kern Golden	T	Fish	Yes
(Oncorhynchus aguabonita whitei)		Freshwater	
Trout, Paiute Cutthroat	T	Fish	No
(Oncorhynchus clarki seleniris)		Freshwater	
Abalone, White	E	Gastropod	No
(Haliotis sorenseni)		Saltwater	
Snail, Morro Shoulderband	E	Gastropod	Yes
(Helminthoglypta walkeriana)		Terrestrial	
Beetle, Delta Green Ground	T	Insect	Yes
(Elaphrus viridis)		Terrestrial, Vernal pool	
Beetle, Mount Hermon June	E	Insect	No
(Polyphylla barbata)		Terrestrial, Subterraneous	
Beetle, Ohlone Tiger	E	Insect	No
(Cicindela ohlone)		Terrestrial	
Beetle, Valley Elderberry Longhorn	T	Insect	Yes
(Desmocerus californicus dimorphus)		Terrestrial	
Butterfly, Bay Checkerspot (Wright's euphydryas)	T	Insect	Yes
(Euphydryas editha bayensis)		Terrestrial	
Butterfly, Behren's Silverspot	E	Insect	No
(Speyeria zerene behrensii)		Terrestrial	
Butterfly, Callippe Silverspot	E	Insect	No
(Speyeria callippe callippe)		Terrestrial	
Butterfly, El Segundo Blue	E	Insect	No
(Euphilotes battoides allyni)		Terrestrial	
Butterfly, Lange's Metalmark	E	Insect	No
(Apodemia mormo langei)		Terrestrial	
Butterfly, Lotis Blue	E	Insect	No
(Lycaeides argyrognomon lotis)		Terrestrial	
Butterfly, Mission Blue	E	Insect	No
(Icaricia icarioides missionensis)		Terrestrial	
Butterfly, Myrtle's Silverspot	E	Insect	No
(Speyeria zerene myrtleae)		Terrestrial	
Butterfly, Oregon Silverspot	T	Insect	Yes
(Speyeria zerene hippolyta)		Terrestrial	
Butterfly, Palos Verdes Blue	E	Insect	Yes
(Glaucopsyche lygdamus palosverdesensis)		Terrestrial	
Butterfly, Quino Checkerspot	E	Insect	Yes
(Euphydryas editha quino (=E. e. wrighti))		Terrestrial	

California (284) species:		**Taxa**	Critical Habitat
Butterfly, San Bruno Elfin	E	Insect	No
(Callophrys mossii bayensis)		Terrestrial	
Butterfly, Smith's Blue	E	Insect	No
(Euphilotes enoptes smithi)		Terrestrial	
Fly, Delhi Sands Flower-loving	E	Insect	No
(Rhaphiomidas terminatus abdominalis)		Terrestrial	
Grasshopper, Zayante Band-winged	E	Insect	Yes
(Trimerotropis infantilis)		Terrestrial	
Moth, Kern Primrose Sphinx	T	Insect	No
(Euproserpinus euterpe)		Terrestrial	
Skipper, Carson Wandering	E	Insect	No
(Pseudocopaeodes eunus obscurus)		Terrestrial	
Skipper, Laguna Mountain	E	Insect	No
(Pyrgus ruralis lagunae)		Terrestrial	
Fox, San Joaquin Kit	E	Mammal	No
(Vulpes macrotis mutica)		Terrestrial	
Fox, San Miguel Island	E	Mammal	Yes
(Urocyon littoralis littoralis)		Terrestrial	
Fox, Santa Catalina Island	E	Mammal	Yes
(Urocyon littoralis catalinae)		Terrestrial	
Fox, Santa Cruz Island	E	Mammal	Yes
(Urocyon littoralis santacruzae)		Terrestrial	
Fox, Santa Rosa Island	E	Mammal	Yes
(Urocyon littoralis santarosae)		Terrestrial	
Kangaroo Rat, Fresno	E	Mammal	Yes
(Dipodomys nitratoides exilis)		Terrestrial	
Kangaroo Rat, Giant	E	Mammal	No
(Dipodomys ingens)		Terrestrial	
Kangaroo Rat, Morro Bay	E	Mammal	Yes
(Dipodomys heermanni morroensis)		Terrestrial	
Kangaroo Rat, San Bernardino Merriam's	E	Mammal	Yes
(Dipodomys merriami parvus)		Terrestrial	
Kangaroo Rat, Stephens'	E	Mammal	No
(Dipodomys stephensi (incl. D. cascus))		Terrestrial	
Kangaroo Rat, Tipton	E	Mammal	No
(Dipodomys nitratoides nitratoides)		Terrestrial	
Mountain Beaver, Point Arena	E	Mammal	No
(Aplodontia rufa nigra)		Terrestrial, Freshwater	
Mouse, Pacific Pocket	E	Mammal	No
(Perognathus longimembris pacificus)		Terrestrial	
Mouse, Salt Marsh Harvest	E	Mammal	No
(Reithrodontomys raviventris)		Terrestrial	
Rabbit, Ripariañ Brush	E	Mammal	No
(Sylvilagus bachmani riparius)		Terrestrial	
Sheep, Peninsular Bighorn	E	Mammal	Yes
(Ovis canadensis)		Terrestrial	
Sheep, Sierra Nevada Bighorn	E	Mammal	No
(Ovis canadensis californiana)		Terrestrial	
Shrew, Buena Vista Lake Ornate	E	Mammal	Yes
(Sorex ornatus relictus)		Terrestrial	

California (284) species:		**Taxa**	Critical Habitat
Vole, Amargosa	E	Mammal	Yes
(Microtus californicus scirpensis)		Terrestrial	
Woodrat, Riparian	E	Mammal	No
(Neotoma fuscipes riparia)		Terrestrial	
Otter, Southern Sea	T	Marine mml	No
(Enhydra lutris nereis)		Saltwater	
Seal, Guadalupe Fur	T	Marine mml	No
(Arctocephalus townsendi)		Saltwater, Coastal	
Alopecurus, Sonoma	E	Monocot	No
(Alopecurus aequalis var. sonomensis)		Terrestrial	
Amole, Cammatta Canyon	T	Monocot	Yes
(Chlorogalum purpureum var. reductum)		Terrestrial	
Amole, Purple	T	Monocot	Yes
(Chlorogalum purpureum var. purpureum)		Terrestrial	
Bluegrass, Napa	E	Monocot	No
(Poa napensis)		Terrestrial, Freshwater	
Bluegrass, San Bernardino	E	Monocot	No
(Poa atropurpurea)		Terrestrial	
Brodiaea, Chinese Camp	T	Monocot	No
(Brodiaea pallida)		Terrestrial	
Brodiaea, Thread-leaved	T	Monocot	Yes
(Brodiaea filifolia)		Terrestrial	
Grass, California Orcutt	E	Monocot	No
(Orcuttia californica)		Terrestrial, Vernal pool	
Grass, Colusa	T	Monocot	Yes
(Neostapfia colusana)		Vernal pool	
Grass, Eureka Dune	E	Monocot	No
(Swallenia alexandrae)		Terrestrial	
Grass, San Joaquin Valley Orcutt	T	Monocot	Yes
(Orcuttia inaequalis)		Vernal pool	
Grass, Solano	E	Monocot	Yes
(Tuctoria mucronata)		Terrestrial, Vernal pool	
Lily, Pitkin Marsh	E	Monocot	No
(Lilium pardalinum ssp. pitkinense)		Freshwater	
Lily, Western	E	Monocot	No
(Lilium occidentale)		Terrestrial	
Onion, Munz's	E	Monocot	Yes
(Allium munzii)		Terrestrial	
Piperia, Yadon's	E	Monocot	Yes
(Piperia yadonii)		Terrestrial	
Sedge, White	E	Monocot	No
(Carex albida)		Terrestrial, Freshwater	
Lizard, Blunt-nosed Leopard	E	Reptile	No
(Gambelia silus)		Terrestrial	
Lizard, Coachella Valley Fringe-toed	T	Reptile	Yes
(Uma inornata)		Terrestrial	
Lizard, Island Night	T	Reptile	No
(Xantusia riversiana)		Terrestrial	
Sea turtle, olive ridley	T	Reptile	No
(Lepidochelys olivacea)		Saltwater	

California (284) species:		**Taxa**	Critical Habitat
Snake, Giant Garter	T	Reptile	No
(Thamnophis gigas)		Terrestrial, Freshwater	
Snake, San Francisco Garter	E	Reptile	No
(Thamnophis sirtalis tetrataenia)		Terrestrial, Freshwater	
Tortoise, Desert	T	Reptile	Yes
(Gopherus agassizii)		Terrestrial	
Whipsnake (=Striped Racer), Alameda	T	Reptile	Yes
(Masticophis lateralis euryxanthus)		Terrestrial	

Colorado (24) species:		**Taxa**	Critical Habitat
Crane, Whooping	E	Bird	Yes
(Grus americana)		Terrestrial, Freshwater	
Owl, Mexican Spotted	T	Bird	Yes
(Strix occidentalis lucida)		Terrestrial	
Beardtongue, Penland	E	Dicot	No
(Penstemon penlandii)		Terrestrial	
Bladderpod, Dudley Bluffs	T	Dicot	No
(Lesquerella congesta)		Terrestrial	
Butterfly Plant, Colorado	T	Dicot	Yes
(Gaura neomexicana var. coloradensis)		Terrestrial	
Cactus, Knowlton	E	Dicot	No
(Pediocactus knowltonii)		Terrestrial	
Cactus, Mesa Verde	T	Dicot	No
(Sclerocactus mesae-verdae)		Terrestrial	
Cactus, Uinta Basin Hookless	T	Dicot	No
(Sclerocactus glaucus)		Terrestrial	
Milk-vetch, Mancos	E	Dicot	No
(Astragalus humillimus)		Terrestrial	
Milk-vetch, Osterhout	E	Dicot	No
(Astragalus osterhoutii)		Terrestrial	
Mustard, Penland Alpine Fen	T	Dicot	No
(Eutrema penlandii)		Terrestrial, Freshwater	
Phacelia, North Park	E	Dicot	No
(Phacelia formosula)		Terrestrial	
Twinpod, Dudley Bluffs	T	Dicot	No
(Physaria obcordata)		Terrestrial	
Wild-buckwheat, Clay-loving	E	Dicot	Yes
(Eriogonum pelinophilum)		Terrestrial	
Chub, Bonytail	E	Fish	Yes
(Gila elegans)		Freshwater	
Chub, Humpback	E	Fish	Yes
(Gila cypha)		Freshwater	
Squawfish, Colorado	E	Fish	Yes
(Ptychocheilus lucius)		Freshwater	
Sucker, Razorback	E	Fish	Yes
(Xyrauchen texanus)		Freshwater	
Trout, Greenback Cutthroat	T	Fish	No
(Oncorhynchus clarki stomias)		Freshwater	
Butterfly, Uncompahgre Fritillary	E	Insect	No
(Boloria acrocnema)		Terrestrial	
Skipper, Pawnee Montane	T	Insect	No
(Hesperia leonardus montana)		Terrestrial	

Colorado (24) species:

		Taxa	Critical Habitat
Ferret, Black-footed *(Mustela nigripes)*	E	Mammal Terrestrial	No
Mouse, Preble's Meadow Jumping *(Zapus hudsonius preblei)*	T	Mammal Terrestrial	Yes
Ladies'-tresses, Ute *(Spiranthes diluvialis)*	T	Monocot Terrestrial	No

Connecticut (9) species:

		Taxa	Critical Habitat
Plover, Piping *(Charadrius melodus)*	E	Bird Terrestrial	Yes
Tern, Roseate *(Sterna dougallii dougallii)*	E	Bird Terrestrial	No
Mussel, Dwarf Wedge *(Alasmidonta heterodon)*	E	Bivalve Freshwater	No
Gerardia, Sandplain *(Agalinis acuta)*	E	Dicot Terrestrial	No
Sturgeon, Shortnose *(Acipenser brevirostrum)*	E	Fish Freshwater, Saltwater	No
Beetle, Puritan Tiger *(Cicindela puritana)*	T	Insect Terrestrial, Coastal	No
Bat, Indiana *(Myotis sodalis)*	E	Mammal Terrestrial, Subterraneous	Yes
Pogonia, Small Whorled *(Isotria medeoloides)*	T	Monocot Terrestrial	No
Turtle, Bog (Northern population) *(Clemmys muhlenbergii)*	T	Reptile Terrestrial, Freshwater	No

Delaware (6) species:

		Taxa	Critical Habitat
Plover, Piping *(Charadrius melodus)*	E	Bird Terrestrial	Yes
Sturgeon, Shortnose *(Acipenser brevirostrum)*	E	Fish Freshwater, Saltwater	No
Squirrel, Delmarva Peninsula Fox *(Sciurus niger cinereus)*	E	Mammal Terrestrial	No
Pink, Swamp *(Helonias bullata)*	T	Monocot Terrestrial, Freshwater	No
Pogonia, Small Whorled *(Isotria medeoloides)*	T	Monocot Terrestrial	No
Turtle, Bog (Northern population) *(Clemmys muhlenbergii)*	T	Reptile Terrestrial, Freshwater	No

Florida (95) species:

		Taxa	Critical Habitat
Salamander, Flatwoods *(Ambystoma cingulatum)*	T	Amphibian Terrestrial, Freshwater, Vernal pool	No
Caracara, Audubon's Crested *(Polyborus plancus audubonii)*	T	Bird Terrestrial	No
Kite, Everglade Snail *(Rostrhamus sociabilis plumbeus)*	E	Bird Terrestrial	Yes
Plover, Piping *(Charadrius melodus)*	E	Bird Terrestrial	Yes
Scrub-Jay, Florida *(Aphelocoma coerulescens)*	T	Bird Terrestrial	No

Florida	(95) species:		**Taxa**	Critical Habitat
Sparrow, Cape Sable Seaside	*(Ammodramus maritimus mirabilis)*	E	Bird Terrestrial	Yes
Sparrow, Florida Grasshopper	*(Ammodramus savannarum floridanus)*	E	Bird Terrestrial	No
Stork, Wood	*(Mycteria americana)*	E	Bird Terrestrial	No
Woodpecker, Red-cockaded	*(Picoides borealis)*	E	Bird Terrestrial	No
Bankclimber, Purple	*(Elliptoideus sloatianus)*	T	Bivalve Freshwater	No
Mussel, Fat Threeridge	*(Amblema neisleri)*	E	Bivalve Freshwater	No
Mussel, Gulf Moccasinshell	*(Medionidus penicillatus)*	E	Bivalve Freshwater	No
Mussel, Ochlockonee Moccasinshell	*(Medionidus simpsonianus)*	E	Bivalve Freshwater	No
Mussel, Oval Pigtoe	*(Pleurobema pyriforme)*	E	Bivalve Freshwater	No
Mussel, Shiny-rayed Pocketbook	*(Lampsilis subangulata)*	E	Bivalve Freshwater	No
Slabshell, Chipola	*(Elliptio chipolaensis)*	T	Bivalve Freshwater	No
Torreya, Florida	*(Torreya taxifolia)*	E	Conf/cycds Terrestrial	No
Shrimp, Squirrel Chimney Cave	*(Palaemonetes cummingi)*	T	Crustacean Freshwater, Subterraneous	No
Aster, Florida Golden	*(Chrysopsis floridana)*	E	Dicot Terrestrial	No
Bellflower, Brooksville	*(Campanula robinsiae)*	E	Dicot Terrestrial	No
Birds-in-a-nest, White	*(Macbridea alba)*	T	Dicot Terrestrial	No
Blazing Star, Scrub	*(Liatris ohlingerae)*	E	Dicot Terrestrial	No
Bonamia, Florida	*(Bonamia grandiflora)*	T	Dicot Terrestrial	No
Buckwheat, Scrub	*(Eriogonum longifolium var. gnaphalifolium)*	T	Dicot Terrestrial	No
Butterwort, Godfrey's	*(Pinguicula ionantha)*	T	Dicot Terrestrial, Freshwater	No
Campion, Fringed	*(Silene polypetala)*	E	Dicot Terrestrial	No
Chaffseed, American	*(Schwalbea americana)*	E	Dicot Terrestrial	No
Fringe Tree, Pygmy	*(Chionanthus pygmaeus)*	E	Dicot Terrestrial	No
Gooseberry, Miccosukee	*(Ribes echinellum)*	T	Dicot Terrestrial	No
Gourd, Okeechobee	*(Cucurbita okeechobeensis ssp. okeechobeensis)*	E	Dicot Terrestrial	No

Florida	(95) species:		**Taxa**	Critical Habitat
Harebells, Avon Park		E	Dicot	No
(Crotalaria avonensis)			Terrestrial	
Hypericum, Highlands Scrub		E	Dicot	No
(Hypericum cumulicola)			Terrestrial	
Jacquemontia, Beach		E	Dicot	No
(Jacquemontia reclinata)			Terrestrial, Coastal	
Lupine, Scrub		E	Dicot	No
(Lupinus aridorum)			Terrestrial	
Meadowrue, Cooley's		E	Dicot	No
(Thalictrum cooleyi)			Terrestrial	
Milkpea, Small's		E	Dicot	No
(Galactia smallii)			Terrestrial	
Mint, Garrett's		E	Dicot	No
(Dicerandra christmanii)			Terrestrial	
Mint, Lakela's		E	Dicot	No
(Dicerandra immaculata)			Terrestrial	
Mint, Longspurred		E	Dicot	No
(Dicerandra cornutissima)			Terrestrial	
Mint, Scrub		E	Dicot	No
(Dicerandra frutescens)			Terrestrial	
Mustard, Carter's		E	Dicot	No
(Warea carteri)			Terrestrial	
Pawpaw, Beautiful		E	Dicot	No
(Deeringothamnus pulchellus)			Terrestrial	
Pawpaw, Four-petal		E	Dicot	No
(Asimina tetramera)			Terrestrial	
Pawpaw, Rugel's		E	Dicot	No
(Deeringothamnus rugelii)			Terrestrial	
Pinkroot, Gentian		E	Dicot	No
(Spigelia gentianoides)			Terrestrial	
Plum, Scrub		E	Dicot	No
(Prunus geniculata)			Terrestrial	
Polygala, Lewton's		E	Dicot	No
(Polygala lewtonii)			Terrestrial	
Polygala, Tiny		E	Dicot	No
(Polygala smallii)			Terrestrial	
Prickly-apple, Fragrant		E	Dicot	No
(Cereus eriophorus var. fragrans)			Terrestrial	
Rhododendron, Chapman		E	Dicot	No
(Rhododendron chapmanii)			Terrestrial	
Rosemary, Apalachicola		E	Dicot	No
(Conradina glabra)			Terrestrial	
Rosemary, Etonia		E	Dicot	No
(Conradina etonia)			Terrestrial	
Rosemary, Short-leaved		E	Dicot	No
(Conradina brevifolia)			Terrestrial	
Sandlace		E	Dicot	No
(Polygonella myriophylla)			Terrestrial	
Skullcap, Florida		T	Dicot	No
(Scutellaria floridana)			Terrestrial	

Florida	(95) species:		**Taxa**	Critical Habitat
Snakeroot		E	Dicot	No
(Eryngium cuneifolium)			Terrestrial	
Spurge, Deltoid		E	Dicot	No
(Chamaesyce deltoidea ssp. deltoidea)			Terrestrial	
Spurge, Garber's		T	Dicot	No
(Chamaesyce garberi)			Terrestrial	
Spurge, Telephus		T	Dicot	No
(Euphorbia telephioides)			Terrestrial	
Warea, Wide-leaf		E	Dicot	No
(Warea amplexifolia)			Terrestrial	
Water-willow, Cooley's		E	Dicot	No
(Justicia cooleyi)			Terrestrial	
Whitlow-wort, Papery		T	Dicot	No
(Paronychia chartacea)			Terrestrial	
Wings, Pigeon		T	Dicot	No
(Clitoria fragrans)			Terrestrial	
Wireweed		E	Dicot	No
(Polygonella basiramia)			Terrestrial	
Ziziphus, Florida		E	Dicot	No
(Ziziphus celata)			Terrestrial	
Darter, Okaloosa		E	Fish	No
(Etheostoma okaloosae)			Freshwater	
Sawfish, Smalltooth		E	Fish	No
(Pristis pectinata)			Freshwater, Brackish, Saltwater	
Sturgeon, Gulf		T	Fish	Yes
(Acipenser oxyrinchus desotoi)			Freshwater, Saltwater	
Sturgeon, Shortnose		E	Fish	No
(Acipenser brevirostrum)			Freshwater, Saltwater	
Butterfly, Schaus Swallowtail		E	Insect	No
(Heraclides aristodemus ponceanus)			Terrestrial	
Cladonia, Florida Perforate		E	Lichen	No
(Cladonia perforata)			Terrestrial	
Bat, Gray		E	Mammal	No
(Myotis grisescens)			Terrestrial, Subterraneous	
Bat, Indiana		E	Mammal	Yes
(Myotis sodalis)			Terrestrial, Subterraneous	
Mouse, Anastasia Island Beach		E	Mammal	No
(Peromyscus polionotus phasma)			Terrestrial, Coastal	
Mouse, Choctawhatchee Beach		E	Mammal	Yes
(Peromyscus polionotus allophrys)			Terrestrial, Coastal	
Mouse, Perdido Key Beach		E	Mammal	Yes
(Peromyscus polionotus trissyllepsis)			Coastal	
Mouse, Southeastern Beach		T	Mammal	No
(Peromyscus polionotus niveiventris)			Terrestrial, Coastal	
Mouse, St. Andrew Beach		E	Mammal	No
(Peromyscus polionotus peninsularis)			Terrestrial, Coastal	
Panther, Florida		E	Mammal	No
(Puma (=Felis) concolor coryi)			Terrestrial	
Vole, Florida Salt Marsh		E	Mammal	No
(Microtus pennsylvanicus dukecampbelli)			Terrestrial, Brackish	

Florida (95) species:

		Taxa	Critical Habitat
Wolf, Red	E	Mammal	No
(Canis rufus)		Terrestrial	
Manatee, West Indian	E	Marine mml	Yes
(Trichechus manatus)		Saltwater	
Beargrass, Britton's	E	Monocot	No
(Nolina brittoniana)		Terrestrial	
Beauty, Harper's	E	Monocot	No
(Harperocallis flava)		Terrestrial, Freshwater	
Seagrass, Johnson's	T	Monocot	Yes
(Halophila johnsonii)		Saltwater, Coastal	
Crocodile, American	T	Reptile	Yes
(Crocodylus acutus)		Terrestrial, Freshwater	
Sea turtle, green	E	Reptile	Yes
(Chelonia mydas)		Saltwater	
Sea turtle, hawksbill	E	Reptile	Yes
(Eretmochelys imbricata)		Saltwater, Coastal	
Sea turtle, Kemp's ridley	E	Reptile	No
(Lepidochelys kempii)		Saltwater, Coastal	
Sea turtle, leatherback	E	Reptile	Yes
(Dermochelys coriacea)		Saltwater, Coastal	
Sea turtle, loggerhead	T	Reptile	No
(Caretta caretta)		Saltwater, Coastal	
Skink, Blue-tailed Mole	T	Reptile	No
(Eumeces egregius lividus)		Terrestrial	
Skink, Sand	T	Reptile	No
(Neoseps reynoldsi)		Terrestrial	
Snake, Atlantic Salt Marsh	T	Reptile	No
(Nerodia clarkii taeniata)		Terrestrial, Brackish, Saltwater	
Snake, Eastern Indigo	T	Reptile	Yes
(Drymarchon corais couperi)		Terrestrial	

Georgia (59) species:

		Taxa	Critical Habitat
Salamander, Flatwoods	T	Amphibian	No
(Ambystoma cingulatum)		Terrestrial, Freshwater, Vernal pool	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Stork, Wood	E	Bird	No
(Mycteria americana)		Terrestrial	
Warbler (=Wood), Kirtland's	E	Bird	No
(Dendroica kirtlandii)		Terrestrial	
Woodpecker, Red-cockaded	E	Bird	No
(Picoides borealis)		Terrestrial	
Bankclimber, Purple	T	Bivalve	No
(Elliptoideus sloatianus)		Freshwater	
Combshell, Upland	E	Bivalve	Yes
(Epioblasma metastriata)		Freshwater	
Fanshell	E	Bivalve	No
(Cyprogenia stegaria)		Freshwater	
Kidneyshell, Triangular	E	Bivalve	Yes
(Ptychobranchus greenii)		Freshwater	
Mucket, Pink (Pearlymussel)	E	Bivalve	No
(Lampsilis abrupta)		Freshwater	

Georgia (59) species:		**Taxa**	Critical Habitat
Mussel, Acornshell Southern	E	Bivalve	Yes
(Epioblasma othcaloogensis)		Freshwater	
Mussel, Alabama Moccasinshell	T	Bivalve	Yes
(Medionidus acutissimus)		Freshwater	
Mussel, Coosa Moccasinshell	E	Bivalve	Yes
(Medionidus parvulus)		Freshwater	
Mussel, Fat Threeridge	E	Bivalve	No
(Amblema neisleri)		Freshwater	
Mussel, Fine-lined Pocketbook	T	Bivalve	Yes
(Lampsilis altilis)		Freshwater	
Mussel, Gulf Moccasinshell	E	Bivalve	No
(Medionidus penicillatus)		Freshwater	
Mussel, Oval Pigtoe	E	Bivalve	No
(Pleurobema pyriforme)		Freshwater	
Mussel, Ovate Clubshell	E	Bivalve	Yes
(Pleurobema perovatum)		Freshwater	
Mussel, Shiny-rayed Pocketbook	E	Bivalve	No
(Lampsilis subangulata)		Freshwater	
Mussel, Southern Clubshell	E	Bivalve	Yes
(Pleurobema decisum)		Freshwater	
Mussel, Southern Pigtoe	E	Bivalve	Yes
(Pleurobema georgianum)		Freshwater	
Torreya, Florida	E	Conf/cycds	No
(Torreya taxifolia)		Terrestrial	
Amphianthus, Little	T	Dicot	No
(Amphianthus pusillus)		Freshwater	
Barbara Buttons, Mohr's	T	Dicot	No
(Marshallia mohrii)		Terrestrial	
Campion, Fringed	E	Dicot	No
(Silene polypetala)		Terrestrial	
Dropwort, Canby's	E	Dicot	No
(Oxypolis canbyi)		Terrestrial, Freshwater	
Harperella	E	Dicot	No
(Ptilimnium nodosum)		Freshwater	
Pitcher-plant, Green	E	Dicot	No
(Sarracenia oreophila)		Terrestrial, Freshwater	
Pondberry	E	Dicot	No
(Lindera melissifolia)		Terrestrial	
Rattleweed, Hairy	E	Dicot	No
(Baptisia arachnifera)		Terrestrial	
Skullcap, Large-flowered	T	Dicot	No
(Scutellaria montana)		Terrestrial	
Spiraea, Virginia	T	Dicot	No
(Spiraea virginiana)		Terrestrial	
Sumac, Michaux's	E	Dicot	No
(Rhus michauxii)		Terrestrial	
Quillwort, Black-spored	E	Ferns	No
(Isoetes melanospora)		Vernal pool	
Quillwort, Mat-forming	E	Ferns	No
(Isoetes tegetiformans)		Vernal pool	

Georgia	(59) species:		**Taxa**	Critical Habitat
Chub, Spotfin		T	Fish	Yes
(Erimonax monachus)			Freshwater	
Darter, Amber		E	Fish	Yes
(Percina antesella)			Freshwater	
Darter, Cherokee		T	Fish	No
(Etheostoma scotti)			Freshwater	
Darter, Etowah		E	Fish	No
(Etheostoma etowahae)			Freshwater	
Darter, Goldline		T	Fish	No
(Percina aurolineata)			Freshwater	
Darter, Snail		T	Fish	No
(Percina tanasi)			Freshwater	
Logperch, Conasauga		E	Fish	Yes
(Percina jenkinsi)			Freshwater	
Madtom, Yellowfin		T	Fish	Yes
(Noturus flavipinnis)			Freshwater	
Shiner, Blue		T	Fish	No
(Cyprinella caerulea)			Freshwater	
Sturgeon, Gulf		T	Fish	Yes
(Acipenser oxyrinchus desotoi)			Freshwater, Saltwater	
Sturgeon, Shortnose		E	Fish	No
(Acipenser brevirostrum)			Freshwater, Saltwater	
Beetle, American Burying		E	Insect	No
(Nicrophorus americanus)			Terrestrial	
Bat, Gray		E	Mammal	No
(Myotis grisescens)			Terrestrial, Subterraneous	
Bat, Indiana		E	Mammal	Yes
(Myotis sodalis)			Terrestrial, Subterraneous	
Bat, Virginia Big-eared		E	Mammal	Yes
(Corynorhinus (=Plecotus) townsendii virginianus)			Terrestrial, Subterraneous	
Manatee, West Indian		E	Marine mml	Yes
(Trichechus manatus)			Saltwater	
Grass, Tennessee Yellow-eyed		E	Monocot	No
(Xyris tennesseensis)			Terrestrial	
Pink, Swamp		T	Monocot	No
(Helonias bullata)			Terrestrial, Freshwater	
Pogonia, Small Whorled		T	Monocot	No
(Isotria medeoloides)			Terrestrial	
Trillium, Persistent		E	Monocot	No
(Trillium persistens)			Terrestrial	
Trillium, Relict		E	Monocot	No
(Trillium reliquum)			Terrestrial	
Water-plantain, Kral's		T	Monocot	No
(Sagittaria secundifolia)			Freshwater	
Sea turtle, loggerhead		T	Reptile	No
(Caretta caretta)			Saltwater, Coastal	
Snake, Eastern Indigo		T	Reptile	Yes
(Drymarchon corais couperi)			Terrestrial	

Hawaii (313) species:		**Taxa**	Critical Habitat
Spider, Kauai Cave Wolf	E	Arachnid	Yes
(Adelocosa anops)		Terrestrial, Subterraneous	
'Akepa, Hawaii	E	Bird	No
(Loxops coccineus coccineus)		Terrestrial	
'Akepa, Maui	E	Bird	No
(Loxops coccineus ochraceus)		Terrestrial	
'Akia Loa, Kauai (Hemignathus procerus)	E	Bird	No
(Hemignathus procerus)		Terrestrial	
'Akia Pola'au (Hemignathus munroi)	E	Bird	No
(Hemignathus munroi)		Terrestrial	
Albatross, Short-tailed	E	Bird	No
(Phoebastria (=Diomedea) albatrus)		Terrestrial, Saltwater	
Coot, Hawaiian (=Alae keo keo)	E	Bird	No
(Fulica americana alai)		Terrestrial	
Creeper, Hawaii	E	Bird	No
(Oreomystis mana)		Terrestrial	
Creeper, Molokai (Kakawahie)	E	Bird	No
(Paroreomyza flammea)		Terrestrial	
Creeper, Oahu (Alauwahio)	E	Bird	No
(Paroreomyza maculata)		Terrestrial	
Crow, Hawaiian ('Alala)	E	Bird	No
(Corvus hawaiiensis)		Terrestrial	
Duck, Hawaiian (Koloa)	E	Bird	No
(Anas wyvilliana)		Terrestrial, Freshwater	
Duck, Laysan	E	Bird	No
(Anas laysanensis)		Terrestrial, Freshwater	
Elepaio, Oahu	E	Bird	Yes
(Chasiempis sandwichensis ibidis)		Terrestrial	
Finch, Laysan	E	Bird	No
(Telespyza cantans)		Terrestrial	
Finch, Nihoa	E	Bird	No
(Telespyza ultima)		Terrestrial	
Goose, Hawaiian (Nene)	E	Bird	No
(Branta (=Nesochen) sandvicensis)		Terrestrial, Freshwater	
Hawk, Hawaiian (Io)	E	Bird	No
(Buteo solitarius)		Terrestrial	
Honeycreeper, Crested ('Akohekohe)	E	Bird	No
(Palmeria dolei)		Terrestrial	
Millerbird, Nihoa	E	Bird	No
(Acrocephalus familiaris kingi)		Terrestrial	
Moorhen, Hawaiian Common	E	Bird	No
(Gallinula chloropus sandvicensis)		Terrestrial	
Nuku Pu'u	E	Bird	No
(Hemignathus lucidus)		Terrestrial	
'O'o, Kauai (='A'a)	E	Bird	No
(Moho braccatus)		Terrestrial	
'O'u (Honeycreeper)	E	Bird	No
(Psittirostra psittacea)		Terrestrial	
Palila	E	Bird	Yes
(Loxioides bailleui)		Terrestrial	

Hawaii (313) species:		**Taxa**	Critical Habitat
Parrotbill, Maui	E	Bird	No
(Pseudonestor xanthophrys)		Terrestrial	
Petrel, Hawaiian Dark-rumped	E	Bird	No
(Pterodroma phaeopygia sandwichensis)		Terrestrial	
Po'ouli	E	Bird	No
(Melamprosops phaeosoma)		Terrestrial	
Shearwater, Newell's Townsend's	T	Bird	No
(Puffinus auricularis newelli)		Terrestrial, Saltwater	
Stilt, Hawaiian (=Ae'o)	E	Bird	No
(Himantopus mexicanus knudseni)		Terrestrial	
Thrush, Large Kauai	E	Bird	No
(Myadestes myadestinus)		Terrestrial	
Thrush, Molokai (Oloma'o)	E	Bird	No
(Myadestes lanaiensis rutha)		Terrestrial	
Thrush, Small Kauai (Puaiohi)	E	Bird	No
(Myadestes palmeri)		Terrestrial	
Amphipod, Kauai Cave	E	Crustacean	Yes
(Spelaeorchestia koloana)		Freshwater, Subterraneous	
Abutilon eremitopetalum (ncn)	E	Dicot	Yes
(Abutilon eremitopetalum)		Terrestrial	
Abutilon sandwicense (ncn)	E	Dicot	Yes
(Abutilon sandwicense)		Terrestrial	
Achyranthes mutica (ncn)	E	Dicot	Yes
(Achyranthes mutica)		Terrestrial	
Achyranthes splendens var. rotundata (ncn)	E	Dicot	No
(Achyranthes splendens var. rotundata)		Terrestrial	
A'e (Zanthoxylum dipetalum var. tomentosum)	E	Dicot	Yes
(Zanthoxylum dipetalum var. tomentosum)		Terrestrial	
A'e (Zanthoxylum hawaiiense)	E	Dicot	Yes
(Zanthoxylum hawaiiense)		Terrestrial	
'Aiea (Nothocestrum breviflorum)	E	Dicot	Yes
(Nothocestrum breviflorum)		Terrestrial	
'Aiea (Nothocestrum peltatum)	E	Dicot	Yes
(Nothocestrum peltatum)		Terrestrial	
'Akoko (Chamaesyce celastroides var. kaenana)	E	Dicot	Yes
(Chamaesyce celastroides var. kaenana)		Terrestrial	
'Akoko (Chamaesyce deppeana)	E	Dicot	Yes
(Chamaesyce deppeana)		Terrestrial	
'Akoko (Chamaesyce herbstii)	E	Dicot	Yes
(Chamaesyce herbstii)		Terrestrial	
'Akoko (Chamaesyce kuwaleana)	E	Dicot	Yes
(Chamaesyce kuwaleana)		Terrestrial	
'Akoko (Chamaesyce rockii)	E	Dicot	Yes
(Chamaesyce rockii)		Terrestrial	
'Akoko (Chamaesyce skottsbergii var. skottsbe	E	Dicot	No
(Chamaesyce skottsbergii var. kalaeloana)		Terrestrial	
'Akoko (Euphorbia haeleeleana)	E	Dicot	Yes
(Euphorbia haeleeleana)		Terrestrial	
Alani (Melicope adscendens)	E	Dicot	Yes
(Melicope adscendens)		Terrestrial	

Hawaii	(313) species:		**Taxa**	Critical Habitat
Alani (Melicope balloui)		E	Dicot	Yes
(Melicope balloui)		Terrestrial		
Alani (Melicope haupuensis)		E	Dicot	Yes
(Melicope haupuensis)		Terrestrial		
Alani (Melicope knudsenii)		E	Dicot	Yes
(Melicope knudsenii)		Terrestrial		
Alani (Melicope lydgatei)		E	Dicot	Yes
(Melicope lydgatei)		Terrestrial		
Alani (Melicope mucronulata)		E	Dicot	Yes
(Melicope mucronulata)		Terrestrial		
Alani (Melicope munroi)		E	Dicot	No
(Melicope munroi)		Terrestrial		
Alani (Melicope ovalis)		E	Dicot	Yes
(Melicope ovalis)		Terrestrial		
Alani (Melicope pallida)		E	Dicot	Yes
(Melicope pallida)		Terrestrial		
Alani (Melicope quadrangularis)		E	Dicot	No
(Melicope quadrangularis)		Terrestrial		
Alani (Melicope reflexa)		E	Dicot	Yes
(Melicope reflexa)		Terrestrial		
Alani (Melicope saint-johnii)		E	Dicot	Yes
(Melicope saint-johnii)		Terrestrial		
Alani (Melicope zahlbruckneri)		E	Dicot	Yes
(Melicope zahlbruckneri)		Terrestrial		
Alsinidendron obovatum (ncn)		E	Dicot	Yes
(Alsinidendron obovatum)		Terrestrial		
Alsinidendron trinerve (ncn)		E	Dicot	Yes
(Alsinidendron trinerve)		Terrestrial		
Alsinidendron viscosum (ncn)		E	Dicot	Yes
(Alsinidendron viscosum)		Terrestrial		
Amaranthus brownii (ncn)		E	Dicot	Yes
(Amaranthus brownii)		Terrestrial		
'Anaunau (Lepidium arbuscula)		E	Dicot	Yes
(Lepidium arbuscula)		Terrestrial		
'Anunu (Sicyos alba)		E	Dicot	Yes
(Sicyos alba)		Terrestrial		
Aupaka (Isodendrion hosakae)		E	Dicot	Yes
(Isodendrion hosakae)		Terrestrial		
Aupaka (Isodendrion laurifolium)		E	Dicot	Yes
(Isodendrion laurifolium)		Terrestrial		
Aupaka (Isodendrion longifolium)		T	Dicot	Yes
(Isodendrion longifolium)		Terrestrial		
'Awikiwiki (Canavalia molokaiensis)		E	Dicot	Yes
(Canavalia molokaiensis)		Terrestrial		
'Awiwi (Centaurium sebaeoides)		E	Dicot	Yes
(Centaurium sebaeoides)		Terrestrial		
'Awiwi (Hedyotis cookiana)		E	Dicot	Yes
(Hedyotis cookiana)		Terrestrial		
Bonamia menziesii (ncn)		E	Dicot	Yes
(Bonamia menziesii)		Terrestrial		

Hawaii (313) species:			**Taxa**	Critical Habitat
Chamaesyce Halemanui (ncn)	E		Dicot	Yes
(Chamaesyce halemanui)		Terrestrial		
Cyanea undulata (ncn)	E		Dicot	Yes
(Cyanea undulata)		Terrestrial		
Delissea rhytodisperma (ncn)	E		Dicot	Yes
(Delissea rhytidosperma)		Terrestrial		
Dubautia latifolia (ncn)	E		Dicot	Yes
(Dubautia latifolia)		Terrestrial		
Dubautia pauciflorula (ncn)	E		Dicot	Yes
(Dubautia pauciflorula)		Terrestrial		
Geranium, Hawaiian Red-flowered	E		Dicot	Yes
(Geranium arboreum)		Terrestrial		
Gouania hillebrandii (ncn)	E		Dicot	Yes
(Gouania hillebrandii)		Terrestrial		
Gouania meyenii (ncn)	E		Dicot	Yes
(Gouania meyenii)		Terrestrial		
Gouania vitifolia (ncn)	E		Dicot	Yes
(Gouania vitifolia)		Terrestrial		
Haha (Cyanea acuminata)	E		Dicot	Yes
(Cyanea acuminata)		Terrestrial		
Haha (Cyanea asarifolia)	E		Dicot	Yes
(Cyanea asarifolia)		Terrestrial		
Haha (Cyanea copelandii ssp. copelandii)	E		Dicot	No
(Cyanea copelandii ssp. copelandii)		Terrestrial		
Haha (Cyanea copelandii ssp. haleakalaensis)	E		Dicot	Yes
(Cyanea copelandii ssp. haleakalaensis)		Terrestrial		
Haha (Cyanea Crispa) (=Rollandia crispa)	E		Dicot	Yes
(Cyanea (=Rollandia) crispa)		Terrestrial		
Haha (Cyanea dunbarii)	E		Dicot	Yes
(Cyanea dunbarii)		Terrestrial		
Haha (Cyanea glabra)	E		Dicot	Yes
(Cyanea glabra)		Terrestrial		
Haha (Cyanea grimesiana ssp. grimesiana)	E		Dicot	Yes
(Cyanea grimesiana ssp. grimesiana)		Terrestrial		
Haha (Cyanea grimesiana ssp. obatae)	E		Dicot	Yes
(Cyanea grimesiana ssp. obatae)		Terrestrial		
Haha (Cyanea hamatiflora ssp. carlsonii)	E		Dicot	Yes
(Cyanea hamatiflora ssp. Carlsonii)		Terrestrial		
Haha (Cyanea hamatiflora ssp. hamatiflora)	E		Dicot	Yes
(Cyanea hamatiflora ssp. hamatiflora)		Terrestrial		
Haha (Cyanea humboldtiana)	E		Dicot	Yes
(Cyanea humboldtiana)		Terrestrial		
Haha (Cyanea koolauensis)	E		Dicot	Yes
(Cyanea koolauensis)		Terrestrial		
Haha (Cyanea longiflora)	E		Dicot	Yes
(Cyanea longiflora)		Terrestrial		
Haha (Cyanea Macrostegia var. gibsonii)	E		Dicot	No
(Cyanea macrostegia ssp. gibsonii)		Terrestrial		
Haha (Cyanea mannii)	E		Dicot	Yes
(Cyanea mannii)		Terrestrial		

Hawaii (313) species:		**Taxa**	Critical Habitat
Haha (Cyanea mceldowneyi)	E	Dicot	Yes
(Cyanea mceldowneyi)		Terrestrial	
Haha (Cyanea pinnatifida)	E	Dicot	Yes
(Cyanea pinnatifida)		Terrestrial	
Haha (Cyanea platyphylla)	E	Dicot	Yes
(Cyanea platyphylla)		Terrestrial	
Haha (Cyanea procera)	E	Dicot	Yes
(Cyanea procera)		Terrestrial	
Haha (Cyanea recta)	T	Dicot	Yes
(Cyanea recta)		Terrestrial	
Haha (Cyanea remyi)	E	Dicot	Yes
(Cyanea remyi)		Terrestrial	
Haha (Cyanea shipmanii)	E	Dicot	Yes
(Cyanea shipmannii)		Terrestrial	
Haha (Cyanea stictophylla)	E	Dicot	Yes
(Cyanea stictophylla)		Terrestrial	
Haha (Cyanea St-Johnii) (=Rollandia St-Johnii)	E	Dicot	Yes
(Cyanea st-johnii)		Terrestrial	
Haha (Cyanea superba)	E	Dicot	Yes
(Cyanea superba)		Terrestrial	
Ha'lwale (Cyrtandra crenata)	E	Dicot	No
(Cyrtandra crenata)		Terrestrial	
Ha'lwale (Cyrtandra dentata)	E	Dicot	Yes
(Cyrtandra dentata)		Terrestrial	
Ha'lwale (Cyrtandra giffardii)	E	Dicot	Yes
(Cyrtandra giffardii)		Terrestrial	
Ha'lwale (Cyrtandra limahuliensis)	T	Dicot	Yes
(Cyrtandra limahuliensis)		Terrestrial	
Ha'lwale (Cyrtandra munroi)	E	Dicot	Yes
(Cyrtandra munroi)		Terrestrial	
Ha'lwale (Cyrtandra polyantha)	E	Dicot	Yes
(Cyrtandra polyantha)		Terrestrial	
Ha'lwale (Cyrtandra subumbellata)	E	Dicot	Yes
(Cyrtandra subumbellata)		Terrestrial	
Ha'lwale (Cyrtandra tintinnabula)	E	Dicot	Yes
(Cyrtandra tintinnabula)		Terrestrial	
Ha'lwale (Cyrtandra viridiflora)	E	Dicot	Yes
(Cyrtandra viridiflora)		Terrestrial	
Haplostachys Haplostachya (ncn)	E	Dicot	No
(Haplostachys haplostachya)		Terrestrial	
Hau Kauhiwi (Hibiscadelphus woodi)	E	Dicot	Yes
(Hibiscadelphus woodii)		Terrestrial	
Hau Kuahiwi (Hibiscadelphus distans)	E	Dicot	No
(Hibiscadelphus distans)		Terrestrial	
Heau (Exocarpos luteolus)	E	Dicot	Yes
(Exocarpos luteolus)		Terrestrial	
Hedyotis degeneri (ncn)	E	Dicot	Yes
(Hedyotis degeneri)		Terrestrial	
Hedyotis parvula (ncn)	E	Dicot	Yes
(Hedyotis parvula)		Terrestrial	

Hawaii (313) species:			**Taxa**	Critical Habitat
Hedyotis St.-Johnii (ncn)	E		Dicot	Yes
(Hedyotis st.-johnii)		Terrestrial		
Hesperomannia arborescens (ncn)	E		Dicot	Yes
(Hesperomannia arborescens)		Terrestrial		
Hesperomannia arbuscula (ncn)	E		Dicot	Yes
(Hesperomannia arbuscula)		Terrestrial		
Hesperomannia lydgatei (ncn)	E		Dicot	Yes
(Hesperomannia lydgatei)		Terrestrial		
Hibiscus, Clay's	E		Dicot	Yes
(Hibiscus clayi)		Terrestrial		
Holei (Ochrosia kilaueaensis)	E		Dicot	No
(Ochrosia kilaueaensis)		Terrestrial		
Iliau (Wilkesia hobdyi)	E		Dicot	Yes
(Wilkesia hobdyi)		Terrestrial		
Kamakahala (Labordia cyrtandrae)	E		Dicot	Yes
(Labordia cyrtandrae)		Terrestrial		
Kamakahala (Labordia lydgatei)	E		Dicot	Yes
(Labordia lydgatei)		Terrestrial		
Kamakahala (Labordia tinifolia var. lanaiensis)	E		Dicot	No
(Labordia tinifolia var. lanaiensis)		Terrestrial		
Kamakahala (Labordia tinifolia var. wahiawaen)	E		Dicot	Yes
(Labordia tinifolia var. wahiawaensis)		Terrestrial		
Kamakahala (Labordia triflora)	E		Dicot	No
(Labordia triflora)		Terrestrial		
Kanaloa kahoolawensis (ncn)	E		Dicot	Yes
(Kanaloa kahoolawensis)		Terrestrial		
Kauila (Colubrina oppositifolia)	E		Dicot	Yes
(Colubrina oppositifolia)		Terrestrial		
Kaulu (Pteralyxia kauaiensis)	E		Dicot	Yes
(Pteralyxia kauaiensis)		Terrestrial		
Kio'Ele (Hedyotis coriacea)	E		Dicot	Yes
(Hedyotis coriacea)		Terrestrial		
Kiponapona (Phyllostegia racemosa)	E		Dicot	Yes
(Phyllostegia racemosa)		Terrestrial		
Koki'o (Kokia drynarioides)	E		Dicot	Yes
(Kokia drynarioides)		Terrestrial		
Koki'o (Kokia kauaiensis)	E		Dicot	Yes
(Kokia kauaiensis)		Terrestrial		
Koki'o Ke'oke'o (Hibiscus arnottianus ssp. immaculatus)	E		Dicot	Yes
(Hibiscus arnottianus ssp. immaculatus)		Terrestrial		
Koki'o Ke'oke'o (Hibiscus waimeae ssp. hannerae)	E		Dicot	Yes
(Hibiscus waimeae ssp. hannerae)		Terrestrial		
Kolea (Myrsine juddii)	E		Dicot	Yes
(Myrsine juddii)		Terrestrial		
Kolea (Myrsine linearifolia)	T		Dicot	Yes
(Myrsine linearifolia)		Terrestrial		
Ko'oko'olau (Bidens micrantha ssp. kalealaha)	E		Dicot	Yes
(Bidens micrantha ssp. kalealaha)		Terrestrial		
Ko'oko'olau (Bidens wiebkei)	E		Dicot	Yes
(Bidens wiebkei)		Terrestrial		

Hawaii (313) species:			**Taxa**	Critical Habitat
Ko'oloa'ula (Abutilon menziesii)	E		Dicot	No
(Abutilon menziesii)		Terrestrial		
Kopa (Hedyotis schlechtendahliana var. remyi)	E		Dicot	No
(Hedyotis schlechtendahliana var. remyi)		Terrestrial		
Kuawawaenohu (Alsinidendron lychnoides)	E		Dicot	Yes
(Alsinidendron lychnoides)		Terrestrial		
Kulu'l (Nototrichium humile)	E		Dicot	Yes
(Nototrichium humile)		Terrestrial		
Laukahi Kuahiwi (Plantago hawaiensis)	E		Dicot	Yes
(Plantago hawaiensis)		Terrestrial		
Laukahi Kuahiwi (Plantago princeps)	E		Dicot	Yes
(Plantago princeps)		Terrestrial		
Laulihilihi (Schiedea stellarioides)	E		Dicot	Yes
(Schiedea stellarioides)		Terrestrial		
Lipochaeta venosa (ncn)	E		Dicot	No
(Lipochaeta venosa)		Terrestrial		
Lobelia monostachya (ncn)	E		Dicot	Yes
(Lobelia monostachya)		Terrestrial		
Lobelia niihauensis (ncn)	E		Dicot	Yes
(Lobelia niihauensis)		Terrestrial		
Lobelia oahuensis (ncn)	E		Dicot	Yes
(Lobelia oahuensis)		Terrestrial		
Lysimachia filifolia (ncn)	E		Dicot	Yes
(Lysimachia filifolia)		Terrestrial		
Lysimachia lydgatei (ncn)	E		Dicot	Yes
(Lysimachia lydgatei)		Terrestrial		
Lysimachia maxima (ncn)	E		Dicot	Yes
(Lysimachia maxima)		Terrestrial		
Mahoe (Alectryon macrococcus)	E		Dicot	Yes
(Alectryon macrococcus)		Terrestrial		
Makou (Peucedanum sandwicense)	T		Dicot	Yes
(Peucedanum sandwicense)		Terrestrial		
Ma'o Hau Hele (Hibiscus brackenridgei)	E		Dicot	Yes
(Hibiscus brackenridgei)		Terrestrial		
Ma'oli'oli (Schiedea apokremnos)	E		Dicot	Yes
(Schiedea apokremnos)		Terrestrial		
Ma'oli'oli (Schiedea kealiae)	E		Dicot	Yes
(Schiedea kealiae)		Terrestrial		
Mapele (Cyrtandra cyaneoides)	E		Dicot	Yes
(Cyrtandra cyaneoides)		Terrestrial		
Mehamehame (Flueggea neowawraea)	E		Dicot	Yes
(Flueggea neowawraea)		Terrestrial		
Munroidendron racemosum (ncn)	E		Dicot	Yes
(Munroidendron racemosum)		Terrestrial		
Na'ena'e (Dubautia herbstobatae)	E		Dicot	Yes
(Dubautia herbstobatae)		Terrestrial		
Na'ena'e (Dubautia plantaginea ssp. humilis)	E		Dicot	Yes
(Dubautia plantaginea ssp. humilis)		Terrestrial		
Nani Wai'ale'ale (Viola kauaensis var. wahiawaensis)	E		Dicot	Yes
(Viola kauaiensis var. wahiawaensis)		Terrestrial		

Hawaii (313) species:			**Taxa**	Critical Habitat
Nanu (Gardenia mannii)	E		Dicot	Yes
(Gardenia mannii)		Terrestrial		
Na'u (Gardenia brighamii)	E		Dicot	No
(Gardenia brighamii)		Terrestrial		
Naupaka, Dwarf (Scaevola coriacea)	E		Dicot	No
(Scaevola coriacea)		Terrestrial		
Nehe (Lipochaeta fauriei)	E		Dicot	Yes
(Lipochaeta fauriei)		Terrestrial		
Nehe (Lipochaeta kamolensis)	E		Dicot	Yes
(Lipochaeta kamolensis)		Terrestrial		
Nehe (Lipochaeta lobata var. leptophylla)	E		Dicot	Yes
(Lipochaeta lobata var. leptophylla)		Terrestrial		
Nehe (Lipochaeta micrantha)	E		Dicot	Yes
(Lipochaeta micrantha)		Terrestrial		
Nehe (Lipochaeta tenuifolia)	E		Dicot	Yes
(Lipochaeta tenuifolia)		Terrestrial		
Nehe (Lipochaeta waimeaensis)	E		Dicot	Yes
(Lipochaeta waimeaensis)		Terrestrial		
Neraudia angulata (ncn)	E		Dicot	Yes
(Neraudia angulata)		Terrestrial		
Neraudia ovata (ncn)	E		Dicot	Yes
(Neraudia ovata)		Terrestrial		
Neraudia sericea (ncn)	E		Dicot	Yes
(Neraudia sericea)		Terrestrial		
Nioi (Eugenia koolauensis)	E		Dicot	Yes
(Eugenia koolauensis)		Terrestrial		
Nohoanu (Geranium multiflorum)	E		Dicot	Yes
(Geranium multiflorum)		Terrestrial		
'Oha (Delissea rivularis)	E		Dicot	Yes
(Delissea rivularis)		Terrestrial		
'Oha (Delissea subcordata)	E		Dicot	Yes
(Delissea subcordata)		Terrestrial		
'Oha (Delissea undulata)	E		Dicot	Yes
(Delissea undulata)		Terrestrial		
'Oha (Lobelia gaudichaudii koolauensis)	E		Dicot	Yes
(Lobelia gaudichaudii ssp. koolauensis)		Terrestrial		
'Oha Wai (Clermontia drepanomorpha)	E		Dicot	Yes
(Clermontia drepanomorpha)		Terrestrial		
'Oha Wai (Clermontia lindseyana)	E		Dicot	Yes
(Clermontia lindseyana)		Terrestrial		
'Oha Wai (Clermontia oblongifolia ssp. brevipes)	E		Dicot	Yes
(Clermontia oblongifolia ssp. brevipes)		Terrestrial		
'Oha Wai (Clermontia oblongifolia ssp. mauiensis)	E		Dicot	Yes
(Clermontia oblongifolia ssp. mauiensis)		Terrestrial		
'Oha Wai (Clermontia peleana)	E		Dicot	Yes
(Clermontia peleana)		Terrestrial		
'Oha Wai (Clermontia pyrularia)	E		Dicot	Yes
(Clermontia pyrularia)		Terrestrial		
'Oha Wai (Clermontia samuelii)	E		Dicot	Yes
(Clermontia samuelii)		Terrestrial		

Hawaii (313) species:			**Taxa**	Critical Habitat
'Ohai (Sesbania tomentosa)	E		Dicot	Yes
(Sesbania tomentosa)		Terrestrial		
'Ohe'ohe (Tetraplasandra gymnocarpa)	E		Dicot	Yes
(Tetraplasandra gymnocarpa)		Terrestrial		
'Olulu (Brighamia insignis)	E		Dicot	Yes
(Brighamia insignis)		Terrestrial		
Opuhe (Urera kaalae)	E		Dicot	Yes
(Urera kaalae)		Terrestrial		
Pamakani (Viola chamissoniana ssp. chamissoniana)	E		Dicot	Yes
(Viola chamissoniana ssp. chamissoniana)		Terrestrial		
Phyllostegia hirsuta (ncn)	E		Dicot	Yes
(Phyllostegia hirsuta)		Terrestrial		
Phyllostegia kaalaensis (ncn)	E		Dicot	Yes
(Phyllostegia kaalaensis)		Terrestrial		
Phyllostegia knudsenii (ncn)	E		Dicot	Yes
(Phyllostegia knudsenii)		Terrestrial		
Phyllostegia mannii (ncn)	E		Dicot	Yes
(Phyllostegia mannii)		Terrestrial		
Phyllostegia mollis (ncn)	E		Dicot	Yes
(Phyllostegia mollis)		Terrestrial		
Phyllostegia parviflora (ncn)	E		Dicot	Yes
(Phyllostegia parviflora)		Terrestrial		
Phyllostegia velutina (ncn)	E		Dicot	Yes
(Phyllostegia velutina)		Terrestrial		
Phyllostegia waimeae (ncn)	E		Dicot	Yes
(Phyllostegia waimeae)		Terrestrial		
Phyllostegia warshaueri (ncn)	E		Dicot	Yes
(Phyllostegia warshaueri)		Terrestrial		
Phyllostegia wawrana (ncn)	E		Dicot	Yes
(Phyllostegia wawrana)		Terrestrial		
Pilo (Hedyotis mannii)	E		Dicot	Yes
(Hedyotis mannii)		Terrestrial		
Po'e (Portulaca sclerocarpa)	E		Dicot	Yes
(Portulaca sclerocarpa)		Terrestrial		
Popolo 'Aiakeakua (Solanum sandwicense)	E		Dicot	Yes
(Solanum sandwicense)		Terrestrial		
Popolo Ku Mai (Solanum incompletum)	E		Dicot	Yes
(Solanum incompletum)		Terrestrial		
Pua'ala (Brighamia rockii)	E		Dicot	Yes
(Brighamia rockii)		Terrestrial		
Remya kauaiensis (ncn)	E		Dicot	Yes
(Remya kauaiensis)		Terrestrial		
Remya montgomeryi (ncn)	E		Dicot	Yes
(Remya montgomeryi)		Terrestrial		
Remya, Maui	E		Dicot	Yes
(Remya mauiensis)		Terrestrial		
Sandalwood, Lanai (='Iliahi)	E		Dicot	No
(Santalum freycinetianum var. lanaiense)		Terrestrial		
Sanicula mariversa (ncn)	E		Dicot	Yes
(Sanicula mariversa)		Terrestrial		

Hawaii	(313) species:		**Taxa**	Critical Habitat
Sanicula purpurea (ncn)		E	Dicot	Yes
(Sanicula purpurea)			Terrestrial	
Schiedea haleakalensis (ncn)		E	Dicot	Yes
(Schiedea haleakalensis)			Terrestrial	
Schiedea helleri (ncn)		E	Dicot	Yes
(Schiedea helleri)			Terrestrial	
Schiedea hookeri (ncn)		E	Dicot	Yes
(Schiedea hookeri)			Terrestrial	
Schiedea kaalae (ncn)		E	Dicot	Yes
(Schiedea kaalae)			Terrestrial	
Schiedea kauaiensis (ncn)		E	Dicot	Yes
(Schiedea kauaiensis)			Terrestrial	
Schiedea lydgatei (ncn)		E	Dicot	Yes
(Schiedea lydgatei)			Terrestrial	
Schiedea membranacea (ncn)		E	Dicot	Yes
(Schiedea membranacea)			Terrestrial	
Schiedea nuttallii (ncn)		E	Dicot	Yes
(Schiedea nuttallii)			Terrestrial	
Schiedea sarmentosa (ncn)		E	Dicot	Yes
(Schiedea sarmentosa)			Terrestrial	
Schiedea spergulina var. leiopoda (ncn)		E	Dicot	Yes
(Schiedea spergulina var. leiopoda)			Terrestrial	
Schiedea spergulina var. spergulina (ncn)		T	Dicot	Yes
(Schiedea spergulina var. spergulina)			Terrestrial	
Schiedea verticillata (ncn)		E	Dicot	Yes
(Schiedea verticillata)			Terrestrial	
Schiedea, Diamond Head (Schiedea adamantis)		E	Dicot	No
(Schiedea adamantis)			Terrestrial	
Silene alexandri (ncn)		E	Dicot	Yes
(Silene alexandri)			Terrestrial	
Silene hawaiiensis (ncn)		T	Dicot	Yes
(Silene hawaiiensis)			Terrestrial	
Silene lanceolata (ncn)		E	Dicot	Yes
(Silene lanceolata)			Terrestrial	
Silene perlmanii (ncn)		E	Dicot	Yes
(Silene perlmanii)			Terrestrial	
Silversword, Haleakala ('Ahinahina)		T	Dicot	Yes
(Argyroxiphium sandwicense ssp. macrocephalum)			Terrestrial	
Silversword, Ka'u (Argyroxiphium kauense)		E	Dicot	Yes
(Argyroxiphium kauense)			Terrestrial	
Silversword, Mauna Kea ('Ahinahina)		E	Dicot	No
(Argyroxiphium sandwicense ssp. sandwicense)			Terrestrial	
Spermolepis hawaiiensis (ncn)		E	Dicot	Yes
(Spermolepis hawaiiensis)			Terrestrial	
Stenogyne angustifolia (ncn)		E	Dicot	No
(Stenogyne angustifolia var. angustifolia)			Terrestrial	
Stenogyne bifida (ncn)		E	Dicot	Yes
(Stenogyne bifida)			Terrestrial	
Stenogyne campanulata (ncn)		E	Dicot	Yes
(Stenogyne campanulata)			Terrestrial	

Hawaii (313) species:		**Taxa**	Critical Habitat
Stenogyne kanehoana (ncn)	E	Dicot	Yes
(Stenogyne kanehoana)		Terrestrial	
Tetramolopium arenarium (ncn)	E	Dicot	No
(Tetramolopium arenarium)		Terrestrial	
Tetramolopium capillare (ncn)	E	Dicot	Yes
(Tetramolopium capillare)		Terrestrial	
Tetramolopium filiforme (ncn)	E	Dicot	Yes
(Tetramolopium filiforme)		Terrestrial	
Tetramolopium lepidotum ssp. lepidotum (ncn)	E	Dicot	Yes
(Tetramolopium lepidotum ssp. lepidotum)		Terrestrial	
Tetramolopium remyi (ncn)	E	Dicot	Yes
(Tetramolopium remyi)		Terrestrial	
Tetramolopium rockii (ncn)	T	Dicot	Yes
(Tetramolopium rockii)		Terrestrial, Coastal	
Trematolobelia singularis (ncn)	E	Dicot	Yes
(Trematolobelia singularis)		Terrestrial	
Uhiuhi (Caesalpinia kavaiensis)	E	Dicot	No
(Caesalpinia kavaiense)		Terrestrial	
Ulihi (Phyllostegia glabra var. lanaiensis)	E	Dicot	No
(Phyllostegia glabra var. lanaiensis)		Terrestrial	
Vetch, Hawaiian (Vicia menziesii)	E	Dicot	No
(Vicia menziesii)		Terrestrial	
Vigna o-wahuensis (ncn)	E	Dicot	Yes
(Vigna o-wahuensis)		Terrestrial	
Viola helenae (ncn)	E	Dicot	Yes
(Viola helenae)		Terrestrial	
Viola lanaiensis (ncn)	E	Dicot	No
(Viola lanaiensis)		Terrestrial	
Viola oahuensis (ncn)	E	Dicot	Yes
(Viola oahuensis)		Terrestrial	
Wahine Noho Kula (Isodendrion pyrifolium)	E	Dicot	Yes
(Isodendrion pyrifolium)		Terrestrial	
Xylosma crenatum (ncn)	E	Dicot	Yes
(Xylosma crenatum)		Terrestrial	
Asplenium fragile var. insulare (ncn)	E	Ferns	Yes
(Asplenium fragile var. insulare)		Terrestrial	
Diellia erecta (ncn)	E	Ferns	Yes
(Diellia erecta)		Terrestrial	
Diellia falcata (ncn)	E	Ferns	Yes
(Diellia falcata)		Terrestrial	
Diellia pallida (ncn)	E	Ferns	Yes
(Diellia pallida)		Terrestrial	
Diellia unisora (ncn)	E	Ferns	Yes
(Diellia unisora)		Terrestrial	
Diplazium molokaiense (ncn)	E	Ferns	Yes
(Diplazium molokaiense)		Terrestrial	
Fern, Pendant Kihi (Adenophorus periens)	E	Ferns	Yes
(Adenophorus periens)		Terrestrial	
'Ihi'Ihi (Marsilea villosa)	E	Ferns	Yes
(Marsilea villosa)		Terrestrial, Vernal pool	

Hawaii (313) species:		**Taxa**	Critical Habitat
Pauoa (Ctenitis squamigera)	E	Ferns	Yes
(Ctenitis squamigera)		Terrestrial	
Pteris lidgatei (ncn)	E	Ferns	Yes
(Pteris lidgatei)		Terrestrial	
Wawae'lole (Phlegmariurus (=Huperzia) mannii)	E	Ferns	Yes
(Huperzia mannii)		Terrestrial	
Wawae'lole (Phlegmariurus (=Lycopodium) nutans)	E	Ferns	Yes
(Lycopodium (=Phlegmariurus) nutans)		Terrestrial	
Snail, Newcomb's	T	Gastropod	Yes
(Erinna newcombi)		Freshwater	
Fly, Hawaiian picture-wing	E	Insect	No
(Drosophila tarphytrichia)		Terrestrial	
Fly, Hawaiian picture-wing	E	Insect	No
(Drosophila ochrobasis)		Terrestrial	
Fly, Hawaiian picture-wing	E	Insect	No
(Drosophila neoclavisetae)		Terrestrial	
Fly, Hawaiian picture-wing	E	Insect	No
(Drosophila musaphilia)		Terrestrial	
Fly, Hawaiian picture-wing	T	Insect	No
(Drosophila mulli)		Terrestrial	
Fly, Hawaiian picture-wing	E	Insect	No
(Drosophila heteroneura)		Terrestrial	
Moth, Blackburn's Sphinx	E	Insect	Yes
(Manduca blackburni)		Terrestrial	
Bat, Hawaiian Hoary	E	Mammal	No
(Lasiurus cinereus semotus)		Terrestrial, Subterraneous	
Seal, Hawaiian Monk	E	Marine mml	Yes
(Monachus schauinslandi)		Saltwater, Coastal	
Bluegrass, Hawaiian	E	Monocot	Yes
(Poa sandvicensis)		Terrestrial	
Bluegrass, Mann's (Poa mannii)	E	Monocot	Yes
(Poa mannii)		Terrestrial	
Gahnia Lanaiensis (ncn)	E	Monocot	No
(Gahnia lanaiensis)		Terrestrial	
Grass, Fosberg's Love	E	Monocot	Yes
(Eragrostis fosbergii)		Terrestrial	
Hala Pepe (Pleomele hawaiiensis)	E	Monocot	Yes
(Pleomele hawaiiensis)		Terrestrial	
Hilo Ischaemum (Ischaemum byrone)	E	Monocot	Yes
(Ischaemum byrone)		Terrestrial	
Kamanomano (Cenchrus agrimonioides)	E	Monocot	Yes
(Cenchrus agrimonioides)		Terrestrial	
Lau'ehu (Panicum niihauense)	E	Monocot	Yes
(Panicum niihauense)		Terrestrial	
Lo`ulu (Pritchardia affinis)	E	Monocot	No
(Pritchardia affinis)		Terrestrial	
Lo`ulu (Pritchardia kaalae)	E	Monocot	No
(Pritchardia kaalae)		Terrestrial	
Lo`ulu (Pritchardia munroi)	E	Monocot	Yes
(Pritchardia munroi)		Terrestrial	

Hawaii (313) species:

		Taxa	Critical Habitat
Lo`ulu (Pritchardia napaliensis)	E	Monocot	No
(Pritchardia napaliensis)		Terrestrial	
Lo`ulu (Pritchardia remota)	E	Monocot	Yes
(Pritchardia remota)		Terrestrial	
Lo`ulu (Pritchardia schattaueri)	E	Monocot	No
(Pritchardia schattaueri)		Terrestrial	
Lo`ulu (Pritchardia viscosa)	E	Monocot	No
(Pritchardia viscosa)		Terrestrial	
Mariscus fauriei (ncn)	E	Monocot	Yes
(Mariscus fauriei)		Terrestrial	
Mariscus pennatiformis (ncn)	E	Monocot	Yes
(Mariscus pennatiformis)		Terrestrial	
Panicgrass, Carter's (Panicum fauriei var.carteri)	E	Monocot	Yes
(Panicum fauriei var. carteri)		Terrestrial	
Platanthera holochila (ncn)	E	Monocot	Yes
(Platanthera holochila)		Terrestrial	
Poa siphonoglossa (ncn)	E	Monocot	Yes
(Poa siphonoglossa)		Terrestrial	
Pu'uka'a (Cyperus trachysanthos)	E	Monocot	Yes
(Cyperus trachysanthos)		Terrestrial	
Wahane (Pritchardia aylmer-robinsonii)	E	Monocot	No
(Pritchardia aylmer-robinsonii)		Terrestrial	
Sea turtle, green	E	Reptile	Yes
(Chelonia mydas)		Saltwater	
Sea turtle, hawksbill	E	Reptile	Yes
(Eretmochelys imbricata)		Saltwater, Coastal	

Idaho (16) species:

		Taxa	Critical Habitat
Crane, Whooping	E	Bird	Yes
(Grus americana)		Terrestrial, Freshwater	
Catchfly, Spalding's	T	Dicot	No
(Silene spaldingii)		Terrestrial	
Four-o'clock, Macfarlane's	T	Dicot	No
(Mirabilis macfarlanei)		Terrestrial	
Howellia, Water	T	Dicot	No
(Howellia aquatilis)		Freshwater	
Salmon, Sockeye	E	Fish	No
(Oncorhynchus (=Salmo) nerka)		Freshwater, Brackish, Saltwater	
Steelhead	E	Fish	Yes
(Oncorhynchus (=Salmo) mykiss)		Freshwater, Brackish, Saltwater	
Sturgeon, White	E	Fish	Yes
(Acipenser transmontanus)		Freshwater, Saltwater	
Trout, Bull	T	Fish	Yes
(Salvelinus confluentus)		Freshwater	
Limpet, Banbury Springs	E	Gastropod	No
(Lanx sp.)		Freshwater	
Snail, Bliss Rapids	T	Gastropod	No
(Taylorconcha serpenticola)		Freshwater	
Snail, Snake River Physa	E	Gastropod	No
(Physa natricina)		Terrestrial	
Snail, Utah Valvata	E	Gastropod	No
(Valvata utahensis)		Terrestrial	

Idaho (16) species:

		Taxa	Critical Habitat
Springsnail, Bruneau Hot	E	Gastropod	No
(Pyrgulopsis bruneauensis)		Freshwater	
Bear, Grizzly	T	Mammal	No
(Ursus arctos horribilis)		Terrestrial	
Caribou, Woodland	E	Mammal	No
(Rangifer tarandus caribou)		Terrestrial	
Squirrel, Northern Idaho Ground	T	Mammal	No
(Spermophilus brunneus brunneus)		Terrestrial	

Illinois (25) species:

		Taxa	Critical Habitat
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Fanshell	E	Bivalve	No
(Cyprogenia stegaria)		Freshwater	
Mucket, Pink (Pearlymussel)	E	Bivalve	No
(Lampsilis abrupta)		Freshwater	
Mussel, Clubshell	E	Bivalve	No
(Pleurobema clava)		Freshwater	
Pearlymussel, Fat Pocketbook	E	Bivalve	No
(Potamilus capax)		Freshwater	
Pearlymussel, Higgins' Eye	E	Bivalve	No
(Lampsilis higginsii)		Freshwater	
Pearlymussel, Orange-footed	E	Bivalve	No
(Plethobasus cooperianus)		Freshwater	
Pearlymussel, White Wartyback	E	Bivalve	No
(Plethobasus cicatricosus)		Freshwater	
Amphipod, Illinois Cave	E	Crustacean	No
(Gammarus acherondytes)		Freshwater, Subterraneous	
Aster, Decurrent False	T	Dicot	No
(Boltonia decurrens)		Terrestrial, Freshwater	
Clover, Leafy Prairie	E	Dicot	No
(Dalea foliosa)		Terrestrial	
Clover, Prairie Bush	T	Dicot	No
(Lespedeza leptostachya)		Terrestrial	
Daisy, Lakeside	T	Dicot	No
(Hymenoxys herbacea)		Freshwater	
Milkweed, Mead's	T	Dicot	No
(Asclepias meadii)		Terrestrial	
Potato-bean, Price's	T	Dicot	No
(Apios priceana)		Terrestrial	
Thistle, Pitcher's	T	Dicot	No
(Cirsium pitcheri)		Terrestrial	
Sturgeon, Pallid	E	Fish	No
(Scaphirhynchus albus)		Freshwater	
Snail, Iowa Pleistocene	E	Gastropod	No
(Discus macclintocki)		Terrestrial	
Butterfly, Karner Blue	E	Insect	No
(Lycaeides melissa samuelis)		Terrestrial	
Dragonfly, Hine's Emerald	E	Insect	Yes
(Somatochlora hineana)		Terrestrial, Freshwater	

Illinois (25) species:

		Taxa	Critical Habitat
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Orchid, Eastern Prairie Fringed	T	Monocot	No
(Platanthera leucophaea)		Terrestrial	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	

Indiana (23) species:

		Taxa	Critical Habitat
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Fanshell	E	Bivalve	No
(Cyprogenia stegaria)		Freshwater	
Mucket, Pink (Pearlymussel)	E	Bivalve	No
(Lampsilis abrupta)		Freshwater	
Mussel, Clubshell	E	Bivalve	No
(Pleurobema clava)		Freshwater	
Mussel, Ring Pink (=Golf Stick Pearly)	E	Bivalve	No
(Obovaria retusa)		Freshwater	
Mussel, Rough Pigtoe	E	Bivalve	No
(Pleurobema plenum)		Freshwater	
Pearlymussel, Fat Pocketbook	E	Bivalve	No
(Potamilus capax)		Freshwater	
Pearlymussel, Orange-footed	E	Bivalve	No
(Plethobasus cooperianus)		Freshwater	
Pearlymussel, Tubercled-blossom	E	Bivalve	No
(Epioblasma torulosa torulosa)		Freshwater	
Pearlymussel, White Cat's Paw	E	Bivalve	No
(Epioblasma obliquata perobliqua)		Freshwater	
Pearlymussel, White Wartyback	E	Bivalve	No
(Plethobasus cicatricosus)		Freshwater	
Riffleshell, Northern	E	Bivalve	No
(Epioblasma torulosa rangiana)		Freshwater	
Clover, Running Buffalo	E	Dicot	No
(Trifolium stoloniferum)		Terrestrial	
Goldenrod, Short's	E	Dicot	No
(Solidago shortii)		Terrestrial	
Milkweed, Mead's	T	Dicot	No
(Asclepias meadii)		Terrestrial	
Thistle, Pitcher's	T	Dicot	No
(Cirsium pitcheri)		Terrestrial	
Butterfly, Karner Blue	E	Insect	No
(Lycaeides melissa samuelis)		Terrestrial	
Butterfly, Mitchell's Satyr	E	Insect	No
(Neonympha mitchellii mitchellii)		Terrestrial, Perm. wetland	
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	

Indiana (23) species:

		Taxa	Critical Habitat
Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)*	T	Monocot Terrestrial	No
Snake, Northern Copperbelly Water *(Nerodia erythrogaster neglecta)*	T	Reptile Terrestrial, Freshwater	No

Iowa (14) species:

		Taxa	Critical Habitat
Plover, Piping *(Charadrius melodus)*	E	Bird Terrestrial	Yes
Tern, Interior (population) Least *(Sterna antillarum)*	E	Bird Terrestrial	No
Pearlymussel, Fat Pocketbook *(Potamilus capax)*	E	Bivalve Freshwater	No
Pearlymussel, Higgins' Eye *(Lampsilis higginsii)*	E	Bivalve Freshwater	No
Clover, Prairie Bush *(Lespedeza leptostachya)*	T	Dicot Terrestrial	No
Milkweed, Mead's *(Asclepias meadii)*	T	Dicot Terrestrial	No
Monkshood, Northern Wild *(Aconitum noveboracense)*	T	Dicot Terrestrial	No
Fern, American hart's-tongue *(Asplenium scolopendrium var. americanum)*	T	Ferns Terrestrial	No
Shiner, Topeka *(Notropis topeka (=tristis))*	E	Fish Freshwater	Yes
Sturgeon, Pallid *(Scaphirhynchus albus)*	E	Fish Freshwater	No
Snail, Iowa Pleistocene *(Discus macclintocki)*	E	Gastropod Terrestrial	No
Bat, Indiana *(Myotis sodalis)*	E	Mammal Terrestrial, Subterraneous	Yes
Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)*	T	Monocot Terrestrial	No
Orchid, Western Prairie Fringed *(Platanthera praeclara)*	T	Monocot Terrestrial	No

Kansas (12) species:

		Taxa	Critical Habitat
Crane, Whooping *(Grus americana)*	E	Bird Terrestrial, Freshwater	Yes
Plover, Piping *(Charadrius melodus)*	E	Bird Terrestrial	Yes
Tern, Interior (population) Least *(Sterna antillarum)*	E	Bird Terrestrial	No
Milkweed, Mead's *(Asclepias meadii)*	T	Dicot Terrestrial	No
Madtom, Neosho *(Noturus placidus)*	T	Fish Freshwater	No
Shiner, Arkansas River *(Notropis girardi)*	T	Fish Freshwater	Yes
Shiner, Topeka *(Notropis topeka (=tristis))*	E	Fish Freshwater	Yes
Sturgeon, Pallid *(Scaphirhynchus albus)*	E	Fish Freshwater	No

Kansas (12) species:

		Taxa	Critical Habitat
Beetle, American Burying	E	Insect	No
(Nicrophorus americanus)		Terrestrial	
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	
Ferret, Black-footed	E	Mammal	No
(Mustela nigripes)		Terrestrial	
Orchid, Western Prairie Fringed	T	Monocot	No
(Platanthera praeclara)		Terrestrial	

Kentucky (49) species:

		Taxa	Critical Habitat
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Warbler (=Wood), Kirtland's	E	Bird	No
(Dendroica kirtlandii)		Terrestrial	
Warbler, Bachman's	E	Bird	No
(Vermivora bachmanii)		Terrestrial	
Woodpecker, Ivory-billed	E	Bird	No
(Campephilus principalis)		Terrestrial	
Woodpecker, Red-cockaded	E	Bird	No
(Picoides borealis)		Terrestrial	
Fanshell	E	Bivalve	No
(Cyprogenia stegaria)		Freshwater	
Mucket, Pink (Pearlymussel)	E	Bivalve	No
(Lampsilis abrupta)		Freshwater	
Mussel, Clubshell	E	Bivalve	No
(Pleurobema clava)		Freshwater	
Mussel, Cumberland Combshell	E	Bivalve	Yes
(Epioblasma brevidens)		Freshwater	
Mussel, Cumberland Elktoe	E	Bivalve	Yes
(Alasmidonta atropurpurea)		Freshwater	
Mussel, Oyster	E	Bivalve	Yes
(Epioblasma capsaeformis)		Freshwater	
Mussel, Ring Pink (=Golf Stick Pearly)	E	Bivalve	No
(Obovaria retusa)		Freshwater	
Mussel, Rough Pigtoe	E	Bivalve	No
(Pleurobema plenum)		Freshwater	
Mussel, Winged Mapleleaf	E	Bivalve	No
(Quadrula fragosa)		Freshwater	
Pearlymussel, Appalachian Monkeyface	E	Bivalve	No
(Quadrula sparsa)		Freshwater	
Pearlymussel, Cracking	E	Bivalve	No
(Hemistena lata)		Freshwater	
Pearlymussel, Cumberland Bean	E	Bivalve	No
(Villosa trabalis)		Freshwater	
Pearlymussel, Dromedary	E	Bivalve	No
(Dromus dromas)		Freshwater	
Pearlymussel, Fat Pocketbook	E	Bivalve	No
(Potamilus capax)		Freshwater	
Pearlymussel, Little-wing	E	Bivalve	No
(Pegias fabula)		Freshwater	

Kentucky (49) species:		**Taxa**	Critical Habitat
Pearlymussel, Orange-footed	E	Bivalve	No
(Plethobasus cooperianus)		Freshwater	
Pearlymussel, Purple Cat's Paw	E	Bivalve	No
(Epioblasma obliquata obliquata)		Freshwater	
Pearlymussel, Tubercled-blossom	E	Bivalve	No
(Epioblasma torulosa torulosa)		Freshwater	
Pearlymussel, White Wartyback	E	Bivalve	No
(Plethobasus cicatricosus)		Freshwater	
Pearlymussel, Yellow-blossom	E	Bivalve	No
(Epioblasma florentina florentina)		Freshwater	
Riffleshell, Northern	E	Bivalve	No
(Epioblasma torulosa rangiana)		Freshwater	
Riffleshell, Tan	E	Bivalve	No
(Epioblasma florentina walkeri (=E. walkeri))		Freshwater	
Shrimp, Kentucky Cave	E	Crustacean	Yes
(Palaemonias ganteri)		Freshwater	
Chaffseed, American	E	Dicot	No
(Schwalbea americana)		Terrestrial	
Clover, Running Buffalo	E	Dicot	No
(Trifolium stoloniferum)		Terrestrial	
Goldenrod, Short's	E	Dicot	No
(Solidago shortii)		Terrestrial	
Goldenrod, White-haired	T	Dicot	No
(Solidago albopilosa)		Terrestrial	
Potato-bean, Price's	T	Dicot	No
(Apios priceana)		Terrestrial	
Rock-cress, Braun's	E	Dicot	Yes
(Arabis perstellata E. L. Braun var. ampla Rollins)		Terrestrial	
Rock-cress, Small	E	Dicot	Yes
(Arabis perstellata E. L. Braun var. perstellata Fernald)		Terrestrial	
Rosemary, Cumberland	T	Dicot	No
(Conradina verticillata)		Terrestrial	
Sandwort, Cumberland	E	Dicot	No
(Arenaria cumberlandensis)		Terrestrial	
Spiraea, Virginia	T	Dicot	No
(Spiraea virginiana)		Terrestrial	
Dace, Blackside	T	Fish	No
(Phoxinus cumberlandensis)		Freshwater	
Darter, Bluemask (=jewel)	E	Fish	No
(Etheostoma sp.)		Freshwater	
Darter, Relict	E	Fish	No
(Etheostoma chienense)		Freshwater	
Shiner, Palezone	E	Fish	No
(Notropis albizonatus)		Freshwater	
Sturgeon, Pallid	E	Fish	No
(Scaphirhynchus albus)		Freshwater	
Beetle, American Burying	E	Insect	No
(Nicrophorus americanus)		Terrestrial	
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	

Kentucky (49) species:

		Taxa	Critical Habitat
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Bat, Virginia Big-eared	E	Mammal	Yes
(Corynorhinus (=Plecotus) townsendii virginianus)		Terrestrial, Subterraneous	
Wolf, Red	E	Mammal	No
(Canis rufus)		Terrestrial	

Louisiana (22) species:

		Taxa	Critical Habitat
Pelican, Brown	E	Bird	No
(Pelecanus occidentalis)		Terrestrial	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, California Least	E	Bird	No
(Sterna antillarum browni)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Woodpecker, Red-cockaded	E	Bird	No
(Picoides borealis)		Terrestrial	
Mucket, Pink (Pearlymussel)	E	Bivalve	No
(Lampsilis abrupta)		Freshwater	
Mussel, Heelsplitter Inflated	T	Bivalve	No
(Potamilus inflatus)		Freshwater	
Pearlshell, Louisiana	T	Bivalve	No
(Margaritifera hembeli)		Freshwater	
Chaffseed, American	E	Dicot	No
(Schwalbea americana)		Terrestrial	
Fruit, Earth (=geocarpon)	T	Dicot	No
(Geocarpon minimum)		Terrestrial	
Quillwort, Louisiana	E	Ferns	No
(Isoetes louisianensis)		Terrestrial, Freshwater	
Sturgeon, Gulf	T	Fish	Yes
(Acipenser oxyrinchus desotoi)		Freshwater, Saltwater	
Sturgeon, Pallid	E	Fish	No
(Scaphirhynchus albus)		Freshwater	
Bear, Louisiana Black	T	Mammal	No
(Ursus americanus luteolus)		Terrestrial	
Manatee, West Indian	E	Marine mml	Yes
(Trichechus manatus)		Saltwater	
Sea turtle, green	E	Reptile	Yes
(Chelonia mydas)		Saltwater	
Sea turtle, hawksbill	E	Reptile	Yes
(Eretmochelys imbricata)		Saltwater, Coastal	
Sea turtle, Kemp's ridley	E	Reptile	No
(Lepidochelys kempii)		Saltwater, Coastal	
Sea turtle, leatherback	E	Reptile	Yes
(Dermochelys coriacea)		Saltwater, Coastal	
Sea turtle, loggerhead	T	Reptile	No
(Caretta caretta)		Saltwater, Coastal	
Tortoise, Gopher	T	Reptile	No
(Gopherus polyphemus)		Terrestrial	
Turtle, Ringed Sawback	T	Reptile	No
(Graptemys oculifera)		Terrestrial, Freshwater	

Maine (8) species:

		Taxa	Critical Habitat
Plover, Piping *(Charadrius melodus)*	E	Bird Terrestrial	Yes
Tern, Roseate *(Sterna dougallii dougallii)*	E	Bird Terrestrial	No
Lousewort, Furbish *(Pedicularis furbishiae)*	E	Dicot Terrestrial	No
Salmon, Atlantic *(Salmo salar)*	E	Fish Freshwater, Brackish, Saltwater	No
Sturgeon, Shortnose *(Acipenser brevirostrum)*	E	Fish Freshwater, Saltwater	No
Lynx, Canada *(Lynx canadensis)*	T	Mammal Terrestrial	No
Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)*	T	Monocot Terrestrial	No
Pogonia, Small Whorled *(Isotria medeoloides)*	T	Monocot Terrestrial	No

Maryland (15) species:

		Taxa	Critical Habitat
Plover, Piping *(Charadrius melodus)*	E	Bird Terrestrial	Yes
Mussel, Dwarf Wedge *(Alasmidonta heterodon)*	E	Bivalve Freshwater	No
Dropwort, Canby's *(Oxypolis canbyi)*	E	Dicot Terrestrial, Freshwater	No
Gerardia, Sandplain *(Agalinis acuta)*	E	Dicot Terrestrial	No
Harperella *(Ptilimnium nodosum)*	E	Dicot Freshwater	No
Joint-vetch, Sensitive *(Aeschynomene virginica)*	T	Dicot Terrestrial, Brackish	No
Darter, Maryland *(Etheostoma sellare)*	E	Fish Freshwater	Yes
Sturgeon, Shortnose *(Acipenser brevirostrum)*	E	Fish Freshwater, Saltwater	No
Beetle, Northeastern Beach Tiger *(Cicindela dorsalis dorsalis)*	T	Insect Terrestrial	No
Beetle, Puritan Tiger *(Cicindela puritana)*	T	Insect Terrestrial, Coastal	No
Bat, Indiana *(Myotis sodalis)*	E	Mammal Terrestrial, Subterraneous	Yes
Squirrel, Delmarva Peninsula Fox *(Sciurus niger cinereus)*	E	Mammal Terrestrial	No
Bulrush, Northeastern (=Barbed Bristle) *(Scirpus ancistrochaetus)*	E	Monocot Terrestrial, Freshwater	No
Pink, Swamp *(Helonias bullata)*	T	Monocot Terrestrial, Freshwater	No
Turtle, Bog (Northern population) *(Clemmys muhlenbergii)*	T	Reptile Terrestrial, Freshwater	No

Massachusetts (12) species:

		Taxa	Critical Habitat
Plover, Piping *(Charadrius melodus)*	E	Bird Terrestrial	Yes

Massachusetts (12) species:

		Taxa	Critical Habitat
Tern, Roseate	E	Bird	No
(Sterna dougallii dougallii)		Terrestrial	
Gerardia, Sandplain	E	Dicot	No
(Agalinis acuta)		Terrestrial	
Sturgeon, Shortnose	E	Fish	No
(Acipenser brevirostrum)		Freshwater, Saltwater	
Beetle, American Burying	E	Insect	No
(Nicrophorus americanus)		Terrestrial	
Beetle, Northeastern Beach Tiger	T	Insect	No
(Cicindela dorsalis dorsalis)		Terrestrial	
Beetle, Puritan Tiger	T	Insect	No
(Cicindela puritana)		Terrestrial, Coastal	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Bulrush, Northeastern (=Barbed Bristle)	E	Monocot	No
(Scirpus ancistrochaetus)		Terrestrial, Freshwater	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	
Turtle, Bog (Northern population)	T	Reptile	No
(Clemmys muhlenbergii)		Terrestrial, Freshwater	
Turtle, Plymouth Red-bellied	E	Reptile	Yes
(Pseudemys rubriventris bangsi)		Terrestrial, Freshwater	

Michigan (19) species:

		Taxa	Critical Habitat
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Warbler (=Wood), Kirtland's	E	Bird	No
(Dendroica kirtlandii)		Terrestrial	
Mussel, Clubshell	E	Bivalve	No
(Pleurobema clava)		Freshwater	
Riffleshell, Northern	E	Bivalve	No
(Epioblasma torulosa rangiana)		Freshwater	
Daisy, Lakeside	T	Dicot	No
(Hymenoxys herbacea)		Freshwater	
Goldenrod, Houghton's	T	Dicot	No
(Solidago houghtonii)		Terrestrial	
Monkey-flower, Michigan	E	Dicot	No
(Mimulus glabratus var. michiganensis)		Terrestrial, Freshwater	
Thistle, Pitcher's	T	Dicot	No
(Cirsium pitcheri)		Terrestrial	
Fern, American hart's-tongue	T	Ferns	No
(Asplenium scolopendrium var. americanum)		Terrestrial	
Beetle, Hungerford's Crawling Water	E	Insect	No
(Brychius hungerfordi)		Freshwater	
Butterfly, Karner Blue	E	Insect	No
(Lycaeides melissa samuelis)		Terrestrial	
Butterfly, Mitchell's Satyr	E	Insect	No
(Neonympha mitchellii mitchellii)		Terrestrial, Perm. wetland	
Dragonfly, Hine's Emerald	E	Insect	Yes
(Somatochlora hineana)		Terrestrial, Freshwater	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	

Michigan (19) species:

		Taxa	Critical Habitat
Lynx, Canada *(Lynx canadensis)*	T	Mammal Terrestrial	No
Iris, Dwarf Lake *(Iris lacustris)*	T	Monocot Terrestrial	No
Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)*	T	Monocot Terrestrial	No
Pogonia, Small Whorled *(Isotria medeoloides)*	T	Monocot Terrestrial	No
Snake, Northern Copperbelly Water *(Nerodia erythrogaster neglecta)*	T	Reptile Terrestrial, Freshwater	No

Minnesota (10) species:

		Taxa	Critical Habitat
Plover, Piping *(Charadrius melodus)*	E	Bird Terrestrial	Yes
Mussel, Winged Mapleleaf *(Quadrula fragosa)*	E	Bivalve Freshwater	No
Pearlymussel, Higgins' Eye *(Lampsilis higginsii)*	E	Bivalve Freshwater	No
Clover, Prairie Bush *(Lespedeza leptostachya)*	T	Dicot Terrestrial	No
Roseroot, Leedy's *(Sedum integrifolium ssp. leedyi)*	T	Dicot Terrestrial	No
Shiner, Topeka *(Notropis topeka (=tristis))*	E	Fish Freshwater	Yes
Butterfly, Karner Blue *(Lycaeides melissa samuelis)*	E	Insect Terrestrial	No
Lynx, Canada *(Lynx canadensis)*	T	Mammal Terrestrial	No
Lily, Minnesota Trout *(Erythronium propullans)*	E	Monocot Terrestrial	No
Orchid, Western Prairie Fringed *(Platanthera praeclara)*	T	Monocot Terrestrial	No

Mississippi (31) species:

		Taxa	Critical Habitat
Frog, Dusky Gopher (Mississippi DPS) *(Rana capito sevosa)*	E	Amphibian Terrestrial, Freshwater	No
Crane, Mississippi Sandhill *(Grus canadensis pulla)*	E	Bird Terrestrial, Freshwater	Yes
Pelican, Brown *(Pelecanus occidentalis)*	E	Bird Terrestrial	No
Plover, Piping *(Charadrius melodus)*	E	Bird Terrestrial	Yes
Tern, Interior (population) Least *(Sterna antillarum)*	E	Bird Terrestrial	No
Woodpecker, Red-cockaded *(Picoides borealis)*	E	Bird Terrestrial	No
Combshell, Southern (=Penitent mussel) *(Epioblasma penita)*	E	Bivalve Freshwater	No
Mucket, Orangenacre *(Lampsilis perovalis)*	T	Bivalve Freshwater	Yes
Mussel, Alabama Moccasinshell *(Medionidus acutissimus)*	T	Bivalve Freshwater	Yes

Mississippi (31) species:

		Taxa	Critical Habitat
Mussel, Black (=Curtus' Mussel) Clubshell	E	Bivalve	No
(Pleurobema curtum)		Freshwater	
Mussel, Heavy Pigtoe (=Judge Tait's Mussel)	E	Bivalve	No
(Pleurobema taitianum)		Freshwater	
Mussel, Heelsplitter Inflated	T	Bivalve	No
(Potamilus inflatus)		Freshwater	
Mussel, Ovate Clubshell	E	Bivalve	Yes
(Pleurobema perovatum)		Freshwater	
Mussel, Southern Clubshell	E	Bivalve	Yes
(Pleurobema decisum)		Freshwater	
Pearlymussel, Fat Pocketbook	E	Bivalve	No
(Potamilus capax)		Freshwater	
Pondberry	E	Dicot	No
(Lindera melissifolia)		Terrestrial	
Potato-bean, Price's	T	Dicot	No
(Apios priceana)		Terrestrial	
Quillwort, Louisiana	E	Ferns	No
(Isoetes louisianensis)		Terrestrial, Freshwater	
Darter, Bayou	T	Fish	No
(Etheostoma rubrum)		Freshwater	
Sturgeon, Gulf	T	Fish	Yes
(Acipenser oxyrinchus desotoi)		Freshwater, Saltwater	
Sturgeon, Pallid	E	Fish	No
(Scaphirhynchus albus)		Freshwater	
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Bear, Louisiana Black	T	Mammal	No
(Ursus americanus luteolus)		Terrestrial	
Sea turtle, green	E	Reptile	Yes
(Chelonia mydas)		Saltwater	
Sea turtle, Kemp's ridley	E	Reptile	No
(Lepidochelys kempii)		Saltwater, Coastal	
Sea turtle, loggerhead	T	Reptile	No
(Caretta caretta)		Saltwater, Coastal	
Snake, Eastern Indigo	T	Reptile	Yes
(Drymarchon corais couperi)		Terrestrial	
Tortoise, Gopher	T	Reptile	No
(Gopherus polyphemus)		Terrestrial	
Turtle, Ringed Sawback	T	Reptile	No
(Graptemys oculifera)		Terrestrial, Freshwater	
Turtle, Yellow-blotched Map	T	Reptile	No
(Graptemys flavimaculata)		Terrestrial, Freshwater	

Missouri (29) species:

		Taxa	Critical Habitat
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Mucket, Pink (Pearlymussel)	E	Bivalve	No
(Lampsilis abrupta)		Freshwater	

Missouri (29) species:		**Taxa**	Critical Habitat
Mussel, Scaleshell	E	Bivalve	No
(Leptodea leptodon)		Freshwater	
Mussel, Winged Mapleleaf	E	Bivalve	No
(Quadrula fragosa)		Freshwater	
Pearlymussel, Curtis'	E	Bivalve	No
(Epioblasma florentina curtisii)		Freshwater	
Pearlymussel, Fat Pocketbook	E	Bivalve	No
(Potamilus capax)		Freshwater	
Pearlymussel, Higgins' Eye	E	Bivalve	No
(Lampsilis higginsii)		Freshwater	
Crayfish, Cave (Cambarus aculabrum)	E	Crustacean	No
(Cambarus aculabrum)		Freshwater	
Aster, Decurrent False	T	Dicot	No
(Boltonia decurrens)		Terrestrial, Freshwater	
Bladderpod, Missouri	T	Dicot	No
(Lesquerella filiformis)		Terrestrial	
Clover, Running Buffalo	E	Dicot	No
(Trifolium stoloniferum)		Terrestrial	
Fruit, Earth (=geocarpon)	T	Dicot	No
(Geocarpon minimum)		Terrestrial	
Milkweed, Mead's	T	Dicot	No
(Asclepias meadii)		Terrestrial	
Pondberry	E	Dicot	No
(Lindera melissifolia)		Terrestrial	
Sneezeweed, Virginia	T	Dicot	No
(Helenium virginicum)		Vernal pool	
Cavefish, Ozark	T	Fish	No
(Amblyopsis rosae)		Freshwater	
Chub, Humpback	E	Fish	Yes
(Gila cypha)		Freshwater	
Darter, Niangua	T	Fish	Yes
(Etheostoma nianguae)		Freshwater	
Madtom, Neosho	T	Fish	No
(Noturus placidus)		Freshwater	
Shiner, Topeka	E	Fish	Yes
(Notropis topeka (=tristis))		Freshwater	
Sturgeon, Gulf	T	Fish	Yes
(Acipenser oxyrinchus desotoi)		Freshwater, Saltwater	
Sturgeon, Pallid	E	Fish	No
(Scaphirhynchus albus)		Freshwater	
Cavesnail, Tumbling Creek	E	Gastropod	No
(Antrobia culveri)		Freshwater, Subterraneous	
Beetle, American Burying	E	Insect	No
(Nicrophorus americanus)		Terrestrial	
Dragonfly, Hine's Emerald	E	Insect	Yes
(Somatochlora hineana)		Terrestrial, Freshwater	
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	

Missouri (29) species:

		Taxa	Critical Habitat
Orchid, Western Prairie Fringed	T	Monocot	No
(Platanthera praeclara)		Terrestrial	

Montana (10) species:

		Taxa	Critical Habitat
Crane, Whooping	E	Bird	Yes
(Grus americana)		Terrestrial, Freshwater	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Catchfly, Spalding's	T	Dicot	No
(Silene spaldingii)		Terrestrial	
Howellia, Water	T	Dicot	No
(Howellia aquatilis)		Freshwater	
Sturgeon, Pallid	E	Fish	No
(Scaphirhynchus albus)		Freshwater	
Sturgeon, White	E	Fish	Yes
(Acipenser transmontanus)		Freshwater, Saltwater	
Trout, Bull	T	Fish	Yes
(Salvelinus confluentus)		Freshwater	
Bear, Grizzly	T	Mammal	No
(Ursus arctos horribilis)		Terrestrial	
Ferret, Black-footed	E	Mammal	No
(Mustela nigripes)		Terrestrial	

Nebraska (10) species:

		Taxa	Critical Habitat
Crane, Whooping	E	Bird	Yes
(Grus americana)		Terrestrial, Freshwater	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Butterfly Plant, Colorado	T	Dicot	Yes
(Gaura neomexicana var. coloradensis)		Terrestrial	
Penstemon, Blowout	E	Dicot	No
(Penstemon haydenii)		Terrestrial	
Shiner, Topeka	E	Fish	Yes
(Notropis topeka (=tristis))		Freshwater	
Sturgeon, Pallid	E	Fish	No
(Scaphirhynchus albus)		Freshwater	
Beetle, Salt Creek Tiger	E	Insect	No
(Cicindela nevadica lincolniana)		Terrestrial	
Ferret, Black-footed	E	Mammal	No
(Mustela nigripes)		Terrestrial	
Orchid, Western Prairie Fringed	T	Monocot	No
(Platanthera praeclara)		Terrestrial	

Nevada (37) species:

		Taxa	Critical Habitat
Flycatcher, Southwestern Willow	E	Bird	Yes
(Empidonax traillii extimus)		Terrestrial	
Rail, Yuma Clapper	E	Bird	No
(Rallus longirostris yumanensis)		Terrestrial	

Nevada (37) species:		**Taxa**	Critical Habitat
Blazing Star, Ash Meadows	T	Dicot	Yes
(Mentzelia leucophylla)		Terrestrial	
Buckwheat, Steamboat	E	Dicot	No
(Eriogonum ovalifolium var. williamsiae)		Terrestrial	
Centaury, Spring-loving	T	Dicot	Yes
(Centaurium namophilum)		Terrestrial	
Gumplant, Ash Meadows	T	Dicot	Yes
(Grindelia fraxino-pratensis)		Terrestrial	
Ivesia, Ash Meadows	T	Dicot	Yes
(Ivesia kingii var. eremica)		Terrestrial	
Milk-vetch, Ash Meadows	T	Dicot	Yes
(Astragalus phoenix)		Terrestrial	
Niterwort, Amargosa	E	Dicot	Yes
(Nitrophila mohavensis)		Terrestrial	
Sunray, Ash Meadows	T	Dicot	Yes
(Enceliopsis nudicaulis var. corrugata)		Terrestrial	
Chub, Bonytail	E	Fish	Yes
(Gila elegans)		Freshwater	
Chub, Pahranagat Roundtail	E	Fish	No
(Gila robusta jordani)		Freshwater	
Chub, Virgin River	E	Fish	Yes
(Gila seminuda (=robusta))		Freshwater	
Cui-ui	E	Fish	No
(Chasmistes cujus)		Freshwater	
Dace, Ash Meadows Speckled	E	Fish	Yes
(Rhinichthys osculus nevadensis)		Freshwater	
Dace, Clover Valley Speckled	E	Fish	No
(Rhinichthys osculus oligoporus)		Freshwater	
Dace, Desert	T	Fish	Yes
(Eremichthys acros)		Freshwater	
Dace, Independence Valley Speckled	E	Fish	No
(Rhinichthys osculus lethoporus)		Freshwater	
Dace, Moapa	E	Fish	No
(Moapa coriacea)		Freshwater	
Poolfish, Pahrump (= Pahrump Killifish)	E	Fish	No
(Empetrichthys latos)		Freshwater	
Pupfish, Ash Meadows Amargosa	E	Fish	Yes
(Cyprinodon nevadensis mionectes)		Freshwater	
Pupfish, Devils Hole	E	Fish	No
(Cyprinodon diabolis)		Freshwater	
Pupfish, Warm Springs	E	Fish	No
(Cyprinodon nevadensis pectoralis)		Freshwater	
Spinedace, Big Spring	T	Fish	Yes
(Lepidomeda mollispinis pratensis)		Freshwater	
Spinedace, White River	E	Fish	Yes
(Lepidomeda albivallis)		Freshwater	
Springfish, Hiko White River	E	Fish	Yes
(Crenichthys baileyi grandis)		Freshwater	
Springfish, Railroad Valley	T	Fish	Yes
(Crenichthys nevadae)		Freshwater	

Nevada (37) species:

		Taxa	Critical Habitat
Springfish, White River	E	Fish	Yes
(Crenichthys baileyi baileyi)		Freshwater	
Sucker, Razorback	E	Fish	Yes
(Xyrauchen texanus)		Freshwater	
Sucker, Warner	T	Fish	Yes
(Catostomus warnerensis)		Freshwater	
Trout, Bull	T	Fish	Yes
(Salvelinus confluentus)		Freshwater	
Trout, Lahontan Cutthroat	T	Fish	No
(Oncorhynchus clarki henshawi)		Freshwater	
Woundfin	E	Fish	Yes
(Plagopterus argentissimus)		Freshwater	
Naucorid, Ash Meadows	T	Insect	Yes
(Ambrysus amargosus)		Terrestrial	
Skipper, Carson Wandering	E	Insect	No
(Pseudocopaeodes eunus obscurus)		Terrestrial	
Ladies'-tresses, Ute	T	Monocot	No
(Spiranthes diluvialis)		Terrestrial	
Tortoise, Desert	T	Reptile	Yes
(Gopherus agassizii)		Terrestrial	

New Hampshire (5) species:

		Taxa	Critical Habitat
Mussel, Dwarf Wedge	E	Bivalve	No
(Alasmidonta heterodon)		Freshwater	
Milk-vetch, Jesup's	E	Dicot	No
(Astragalus robbinsii var. jesupi)		Terrestrial	
Butterfly, Karner Blue	E	Insect	No
(Lycaeides melissa samuelis)		Terrestrial	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	

New Jersey (10) species:

		Taxa	Critical Habitat
Curlew, Eskimo	E	Bird	No
(Numenius borealis)		Terrestrial	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Chaffseed, American	E	Dicot	No
(Schwalbea americana)		Terrestrial	
Joint-vetch, Sensitive	T	Dicot	No
(Aeschynomene virginica)		Terrestrial, Brackish	
Sturgeon, Shortnose	E	Fish	No
(Acipenser brevirostrum)		Freshwater, Saltwater	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Beaked-rush, Knieskern's	T	Monocot	No
(Rhynchospora knieskernii)		Terrestrial	
Pink, Swamp	T	Monocot	No
(Helonias bullata)		Terrestrial, Freshwater	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	

New Jersey	(10) species:		**Taxa**	Critical Habitat
Turtle, Bog (Northern population)		T	Reptile	No
(Clemmys muhlenbergii)			Terrestrial, Freshwater	
New Mexico	(45) species:		**Taxa**	Critical Habitat
Frog, Chiricahua Leopard		T	Amphibian	No
(Rana chiricahuensis)			Terrestrial, Freshwater	
Crane, Whooping		E	Bird	Yes
(Grus americana)			Terrestrial, Freshwater	
Falcon, Northern Aplomado		E	Bird	No
(Falco femoralis septentrionalis)			Terrestrial	
Flycatcher, Southwestern Willow		E	Bird	Yes
(Empidonax traillii extimus)			Terrestrial	
Owl, Mexican Spotted		T	Bird	Yes
(Strix occidentalis lucida)			Terrestrial	
Plover, Piping		E	Bird	Yes
(Charadrius melodus)			Terrestrial	
Tern, Interior (population) Least		E	Bird	No
(Sterna antillarum)			Terrestrial	
Amphipod, Noel's		E	Crustacean	Yes
(Gammarus desperatus)			Freshwater	
Isopod, Socorro		E	Crustacean	No
(Thermosphaeroma thermophilus)			Freshwater	
Cactus, Knowlton		E	Dicot	No
(Pediocactus knowltonii)			Terrestrial	
Cactus, Kuenzler Hedgehog		E	Dicot	No
(Echinocereus fendleri var. kuenzleri)			Terrestrial	
Cactus, Lee Pincushion		T	Dicot	No
(Coryphantha sneedii var. leei)			Terrestrial	
Cactus, Mesa Verde		T	Dicot	No
(Sclerocactus mesae-verdae)			Terrestrial	
Cactus, Sneed Pincushion		E	Dicot	No
(Coryphantha sneedii var. sneedii)			Terrestrial	
Fleabane, Zuni		T	Dicot	No
(Erigeron rhizomatus)			Terrestrial	
Ipomopsis, Holy Ghost		E	Dicot	No
(Ipomopsis sancti-spiritus)			Terrestrial	
Milk-vetch, Mancos		E	Dicot	No
(Astragalus humillimus)			Terrestrial	
Pennyroyal, Todsen's		E	Dicot	Yes
(Hedeoma todsenii)			Terrestrial	
Poppy, Sacramento Prickly		E	Dicot	No
(Argemone pleiacantha ssp. pinnatisecta)			Terrestrial	
Sunflower, Pecos		T	Dicot	Yes
(Helianthus paradoxus)			Terrestrial, Perm. wetland	
Thistle, Sacramento Mountains		T	Dicot	No
(Cirsium vinaceum)			Terrestrial	
Wild-buckwheat, Gypsum		T	Dicot	Yes
(Eriogonum gypsophilum)			Terrestrial	
Chub, Chihuahua		T	Fish	No
(Gila nigrescens)			Freshwater	
Chub, Gila		E	Fish	Yes
(Gila intermedia)			Freshwater	

New Mexico (45) species:

		Taxa	Critical Habitat
Gambusia, Pecos	E	Fish	No
(Gambusia nobilis)		Freshwater	
Minnow, Loach	T	Fish	Yes
(Tiaroga cobitis)		Freshwater	
Minnow, Rio Grande Silvery	E	Fish	Yes
(Hybognathus amarus)		Freshwater	
Shiner, Arkansas River	T	Fish	Yes
(Notropis girardi)		Freshwater	
Shiner, Beautiful	T	Fish	Yes
(Cyprinella formosa)		Freshwater	
Shiner, Pecos Bluntnose	T	Fish	Yes
(Notropis simus pecosensis)		Freshwater	
Spikedace	T	Fish	Yes
(Meda fulgida)		Freshwater	
Squawfish, Colorado	E	Fish	Yes
(Ptychocheilus lucius)		Freshwater	
Sucker, Razorback	E	Fish	Yes
(Xyrauchen texanus)		Freshwater	
Topminnow, Gila (Yaqui)	E	Fish	No
(Poeciliopsis occidentalis)		Freshwater	
Trout, Gila	E	Fish	No
(Oncorhynchus gilae)		Freshwater	
Snail, Pecos Assiminea	E	Gastropod	Yes
(Assiminea pecos)		Freshwater	
Springsnail, Alamosa	E	Gastropod	No
(Tryonia alamosae)		Freshwater	
Springsnail, Koster's	E	Gastropod	No
(Juturnia kosteri)		Terrestrial	
Springsnail, Roswell	E	Gastropod	Yes
(Pyrgulopsis roswellensis)		Freshwater	
Springsnail, Socorro	E	Gastropod	No
(Pyrgulopsis neomexicana)		Freshwater	
Bat, Lesser (=Sanborn's) Long-nosed	E	Mammal	No
(Leptonycteris curasoae yerbabuenae)		Terrestrial, Subterraneous	
Bat, Mexican Long-nosed	E	Mammal	No
(Leptonycteris nivalis)		Terrestrial, Subterraneous	
Ferret, Black-footed	E	Mammal	No
(Mustela nigripes)		Terrestrial	
Jaguar	E	Mammal	No
(Panthera onca)		Terrestrial	
Rattlesnake, New Mexican Ridge-nosed	T	Reptile	Yes
(Crotalus willardi obscurus)		Terrestrial	

New York (14) species:

		Taxa	Critical Habitat
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Roseate	E	Bird	No
(Sterna dougallii dougallii)		Terrestrial	
Mussel, Dwarf Wedge	E	Bivalve	No
(Alasmidonta heterodon)		Freshwater	
Amaranth, Seabeach	T	Dicot	No
(Amaranthus pumilus)		Coastal	

New York (14) species:

		Taxa	Critical Habitat
Gerardia, Sandplain	E	Dicot	No
(Agalinis acuta)		Terrestrial	
Monkshood, Northern Wild	T	Dicot	No
(Aconitum noveboracense)		Terrestrial	
Roseroot, Leedy's	T	Dicot	No
(Sedum integrifolium ssp. leedyi)		Terrestrial	
Fern, American hart's-tongue	T	Ferns	No
(Asplenium scolopendrium var. americanum)		Terrestrial	
Sturgeon, Shortnose	E	Fish	No
(Acipenser brevirostrum)		Freshwater, Saltwater	
Snail, Chittenango Ovate Amber	T	Gastropod	No
(Succinea chittenangoensis)		Terrestrial, Freshwater	
Butterfly, Karner Blue	E	Insect	No
(Lycaeides melissa samuelis)		Terrestrial	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	
Turtle, Bog (Northern population)	T	Reptile	No
(Clemmys muhlenbergii)		Terrestrial, Freshwater	

North Carolina (57) species:

		Taxa	Critical Habitat
Spider, Spruce-fir Moss	E	Arachnid	Yes
(Microhexura montivaga)		Terrestrial	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Stork, Wood	E	Bird	No
(Mycteria americana)		Terrestrial	
Tern, Roseate	E	Bird	No
(Sterna dougallii dougallii)		Terrestrial	
Woodpecker, Red-cockaded	E	Bird	No
(Picoides borealis)		Terrestrial	
Elktoe, Appalachian	E	Bivalve	Yes
(Alasmidonta raveneliana)		Freshwater	
Mussel, Dwarf Wedge	E	Bivalve	No
(Alasmidonta heterodon)		Freshwater	
Mussel, Heelsplitter Carolina	E	Bivalve	Yes
(Lasmigona decorata)		Freshwater	
Mussel, Oyster	E	Bivalve	Yes
(Epioblasma capsaeformis)		Freshwater	
Pearlymussel, Little-wing	E	Bivalve	No
(Pegias fabula)		Freshwater	
Purple Bean	E	Bivalve	Yes
(Villosa perpurpurea)		Freshwater	
Spinymussel, James River	E	Bivalve	No
(Pleurobema collina)		Freshwater	
Spinymussel, Tar River	E	Bivalve	No
(Elliptio steinstansana)		Freshwater	
Amaranth, Seabeach	T	Dicot	No
(Amaranthus pumilus)		Coastal	
Avens, Spreading	E	Dicot	No
(Geum radiatum)		Terrestrial	

North Carolina (57) species:		**Taxa**	Critical Habitat
Bittercress, Small-anthered	E	Dicot	No
(Cardamine micranthera)		Terrestrial	
Blazing Star, Heller's	T	Dicot	No
(Liatris helleri)		Terrestrial	
Bluet, Roan Mountain	E	Dicot	No
(Hedyotis purpurea var. montana)		Terrestrial	
Chaffseed, American	E	Dicot	No
(Schwalbea americana)		Terrestrial	
Coneflower, Smooth	E	Dicot	No
(Echinacea laevigata)		Terrestrial	
Dropwort, Canby's	E	Dicot	No
(Oxypolis canbyi)		Terrestrial, Freshwater	
Goldenrod, Blue Ridge	T	Dicot	No
(Solidago spithamaea)		Terrestrial	
Harperella	E	Dicot	No
(Ptilimnium nodosum)		Freshwater	
Heartleaf, Dwarf-flowered	T	Dicot	No
(Hexastylis naniflora)		Terrestrial	
Heather, Mountain Golden	T	Dicot	Yes
(Hudsonia montana)		Terrestrial	
Joint-vetch, Sensitive	T	Dicot	No
(Aeschynomene virginica)		Terrestrial, Brackish	
Loosestrife, Rough-leaved	E	Dicot	No
(Lysimachia asperulaefolia)		Terrestrial	
Meadowrue, Cooley's	E	Dicot	No
(Thalictrum cooleyi)		Terrestrial	
Pitcher-plant, Green	E	Dicot	No
(Sarracenia oreophila)		Terrestrial, Freshwater	
Pitcher-plant, Mountain Sweet	E	Dicot	No
(Sarracenia rubra ssp. jonesii)		Terrestrial, Freshwater	
Pondberry	E	Dicot	No
(Lindera melissifolia)		Terrestrial	
Spiraea, Virginia	T	Dicot	No
(Spiraea virginiana)		Terrestrial	
Sumac, Michaux's	E	Dicot	No
(Rhus michauxii)		Terrestrial	
Sunflower, Schweinitz's	E	Dicot	No
(Helianthus schweinitzii)		Terrestrial	
Chub, Spotfin	T	Fish	Yes
(Erimonax monachus)		Freshwater	
Shiner, Cape Fear	E	Fish	Yes
(Notropis mekistocholas)		Freshwater	
Silverside, Waccamaw	T	Fish	Yes
(Menidia extensa)		Freshwater	
Sturgeon, Shortnose	E	Fish	No
(Acipenser brevirostrum)		Freshwater, Saltwater	
Snail, Noonday	T	Gastropod	No
(Mesodon clarki nantahala)		Terrestrial	
Butterfly, Saint Francis' Satyr	E	Insect	No
(Neonympha mitchellii francisci)		Terrestrial	

North Carolina (57) species:

		Taxa	Critical Habitat
Lichen, Rock Gnome	E	Lichen	No
(Gymnoderma lineare)		Terrestrial	
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Bat, Virginia Big-eared	E	Mammal	Yes
(Corynorhinus (=Plecotus) townsendii virginianus)		Terrestrial, Subterraneous	
Squirrel, Carolina Northern Flying	E	Mammal	No
(Glaucomys sabrinus coloratus)		Terrestrial	
Wolf, Red	E	Mammal	No
(Canis rufus)		Terrestrial	
Manatee, West Indian	E	Marine mml	Yes
(Trichechus manatus)		Saltwater	
Arrowhead, Bunched	E	Monocot	No
(Sagittaria fasciculata)		Freshwater	
Irisette, White	E	Monocot	No
(Sisyrinchium dichotomum)		Terrestrial	
Pink, Swamp	T	Monocot	No
(Helonias bullata)		Terrestrial, Freshwater	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	
Sedge, Golden	E	Monocot	No
(Carex lutea)		Terrestrial	
Sea turtle, green	E	Reptile	Yes
(Chelonia mydas)		Saltwater	
Sea turtle, hawksbill	E	Reptile	Yes
(Eretmochelys imbricata)		Saltwater, Coastal	
Sea turtle, Kemp's ridley	E	Reptile	No
(Lepidochelys kempii)		Saltwater, Coastal	
Sea turtle, leatherback	E	Reptile	Yes
(Dermochelys coriacea)		Saltwater, Coastal	
Sea turtle, loggerhead	T	Reptile	No
(Caretta caretta)		Saltwater, Coastal	

North Dakota (5) species:

		Taxa	Critical Habitat
Crane, Whooping	E	Bird	Yes
(Grus americana)		Terrestrial, Freshwater	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Sturgeon, Pallid	E	Fish	No
(Scaphirhynchus albus)		Freshwater	
Orchid, Western Prairie Fringed	T	Monocot	No
(Platanthera praeclara)		Terrestrial	

Ohio (22) species:

		Taxa	Critical Habitat
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Fanshell	E	Bivalve	No
(Cyprogenia stegaria)		Freshwater	

Ohio (22) species:

		Taxa	Critical Habitat
Mucket, Pink (Pearlymussel)	E	Bivalve	No
(Lampsilis abrupta)		Freshwater	
Mussel, Clubshell	E	Bivalve	No
(Pleurobema clava)		Freshwater	
Pearlymussel, Purple Cat's Paw	E	Bivalve	No
(Epioblasma obliquata obliquata)		Freshwater	
Pearlymussel, White Cat's Paw	E	Bivalve	No
(Epioblasma obliquata perobliqua)		Freshwater	
Riffleshell, Northern	E	Bivalve	No
(Epioblasma torulosa rangiana)		Freshwater	
Clover, Running Buffalo	E	Dicot	No
(Trifolium stoloniferum)		Terrestrial	
Daisy, Lakeside	T	Dicot	No
(Hymenoxys herbacea)		Freshwater	
Monkshood, Northern Wild	T	Dicot	No
(Aconitum noveboracense)		Terrestrial	
Spiraea, Virginia	T	Dicot	No
(Spiraea virginiana)		Terrestrial	
Madtom, Scioto	E	Fish	No
(Noturus trautmani)		Freshwater	
Beetle, American Burying	E	Insect	No
(Nicrophorus americanus)		Terrestrial	
Butterfly, Karner Blue	E	Insect	No
(Lycaeides melissa samuelis)		Terrestrial	
Butterfly, Mitchell's Satyr	E	Insect	No
(Neonympha mitchellii mitchellii)		Terrestrial, Perm. wetland	
Dragonfly, Hine's Emerald	E	Insect	Yes
(Somatochlora hineana)		Terrestrial, Freshwater	
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Orchid, Eastern Prairie Fringed	T	Monocot	No
(Platanthera leucophaea)		Terrestrial	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	
Snake, Lake Erie Water	T	Reptile	No
(Nerodia sipedon insularum)		Terrestrial, Freshwater	
Snake, Northern Copperbelly Water	T	Reptile	No
(Nerodia erythrogaster neglecta)		Terrestrial, Freshwater	

Oklahoma (18) species:

		Taxa	Critical Habitat
Crane, Whooping	E	Bird	Yes
(Grus americana)		Terrestrial, Freshwater	
Curlew, Eskimo	E	Bird	No
(Numenius borealis)		Terrestrial	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Vireo, Black-capped	E	Bird	No
(Vireo atricapilla)		Terrestrial	

Oklahoma (18) species:

		Taxa	Critical Habitat
Woodpecker, Red-cockaded	E	Bird	No
(Picoides borealis)		Terrestrial	
Mussel, Scaleshell	E	Bivalve	No
(Leptodea leptodon)		Freshwater	
Rock-pocketbook, Ouachita (=Wheeler's pm)	E	Bivalve	No
(Arkansia wheeleri)		Freshwater	
Cavefish, Ozark	T	Fish	No
(Amblyopsis rosae)		Freshwater	
Darter, Leopard	T	Fish	Yes
(Percina pantherina)		Freshwater	
Madtom, Neosho	T	Fish	No
(Noturus placidus)		Freshwater	
Shiner, Arkansas River	T	Fish	Yes
(Notropis girardi)		Freshwater	
Beetle, American Burying	E	Insect	No
(Nicrophorus americanus)		Terrestrial	
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Bat, Ozark Big-eared	E	Mammal	No
(Corynorhinus (=Plecotus) townsendii ingens)		Terrestrial, Subterraneous	
Orchid, Eastern Prairie Fringed	T	Monocot	No
(Platanthera leucophaea)		Terrestrial	
Orchid, Western Prairie Fringed	T	Monocot	No
(Platanthera praeclara)		Terrestrial	

Oregon (34) species:

		Taxa	Critical Habitat
Murrelet, Marbled	T	Bird	Yes
(Brachyramphus marmoratus)		Terrestrial, Freshwater, Saltwater	
Owl, Northern Spotted	T	Bird	Yes
(Strix occidentalis caurina)		Terrestrial	
Pelican, Brown	E	Bird	No
(Pelecanus occidentalis)		Terrestrial	
Plover, Western Snowy	T	Bird	Yes
(Charadrius alexandrinus nivosus)		Terrestrial	
Fairy Shrimp, Vernal Pool	T	Crustacean	Yes
(Branchinecta lynchi)		Vernal pool	
Catchfly, Spalding's	T	Dicot	No
(Silene spaldingii)		Terrestrial	
Checker-mallow, Nelson's	T	Dicot	No
(Sidalcea nelsoniana)		Terrestrial	
Daisy, Willamette	E	Dicot	Yes
(Erigeron decumbens var. decumbens)		Terrestrial	
Four-o'clock, Macfarlane's	T	Dicot	No
(Mirabilis macfarlanei)		Terrestrial	
Lomatium, Bradshaw's	E	Dicot	No
(Lomatium bradshawii)		Terrestrial, Freshwater	
Lomatium, Cook's	E	Dicot	No
(Lomatium cookii)		Vernal pool	
Lupine, Kincaid's	T	Dicot	Yes
(Lupinus sulphureus (=oreganus) ssp. kincaidii (=var. kincaidii))		Terrestrial	

Oregon (34) species:

		Taxa	Critical Habitat
Meadowfoam, Large-flowered Woolly	E	Dicot	No
(Limnanthes floccosa ssp. Grandiflora)		Vernal pool	
Milk-vetch, Applegate's	E	Dicot	No
(Astragalus applegatei)		Terrestrial	
Popcornflower, Rough	E	Dicot	No
(Plagiobothrys hirtus)		Vernal pool	
Thelypody, Howell's Spectacular	T	Dicot	No
(Thelypodium howellii spectabilis)		Terrestrial	
Wire-lettuce, Malheur	E	Dicot	Yes
(Stephanomeria malheurensis)		Terrestrial	
Chub, Borax Lake	E	Fish	Yes
(Gila boraxobius)		Freshwater	
Chub, Hutton Tui	T	Fish	No
(Gila bicolor ssp.)		Freshwater	
Chub, Oregon	E	Fish	No
(Oregonichthys crameri)		Freshwater	
Dace, Foskett Speckled	T	Fish	No
(Rhinichthys osculus ssp.)		Freshwater	
Salmon, Chum	T	Fish	Yes
(Oncorhynchus (=Salmo) keta)		Freshwater, Brackish, Saltwater	
Salmon, Sockeye	E	Fish	No
(Oncorhynchus (=Salmo) nerka)		Freshwater, Brackish, Saltwater	
Steelhead	E	Fish	Yes
(Oncorhynchus (=Salmo) mykiss)		Freshwater, Brackish, Saltwater	
Sucker, Lost River	E	Fish	No
(Deltistes luxatus)		Freshwater	
Sucker, Shortnose	E	Fish	No
(Chasmistes brevirostris)		Freshwater	
Sucker, Warner	T	Fish	Yes
(Catostomus warnerensis)		Freshwater	
Trout, Bull	T	Fish	Yes
(Salvelinus confluentus)		Freshwater	
Trout, Lahontan Cutthroat	T	Fish	No
(Oncorhynchus clarki henshawi)		Freshwater	
Butterfly, Fender's Blue	E	Insect	Yes
(Icaricia icarioides fenderi)		Terrestrial	
Butterfly, Oregon Silverspot	T	Insect	Yes
(Speyeria zerene hippolyta)		Terrestrial	
Deer, Columbian White-tailed	E	Mammal	No
(Odocoileus virginianus leucurus)		Terrestrial	
Fritillary, Gentner's	E	Monocot	No
(Fritillaria gentneri)		Terrestrial	
Lily, Western	E	Monocot	No
(Lilium occidentale)		Terrestrial	

Pennsylvania (8) species:

		Taxa	Critical Habitat
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Mussel, Clubshell	E	Bivalve	No
(Pleurobema clava)		Freshwater	
Riffleshell, Northern	E	Bivalve	No
(Epioblasma torulosa rangiana)		Freshwater	

Pennsylvania (8) species:

		Taxa	Critical Habitat
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Squirrel, Delmarva Peninsula Fox	E	Mammal	No
(Sciurus niger cinereus)		Terrestrial	
Bulrush, Northeastern (=Barbed Bristle)	E	Monocot	No
(Scirpus ancistrochaetus)		Terrestrial, Freshwater	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	
Turtle, Bog (Northern population)	T	Reptile	No
(Clemmys muhlenbergii)		Terrestrial, Freshwater	

Rhode Island (6) species:

		Taxa	Critical Habitat
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Gerardia, Sandplain	E	Dicot	No
(Agalinis acuta)		Terrestrial	
Sturgeon, Shortnose	E	Fish	No
(Acipenser brevirostrum)		Freshwater, Saltwater	
Beetle, American Burying	E	Insect	No
(Nicrophorus americanus)		Terrestrial	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	

South Carolina (37) species:

		Taxa	Critical Habitat
Salamander, Flatwoods	T	Amphibian	No
(Ambystoma cingulatum)		Terrestrial, Freshwater, Vernal pool	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Stork, Wood	E	Bird	No
(Mycteria americana)		Terrestrial	
Warbler, Bachman's	E	Bird	No
(Vermivora bachmanii)		Terrestrial	
Woodpecker, Red-cockaded	E	Bird	No
(Picoides borealis)		Terrestrial	
Mussel, Heelsplitter Carolina	E	Bivalve	Yes
(Lasmigona decorata)		Freshwater	
Amaranth, Seabeach	T	Dicot	No
(Amaranthus pumilus)		Coastal	
Amphianthus, Little	T	Dicot	No
(Amphianthus pusillus)		Freshwater	
Chaffseed, American	E	Dicot	No
(Schwalbea americana)		Terrestrial	
Coneflower, Smooth	E	Dicot	No
(Echinacea laevigata)		Terrestrial	
Dropwort, Canby's	E	Dicot	No
(Oxypolis canbyi)		Terrestrial, Freshwater	
Gooseberry, Miccosukee	T	Dicot	No
(Ribes echinellum)		Terrestrial	
Harperella	E	Dicot	No
(Ptilimnium nodosum)		Freshwater	

South Carolina	(37) species:		**Taxa**	Critical Habitat
Heartleaf, Dwarf-flowered		T	Dicot	No
(Hexastylis naniflora)			Terrestrial	
Loosestrife, Rough-leaved		E	Dicot	No
(Lysimachia asperulaefolia)			Terrestrial	
Pitcher-plant, Mountain Sweet		E	Dicot	No
(Sarracenia rubra ssp. jonesii)			Terrestrial, Freshwater	
Pondberry		E	Dicot	No
(Lindera melissifolia)			Terrestrial	
Sunflower, Schweinitz's		E	Dicot	No
(Helianthus schweinitzii)			Terrestrial	
Quillwort, Black-spored		E	Ferns	No
(Isoetes melanospora)			Vernal pool	
Sturgeon, Shortnose		E	Fish	No
(Acipenser brevirostrum)			Freshwater, Saltwater	
Lichen, Rock Gnome		E	Lichen	No
(Gymnoderma lineare)			Terrestrial	
Bat, Indiana		E	Mammal	Yes
(Myotis sodalis)			Terrestrial, Subterraneous	
Wolf, Red		E	Mammal	No
(Canis rufus)			Terrestrial	
Manatee, West Indian		E	Marine mml	Yes
(Trichechus manatus)			Saltwater	
Whale, Finback		E	Marine mml	No
(Balaenoptera physalus)			Saltwater	
Whale, Humpback		E	Marine mml	No
(Megaptera novaeangliae)			Saltwater	
Arrowhead, Bunched		E	Monocot	No
(Sagittaria fasciculata)			Freshwater	
Irisette, White		E	Monocot	No
(Sisyrinchium dichotomum)			Terrestrial	
Pink, Swamp		T	Monocot	No
(Helonias bullata)			Terrestrial, Freshwater	
Pogonia, Small Whorled		T	Monocot	No
(Isotria medeoloides)			Terrestrial	
Trillium, Persistent		E	Monocot	No
(Trillium persistens)			Terrestrial	
Trillium, Relict		E	Monocot	No
(Trillium reliquum)			Terrestrial	
Sea turtle, green		E	Reptile	Yes
(Chelonia mydas)			Saltwater	
Sea turtle, Kemp's ridley		E	Reptile	No
(Lepidochelys kempii)			Saltwater, Coastal	
Sea turtle, leatherback		E	Reptile	Yes
(Dermochelys coriacea)			Saltwater, Coastal	
Sea turtle, loggerhead		T	Reptile	No
(Caretta caretta)			Saltwater, Coastal	
Snake, Eastern Indigo		T	Reptile	Yes
(Drymarchon corais couperi)			Terrestrial	

South Dakota	(8) species:		**Taxa**	Critical Habitat
Crane, Whooping		E	Bird	Yes
(Grus americana)			Terrestrial, Freshwater	

South Dakota (8) species:

		Taxa	Critical Habitat
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Shiner, Topeka	E	Fish	Yes
(Notropis topeka (=tristis))		Freshwater	
Sturgeon, Pallid	E	Fish	No
(Scaphirhynchus albus)		Freshwater	
Beetle, American Burying	E	Insect	No
(Nicrophorus americanus)		Terrestrial	
Ferret, Black-footed	E	Mammal	No
(Mustela nigripes)		Terrestrial	
Orchid, Western Prairie Fringed	T	Monocot	No
(Platanthera praeclara)		Terrestrial	

Tennessee (87) species:

		Taxa	Critical Habitat
Spider, Spruce-fir Moss	E	Arachnid	Yes
(Microhexura montivaga)		Terrestrial	
Stork, Wood	E	Bird	No
(Mycteria americana)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Woodpecker, Red-cockaded	E	Bird	No
(Picoides borealis)		Terrestrial	
Combshell, Upland	E	Bivalve	Yes
(Epioblasma metastriata)		Freshwater	
Elktoe, Appalachian	E	Bivalve	Yes
(Alasmidonta raveneliana)		Freshwater	
Fanshell	E	Bivalve	No
(Cyprogenia stegaria)		Freshwater	
Kidneyshell, Triangular	E	Bivalve	Yes
(Ptychobranchus greenii)		Freshwater	
Mucket, Pink (Pearlymussel)	E	Bivalve	No
(Lampsilis abrupta)		Freshwater	
Mussel, Alabama Moccasinshell	T	Bivalve	Yes
(Medionidus acutissimus)		Freshwater	
Mussel, Clubshell	E	Bivalve	No
(Pleurobema clava)		Freshwater	
Mussel, Coosa Moccasinshell	E	Bivalve	Yes
(Medionidus parvulus)		Freshwater	
Mussel, Cumberland Combshell	E	Bivalve	Yes
(Epioblasma brevidens)		Freshwater	
Mussel, Cumberland Elktoe	E	Bivalve	Yes
(Alasmidonta atropurpurea)		Freshwater	
Mussel, Cumberland Pigtoe	E	Bivalve	No
(Pleurobema gibberum)		Freshwater	
Mussel, Fine-lined Pocketbook	T	Bivalve	Yes
(Lampsilis altilis)		Freshwater	
Mussel, Fine-rayed Pigtoe	E	Bivalve	No
(Fusconaia cuneolus)		Freshwater	
Mussel, Ovate Clubshell	E	Bivalve	Yes
(Pleurobema perovatum)		Freshwater	

Tennessee	(87) species:		**Taxa**	Critical Habitat
Mussel, Oyster	*(Epioblasma capsaeformis)*	E	Bivalve Freshwater	Yes
Mussel, Ring Pink (=Golf Stick Pearly)	*(Obovaria retusa)*	E	Bivalve Freshwater	No
Mussel, Rough Pigtoe	*(Pleurobema plenum)*	E	Bivalve Freshwater	No
Mussel, Shiny Pigtoe	*(Fusconaia cor)*	E	Bivalve Freshwater	No
Mussel, Southern Pigtoe	*(Pleurobema georgianum)*	E	Bivalve Freshwater	Yes
Pearlymussel, Alabama Lamp	*(Lampsilis virescens)*	E	Bivalve Freshwater	No
Pearlymussel, Appalachian Monkeyface	*(Quadrula sparsa)*	E	Bivalve Freshwater	No
Pearlymussel, Birdwing	*(Conradilla caelata)*	E	Bivalve Freshwater	No
Pearlymussel, Cracking	*(Hemistena lata)*	E	Bivalve Freshwater	No
Pearlymussel, Cumberland Bean	*(Villosa trabalis)*	E	Bivalve Freshwater	No
Pearlymussel, Cumberland Monkeyface	*(Quadrula intermedia)*	E	Bivalve Freshwater	No
Pearlymussel, Dromedary	*(Dromus dromas)*	E	Bivalve Freshwater	No
Pearlymussel, Green-blossom	*(Epioblasma torulosa gubernaculum)*	E	Bivalve Freshwater	No
Pearlymussel, Little-wing	*(Pegias fabula)*	E	Bivalve Freshwater	No
Pearlymussel, Orange-footed	*(Plethobasus cooperianus)*	E	Bivalve Freshwater	No
Pearlymussel, Pale Lilliput	*(Toxolasma cylindrellus)*	E	Bivalve Freshwater	No
Pearlymussel, Purple Cat's Paw	*(Epioblasma obliquata obliquata)*	E	Bivalve Freshwater	No
Pearlymussel, Tubercled-blossom	*(Epioblasma torulosa torulosa)*	E	Bivalve Freshwater	No
Pearlymussel, Turgid-blossom	*(Epioblasma turgidula)*	E	Bivalve Freshwater	No
Pearlymussel, White Wartyback	*(Plethobasus cicatricosus)*	E	Bivalve Freshwater	No
Pearlymussel, Yellow-blossom	*(Epioblasma florentina florentina)*	E	Bivalve Freshwater	No
Purple Bean	*(Villosa perpurpurea)*	E	Bivalve Freshwater	Yes
Rabbitsfoot, Rough	*(Quadrula cylindrica strigillata)*	E	Bivalve Freshwater	Yes
Riffleshell, Tan	*(Epioblasma florentina walkeri (=E. walkeri))*	E	Bivalve Freshwater	No
Crayfish, Nashville	*(Orconectes shoupi)*	E	Crustacean Freshwater	No

Tennessee	(87) species:		**Taxa**	Critical Habitat
Aster, Ruth's Golden		E	Dicot	No
(Pityopsis ruthii)			Terrestrial	
Avens, Spreading		E	Dicot	No
(Geum radiatum)			Terrestrial	
Bladderpod, Spring Creek		E	Dicot	No
(Lesquerella perforata)			Floodplain	
Bluet, Roan Mountain		E	Dicot	No
(Hedyotis purpurea var. montana)			Terrestrial	
Chaffseed, American		E	Dicot	No
(Schwalbea americana)			Terrestrial	
Clover, Leafy Prairie		E	Dicot	No
(Dalea foliosa)			Terrestrial	
Coneflower, Tennessee Purple		E	Dicot	No
(Echinacea tennesseensis)			Terrestrial	
Goldenrod, Blue Ridge		T	Dicot	No
(Solidago spithamaea)			Terrestrial	
Ground-plum, Guthrie's		E	Dicot	No
(Astragalus bibullatus)			Terrestrial	
Pitcher-plant, Green		E	Dicot	No
(Sarracenia oreophila)			Terrestrial, Freshwater	
Potato-bean, Price's		T	Dicot	No
(Apios priceana)			Terrestrial	
Rock-cress, Braun's		E	Dicot	Yes
(Arabis perstellata E. L. Braun var. ampla Rollins)			Terrestrial	
Rock-cress, Small		E	Dicot	Yes
(Arabis perstellata E. L. Braun var. perstellata Fernald)			Terrestrial	
Rosemary, Cumberland		T	Dicot	No
(Conradina verticillata)			Terrestrial	
Sandwort, Cumberland		E	Dicot	No
(Arenaria cumberlandensis)			Terrestrial	
Skullcap, Large-flowered		T	Dicot	No
(Scutellaria montana)			Terrestrial	
Spiraea, Virginia		T	Dicot	No
(Spiraea virginiana)			Terrestrial	
Fern, American hart's-tongue		T	Ferns	No
(Asplenium scolopendrium var. americanum)			Terrestrial	
Chub, Slender		T	Fish	Yes
(Erimystax cahni)			Freshwater	
Chub, Spotfin		T	Fish	Yes
(Erimonax monachus)			Freshwater	
Dace, Blackside		T	Fish	No
(Phoxinus cumberlandensis)			Freshwater	
Darter, Amber		E	Fish	Yes
(Percina antesella)			Freshwater	
Darter, Bluemask (=jewel)		E	Fish	No
(Etheostoma sp.)			Freshwater	
Darter, Boulder		E	Fish	No
(Etheostoma wapiti)			Freshwater	
Darter, Duskytail		E	Fish	No
(Etheostoma percnurum)			Freshwater	

Tennessee (87) species:

		Taxa	Critical Habitat
Darter, Slackwater	T	Fish	Yes
(Etheostoma boschungi)		Freshwater	
Darter, Snail	T	Fish	No
(Percina tanasi)		Freshwater	
Logperch, Conasauga	E	Fish	Yes
(Percina jenkinsi)		Freshwater	
Madtom, Pygmy	E	Fish	No
(Noturus stanauli)		Freshwater	
Madtom, Smoky	E	Fish	Yes
(Noturus baileyi)		Freshwater	
Madtom, Yellowfin	T	Fish	Yes
(Noturus flavipinnis)		Freshwater	
Shiner, Blue	T	Fish	No
(Cyprinella caerulea)		Freshwater	
Shiner, Palezone	E	Fish	No
(Notropis albizonatus)		Freshwater	
Sturgeon, Pallid	E	Fish	No
(Scaphirhynchus albus)		Freshwater	
Marstonia, Royal (=Royal Snail)	E	Gastropod	No
(Pyrgulopsis ogmorhaphe)		Terrestrial	
Riversnail, Anthony's	E	Gastropod	No
(Athearnia anthonyi)		Freshwater	
Snail, Painted Snake Coiled Forest	T	Gastropod	No
(Anguispira picta)		Terrestrial	
Lichen, Rock Gnome	E	Lichen	No
(Gymnoderma lineare)		Terrestrial	
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Squirrel, Carolina Northern Flying	E	Mammal	No
(Glaucomys sabrinus coloratus)		Terrestrial	
Wolf, Red	E	Mammal	No
(Canis rufus)		Terrestrial	
Grass, Tennessee Yellow-eyed	E	Monocot	No
(Xyris tennesseensis)		Terrestrial	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	

Texas (87) species:

		Taxa	Critical Habitat
Salamander, Barton Springs	E	Amphibian	No
(Eurycea sosorum)		Terrestrial, Freshwater	
Salamander, San Marcos	T	Amphibian	Yes
(Eurycea nana)		Terrestrial, Freshwater	
Salamander, Texas Blind	E	Amphibian	No
(Typhlomolge rathbuni)		Freshwater, Subterraneous	
Toad, Houston	E	Amphibian	Yes
(Bufo houstonensis)		Terrestrial, Freshwater	
Harvestman, Bee Creek Cave	E	Arachnid	No
(Texella reddelli)		Terrestrial, Subterraneous	
Harvestman, Bone Cave	E	Arachnid	No
(Texella reyesi)		Terrestrial, Subterraneous	

Texas (87) species:		**Taxa**	Critical Habitat
Harvestman, Robber Baron Cave	E	Arachnid	Yes
(Texella cokendolpheri)		Terrestrial, Subterraneous	
Meshweaver, Braken Bat Cave	E	Arachnid	Yes
(Cicurina venii)		Terrestrial, Subterraneous	
Pseudoscorpion, Tooth Cave	E	Arachnid	No
(Tartarocreagris texana)		Terrestrial, Subterraneous	
Spider, Government Canyon Cave	E	Arachnid	No
(Neoleptoneta microps)		Terrestrial, Subterraneous	
Spider, Madla's Cave	E	Arachnid	Yes
(Cicurina madla)		Terrestrial, Subterraneous	
Spider, Robber Baron Cave	E	Arachnid	Yes
(Cicurina baronia)		Terrestrial, Subterraneous	
Spider, Tooth Cave	E	Arachnid	No
(Leptoneta myopica)		Terrestrial, Subterraneous	
Spider, Vesper Cave	E	Arachnid	Yes
(Cicurina vespera)		Terrestrial, Subterraneous	
Crane, Whooping	E	Bird	Yes
(Grus americana)		Terrestrial, Freshwater	
Curlew, Eskimo	E	Bird	No
(Numenius borealis)		Terrestrial	
Falcon, Northern Aplomado	E	Bird	No
(Falco femoralis septentrionalis)		Terrestrial	
Flycatcher, Southwestern Willow	E	Bird	Yes
(Empidonax traillii extimus)		Terrestrial	
Owl, Mexican Spotted	T	Bird	Yes
(Strix occidentalis lucida)		Terrestrial	
Pelican, Brown	E	Bird	No
(Pelecanus occidentalis)		Terrestrial	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Prairie-chicken, Attwater's Greater	E	Bird	No
(Tympanuchus cupido attwateri)		Terrestrial	
Tern, Interior (population) Least	E	Bird	No
(Sterna antillarum)		Terrestrial	
Vireo, Black-capped	E	Bird	No
(Vireo atricapilla)		Terrestrial	
Warbler (=Wood), Golden-cheeked	E	Bird	No
(Dendroica chrysoparia)		Terrestrial	
Woodpecker, Red-cockaded	E	Bird	No
(Picoides borealis)		Terrestrial	
Amphipod, Peck's Cave	E	Crustacean	No
(Stygobromus (=Stygonectes) pecki)		Freshwater, Subterraneous	
Ambrosia, South Texas	E	Dicot	No
(Ambrosia cheiranthifolia)		Terrestrial	
Ayenia, Texas	E	Dicot	No
(Ayenia limitaris)		Terrestrial	
Bladderpod, White	E	Dicot	No
(Lesquerella pallida)		Terrestrial	
Bladderpod, Zapata	E	Dicot	Yes
(Lesquerella thamnophila)		Terrestrial	

Texas (87) species:		**Taxa**	Critical Habitat
Cactus, Black Lace	E	Dicot	No
(Echinocereus reichenbachii var. albertii)		Terrestrial	
Cactus, Bunched Cory	T	Dicot	No
(Coryphantha ramillosa)		Terrestrial	
Cactus, Chisos Mountain Hedgehog	T	Dicot	No
(Echinocereus chisoensis var. chisoensis)		Terrestrial	
Cactus, Lloyd's Mariposa	T	Dicot	No
(Echinomastus mariposensis)		Terrestrial	
Cactus, Nellie Cory	E	Dicot	No
(Coryphantha minima)		Terrestrial	
Cactus, Sneed Pincushion	E	Dicot	No
(Coryphantha sneedii var. sneedii)		Terrestrial	
Cactus, Star	E	Dicot	No
(Astrophytum asterias)		Terrestrial	
Cactus, Tobusch Fishhook	E	Dicot	No
(Ancistrocactus tobuschii)		Terrestrial	
Cat's-eye, Terlingua Creek	E	Dicot	No
(Cryptantha crassipes)		Terrestrial	
Dawn-flower, Texas Prairie (=Texas Bitterweed)	E	Dicot	No
(Hymenoxys texana)		Terrestrial	
Dogweed, Ashy	E	Dicot	No
(Thymophylla tephroleuca)		Terrestrial	
Frankenia, Johnston's	E	Dicot	No
(Frankenia johnstonii)		Terrestrial	
Fruit, Earth (=geocarpon)	T	Dicot	No
(Geocarpon minimum)		Terrestrial	
Manioc, Walker's	E	Dicot	No
(Manihot walkerae)		Terrestrial	
Oak, Hinckley	T	Dicot	No
(Quercus hinckleyi)		Terrestrial	
Phlox, Texas Trailing	E	Dicot	No
(Phlox nivalis ssp. texensis)		Terrestrial	
Pitaya, Davis' Green	E	Dicot	No
(Echinocereus viridiflorus var. davisii)		Terrestrial	
Poppy-mallow, Texas	E	Dicot	No
(Callirhoe scabriuscula)		Terrestrial	
Rush-pea, Slender	E	Dicot	No
(Hoffmannseggia tenella)		Terrestrial	
Sand-verbena, Large-fruited	E	Dicot	No
(Abronia macrocarpa)		Terrestrial	
Snowbells, Texas	E	Dicot	No
(Styrax texanus)		Terrestrial	
Sunflower, Pecos	T	Dicot	Yes
(Helianthus paradoxus)		Terrestrial, Perm. Wetland	
Wild-buckwheat, Gypsum	T	Dicot	Yes
(Eriogonum gypsophilum)		Terrestrial	
Darter, Fountain	E	Fish	Yes
(Etheostoma fonticola)		Freshwater	
Gambusia, Big Bend	E	Fish	No
(Gambusia gaigei)		Freshwater	

Texas	(87) species:		**Taxa**	Critical Habitat
Gambusia, Clear Creek		E	Fish	No
(Gambusia heterochir)			Freshwater	
Gambusia, Pecos		E	Fish	No
(Gambusia nobilis)			Freshwater	
Gambusia, San Marcos		E	Fish	Yes
(Gambusia georgei)			Freshwater	
Minnow, Devils River		T	Fish	No
(Dionda diaboli)			Freshwater	
Pupfish, Comanche Springs		E	Fish	No
(Cyprinodon elegans)			Freshwater	
Pupfish, Leon Springs		E	Fish	Yes
(Cyprinodon bovinus)			Freshwater	
Shiner, Arkansas River		T	Fish	Yes
(Notropis girardi)			Freshwater	
Snail, Pecos Assiminea		E	Gastropod	Yes
(Assiminea pecos)			Freshwater	
Beetle, American Burying		E	Insect	No
(Nicrophorus americanus)			Terrestrial	
Beetle, Coffin Cave Mold		E	Insect	No
(Batrisodes texanus)			Subterraneous	
Beetle, Comal Springs Dryopid		E	Insect	No
(Stygoparnus comalensis)			Freshwater, Subterraneous	
Beetle, Comal Springs Riffle		E	Insect	No
(Heterelmis comalensis)			Freshwater, Subterraneous	
Beetle, Helotes Mold		E	Insect	Yes
(Batrisodes venyivi)			Subterraneous	
Beetle, Kretschmarr Cave Mold		E	Insect	No
(Texamaurops reddelli)			Subterraneous	
Beetle, Tooth Cave Ground		E	Insect	No
(Rhadine persephone)			Subterraneous	
Rhadine exilis (ncn)		E	Insect	Yes
(Rhadine exilis)			Terrestrial, Subterraneous	
Rhadine infernalis (ncn)		E	Insect	Yes
(Rhadine infernalis)			Terrestrial, Subterraneous	
Bat, Mexican Long-nosed		E	Mammal	No
(Leptonycteris nivalis)			Terrestrial, Subterraneous	
Bear, Louisiana Black		T	Mammal	No
(Ursus americanus luteolus)			Terrestrial	
Jaguarundi, Gulf Coast		E	Mammal	No
(Herpailurus (=Felis) yagouaroundi cacomitli)			Terrestrial	
Jaguarundi, Sinaloan		E	Mammal	No
(Herpailurus (=Felis) yagouaroundi tolteca)			Terrestrial	
Ocelot		E	Mammal	No
(Leopardus (=Felis) pardalis)			Terrestrial	
Ladies'-tresses, Navasota		E	Monocot	No
(Spiranthes parksii)			Terrestrial	
Pondweed, Little Aguja Creek		E	Monocot	No
(Potamogeton clystocarpus)			Freshwater	
Wild-rice, Texas		E	Monocot	Yes
(Zizania texana)			Freshwater	

Texas (87) species:

		Taxa	Critical Habitat
Sea turtle, green	E	Reptile	Yes
(Chelonia mydas)		Saltwater	
Sea turtle, hawksbill	E	Reptile	Yes
(Eretmochelys imbricata)		Saltwater, Coastal	
Sea turtle, Kemp's ridley	E	Reptile	No
(Lepidochelys kempii)		Saltwater, Coastal	
Sea turtle, leatherback	E	Reptile	Yes
(Dermochelys coriacea)		Saltwater, Coastal	
Sea turtle, loggerhead	T	Reptile	No
(Caretta caretta)		Saltwater, Coastal	
Snake, Concho Water	T	Reptile	Yes
(Nerodia paucimaculata)		Terrestrial, Freshwater	

Utah (37) species:

		Taxa	Critical Habitat
Flycatcher, Southwestern Willow	E	Bird	Yes
(Empidonax traillii extimus)		Terrestrial	
Owl, Mexican Spotted	T	Bird	Yes
(Strix occidentalis lucida)		Terrestrial	
Bearclaw poppy, Dwarf	E	Dicot	No
(Arctomecon humilis)		Terrestrial	
Bladderpod, Kodachrome	E	Dicot	No
(Lesquerella tumulosa)		Terrestrial	
Buttercup, Autumn	E	Dicot	No
(Ranunculus aestivalis (=acriformis))		Terrestrial	
Cactus, San Rafael	E	Dicot	No
(Pediocactus despainii)		Terrestrial	
Cactus, Siler Pincushion	T	Dicot	No
(Pediocactus (=Echinocactus,=Utahia) sileri)		Terrestrial	
Cactus, Uinta Basin Hookless	T	Dicot	No
(Sclerocactus glaucus)		Terrestrial	
Cactus, Winkler	T	Dicot	No
(Pediocactus winkleri)		Terrestrial	
Cactus, Wright Fishhook	E	Dicot	No
(Sclerocactus wrightiae)		Terrestrial	
Cycladenia, Jones	T	Dicot	No
(Cycladenia jonesii (=humilis))		Terrestrial	
Daisy, Maguire	T	Dicot	No
(Erigeron maguirei)		Freshwater	
Milk-vetch, Deseret	T	Dicot	No
(Astragalus desereticus)		Terrestrial	
Milk-vetch, Heliotrope	T	Dicot	Yes
(Astragalus montii)		Terrestrial	
Milk-vetch, Holmgren	E	Dicot	No
(Astragalus holmgreniorum)		Terrestrial	
Milk-vetch, Shivwits	E	Dicot	No
(Astragalus ampullarioides)		Terrestrial	
Milkweed, Welsh's	T	Dicot	Yes
(Asclepias welshii)		Terrestrial	
Phacelia, Clay	E	Dicot	No
(Phacelia argillacea)		Terrestrial	
Primrose, Maguire	T	Dicot	No
(Primula maguirei)		Terrestrial	

Utah	(37) species:		**Taxa**	Critical Habitat
Reed-mustard, Barneby		E	Dicot	No
(Schoenocrambe barnebyi)			Terrestrial	
Reed-mustard, Clay		T	Dicot	No
(Schoenocrambe argillacea)			Terrestrial	
Reed-mustard, Shrubby		E	Dicot	No
(Schoenocrambe suffrutescens)			Terrestrial	
Ridge-cress (=Pepper-cress), Barneby		E	Dicot	No
(Lepidium barnebyanum)			Terrestrial	
Townsendia, Last Chance		T	Dicot	No
(Townsendia aprica)			Terrestrial	
Chub, Bonytail		E	Fish	Yes
(Gila elegans)			Freshwater	
Chub, Humpback		E	Fish	Yes
(Gila cypha)			Freshwater	
Chub, Virgin River		E	Fish	Yes
(Gila seminuda (=robusta))			Freshwater	
Squawfish, Colorado		E	Fish	Yes
(Ptychocheilus lucius)			Freshwater	
Sucker, June		E	Fish	Yes
(Chasmistes liorus)			Freshwater	
Sucker, Razorback		E	Fish	Yes
(Xyrauchen texanus)			Freshwater	
Trout, Lahontan Cutthroat		T	Fish	No
(Oncorhynchus clarki henshawi)			Freshwater	
Woundfin		E	Fish	Yes
(Plagopterus argentissimus)			Freshwater	
Ferret, Black-footed		E	Mammal	No
(Mustela nigripes)			Terrestrial	
Prairie Dog, Utah		T	Mammal	No
(Cynomys parvidens)			Terrestrial, Subterraneous	
Ladies'-tresses, Ute		T	Monocot	No
(Spiranthes diluvialis)			Terrestrial	
Sedge, Navajo		T	Monocot	Yes
(Carex specuicola)			Terrestrial	
Tortoise, Desert		T	Reptile	Yes
(Gopherus agassizii)			Terrestrial	

Vermont	(4) species:		**Taxa**	Critical Habitat
Mussel, Dwarf Wedge		E	Bivalve	No
(Alasmidonta heterodon)			Freshwater	
Milk-vetch, Jesup's		E	Dicot	No
(Astragalus robbinsii var. jesupi)			Terrestrial	
Bat, Indiana		E	Mammal	Yes
(Myotis sodalis)			Terrestrial, Subterraneous	
Bulrush, Northeastern (=Barbed Bristle)		E	Monocot	No
(Scirpus ancistrochaetus)			Terrestrial, Freshwater	

Virginia	(58) species:		**Taxa**	Critical Habitat
Salamander, Shenandoah		E	Amphibian	No
(Plethodon shenandoah)			Terrestrial, Freshwater	
Plover, Piping		E	Bird	Yes
(Charadrius melodus)			Terrestrial	

Virginia	(58) species:		**Taxa**	Critical Habitat
Woodpecker, Red-cockaded		E	Bird	No
(Picoides borealis)			Terrestrial	
Fanshell		E	Bivalve	No
(Cyprogenia stegaria)			Freshwater	
Mucket, Pink (Pearlymussel)		E	Bivalve	No
(Lampsilis abrupta)			Freshwater	
Mussel, Cumberland Combshell		E	Bivalve	Yes
(Epioblasma brevidens)			Freshwater	
Mussel, Cumberland Elktoe		E	Bivalve	Yes
(Alasmidonta atropurpurea)			Freshwater	
Mussel, Dwarf Wedge		E	Bivalve	No
(Alasmidonta heterodon)			Freshwater	
Mussel, Fine-rayed Pigtoe		E	Bivalve	No
(Fusconaia cuneolus)			Freshwater	
Mussel, Oyster		E	Bivalve	Yes
(Epioblasma capsaeformis)			Freshwater	
Mussel, Rough Pigtoe		E	Bivalve	No
(Pleurobema plenum)			Freshwater	
Mussel, Shiny Pigtoe		E	Bivalve	No
(Fusconaia cor)			Freshwater	
Pearlymussel, Appalachian Monkeyface		E	Bivalve	No
(Quadrula sparsa)			Freshwater	
Pearlymussel, Birdwing		E	Bivalve	No
(Conradilla caelata)			Freshwater	
Pearlymussel, Cracking		E	Bivalve	No
(Hemistena lata)			Freshwater	
Pearlymussel, Cumberland Bean		E	Bivalve	No
(Villosa trabalis)			Freshwater	
Pearlymussel, Cumberland Monkeyface		E	Bivalve	No
(Quadrula intermedia)			Freshwater	
Pearlymussel, Dromedary		E	Bivalve	No
(Dromus dromas)			Freshwater	
Pearlymussel, Green-blossom		E	Bivalve	No
(Epioblasma torulosa gubernaculum)			Freshwater	
Pearlymussel, Little-wing		E	Bivalve	No
(Pegias fabula)			Freshwater	
Purple Bean		E	Bivalve	Yes
(Villosa perpurpurea)			Freshwater	
Rabbitsfoot, Rough		E	Bivalve	Yes
(Quadrula cylindrica strigillata)			Freshwater	
Riffleshell, Tan		E	Bivalve	No
(Epioblasma florentina walkeri (=E. walkeri))			Freshwater	
Spinymussel, James River		E	Bivalve	No
(Pleurobema collina)			Freshwater	
Isopod, Lee County Cave		E	Crustacean	No
(Lirceus usdagalun)			Freshwater	
Isopod, Madison Cave		T	Crustacean	No
(Antrolana lira)			Freshwater	
Amaranth, Seabeach		T	Dicot	No
(Amaranthus pumilus)			Coastal	

Virginia	(58) species:		**Taxa**	Critical Habitat
Birch, Virginia Round-leaf		T	Dicot	No
(Betula uber)			Floodplain	
Bittercress, Small-anthered		E	Dicot	No
(Cardamine micranthera)			Terrestrial	
Chaffseed, American		E	Dicot	No
(Schwalbea americana)			Terrestrial	
Coneflower, Smooth		E	Dicot	No
(Echinacea laevigata)			Terrestrial	
Harperella		E	Dicot	No
(Ptilimnium nodosum)			Freshwater	
Joint-vetch, Sensitive		T	Dicot	No
(Aeschynomene virginica)			Terrestrial, Brackish	
Mallow, Peter's Mountain		E	Dicot	No
(Iliamna corei)			Terrestrial	
Rock-cress, Shale Barren		E	Dicot	No
(Arabis serotina)			Terrestrial	
Sneezeweed, Virginia		T	Dicot	No
(Helenium virginicum)			Vernal pool	
Spiraea, Virginia		T	Dicot	No
(Spiraea virginiana)			Terrestrial	
Sumac, Michaux's		E	Dicot	No
(Rhus michauxii)			Terrestrial	
Sunflower, Schweinitz's		E	Dicot	No
(Helianthus schweinitzii)			Terrestrial	
Chub, Slender		T	Fish	Yes
(Erimystax cahni)			Freshwater	
Chub, Spotfin		T	Fish	Yes
(Erimonax monachus)			Freshwater	
Dace, Blackside		T	Fish	No
(Phoxinus cumberlandensis)			Freshwater	
Darter, Duskytail		E	Fish	No
(Etheostoma percnurum)			Freshwater	
Logperch, Roanoke		E	Fish	No
(Percina rex)			Freshwater	
Madtom, Yellowfin		T	Fish	Yes
(Noturus flavipinnis)			Freshwater	
Sturgeon, Shortnose		E	Fish	No
(Acipenser brevirostrum)			Freshwater, Saltwater	
Snail, Virginia Fringed Mountain		E	Gastropod	No
(Polygyriscus virginianus)			Terrestrial	
Beetle, Northeastern Beach Tiger		T	Insect	No
(Cicindela dorsalis dorsalis)			Terrestrial	
Butterfly, Mitchell's Satyr		E	Insect	No
(Neonympha mitchellii mitchellii)			Terrestrial, Perm. wetland	
Bat, Gray		E	Mammal	No
(Myotis grisescens)			Terrestrial, Subterraneous	
Bat, Indiana		E	Mammal	Yes
(Myotis sodalis)			Terrestrial, Subterraneous	
Bat, Virginia Big-eared		E	Mammal	Yes
(Corynorhinus (=Plecotus) townsendii virginianus)			Terrestrial, Subterraneous	

Virginia (58) species:

		Taxa	Critical Habitat
Squirrel, Delmarva Peninsula Fox	E	Mammal	No
(Sciurus niger cinereus)		Terrestrial	
Bulrush, Northeastern (=Barbed Bristle)	E	Monocot	No
(Scirpus ancistrochaetus)		Terrestrial, Freshwater	
Orchid, Eastern Prairie Fringed	T	Monocot	No
(Platanthera leucophaea)		Terrestrial	
Pink, Swamp	T	Monocot	No
(Helonias bullata)		Terrestrial, Freshwater	
Pogonia, Small Whorled	T	Monocot	No
(Isotria medeoloides)		Terrestrial	
Sea turtle, loggerhead	T	Reptile	No
(Caretta caretta)		Saltwater, Coastal	

Washington (20) species:

		Taxa	Critical Habitat
Murrelet, Marbled	T	Bird	Yes
(Brachyramphus marmoratus)		Terrestrial, Freshwater, Saltwater	
Owl, Northern Spotted	T	Bird	Yes
(Strix occidentalis caurina)		Terrestrial	
Pelican, Brown	E	Bird	No
(Pelecanus occidentalis)		Terrestrial	
Plover, Western Snowy	T	Bird	Yes
(Charadrius alexandrinus nivosus)		Terrestrial	
Catchfly, Spalding's	T	Dicot	No
(Silene spaldingii)		Terrestrial	
Checker-mallow, Nelson's	T	Dicot	No
(Sidalcea nelsoniana)		Terrestrial	
Checker-mallow, Wenatchee Mountains	E	Dicot	Yes
(Sidalcea oregana var. calva)		Terrestrial	
Howellia, Water	T	Dicot	No
(Howellia aquatilis)		Freshwater	
Lupine, Kincaid's	T	Dicot	Yes
(Lupinus sulphureus (=oreganus) ssp. kincaidii (=var. kincaidii))		Terrestrial	
Paintbrush, Golden	T	Dicot	No
(Castilleja levisecta)		Terrestrial	
Stickseed, Showy	E	Dicot	No
(Hackelia venusta)		Terrestrial	
Salmon, Chum	T	Fish	Yes
(Oncorhynchus (=Salmo) keta)		Freshwater, Brackish, Saltwater	
Salmon, Sockeye	E	Fish	No
(Oncorhynchus (=Salmo) nerka)		Freshwater, Brackish, Saltwater	
Steelhead	E	Fish	Yes
(Oncorhynchus (=Salmo) mykiss)		Freshwater, Brackish, Saltwater	
Trout, Bull	T	Fish	Yes
(Salvelinus confluentus)		Freshwater	
Butterfly, Oregon Silverspot	T	Insect	Yes
(Speyeria zerene hippolyta)		Terrestrial	
Bear, Grizzly	T	Mammal	No
(Ursus arctos horribilis)		Terrestrial	
Caribou, Woodland	E	Mammal	No
(Rangifer tarandus caribou)		Terrestrial	
Deer, Columbian White-tailed	E	Mammal	No
(Odocoileus virginianus leucurus)		Terrestrial	

Washington (20) species:		**Taxa**	Critical Habitat
Rabbit, Pygmy	E	Mammal	No
(Brachylagus idahoensis)		Terrestrial	
West Virginia (16) species:		**Taxa**	Critical Habitat
Salamander, Cheat Mountain	T	Amphibian	No
(Plethodon nettingi)		Terrestrial, Freshwater	
Fanshell	E	Bivalve	No
(Cyprogenia stegaria)		Freshwater	
Mucket, Pink (Pearlymussel)	E	Bivalve	No
(Lampsilis abrupta)		Freshwater	
Mussel, Clubshell	E	Bivalve	No
(Pleurobema clava)		Freshwater	
Pearlymussel, Tubercled-blossom	E	Bivalve	No
(Epioblasma torulosa torulosa)		Freshwater	
Spinymussel, James River	E	Bivalve	No
(Pleurobema collina)		Freshwater	
Clover, Running Buffalo	E	Dicot	No
(Trifolium stoloniferum)		Terrestrial	
Harperella	E	Dicot	No
(Ptilimnium nodosum)		Freshwater	
Rock-cress, Shale Barren	E	Dicot	No
(Arabis serotina)		Terrestrial	
Spiraea, Virginia	T	Dicot	No
(Spiraea virginiana)		Terrestrial	
Snail, Flat-spired Three-toothed	T	Gastropod	No
(Triodopsis platysayoides)		Terrestrial	
Bat, Gray	E	Mammal	No
(Myotis grisescens)		Terrestrial, Subterraneous	
Bat, Indiana	E	Mammal	Yes
(Myotis sodalis)		Terrestrial, Subterraneous	
Bat, Virginia Big-eared	E	Mammal	Yes
(Corynorhinus (=Plecotus) townsendii virginianus)		Terrestrial, Subterraneous	
Squirrel, Carolina Northern Flying	E	Mammal	No
(Glaucomys sabrinus coloratus)		Terrestrial	
Bulrush, Northeastern (=Barbed Bristle)	E	Monocot	No
(Scirpus ancistrochaetus)		Terrestrial, Freshwater	
Wisconsin (14) species:		**Taxa**	Critical Habitat
Crane, Whooping	E	Bird	Yes
(Grus americana)		Terrestrial, Freshwater	
Plover, Piping	E	Bird	Yes
(Charadrius melodus)		Terrestrial	
Warbler (=Wood), Kirtland's	E	Bird	No
(Dendroica kirtlandii)		Terrestrial	
Mussel, Winged Mapleleaf	E	Bivalve	No
(Quadrula fragosa)		Freshwater	
Pearlymussel, Higgins' Eye	E	Bivalve	No
(Lampsilis higginsii)		Freshwater	
Clover, Prairie Bush	T	Dicot	No
(Lespedeza leptostachya)		Terrestrial	
Locoweed, Fassett's	T	Dicot	No
(Oxytropis campestris var. chartacea)		Terrestrial	

Wisconsin (14) species:

		Taxa	Critical Habitat
Monkshood, Northern Wild	T	Dicot	No
(Aconitum noveboracense)		Terrestrial	
Thistle, Pitcher's	T	Dicot	No
(Cirsium pitcheri)		Terrestrial	
Butterfly, Karner Blue	E	Insect	No
(Lycaeides melissa samuelis)		Terrestrial	
Dragonfly, Hine's Emerald	E	Insect	Yes
(Somatochlora hineana)		Terrestrial, Freshwater	
Lynx, Canada	T	Mammal	No
(Lynx canadensis)		Terrestrial	
Iris, Dwarf Lake	T	Monocot	No
(Iris lacustris)		Terrestrial	
Orchid, Eastern Prairie Fringed	T	Monocot	No
(Platanthera leucophaea)		Terrestrial	

Wyoming (8) species:

		Taxa	Critical Habitat
Toad, Wyoming	E	Amphibian	No
(Bufo baxteri (=hemiophrys))		Terrestrial, Freshwater	
Butterfly Plant, Colorado	T	Dicot	Yes
(Gaura neomexicana var. coloradensis)		Terrestrial	
Yellowhead, Desert	T	Dicot	Yes
(Yermo xanthocephalus)		Terrestrial	
Dace, Kendall Warm Springs	E	Fish	No
(Rhinichthys osculus thermalis)		Freshwater	
Dace, Moapa	E	Fish	No
(Moapa coriacea)		Freshwater	
Bear, Grizzly	T	Mammal	No
(Ursus arctos horribilis)		Terrestrial	
Ferret, Black-footed	E	Mammal	No
(Mustela nigripes)		Terrestrial	
Mouse, Preble's Meadow Jumping	T	Mammal	Yes
(Zapus hudsonius preblei)		Terrestrial	