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

OFFICE OF
PREVENTION, PESTICIDES, AND
TOXIC SUBSTANCES

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**MEMORANDUM**

October 23, 2007

**SUBJECT:** **Pyroxsulam Section 3:** Environmental Fate and Ecological Risk Assessment

**TO:** Joanne Miller, Risk Manager
James Stone, Reviewer
Registration Division (7505P)

**FROM:** Christopher Salice, Biologist
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Environmental Risk Branch IV
Environmental Fate and Effects Division (7507P)

10-23-07
EBehl for Greg Orrick 10-23-07

**THROUGH:** Elizabeth Behl, Branch Chief
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Environmental Fate and Effects Division (EFED) has completed its ecological risk assessment for the new herbicide pyroxsulam and its end-use products GF-1674® (oil dispersion: 2.87% a.i.) and GF-1274® (water dispersible granule: 7.5% a.i.). The herbicide is initially proposed for use on winter and spring wheat.

The results of this screening-level assessment indicate a potential for direct adverse acute effects to non-target terrestrial and semi-aquatic plants. Although this screening-level analysis showed that there is limited potential for direct adverse effects to animal species associated with the use of pyroxsulam on wheat, indirect effects may result as a consequence of potential effects on plants.

Clarification is recommended for the proposed labels. Application rates are limited per growing season in the "Crop Specific Use Restrictions" sections. While winter and spring wheat only have one growing season per year, other crops may be planted during the same year. In order to clarify the labeling, we recommend modifying the maximum application rate statement to limit application rates per calendar year.

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**Tables 1 and 2** list all of the available environmental fate and ecological effect studies, respectively, that were submitted to fulfill data requirements under 40 CFR Pt. 158 for a terrestrial food use. The environmental fate and toxicology data requirements are not adequately fulfilled for a terrestrial food use. The submitted anaerobic aquatic metabolism, aerobic aquatic metabolism, and terrestrial field dissipation studies were supplemental and no anaerobic soil metabolism study was submitted. However, further submission of data may upgrade the submitted terrestrial field dissipation study. New anaerobic soil metabolism, anaerobic aquatic metabolism, and aerobic aquatic metabolism studies are not requested at this time because they are not expected to significantly alter risk conclusions.

Although no toxicity data were submitted for estuarine/marine animal species, the toxicity profile based on freshwater species and the physical properties of the chemical indicates that risks to estuarine/marine species are unlikely and that the toxicity data are not a requirement. However, without appropriate toxicity data, some uncertainty exists regarding the potential risks to estuarine/marine animal species associated with the proposed use of pyroxsulam on wheat.

**Table 1. Status of environmental fate data adequacy for terrestrial food uses of pyroxsulam.**

| Guideline | Study Title | MRID | Issues | Study Classification |
|---|---|---|---|---|
| 161-1 | Hydrolysis | 46908326 | None | Acceptable |
| 161-2 | Aqueous photolysis | MRID pending (modifies 46908327) | None | Acceptable |
| 161-3 | Soil photolysis | 46908328 | None | Acceptable |
| 161-4 | Air photolysis | No study | Study not required. | -- |
| 162-1 | Aerobic soil metabolism | 47202701 | None | Acceptable |
| | | 46908329<br>46908335<br>46908330 | Multiple solvent systems were not employed in a reasonable extraction attempt; non-extractable [$^{14}$C]residues were as high as 94% or unmeasured. | Supplemental<br>Unacceptable<br>Supplemental |
| 162-2 | Anaerobic soil metabolism | No study | **Study not submitted (apparent data gap).** | -- |
| 162-3 | Anaerobic aquatic metabolism | 46908331 | Anaerobic conditions were not assured; multiple solvent systems were not employed in a reasonable extraction attempt. **This study does not adequately fulfill the §162-3 data requirement.** | Supplemental |
| 162-4 | Aerobic aquatic metabolism | 46908336 | Multiple solvent systems were not employed in a reasonable extraction attempt; non-extractable [$^{14}$C]residues were as high as 73%. **This study does not adequately fulfill the §162-4 data requirement.** | Supplemental |

| Guideline | Study Title | MRID | Issues | Study Classification |
|---|---|---|---|---|
| 163-1 | Batch equilibrium/ aged leaching | 47159601 (modifies 46908332) | None | Acceptable |
| | | 46908333 | Conducted with six transformation products of pyroxsulam at only one concentration. | Supplemental |
| 163-2 | Lab volatility | No study | Study not required. | -- |
| 164-1 | Terrestrial field dissipation | 46908334 | Samples were stored as long as 588 days. An ongoing storage stability study of XDE-742 and its transformation products has only confirmed stability for XDE-742, 5-OH-XDE-742, and 6-Cl-7-OH-XDE-742 in frozen soil samples for six months (MRID 46908317). 7-OH-XDE-742 displayed reduced recovery over six months in a loam soil. **This study may be upgraded to fulfill the §164-1 data requirement.** | Supplemental |
| 164-2 | Aquatic field dissipation | No study | Study not required. | -- |
| 165-4 | Fish bioaccumulation | No study | Study not required due to low $K_{ow}$. | -- |

**Table 2. Status of ecological effects data adequacy for pyroxsulam.**

| Guideline | MRID | Study Title | Issues | Study Classification |
|---|---|---|---|---|
| 71-1 | 469084-16 | XDE-742 / BAS 770 H – Avian Single-Dose Oral $LD_{50}$ on the Bobwhite Quail (*Colinus virgnianus*) | None | (Pending) |
| 71-1 | 469084-17 | XDE-742 / BAS 770 H – Avian Single-Dose Oral $LD_{50}$ on the Mallard Duck (*Anas platyrhynchos*). | None | (Pending) |
| 850.2200 (71-2b) | 469084-18 | XDE-742 – Dietary Toxicity Test with the Mallard Duck (*Anas platyrhynchos*) | None | (Pending) |
| 850.2200 (71-2a) | 469084-19 | XDE-742 – Dietary Toxicity Test with the Northern Bobwhite Quail (*Colinus virginianus*). | None | (Pending) |
| 850.2300 (71-4b) | 469084-20 | XDE-742: Reproductive Toxicity Test with the Mallard Duck (*Anas platyrhynchos*). | None | (Pending) |
| 850.2300 (71-4a) | 469084-21 | XDE-742: Reproductive Toxicity Test with the Northern Bobwhite Quail (*Colinus virginiamus*) | None | (Pending) |
| 72-1 | 469084-22 | XDE-742/BAS 770 H: Acute Toxicity Study On The Fathead Minnow (*Pimephales promelas*) In A Static System Over 96 Hours | None | (Pending) |
| 72-1 | 469084-23 | XDE-742/BAS 770 H: Acute Toxicity Study On The Fathead Minnow (*Oncorhynchus mykiss*) In A Static System Over 96 Hours | None | (Pending) |
| 72-1 | 469084-24 | 7-OH Metabolite of XDE-742- Acute Toxicity to Rainbow Trout (*Oncorhynchus mykiss*) Under Static Conditions | None | (Pending) |

| Guideline | MRID | Study Title | Issues | Study Classification |
|---|---|---|---|---|
| 72-1 | 469084-25 | ASTA Metabolite of XDE-742: An Acute Toxicity Study with the Rainbow Trout, *Oncorhynchus mykiss* | None | (Pending) |
| 72-2 | 469084-26 | 7-OH Metabolite of XDE-742- Acute Toxicity to Water Fleas, *Daphnia magna*, Under Static Conditions | None | (Pending) |
| 72-2 | 469084-27 | ASTA Metabolite of XDE-742: An Acute Toxicity Study with the Daphnid, *Daphnia magna* | None | (Pending) |
| 72-2 | 469084-28 | XDE-742: An Acute Toxicity Study with the Daphnid, *Daphnia magna* | None | (Pending) |
| 72-4a | 469084-30; 469086-26 (registrant -prepared DER) | XDE-742: Toxicity to the Early-Life Stages of the Fathead Minnow, *Pimephales promelas*. | None | (Pending) |
| 72-4b | 469084-29 | XDE-742: A 21-Day Chronic Toxicity Study with the Daphnid (*Daphnia magna*) | None | (Pending) |
| 123-2 | 469084-31 | XDE-742-Growth Inhibition Test with Freshwater Blue-Green Alga (*Anabaena flos-aquae*) | Test material was detected at a concentration above the LOQ in the negative control at test termination; however, this was believed to be an error during analytical sampling. | (Pending) |
| 123-2 | 469084-32 | XDE-742-Growth Inhibition Test with Freshwater Diatom (*Navicula pelliculosa*) | None | (Pending) |
| 850.4400 (123-2) | 469084-33 | 7-OH Metabolite of XDE-742- Toxicity to Duckweed, *Lemna gibba* | None | (Pending) |
| 850.4400 (123-2) | 469084-34 | ADTP Metabolite of XDE-742- Toxicity to Duckweed, *Lemna gibba* | None | (Pending) |
| 850.4400 (123-2) | 469084-35 | 5,7-Di-OH Metabolite of XDE-742- Toxicity to Duckweed, *Lemna gibba* | None | (Pending) |
| 850.4400 (123-2) | 469084-36 | 5-OH Metabolite of XDE-742- Toxicity to Duckweed, *Lemna gibba* | None | (Pending) |
| 850.4400 (123-2) | 469084-37 | 6-Cl-7-OH Metabolite of XDE-742- Toxicity to Duckweed, *Lemna gibba* | None | (Pending) |
| 850.4400 (123-2) | 469084-38 | XDE-742 Sulfinic Acid Metabolite- Toxicity to Duckweed, *Lemna gibba* | None | (Pending) |
| 850.4225 (123-1b) | 469084-39 | Effects of GF-1674 on Seedling Emergence and Seedling Growth on Non-Target Terrestrial Plants (Tier II)-2005 | None | (Pending) |
| 850.4250 (123-1a) | 469084-40 | Effects of GF-1674 on the Vegetative Vigor on Non-Target Terrestrial Plants (Tier II)- 2005 | None | (Pending) |

| Guideline | MRID | Study Title | Issues | Study Classification |
|---|---|---|---|---|
| 123-2 | 469084-41 | XDE-742: Growth Inhibition Test with the Saltwater Diatom *Skeletonema costatum* | None | (Pending) |
| 850.4400 (123-2) | 469084-42 | XDE-742: Growth Inhibition Test with the Aquatic Plant, *Lemna gibba* | None | (Pending) |
| 123-2 | 469084-43 | XDE-742 Sulfinic Acid Metabolite- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | None | (Pending) |
| 850.4400 (123-2) | 469084-44 | Inhibition of Growth of the Aquatic Plant Duckweed, *Lemna gibba*, Following One and Three Day Exposures to XDE-742 | None | (Pending) |
| 123-2 | 469084-45 | XDE-742: Growth Inhibition Test with the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | None | (Pending) |
| 123-2 | 469084-46 | ADTP Metabolite of XDE-742- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | None | (Pending) |
| 123-2 | 469084-47 | 5-OH Metabolite of XDE-742- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | None | (Pending) |
| 123-2 | 469084-48 | 6-Cl-7-OH Metabolite of XDE-742- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | None | (Pending) |
| 123-2 | 469084-49 | 5,7-Di-OH Metabolite of XDE-742- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | None | (Pending) |
| 123-2 | 469084-50 | 7-OH Metabolite of XDE-742- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | None | (Pending) |
| 123-2 | 469084-51 | ASTA Metabolite of XDE-742: Growth Inhibition Test with the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | None | (Pending) |
| 850.4400 (123-2) | 469084-52 | ASTA Metabolite of XDE-742: Growth Inhibition Test with the Aquatic Plant Duckweed, *Lemna gibba* | None | (Pending) |
| OECD 207 | 469085-04 | 5-OH Metabolite of XDE-742: An Acute Toxicity Study with the Earthworm in an Artificial Soil Substrate | None | (Pending) |
| OECD 207 | 469085-05 | XR-742: 14 Day Soil Exposure Acute Toxicity to the Earthworm, *Eisenia foetida* | None | (Pending) |
| OECD 207 | 469085-06 | 6-Cl-7-OH Metabolite of XDE-742: An Acute Toxicity Study with the Earthworm in an Artificial Soil Substrate | None | (Pending) |
| OECD 207 | 469085-07 | 7-OH Metabolite of XDE-742: An Acute Toxicity Study with the Earthworm in an Artificial Soil Substrate | None | (Pending) |

| Guideline | MRID | Study Title | Issues | Study Classification |
|---|---|---|---|---|
| OECD 213 & 214 | 469085-08 | Effects of XDE-742/ BAS770H (*Acute Contact and Oral*) on Honey Bees *Apis mellifera L.* In the Laboratory | None | (Pending) |
| OECD 219 (Non-G) | 469085-09 | 7-OH Metabolite of XDE-742 – Chironomid Toxicity Test with Midge (*Chironomus riparius*) Under Static Conditions using Spiked Water. | None | (Pending) |
| OECD 219 (Non-G) | 469085-10 | XDE-742: 28-Day Chronic Toxicity Study with the Midge, *Chironomus riparius*, Using Spiked Water in a Sediment-Water Exposure System. | Midge larvae were added to each vessel on the same day the vessels were spiked, and aeration was stopped for approx. 3 hours during and thereafter. | (Pending) |
| OECD 222 (Non-G) | 469085-11 | 6-Cl-7-OH Metabolite of XDE-742: A Reproduction Study with the Earthworm in an Artificial Soil Substrate | None | (Pending) |
| None | 469085-12 | Herbicidal Activity of XDE-742 Soil Metabolites on Weeds and Crops in a Discovery Weed Management Level 3 Postemergence Screen | No quantitative data were provided on survival, plant height or dry weight. Therefore, this study cannot be considered for a traditional review as it only provides qualitative data on the injury to the plants from exposure to the test material and associated metabolites. | (Pending) |

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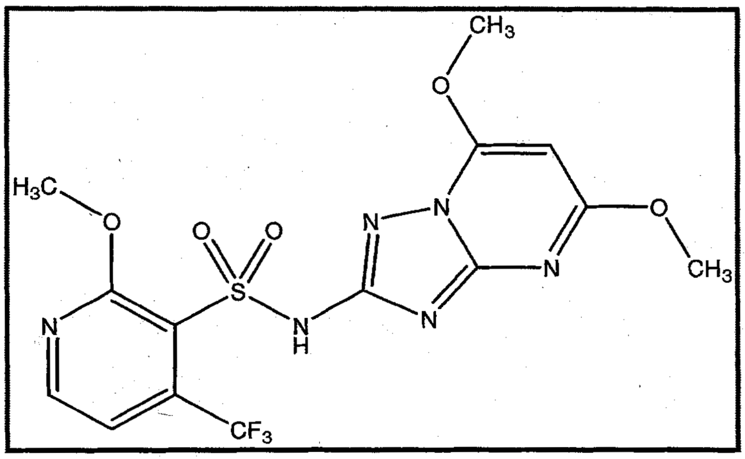
# Environmental Fate and Ecological Risk Assessment for the Registration of Pyroxsulam (XDE-742)




**Pyroxsulam**
**CAS 422556-08-9          PC Code 108702**

| | |
|---|---|
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| ***Reviewed by:***<br>Elizabeth Behl, Branch Chief | |

# I. Executive Summary

## A. Nature of Chemical Stressor

Dow Agro Sciences LLC is seeking registration for the use of the new chemical herbicide pyroxsulam [N-(5,7-dimethoxy[1,2,4]triazolo[1,5-a]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide)] and its flowable formulation, end-use products GF-1674 (2.87%) and GF-1274 (7.5% a.i.). This is a national registration request for control of a number of weed species associated with spring and winter wheat. Ground or aerial applications are proposed once per growing season with rates of 0.0132 lbs a.i./A to 0.0164 lbs a.i./A.

## B. Potential Risks to Non-target Organisms

The results of this screening-level assessment indicate a potential for direct adverse acute effects to non-target terrestrial and semi-aquatic plants (**Table 1.1**). Although this screening-level analysis showed that there is limited potential for direct adverse effects to animal species associated with the use of pyroxsulam on wheat, indirect effects may result as a consequence of potential effects on plants.

**Table 1.1. Summary of Direct and Indirect Effects for Federally Listed Species.**

| Listed Species Taxonomic Group of Concern | Direct Effects | RQ | Indirect Effects | |
|---|---|---|---|---|
| | | | Potential | Associated Taxa[1] |
| Aquatic vascular plants | None | | No | |
| Aquatic non-vascular plants | None | | No | |
| Estuarine/marine non-vascular plants | None | | No | |
| Dicot terrestrial plants | Acute: plant growth | 4.3-251 | Yes | Terrestrial Plants |
| Monocot terrestrial plants | Acute: plant growth | 2.2-150 | Yes | Terrestrial Plants |
| Freshwater fish | None | | Yes | Terrestrial Plants |
| Estuarine/Marine fish | None | | Yes | |
| Freshwater invertebrates | None | | Yes | Terrestrial Plants |
| Estuarine/Marine Invertebrates | None | | Yes | Terrestrial Plants |
| Mollusks | None | | Yes | Terrestrial Plants |
| Mammals | None | | Yes | Terrestrial Plants |
| Birds | None | | Yes | Terrestrial Plants |
| Terrestrial invertebrates | None | | Yes | Terrestrial Plants |

[1]Associated Taxa refers to those taxa for which there are direct effects that may indirectly affect a listed species taxa.

Overall, potential risks appear to be greatest for terrestrial and semi-aquatic plants since these organisms appear to be very sensitive. Functionally, estimated risks may translate to reduced survival, reproduction, or growth in affected species with the potential for subsequent effects at higher levels of biological organization.

For federally listed endangered or threatened (hereafter "listed") species, acute risk levels of concern were exceeded for semi-aquatic and terrestrial monocot and dicot plants. No listed species acute or chronic LOCs were exceeded for any animal species evaluated in this assessment. Because terrestrial/semi-aquatic plant risk quotients are above the non-endangered species level of concern, the Environmental Protection Agency considers this to be indicative of a potential for adverse effects to those listed species that rely either on a specific plant species (plant species obligate) or multiple plant species (plant dependant) for some component of their life cycle.

There is a potential to affect listed plant species and the species which depend upon listed or non-listed plant species for food and/or habitat. Indirect effects in this case should be considered for both terrestrial and aquatic animal species. The extent to which the proposed uses of pyroxsulam will directly effect plant species and indirectly effect animal species will require further assessment; specifically, clear delineation of action area, identification of listed species that co-occur in areas of pyroxsulam use, species-specific life history information, and an evaluation of critical habitat for listed species that occur within the defined action area.

### C. Conclusions - Exposure Characterization

Pyroxsulam has low volatility and exhibits acid-base behavior with pH-dependent water solubility. It is mobile to highly mobile in soil ($K_{FOC}$ range of 7.1–68.0 L/kg$_{OC}$), presenting a groundwater concern in alkaline, sandy soils. The compound's affinity to soil, however low, correlates with organic carbon. Pyroxsulam is not expected to persist in aerobic environments. Primary routes of degradation include aqueous photolysis ($t_{1/2}$ of 4.5 days), aerobic soil metabolism ($t_{1/2}$ range of 2.64-14.6 days), and aerobic aquatic metabolism ($t_{1/2}$ range of 14.5-18.8 days). The compound is stable to biodegradation in anaerobic aquatic environments and the abiotic processes of soil photolysis and hydrolysis.

Major degradates include the demethylation products, 5-OH-XDE-742, 7-OH-XDE-742, 6-Cl-7-OH-XDE-742, and 5,7-diOH-XDE-742, and the further degraded products, XDE-742 ATSA, XDE-742 sulfinic acid, XDE-742 ADTP, and carbon dioxide.

There are a number of studies on the toxicity of pyroxsulam's major degradates to aquatic plants; all available toxicity data indicate that the degradates of pyroxsulam are less toxic than the parent to aquatic plants. Therefore, aquatic exposure estimates were based on residues of the parent compound alone. Review of the toxicity of pyroxsulam's degradates to mammals by the Health Effects Division (HED) indicates that the parent and degradates are practically non-toxic to mammals on an acute exposure basis. Therefore, terrestrial exposure estimates were based on residues of the parent compound alone.

### D. Conclusions - Effects Characterization

Pyroxsulam is practically non-toxic to birds, mammals, fish, freshwater invertebrates and honeybees under acute exposure conditions. Pyroxsulam is highly toxic to terrestrial plants following acute exposure. In terrestrial plants, monocotyledonous plants appear more sensitive to pyroxsulam compared to dicotyledonous plants.

### E. Uncertainties and Data Gaps

The environmental fate and toxicology data requirements have not been adequately fulfilled for a terrestrial food use. The submitted anaerobic aquatic metabolism, aerobic aquatic metabolism, and terrestrial field dissipation studies were supplemental and no anaerobic soil metabolism study was submitted. However, submission of additional data may upgrade the submitted terrestrial field dissipation study. New anaerobic soil metabolism, anaerobic aquatic metabolism, and aerobic aquatic metabolism studies are not requested at this time because they are not expected to significantly alter risk conclusions.

Although no toxicity data were submitted for estuarine/marine animal species, the toxicity profile based on freshwater species and the physical properties of the chemical indicates that risks to estuarine/marine species are unlikely and that the toxicity data are not a requirement. However, without appropriate toxicity data, some uncertainty exists regarding the potential risks to estuarine/marine animal species associated with the proposed use of pyroxsulam on wheat.

## II. Problem Formulation

The purpose of problem formulation is to provide the foundation for the environmental fate and ecological risk assessment being conducted for pyroxsulam (XDE-742). 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, 1998).

### A. Nature of Regulatory Action

Dow Agro Sciences LLC is seeking the Section 3 registration, under the authority of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), for the new active ingredient, pyroxsulam, for use as an herbicide.

### B. Stressor Source and Distribution

#### 1. Nature of the Chemical Stressor

Pyroxsulam is a new systemic post-emergence cereals herbicide for selective control of wild oat, winter annual brome species, annual ryegrass and other annual grass and broadleaf weeds in winter and spring wheat (including durum). The herbicide acts through inhibiting the acetolactate synthesis (ALS) enzyme.

Pyroxsulam exhibits acid-base behavior and is mobile to highly mobile in soil (mean $K_{FOC}$ of 30.4 L/$kg_{OC}$), presenting a groundwater concern in alkaline, sandy soils. Pyroxsulam is not expected to persist in aerobic environments, but may persist in anaerobic environments. Major degradates include the demethylation products, 5-OH-XDE-742, 7-OH-XDE-742, 6-Cl-7-OH-XDE-742, and 5,7-diOH-XDE-742, and the further degraded products, XDE-742 ATSA, XDE-742 sulfinic acid, XDE-742 ADTP, and carbon dioxide.

There are a number of studies on the toxicity of pyroxsulam's major degradates to aquatic plants; all available toxicity data indicate that the degradates of pyroxsulam are less toxic than the parent to aquatic plants. Therefore, aquatic exposure estimates were based on residues of the parent compound alone. Review of the toxicity of pyroxsulam's degradates to mammals by the Health Effects Division (HED) indicates that the parent and degradates are practically non-toxic to mammals on an acute exposure basis. Therefore, terrestrial exposure estimates were based on residues of the parent compound alone.

### 2. Overview of Pesticide Usage

Two formulations of pyroxsulam are proposed for registration; these include GF-1274 (7.5% a.i.), a water dispersible granule (WDG) formulation, and GF-1674 (2.87% a.i.), an oil dispersion (OD) formulation. Both formulations are to be mixed with water and applied as a post-emergence foliar application with aerial and ground-spray equipment. The maximum proposed application rates per use and per growing season are the same for each formulation, at 0.0164 lbs a.i./A for GF-1274 and 0.0132 lbs a.i./A, for GF-1674.

The herbicide is proposed for use on both winter and spring wheat (including durum). Key winter wheat producing areas in the United States include the High Plains states extending from South Dakota, south to Texas, and the Pacific Northwest states. Winter wheat is also an important rotational crop grown in most Midwestern and Southeastern states. Key spring wheat and durum producing states include Idaho, Minnesota, Montana, North Dakota, South Dakota and Washington.

## C. Receptors

### 1. Aquatic and Terrestrial Effects

The receptor is the biological entity that is exposed to the stressor (USEPA, 1989). Consistent with the process described in the Overview Document (USEPA, 2004), this risk assessment uses a surrogate species approach in its evaluation of pyroxsulam. Toxicological data generated from surrogate test species, that are intended to be representative of broad taxonomic groups, are used to extrapolate to potential effects on a variety of species (receptors) included under these taxonomic groupings.

Acute toxicity data from studies submitted by pesticide registrants along with the available open literature are used to evaluate potential direct effects of pyroxsulam to the 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. The evaluation of both sources of data can also provide insight into the indirect effects of pyroxsulam on biotic communities due to loss of species that are sensitive to the chemical and changes in structure and functional characteristics of the affected communities.

**Table 2.1** provides examples of taxonomic groups and the surrogate species tested to help understand potential ecological effects of pesticides to these non-target taxonomic groups. Based on a preliminary review of the ecological effects data, pyroxsulam and its degradates are, practically non-toxic to freshwater fish, freshwater invertebrates, and earthworms under acute exposure conditions. Under chronic exposure conditions, the parent material did not exhibit any toxic effects in fathead minnow (*Pimephales promelas*), waterfleas (*Daphnia magna*), midges (*Chironomus riparius*), bobwhite quail (*Colinus virginianus*), laboratory rats (*Rattus norvegicus*) or earthworms (*Eisenia fetidia*) over the range of concentrations tested. However, the 7-OH metabolite yielded some chronic toxic effects to female midge and combined sex development. Additionally, growth of chicks and adult female mallard ducks (*Anas platyrhynchos*) was adversely affected when birds are exposed to pyroxsulam. Aquatic and terrestrial plants show the greatest sensitivity to the parent compound and little or no sensitivity to its major degradates.

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

| Taxonomic Group | Example(s) of Surrogate Species |
|---|---|
| Birds[1] | Mallard duck (*Anas platyrhynchos*)<br>Bobwhite quail (*Colinus virginianus*) |
| Mammals | Laboratory rat (*Rattus norvegicus*) |
| Insects | Honey bee (*Apis mellifera L.*) |
| Freshwater fish[2] | Bluegill sunfish (*Lepomis macrochirus*)<br>Rainbow trout (*Oncorhynchus mykiss*) |
| Freshwater invertebrates | Water flea (*Daphnia magna*) |
| Estuarine/marine fish | Sheepshead minnow (*Cyprinodon variegatus*) |
| Terrestrial plants[3] | Monocots – corn (*Zea mays*)<br>Dicots – soybean (*Glycine max*) |
| Aquatic plants and algae | Duckweed (*Lemna gibba*)<br>Green algae (*Selenastrum capricornutum*) |

[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. Ecosystems Potentially at Risk

The ecosystems at risk are often extensive in scope, and as a result it may not be possible to identify specific ecosystems at the screening level. However, in general terms, terrestrial ecosystems potentially at risk could include the treated field and areas immediately adjacent to the treated field that may receive drift or runoff. This could include the field itself as well as 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 field and might include impounded bodies such as ponds, lakes and reservoirs, or flowing waterways such as streams or rivers. For uses in coastal areas, aquatic habitat also includes marine ecosystems, including estuaries.

### D. 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 pyroxsulam, the ecological entities include the following: birds, 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 II.F.2**, the Analysis Plan, for further discussion.)

### E. 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.

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

#### 1. Risk Hypotheses

For pyroxsulam, the following ecological risk hypothesis is being employed for this screening-level risk assessment:

> *Pyroxsulam, when used in accordance with the label, results in potential direct adverse effects upon the survival, growth, and reproduction of non-target plants; terrestrial plants adjacent to the site of application are likely to be affected. Transport of the compound through runoff and/or erosion is likely to be limited by low application rates and the compound's low persistence under aerobic conditions. The compound can move to surface waters adjacent to application sites through spray drift, where it will likely affect both vascular and nonvascular aquatic plants. Although pyroxsulam and its degradates are practically nontoxic to aquatic animals on an acute exposure basis, chronic effects on invertebrates may occur. Although pyroxsulam is practically nontoxic to birds and mammals on an acute exposure basis and shows little toxicity under chronic exposure conditions, indirect effects on terrestrial and aquatic animals may occur through the loss of primary productivity and habitat.*

### 2. Conceptual Diagram

The potential exposure pathways and effects of pyroxsulam in terrestrial and aquatic environments are depicted in **Figure 2.1** and **Figure 2.2**, respectively. Solid arrows depict the most likely routes of exposure and effects; dashed lines depict potential routes of exposure that are not considered likely for pyroxsulam. As depicted in **Figure 2.1**, direct exposure of plants through aerial and ground spray applications and indirect exposure of non-target plants through spray drift are considered to be the most likely routes to exposure of terrestrial animals and plants. The most likely effects are decreased survival and growth of terrestrial plants.

**Figure 2.2** depicts the potential exposure of aquatic plants and animals through the most likely routes of exposure, *i.e.*, runoff and spray drift. Depending on the extent of spray drift contamination, plants in aquatic environments will likely be affected. Pyroxsulam is hypothesized to be practically nontoxic to aquatic animals on an acute exposure basis.

Because direct effects are expected to non-target terrestrial and aquatic plants, terrestrial and aquatic animals may in turn be affected through the reductions in primary productivity and habitat.

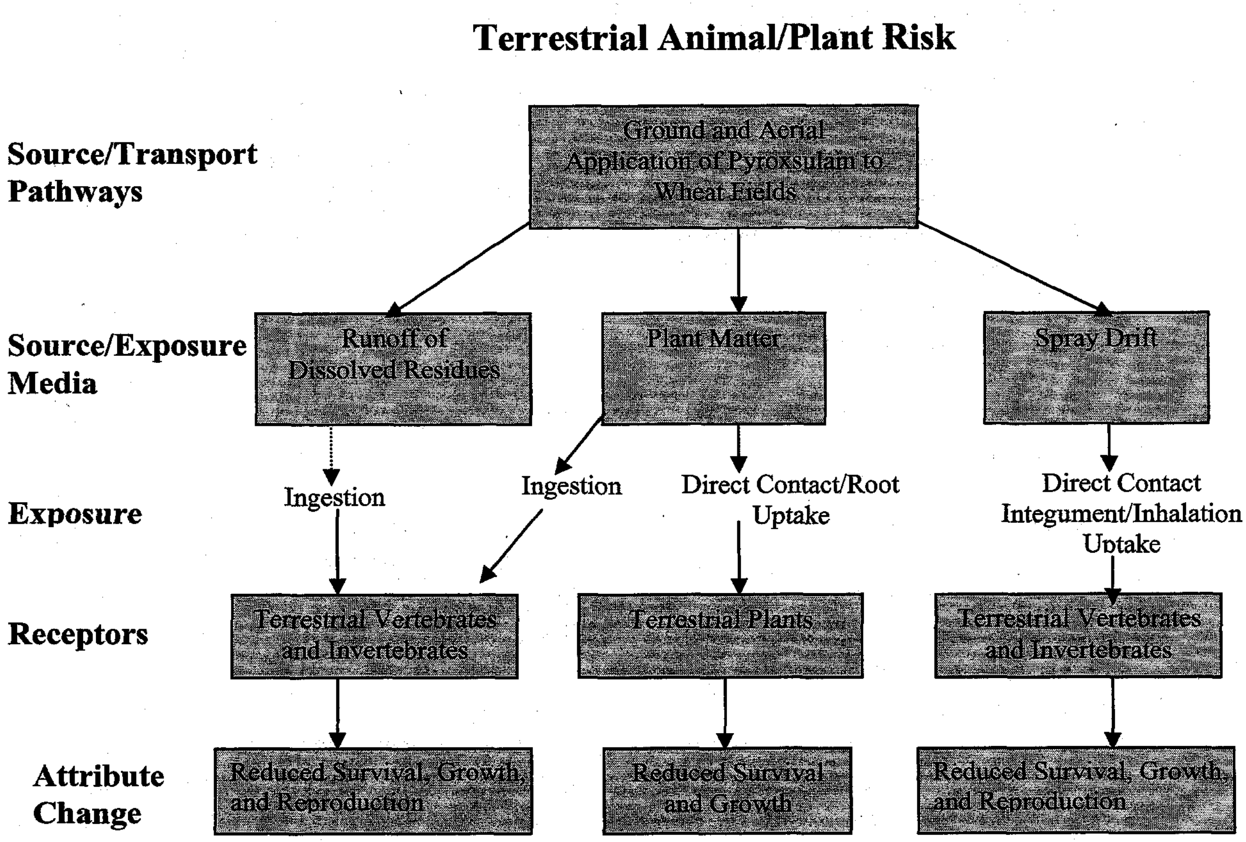



**Figure 2.1. Conceptual model depicting potential risks to terrestrial animals and plants from the use of pyroxsulam as a post-emergent herbicide on wheat.**

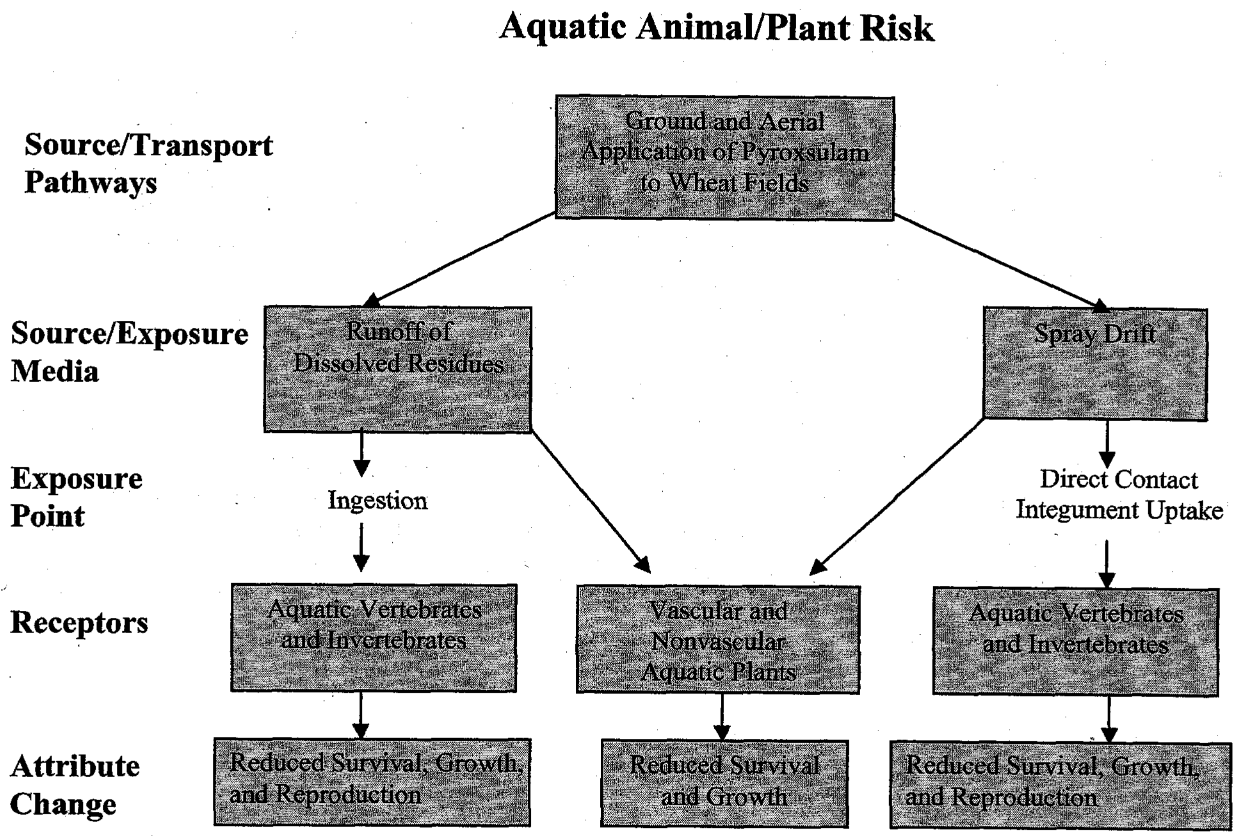



**Figure 2.2. Conceptual model depicting potential risks to aquatic animals and plants from the use of pyroxsulam as a post-emergent herbicide on wheat.**

### F. Analysis Plan

Pyroxsulam is a tri-lateral review chemical, and the responsibility for environmental fate and ecological effects data preliminary reviews resides with the Canadian Pest Management Regulatory Agency (PMRA) and the Australian Pesticide and Veterinary Medicine Authority (APVMA), respectively. Primary data reviews from each of these government agencies have been independently reviewed by the Environmental Fate and Effects Division (EFED) of the U.S. Environmental Protection Agency (Agency) Office of Pesticide Programs (OPP) and finalized versions of the data reviews have been agreed to by the participating countries.

#### 1. Preliminary Identification of Data Gaps and Analysis Plan

A total of 47 registrant-submitted studies are available for assessing the potential effects of pyroxsulam and its major metabolites on non-target organisms. Based on a preliminary data screen, ecological effect data are missing for estuarine/marine species, however, given the chemical characteristics and use of the chemical and the apparent low toxicity to freshwater species, the ecological effect studies appear to meet the basic guideline requirements and no toxicological data gaps have been identified at this time. However, the lack of data on the ecological effects to estuarine/marine organisms is a source of uncertainty although pyroxsulam does not appear to meet the conditional requirements for requesting toxicity data for estuarine/marine organisms.

A total of 12 registrant-submitted studies are available for assessing the environmental fate of pyroxsulam. The preliminary data screen indicated that the environmental fate studies met the basic guideline requirements even though no anaerobic soil metabolism study was submitted. The submitted anaerobic aquatic metabolism, aerobic aquatic metabolism, and terrestrial field dissipation studies were classified supplemental upon review and are sources of uncertainty in the environmental fate of pyroxsulam.

### 2. Measures of Effect and Exposure

**Table 2.2** lists the measures of environmental exposure and ecological effects used to assess the potential risks of pyroxsulam 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 the Herbicide Pyroxsulam on Wheat. | | | |
|---|---|---|---|
| Assessment Endpoint | | Surrogate Species and Measures of Ecological Effect[1] | Measures of Exposure |
| Birds[2] | Survival | Bobwhite quail/Mallard duck $LD_{50}$ : (>2000 mg/kg) Bobwhite quail/Mallard duck dietary $LC_{50}$ : 5000 mg/kg feed | Upper-bound residues on food items (foliar) |
| | Reproduction and growth | Bobwhite quail/Mallard duck chronic reproduction NOAEC: 1000 mg/kg feed | |
| Mammals | Survival | Laboratory rat acute oral $LD_{50}$: 3129 mg/kg | |
| | Reproduction and growth | Laboratory rat oral reproduction chronic NOAEC: 1000 mg/kg feed | |
| Freshwater fish[3] | Survival | Rainbow trout acute $LC_{50}$ : >87 mg a.i./L | Peak EEC[4] |
| | Reproduction and growth | Fathead minnow chronic (early life-stage) NOAEC and LOAEC: 10.1 and >10.1 mg a.i./L, respectively. | 60-day average EEC[4] |
| Freshwater invertebrates | Survival | Water flea acute $EC_{50}$: >99 mg a.i./L | Peak EEC[4] |
| | Reproduction and growth | Midge chronic reproduction (life cycle) NOAEC and LOAEC: 30 and 60 mg a.i./L | 21-day average EEC[4] |
| Estuarine/ marine fish | Survival | Sheepshead minnow acute $LC_{50}$ (no study available) | Peak EEC[4] |
| | Reproduction and growth | Sheepshead minnow chronic (early life-stage) NOAEC and LOAEC (no study available) | 60-day average EEC[4] |

| Table 2.2. Measures of Exposure and Measures of Effect Used in Assessing Potential Risks Associated with the Proposed Use of the Herbicide Pyroxsulam on Wheat. | | | |
|---|---|---|---|
| Assessment Endpoint | | Surrogate Species and Measures of Ecological Effect[1] | Measures of Exposure |
| Estuarine/marine invertebrates | Survival | Eastern oyster acute $EC_{50}$ and mysid acute $LC_{50}$ (no study available) | Peak EEC[4] |
| | Reproduction and growth | Mysid chronic NOAEC and LOAEC (no study available) | 21-day average EEC[4] |
| Terrestrial plants[5] | Survival and growth | Monocot seedling emergence $EC_{25}$ and $EC_{05}$: 0.00022 and 0.000062 lbs a.i./A<br>Dicot seedling emergence $EC_{25}$ and $EC_{05}$: 0.00057 and 0.000036 lbs a.i./A<br>Monocot vegetative vigor $EC_{25}$ and $EC_{05}$: 0.00056 and 0.000046 lbs a.i./A<br>Dicot vegetative vigor $EC_{25}$ and $EC_{05}$: 0.000052 and 0.000031 lbs a.i./A | Estimates of runoff and spray drift to non-target areas |
| Insects | Survival (not quantitatively assessed) | Honeybee acute contact $LD_{50}$: >107.4 mg a.i./kg sub | Maximum application rate |
| Aquatic plants | Survival and growth | Duckweed $EC_{50}$ and NOAEC: 0.00257 and 0.00068 mg a.i./L<br>Algae $EC_{50}$ and NOAEC: 0.111 and 0.0261 mg a.i./L | Peak EEC |

[1] If species listed in this table represent most commonly encountered species from registrant-submitted studies, risk assessment guidance indicates most sensitive species tested within taxonomic group are to be used for screening-level risk assessments.
[2] Birds represent surrogates for amphibians (terrestrial phase) and reptiles.
[3] Freshwater fish may be surrogates for amphibians (aquatic phase).
[4] One in 10-year return frequency.
[5] Four species of two families of monocots - one is corn, six species of at least four dicot families, of which one is soybeans. $LD_{50}$ = Lethal dose to 50% of the test population; NOAEC = No observed adverse effect concentration; LOAEC = Lowest observed adverse effect concentration; $LC_{50}$ = Lethal concentration to 50% of the test population; $EC_{50}/EC_{25}$ = Effect concentration to 50%/25% of the test population.

# III. Analysis

## A. Use Characterization

Pyroxsulam [N-(5,7-dimethoxy[1,2,4]triazolo[1,5-α]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide], also known as XDE-742, is a new systemic post-emergence cereals herbicide in the class of compounds known as triazolopyridine sulfonamides. The compound inhibits the acetolactate synthesis (ALS) enzyme and is used to achieve selective control of wild oat, winter annual brome species, annual ryegrass, and other annual grass and broadleaf weeds in winter and spring wheat (including durum).

Key winter wheat producing areas in the United States include the High Plains states, extending from South Dakota south to Texas, and the Pacific Northwest states. Winter wheat is also an important rotational crop grown in most Midwestern and Southeastern states. Key spring wheat and durum producing states include Idaho, Minnesota, Montana, North Dakota, South Dakota and Washington. **Figure 3.1** displays the spatial extent in 2002 of wheat harvested for grain.

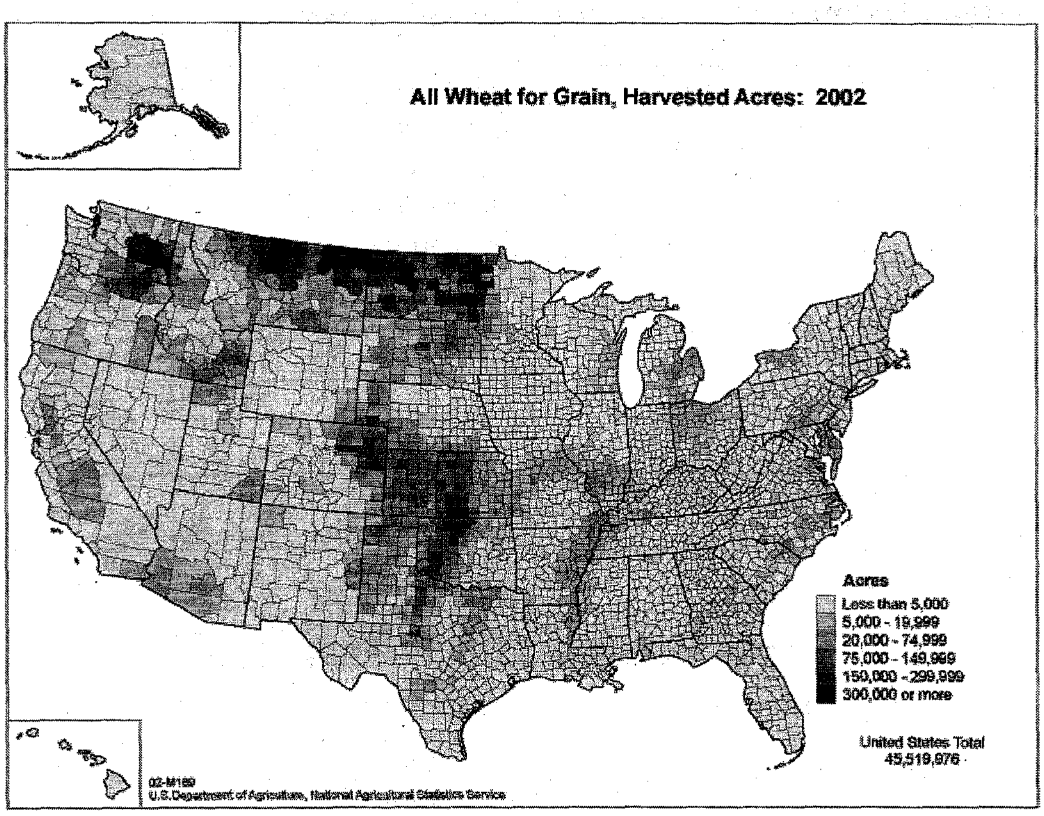



**Figure 3.1. Acres of wheat for grain harvested in 2002 (USDA, 2007).**

Two formulations of pyroxsulam are proposed for registration; these include GF-1274 (7.5% a.i.), a water dispersible granule (WDG) formulation for use on winter wheat, and GF-1674 (2.87% a.i.), an oil dispersion (OD) formulation for use on both spring and winter wheat. Both formulations are to be mixed with water and applied as a post-emergence foliar application with aerial and ground-spray equipment.

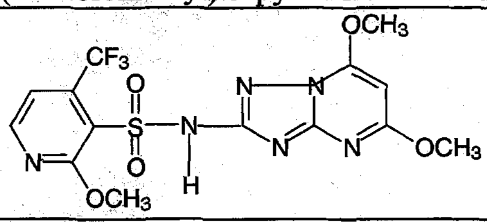
The maximum proposed application rates per use and per growing season are the same, limited at 0.0164 lbs a.i./A for GF-1274 and 0.0132 lbs a.i./A, for GF-1674. Therefore, the maximum annual application rate of 0.0164 lbs a.i./A characterizes the maximum use pattern for pyroxsulam on wheat, as only one growing season occurs per year.

## B. Exposure Characterization

### 1. Environmental Fate and Transport Characterization

Pyroxsulam exhibits acid-base behavior and is mobile to highly mobile in soil (mean $K_{FOC}$ of 30.4 L/$kg_{OC}$), presenting a groundwater concern in alkaline, sandy soils. Pyroxsulam is not expected to persist in aerobic environments, but may persist in anaerobic environments. A brief summary of the chemical properties and environmental fate parameters of pyroxsulam is provided in **Table 3.1**.

**Table 3.1. General Chemical Properties and Environmental Fate Parameters of Pyroxsulam.**

| Parameter | Value |
|---|---|
| Common name | Pyroxsulam, XDE-742 |
| IUPAC name | N-(5,7-dimethoxy[1,2,4]triazolo[1,5-α]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide |
| Structure |  |
| Pesticide type, such as herbicide or insecticide, | Herbicide |
| Chemical class | Triazolopyridine sulfonamides |
| CAS number | 422556-08-9 |
| Empirical formula | $C_{14}H_{13}F_3N_6O_5S$ |
| **Selected Physical/Chemical Parameters** | |
| Molecular mass (g/mol) | 434.4 |
| Vapor pressure at 20°C (torr) | $<10^{-9}$ |
| Henry's Law Constant at 20°C (Pa $m^3$/mol) | $<1.36 \times 10^{-8}$ |
| Solubility in water (g/L) at 20°C (mg/L) | 16.4 (pH 4)<br>$3.20 \times 10^3$ (pH 7)<br>$1.37 \times 10^4$ (pH 9) |
| pKa at 20°C | 4.67 |
| $K_{OW}$ | 12.1 (pH 4)<br>0.097 (pH 7)<br>0.024 (pH 9) |

| Table 3.1. General Chemical Properties and Environmental Fate Parameters of Pyroxsulam. | |
|---|---|
| **Parameter** | **Value** |
| **Persistence** | |
| Hydrolysis half-life | No significant degradation (pH 5, 7, and 9) |
| Aqueous photolysis half-life (days) | 4.5 |
| Soil photolysis half-life | No significant degradation |
| Aerobic soil metabolism half-life range (days) | 2.64–14.6 |
| Aerobic aquatic metabolism half-life range (days) | 14.5–18.8 |
| Anaerobic aquatic metabolism half-life (days) | No significant degradation |
| **Mobility** | |
| $K_F$ range for adsorption | 0.18 (1/n=0.93) – 1.60 (1/n=0.96) |
| $K_{FOC}$ range for adsorption | 7.1–68.0 L/kg$_{OC}$ |
| **Field Dissipation** | |
| Terrestrial field dissipation half-life range (days) | 4.6–23 |

### a. Transport and Mobility

Pyroxsulam will not significantly volatilize due to a low vapor pressure (<$10^{-9}$ torr at 20°C) and a pH-dependant solubility in water (16.4 mg/L (pH 4) to 1.37 x $10^4$ mg/L (pH 9) at 20°C) that is high at environmentally relevant pH values (MRID 46908303). Ranges of $K_{OW}$ and solubility in water across pH values indicate that the compound exhibits acid/base behavior, with a pKa of 4.67 at 20°C (MRID 46908303). Pyroxsulam is not expected to bioconcentrate in fish, as $K_{OW}$ values are less than 1.0 at environmentally relevant pH values and only up to 12 at pH 4.

Pyroxsulam weakly sorbs to soil; however, the compound's sorption correlates with organic matter, as the coefficient of variation (CV) across ten soils for $K_{FOC}$ (69%) is less than that for $K_F$ (87%) (MRID 47159601). Pyroxsulam is mobile to highly mobile ($K_{FOC}$ of 7.1 to 68.0 L/kg$_{OC}$) and may readily move into surface water through runoff and/or leach into ground water, depending on the permeability of the soil.

### b. Degradation

Pyroxsulam is not expected to persist in aerobic environments. Primary routes of degradation include aqueous photolysis ($t_{1/2}$ of 4.5 days; MRID pending) and aerobic soil metabolism ($t_{1/2}$ range of 2.64-14.6 days; MRID 47202701). Aerobic aquatic metabolism may also be a primary route of degradation ($t_{1/2}$ range of 14.5-18.8 days; MRID 46908336). However, the submitted data are uncertain and half-life estimates may be low because residues were inadequately extracted. Pyroxsulam is stable to the abiotic processes of soil photolysis and hydrolysis (MRID 46908326, 46908328).

The aerobic soil metabolism study was conducted to demonstrate that the majority of unextracted residues in a previously submitted study conducted with only one extraction method were bound to soil and unavailable (up to 94% of the applied radioactivity; MRID 46908329), as up to 83% of the applied in the latter study remained unextracted after exhaustive extraction procedures.

These results indicate that the kinetics of the aerobic aquatic metabolism study, which was conducted with the same single extraction method as the previously submitted aerobic soil metabolism study, are not greatly overestimated, even though unextracted residues accounted for up to 73% of the applied.

Pyroxsulam in sterilized soil was shown not to degrade (projected $DT_{50}$ greater than 450 days) and remained extractable after four months (10.0% to 10.5% of the applied remained unextracted; MRID 46908329). These results indicate that bound residues are biodegradation products and not pyroxsulam parent. Because the majorities of unextracted residues in the submitted metabolism studies are likely irreversibly bound to soil, all half-life calculations for this assessment were conducted based on only the parent compound residues that were available for extraction.

Pyroxsulam appears to persist under anaerobic conditions (MRID 46908331). The submitted anaerobic aquatic metabolism study indicates that pyroxsulam is stable through the first 30 days, when redox potentials were the lowest ($E_h$ 7 range -10.2 to -143.3 mV). Degradation occurred suddenly after 30 days, coinciding with an increase in aqueous redox potential (range +8.5 to -80.0 mV), suggesting that changes in aerobicity in the test system may have led to rapid biodegradation.

### c. Field Studies

A terrestrial field dissipation study was conducted for pyroxsulam using four sites in Canada with three bare ground plots each (MRID 46908334). Two of the sites, SK2 (loam soil) and MB (clay loam soil), were found in ecoregions relevant to use sites in the U.S. The end-use product, GF-1442, was surface broadcast sprayed to achieve an application rate of 0.025 kg a.i./ha. The plots were irrigated to a target of 110% of the 30-year precipitation normal. Soil samples (0-90 cm depth) were collected through 126 or 359 days post-treatment. The limit of detection was 0.0003 µg/g and the limit of quantitation was 0.001 µg/g. Pyroxsulam dissipated in the loam and clay loam soils with half-lives of 4.6 days (0-30 cm depth) and 23 days (0-60 cm depth), respectively.

Test sites were analyzed for 5-OH-XDE-742, 7-OH-XDE-742, and 6-Cl-7-OH-XDE-742. No major degradates were detected. 6-Cl-7-OH-XDE-742 was initially detected in the loam soil at 3% of the applied on day 14, with a 5-day half-life, and was not detected in the clay loam soil. 7-OH-XDE-742 was detected at up to 4% of the applied (day 14) in the loam soil and up to 8% of the applied (day 28) in the clay loam soil; no pattern of decline could be calculated in either soil. 5-OH-XDE-742 was below detection limits in all samples from the loam and clay loam soils.

At SK2, detections of pyroxsulam and degradates were limited to the upper 15-cm of the soil profile. At MB, detections of pyroxsulam and degradates were limited to the upper 30-cm of the soil profile, except for trace detections of pyroxsulam at 1-2% of the applied observed at 30-60 cm 15 days post-treatment. These results appear to indicate that pyroxsulam may largely degrade or dissipate in runoff rather than present a ground water concern. However, sampling intervals may have been too course to capture pulses of leaching residues and detection limits may have been too high to detect traces of residues in samples.

### d. Degradates

Major identified degradates include 5-OH-XDE-742, 7-OH-XDE-742, 6-Cl-7-OH-XDE-742, 5,7-diOH-XDE-742, XDE-742 ATSA, XDE-742 sulfonic acid, XDE-742 ADTP, and carbon dioxide (IUPAC names in **Table 3.2**; structures in **Table B.2** of **Appendix B**); the first four listed are most structurally similar to the parent compound. The maximum reported amounts of pyroxsulam degradation products are reported in **Table B.1** of **Appendix B**. XDE-742 sulfonic acid and XDE-742 ADTP were photodegradates identified at up to 79.2% and 39.8% of the applied, respectively. 5-OH-XDE-742, 7-OH-XDE-742, 6-Cl-7-OH-XDE-742, and carbon dioxide were major biodegradates in aerobic soil at up to 24.1%, 13.7%, 26.2%, and 15.6% of the applied, respectively. 7-OH-XDE-742 and XDE-742 ATSA were major biodegradates in aerobic aquatic systems, forming up to 58.4% and 12.9% of the applied, respectively. Minor biodegradates formed in aerobic soil include XDE-742 CSF and XDE-742 PSA at up 8.1% and 5.9% of the applied, respectively.

**Table 3.2. Chemical Names for the Transformation Products of Pyroxsulam.**

| Synonym | IUPAC Chemical Name |
|---|---|
| **Major Degradates** | |
| 5-OH-XDE-742 | N-(5-hydroxy-7-methoxy[1,2,4]triazolo[1,5-α]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide |
| 7-OH-XDE-742 | N-(7-hydroxy-5-methoxy[1,2,4]triazolo[1,5-α]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide |
| 6-Cl-7-OH-XDE-742 | N-(6-chloro-7-hydroxy-5-methoxy[1,2,4]triazolo[1,5-α]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide |
| 5,7-diOH-XDE-742 | N-(5,7-dihydroxy[1,2,4]triazolo[1,5-α]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide |
| XDE-742 ATSA | N-(5-amino-1H-1,2,4-triazol-3-yl)-2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide |
| XDE-742 sulfonamide | 2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide |
| XDE-742 sulfonic acid | 2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonic acid |
| XDE-742 ADTP | 5,7-dimethoxy[1,2,4]triazolo[1,4-α]pyrimidin-2-amine |
| **Minor Degradates** | |
| XDE-742 CSF | N-cyano-2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide |
| XDE-742 PSA | 2-methoxy-4-(trifluoromethyl)pyridine-3-sulfinic acid |

The toxicities of the major degradates of pyroxsulam are significantly less than that of the parent to aquatic plants and both the parent and degradates are practically non-toxic to fish and mammals on an acute exposure basis. Therefore, both aquatic and terrestrial exposure estimates were based on residues of the parent compound alone.

## 2. Measures of Aquatic Exposure

The Tier II-screening simulation models Pesticide Root Zone Model (PRZM v3.12.2, May 12, 2005) and Exposure Analysis Modeling System (EXAMS v2.98.04.06, Apr. 25, 2005) were coupled with the input shell PE v5.0 (Nov. 15, 2006) to generate 1-in-10-year estimated environmental concentrations (EEC) of pyroxsulam that may occur in surface waters adjacent to use sites. The PRZM model simulates pesticide movement and transformation from crop application through dissipation processes. The EXAMS model simulates the fate and transport of the pesticide in a receiving water body adjacent to the field of application. The coupled 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 and no outlet (USEPA, 2007).

The EECs listed in **Table 3.3** reflect 1-in-10 year peak and averaged surface water concentrations of pyroxsulam based on the proposed maximum use rate for winter wheat (0.0164 lbs a.i./A/yr).

**Table 3.3. Tier II Surface Water 1-in-10-year EECs (μg a.i./L) of Pyroxsulam from Use on Winter Wheat.**

| Use Pattern | Peak | 4-Day Avg | 21-Day Avg | 60-Day Avg | 90-Day Avg |
|---|---|---|---|---|---|
| Winter wheat | 0.182 | 0.180 | 0.173 | 0.145 | 0.121 |

The model input parameters used to generate these exposure values are listed in **Table 3.4**.

**Table 3.4. PRZM/EXAMS Model Input Parameters for Pyroxsulam Use on Winter Wheat. Source Data are in Table 3.1.**

| Input Parameter | Value | Justification | Source |
|---|---|---|---|
| Application Rate in lbs a.i./A (kg a.i./ha) | 0.0164 (0.0184) | Label directions | Proposed labels |
| Applications per Year | 1 | Label directions | Proposed labels |
| Date of Application | Apr. 1$^{st}$ | Application occurs in Fall or Spring. | USDA crop profiles (USDA, 2007a), and label directions |
| Application Method | Aerial | Label directions | Proposed labels |
| CAM Input | Foliar applied (CAM=2) | Label directions | Proposed labels |
| IPSCND Input | 1 | Foliar residue after harvest is applied to the field. | USDA crop profiles (USDA, 2007a) |
| Spray Drift Fraction | 0.05 | Default ecological assessment value for aerial spray | Input parameter guidance (USEPA, 2002) and Spray Drift Task Force studies[1] |
| Application Efficiency | 0.95 | Default value for aerial spray | Input parameter guidance (USEPA, 2002) |
| Molecular Mass (g/mol) | 434.4 | Product chemistry data | MRID 46908334 |
| Vapor Pressure (torr) | $1 \times 10^{-9}$ | Maximum reported value at 20°C | MRID 46908303 |

| Table 3.4. PRZM/EXAMS Model Input Parameters for Pyroxsulam Use on Winter Wheat. Source Data are in Table 3.1. | | | |
|---|---|---|---|
| Input Parameter | Value | Justification | Source |
| Solubility in Water (mg/L) | 32000 | Represents 10x the measured water solubility value at pH 7, 20°C. | MRID 46908303 |
| Organic Carbon Partition Coefficient ($K_{OC}$) (mL/$g_{OC}$) | 30.4 | Represents the average $K_{FOC}$ from ten soils. | MRID 47159601 |
| Aerobic Soil Metabolism Half-life (days) | 11.0 | Represents the 90$^{th}$ percentile confidence bound on the mean half-life. | MRID 47202701 |
| Aerobic Aquatic Metabolism Half-life (days) | 23.4 | Represents the 90$^{th}$ percentile confidence bound on the mean half-life. | MRID 46908336 |
| Anaerobic Aquatic Metabolism Half-life (days) | 0 | Represents no significant degradation. | MRID 46908331 |
| Hydrolysis Half-lives (days) | 0 (pH 5)<br>0 (pH 7)<br>0 (pH 9) | Represents stability to hydrolysis. | MRID 46908326 |
| Aqueous Photolysis Half-life (days) | 0 | Represents no significant degradation. | MRID pending |

1. Spray Drift Task Force studies were reviewed by the FIFRA Scientific Advisory Panel (SAP meeting, Dec 10-11, 1997); online at: http://www.epa.gov/scipoly/sap/1997/index.htm.

*Scenario Inputs.* The currently approved North Dakota wheat scenario was used to model use on winter wheat, as it is the lone scenario available for modeling applications to wheat. The maximum application method and rate were obtained from the proposed labels for pyroxsulam. The application date was selected in the Spring, when weed pressures may increase as temperatures rise.

*Environmental Fate.* Chemical property input values were chosen in accordance with current input parameter guidance (USEPA, 2002). The 90th %-ile confidence bound on the mean was selected for the aerobic soil metabolism half-life (11.0 d) and the aerobic aquatic metabolism half-life (23.4 d).

The PRZM and EXAMS models have limitations in their ability to thoroughly account for spray drift, runoff, within-site variability, crop growth, soil water transport, and weather. While PRZM and EXAMS are themselves designed to be best estimators, the selection of scenario and input parameters are such that the simulation results are expected to be greater than concentrations seen at most sites in the environment most of the time. These models are intended to provide a reasonable screening-level estimate by which to gauge whether impacts on aquatic organisms are unlikely to occur. An exceedance of a level of concern indicates that there may be potential risk and that additional refinements in exposure modeling may be necessary.

### 3. Measures of Terrestrial Exposure

Pyroxsulam is proposed for use on wheat and will be applied by ground or aerial spray. Measures of exposure for terrestrial organisms can be obtained from a variety of sources including monitoring data, field studies, GIS analysis, and exposure modeling. For this assessment, exposure modeling was used to generate EECs for both terrestrial animals and plants.

The screening-level assessment focuses on dietary exposure for terrestrial birds, mammals, reptiles, and amphibians that may come in contact with pyroxsulam use areas. Although other routes of exposure can be important, for the most part dietary routes of exposure are considered to contribute significantly to total exposure and hence are the focus here. Moreover, suitable data are frequently unavailable to adequately assess other exposure routs such as dermal, inhalation, or incidental soil ingestion.

**a. Terrestrial Animal Species**

Exposure of free-ranging terrestrial animals is a function of the timing and extent of pesticide application with respect to the location and behavior of those species. OPP's terrestrial exposure model generates exposure estimates assuming that the animal is present on the use site at the time that pesticide levels are highest. The upper-bound pesticide residue concentration on food items is calculated from both initial applications and any additional applications, taking into account pesticide degradation between applications, however, for pyroxsulam only one application is required for the proposed use. Although this approach is conservative, it is reasonable, particularly when considering acute risks. For acute risks, the assumption is that the duration of exposure is a single day and, again, occurs when residue levels are highest. In evaluating chronic risks, longer-term exposure estimates are also based on the assumption that the animal is present on the use site when residue levels are highest and furthermore that it repeatedly forages on the use site although the frequency and duration of foraging events on the use site are not explicitly considered or specified.

The current screening-level approach does not directly relate timing of exposure to critical or sensitive population, community, or ecosystem processes. Given that the application timing and location is crop-dependent, it is difficult to address the temporal and spatial co-occurrence of pyroxsulam use and sensitive ecological processes. However, pesticides are frequently used from spring through fall, hence uses of pyroxsulam are likely to occur in spring and perhaps summer. Spring and early summer are typically seasons of active migrating, feeding, and reproduction for many wildlife species. The increased energy demands associated with these activities (as opposed to hibernation, for example) can increase the potential for exposure to pesticide-contaminated food items since agricultural areas can represent a concentrated source of relatively easily obtained, high-energy food items. In this assessment, the spatial extent of exposure for terrestrial animal species is limited to the use area only and the area immediately surrounding the use area.

Currently, the Agency does not require toxicity studies on reptiles and amphibians in support of pesticide registrations. To accommodate this data gap, birds are used as surrogates for terrestrial-phase amphibians and reptiles. It is assumed that, given the usually lower metabolic demands of reptiles and amphibians compared to birds, exposure to birds would be greater due to higher relative food consumption. While this assumption is likely true, there are no supported relationships regarding the relative toxicity of a compound to birds and herpetofauna. The lack of toxicity data on reptiles and amphibians represents a source of uncertainty in this assessment.

#### b. Terrestrial Animal Exposure Modeling

The approach used to estimate exposure of terrestrial animals to pyroxsulam was based on potential foliar applications of pyroxsulam. These exposure estimates were determined using the standard screening-level exposure model, TREX (v1[1].2.3) (USEPA, 2004). Upper-bound exposure levels were calculated for spray applications of pyroxsulam using maximum proposed application rates for one application for the proposed use on wheat (**Table 3.5, Appendix E**). The exposure estimates are based on a database of pesticide residues on wildlife food sources associated with specified application rates (Kenaga, 1972; Fletcher *et al.*, 1994). Essentially, for a single application, there is a linear relationship between the amount of pesticide applied and the amount of pesticide residue present on a given food item. For 1.0 lb a.i. of pesticide per acre, the upper-bound, food item concentration in mg a.i./kg of diet (parts per million [ppm]) is: 240 for short grass, 110 for tall grass, 135 for broadleaf plants and small insects, and 15 for fruits pods, and large insects. Food item residue levels are then linearly adjusted based on application rate. The upper-bound estimates are used to estimate risks since these values represent the high-end exposure that may be encountered for terrestrial species that consume food items that have received label-specified pesticide application. Although these represent higher-end estimates, they do not represent the highest possible exposure estimates.

TREX is a simulation model that, in addition to incorporating the relationship between application rate and food item residue concentrations, accounts for pesticide degradation in the estimation of EECs. TREX calculates pesticide residues on each type of food item on a daily interval for one year. A first-order decay function is used to calculate the residue concentration at each day based on the concentrations present from both initial and all subsequent applications, although for pyroxsulam only one application is proposed. The decay rate is dependent on the foliar dissipation half-life. The food item concentration on any given day is the sum of all concentrations up to that day, taking into account the first-order degradation. The initial application occurs on day 0 (t=0) and the model runs for 365 days. Over the 365-day run, the highest residue concentration is the measure of exposure (EEC) used to calculate RQs.

The foliar dissipation half-life can be important in estimating exposure because it essentially determines how long the pesticide remains on food items after application. In many cases, an empirically determined foliar dissipation half-life value is not available, in which case the default value of 35 days is used (Willis and McDowell, 1987). For pyroxsulam, the default foliar dissipation half-life was used.

**Table 3.5** lists EECs for birds, reptiles, terrestrial amphibians, and mammals obtained from TREX simulation for all proposed uses of pyroxsulam at the maximum label rates.

| Table 3.5. Terrestrial Food-Item Residue Estimates for Pyroxsulam Proposed Uses Assuming a Foliar Dissipation Half-life of 35 Days. | | | |
|---|---|---|---|
| Crop | Single Application Rate lbs. a.i./A (1 application only) | Food Item | Maximum EEC (mg/kg)[1] |
| GF-1274 | | | |
| Wheat (winter only) | 0.0164 | Short grass | 3.94 |
| | | Tall grass | 1.80 |
| | | Broadleaf plants/ small insects | 2.21 |
| | | Fruits, pods, seeds, lg. insects | 0.25 |
| GF-1674 | | | |
| Wheat (spring and winter) | 0.0132 | Short grass | 3.17 |
| | | Tall grass | 1.45 |
| | | Broadleaf plants/ small insects | 1.78 |
| | | Fruits, pods, seeds, lg. insects | 0.20 |

### c. Terrestrial and Semi-Aquatic Plants Exposure Modeling

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. 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 applications and 5% for aerial, air-blast, forced air, and chemigation 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 propyzamide at the maximum label rate for proposed uses are presented in **Table 3.6 (Appendix F)**.

| **Table 3.6. EECs for terrestrial and semi-aquatic plants near pyroxsulam use areas.** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Crop** | **Single Max. Application Rate (lbs a.i./A)** | **EECs (lbs a.i./A) (Ground Spray, Aerial Spray)** | | | | | |
| | | **Total Loading to Semi-Aquatic Areas** | | **Spray Drift** | | **Dry Areas (Total)** | |
| | | **Ground spray** | **Aerial spray** | **Ground spray** | **Aerial spray** | **Ground spray** | **Aerial spray** |
| Wheat (spring and winter) | 0.0164 | 0.008 | 0.009 | 0.0002 | 0.0008 | 0.001 | 0.002 |
| Wheat (winter) | 0.0132 | 0.007 | 0.007 | 0.0001 | 0.0007 | 0.0008 | 0.001 |

## C. Ecological Effects Characterization

Toxicity testing reported in this section does not represent all species of bird, mammal, or aquatic organisms. Only a few surrogate species for both freshwater fish and birds are used to represent all freshwater fish (2000+) and bird (680+) species in the United States. For mammals, acute studies are usually limited to Norway rat or the house mouse. Estuarine/marine testing is usually limited to a crustacean, a mollusk, and a fish. Also, neither reptiles nor amphibians are tested. The assessment of risk or hazard assumes that avian toxicity is similar to that of terrestrial-phase amphibians and reptiles. The same assumption is made for fish and aquatic-phase amphibians.

### 1. Categories of Acute Toxicity

In general, acute toxicity categories for pyroxsulam ranging from "practically nontoxic" to "very highly toxic" have been established for aquatic organisms based on $LC_{50}$ values (**Table 3.7**) and terrestrial organisms based on $LD_{50}$ values (**Table 3.8**). Subacute dietary toxicity for avian species is based on the $LC_{50}$ values (**Table 3.9**).

**Table 3.7. Categories for aquatic animal acute toxicity based on median lethal concentration in milligrams per liter (parts per million).**

| $LC_{50}$ (mg a.i./L) | Toxicity Category |
|---|---|
| <0.1 | Very highly toxic |
| 0.1–1 | Highly toxic |
| >1–10 | Moderately toxic |
| >10–100 | Slightly toxic |
| >100 | Practically non-toxic |

**Table 3.8. Categories for avian and mammalian acute toxicity based on median lethal dose in milligrams per kilogram body weight (parts per million).**

| $LD_{50}$ (mg a.i./kg) | Toxicity Category |
|---|---|
| <10 | Very highly toxic |
| 10–50 | Highly toxic |
| 51–500 | Moderately toxic |
| 501–2000 | Slightly toxic |
| >2000 | Practically non-toxic |

| Table 3.9. Categories of avian subacute dietary toxicity based on median lethal concentration in milligrams per kilogram diet per day (parts per million). | |
|---|---|
| $LC_{50}$ (mg a.i./kg) | Toxicity Category |
| <50 | Very highly toxic |
| 50–500 | Highly toxic |
| 501–1000 | Moderately toxic |
| 1001–5000 | Slightly toxic |
| >5000 | Practically non-toxic |

The ecological effects characterization for pyroxsulam is based on registrant-submitted toxicity studies that provide toxicity data on pyroxsulam and its major degradates. The lowest available toxicity value for a taxa and duration (*e.g.*, 7-day duckweed) will be used to calculate RQs. Relative to the chemical's degradates, pyroxsulam parent was the most toxic form tested, with toxicity mostly confined to aquatic and terrestrial plants; toxicity resulting from exposure to this compound was used for RQ calculations. A brief summary of available toxicity data used to calculate RQs is provided below; a more detailed discussion of all available studies can be found in **Appendix G**.

Pyroxsulam and its degradates (7-OH, 5-OH, ATSA, ADTP, 5,7-Di-OH, 6-Cl-7-OH, sulfonic acid and cyanosulfonamide) are, for the most part, practically non-toxic to freshwater fish, freshwater invertebrates, birds, honeybees and earthworms under acute exposure conditions. The parent material pyroxsulam was not toxic to the fathead minnow (*Pimephales promelas*), the waterflea (*Daphnia magna*), the midge (*Chironomus riparius*), the bobwhite quail (*Colinus virginianus*) or the earthworm (*Eisenia fetidia*) at any of the concentrations tested under chronic exposure conditions. However, the 7-OH metabolite yielded some chronic effects to female midge development rate. Additionally, chick body weights of mallard ducks (*Anas platyrhynchos*) were significantly lower when exposed to pyroxsulam. Aquatic and terrestrial plants showed the greatest sensitivity to the parent pyroxsulam and little or no sensitivity to its major degradates.

Importantly, results from submitted toxicity studies are not likely to capture the toxicity of pyroxsulam and metabolites to all species of birds, mammals, plants, or aquatic organisms. Only a few surrogate species are used to represent all fish, birds, mammals, invertebrates, and plants. Furthermore, there are no required toxicity tests for amphibians or reptiles, birds are used as surrogates for reptiles and terrestrial-phase amphibians, and freshwater fish are used as surrogates for aquatic-phase amphibians. In general, the representation of numerous species by a few commonly used laboratory species, which are often chosen for amenability to laboratory study, is a source of uncertainty.

In addition to the data submitted in support of registration and the information compiled through the Agency pesticide review process, the ECOTOX (ECOTOXicity) database is typically used to identify additional toxicity data from the open literature. The ECOTOX database is a user-friendly, publicly-available, quality-assured, comprehensive tool for locating toxicity data from the open literature and is maintained by EPA Mid-Atlantic Ecology Division. More information on ECOTOX can be found at: http://www.epa.gov/ecotox. Research papers are thoroughly screened using standard procedures before being accepted into ECOTOX thereby ensuring consistent, high quality information. No studies for pyroxsulam were identified by ECOTOX.

### 2. Aquatic Effects Characterization

#### a. Aquatic Animals

Toxicity values for aquatic animals are summarized below in **Table 3.10**.

| **Table 3.10. Summary of Acute and Chronic Toxicity Data for Aquatic Animals Exposed to Pyroxsulam.** | | | | | |
|---|---|---|---|---|---|
| Species/ Chemical | Acute Toxicity | | | Chronic Toxicity | |
| | 96-hr $LC_{50}/EC_{50}$ (mg a.i./L) | 48-hr $EC_{50}$ (mg a.i./L) | Toxicity Classification (MRID) | NOAEC/ LOAEC (mg a.i./L) | Endpoints (MRID) |
| Rainbow Trout *Oncorhynchus mykiss* | >87.0 to >120 | -- | Practically Non-Toxic (469086-19, -20, -21) | -- | |
| Fathead Minnow *Pimephales promelas* | -- | -- | -- | 10.1/>10.1 | No Effects (469086-26) |
| Waterflea *Daphnia magna* | | >99 to >121 | Practically Non-Toxic (469086-22, -23, -24) | 10.4/10.4 | No Effects (469084-29) |
| Midge *Chironomus riparius* | -- | -- | -- | 100/>100 | No Effects (469086-58) |

##### i. Freshwater Fish

Four acute freshwater fish studies were submitted for review. The studies involved the parent (technical grade pyroxsulam) and the metabolites ATSA and 7-OH. In all four studies, the data indicated that the compounds tested are practically non-toxic to freshwater fish on an acute exposure basis. The median lethal concentrations ($LC_{50}$s) exceeded the highest concentration tested for each compound (*i.e.*, >87.0 mg a.i./L for the parent pyroxsulam, >119 mg a.i./L for the ATSA metabolite, and >120 mg a.i./L for the 7-OH metabolite).

One freshwater fish early-life stage test was submitted for review. In this study, fathead minnows (*Pimephales promelas*) were exposed to the parent material pyroxsulam. No significant reductions were observed for any of the test endpoints (*i.e.*, % hatch, days to mean hatch, post-hatch survival, overall survival, % normal at hatch, % normal at test termination, and growth). The no-observed-adverse-effect concentration (NOAEC) is the highest concentration tested, i.e., NOEA=10.1 mg a.i./L, and the associated lowest-observed-adverse-effect concentration (LOAEC) is >10.1 mg a.i./L.

### ii. Freshwater Invertebrates

Three freshwater invertebrate acute toxicity studies were submitted for review. Each study exposed the water flea (*Daphnia magna*) to either the parent material pyroxsulam, the metabolite ATSA, or the metabolite 7-OH. Daphnids did not exhibit any signs of toxicity, yielding median effect concentrations ($EC_{50}$s) of >100 mg a.i./L for the parent material, >121 mg a.i./L for the ATSA metabolite, and >99 mg a.i./L for the 7-OH metabolite. All compounds are classified as practically non-toxic to freshwater invertebrates on an acute exposure basis.

Three freshwater invertebrate life-cycle toxicity studies were submitted for review. One study exposed the water flea (*Daphnia magna*) to the parent pyroxsulam and the other two studies exposed the midge (*Chironomus riparius*) to either the parent pyroxsulam or the 7-OH metabolite in conjunction with sediment. The midge was sensitive to the 7-OH metabolite with a NOAEC of 30 mg a.i./L and an associated LOAEC of 60 mg a.i./L. These effect levels are associated with reduced female development and combined-sex development (9% and 7% inhibition, respectively, compared to control values). Neither the midge nor the daphnid showed sensitivity to the parent pyroxsulam and the NOAEC was equivalent to the highest concentration tested which was 100 mg a.i./L and 10.4 mg a.i./L, respectively.

### iii. Estuarine/Marine Fish

No acute or chronic estuarine/marine fish studies were submitted for review.

### iv. Estuarine/Marine Invertebrates

No acute or chronic estuarine/marine invertebrate studies were submitted for review.

## b. Aquatic Plants

Toxicity values for aquatic plants are summarized below in **Table 3.11**.

**Table 3.11. Summary of Aquatic Plant Toxicity Data for Pyroxsulam**

| Species/ Chemical | Acute Toxicity | | | |
|---|---|---|---|---|
| | $EC_{50}$ (mg a.i./L) | 7-day $EC_{50}$ (mg a.i./L) | NOAEC/ $EC_{05}$ (mg a.i./L) | Endpoints (MRID) |
| Duckweed (*Lemna gibba*) pyroxsulam (parent) | -- | 0.00257 | 0.00068 | Frond Number (469084-42) |
| Freshwater Green Algae (*Pseudokirchneriella subcapitata*) pyroxsulam (parent) | 0.111 | -- | 0.0261/<0.0261 | Biomass (0-72-hr) (469086-40) |
| Saltwater Diatom (*Skeletonema costatum*) pyroxsulam (parent) | 13.1 | -- | 3.40/Not Reported | Cell Density (120-hr) (469086-36) |

### i. Aquatic Plants

Nine studies were submitted on the acute toxicity of pyroxsulam and its major degradates to the aquatic vascular plant, *Lemna gibba*. This aquatic vascular plant species showed the greatest sensitivity to the parent pyroxsulam. Plants in this study were exposed to the parent compound under static-renewal conditions for 7 days (renewal on days 3 and 5). The 7-day $EC_{50}$ was 0.00257 mg a.i./L, based on reduced frond number in exposed plants. The corresponding NOAEC was 0.00068 mg a.i./L; inhibition of frond number ranged from 14-89% across the four highest treatment groups relative to the pooled control.

Ten studies ranging in duration from 96 to 120 hours were submitted on the acute toxicity of pyroxsulam and its major degradates to aquatic non-vascular plants. Green algae (*Pseudokirchneriella subcapitata*) are most sensitive to the parent pyroxsulam, with an $EC_{50}$ value of 0.111 mg a.i./L. The corresponding NOAEC and $EC_{05}$ were 0.0261 and <0.0261 mg a.i./L, respectively, based on the biomass inhibition (0-72-hour) of 35% and greater at all levels above the NOAEC.

One 120-hr study was submitted on the acute toxicity of the parent pyroxsulam to the non-vascular saltwater diatom (*Skeletonema costatum*). The 120-hr $EC_{50}$ value was 13.1 mg a.i./L, based on cell density. The corresponding NOAEC was 3.40 mg a.i./L based on inhibition of 34% and greater at higher concentrations; the $EC_{05}$ was not reported.

## 3. Terrestrial Effects Characterization

### a. Terrestrial Animals

Toxicity values for terrestrial animals are summarized below in **Table 3.12.**

**Table 3.12. Summary of Acute and Chronic Toxicity Data for Terrestrial Animals Exposed to Pyroxsulam and Pyroxsulam Metabolites.**

| Species/ Chemical | Acute Toxicity | | | | Chronic Toxicity | |
|---|---|---|---|---|---|---|
| | 48-hr $LD_{50}$ µg a.i./bee | 14-day $LD_{50}$ (mg/kg bw) | 8-day $LC_{50}$ (mg/kg diet (ppm)) | Toxicity Classification (MRID) | NOAEC/LOAEC (mg/kg diet (ppm)) | Endpoints (MRID) |
| Bobwhite Quail (*Colinus virginianus*) Pyroxsulam (parent) | NA | >2000 | >5000 | Practically Non-Toxic (469086-12, -15) | | |
| Mallard Duck (*Anas platyrhynchos*) Pyroxsulam (parent) | NA | >2000 | >5000 | Practically Non-Toxic (469086-13, -14) | 500/1000 | Chick Body Weight and Adult Female Body Weight (469086-16) |
| Laboratory Rat (*Rattus norvegicus*) | NA | 3129 | | Practically Non-Toxic (469083-38 and 469085-39) | NOAEC = 1000 mg/kg feed/day (469084-04) | No effects |
| Honey Bee (*Apis mellifera*) Pyroxsulam (parent) | >107.4 | -- | -- | Non-Toxic (469086-57) | -- | -- |

| Table 3.12. Summary of Acute and Chronic Toxicity Data for Terrestrial Animals Exposed to Pyroxsulam and Pyroxsulam Metabolites. | | | | | | |
|---|---|---|---|---|---|---|
| Species/ Chemical | Acute Toxicity | | | | Chronic Toxicity | |
| | 48-hr $LD_{50}$ µg a.i./bee | 14-day $LD_{50}$ (mg/kg bw) | 8-day $LC_{50}$ (mg/kg diet (ppm)) | Toxicity Classification (MRID) | NOAEC/LOAEC (mg/kg diet (ppm)) | Endpoints (MRID) |
| Earthworm (*Eisenia fetida*) parent and metabolties | NA | >1000 mg a.i./kg sub | -- | Non-Toxic (469086-53, -54, -55, -56) | | -- |
| Earthworm (*Eisenia fetida*) 6-Cl-7-OH (metabolite) | NA | -- | -- | -- | 130/>130 µg a.i./kg dry soil | No Effects (469086-60) |

NA not applicable

### i. Birds

Two acute oral and two subacute dietary studies were conducted to determine the toxicity of pyroxsulam to avian species. The results indicate that the parent material is practically non-toxic to bobwhite quail (*Colinus virginianus*) and mallard ducks (*Anas platyrhynchos*) under acute oral and subacute dietary exposure basis. The $LC_{50}$ and NOAEC values were >2000 and 2000 mg/kg bw, respectively, for the acute oral tests and >5000 and 5000 mg/kg dw diet, respectively, for the subacute dietary tests.

Two avian reproduction studies with the parent pyroxsulam were submitted for review. Bobwhite quail exhibited no effects up to the maximum concentration tested, 1000 mg/kg feed, while mallard ducks exhibited significant reductions from control in 14-day chick body weight (4%) and adult female weight (7.5%) at test termination at the maximum (1000 mg/kg) dietary treatment level. The NOAEC and LOAEC values were 500 and 1000 mg/kg diet, respectively.

### ii. Mammals

In an acute oral toxicity study (MRID 46908338 and 46908539), nine female Fischer 344 young adult rats (age: 8-12 weeks; source: Charles River Laboratories, Raleigh, NC; 117-147 g ) were given a single oral dose of GF-1674 (XR-742 (Pyroxsulam) using the Up and Down Procedure. At the 5000 mg/kg dose level, the three animals died within two days of test substance administration. No gross abnormalities were noted in any of the animals at the 175, 550 and 1750 dose levels. Gross necropsy of the animals dosed at 5000 mg/kg revealed discoloration of the intestines. The oral $LD_{50}$ for female rats is 3129 mg/kg bw (95% C.L. 1750 – 5000). The results indicate that pyroxsulam is practically nontoxic to mammals on acute oral basis.

In a 2-generation reproduction study, pyroxsulam was administered to 27 CD (CrlCD(SD) IGC BR) rats/sex/dose in the diet at the nominal dose levels of 0, 100, 300, or 1000 mg/kg feed/day. There was one breeding per generation. There were no adverse effects on parental survival, clinical signs, body weight, or food consumption up to the maximum dietary concentration tested (NOAEC=1000 mg/kg diet/day). There was no adverse effect on the survival, growth, organ weights (brain, spleen, thymus), or development (onset of puberty) of the offspring of either generation. In addition, there were no adverse effects on any reproductive function parameter of the parental animals, including estrous cyclicity and periodicity, sperm measures, mating, conception, fertility or gestation indices, post-implantation loss, time to mating, or gestation length in either generation. The NOAEC based on all endpoints is equivalent to the highest dietary concentration tested, i.e., 1000 mg/kg feed/day.

### iii. Insects

One acute oral toxicity study was submitted to evaluate the toxicity of pyroxsulam to the honeybee (*Apis mellifera*). The results indicated that the parent material was practically non-toxic to honeybees on an acute oral exposure basis, yielding NOAEL and $LD_{50}$ values of 107.4 and >107.4 µg a.i./bee, respectively.

Several non-guideline toxicity tests on soil-dwelling terrestrial invertebrates were submitted. EFED does not calculate RQs to assess risks to terrestrial invertebrates at this time. Four, 14-day acute earthworm (*Eisenia fetida*) studies were submitted. One study was conducted with the parent material and the other three were conducted using the 5-OH, 6-Cl-7-OH and 7-OH metabolites. The results indicate that pyroxsulam and its degradates are not toxic to terrestrial invertebrates on an acute exposure basis because the $LC_{50}$ values exceeded the highest tested concentration (>1000 mg a.i./kg substrate for metabolites and >10000 mg a.i./kg substrate for pyroxsulam). The NOAEC value associated with all three metabolites was 1000 mg a.i./kg substrate, as no significant reductions were observed. However, the parent pyroxsulam caused an 18% loss in body weight in the earthworms exposed to 10000 mg a.i./kg substrate (compared to a 1.9% loss of body weight of the control organisms), resulting in a NOAEC of <10000 mg a.i./kg substrate. Additionally, one chronic reproductive study was submitted in which earthworms were exposed to the 6-Cl-7-OH metabolite. No effects were observed in a 56-day reproductive toxicity study up to and including 130 µg a.i./kg of dry soil indicating that this metabolite did not exhibit reproductive toxicity in terrestrial invertebrates on a chronic exposure basis. The subsequent NOAEC and LOAEC values were 130 and >130 µg a.i./kg dry soil, respectively.

### iv. Terrestrial Plants

Toxicity values for terrestrial plants are summarized in **Table 3.13**. A Tier II terrestrial plant seedling emergence and vegetative vigor studies were submitted exposing 10 species (4 monocots and 6 dicots) to GF-1674, a typical end-use OD (oil dispersion) formulation containing 2.78% pyroxsulam (equivalent to 29 g a.i./L). In the seedling emergence test, onion (*Allium cepa*) was the most sensitive monocot species, with fresh shoot weight $EC_{05}$ and $EC_{25}$ values of 0.00062 and 0.00022 lbs a.i./A, respectively. The most sensitive dicot in the seedling emergence test was carrot (*Daucus carota)*, based on fresh shoot weight, with $EC_{05}$ and $EC_{25}$ values of <0.0000089 and 0.0014 lbs a.i./A, respectively. Similar to the seedling emergence test, onion was the most sensitive monocot in the vegetative vigor test, with fresh weight $EC_{05}$ and $EC_{25}$ values of 0.00056 and 0.000046 lbs a.i./A, respectively. The most sensitive dicot in the vegetative vigor test was oilseed rape (*Brassica napus*), based on shoot height, with NOAEC and $EC_{25}$ values of 0.000031 and 0.000052 lbs a.i./A, respectively.

**Table 3.13. Summary of the Effects of Pyroxsulam on Terrestrial Plants.**

| Plant Type | Study Species | Shoot Height | | Fresh Weight | |
|---|---|---|---|---|---|
| | | NOAEC / $EC_{05}$* (g a.i./ha) | $EC_{25}$ (g a.i./ha) | NOAEC / $EC_{05}$* (g a.i./ha) | $EC_{25}$ (g a.i./ha) |
| Tier II Results-Seedling Emergence | | | | | |
| Monocot | Corn | 0.0017 | 0.0046 | 0.0023 | 0.0047 |
| | Oat | 0.00033 | 0.0011 | 0.00026 | 0.00099 |
| | Onion | 0.000071 | 0.00029 | 0.000062 | 0.00022 |
| | Ryegrass | <0.00022 | 0.00067 | <0.0015 | 0.00054 |
| Dicots | Cabbage | 0.00018 | 0.0012 | 0.00061 | 0.0014 |
| | Carrot | <0.000027 | 0.0028 | <0.0000089 | 0.0014 |
| | Cucumber | 0.0024 | >0.013 | 0.0019 | 0.0062 |
| | Oilseed Rape | 0.00094 | 0.0019 | 0.000054 | 0.0015 |
| | Soybean | <0.00038 | 0.0011 | <0.00029 | 0.0013 |
| | Sugarbeet | 0.000027 | 0.00085 | 0.000036 | 0.00057 |
| Tier II Results-Vegetative Vigor | | | | | |
| Monocot | Corn | 0.00051 | 0.018 | 0.00013 | 0.0012 |
| | Oat | 0.000029 | >0.013 | 0.000038 | 0.00085 |
| | Onion | 0.00047 | 0.0012 | 0.000046 | 0.00056 |
| | Ryegrass | 0.00024 | 0.0013 | 0.00027 | 0.00067 |
| Dicots | Cabbage | 0.013 | 0.013 | 0.0067 | 0.0054 |
| | Carrot | 0.000019 | 0.00042 | 0.000022 | 0.00041 |
| | Cucumber | 0.00031 | >0.013 | 0.000013 | 0.0083 |
| | Oilseed Rape | 0.000031 | 0.000052 | 0.00093 | 0.0045 |
| | Soybean | 0.000068 | 0.00017 | 0.000041 | 0.00022 |
| | Sugarbeet | 0.00031 | >0.013 | 0.000048 | 0.0014 |

Additionally, one study (MRID 469086-61) was submitted which evaluated the herbicidal activity of the parent pyroxsulam and six soil metabolites (7-OH; 5-OH; 5,7-Di-OH; Sulfonic Acid; 6-Cl, 7-OH; and Cyanosulfonamide) to 22 species of terrestrial plants; test material was applied post-emergence. Test species included 9 monocots (oat, wheat, corn, buckwheat, blackgrass, barnyard grass, large crab grass and yellow nutsedge) and 14 dicots (soybean, oilseed rape, chickweed, field pansy, wild poinsettia, giant foxtail, rox orange sorghum, lambs quarter, ivy leaf morning glory, redroot pigweed, velvetleaf, Canada thistle, volunteer sunflower and wheat). The only endpoint was whole plant characterization, assessed on a rating scale of 0 (no effect) to 100% (complete kill) relative to the control plants. All six metabolites tested had little or no effect at any rate tested up to 62.5 ppm. Redroot pigweed was the most sensitive species when tested with the 7-OH metabolite, exhibiting a 60% overall effect at the 62.5 ppm treatment level. The $EC_{50}$ value for the 7-OH metabolite for the mean activity across all species was 475 g/ha, compared to 0.09 g/ha for the parent material, indicating more than a 1000-fold higher activity for the parent compared to this metabolite. These results further demonstrate the lack of herbicidal activity of all metabolites on a wide array of grass and broadleaf whole plants relative to the parent compound, thereby posing a low probability of the degradates causing injury to non-target plants. As such, the parent material is not considered to be a "pro-herbicide", which when metabolized is converted to the active herbicide moiety.

Finally, two method validation studies were conducted and submitted to determine the efficiency of recovery of the parent material and metabolites from soil and sediment (MRID 469086-48) and for the quantitative determination of residues in representative acidic, dry (including processed products), oily and wet crops (MRID 469086-49). Results from both studies indicated that the analytical methodologies employed were acceptable: except for two recoveries of 69%, the individual recoveries were within the range of 70-120%.

# IV. Risk Characterization

Risk characterization is the integration of exposure and effects to estimate the potential ecological risk from the proposed use of pyroxsulam on wheat. The goal of risk characterization is to provide an estimate and description of potential adverse effects and to articulate risk assessment assumptions, limitations, and uncertainties in order to synthesize an overall risk conclusion.

## A. Risk Estimation – Integration of Exposure and Effects Data

Toxicity data and exposure estimates are used to evaluate the potential for adverse ecological effects on non-target species. For this screening-level assessment of pyroxsulam, the deterministic risk quotient method is used to provide a metric of potential risks. The RQ is a comparison of exposure estimates to toxicity endpoints; estimated exposure concentrations are divided by acute and chronic toxicity values. The resulting unitless RQs are compared to the Agency's LOCs, which are the Agency's interpretive policy such that when LOCs are exceeded, the need for regulatory action should be considered. These criteria are used to indicate when the use of a pesticide, as directed on the label, has the potential to cause adverse effects on non-target organisms.

### 1. Non-target Aquatic Organisms

The surface water EECs (peak and chronic values) from the PRZM/EXAMS model were compared to acute and chronic toxicity endpoints to derive acute and chronic RQs for non-target aquatic organisms. Acute and chronic RQs for freshwater and estuarine/marine organisms are summarized in **Tables 4.1 and 4.2**, respectively.

For aquatic vascular and non-vascular plants, peak EECs are compared to acute $EC_{50}$ values to derive acute non-listed species RQs. In addition, peak EECs are also compared to NOAEC or $EC_{05}$ values for aquatic plants to derive listed species RQs. All RQs for aquatic plants are presented in **Table 4.3.**

#### a. Freshwater Fish and Invertebrates

The RQs did not exceed non-listed or listed species acute or chronic risk LOCs for freshwater fish, aquatic-phase amphibians, or freshwater invertebrates. **Table 4.1** lists the RQs for freshwater fish, aquatic-phase amphibians, and freshwater invertebrates potentially exposed to pyroxsulam associated with the proposed use on wheat.

| Table 4.1. Risk Quotients for Freshwater Fish and Invertebrates Exposed to Pyroxsulam for Use on Wheat. | | | | | | |
|---|---|---|---|---|---|---|
| Use | Annual Application Rate | EECs (ppb) | Fish and Amphibian RQs $LC_{50}$ = >87000 ppb NOAEC = 10100 ppb | | Invertebrate RQs $LC_{50}$ = >99000 ppb NOAEC = 30000 ppb | |
| | | Peak | Acute | Chronic | Acute | Chronic |
| Wheat | 0.0164 lbs a.i./A | 0.182 | <0.01 | <0.01 | <0.01 | <0.01 |

### b. Aquatic Plants

The RQs for aquatic plants did not exceed the acute risk LOCs for both non-listed and listed species (highest RQ = 0.27). **Table 4.2** lists the RQs for aquatic vascular and non-vascular plants potentially exposed to pyroxsulam.

| Table 4.2. Risk Quotients for Fresh- and Saltwater Plants Exposed to Pyroxsulam for Use on Wheat. | | | | | | |
|---|---|---|---|---|---|---|
| Use | Total Seasonal Application Rate lbs ai/A | EECs (ppb) | Freshwater Vascular Plant RQs $EC_{50}$ = 2.6 ppb NOAEC = 0.68 ppb | | Freshwater Non-Vascular Plant RQs $EC_{50}$ = 111 ppb NOAEC = 26.1 ppb | |
| | | Peak | Acute | Acute Listed Species | Acute | Acute Listed Species |
| Wheat | 0.0164 | 0.182 | 0.070 | 0.27 | <0.01 | <0.01 |

## 2. Non-target Terrestrial Organisms

The EEC values for estimated exposure to terrestrial animals for spray applications of pyroxsulam were derived using the Kenaga nomogram, as modified by Fletcher (Fletcher *et al.*, 1994). Exposure estimates were generated for the proposed label use of pyroxsulam on winter wheat with a single application of the flowable formulation of 0.0164 lbs a.i./A. The RQs are based on these maximum exposure estimates and the lowest available toxicity endpoints for a given taxa and exposure duration (*e.g.* acute avian). Specifically for this assessment, the lowest $LC/LD_{50}$ and NOAEC values were used for birds and mammals. Note again that data from avian toxicity studies were used to represent reptiles and terrestrial-phase amphibians.

Acute and chronic RQs for birds, reptiles, and terrestrial-phase amphibians are presented in **Tables 4.3** and **4.4**, respectively, acute and chronic RQs for mammals are summarized in **Tables 4.5**, **4.6**, and **4.7**, respectively.

### a. Birds

No RQs exceed non-listed or listed species acute risk LOCs with RQs ≤0.01. **Table 4.3** lists the avian dose-based acute RQs for proposed use of the dry granule and water dispersible granule formulation of pyroxsulam on wheat.

| Table 4.3. Avian Dose-Based Acute RQ Values for Pyroxsulam Use on Winter Wheat; Based on Mallard Duck $LD_{50}$ >2000 mg/kg bw and Upper-Bound Kenaga Residues. | | | | | | |
|---|---|---|---|---|---|---|
| Use | Application Rate lbs ai/A | Body Weight (g) | Avian Acute RQs for Specified Food Items[1] | | | |
| | | | Short Grass | Tall Grass | Broadleaf Plants/Small Insects | Fruits/Pods/ Seeds/ Large Insects |
| Wheat | 0.0164 | 20 | <0.01 | <0.01 | <0.01 | <0.01 |
| | | 100 | <0.01 | <0.01 | <0.01 | <0.01 |
| | | 1000 | <0.01 | <0.01 | <0.01 | <0.01 |
| [1] Acute Risk LOCs; non-listed species RQ≥0.5 and listed species RQ≥0.1 | | | | | | |

No acute or chronic LOCs are exceeded. Acute and chronic dietary-based RQs are ≤0.01. **Table 4.4** lists the acute and chronic dietary-based avian RQs for proposed use of pyroxsulam.

| Table 4.4. Acute and Chronic Dietary-Based RQ Values for Birds Exposed to Pyroxsulam Based on Upper-Bound Kenaga Values. | | | | | |
|---|---|---|---|---|---|
| Use | Application Rate lbs ai/A 1 application | Food Items | EEC (mg/kg) | Acute Dietary RQ[1] | Chronic Dietary RQ[2] |
| Wheat | 0.0164 | Short Grass | 3.94 | <0.01 | 0.01 |
| | | Tall Grass | 1.80 | <0.01 | <0.01 |
| | | Broadleaf plants / small insects | 2.21 | <0.01 | <0.01 |
| | | Fruits, pods, seeds, large insects | 0.25 | <0.01 | <0.01 |
| [1] Acute Risk LOCs; non-listed species RQ≥0.5 and listed species RQ≥0.1<br>[2] Chronic Risk LOC; RQ≥1.0 for non-listed and listed species | | | | | |

### b. Mammals

No acute risk LOCs are exceeded with RQs <0.01. **Table 4.5** lists the dose-based acute mammalian RQs for proposed use of both the dry granule and water dispersible granule formulations of pyroxsulam.

| Table 4.5. Mammalian Dose-Based Acute RQ Values for Uses of Pyroxsulam; Based on Rat $LD_{50}$ 3129mg/kg bw and Upper-Bound Kenaga Residues. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Use | Application Rate lbs ai/A | Body Weight (g) | RQs for Granular | Mammalian Acute RQs for Specified Food Items[1] | | | | |
| | | | | Short Grass | Tall Grass | Broadleaf Plants/Small Insects | Fruits/Pods/ Lg Insects | Seeds |
| Wheat | 0.0164 | 15 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | | 35 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | | 1000 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| [1] Acute Risk LOCs; non-listed species RQ≥0.5 and listed species RQ≥0.1 | | | | | | | | |

The non-listed and listed species chronic risk LOC (RQ>1.0) is not exceeded for the proposed use of pyroxsulam on wheat for mammals (RQs range from <0.01-0.08). **Table 4.6** lists the dose-based chronic mammalian RQs for proposed uses of pyroxsulam.

| **Table 4.6. Mammalian Dose-Based Chronic RQ Values for Uses of Pyroxsulam; Based on Rat NOAEC of 1000 mg/kg feed and Upper-Bound Kenaga Residues.** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Use | Application Rate lbs ai/A | Body Weight (g) | Mammalian Acute RQs for Specified Food Items | | | | |
| | | | Short Grass | Tall Grass | Broadleaf Plants/Small Insects | Fruits/Pods/ Lg Insects | Seeds |
| | | | | | | | |
| Wheat | 0.0164 | 15 | 0.03 | 0.02 | 0.02 | <0.01 | <0.01 |
| | | 35 | 0.03 | 0.01 | 0.02 | <0.01 | <0.01 |
| | | 1000 | 0.02 | 0.01 | 0.01 | <0.01 | <0.01 |
| | | | | | | | |

The RQs do not exceed the chronic risk LOCs for any proposed uses of pyroxsulam with RQs ≤0.01. **Table 4.7** lists chronic dietary-based mammalian RQs for proposed uses of pyroxsulam. These RQs are based on effects levels associated with chemical concentrations in feed.

| **Table 4.7. Chronic Dietary-Based RQ Values for Mammals Exposed to Pyroxsulam Based on Upper-Bound Kenaga Values.** | | | | |
|---|---|---|---|---|
| Use | Application Rate lbs ai/A | Food Items | EEC (mg/kg) | Chronic Dietary RQ[1] |
| | | | | |
| Wheat | 0.0164 | Short Grass | 3.94 | <0.01 |
| | | Tall Grass | 1.80 | <0.01 |
| | | Broadleaf plants / small insects | 2.21 | <0.01 |
| | | Fruits, pods, seeds, large insects | 0.25 | <0.01 |
| [1] Chronic risk LOC for non-listed and listed mammalian species is RQ≥1.0 | | | | |

### c. Terrestrial Plants

**Table 4.8** lists the terrestrial and semi-aquatic plant RQs for proposed uses of pyroxsulam based on results from TerrPlant v. 1.2.1. The analysis indicates that for dicotyledonous plants adjacent to pyroxsulam treated fields, the RQ exceeds the acute risk LOC (RQ ≥ 1.0) as a result of drift and for semi-aquatic dicots with exposure resulting from drift and channel runoff. For non-listed monocots, RQs exceed the LOC as a result of sheet runoff (dry scenario) and also for semi-aquatic plants. The difference in risk estimates for the various scenarios is in part due to the fact that results from the vegetative vigor study are used for risk estimates associated with drift; the other scenarios incorporate toxicity values from the seedling emergence tests. For listed species, RQs exceeded the listed species acute risk LOC for semi-aquatic monocots and dicots. In addition, RQs exceeded the listed species acute risk LOC associated with spray drift and for plants in dry areas (sheet runoff) for monocots and dicots. These RQs are based on the maximum proposed use rate for winter wheat of 0.0164 lbs ai/A; RQs based on the lower proposed use rate for spring and winter wheat of 0.0132 lbs ai/A are slightly lower but the RQs still exceed the LOCs.

| Table 4.8. RQ Values for Terrestrial and Semi-Aquatic Plants Exposed to Pyroxsulam Based on Proposed Use on Wheat of 0.0164 lbs a.i./A. | | | | |
|---|---|---|---|---|
| Plant | Toxicity Measurement Endpoint | RQs Based on Tier II Seedling Emergence and Vegetative Vigor Studies | | |
| | | Dry | Drift | Semi-aquatic |
| **Based on Ground Spray** | | | | |
| Non-Listed Plant Species (Based on $EC_{25}$) | | | | |
| Monocot | 0.00022 lbs ai./A Seed Emerg<br>0.00056 lbs ai/A Veg Vig | **4.5** | 0.75 | **38** |
| Dicot | 0.00057 lbs ai/A Seed Emerg<br>0.000052 lbs ai/A Veg Vig | **1.7** | **3.2** | **15** |
| Listed Plant Species (Based on NOAEC or $EC_{05}$) | | | | |
| Monocot | 0.00006 lbs ai/A Seed Emerg<br>0.000046 lbs ai/A Veg Vig | **16** | **2.7** | **139** |
| Dicot | 0.000036 lbs ai/A Seed Emerg<br>0.000031 lbs ai/A Veg Vig | **27** | **5.3** | **232** |
| **Based on Aerial Spray** | | | | |
| | | Dry | Drift | Semi-aquatic |
| Non-Listed Plant Species (Based on $EC_{25}$) | | | | |
| Monocot | 0.00022 lbs ai./A Seed Emerg<br>0.00056 lbs ai/A Veg Vig | **7.5** | **3.7** | **41** |
| Dicot | 0.00057 lbs ai/A Seed Emerg<br>0.000052 lbs ai/A Veg Vig | **2.9** | **16** | **16** |
| Listed Plant Species (Based on NOAEC or $EC_{05}$) | | | | |
| Monocot | 0.00006 lbs ai/A Seed Emerg<br>0.000046 lbs ai/A Veg Vig | **27** | **14** | **150** |
| Dicot | 0.000036 lbs ai/A Seed Emerg<br>0.000031 lbs ai/A Veg Vig | **46** | **26** | **251** |

### B. Risk Description

The available data on the fate and effects of pyroxsulam are sufficient to address the risk hypothesis for all taxa, as specified in the Overview Document (USEPA, 2004). Although no effects data were submitted for estuarine/marine animal species, the physicochemical properties, proposed uses, and toxicity to freshwater animals indicates that effects data are not required for estuarine/marine animal species at this time. The results of this screening-level risk assessment indicate some components of the risk hypothesis are accepted; there is potential for direct adverse acute effects for and terrestrial and semi-aquatic monocot and dicot plants. These results are based on modeled spray application rates of 0.0164lbs a.i./A per year, which represents the proposed use of pyroxsulam applied at the maximum label rate; risk conclusions are the same based on the slightly lower rate of 0.0132 lbs a.i./A per year associated with the winter and spring wheat use.

### 1. Risk to Aquatic Organisms

Aquatic EECs were based on PRZM/EXAMS and represent peak and chronic values of pyroxsulam that may be present in a representative farm pond water body. The results of the screening-level analysis indicate that the potential of pyroxsulam to adversely affect aquatic freshwater animals is low. Risk quotients for freshwater fish and invertebrates are all below 0.01; no acute or chronic risk LOCs are exceeded. In addition, pyroxsulam appears to pose little potential for adverse effects to aquatic plants with RQs for non-vascular and vascular plants that are below 1.0. However, given the potential for effects on terrestrial and semi-aquatic plant species associated with the use of pyroxsulam, indirect effects on aquatic species are possible via potential alterations in riparian habitat.

#### a. Freshwater Fish

Acute and chronic RQs for freshwater fish are below acute and chronic risk LOCs, indicating that direct effects to freshwater fish are unlikely for the use of pyroxsulam on wheat.

The freshwater fish toxicity data indicate that pyroxsulam and degradates are practically non-toxic to tested species, which partly explains why RQ values are below the LOCs. Extrapolation to other freshwater fish is uncertain. In all likelihood, more sensitive species exist; however, given the low potential for adverse effect to tested species, the potential for adverse effects on freshwater fish or aquatic-phase amphibians is believed to be low.

#### b. Freshwater Invertebrates

Acute and chronic RQs for freshwater invertebrates are below acute and chronic risk LOCs, indicating a low potential for direct adverse effects to freshwater invertebrates based on the use of pyroxsulam on wheat.

The freshwater invertebrate toxicity data indicate that pyroxsulam is practically non-toxic to tested species. Extrapolation to other freshwater invertebrates is uncertain. In all likelihood, more sensitive species exist but given the low potential for adverse effects based on tested species, the potential for adverse effects on other freshwater invertebrates is expected to be low.

Additionally, a chronic chironimid study indicated that the 7-OH metabolite of pyroxsulam is slightly toxic to this species with a NOAEC of 30 mg/L. Peak EECs for the total toxic residues are 0.18 ppb and represent the highest concentration obtained in model results; the ratio of exposure to toxicity is below 0.001, well below the aquatic species LOCs. Furthermore, the estimated 21-day pore water EEC of 0.08ppb suggests that exposures to sediment-dwelling invertebrates are unlikely to approach toxicity thresholds.

#### c. Estuarine/Marine Fish

The potential for adverse effects including acute mortality for estuarine/marine fish is likely low, based on the results of the screening assessment; acute RQs for wheat are well below the acute risk LOC for freshwater fish. No acute or chronic estuarine/marine fish toxicity data were submitted for pyroxsulam, however, given the low potential for adverse effects in freshwater fish species, the potential for chronic effects in estuarine/marine fish species is presumed to be low.

#### d. Estuarine/marine Invertebrates

Acute and chronic RQs for freshwater invertebrates are below acute risk LOCs for the proposed use of pyroxsulam on wheat, indicating that a potential for direct adverse effects to estuarine/marine invertebrates is likely low as well.

There are no estuarine/marine invertebrate toxicity data for pyroxsulam although it is characterized as practically non-toxic to tested freshwater species. Although there is uncertainty associated with the toxicity of pyroxsulam to estuarine/marine invertebrates due to a lack of data, it seems unlikely that estuarine/marine invertebrates would be so much more sensitive than freshwater invertebrates that RQs would exceed the LOC; estuarine/marine species would have to be tens of thousands times more sensitive. In all likelihood, more sensitive species exist but given the low potential for effects to tested species, the potential for adverse effects on estuarine/marine invertebrates is expected to be low.

#### e. Aquatic Plants

Based on predicted EECs for the modeled pyroxsulam use and available toxicity data, LOCs are not exceeded for non-listed or listed vascular and non-vascular aquatic plants. In part, the low RQs for aquatic plants, despite the intended use as an herbicide, is due to the relatively low toxicity of pyroxsulam to aquatic plants. In addition, the fairly low application rate likely contributes to the low potential for adverse effects to aquatic plants.

### 2. Risk to Terrestrial Organisms

#### a. Birds

No avian acute or chronic risk LOCs are exceeded for any uses of pyroxsulam indicating that the potential for adverse effects on birds is low. Toxicity studies on pyroxsulam indicate that technical grade pyroxsulam is practically non-toxic to birds on an acute oral and acute dietary exposure basis. Results from the chronic study yielded a NOAEC for Mallard ducks exposed to pyroxsulam of 500 mg/kg feed, based on reduced body weight. Taken as a whole, the risk estimation results and the toxicity data indicate a low potential for direct adverse effects to avian species associated with the proposed use of pyroxsulam. However, given the potential for effects on terrestrial semi-plant species associated with the use of pyroxsulam, indirect effects on birds are possible. Since plants comprise vital components of all habitats and ecosystems, if alterations in the abundance of plants or in the composition of habitats (plant community) were to occur as a result of pyroxsulam use, then it is possible that some bird species may be affected. Potential indirect effects might include a decrease or change in the forage base or reduction in the availability of suitable nesting habitats.

#### b. Mammals

Acute risks to wild mammals were evaluated using a common laboratory rat $LD_{50}$ value (3129 mg/kg bw). Pyroxsulam is practically non-toxic to mammals on an acute exposure basis. Calculated dose-based RQs for all proposed uses of pyroxsulam on wheat are below the acute risk LOC. The low apparent acute toxicity of pyroxsulam and the calculated RQs indicate a low potential for direct adverse effects to mammals associated with the use of pyroxsulam on wheat. Similarly, an evaluation of chronic risks showed that the dose-based chronic risk LOCs are not exceeded for the proposed use of pyroxsulam on wheat. Taken as a whole, the toxicity data and the risk estimates indicate that the potential for adverse effects to mammals associated with the use of pyroxsulam on wheat is low. However, similar to the potential for indirect effects to birds, the use of pyroxsulam could indirectly affect mammals by altering critical habitat components. An alteration in the abundance or composition of plant species in a given habitat could result in an inability to acquire necessary energy for survival or alter the use of the habitat in such a way as to disrupt normal behaviors (like mating).

**c. Potential Risk to Birds and Mammals: BCF Analysis**

A fish bioconcentration study was not submitted for pyroxsulam because of its low $K_{OW}$. Because bioconcentration of pyroxsulam is unlikely, risks to piscivorous birds and mammals associated with the proposed use of pyroxsulam on wheat are unlikely.

**d. Plants**

Tier II plant studies demonstrate the potential for pyroxsulam to affect terrestrial dicot and monocot plants. Exposure levels equivalent to a 25% effect level were 0.00056 lbs a.i./A for monocots and 0.000052 lbs a.i./A for dicots for the vegetative vigor study. Results from the seedling emergence test indicated that a 25% effect level was 0.00022 lbs a.i./a for monocots and 0.00057 lbs a.i./a for dicots. Risk quotients for terrestrial plants ranged from 0.75 to 16 and for semi-aquatic plants RQs ranged from 15 to 251. Taken as a whole, the toxicity studies and the RQs indicate a potential for adverse effects to terrestrial plants as a result of exposures to pyroxsulam. Risk quotients for both monocots and dicots exceed the listed species acute risk LOC for terrestrial and semi-aquatic plants.

As with any toxicity test, there are uncertainties regarding whether test species adequately represent the range of possible sensitivities in the wild. Plants tested are crop plants, typically subjected to hundreds of years of human selection. It is likely that some native species are more sensitive than commonly used agricultural test species given the tremendous variation and number of wild plant species. Tests using a broader range of species may help reduce this uncertainty; however, a critical review paper McKelvey *et al.* (2002) suggests that, in general, crop testing may be sufficiently protective of most plants. Further supporting this contention is a review paper by Clark *et al.* (2004) which indicates that the current agricultural species used for testing are at least as sensitive as non-crop species in 95% of cases evaluated. Importantly, however, these authors also point out that there is no one species or endpoint that is consistently the most sensitive for all species and that numerous factors can confound comparison of test results. Moreover, neither study was a comprehensive review of the relative sensitivity of all (or even most) plants; therefore, considerable uncertainty still remains concerning the adequacy of test species in representing non-test species. In the submitted toxicity tests for pyroxsulam, 10 species (4 monocots, 6 dicots) are used to represent all plant species.

There are several uncertainties regarding the use of TerrPlant to assess risk to plants. One is whether the default assumption of 5% spray drift (from aerial application) is sufficiently protective. Estimates made from actual drift assessments range to higher than 20% for fine sprays, which may result in an underestimation of risks to plants is underestimated. To gain a better understanding of the potential for spray drift to affect terrestrial plants, Tier I AgDRIFT® modeling for aerial application (v. 2.01) was used to determine how far off-field pyroxsulam levels would remain above the lowest vegetative vigor $EC_{25}$ for dicotyledonous plants (0.000052 lbs a.i./A). AgDRIFT® utilizes empirical data to estimate off-site deposition of aerial and ground applied pesticides, and acts as a tool for evaluating the potential of buffer zones to protect sensitive habitats from undesired exposures. Assuming the maximum single application rate of 0.0164 lbs a.i./A, fine to medium droplet size,10 mph winds, and 10 ft application height, plants may be exposed to levels of pyroxsulam above the $EC_{25}$ for up to and beyond 1000 feet from the treated field; this combination of application rate and variables exceeds the range of AgDRIFT® (1000 ft). If droplet size is increased to medium-coarse, plants may be exposed to levels of pyroxsulam above the $EC_{25}$ for up to 850 feet from the treated field, while the use of coarse to very coarse droplet size would result in plants potentially being exposed to pyroxsulam at levels above the $EC_{25}$ for up to 500 feet from the treated field. Alternatively, if droplet size were reduced to very fine to fine, the distance from the treated field where spray drift might exceed the $EC_{25}$ extends beyond the range that AgDRIFT® calculates (>1000 ft). Clearly, droplet size has a significant impact on the extent of spray drift. For listed plant species, all estimated distances would be even greater. A number of factors other than droplet size can significantly impact spray drift including wind speed, release height, nozzle size and angle, boom width, *etc.* These results are based on a ground application; simulations involving aerial applications would produce greater distances from the treated field. AgDRIFT® allows for higher tier assessments although these were not conducted for pyroxsulam. More details concerning the specifics and uncertainties of AgDRIFT® are available online at www.agdrift.com.

Screening-level estimates of exposure to semi-aquatic plants is estimated using TerrPlant, which combines exposure due to runoff and drift. TerrPlant assumes that drift and runoff concentrations are uniform over the non-target area. In the field, decreasing concentration gradients would be expected for each of these exposure pathways as the distance increases from the application site. If the dimensions (*i.e.* length and width) of the target area and non-target area were defined, the uncertainties associated with these assumptions could be explored. TerrPlant assumes a 10 to 1 ratio of target area to semi-aquatic non-target area, which is based on research indicating a pond located in Georgia with a 6-7 foot typical depth and a requirement of 2 acre drainage areas per foot of depth (USDA, 1997). Although the data are derived from observations of aquatic areas (*e.g.* farm ponds), it is assumed that this ratio is relevant to low-lying semi-aquatic areas. However, there is uncertainty associated with the depth of the ponds used for modeling purposes and the expected depth of a semi-aquatic area.

Another uncertainty associated with estimating risks to plants is that current assessment methods account for only a single application of the chemical since it is assumed that effects to plants would likely manifest after a single application and that toxicological response is less dependent on subsequent exposures. It may be difficult to confidently apply this reasoning to all plants under all circumstances; therefore, the assumption of a single application remains a source of uncertainty. However, for the proposed use of pyroxsulam, only one application is permitted; if any future proposed uses require multiple applications, this source of uncertainty could play an important role.

#### e. Non-Target Terrestrial Invertebrates

EFED currently does not estimate risk quotients for terrestrial non-target insects. However, a label statement is required to protect foraging honeybees when the $LD_{50}$ is < 11 µg/bee. Based on the acute contact toxicity study to honeybees, the $LD_{50}$ for pyroxsulam is >107 µg/bee. This classifies pyroxsulam as practically non-toxic to honeybees on an acute contact exposure basis.

Data are available on the toxicity of pyroxsulam to earthworms. A brief analysis indicates that the NOAEC is < 10,000 mg/kg soil, an estimate of pyroxsulam in soil assuming even distribution to a depth of 5cm is 0.86 mg/kg soil. Although the NOAEC is below 10,000 mg/kg soil, it would have to be below 1.0 for there to be potential effects to earthworms which appears unlikely.

### 3. 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, or the United States Fish and Wildlife Service (FWS) 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 pesticide products that contain the active ingredient pyroxsulam. Pyroxsulam is proposed for use on wheat. Wheat production areas are predominantly found in the states of California, Mississippi, Arkansas, Louisiana, Texas, and Missouri. However, wheat production has been documented in Illinois, Florida, Oklahoma and Tennessee, although to a lesser degree (USDA, 2007).

**a. Action Area**

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by pyroxsulam use and not merely the immediate area where pyroxsulam 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 1.0** of this risk assessment presents the proposed pesticide use sites that are used to establish initial co-location of species with treatment areas.

**b. 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 model addressing proposed pyroxsulam uses, and the associated exposure and effects analyses conducted for the pyroxsulam 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 endangered 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 endangered LOCs in the screening level risk assessment, with an evaluation of the potential probability of individual effects for exposures that may occur at the established endangered species LOC. Data on exposure and effects collected under field 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.

A description of the potential direct effects associated with exposure to pyroxsulam for each of the taxonomic groups is provided below. **Table 4.9** provides a summary of the potential direct and indirect effects for federally listed species, including the range of RQ values.

**Table 4.9. Summary of Direct and Indirect Effects for Federally Listed Species.**

| Listed Species Taxonomic Group of Concern | Direct Effects | RQ | Indirect Effects | |
|---|---|---|---|---|
| | | | Potential | Associated Taxa[1] |
| Aquatic vascular plants | None | | No | |
| Aquatic non-vascular plants | None | | No | |
| Estuarine/marine non-vascular plants | None | | No | |
| Dicot terrestrial plants | Acute: plant growth | 0.49-6.83 | No | |
| Monocot terrestrial plants | Acute: plant growth | 0.75-68.33 | No | |
| Freshwater fish | None | | Yes | Terrestrial Plants |
| Estuarine/Marine fish | None | | No | |
| Freshwater invertebrates | None | | Yes | Terrestrial Plants |
| Estuarine/Marine Invertebrates | None | | No | |
| Mollusks | None | | Yes | Terrestrial Plants |
| Mammals | None | | Yes | Terrestrial Plants |
| Birds | None | | Yes | Terrestrial Plants |
| Terrestrial invertebrates | None | | Yes | Terrestrial Plants |

[1]Associated Taxa refers to those taxa for which there are direct effects that may indirectly affect a listed species taxa.

### i. Listed Species Direct Effects

*Freshwater Fish and Amphibians*

For the proposed use of pyroxsulam on wheat, acute and chronic LOCs are not exceeded for freshwater fish and aquatic phase amphibians with all RQs ≤0.01.

*Freshwater Invertebrates*

For the proposed use of pyroxsulam on wheat, acute and chronic LOCs are not exceeded for freshwater invertebrates with all RQs ≤0.01.

*Estuarine/Marine Fish and Invertebrates*

No data were submitted regarding the toxicity of pyroxsulam to estuarine/marine fish or invertebrates. However, the risks to freshwater fish and invertebrates are expected to be low; this is due, in large part, to the lack of toxicity of pyroxsulam to representative species from these taxa. Although estuarine/marine fish and invertebrates are physiologically different than freshwater species, they would have to be thousands of times more sensitive than freshwater counterparts, which seems unlikely. Hence, direct effects to estuarine/marine fish and invertebrates is not expected.

*Aquatic Plants*

The listed species acute risk LOCs are not exceeded for vascular and non-vascular aquatic plants for the use of pyroxsulam on wheat. Therefore, direct effects to aquatic plants are not expected for the proposed use of pyroxsulam on wheat.

*Birds*

The listed species acute and chronic risk LOCs for birds, reptiles, and terrestrial-phase amphibians are not exceeded for the use of pyroxsulam on wheat applied at the maximum label rates. Both acute and chronic RQs are <0.01.

*Mammals*

Listed species acute risk LOCs (RQ ≥ 0.1) for direct effects of pyroxsulam on mammals are not exceeded for the proposed use of pyroxsulam on wheat; all acute RQs <0.01. Similarly, listed species chronic risk LOCs (RQ ≥ 1.0) are not exceeded for the proposed use of pyroxsulam on wheat.

*Terrestrial Plants*

Listed species acute risk LOCs (RQ≥1.0) for direct effects of pyroxsulam on semi-aquatic plants are exceeded for a single application for the proposed use of pyroxsulam with RQs ranging from 3.44-68.33 for dicots and monocots, respectively. In addition, for terrestrial plants exposed to pyroxsulam via spray drift, the listed species acute risk LOC is exceeded for monocots an dicots from both ground spray and aerial spray. Listed species acute risk LOCs are exceeded for terrestrial monocot plants adjacent to treated areas.

### ii. Probit Dose-Response Analysis

*Listed Animal Species Probability of Effects on Individuals*

The probability of individual effects at the acute endangered species LOC (RQ = 0.05 which is equivalent to 1/20 of the $LC_{50}$ or $EC_{50}$) for each major listed species' taxonomic group and the probability of individual effects at estimated acute RQs above the endangered species acute risk LOC is provided here. In addition, extrapolation of low probability events such as those occurring at the LOC, are associated with a high degree of uncertainty. Since an $LD_{50}$ or $LC_{50}$ could not be estimated for most aquatic or terrestrial animal species a slope value is not available. Assuming a default slope of 4.5, the probability of individual effects if exposures were to occur at the LOC for birds and mammals is 1 in 2.9E05; for freshwater fish and invertebrates the probability of individual effects is 1 in 4.2E08.

*Listed Plant Species Probability of Effects on Individuals*

For plants, a probit dose-response analysis is not conducted since the Tier II plant tests do not evaluate mortality ($LC_{50}$) and instead measures the inhibitory effects of a chemical; therefore it is difficult to estimate the probability that an individual will be affected.

### iii. Indirect Effects

Pesticides have the potential to cause indirect effects to endangered or threatened species by, for example, perturbing forage or prey availability, altering the extent of nesting habitat, *etc.* The potential for indirect effects is determined by comparing RQs to the listed and non-listed species LOCs. If the RQ exceeds the listed species LOC then there is the potential for indirect effects to listed species dependent on those species for which the RQ exceeded the listed species LOC. Similarly, if the RQ exceeds the non-listed species LOC there is the potential for indirect effects to listed species that are generally dependent on organisms from the taxa for which RQs exceed the LOC.

The screening-level analysis indicated that, for the proposed use on wheat, pyroxsulam has the potential to cause deleterious effects in exposed terrestrial and semi-aquatic plant species **(Section 4)**. Terrestrial plants had the highest RQs for both uses of pyroxsulam, ranging from 0.49-57.4. This suggests potential concern for indirect effects on listed terrestrial and aquatic organisms dependant upon these plant species as food items or as important habitat components. A potential drop in plant biomass associated with pyroxsulam use, for example, may significantly alter habitat suitability. While it is likely that plant communities can be repopulated by immigrants and living breeders after the use of pesticides, if the habitat is altered at a critical life-cycle juncture, over a large area or of if it is altered for long enough duration, some species may have difficulty surviving. Importantly, even if the plant biomass of a particular habitat is not significantly altered in the long-term, changes in plant community structure as a result of differential sensitivity to pyroxsulam could result in significant ecological changes. The toxicity data for pyroxsulam indicates that there are differences in the sensitivity of monocotyledonous and dicotyledonous plants and that there is variation in sensitivity within the tested species; this variability suggests that plant community structure could be significantly altered in habitats where pyroxsulam is present. Even if changes in habitat were not permanent, if they were to occur during a sensitive part of the life cycle, such as reproduction or development, significant indirect effects might be expected. A starting point for evaluating the potential risk of such scenarios would be to first identify listed species likely to occur in the proposed pyroxsulam use areas and their associated life histories and determine if use is likely to overlap with a sensitive life-cycle component. Overlap in this case, would consist of temporal and spatial co-occurrence of pyroxsulam use and species.

The information presented on indirect effects serves as a guide to establish the need for and extent of additional analyses that may be performed using Services-provided "species profiles" as well as evaluations of the geographical and temporal nature of the exposure to ascertain if a "not likely to adversely affect" determination can be made. The degree to which additional analyses are performed is commensurate with the predicted probability of adverse effects from the comparison of the dose-response information with the EECs. The greater the probability that exposures will produce effects on a taxa, the greater the concern for potential indirect effects for listed species dependant upon that taxa, and therefore, the more intensive the analysis on the potential listed species of concern, their locations relative to the use site, and information regarding the use scenario (*e.g.*, timing, frequency, and geographical extent of pesticide application).

#### iv. Listed Species Occurrence Associated with Pyroxsulam Uses

A preliminary analysis of the co-occurrence of listed plant species and the proposed use of pyroxsulam was conducted using OPP's LOCATES database (Version 2.10). 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. A tabulation of the number of unique listed plant species in each state associated with proposed uses of pyroxsulam is provided in **Table 4.10.**

Based the results of the LOCATES database query, there are a total of 134 listed species from all taxa associated with counties where pyroxsulam may potentially be used on wheat. A total of 8 states have listed species associated with crops on which pyroxsulam may be used. California has the highest number (72) of listed species that may co-occur with proposed pyroxsulam use areas. The taxa that has the highest number of listed species is dicot plants with a total of 40 unique species for all states for which there is a record of wheat cultivation.

In general, for all proposed uses of pyroxsulam there is at least one, and usually more, listed species that may potentially occur in or near a proposed use area. **Appendix G** lists the occurrence in each state of counties that have a listed species of specified taxa and the total list of endangered species that may co-occur with proposed uses of pyroxsulam and a comprehensive list of species in counties where pyroxsulam may be used. This preliminary analysis indicates that there is a potential for pyroxsulam 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 pyroxsulam and 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 4.10. Tabulation by State and Taxonomic Group of Listed Species that Occur in Pyroxsulam Use Areas for All Proposed Uses.**

| State | Amphibians | Arachnid | Birds | Bivalve | Conifer/cycads | Crustacean | Dicot | Ferns & allies | Fish | Gastropod | Insect | Lichen | Mammal | Monocot | Reptiles | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | 2 | | 3 | 30 | | 1 | 10 | 3 | 15 | 10 | | | 4 | 3 | 5 | |
| Arizona | 2 | | 7 | | | | 9 | | 15 | | | | 8 | 2 | 1 | |
| Arkansas | | | 2 | 5 | | 1 | 4 | | 2 | 1 | 1 | | 3 | | | |
| California | 6 | | 14 | | 1 | 9 | 116 | | 28 | 1 | 16 | | 18 | 14 | 7 | |
| Colorado | | | 2 | | | | 8 | | 6 | | 2 | | 2 | 1 | | |
| Connecticut | | | 1 | 1 | | | | | 1 | | | | | | | |
| Delaware | | | 1 | | | | | | 1 | | | | | | | |
| Florida | 1 | | 7 | 6 | 1 | | 22 | | 2 | | | 1 | 7 | 1 | 8 | |
| Georgia | 1 | | 4 | 15 | 1 | | 11 | 2 | 11 | | 1 | | 3 | 5 | 2 | |
| Idaho | | | 1 | | | | 3 | | 8 | 5 | | | 4 | | | |
| Illinois | | | 2 | 7 | | 1 | 7 | | 1 | 1 | 2 | | 2 | 2 | | |
| Indiana | | | 2 | 11 | | | 4 | | | | 2 | | 2 | 1 | 1 | |
| Iowa | | | 2 | 2 | | | 3 | 1 | 2 | 1 | | | 1 | 2 | | |
| Kansas | | | 3 | | | | 1 | | 4 | | 1 | | 2 | 1 | | |
| Kentucky | | | 6 | 22 | | 1 | 9 | | 5 | | 1 | | 3 | | | |
| Louisiana | | | 5 | 3 | | | 1 | 1 | 2 | | | | 2 | | 7 | |
| Maine | | | 2 | | | | 1 | | 1 | | | | 1 | 2 | | |
| Maryland | | | 1 | 1 | | | 4 | | 2 | | 2 | | 2 | 2 | 1 | |
| Massachusetts | | | 2 | | | | | | 1 | | 1 | | 1 | 1 | 1 | |
| Michigan | | | 2 | 2 | | | 4 | 1 | | | 4 | | 3 | 3 | 1 | |
| Minnesota | | | 1 | 2 | | | 2 | | 1 | | 1 | | 2 | 2 | | |
| Mississippi | 1 | | 5 | 8 | | | 2 | 1 | 3 | | | | 3 | | 7 | |
| Missouri | | | 2 | 6 | | 1 | 7 | | 7 | 1 | 2 | | 2 | 1 | | |
| Montana | | | 3 | | | | 2 | | 4 | | | | 3 | | | |
| Nebraska | | | 3 | | | | 2 | | 2 | | 1 | | 1 | 1 | | |
| Nevada | | | | | | | 7 | | 10 | | 1 | | | | 1 | |
| New Hampshire | | | | 1 | | | | | | | | | | | | |
| New Jersey | | | 2 | | | | 2 | | 1 | | | | 1 | 3 | 1 | |
| New Mexico | 1 | | 6 | | | 2 | 10 | | 8 | 5 | | | 2 | | | |
| New York | | | 2 | 1 | | | 3 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | |
| North Carolina | | 1 | 4 | 8 | | | 20 | | 4 | | 1 | 1 | 4 | 5 | 5 | |
| North Dakota | | | 3 | | | | | | 1 | | | | | 1 | | |
| Ohio | | | 1 | 6 | | | 4 | | 1 | | 4 | | 2 | 2 | 2 | |
| Oklahoma | | | 6 | 2 | | | | | 4 | | 1 | | 3 | 2 | | |
| Oregon | | | 4 | | | 1 | 11 | | 22 | | 2 | | 1 | 1 | | |
| Pennsylvania | | | 1 | 2 | | | | | | | | | 2 | 2 | 1 | |
| Rhode Island | | | 1 | | | | | | 1 | | | | | | | |
| South Carolina | 1 | | 4 | 1 | | | 12 | 1 | 1 | | | 1 | 4 | 6 | 5 | |
| South Dakota | | | 3 | | | | | | 2 | | 1 | | 1 | 1 | | |
| Tennessee | | 1 | 3 | 37 | | 1 | 15 | 1 | 15 | 3 | | 1 | 3 | 2 | | |
| Texas | 4 | 10 | 12 | | | 1 | 19 | | 8 | 1 | 9 | | 4 | 3 | 6 | |
| Utah | | | 2 | | | | 19 | | 8 | | | | 2 | 2 | 1 | |
| Vermont | | | | | | | | | | | | | 1 | 1 | | |
| Virginia | 1 | | 2 | 21 | | 2 | 12 | | 7 | 1 | 3 | | 5 | 4 | 1 | |
| Washington | | | 2 | | | | 7 | | 18 | | | | 4 | | | |
| West Virginia | 1 | | | 3 | | | 4 | | | 1 | | | 4 | 1 | | |
| Wisconsin | | | 3 | 2 | | | 4 | | | | 2 | | 2 | 2 | | |
| Wyoming | | | | | | | 2 | | | | | | 4 | | | |

### C. Description of Assumptions, Limitations, and Data Gaps

#### 1. Assumptions and Limitations Related to Exposure for All Taxa

This screening-level risk assessment relies on proposed labeled statements of the maximum rate of pyroxsulam application for use on spring and winter wheat. The label specifies that pyroxsulam is to be applied only once per growing season, which translates to once per year for these varieties of wheat. The frequency at which actual uses approach the maximum is dependant on agricultural conditions (presence of weeds) and market forces. Moreover, conditions can change from year to year as weed resistance changes through time. It is important to realize that while a certain use pattern may prevail at present; these patterns can change as a result of varying conditions.

#### 2. Assumptions and Limitations of Aquatic Exposure Estimates

The screening models PRZM and EXAMS are not designed to simulate real events or typical exposure. These models should simply indicate which chemicals surpass high-end levels of concern and warrant refinement of risk.

#### 3. Assumptions and Limitations of Terrestrial Exposure Estimates

##### a. Location of plant species

For screening-level risk assessments for terrestrial plants, all estimated exposures are for plants that occur off the treated field. Exposure is therefore a function of the amount of pesticide that leaves the treated area and enters surrounding habitat via spray drift, runoff, or both.

##### b. Routes of exposure

Screening-level risk assessments for spray applications of pesticides consider exposure to plants to occur either through soil mediated pathways or through topical application but not both. This is primarily due to the fact that submitted toxicity studies do not evaluate combined exposures. Moreover, the only way this would likely occur in the field is if there were multiple applications with root uptake occurring from left over residues of the first application and topical exposure ring occurs as a result of subsequent applications. Current approaches to assessing risks to plants do not take into account multiple applications; however, proposed uses for pyroxsulam are limited to single applications per year.

##### c. Incidental Pesticide Releases Associated with Use

This risk assessment is based on the assumption that the entire treatment area is subject to pyroxsulam application at the proposed application rates. In reality, there is the potential for uneven application of pyroxsulam through such plausible incidents as changes in calibration of application equipment, spillage, and localized releases at specific areas of the treated field that are associated with specifics of the type of application equipment used (*e.g.*, increased application at turnabouts when using older ground application equipment).

For this assessment, the default foliar dissipation half-life of 35 days (Willis and McDowell, 1987) was used to estimate decline in food-item residues as a function of time after application. Frequently, studies are available that allow an estimation of the foliar dissipation half-life for a given chemical. In this assessment, since no terrestrial animal RQs exceeded any LOCs, use of a foliar dissipation half-life specific to pyroxsulam would not have altered risk conclusions and hence was not used. For other uses, however, a pyroxsulam-specific foliar dissipation half-life may be important in more accurately characterizing potential risks.

### 4. Effects Assessment Assumptions and Limitation

#### a. Age Class and Sensitivity of Effects Thresholds

It is generally recognized that test organism age may have a significant impact on the observed sensitivity to a toxicant. Although this source of variability is perhaps most well documented in animal species, it may apply to plant species as well. However, toxicity studies are generally limited to young plants or seedlings limiting the ability to interpret the differential sensitivity of various stages. Further complicating this issue is that some plants have very complex life histories that have hardly been characterized from a toxicological perspective.

#### b. Lack of Effects Data for Amphibians and Reptiles

Currently, toxicity studies on amphibians and reptiles are not required for pesticide registration. Since these data are lacking, the Agency uses fish as surrogates for aquatic phase amphibians and birds as surrogates for terrestrial phase amphibians and reptiles. These surrogates are thought to be reflective of or protective (more sensitive) of herpetofauna. Amphibians are characterized by a permeable skin. The most important route of exposure for aquatic amphibians would likely be the dermal route. Using freshwater fish may be suitable surrogates since exposure would likely be surface area dependent and the gill surface of many fish is a fairly large surface area. Also, both fish and amphibians are ectothermic, so metabolic rates and demands would likely be similar. For terrestrial species, however, the difference between amphibians and birds and reptiles and birds is quite large. Terrestrial amphibians and reptiles are both ectothermic while birds are endothermic; birds have a higher basal metabolic rate required to maintain constant body temperature. The higher metabolic demands of birds may predispose birds to higher relative exposures. However, this does not address any potential differences in toxicity. To date, there are few controlled studies on reptile species that could be used to compare to similar studies on birds. *A priori*, there is no strong reason suggesting that one taxon is more or less sensitive than another. Further research is required to determine whether reptiles and terrestrial-phase amphibians are suitably represented by bird species in assessing risks.

#### c. Use of the Most Sensitive Species Tested

Although the screening risk assessment relies on a selected toxicity endpoint from the most sensitive species tested, it does not necessarily mean that the selected toxicity endpoints reflect the most sensitive species existing in a given environment. The relative position of the most sensitive species tested in the distribution of all possible species is a function of the overall variability among species to a particular chemical. The relationship between the sensitivity of the most tested species versus wild species (including listed species) is unknown and a source of significant uncertainty. The use of laboratory species has historically been driven by availability and ease of maintenance. A widespread comparison of species is lacking, however, even variation within a species can be quite high. Clark *et al.* (2004) conducted a fairly extensive review of available toxicity data on non-agricultural plants. The aim was to compare these toxicity data to data from typically used test species which are crop species. Although the authors identified several sources of uncertainty and variability that can complicate interpretation of results, they concluded that plants typically used for toxicity testing are at least as sensitive as non-crop species in 95% of the cases they evaluated. It is important to consider, however, that the available dataset on non-crop species is smaller than for crop species. Moreover, as mentioned previously, the complex and varied life history of plants, in general, may preclude a solid understanding of the relative sensitivities of plants used for toxicity testing and plants occurring in the wild.

### d. Data Gaps

The environmental fate and toxicology data requirements are not satisfied for a terrestrial food use. The submitted anaerobic aquatic metabolism, aerobic aquatic metabolism, and terrestrial field dissipation studies were supplemental and no anaerobic soil metabolism study was submitted. However, further submission of data may upgrade the submitted terrestrial field dissipation study. New anaerobic soil metabolism, anaerobic aquatic metabolism, and aerobic aquatic metabolism studies are not requested at this time because they are not expected to significantly alter risk conclusions.

Although no toxicity data were submitted for estuarine/marine animal species, the toxicity profile based on freshwater species and the physical properties of the chemical indicates that risks to estuarine/marine species are unlikely and that the toxicity data are not a requirement. However, without appropriate toxicity data, some uncertainty exists regarding the potential risks to estuarine/marine animal species associated with the proposed use of pyroxsulam on wheat.

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### A. Submitted Fate Studies

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MRID 46908336. Yoder, R. N., Cook, W. L., Meitl, T. J., Balcer, J. L., and Linder, S. J. 2006. Aerobic Aquatic Degradation of XDE-742 in Two European Sediment and Pond Water Systems. Study No. 030076. Performed and sponsored by Dow AgroSciences LLC, Indianapolis, IN. 8-Feb-2006.

MRID 47159601. Smith-Drake, J.K. 2004. Soil Batch Equilibrium Adsorption/ Desorption of $^{14}$C-XDE-742; amendment to MRID 46908332. Study No. 030069. Performed and sponsored by Dow AgroSciences LLC, Indianapolis, IN. 7-Apr-2004.

MRID 47202701. Yoder, R. N., Smith, K. P., and Balcer, J. L. 2007. Aerobic Degradation of XDE-742 in 4 European Soils Employing Exhaustive Extraction Methods. Study No. 060113. Performed and sponsored by Dow AgroSciences LLC, Indianapolis, IN. 11-May-2007.

MRID (pending). Byrne, S. L., Meitl, T. J., Crabtree, A. B., Linder, S. L., and Balcer, J. L. 2006. Aqueous Photolysis of XDE-742 in pH 7 Buffer Using a Xenon Lamp. Study No. 040002. Performed and sponsored by Dow AgroSciences LLC, Indianapolis, IN. 10-Feb-2006.

## APPENDIX A. Preliminary Data Screen.

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

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

**MEMORANDUM** **DATE:** October 24, 2006

**SUBJECT:** Preliminary Data Screen (DP Barcodes D333304, D333305 and D333306) of the Environmental Fate and Ecological Effects of XDE-742 (PC Code 108702)

**FROM:** Cheryl Sutton, Ph.D., Environmental Scientist
Thomas Steeger, Ph.D., Senior Biologist

**THRU:** Elizabeth Behl, Branch Chief
Environmental Risk Branch 4
Environmental Fate and Effects Division

**TO:** James Stone, Risk Manager Reviewer
Joanne Miller, Risk Manager
Registration Division

In a follow-up to the emails forwarded to the Registration Division on October 5, 2006, the Environmental Fate and Effects Division (EFED) has completed the preliminary screens of the environmental fate and ecological effect data submitted in support of the registration of XDE-742 (Pyroxsulam). Except for what appear to be a few minor discrepancies identified in **Attachment 1**, none of the ecological effect studies contain significant problems that would prevent their further review. Similarly, all of the environmental fate studies are deemed as reviewable; comments regarding each of the submitted studies are contained in **Attachment 2**. The ecological effect and environmental fate studies have been retrieved from the contractor, and EFED is awaiting the primary reviews from APVMA/Australia and PMRA/Canada, respectively.

**Attachment 1. Ecological Effect Data Screen**

**XDE-742**

| Guideline | MRID | Study Title | Problems |
|---|---|---|---|
| 71-1 | 469084-16 | XDE-742 / BAS 770 H – Avian Single-Dose Oral $LD_{50}$ on the Bobwhite Quail (*Colinus virgnianus*). | NP |
| 71-1 | 469084-17 | XDE-742 / BAS 770 H – Avian Single-Dose Oral $LD_{50}$ on the Mallard Duck (*Anas platyrhynchos*). | NP |
| 850.2200 (71-2b) | 469084-18 | XDE-742 – Dietary Toxicity Test with the Mallard Duck (*Anas platyrhynchos*). | NP |
| 850.2200 (71-2a) | 469084-19 | XDE-742 – Dietary Toxicity Test with the Northern Bobwhite Quail (*Colinus virginianus*). | NP |
| 850.2300 (71-4b) | 469084-20 | XDE-742: Reproductive Toxicity Test with the Mallard Duck (*Anas platyrhynchos*). | NP |
| 850.2300 (71-4a) | 469084-21 | XDE-742: Reproductive Toxicity Test with the Northern Bobwhite Quail (*Colinus virginiamus*). | NP |
| 72-1 | 469084-22 | XDE-742/BAS 770 H: Acute Toxicity Study On The Fathead Minnow (*Pimephales promelas*) In A Static System Over 96 Hours | NP |
| 72-1 | 469084-23 | XDE-742/BAS 770 H: Acute Toxicity Study On The Fathead Minnow (*Oncorhynchus mykiss*) In A Static System Over 96 Hours | NP |
| 72-1 | 469084-24 | 7-OH Metabolite of XDE-742- Acute Toxicity to Rainbow Trout (*Oncorhynchus mykiss*) Under Static Conditions | NP |
| 72-1 | 469084-25 | ASTA Metabolite of XDE-742: An Acute Toxicity Study with the Rainbow Trout, *Oncorhynchus mykiss* | NP |
| 72-2 | 469084-26 | 7-OH Metabolite of XDE-742- Acute Toxicity to Water Fleas, *Daphnia magna*, Under Static Conditions | NP |
| 72-2 | 469084-27 | ASTA Metabolite of XDE-742: An Acute Toxicity Study with the Daphnid, *Daphnia magna* | NP |
| 72-2 | 469084-28 | XDE-742: An Acute Toxicity Study with the Daphnid, *Daphnia magna* | NP |
| 72-4a | 469084-30; 469086-26 (registrant-prepared DER) | XDE-742: Toxicity to the Early-Life Stages of the Fathead Minnow, *Pimephales promelas.* | NP |
| 72-4b | 469084-29 | XDE-742: A 21-Day Chronic Toxicity Study with the Daphnid (*Daphnia magna*) | NP |

| | | | |
|---|---|---|---|
| 123-2 | 469084-31 | XDE-742-Growth Inhibition Test with Freshwater Blue-Green Alga (*Anabaena flos-aquae*) | Test material was detected at a concentration above the LOQ in the negative control at test termination; however, this was believed to be an error during analytical sampling. |
| 123-2 | 469084-32 | XDE-742-Growth Inhibition Test with Freshwater Diatom (*Navicula pelliculosa*) | NP |
| 850.4400 (123-2) | 469084-33 | 7-OH Metabolite of XDE-742- Toxicity to Duckweed, *Lemna gibba* | NP |
| 850.4400 (123-2) | 469084-34 | ADTP Metabolite of XDE-742- Toxicity to Duckweed, *Lemna gibba* | NP |
| 850.4400 (123-2) | 469084-35 | 5,7-Di-OH Metabolite of XDE-742- Toxicity to Duckweed, *Lemna gibba* | NP |
| 850.4400 (123-2) | 469084-36 | 5-OH Metabolite of XDE-742- Toxicity to Duckweed, *Lemna gibba* | NP |
| 850.4400 (123-2) | 469084-37 | 6-Cl-7-OH Metabolite of XDE-742- Toxicity to Duckweed, *Lemna gibba* | NP |
| 850.4400 (123-2) | 469084-38 | XDE-742 Sulfinic Acid Metabolite- Toxicity to Duckweed, *Lemna gibba* | NP |
| 850.4225 (123-1b) | 469084-39 | Effects of GF-1674 on Seedling Emergence and Seedling Growth on Non-Target Terrestrial Plants (Tier II)-2005 | NP |
| 850.4250 (123-1a) | 469084-40 | Effects of GF-1674 on the Vegetative Vigor on Non-Target Terrestrial Plants (Tier II)-2005 | NP |
| 123-2 | 469084-41 | XDE-742: Growth Inhibition Test with the Saltwater Diatom *Skeletonema costatum* | NP |
| 850.4400 (123-2) | 469084-42 | XDE-742: Growth Inhibition Test with the Aquatic Plant, *Lemna gibba* | NP |
| 123-2 | 469084-43 | XDE-742 Sulfinic Acid Metabolite- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | NP |
| 850.4400 (123-2) | 469084-44 | Inhibition of Growth of the Aquatic Plant Duckweed, *Lemna gibba*, Following One and Three Day Exposures to XDE-742 | NP |
| 123-2 | 469084-45 | XDE-742: Growth Inhibition Test with the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | NP |
| 123-2 | 469084-46 | ADTP Metabolite of XDE-742- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | NP |
| 123-2 | 469084-47 | 5-OH Metabolite of XDE-742- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | NP |
| 123-2 | 469084-48 | 6-Cl-7-OH Metabolite of XDE-742- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | NP |
| 123-2 | 469084-49 | 5,7-Di-OH Metabolite of XDE-742- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | NP |
| 123-2 | 469084-50 | 7-OH Metabolite of XDE-742- Acute Toxicity to the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | NP |

| | | | |
|---|---|---|---|
| 123-2 | 469084-51 | ASTA Metabolite of XDE-742: Growth Inhibition Test with the Freshwater Green Alga, *Pseudokirchneriella subcapitata* | NP |
| 850.4400 (123-2) | 469084-52 | ASTA Metabolite of XDE-742: Growth Inhibition Test with the Aquatic Plant Duckweed, *Lemna gibba* | NP |
| OECD 207 | 469085-04 | 5-OH Metabolite of XDE-742: An Acute Toxicity Study with the Earthworm in an Artificial Soil Substrate | NP |
| OECD 207 | 469085-05 | XR-742: 14 Day Soil Exposure Acute Toxicity to the Earthworm, *Eisenia foetida* | NP |
| OECD 207 | 469085-06 | 6-Cl-7-OH Metabolite of XDE-742: An Acute Toxicity Study with the Earthworm in an Artificial Soil Substrate | NP |
| OECD 207 | 469085-07 | 7-OH Metabolite of XDE-742: An Acute Toxicity Study with the Earthworm in an Artificial Soil Substrate | NP |
| OECD 213 & 214 | 469085-08 | Effects of XDE-742/ BAS770H (*Acute Contact and Oral*) on Honey Bees *Apis mellifera L.* In the Laboratory | NP |
| OECD 219 (Non-G) | 469085-09 | 7-OH Metabolite of XDE-742 – Chironomid Toxicity Test with Midge (*Chironomus riparius*) Under Static Conditions using Spiked Water. | NP |
| OECD 219 (Non-G) | 469085-10 | XDE-742: 28-Day Chronic Toxicity Study with the Midge, *Chironomus riparius*, Using Spiked Water in a Sediment-Water Exposure System. | Midge larvae were added to each vessel on the same day the vessels were spiked, and aeration was stopped for approx. 3 hours during and thereafter. |
| OECD 222 (Non-G) | 469085-11 | 6-Cl-7-OH Metabolite of XDE-742: A Reproduction Study with the Earthworm in an Artificial Soil Substrate | NP |
| None | 469085-12 | Herbicidal Activity of XDE-742 Soil Metabolites on Weeds and Crops in a Discovery Weed Management Level 3 Postemergence Screen | No quantitative data were provided on survival, plant height or dry weight. Therefore, this study cannot be considered for a traditional review as it only provides qualitative data on the injury to the plants from exposure to the test material and associated metabolites. |

NP= no problem

**Attachment 2. Environmental Fate Data Screen**

**New Chemical Screening Summary**
**Environmental Fate – XDE-742**

| Guideline | MRID | Study Title | Issues | Reviewable (Yes/No) |
|---|---|---|---|---|
| 161-1 | 469083-26 | Hydrolysis Study | No issues affecting the acceptability of the study were identified. | Yes |
| 161-2 | 469083-27 | Photodegradation in Water | At least one transformation product reacted with the buffer used in the primary experiment.<br>In a supplementary study using a different buffer (TRIS) included in this MRID, the buffer failed to adequately buffer and the pH of the solution decreased from pH 7 to pH 5.4-5.9. | Yes. The supplementary study appears to support the rate of degradation and the identification of transformation products. |
| 161-3 | 469083-28 | Photodegradation on Soil | No issues affecting the acceptability of the studies were identified. The rate of degradation in the dark control was much faster in the dark control than in the irradiated samples. | Yes |
| 161-4 | --- | Photodegradation in Air | --- | --- |
| 162-1 | 469083-29<br>469083-30<br>469083-35 | Aerobic Soil Metabolism | MRIDs 46908329 and 46908335 are companion studies, with MRID 46908335 intended only to provide additional information on the rate of dissipation of XDE-742. In MRID 46908335, only the concentration of XDE-742 was measured; material balance and transformation products were not addressed.<br><br>MIRD 46908330 was conducted using a transformation product. It was assumed that all extractable radioactivity was parent compound. | Yes |
| 162-2 | | Anaerobic Soil Metabolism | --- | --- |
| 162-3 | 469083-31 | Anaerobic Aquatic Metabolism | This study was defined by the registrant as anaerobic soil metabolism (162-2). However, it is an anaerobic aquatic metabolism study (162-3). The systems were incubated for 30 days under nitrogen prior to treatment. | Yes |
| 162-4 | 46908-36 | Aerobic Aquatic Metabolism | No issues affecting the acceptability of the studies were identified. | Yes |
| 163-1 | 469083-32<br>469083-33 | Mobility - Adsorption/Desorption | No issues affecting the acceptability of the studies were identified. | Yes |

| Guideline | MRID | Study Title | Issues | Reviewable (Yes/No) |
|---|---|---|---|---|
| 164-1 | 469083-34 | Terrestrial Field Dissipation | The study was conducted in Canada. | Yes |
| 164-2 | --- | Aquatic Sediment Dissipation | --- | --- |
| 164-3 | --- | Forestry Dissipation | ---. | --- |
| 165-4 | --- | Fish Accumulation | | --- |
| 165-5 | --- | Accumulation in Aquatic Non-target Organisms | ---. | --- |
| 166-1 | --- | Groundwater | --- | --- |
| N/A | 469083-16<br>469083-17 | *Other Special Studies* | Storage stability | MRID 469083-16 was conducted using cloquintocet-mexyl. This compound is the safener used with XDE-742 in the formulated product. |

Note: The majority of MRIDs include data for two label positions. Although the radiolabeled positions were studied in separate experiments, the study authors combine the data into the same tables. In several cases, averaged data rather than data for the individual samples/different radiolabels are provided, so it is difficult to confirm the material balance.

## APPENDIX B. Environmental Fate Data.

Detailed information regarding the fate and transport of pyroxsulam in the environment is provided in the study summaries below.

### 161-1. Hydrolysis

**MRID 46908326 (Acceptable)**
Hydrolysis of radiolabelled XDE-742 (labelled at a. the triazole ring and b. the pyridine ring) at 0.1 mg a.i/L was studied in the dark at 20 °C in sterile aqueous buffered solutions at pH 5 (sodium acetate buffer), pH 7 (TRIS buffer) and pH 9 (sodium tetraborate buffer) for 32 days. Samples were analysed at 0, 4, 7, 14, 21 and 32 days without extraction, and the XDE-742 residues were analysed by LSC and HPLC-radiochromatography (HLPC-RAM). There were no transformation products observed. At test termination, the concentration of the parent compound was 100 % in all three pH systems. There was no unidentified radioactivity and sample pH did not change throughout the study.

The half-life (lives)/ DT50 (50% décline times) of XDE-742 could not be determined in any of the three buffer systems studied as the parent compound was stable to hydrolysis.

### 161-2. Aqueous Photolysis

**MRID (pending) (Acceptable)**
The aqueous phototransformation of radiolabeled XDE-742 (labeled in the 2-C and 6-C position of the pyrimidine ring (PY-label) or in the 2-C position of the triazolopyrimidine portion (TP- label)) was studied at 20 °C in sterile aqueous pH 7 HEPES buffered solution at an initial concentration of 1 mg a.i./L. 15 days of continuous irradiation was employed using a xenon lamp. A supplemental experiment was carried out using pH 7 TRIS buffer as an attempt to circumvent problems arising from the reaction of the HEPES buffer with the 742-ADTP transformation product. Samples were analyzed at 0, 2, 4, 8, and 20 hours, and 2, 4, 7, and 15 days after treatment (DAT), and were analyzed directly by LSC and HPLC. Identification of transformation products was done by LC-MS/MS. Traps for the collection of $CO_2$ and organic volatiles were not used for the main test samples; a duplicate PY-labeled sample was irradiated for 15 days and used to determine the amount of volatile radioactivity at test termination. A PNAP/pyridine chemical actinometer solution was used to quantify the amount of light that the samples received, such that 1 day of continuous irradiation (DAT) was equated with 4.9 days of irradiation in the summer sun at 40° N latitude for that portion of the spectrum required for the study.

Material balance was 97.5 ± 4.6% of the applied radioactivity for the irradiated samples and 100.5 ± 1.2% applied radioactivity for the dark controls. No significant transformation occurred in the dark samples (100% of the applied radioactivity remained as parent at test termination), and the presence of unidentified products that were detected at low levels throughout the study likely results from (minor) contamination of the test material, not transformation.

In the irradiated samples, the concentration of the parent compound decreased from 99.0% at 0 DAT to 0.6% of the applied amount at 6.8 DAT. The parent compound was not detected at test termination (14.9 DAT). The two major transformation products detected in the irradiated samples were the 742-sulfinic acid (2-methoxy-4-(trifluoromethyl)pyridine-3-sulfinic acid) and 742-ADTP (5,7-dimethoxy[1,2,4]triazolo[1,4-α]pyrimidin-2-amine), with maximum concentrations of 79.2% and 39.8% of the applied amount, respectively, at 3.8 DAT. An additional 7.9% of the radiation was present as a 742-ADTP + HEPES adduct at this time. Both major transformation product concentrations decreased through the remainder of the study, to 45.0% and 23.6% of the applied amount at study termination. The minor transformation products in the irradiated samples were the 742-sulfonic acid (2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonic acid), which formed in the PY-labeled samples at levels too low to be quantified, and multiple unknown minor products. Volatiles were found to be 1.2% of the applied radioactivity in the surrogate test (examined only at 14.9 DAT). The total unidentified radioactivity at test termination was 2.2% and 49-69% of the applied radioactivity in the dark and irradiated samples, respectively.

The photodegradation mechanism of XDE-742 appears to be cleavage of the sulfonamide bridge, yielding the 742-sulfinic acid, which may then oxidize to produce the small quantities of 742-sulfonic acid observed, and the 742-ADTP. The major transformation products are then further transformed to multiple, low level components which could not be separated nor identified in the study.

The environmental photolytic half-life, derived from the measured half-life in laboratory under artificial lamp, is predicted to be 4.5 days at 40° N latitude in summer sunlight (0.91 days continuous irradiance in the laboratory), and the $t_{9/10}$ is predicted to be 14.7 days ($r^2$= 0.9957 for first order curve fit of non-zero concentration data).

The concentrations of the two major transformation products peaked at 3.8 DAT and were in decline by the end of the study (14.9 DAT). A supplemental study of the transformation of the 742-ADTP transformation product in three different solutions (pH 7 TRIS buffer, pH 7 HEPES buffer and HPLC-grade water) also gave an excellent fit to first-order kinetics ($r^2$= 0.9852- 0.9892), but the estimated $t_{1/2}$ for all three were between 22 and 23 days (approx 108-113 equivalent days at 40° N latitude in summer sunlight), which was in excess of the study duration of 15 days.

**Results Synopsis**

| | |
|---|---|
| Test medium: | 0.01 M HEPES buffer at pH 7 |
| Source of irradiation: | Xenon lamp |
| Half-life/DT50 for Dark: | no degradation occurred in the dark samples |
| Half-life/DT50 for phototransformation: | 0.91 days (laboratory); 4.5 days (expected at 40°N latitude in summer sunlight) |
| Major transformation products: | 742-ADTP, 742-sulfinic acid |
| Minor transformation products: | 742-sulfonic acid |

This study is a revision of and replaces MRID 46908327.

### 161-3. Soil Photolysis

**MRID 46908328 (Acceptable)**

The phototransformation of $^{14}C$-XDE-742 (two radiolabels: triazdopyrimidine and pyridine) was studied on a Charentilly silt loam soil (pH 6.2, organic carbon 1.0%) from France at 25 °C and 75% of 1/3 bar moisture using a xenon lamp as a light source. Samples, fortified at approximately 3 mg a.i./kg soil, were irradiated for up to the equivalent of 30 days of spring sunlight at 50° N latitude.

$^{14}C$-XDE-742 was applied in water on the soil surface by positive displacement pipette. The treated samples were irradiated by continuous irradiation using a 6500 W xenon arc lamp, with an inner CERA filter and an outer Soda Lime filter. Irradiated test vessels were connected to traps containing ascarite for the collection of $CO_2$ and acidic volatiles. Dark control samples were maintained in a dark incubator set at 25 °C. Samples were taken at 0, 1, 3, 7, 10, and 15 days after treatment for the determination of the parent compound and transformation products. The soil samples were extracted with 90:10 acetonitrile:0.1 N HCl and the $^{14}C$-XDE-742 residues were analyzed by HPLC. Soils were not sterilized.

A PNAP/pyridine (p-nitroacetophenone/pyridine) chemical actinometer solution was used to quantitate the amount of light that the samples received. Based on the PNAP/pyridine actinometer data, 15 DAT of irradiation was equivalent to 30 days of irradiation in the spring sun at 50° N latitude.

The mass balance was 97.1 ± 5.7% and 96.2 ± 4.8% in the dark and irradiated samples, respectively. At the test termination, approximately 31% of the applied $^{14}C$ remained as the parent XDE-742 in the dark samples. The major biotransformation products identified in the dark samples were 5-OH-XDE-742 and 7-OH-XDE-742 formed at approximately 9% and 11% of applied radiocarbon, respectively. The minor biotransformation product identified in the dark samples was the 7-OH-6-Cl-XDE-742 formed at approximately 4% of applied radiocarbon. At study termination, levels of the transformation products 5-OH-XDE-742 and 7-OH-XDE-742 in the dark control samples remained stable at approximately 9% and 11% of applied, respectively, while 6-Cl-7-OH-XDE-742 was increasing.

In the irradiated samples, concentration of the parent XDE-742 decreased from 98.5% at day 0 to 60.7% of the applied amount at test termination. Since the transformation products formed in the irradiated samples were less than 6% of applied, they were not conclusively identified. In irradiated samples, at the end of the study, less than 1% of the applied radioactivity was present in the ascarite traps as evolved $CO_2$ and acid gases.

Extractable $^{14}C$ residues decreased from 98.9% of the applied amount at day 0 to 56.9% and 75.6% of the applied amount at termination in the dark and irradiated samples, respectively. In the irradiated samples, non-extractable $^{14}C$ residues increased from 0.3% of the applied amount at day 0 to 16.2% of the applied at study termination. Non-extractable residues in the dark samples were 0.3% of the applied amount at day 0, and 39.0% of the applied amount at test termination. XDE-742 transformed into non-extractable residues and volatiles when irradiated. Characterization of these residues from irradiated samples showed that 68% of $^{14}C$ non-extractable residues are associated with the fulvic acid fraction. Approximately 6% and 18% are associated with the humic and acid humin fraction, respectively. For the dark control, 45%, 14% and 41% of the $^{14}C$ non-extractable residues were associated with the fulvic acid, humic acid and humin fraction, respectively. Unidentified radioactivity increased to 14.8% in the irradiated samples, however, no single transformation product was >6% in any single sample.

The transformation rate constants of XDE-742 in the dark and irradiated samples were 0.079 and 0.017 days$^{-1}$, respectively. The transformation rate in the dark was greater than the total (phototransformation + non-phototransformation) rate; therefore, a $k_{photolysis}$ could not be calculated. First order kinetic half-life values were 23 ($r^2$=>0.92) and 9 ($r^2$=>0.92) days for the light and dark samples, respectively. Since the soil samples were not sterilized, other possible routes of transformation such as biotransformation might have contributed to the transformation rates in this study.

**Results Synopsis**
Soil type: Charentilly silt loam
Source of irradiation: Xenon lamp
Half-life/$DT_{50}$ for dark: 9 days ($r^2$=>0.92)
Half-life/$DT_{50}$ for irradiated: 23 days ($r^2$=>0.92)

| | |
|---|---|
| Half-life/$DT_{50}$ for phototransformation: | Stable. (The metabolism rate in the dark was greater than the total (phototransformation + metabolism) rate; therefore, a $k_{photolysis}$ couldn't be calculated.) |
| Major phototransformation products: | None. |
| Minor phototransformation products: | None. |

### 162-1. Aerobic Soil Metabolism

**MRID 46908329 (Supplemental)**
The biotransformation of radiolabeled XDE-742 was studied in one French and three German soils; a Charentilly light clay (France), a LUFA 3A clay loam, a Borstel loamy sand, and a Bruch West sandy loam for 133 days after treatment (DAT). Samples were treated separately with $^{14}C$-XDE-742 radiolabeled at the 2 and 6 positions of the pyridine ring or at the 2-position of the triazolopyrimidine ring. XDE-742 was applied at the rate of 0.033 mg a.i./kg soil (equivalent to 25 g a.i./ha). Samples were incubated under aerobic conditions in the dark (20°C and 40% moisture holding capacity) for up to 4 months after treatment.

The test system consisted of two-chambered biometer flasks; one chamber containing 0.2 N NaOH for the collection of $CO_2$, and the other contained the treated soil. Samples were analysed at 0, 1, 3, 7, 14, 21, 29, 63, 94, and 133 days after treatment. One sample of each radiolabel was analysed at each time point. The soil samples were extracted three times with 90:10 acetonitrile: 1.0 N HCl and XDE-742 residues were analysed by HPLC. Five transformation products reaching concentrations of greater than 5% of the applied radioactivity were identified by a LC/MS comparison with authentic standards.

Average material balance values for the four tested soils were 99-101% of applied radioactivity. Several individual samples with recoveries less than 90% or greater than 110% of the applied radiocarbon were not used to determine transformation rates and their results were not reported.

The concentration of the parent compound decreased from approximately 100% at 0 DAT to less than 5% of the applied radioactivity at the end of study period.

XDE-742 aerobic soil transformation rates were calculated for all four tested soils. Half-lives ranged from 2 to 10 days on the four soils tested in this study. The corresponding $t_{9/10}$s ranged from 7 to 33 days.

Five transformation products reaching concentrations of greater than 5% of the applied radiocarbon were identified. The 5-OH-XDE-742 reached at a maximum concentration of 24% of the applied radiocarbon in the LUFA 3A clay loam at 3 DAT. The other four transformation products were observed at their maximum concentrations in the Charentilly light clay. The 7-OH-XDE-742 was observed at 13% of applied and the 6-Cl-7-OH-XDE-742 was observed at 26% of applied at 7 DAT. The transformation products cyanosulfonamide (CSF) and the pyridine sulfonic acid (PSA) reached their respective maximum concentrations of 8% and 6% of the applied at the 21-DAT and 1-month time points. All transformation products were observed at declining concentrations in all soil types at the end of the study period.

At the end of the study period, between 5 and 15% of the applied radioactivity was recovered in the gas traps and was identified as $CO_2$. Non-extractable residues (NER) accounted for up to 94% of the applied radioactivity, with 60-90% at study termination. The unidentified radioactivity was made up of several small, extractable transformation products in total accounting for less than 5% of the applied radiocarbon.

The degradation of $^{14}C$-XDE-742 at 10°C was studied on one soil, the Charentilly light clay. At 10°C, the $DT_{50}$ was 14 days compared to 4 days at 20 °C. XDE-742 degradation was greatly reduced on Charentilly light clay soil samples sterilized with gamma irradiation. In sterilized soil at 20 °C, XDE-742 was projected to have a $DT_{50}$ greater than 450 days (extrapolated beyond test duration of 133 days), indicating that the transformation of XDE-742 in the soil was microbially-mediated. Results in the Charentilly light clay soil also demonstrate a correlation between the rate of transformation of the parent and the formation of the NER. The NER is a result of incorporation of the radiocarbon into the soil biomass. After four months, the slower transformation rate at 10°C still led to essentially complete transformation of the parent and incorporation of the radiocarbon into the soil NER pool (parent was 2.1-2.6% and NER was 46.3-53.3%), while the untransformed parent was still readily extractable in the sterile soil (between 83.8 and 89.7% of the applied radioactivity remained as parent, while only 10.0 to 10.5% was NER).

**Results Synopsis:**

| Soil type | Half-life (days) | $t_{9/10}$ (days) |
|---|---|---|
| Charentilly | 3.8 | 12.6 |
| LUFA 3A | 2.1 | 6.8 |
| Borstel | 10.0 | 33.3 |
| Bruch West | 2.7 | 9.1 |

**Major transformation products:** 5-OH-XDE-742, 7-OH-XDE-742, 6-Cl-7-OH-XDE-742 (XDE-742 sulfonamide, formed in the supplementary study submitted).

**Minor transformation products:** cyanosulfonamide (CFS) and pyridine sulfonic acid (PSA).

This study is classified as supplemental, as multiple solvent systems were not employed in a reasonable extraction attempt; non-extractable [$^{14}$C]residues were measured at >10% of the applied by day 1, 3 or 7, were as high as 94%, and remained at 59-90% at study termination. A following study confirmed that multiple extraction procedures extracted up to 28.8% of the applied more than the extraction procedure of this study alone, which indicates that the results of this study are uncertain and should be superseded by those of the following study (Yoder *et al.*, 2007).

### 162-1. Aerobic Soil Metabolism

**MRID 46908335 (Unacceptable)**
The aerobic soil transformation rate of XDE-742 was determined in 16 soils from five countries. XDE-742 was applied at approximately 0.03 mg/kg to soil at 40% MHC (moisture holding capacity). This application rate is equivalent to the anticipated maximum label rate of 25 g a.i./ha. Samples were incubated in the dark at 20 °C under aerobic conditions for up to 1 month after treatment.

Samples were analyzed until XDE-742 concentrations were below the level of detection (LOD) for at least two time points or for up 1 month of incubation, whichever was shorter. An LOQ of 1.5 ng/g and an LOD of 0.5 ng/g were established. The soil samples were extracted with 90:10 acetonitrile:1.0 N HCl and the residues of XDE-742 were analyzed by LC/MS/MS.

$DT_{50}$ values ranged from 1 to 17 days; 12 of the 16 soils had $DT_{50}$ values of less than 5 days. The aerobic soil degradation rate of XDE-742 was uniformly rapid, regardless of soil type. No single soil property examined correlated with the degradation rate of XDE-742 on aerobic soil.

This study is classified as unacceptable, as no material balance was provided; degradates and non-extractable residues were not measured; and multiple solvent systems were not employed in a reasonable extraction attempt. In a submitted aerobic soil metabolism study conducted with the same extraction procedure on radiolabeled XDE-742, non-extractable [$^{14}$C]residues accounted for >10% of the applied by day 1, 3 or 7, were as high as 94%, and remained at 59-90% at study termination (MRID 46908329). Exhaustive extraction procedures performed in a supplemental study demonstrated that up to 28.8% of the applied in the non-extracted residues of the original study were extractable (Yoder *et al.*, 2007). Therefore, the degradation kinetics of XDE-742 and its degradates are uncertain in this study.

### 162-1. Aerobic Soil Metabolism

**MRID 47202701 (Acceptable)**
The biotransformation of radiolabeled XDE-742 was studied in one French and three German soils; a Charentilly clay loam (France), a LUFA 3A clay loam, a Borstel sandy loam, and a Bruch West sandy loam for 118 days after treatment (DAT). Samples were treated separately with $^{14}$C-XDE-742 radiolabeled at the 2 and 6 positions of the pyridine ring or at the 2-position

of the triazolopyrimidine ring. XDE-742 was applied at the rate of 0.033 mg a.i./kg soil (equivalent to 25 g a.i./ha). Samples were incubated under aerobic conditions in the dark (20°C and 40% moisture holding capacity) for up to 4 months after treatment. No sterile treatments were used.

The test system consisted of two-chambered biometer flasks; one chamber containing 0.2 N NaOH for the collection of $CO_2$, and the other contained the treated soil. Samples were analyzed at 0, 1, 4, 7, 14, 29, 42, 63, 82, 100, and 118 days after treatment. One sample of each radiolabel was analyzed at each time point. The soil samples were initially extracted three times with 90:10 acetonitrile: 1.0 N HCl. The acetonitrile extracts were neutralized and XDE-742 residues were analysed by HPLC after a concentration step.

Samples with more than 10% of the applied radioactivity unextracted after the initial extraction procedure were subjected to additional extractions. Samples were sequentially extracted 2x with 90:10 methanol: 5 N HCl, 2x with a borate aqueous buffer (pH ~ 10) and 2x with 90:10 methanol: 2 N NaOH. These extracts were neutralized and combined before concentration. The combined, concentrated extracts were analyzed by HPLC.

Material balance was 99-103% (100.6 $\pm$ 4.4%) of the applied amount. The concentration of the parent compound decreased from 95% of the applied amount at day 0, to 5% of the applied at the end of study period at all test sites. The DT50 and DT90 of XDE-742 in aerobic soil for all soil types ranged from 2.1 to 14.6 days, and from 6.8 to 48.4 days, respectively.

Two major and one minor transformation product identified by LC/MS in a previous XDE-742 aerobic soil biotransformation study were identified by reverse-phase HPLC retention time match with authentic standards. 5-OH-XDE-742 was detected at a maximum of 24.4% of applied radioactivity at day 4 in LUFA 3A clay loam, and had declined to less than 1% after 29 days. 6-Cl-7-OH-XDE-742 was detected at a maximum of 11% of the applied radioactivity in Charentilly clay loam on day 7, and had declined to 2.3% by study termination. The transformation product 7-OH-XDE-742 was observed at a maximum concentration of 7.9% of the applied radioactivity on day 14 in Borstel sandy loam, and had declined to 1.4% by study termination. Another major transformation product, not observed in the original study, was identified by LC/MS and comparison with an authentic standard of the XDE-742 sulfonamide. XDE-742 sulfonamide reached a maximum of 13.2% of application radioactivity at day 29 in Charentilly clay loam, and had declined to 8.6% at the end of the study. Two additional transformation products that reached 5% of applied in the original study, the cyanosulfonamide and the sulfonic acid of XDE-742, were not observed at concentrations above 4% of applied in this study.

At the end of the study period, up to 11% of the applied radioactivity was recovered in the caustic traps and was assumed to be $CO_2$. In all but the LUFA 3A clay loam, the TP-labelled traps consistently contained more radioactivity than the PY-labelled traps for the same time point. Conversely, higher amounts of radioactivity were extracted from the soil samples treated with PY-labelled XDE-742. XDE- 742 sulfonamide contains only the PY radiolabel and its appearance correlates with the higher percent extractable from the PY-labelled samples. Non-extractable residues (NER) accounted for 37.9-82.8% of the applied radioactivity, even after the exhaustive extraction procedures.

The first step in XDE-742 aerobic soil degradation is de-methylation of one of the two methoxy groups on the triazolopyrimidine (TP) ring system to 5-OH-XDE-742 or 7-OH-XDE-742. The 7-OH transformation product can then undergo chlorination to form 6-Cl-7-OH-XDE-742. Further degradation of the TP ring system occurs to give the cyanosulfonamide, sulfonamide and sulfonic acid transformation products. The terminal transformation products are $CO_2$ (minor) and bound residues (major).

**Results Synopsis:**

| Soil type | Half-life (days) | $t_{9/10}$ (days) |
|---|---|---|
| Charentilly | 3.7 | 12.4 |
| LUFA 3A | 2.1 | 6.8 |
| Borstel | 14.6 | 48.4 |
| Bruch West | 5.0 | 16.8 |

**Major transformation products:** 5-OH-XDE-742, 6-Cl-7-OH-XDE-742, and XDE-742-sulfonamide
**Minor transformation products:** 7-OH-XDE-742, cyanosulfonamide (CFS) and pyridine sulfonic acid (PSA).

### 162-1. Aerobic Soil Metabolism

**MRID 46908330 (Supplemental)**
The transformation product 5,7-di-OH-XDE-742 is a soil transformation product of XDE-742 that exceeded 5% of applied material in the anaerobic aquatic transformation study. This transformation product, however, was not observed in the aerobic soil study. As part of the registration process and to provide degradation kinetics data for environmental fate simulation models, however, it was necessary to determine the degradation rate of this metabolite in an aerobic soil test system.

The biotransformation of radiolabeled 5,7-di-OH-XDE-742 was studied in a Borstel loamy sand (pH 6.8, organic carbon 0.9%) from Nienburg, Germany, a Limburgerhof loamy sand (pH 7.1, organic carbon 0.8%) from Rheinland-Pfalz, Germany, a Charentilly light clay (pH 6.1, organic carbon 1.0%) from France, and a Speyer LUFA 3A sandy clay loam (pH 8.0, organic carbon 1.3%) from Baden-Württemberg, Germany. $^{14}C$-5,7-di-OH-XDE-742 was applied at a rate of 0.03 mg a.i./kg soil, equivalent to 25 g a.i./ha. This rate is equivalent to 1X the anticipated maximum use rate of 25 g a.i./ha of XDE-742 application. Samples were incubated for up to 14 days under aerobic conditions in the dark at 20 °C and 40% moisture-holding capacity.

The test system consisted of a two-chambered biometer flask with one chamber as a trap for the collection of $CO_2$ and the other chamber for the soil. Samples were analyzed at 0, 2, 8, and

22 hours, 3, 7, and 14 days after treatment. The soil samples were extracted with a methanol:water (25:75) solution containing 0.05 M ammonium acetate on a horizontal shaker at low speed. Residues of 5,7-di-OH-XDE-742 were analysed by LSC. Representative 0 and 2 hour samples were analyzed by HPLC. Material balance for the four soils averaged 97 ± 4% (range = 85% to 107%) of the applied radioactivity. The average concentration of the test compound decreased from 90% of the applied radioactivity at Day 0 to 7% of the applied at the end of the study period. A stepwise approach was used to evaluate the degradation kinetics for 5,7-di-OH-XDE-742. First, simple first-order (SFO) kinetics calculated a geometric mean $DT_{50}$ of 0.4 days and $DT_{90}$ of 1.3 days. Next, first order multi-compartment (FOMC) kinetics calculated a geometric mean $DT_{50}$ of 0.2 days and a $DT_{90}$ of 8 days. The FOMC was a better fit for the data because it had a better curve fit, a more random distribution of the residuals, and the fit passed the $\chi^2$ test at a lower error level.

No major or minor transformation products were identified. Averaged extractable $^{14}C$-residues decreased from 90% of the applied radioactivity at Day 0 to 7% of applied at the end of the study period. Averaged non-extractable $^{14}C$-residues increased from 9% of the applied amount at Day 0 to 83% of the applied at the end of the incubation period. At study termination, volatile transformation products accounted for up to 15% of the applied radioactivity.

**Results Synopsis:**

| Soil type | DT50 | DT 90 |
|---|---|---|
| Borstel loamy sand (Germany) | First-order multi-compartment (FOMC) kinetics calculated a geometric mean of 0.2 days (range: 0.1-0.37 days) | First-order multi-compartment (FOMC) kinetics calculated a geometric mean of 8 days (range: 3-15 days) |
| Limburgerhof loamy sand (Germany) | | |
| Charentilly light clay (France) | | |
| Speyer JUFA 3A sandy clay loam (Germany) | | |

Major transformation products: None identified.
Minor transformation products: None identified.

This study is classified as supplemental, as multiple solvent systems were not employed in a reasonable extraction attempt; non-extractable [$^{14}C$]residues were measured at >10% of the applied at 0-2 hours after treatment, were as high as 91%, and remained at 72-89% at study termination. Transformation products were not identified.

## 162-3. Anaerobic Aquatic Metabolism

**MRID 46908331 (Supplemental)**

The anaerobic biotransformation of radiolabeled XDE-742 was studied in a flooded soil system using a Charentilly soil from France (soil texture silt loam, pH 6.2, organic carbon 1.0%) and HPLC-grade water for 126 days in the dark at 20 °C. XDE-742 was applied at the rate of 0.02 mg a.i./L (0.033 mg a.i./kg). The soil/water ratio used was 5:8. The test system consisted of two-chambered biometer flasks with traps for the collection of $CO_2$. Anaerobicity of the soil was attempted by filling a sufficient layer of water over the soil and gently blowing nitrogen over the water to remove oxygen in the test system during dosing. Anaerobic conditions were maintained in soils ($E_h$ corrected to pH 7 = -134.3 to 54.2 mV). However anaerobic conditions could not be confirmed in the aqueous phase as $E_h$ 7 values were generally above the -100 mV criterion for anaerobicity stipulated by OECD Guideline No. 308 (mean $E_h$ 7 = -58.9 to 60.4), and dissolved oxygen levels ranged from 0.0 – 0.74 mg/L.

Samples were collected for analysis of parent and transformation products at 0, 1, 3, 7, 14, 30, 58, 74 or 78, and 126 days of incubation. At each time point the water and soil layers were transferred to a centrifuge tube and the layers were separated by centrifugation. Aliquots of the water were directly analyzed by LSC and HPLC and the soil samples were extracted on a horizontal shaker at low speed with 90:10 acetonitrile:1.0 N HCl. XDE-742 residues were analyzed by LSC and HPLC. Identification of the transformation products was initially performed by co-chromatography with authentic standards, and identifications were confirmed by LC/MS.

The test conditions outlined in the study protocol were maintained throughout the study. The total material balance in the water/soil system was 98.3 ± 2.3 % of the applied radioactivity. The mean total recovery of the radiolabeled material was 68.7 ± 10.6 % and 23.0 ± 3.9 % of the applied radioactivity in the water and soil, respectively. Extractable $^{14}C$ residues in the soil increased from 16.7% at Day 0 to 27.6% at Day 74/78, before declining to 22.1% of the applied radioactivity at the end of the incubation period. Non-extractable $^{14}C$ residues (NER) in the soil increased from 0.6% at Day 0 to 25.7% of the applied radioactivity at study termination. At the end of the study 0.1% of the applied radioactivity was present as $CO_2$.

The concentration of XDE-742 in water decreased from 80.5% at Day 0 to 71.6% at Day 30. After Day 30, concentration of XDE-742 decreased to 0% of the applied radioactivity at study termination. The concentration of XDE-742 in the soil increased from 16.7% at Day 0 to 24.9% at Day 30. After Day 30, concentration of XDE-742 decreased to 1.9% of the applied radioactivity at the end of the study period.

The major transformation products detected in water were 7-OH-XDE-742 and 5,7-diOH-XDE-742, with maximum concentrations of 48.6 % and 23.5 % of the applied amount, observed on the 58$^{th}$ day and 126$^{th}$ day of incubation, respectively. The corresponding concentrations in water at the end of the study were an average of 26.5 % and 23.1 % of the applied amount, respectively. The major transformation products detected in the soil were 7-OH-XDE-742 and 5,7-diOH-XDE-742, with maximum concentrations of 27.9 % and 4.4 % of the applied amount, observed on the 58$^{th}$ day and 126$^{th}$ day of incubation, respectively. The corresponding concentrations in soil at the end of the study were an average of 12.8 % and 4.1 % of the applied amount, respectively. No minor transformation products were identified in the water or the soil. The unidentified $^{14}C$ ranged from 0.0 to 3.3 % of the applied amount.

Kinetics calculations were not conducted because anaerobic conditions in the aqueous phase were not assured throughout the study. XDE-742 was stable through the first 30 days, when redox potentials were the lowest ($E_h$ 7 range -10.2 to -143.3 mV). However, the sudden decrease in parent concentrations after Day 30 coincided with an increase in aqueous redox potential (range +8.5 to -80.0 mV), suggesting that changes in aerobicity in the test system may have lead to rapid biotransformation.

**Results Synopsis:**
Test system used: Charentilly silt loam covered by HPLC-grade water

$DT_{50}$ in water: Not calculated
Half-life/$DT_{50}$ in sediment: Not calculated
Half-life/$DT_{50}$ in the entire system: Not calculated due to loss of anaerobicity in aqueous phase.
Major transformation products: 7-OH-XDE-742, 5,7-di-OH-XDE-742, NER
Minor transformation products: $CO_2$

This study is classified as supplemental, as anaerobic conditions were not assured and maintained. Dissolved oxygen was measured at all sampling times other than day 30 and redox potentials were unreasonably high. Also, multiple solvent systems were not employed in a reasonable extraction attempt.

XDE-742 did not significantly degrade through the first 30 days, when redox potentials were the lowest ($E_h$ 7 range -10.2 to -143.3 mV). However, a sudden decrease in parent concentrations after Day 30 coincided with an increase in aqueous redox potential (range +8.5 to -80.0 mV), suggesting that changes in aerobicity in the test system may have lead to rapid biotransformation. Therefore, XDE-742 is assumed stable in anaerobic aquatic systems.

### 162-4. Aerobic Aquatic Metabolism

**MRID 46908336 (Supplemental)**
The aerobic biotransformation of $^{14}C$- radiolabeled XDE-742 was studied in two pond water/sediment systems. One system was collected in England and one in France. The English test system consisted of pond water (pH 8.3), and sediment (sandy clay loam, pH 7.3, and organic carbon 2.2%). The French test system consisted of pond water (pH 8.1), and sediment (sand, pH 4.8, and organic carbon 2.9%). Samples were prepared in glass centrifuge tubes so that the sediment and water depths were approximately 2 and 6.0 cm, respectively. The test material was applied to the aqueous layer at a rate of 0.02 mg a.i./L. Samples were incubated in the dark at 20°C for up to 101 days after treatment.

Moist sediment was weighed into 55-mL centrifuge tubes. On an oven-dry basis, approximately 8 g or 11 g were weighed out for the English and French samples, respectively. Each sample was flooded with approximately 20 mL of pond water and pre-incubated for two weeks before dosing.

Samples were incubated using a flow-through system, in which moist air was passed through the samples continuously. The samples were connected to 0.2 M NaOH traps to capture any volatile degradates. Samples were analyzed after 0, 3, 7, 17, 33, 54, 75 and 101 days of incubation. The water layer was decanted and analyzed by LSC and reverse phase HPLC and the sediment samples were extracted with 90:10 acetonitrile: 0.1 N HCl. Extractable residues were analyzed by LSC and reverse phase HPLC. Identification of the transformation products was performed by LC/MS comparison with authentic standards.

Material balance for the total English system was 98.7 ± 4.2% (91.0% to 106.9%) of the applied radioactivity. The concentration of XDE-742 in water decreased from 103.9% of the applied radioactivity at Day 0 to less than 5% at experimental termination. The concentration of XDE-742 in sediment increased from approximately 1% at Day 0 to 13% at Day 75.

Material balance for the French system was 96.3 ± 4.5% (90.0% to 105.7%) of the applied radioactivity. The concentration of XDE-742 in water decreased from approximately 90% of the applied at Day 0 to less than 15% at Day 101. The concentration of XDE-742 in sediment decreased from approximately 16% of the applied radioactivity at Day 0 to less than 10% of applied at Day 75.

The major transformation products detected in the water were XDE-742 ATSA, which reached a maximum concentration of 10% at Day 54 and 7-OH-XDE-742, which reached 33% of the applied radioactivity at Day 17. Both transformation products reached their maximum aqueous concentration in the French sediment system. ATSA and 7-OH reached their maximum concentrations in the English water column of approximately 5% and 30%, respectively, at Day 33. A third peak, with a retention time of 14.7 minutes (more polar than XDE-742 ATSA), was observed at a maximum of 11% of the applied radioactivity at Day 75 in the English water column. This peak was also observed at 4% at Day 54 in the French water column.

The major transformation products detected in the sediment were 7-OH-XDE-742, and an unknown peak, reaching concentrations of 26% at Day 17 and 13% at Day 33, respectively in the French sediment. XDE-742 ATSA was observed at a maximum concentration of 5% of the applied radioactivity at Day 75 in the French sediment. ATSA accounted for less than 2% of the applied radiocarbon in the English sediment at any time point while 11% of the applied radioactivity was recovered as 7-OH at Day 33 in the English sediment. The unknown peak accounted for 10% of the applied radioactivity at Day 33 in the English sediment.

XDE-742 ATSA reached a total system maximum concentration of 6% of applied at Day 33 in the English system and 13% of applied at Day 54 in the French system. The maximum total concentration of 7-OH-XDE-742 was 40% at Day 33 in the English system and 58% of applied at Day 17 in the French system. The unknown transformation product reached a total system maximum concentration of 16% of the applied radiocarbon at Day 101 in the English system and Day 33 in the French system. No other unidentified transformation products accounted for more than 5% of the applied radioactivity in the total system.

Numerous attempts to generate sufficient mass of the unknown transformation product for identification efforts were unsuccessful. This unknown transformation product could be considered an anomaly generated under a very specific set of physico-chemical parameters in these sediment-water systems that were not re-created. The transformation product could be a metastable compound that can exist under anaerobic conditions but is unstable under aerobic conditions, as was observed for the related sulphonamide flumetsulam (7).

The English sediment extractable residues increased from approximately 1% at Day 0 to 12% of applied at the end of incubation period. The French sediment extractable residues accounted for 4-16% at Day 0 and approximately 30% of applied radioactivity at the end of incubation period. English sediment non-extractable residues increased from less than 1% at Day 0 to approximately 70% of the applied amount at the end of the study. French sediment non-extractable residues increased from less than 1% at Day 0 to approximately 35% of the applied amount at Day 101. The caustic traps all contained less than 3% of the applied radioactivity.

First-order $DT_{50}$ values of 24 and 12 days were calculated for XDE-742 in the entire English and French systems, respectively. $DT_{50}$ values of 21 and 14 days were observed in the aqueous and sediment phases of the English system while $DT_{50}$ values of 11 and 21 days were calculated in the French aqueous and sediment layers. Total system $DT_{50}$ values for 7-OH-XDE-742 were 12 (English system) and 42 days (French system). Total system $DT_{50}$ values for XDE-742 ATSA were 71 (English system) and 22 days (French system).

**Results Synopsis:**

| Test System | $DT_{50}$ (days) | $DT_{90}$ (days) |
|---|---|---|
| English : | | |
| XDE-742 Total System | 23.6 | 78.3 |
| Water phase | 20.6 | 68.3 |
| Sediment phase | 14.4 | 47.8 |
| 7-OH-XDE-742 Total System | 15.8 | 52.4 |
| Water phase | 17.9 | 59.3 |
| Sediment phase | 9.7 | 32.2 |
| XDE-742 ATSA Total System | 71.4 | 237.2 |
| French : | | |
| XDE-742 Total System | 11.9 | 39.5 |
| Water phase | 10.6 | 35.2 |
| Sediment phase | 20.6 | 68.5 |
| 7-OH-XDE-742Total System | 42.4 | 140.9 |
| Water phase | 50.5 | 167.9 |
| Sediment phase | N/A | N/A |
| XDE-742 ATSA Total System | 22.0 | 73.1 |

N/A—Degradation rate in sediment only could not be determined for 7-OH-XDE-742 because the concentration of the metabolite in the sediment was not declining at experimental termination.
Due to the paucity of data available, only a total system degradation rate could be determined for XDE-742 ATSA in either test system.

**Major transformation products:** 7-OH-XDE-742, XDE-742 ATSA and an unknown compound more polar than XDE-742 ATSA.
**Minor transformation products:** No minor transformation products were identified.

This study is classified as supplemental, as multiple solvent systems were not employed in a reasonable extraction attempt; non-extractable [$^{14}$C]residues were measured at >10% of the applied by day 17 or day 33 and were 42-73% at study termination. A following study of the submitted aerobic soil metabolism study confirmed that multiple extraction procedures extracted up to 28.8% of the applied more than the extraction procedure of this study alone, which indicates that the results of this study are uncertain (Yoder *et al.*, 2007).

### 163-1. Batch Equilibrium

**MRID 47159601 (Acceptable)**
The adsorption/desorption characteristics of radiolabelled XDE-742 were studied in twenty soils of varying textures, organic matter contents and pHs in a batch equilibrium experiment. A preliminary (Tier 2) study was conducted using 16 European soils, 2 U. S. soils, and 2 Canadian soils to determine Kd values. Based on the results of the preliminary test, the definitive (Tier 3) isotherm test was conducted at a 1:5 soil:solution ratio with 10 European soils. The adsorption phase of the definitive isotherm study was carried out by equilibrating fresh soil with XDE-742 at 0.025, 0.050, 0.125, 0.250 and 0.500 µg a.i./g soil (or, 0.005, 0.010, 0.025, 0.05 and 0.1 µg a.i./mL) in the dark at 25 °C for 72 hours. The equilibration solution used was 0.01 M $CaCl_2$, with a soil:solution ratio of 1:5. The desorption phase of the study was carried out by adding approximately the amount of 0.01 M $CaCl_2$ removed for adsorption and equilibrating in the dark at 25 °C for 24 hours. The samples were desorbed once. The supernatant solution after adsorption and desorption was separated by centrifugation and the XDE-742 residues were analyzed by HPLC with fraction collection. The fractions were then assayed by LSC. The soils were extracted three times with 90:10 acetone:0.1 N HCl. The extracts were concentrated using a turbo evaporator and analyzed by HPLC fitted with a fraction collector. The $^{14}$C residue remaining in the soil after extraction was determined by combustion.

For the definitive isotherm study, $K_d$ and $K_{OC}$ values were re-calculated by the PMRA by combining data from both replicates into a single adsorption isotherm and by using single-point desorption isotherms from the highest test concentration. For the adsorption phase, the average $K_d$ value for the ten soils was 0.57 mL/g (range 0.19 to 1.76 mL/g); the corresponding average $K_{OC}$ values were 30.0 mL/g (range 7.1 to 54.3 mL/g). Following a single desorption cycle, the average $K_d$ value for the ten soils was 0.42 mL/g (range 0.13 to 1.27 mL/g); the corresponding average $K_{OC\text{-}des}$ value was 22.3 mL/g (range 5.0 to 46.0 mL/g).

When adsorption Koc values are plotted against the pH of the soil, the inverse relationship between Koc and pH is apparent. Since Koc is simply Kd/soil organic carbon content, this shows that pH is a good indicator of XDE-742 adsorption provided that the influence of organic carbon is also considered. In other words, adsorption of XDE-742 is influenced by both pH and soil organic carbon content, as the soil pH decreases the Koc value increases.

Freundlich adsorption isotherm plots were also generated by the PMRA reviewer for the definitive isotherm data. Freundlich adsorption correlation coefficients ranged from 0.809 to 0.995, and 1/n values from 0.93 to 1.21. Adsorption $K_F$ values ranged from 0.18 to 1.60 $\mu g^{1-1/n}$ $mL^{1/n}$ $g^{-1}$, and corresponding $K_{FOC\text{-}ads}$ values ranged from 7.2 to 68.0 $\mu g^{1-1/n}$ $mL^{1/n}$ $g^{-1}$, respectively. Freundlich desorption correlation coefficients ranged from 0.883 to 0.999, and 1/n values ranged from 0.33 to 0.86. Desorption $K_F$ values ranged from 0.04 to 0.51 $\mu g^{1-1/n}$ $mL^{1/n}$ $g^{-1}$, and corresponding $K_{FOC\text{-}des}$ values ranged from 1.0 to 18.0 $\mu g^{1-1/n}$ $mL^{1/n}$ $g^{-1}$, respectively.

Adsorption of XDE-742 in the range of soils tested is generally linear with respect to concentration (*i.e.*, the majority of the slopes of the Freundlich adsorption coefficients [1/n] fall within the range of 0.9 - 1.1). Therefore, adsorption can be described using non-Freundlich $K_{oc\text{-}ads}$ values. Based on the PMRA-calculated adsorption coefficients in the ten soils used in the definitive study (average $K_{OC\text{-}ads}$ = 29.97 mL/g [range 7.09 to 54.26 mL/g]), XDE-742 Technical can be considered very highly mobile according to the classification criteria of McCall *et al.* (1981) and considered mobile to highly mobile according to the FAO classification shceme (FAO, 2000). Desorption coefficients (average $K_{OC\text{-}des}$ = 22.3 mL/g [range 5.0 to 46.0 mL/g]), indicate that XDE-742 does not bind irreversibly with soil, and can readily desorb.

**PMRA Results Synopsis:**

| | | Adsorption - PMRA Values | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Freundlich | | | | Non-Freundlich | | |
| Soil | pH[a] | $r^2$ | 1/n | $K_{F\text{-}ads}$[b] | $K_{FOC\text{-}ads}$[b] | $r^2$ | $K_{d\text{-}ads}$[c] | $K_{OC\text{-}ads}$[c] |
| M641 | 6.2 | 0.990 | 1.01 | 0.50 | 55.4 | 0.990 | 0.49 | 54.3 |
| M642 | 7.8 | 0.984 | 0.94 | 0.24 | 9.7 | 0.993 | 0.29 | 11.8 |
| M644 | 7.7 | 0.837 | 0.93 | 0.18 | 22.7 | 0.422 | 0.22 | 27.8 |
| M645 | 7.8 | 0.809 | 1.21 | 0.29 | 22.6 | 0.800 | 0.20 | 15.0 |
| M646 | 5.9 | 0.979 | 0.93 | 1.04 | 38.6 | 0.957 | 1.32 | 48.9 |
| M649 | 7.6 | 0.948 | 0.98 | 0.27 | 7.1 | 0.810 | 0.27 | 7.1 |
| M650 | 5.4 | 0.995 | 0.96 | 1.60 | 43.3 | 0.992 | 1.76 | 47.7 |
| M660 | 6.3 | 0.913 | 0.97 | 0.29 | 28.9 | 0.684 | 0.28 | 28.5 |
| M661 | 5.7 | 0.963 | 1.11 | 0.88 | 68.0 | 0.989 | 0.67 | 51.2 |
| M662 | 7.9 | 0.931 | 0.98 | 0.19 | 7.4 | 0.894 | 0.19 | 7.5 |

[a] soil pH
[b] $\mu g^{1-1/n} mL^{1/n} g^{-1}$
[c] $mLg^{-1}$

| | | Desorption - PMRA Values | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Freundlich | | | | Non-Freundlich | | |
| Soil | pH[a] | $r^2$ | 1/n | $K_{F\text{-}des}$[b] | $K_{FOC\text{-}des}$[b] | $r^2$ | $K_{d\text{-}des}$[c] | $K_{OC\text{-}des}$[c] |
| M641 | 6.2 | 0.986 | 0.50 | 0.15 | 17 | 0.997 | 0.41 | 46 |
| M642 | 7.8 | 0.998 | 0.86 | 0.21 | 8 | 0.990 | 0.28 | 11 |
| M644 | 7.7 | 0.996 | 0.34 | 0.04 | 4 | 0.998 | 0.13 | 16 |
| M645 | 7.8 | 0.883 | 0.47 | 0.06 | 4 | 0.841 | 0.18 | 14 |
| M646 | 5.9 | 0.987 | 0.35 | 0.25 | 9 | 0.977 | 0.81 | 30 |
| M649 | 7.6 | 0.982 | 0.33 | 0.05 | 1 | 0.947 | 0.18 | 5 |
| M650 | 5.4 | 0.998 | 0.54 | 0.51 | 14 | 0.996 | 1.27 | 34 |
| M660 | 6.3 | 0.999 | 0.36 | 0.05 | 5 | 0.997 | 0.18 | 18 |
| M661 | 5.7 | 0.998 | 0.56 | 0.24 | 18 | 0.998 | 0.56 | 43 |
| M662 | 7.9 | 0.983 | 0.37 | 0.04 | 2 | 0.933 | 0.15 | 6 |

[a] soil pH
[b] $\mu g^{1-1/n} mL^{1/n} g^{-1}$
[c] $mLg^{-1}$

This study is a revision of and replaces MRID 46908332.

### 163-1. Batch Equilibrium

**MRID 46908333 (Supplemental)**
The adsorption characteristics of radiolabeled XDE-742 transformation products 5-OH-XDE-742, 7-OH-XDE-742, 5,7di-OH-XDE-742, 6-Cl-7-OH-XDE-742, XDE-742 sulfonic acid, and XDE-742 cyanosulfonamide were studied in four soil types: a Charentilly loam (pH 6.3, 1.0% organic carbon) from France, a Speyer LUFA 3A sandy loam (pH 7.8, 2.5% organic carbon) from Germany, a Borstel loamy sand (pH 5.7, 1.3% organic carbon) from Germany, and a Bruch West sandy loam (pH 7.9, 2.5% organic carbon) from Germany. Soil samples were sterilized by gamma radiation prior to treatment with test material. Samples were sterilized to eliminate microbial degradation during the sorption tests.

To determine the soil: solution ratio, a preliminary study (Tier 1) was conducted. The adsorption phase of the study was carried out by equilibrating sterile soil with each transformation product in solution at nominal concentrations of 0.01 µg/mL solution in the dark at 25 °C. The equilibrating solution used was 0.01 M $CaCl_2$, with soil: solution ratios of 1:2, 1:5 and 1:10. Samples were equilibrated for 2, 4, 8, 24 and 48 hours. Based on the results of the preliminary testing, a soil: solution ratio of 1:2 was selected for the subsequent experiments.

The objectives of the definitive test were to determine the $K_d$ and $K_{oc}$ of the six transformation products in the four soils. The adsorption phase of the study was carried out by equilibrating sterile soil with each transformation product in solution at nominal concentrations of 0.01 µg/mL solution in the dark at 25°C. The equilibrating solution used was 0.01 M $CaCl_2$, with a soil: solution ratio of 1:2. Samples were equilibrated for 2, 4, 8, 24 and 48 hours, except for the 5,7-dihydroxy-XDE-742.

Soil and aqueous phases were separated by centrifugation after the desorption step. Selected soil samples were extracted twice with 90:10 (v:v) acetonitrile: 0.1 N HCl, centrifuged, and the extracts decanted and combined. The aqueous solution and organic extracts were assayed by LSC. $^{14}C$-residue remaining in the soil after extraction was determined by oxidative combustion. For the definitive adsorption study using these transformation products, the average adsorption $K_d$ value for four soils and the corresponding average $K_{oc}$ values were calculated.

Representative samples of each type were analyzed by HPLC to determine stability of the test materials over the course of the study. The % purity for 5-OH-XDE-742, 6-Cl-7-OH-XDE-742, XDE-742 sulfonic acid and XDE-742 cyanosulfonamide metabolite samples did not change over the course of the study, proving their stability through the adsorption and extraction phases. 7OH-XDE-742 did show degradation over the course of the study. Also, 5,7-di-OH-XDE-742 had a low purity at the beginning of the experiment. All calculations were made on the assumption that 100% of the extractable $^{14}C$-material was the starting test material and would therefore present the worst case scenario for the adsorption calculations.

The average mass balance for 6-Cl-7-OH-XDE-742 in all four soils at the end of the adsorption phase was 100.5 ± 1.6% of the applied. The average mass balance in all four soils at the end of the adsorption phase was 99.6 ± 4.8% of the applied for 5-OH-XDE-742. The average mass balance in all four soils at the end of the adsorption phase was 101.4 ± 0.8% of the applied for 7OH-XDE-742. The average mass balance in all four soils at the end of the adsorption phase was 101.7 ± 3.1% of the applied for 5,7-di-OH-XDE-742. The average mass balance in all four soils at the end of the adsorption phase was 101.9 ± 2.8% of the applied for XDE-742 cyanosulfonamide. The average mass balance in all four soils at the end of the adsorption phase was 107.2 ± 1.9% of the applied for XDE-742 sulfonic acid.

After 48 hours of equilibration, an average of 81.3%, 83.4%, 66.1% and 85.5% of the applied 6-Cl-7-OH-XDE-742 was recovered in the adsorption solution for the Charentilly loam, the Speyer LUFA 3A sandy loam, the Borstel loamy sand and the Bruch West sandy loam, respectively. An average of 92.9%, 96.5%, 86.2% and 97.4% of the applied 5-OH-XDE-742 was recovered in the adsorption solution for the Charentilly loam, the Speyer LUFA 3A sandy loam, the Borstel loamy sand and the Bruch West sandy loam, respectively. An average of 70.1%, 71.2%, 59.3% and 80.4% of the applied 7-OH-XDE-742 was recovered in the adsorption solution for the Charentilly loam, the Speyer LUFA 3A sandy loam, the Borstel loamy sand and the Bruch West sandy loam, respectively. An average of 26.7%, 60.0%, 25.4% and 59.3% of the applied 5,7-di-OH-XDE-742 was recovered in the adsorption solution for the Charentilly loam, the Speyer LUFA 3A sandy loam, the Borstel loamy sand and the Bruch West sandy loam, respectively. An average of 97.9%, 100.4%, 97.8% and 100.5% of the applied XDE-742 cyanosulfonamide was recovered in the adsorption solution for the Charentilly loam, the Speyer LUFA 3A sandy loam, the Borstel loamy sand and the Bruch West sandy loam, respectively. An average of 102.8%, 102.4%, 100.7% and 101.7% of the applied XDE-742 sulfonic acid was recovered in the adsorption solution for the Charentilly loam, the Speyer LUFA 3A sandy loam, the Borstel loamy sand and the Bruch West sandy loam, respectively.

The average 6-Cl-7-OH-XDE-742 adsorption $K_d$ value was 0.571 mL/g; the average $K_{oc}$ value was 40 mL/g (very high mobility). The average 5-OH-XDE-742 adsorption $K_d$ value was 0.151 mL/g; the average Koc value was 11 mL/g (very high mobility). The average 7-OH-XDE-742 adsorption Kd value was 0.903 mL/g; the average $K_{oc}$ value was 62 mL/g (high mobility). The average 5,7-di-OH-XDE-742 adsorption $K_d$ value was 3.556 mL/g; the average $K_{oc}$ value was 280 mL/g (moderate mobility). The average XDE-742 cyanosulfonamide adsorption $K_d$ value was 0.073 mL/g; the average $K_{oc}$ value was 7 mL/g (very high mobility). The average XDE-742 sulfonic acid adsorption $K_d$ and $K_{oc}$ values were <LOD (very high mobility).

**Results Synopsis:**

| **Soil type:** | **Charentilly Loam** | **Speyer LUFA 3A Sandy Loam** | **Borstel Loamy Sand** | **Bruch West Sandy Loam** |
|---|---|---|---|---|
| | 6-Cl-7-OH-XDE-742 | | | |
| Amount adsorbed [a]: | | | | |
| Adsorption Kd (mL/g): | 0.473 | 0.404 | 1.057 | 0.350 |
| Adsorption Koc (mL/g): | 47 | 16 | 81 | 14 |
| Average $K_{OC\text{-}ads}$ (± S.D.) (mL/g) | 40 (30) | | | |
| Mobility Classification* | Very high | | | |
| | 5-OH-XDE-742 | | | |
| Amount adsorbed [a]: | | | | |
| Adsorption Kd (mL/g): | 0.156 | 0.073 | 0.322 | 0.053 |
| Adsorption Koc (mL/g): | 16 | 3 | 22 | 2 |
| Average $K_{OC\text{-}ads}$ (± S.D.) (mL/g) | 11 (8) | | | |
| Mobility Classification* | Very high | | | |
| | 7-OH-XDE-742 | | | |
| Amount adsorbed [a]: | | | | |
| Adsorption Kd (mL/g): | 0.877 | 0.823 | 1.408 | 0.502 |
| Adsorption Koc (mL/g): | 88 | 33 | 108 | 20 |
| Average $K_{OC\text{-}ads}$ (± S.D.) (mL/g) | 62 (39) | | | |
| Mobility Classification* | High | | | |
| | 5,7-di-OH-XDE-742 | | | |
| Amount adsorbed [a]: | | | | |
| Adsorption Kd (mL/g): | 5.572 | 1.333 | 5.923 | 1.396 |
| Adsorption Koc (mL/g): | 557 | 53 | 456 | 56 |
| Average $K_{OC\text{-}ads}$ (± S.D.) (mL/g) | 280 (255) | | | |
| Mobility Classification* | Moderate | | | |
| | XDE-742 cyanosulfonamide | | | |
| Amount adsorbed [a]: | | | | |
| Adsorption Kd (mL/g): | 0.098 | <LOD[b] | 0.046 | <LOD[b] |

| Soil type: | Charentilly Loam | Speyer LUFA 3A Sandy Loam | Borstel Loamy Sand | Bruch West Sandy Loam |
|---|---|---|---|---|
| Adsorption Koc (mL/g): | 10 | <LOD | 4 | <LOD |
| Average $K_{OC\text{-}ads}$ (± S.D.) (mL/g) | 7 (4) | | | |
| Mobility Classification* | Very high | | | |
| | | XDE-742 sulfonic acid | | |
| Amount adsorbed [a]: | | | | |
| Adsorption Kd (mL/g): | <LOD[c] | <LOD[c] | <LOD[c] | <LOD[c] |
| Adsorption Koc (mL/g): | <LOD | <LOD | <LOD | <LOD |
| Average $K_{OC\text{-}ads}$ (± S.D.) (mL/g) | <LOD (no measurable adsorption) | | | |
| Mobility Classification* | Very high | | | |

[a] Expressed as percent of the applied radioactivity

[b] LOD = 0.354% of applied $^{14}C$ or 0.38 ng

[c] LOD = 0.463% of applied $^{14}C$ or 0.45 ng

This study is classified supplemental, as it is conducted with transformation products at only one concentration. The results of this study complement the batch equilibrium study of the active ingredient.

### 164-1. Terrestrial Field Dissipation

**MRID 46908334 (Supplemental)**
Field dissipation of GF-1442 under Canadian prairie field conditions was conducted in bare ground plots at 4 sites: Alberta (AB) (Ecoregion 9.1/9.2 ; sandy clay loam); Saskatchewan 1 (SK1) (Ecoregion 9.1/9.2 , clay); Saskatchewan 1 (SK2) (Ecoregion 9.3, loam); and Manitoba (MB) (Ecoregion 9.2, clay loam). Sites SK2 and MB are found in Ecoregions relevant to use sites in the US.

The end-use product, GF-1442, was surface broadcast sprayed to achieve an XDE-742 (a.i.) application rate of 25 g a.i./ha in three replicate 32 m X 6 m plots at each site. Randomly placed application monitors (15 24-cm diameter filter paper circles per site) found that rates were 25.6, 25.6, 24.8 and 25.3 g a.i./ha in AB, SK1, SK2 and MB respectively. Field spiking was not conducted. All sites were irrigated (May-Sept) to a target of 110% of the 30 year precipitation normal. For the duration of the studies, total precipitation was 99%, 136%, 111% and 121% of normal for AB, SK1, SK2 and MB, respectively.

Soil samples were collected at: 0, 5, 7, 15, 22, 29, 68, 91, 120, 370, 403, 433 and 462 days post-application in AB; 0, 7, 14, 20, 35, 59, 93, 136 and 370 days in SK1; 0, 3, 7, 14, 21, 28, 64, 94, 125 and 359 days in SK2; and 0, 3, 8, 15, 21, 28, 62, 92 and 126 days in MB. Samples were taken to a depth of 90 cm, segmented into 15 cm sections and combined to produce 3 composite samples per 15 cm segment. Samples were analyzed for XDE-742 and the transformation products 7-OH-XDE-742, 5-OH-XDE-742 and 6-Cl-7-OH-XDE-742

At AB, the initial concentration was 12.8 g a.i./ha. XDE-742 dissipated steadily and rapidly from the maximum concentration. On day 370 the concentration was 1.3 g a.i./ha and at study termination the concentration was 0.8 g a.i./ha. The residues of XDE-742 were primarily detected in the top 30-cm soil profile. The major transformation products detected at AB were 7-OH-XDE-742 and 6-Cl-7-OH-XDE-742. The 7-OH-XDE-742 maximum concentration was 5.3 g a.i./ha (parent equivalents) or 41% of initial parent, observed at 68-DAT in the upper 30-cm soil profile. However, there were detections in the 30-45 cm and 45-60 cm depths on day 5 for which there was no discussion by the study author. At the end of the study, 7-OH-XDE-742 was 1.5 g a.i./kg (parent equivalent) or 12% of the initial parent. The residues of 7-OH-XDE-742 were primarily detected in the top 15-cm soil profile. The 6-Cl-7-OH-XDE-742 maximum concentration was 0.8 to 0.9 g a.i./kg or 6 to 7% of initial parent, observed at 68-DAT through 462-DAT, primarily observed in the top 15-cm soil profile.

At SK1, the initial concentration was 25.9 g a.i./ha. XDE-742 dissipated steadily and rapidly from the maximum concentration. On day 35 the parent was last detected at a concentration of 0.3 g a.i./ha and at study termination the concentration was 0 g a.i./ha. The residues of XDE-742 were primarily detected in the top 30-cm soil profile. The major transformation products detected at SK1 were 5-OH-XDE-742, 7-OH-XDE-742 and 6-Cl-7-OH-XDE-742. The 5-OH-XDE-742 maximum concentration and only day of detection was 0.5 g a.i./ha (parent equivalents) or 2% of initial parent, observed at 7-DAT in the upper 15-cm soil profile. The 7- OH-XDE-742 maximum concentration was 2.1 g a.i./ha (parent equivalents) or 8% of initial parent, observed at 7-DAT in the upper 15-cm soil profile. The last detection of 7-OH-XDE-742 was 0.3 g a.i./kg (parent equivalent) or 1% of the initial parent on day 35. The residues of 7-OH-XDE-742 were primarily detected in the top 15-cm soil profile. The 6-Cl-7-OH-XDE-742 only concentration measured was 0.2 g a.i./kg or 1% of initial parent, observed on days 14, 35 and 370 in the top 15-cm soil profile.

At SK2, the initial concentration was 21.7 g a.i./ha. XDE-742 dissipated steadily and rapidly from the maximum concentration. On day 28 the parent was last detected at a concentration 0.2 g a.i./ha. The residues of XDE-742 were primarily detected in the top 15-cm soil profile. The major transformation products detected at SK2 were 7-OH-XDE-742 and 6-Cl-7-OH-XDE-742. The 7-OH-XDE-742 maximum concentration was 0.8 g a.i./ha (parent equivalents) or 4% of initial parent, observed on day 14 in the upper 15-cm soil profile. The last detection of 7-OH-XDE-742 was on day 21 at 0.4 g a.i./kg (parent equivalent) or 2% of the initial parent. The residues of 7-OH-XDE-742 were primarily detected in the top 15-cm soil profile. The 6-Cl-7-OH-XDE-742 maximum concentration was 0.7 g a.i./kg or 3% of initial parent, observed on day 14. The last detection was on day 28 at 0.1 g a.i./ha or 0.5% of the initial parent. All detections were primarily observed in the top 15-cm soil profile.

At MB, the initial concentration was 16.6 g a.i./ha and then rose to 17.0 g a.i./ha on day 3. XDE-742 dissipated steadily and rapidly from the maximum concentration. At study termination (126 DAT), the parent was detected at a concentration of 0.7 g a.i./ha. The residues of XDE-742 were detected primarily in the 30-cm soil profile, however, on day 15 there were detections in each section down to a depth of 60 cm. The major transformation products detected at MB were 7-OH-XDE-742 and 6-Cl-7-OH-XDE-742. The 7-OH-XDE-742 maximum concentration was 1.3 g a.i./ha (parent equivalents) or 8% of initial parent, observed on day 28 in the upper 30-cm soil profile. The last detection of 7-OH-XDE-742 was on day 62 at 0.4 g a.i./kg (parent equivalent) or 2% of the initial parent. The residues of 7-OH-XDE-742 were primarily detected in the top 30-cm soil profile. The transformation product 6-Cl-7-OH-XDE-742 was not detected at the MB site.

Under field conditions, XDE-742 was found to have a DT50 ranging from 5 - 29 days and a DT90 ranging from 15 - 239 days, calculated using simple first order kinetics for all sites excluding Alberta, for which double first order in parallel models were used. The major transformation product 7-OH-XDE-742 was found to have a DT50 ranging from 3 - 97 days and a DT90 10-321 days. A DT50 could only be calculated for 6-Cl-7-OH-XDE-742 in the AB site at 84 days and the DT90 was found to be 279 days.

The maximum carry-over to the next growing season occurred at the AB site with 10% of the parent still present the following spring.

**Results Synopsis:**

The field dissipation half-lives and dissipation times of parent XDE-742 were:

| Site | Half-life (non-linear) | $DT_{50}$ | $DT_{90}$ |
|---|---|---|---|
| **AB** | **31 days** | **~29 days** | **370-403 days** |
| **SK1** | **5 days** | **<7 days** | **14 days** |
| **SK2** | **5 days** | **3-7 days** | **14-21 days** |
| **MB** | **23 days** | **<20 days** | **<93 days** |

This study is classified as supplemental because samples were stored as long as 588 days. An ongoing storage stability study of XDE-742 and its transformation products has only confirmed stability for XDE-742, 5-OH-XDE-742, and 6-Cl-7-OH-XDE-742 in frozen soil samples for six months (MRID 46908317). 7-OH-XDE-742 displayed reduced recovery over six months in a loam soil. Pending results from the completed storage stability study, the dissipation kinetics of this study are uncertain.

# APPENDIX C. PRZM/EXAMS Input Data.

| | | | | |
|---|---|---|---|---|
| Output File: XDE_Eco | | | | |
| Metfile: | w14914.dvf | | | |
| PRZM scenario: | NDwheatSTD.txt | | | |
| EXAMS environment file: | pond298.exv | | | |
| Chemical Name: | Pyroxsulam | | | |
| Description | Variable Name | Value | Units | Comments |
| Molecular weight | mwt | 434.4 | g/mol | |
| Henry's Law Const. | henry | | atm-m^3/mol | |
| Vapor Pressure | vapr | 1e-9 | torr | |
| Solubility | sol | 32000 | mg/L | |
| Kd | Kd | | mg/L | |
| Koc | Koc | 30.4 | mg/L | |
| Photolysis half-life | kdp | 0 | days | Half-life |
| Aerobic Aquatic Metabolism | kbacw | 23.4 | days | Halfife |
| Anaerobic Aquatic Metabolism | kbacs | 0 | days | Halfife |
| Aerobic Soil Metabolism | asm | 11.0 | 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 | 0 | cm | |
| Application Rate: | TAPP | 0.0184 | kg/ha | |
| Application Efficiency: | APPEFF | .95 | fraction | |
| Spray Drift | DRFT | .05 | fraction of application rate applied to pond | |
| Application Date | Date | 01-04 | dd/mm or dd/mmm or dd-mm or dd-mmm | |
| Record 17: | FILTRA | | | |
| | IPSCND | 1 | | |
| | 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 D. Chemical Names, Structures, and Maximum Reported Amounts of Pyroxsulam and Its Degradates.

| Table D-1. Maximum Reported Amounts of Pyroxsulam Degradation Products. | | | |
|---|---|---|---|
| **Degradate** | **Maximum % of Applied** | **Study Type** | **MRID** |
| **XDE-742 sulfinic acid** | **79.2%** (3.8 d) | Aqueous photolysis | MRID pending |
| **XDE-742-ADTP** | **39.8%** (3.8 d) | Aqueous photolysis | MRID pending |
| **5-OH-XDE-742** | **24.1%** (3 d)<br>**24.4%** (4 d)<br>2% (7 d)[1] | Aerobic soil metabolism<br>Aerobic soil metabolism<br>Terrestrial Field dissipation | MRID 46908329<br>MRID 47202701<br>MRID 46908334 |
| **7-OH-XDE-742** | **13.7%** (3 d)<br>7.9% (14 d)<br>**76.5%** (58 d)<br>**58.4%** 17 d)<br>**41%** (68 d)[1] | Aerobic soil metabolism<br>Aerobic soil metabolism<br>Anaerobic aquatic metabolism[2]<br>Aerobic aquatic metabolism<br>Terrestrial Field dissipation | MRID 46908329<br>MRID 47202701<br>MRID 46908331<br>MRID 46908336<br>MRID 46908334 |
| **6-Cl-7-OH-XDE-742** | **26.2%** (7 d)<br>**11.0%** (7 d)<br>5-7% (68-462 d)[1] | Aerobic soil metabolism<br>Aerobic soil metabolism<br>Terrestrial Field dissipation | MRID 46908329<br>MRID 47202701<br>MRID 46908334 |
| **XDE-742 sulfonamide** | **13.2%** (29 d) | Aerobic soil metabolism | MRID 47202701 |
| **XDE-742 CSF** | 8.1 (21 d)<br>0.7% (63 d) | Aerobic soil metabolism<br>Aerobic soil metabolism | MRID 46908329<br>MRID 47202701 |
| **XDE-742 PSA** | 5.9% (29 d)<br>3.6% (100 d) | Aerobic soil metabolism<br>Aerobic soil metabolism | MRID 46908329<br>MRID 47202701 |
| **5,7-diOH-XDE-742** | **27.3%** (126 d) | Anaerobic aquatic metabolism[2] | MRID 46908331 |
| **XDE-742-ATSA** | **12.9%** 54 d) | Aerobic aquatic metabolism | MRID 46908336 |
| **$CO_2$** | 1.2% (15 d)<br>**15.6%** (133 d)<br>0.1% (14-126 d)<br>2.3% (75 d) | Aqueous photolysis<br>Aerobic soil metabolism<br>Anaerobic aquatic metabolism[2]<br>Aerobic aquatic metabolism | MRID pending<br>MRID 46908329<br>MRID 46908331<br>MRID 46908336 |
| **Unidentified/non-extracted residues** | **69.9%** (14.9 d)<br>**31.0%** (15 d)<br>**94.1%** (29 d)<br>**82.8%** (118 d)<br>**76.5%** (54 d) | Aqueous photolysis<br>Soil photolysis<br>Aerobic soil metabolism<br>Aerobic soil metabolism<br>Aerobic aquatic metabolism | MRID pending<br>MRID 46908328<br>MRID 46908329<br>MRID 47202701<br>MRID 46908336 |

[1] Terrestrial field dissipation values are expressed in percent of initial measured parent concentration.
[2] Anaerobic conditions were not maintained in the anaerobic aquatic metabolism study. The degradates identified were likely the result of aerobic biodegradation.

Table D-2. Chemical Names and Structures of Pyroxsulam and its Degradates.

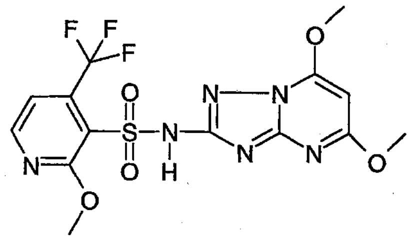
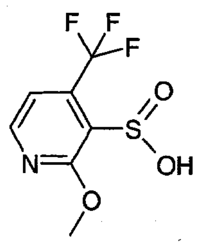
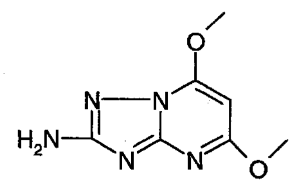
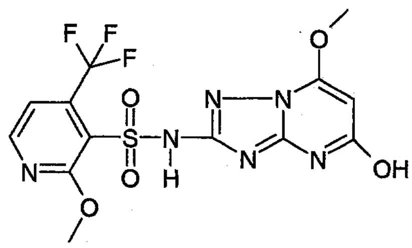
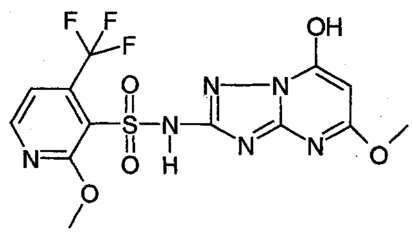
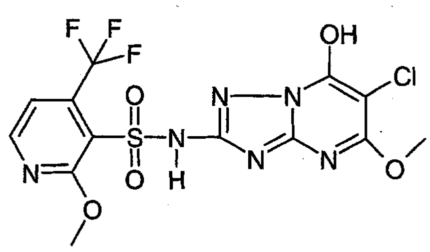
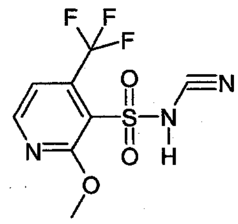
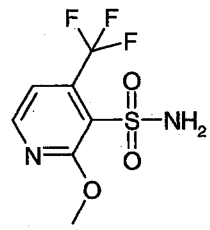
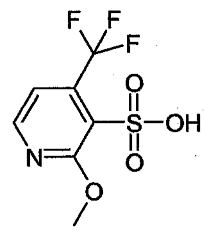
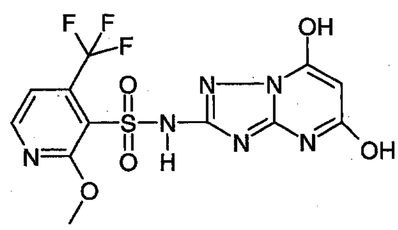
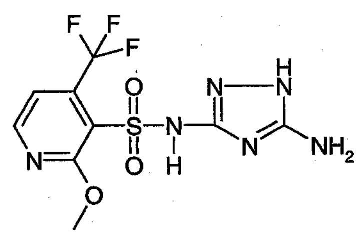
| Chemical Name | Structure |
|---|---|
| Pyroxsulam,<br>XDE-742<br><br>**N-(5,7-dimethoxy[1,2,4]triazolo[1,5--α]]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide** |  |
| XDE-742 sulfinic acid<br><br>**2-methoxy-4-(trifluoromethyl)pyridine-3-sulfinic acid** |  |
| XDE-742 ADTP<br><br>**5,7-dimethoxy[1,2,4]triazolo[1,4-α]pyrimidin-2-amine** |  |
| 5-OH-XDE-742<br><br>**N-(5-hydroxy-7-methoxy[1,2,4]triazolo[1,5-α]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide** |  |
| 7-OH-XDE-742<br><br>**N-(7-hydroxy-5-methoxy[1,2,4]triazolo[1,5-α]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide** |  |
| 6-Cl-7-OH-XDE-742<br><br>**N-(6-chloro-7-hydroxy-5-methoxy[1,2,4]triazolo[1,5-α]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide** |  |

Table D-2. Chemical Names and Structures of Pyroxsulam and its Degradates.

| Chemical Name | Structure |
|---|---|
| XDE-742 CSF,<br>XDE-742 cyanosulfonamide<br><br>**N-cyano-2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide** |  |
| XDE-742 sulfonamide<br><br>**2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide** |  |
| XDE-742 PSA,<br>XDE-742 sulfonic acid<br><br>**2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonic acid** |  |
| 5,7-diOH-XDE-742<br><br>**N-(5,7-dihydroxy[1,2,4]triazolo[1,5-α]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide** |  |
| XDE-742-ATSA<br><br>**N-(5-amino-1H-1,2,4-triazol-3-yl)-2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide** |  |

## APPENDIX E. Example TREX Input and Output for Pyroxsulam.

**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 | |
| | | EEC | RQ | EEC | RQ | EEC | RQ | EEC | RQ |
| 20 | 1038.45 | 4.48 | 0.00 | 2.05 | 0.00 | 2.52 | 0.00 | 0.28 | 0.00 |
| 100 | 1322.00 | 2.56 | 0.00 | 1.17 | 0.00 | 1.44 | 0.00 | 0.16 | 0.00 |
| 1000 | 1867.37 | 1.14 | 0.00 | 0.52 | 0.00 | 0.64 | 0.00 | 0.07 | 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 |
| 5000 | 3.94 | 0.00 | 1.80 | 0.00 | 2.21 | 0.00 | 0.25 | 0.00 |

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 |
| 500 | 3.94 | 0.01 | 1.80 | 0.00 | 2.21 | 0.00 | 0.25 | 0.00 |

Size class not used for dietary risk quotients

| Table X. Upper Bound Kenaga, Acute Mammalian Dose-Based Risk Quotients | | |
|---|---|---|
| Size | Adjusted | EECs and RQs |

| Class (grams) | LD50 | 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 | 6877.01 | 3.75 | 0.00 | 1.72 | 0.00 | 2.11 | 0.00 | 0.23 | 0.00 | 0.05 | 0.00 |
| 35 | 5564.24 | 2.59 | 0.00 | 1.19 | 0.00 | 1.46 | 0.00 | 0.16 | 0.00 | 0.04 | 0.00 |
| 1000 | 2406.70 | 0.60 | 0.00 | 0.28 | 0.00 | 0.34 | 0.00 | 0.04 | 0.00 | 0.01 | 0.00 |

| Table X. Upper Bound Kenaga, Acute Mammalian Dietary Based Risk Quotients | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | EECs and RQs | | | | | | | |
| | Short Grass | | Tall Grass | | Broadleaf Plants/ Small Insects | | Fruits/Pods/ Seeds/ Large Insects | |
| LC50 (ppm) | EEC | RQ | EEC | RQ | EEC | RQ | EEC | RQ |
| 0 | 3.94 | ##### | 1.80 | ##### | 2.21 | ##### | 0.25 | ##### |

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 |
| 1000 | 3.94 | 0.00 | 1.80 | 0.00 | 2.21 | 0.00 | 0.25 | 0.00 |

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 | 109.89 | 3.75 | 0.03 | 1.72 | 0.02 | 2.11 | 0.02 | 0.23 | 0.00 | 0.05 | 0.00 |
| 35 | 88.91 | 2.59 | 0.03 | 1.19 | 0.01 | 1.46 | 0.02 | 0.16 | 0.00 | 0.04 | 0.00 |
| 1000 | 38.46 | 0.60 | 0.02 | 0.28 | 0.01 | 0.34 | 0.01 | 0.04 | 0.00 | 0.01 | 0.00 |

## APPENDIX F. Example Terrplant (v. 1.2.1) Input and Output for Pyroxsulam.

**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** | pyroxsulam |
| **PC code** | x |
| **Use** | wheat |
| **Application Method** | 3 |
| **Application Form** | x |
| **Solubility in Water (ppm)** | 3200 |

| Table 2. Input parameters used to derive EECs. | | | |
|---|---|---|---|
| **Input Parameter** | **Symbol** | **Value** | **Units** |
| Application Rate | A | **0.0164** | **y** |
| Incorporation | I | **1** | none |
| Runoff Fraction | R | **0.05** | none |
| Drift Fraction | D | **0.05** | none |

| Table 3. EECs for pyroxsulam. Units in y. | | |
|---|---|---|
| **Description** | **Equation** | **EEC** |
| Runoff to dry areas | (A/I)*R | 0.00082 |
| Runoff to semi-aquatic areas | (A/I)*R*10 | 0.0082 |
| **Spray drift** | **A*D** | **0.00082** |
| **Total for dry areas** | **((A/I)*R)+(A*D)** | **0.00164** |
| **Total for semi-aquatic areas** | **((A/I)*R*10)+(A*D)** | **0.00902** |

| Table 4. Plant survival and growth data used for RQ derivation. Units are in y. | | | | |
|---|---|---|---|---|
| | **Seedling Emergence** | | **Vegetative Vigor** | |
| **Plant type** | **$EC_{25}$** | **NOAEC** | **$EC_{25}$** | **NOAEC** |
| Monocot | **0.00022** | **0.00006** | **0.00056** | **0.000046** |
| Dicot | **0.00057** | **0.000036** | **0.000052** | **0.000031** |

| Table 5. RQ values for plants in dry and semi-aquatic areas exposed to pyroxsulam through runoff and/or spray drift.* | | | | |
|---|---|---|---|---|
| **Plant Type** | **Listed Status** | **Dry** | **Semi-Aquatic** | **Spray Drift** |
| Monocot | non-listed | 7.45 | 41.00 | 3.73 |
| Monocot | listed | 27.33 | 150.33 | 13.67 |
| Dicot | non-listed | 2.88 | 15.82 | 15.77 |
| Dicot | listed | 45.56 | 250.56 | 26.45 |
| *If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group. | | | | |

## APPENDIX G. Ecological Effects Assessment.

# *Species Listing by State with Use Criteria*

No species were excluded
Minimum of 1 Acre.
All Medium Types Reported
*Mammal, Marine mml, Bird, Amphibian, Reptile, Fish, Crustacean, Bivalve, Gastropod, Arachnid, Insect, Dicot, Monocot, Ferns, Conf/cycds, Coral, Lichen*
wheat

| ***Alabama*** ( 86) species: | | Taxa | Critical Habitat |
|---|---|---|---|
| Salamander, Flatwoods *(Ambystoma cingulatum)* | Threatened | Amphibian<br>Freshwater, Vernal pool, Terrestrial | No |
| Salamander, Red Hills *(Phaeognathus hubrichti)* | Threatened | Amphibian<br>Freshwater, Terrestrial | No |
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird<br>Terrestrial | Yes |
| Stork, Wood *(Mycteria americana)* | Endangered | Bird<br>Terrestrial | No |
| Woodpecker, Red-cockaded *(Picoides borealis)* | Endangered | Bird<br>Terrestrial | No |
| Combshell, Southern (=Penitent mussel) *(Epioblasma penita)* | Endangered | Bivalve<br>Freshwater | No |
| Combshell, Upland *(Epioblasma metastriata)* | Endangered | Bivalve<br>Freshwater | Yes |
| Kidneyshell, Triangular *(Ptychobranchus greenii)* | Endangered | Bivalve<br>Freshwater | Yes |
| Mucket, Orangenacre *(Lampsilis perovalis)* | Threatened | Bivalve<br>Freshwater | Yes |
| Mucket, Pink (Pearlymussel) *(Lampsilis abrupta)* | Endangered | Bivalve<br>Freshwater | No |
| Mussel, Acornshell Southern *(Epioblasma othcaloogensis)* | Endangered | Bivalve<br>Freshwater | Yes |
| Mussel, Alabama Moccasinshell *(Medionidus acutissimus)* | Threatened | Bivalve<br>Freshwater | Yes |
| Mussel, Coosa Moccasinshell *(Medionidus parvulus)* | Endangered | Bivalve<br>Freshwater | Yes |
| Mussel, Cumberland Combshell *(Epioblasma brevidens)* | Endangered | Bivalve<br>Freshwater | Yes |
| Mussel, Dark Pigtoe *(Pleurobema furvum)* | Endangered | Bivalve<br>Freshwater | Yes |
| Mussel, Fine-lined Pocketbook *(Lampsilis altilis)* | Threatened | Bivalve<br>Freshwater | Yes |
| Mussel, Fine-rayed Pigtoe *(Fusconaia cuneolus)* | Endangered | Bivalve<br>Freshwater | No |

| **Alabama** ( 86) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|
| Mussel, Flat Pigtoe (=Marshall's Mussel) *(Pleurobema marshalli)* | Endangered | Bivalve Freshwater | No |
| Mussel, Heavy Pigtoe (=Judge Tait's Mussel) *(Pleurobema taitianum)* | Endangered | Bivalve Freshwater | No |
| Mussel, Heelsplitter Inflated *(Potamilus inflatus)* | Threatened | Bivalve Freshwater | No |
| Mussel, Ovate Clubshell *(Pleurobema perovatum)* | Endangered | Bivalve Freshwater | Yes |
| Mussel, Ring Pink (=Golf Stick Pearly) *(Obovaria retusa)* | Endangered | Bivalve Freshwater | No |
| Mussel, Rough Pigtoe *(Pleurobema plenum)* | Endangered | Bivalve Freshwater | No |
| Mussel, Shiny Pigtoe *(Fusconaia cor)* | Endangered | Bivalve Freshwater | No |
| Mussel, Shiny-rayed Pocketbook *(Lampsilis subangulata)* | Endangered | Bivalve Freshwater | No |
| Mussel, Southern Clubshell *(Pleurobema decisum)* | Endangered | Bivalve Freshwater | Yes |
| Mussel, Southern Pigtoe *(Pleurobema georgianum)* | Endangered | Bivalve Freshwater | Yes |
| Pearlymussel, Alabama Lamp *(Lampsilis virescens)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Cracking *(Hemistena lata)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Cumberland Monkeyface *(Quadrula intermedia)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Orange-footed *(Plethobasus cooperianus)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Pale Lilliput *(Toxolasma cylindrellus)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Turgid-blossom *(Epioblasma turgidula)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, White Wartyback *(Plethobasus cicatricosus)* | Endangered | Bivalve Freshwater | No |
| Stirrupshell *(Quadrula stapes)* | Endangered | Bivalve Freshwater | No |
| Shrimp, Alabama Cave *(Palaemonias alabamae)* | Endangered | Crustacean Freshwater | No |
| Amphianthus, Little *(Amphianthus pusillus)* | Threatened | Dicot Freshwater | No |
| Barbara Buttons, Mohr's *(Marshallia mohrii)* | Threatened | Dicot Terrestrial | No |

## *Alabama* ( 86) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Bladderpod, Lyrate<br>*(Lesquerella lyrata)* | Threatened | Dicot<br>Terrestrial | No |
| Clover, Leafy Prairie<br>*(Dalea foliosa)* | Endangered | Dicot<br>Terrestrial | No |
| Harperella<br>*(Ptilimnium nodosum)* | Endangered | Dicot<br>Freshwater | No |
| Leather-flower, Alabama<br>*(Clematis socialis)* | Endangered | Dicot<br>Terrestrial | No |
| Leather-flower, Morefield's<br>*(Clematis morefieldii)* | Endangered | Dicot<br>Terrestrial | No |
| Pitcher-plant, Alabama Canebrake<br>*(Sarracenia rubra alabamensis)* | Endangered | Dicot<br>Freshwater, Terrestrial | No |
| Pitcher-plant, Green<br>*(Sarracenia oreophila)* | Endangered | Dicot<br>Terrestrial, Freshwater | No |
| Potato-bean, Price's<br>*(Apios priceana)* | Threatened | Dicot<br>Terrestrial | No |
| Fern, Alabama Streak-sorus<br>*(Thelypteris pilosa var. alabamensis)* | Threatened | Ferns<br>Terrestrial | No |
| Fern, American hart's-tongue<br>*(Asplenium scolopendrium var. americanum)* | Threatened | Ferns<br>Terrestrial | No |
| Quillwort, Louisiana<br>*(Isoetes louisianensis)* | Endangered | Ferns<br>Freshwater, Terrestrial | No |
| Cavefish, Alabama<br>*(Speoplatyrhinus poulsoni)* | Endangered | Fish<br>Freshwater | Yes |
| Chub, Spotfin<br>*(Erimonax monachus)* | Threatened | Fish<br>Freshwater | Yes |
| Darter, Boulder<br>*(Etheostoma wapiti)* | Endangered | Fish<br>Freshwater | No |
| Darter, Goldline<br>*(Percina aurolineata)* | Threatened | Fish<br>Freshwater | No |
| Darter, Slackwater<br>*(Etheostoma boschungi)* | Threatened | Fish<br>Freshwater | Yes |
| Darter, Snail<br>*(Percina tanasi)* | Threatened | Fish<br>Freshwater | No |
| Darter, Vermilion<br>*(Etheostoma chermocki)* | Endangered | Fish<br>Freshwater | No |
| Darter, Watercress<br>*(Etheostoma nuchale)* | Endangered | Fish<br>Freshwater | No |
| Madtom, Yellowfin<br>*(Noturus flavipinnis)* | Threatened | Fish<br>Freshwater | Yes |
| Sculpin, Pygmy<br>*(Cottus paulus (=pygmaeus))* | Threatened | Fish<br>Freshwater | No |

| **Alabama** | ( 86) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Shiner, Blue *(Cyprinella caerulea)* | | Threatened | Fish Freshwater | No |
| Shiner, Cahaba *(Notropis cahabae)* | | Endangered | Fish Freshwater | No |
| Shiner, Palezone *(Notropis albizonatus)* | | Endangered | Fish Freshwater | No |
| Sturgeon, Alabama *(Scaphirhynchus suttkusi)* | | Endangered | Fish Freshwater | No |
| Sturgeon, Gulf *(Acipenser oxyrinchus desotoi)* | | Threatened | Fish Saltwater, Freshwater | Yes |
| Campeloma, Slender *(Campeloma decampi)* | | Endangered | Gastropod Freshwater | No |
| Elimia, Lacy *(Elimia crenatella)* | | Threatened | Gastropod Freshwater | No |
| Pebblesnail, Flat *(Lepyrium showalteri)* | | Endangered | Gastropod Freshwater | No |
| Riversnail, Anthony's *(Athearnia anthonyi)* | | Endangered | Gastropod Freshwater | No |
| Rocksnail, Painted *(Leptoxis taeniata)* | | Threatened | Gastropod Freshwater | No |
| Rocksnail, Plicate *(Leptoxis plicata)* | | Endangered | Gastropod Freshwater | No |
| Rocksnail, Round *(Leptoxis ampla)* | | Threatened | Gastropod Freshwater | No |
| Snail, Armored *(Pyrgulopsis (=Marstonia) pachyta)* | | Endangered | Gastropod Freshwater | No |
| Snail, Lioplax Cylindrical *(Lioplax cyclostomaformis)* | | Endangered | Gastropod Freshwater | No |
| Snail, Tulotoma *(Tulotoma magnifica)* | | Endangered | Gastropod Terrestrial | No |
| Bat, Gray *(Myotis grisescens)* | | Endangered | Mammal Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Mouse, Alabama Beach *(Peromyscus polionotus ammobates)* | | Endangered | Mammal Terrestrial, Coastal (neritic) | Yes |
| Mouse, Perdido Key Beach *(Peromyscus polionotus trissyllepsis)* | | Endangered | Mammal Coastal (neritic) | Yes |
| Grass, Tennessee Yellow-eyed *(Xyris tennesseensis)* | | Endangered | Monocot Terrestrial | No |
| Trillium, Relict *(Trillium reliquum)* | | Endangered | Monocot Terrestrial | No |

| **Alabama** | ( 86) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Water-plantain, Kral's | | Threatened | Monocot | No |
| *(Sagittaria secundifolia)* | | | Freshwater | |
| Sea turtle, loggerhead | | Threatened | Reptile | No |
| *(Caretta caretta)* | | | Saltwater | |
| Snake, Eastern Indigo | | Threatened | Reptile | No |
| *(Drymarchon corais couperi)* | | | Terrestrial | |
| Tortoise, Gopher | | Threatened | Reptile | No |
| *(Gopherus polyphemus)* | | | Terrestrial | |
| Turtle, Alabama Red-bellied | | Endangered | Reptile | No |
| *(Pseudemys alabamensis)* | | | Terrestrial, Freshwater | |
| Turtle, Flattened Musk | | Threatened | Reptile | No |
| *(Sternotherus depressus)* | | | Freshwater, Terrestrial | |

| **Arizona** | ( 36) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Frog, Chiricahua Leopard | | Threatened | Amphibian | No |
| *(Rana chiricahuensis)* | | | Freshwater, Terrestrial | |
| Bobwhite, Masked | | Endangered | Bird | No |
| *(Colinus virginianus ridgwayi)* | | | Terrestrial | |
| Condor, California | | Endangered | Bird | Yes |
| *(Gymnogyps californianus)* | | | Terrestrial | |
| Flycatcher, Southwestern Willow | | Endangered | Bird | Yes |
| *(Empidonax traillii extimus)* | | | Terrestrial | |
| Owl, Mexican Spotted | | Threatened | Bird | Yes |
| *(Strix occidentalis lucida)* | | | Terrestrial | |
| Pygmy-owl, Cactus Ferruginous | | Endangered | Bird | No |
| *(Glaucidium brasilianum cactorum)* | | | Terrestrial | |
| Rail, Yuma Clapper | | Endangered | Bird | No |
| *(Rallus longirostris yumanensis)* | | | Terrestrial | |
| Blue-star, Kearney's | | Endangered | Dicot | No |
| *(Amsonia kearneyana)* | | | Terrestrial | |
| Cactus, Arizona Hedgehog | | Endangered | Dicot | No |
| *(Echinocereus triglochidiatus var. arizonicus)* | | | Terrestrial | |
| Cactus, Nichol's Turk's Head | | Endangered | Dicot | No |
| *(Echinocactus horizonthalonius var. nicholii)* | | | Terrestrial | |
| Cactus, Peebles Navajo | | Endangered | Dicot | No |
| *(Pediocactus peeblesianus peeblesianus)* | | | Terrestrial | |
| Cactus, Pima Pineapple | | Endangered | Dicot | No |
| *(Coryphantha scheeri var. robustispina)* | | | Terrestrial | |
| Cliffrose, Arizona | | Endangered | Dicot | No |
| *(Purshia (=cowania) subintegra)* | | | Terrestrial | |
| Fleabane, Zuni | | Threatened | Dicot | No |
| *(Erigeron rhizomatus)* | | | Terrestrial | |
| Umbel, Huachuca Water | | Endangered | Dicot | Yes |
| *(Lilaeopsis schaffneriana var. recurva)* | | | Terrestrial, Freshwater | |

| **Arizona** | ( 36) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Chub, Bonytail | | Endangered | Fish | Yes |
| *(Gila elegans)* | | | Freshwater | |
| Chub, Gila | | Endangered | Fish | Yes |
| *(Gila intermedia)* | | | Freshwater | |
| Chub, Humpback | | Endangered | Fish | Yes |
| *(Gila cypha)* | | | Freshwater | |
| Minnow, Loach | | Threatened | Fish | Yes |
| *(Tiaroga cobitis)* | | | Freshwater | |
| Pupfish, Desert | | Endangered | Fish | Yes |
| *(Cyprinodon macularius)* | | | Freshwater | |
| Spikedace | | Threatened | Fish | Yes |
| *(Meda fulgida)* | | | Freshwater | |
| Spinedace, Little Colorado | | Threatened | Fish | Yes |
| *(Lepidomeda vittata)* | | | Freshwater | |
| Squawfish, Colorado | | Endangered | Fish | Yes |
| *(Ptychocheilus lucius)* | | | Freshwater | |
| Sucker, Razorback | | Endangered | Fish | Yes |
| *(Xyrauchen texanus)* | | | Freshwater | |
| Topminnow, Gila (Yaqui) | | Endangered | Fish | No |
| *(Poeciliopsis occidentalis)* | | | Freshwater | |
| Trout, Apache | | Threatened | Fish | No |
| *(Oncorhynchus apache)* | | | Freshwater | |
| Trout, Gila | | Endangered | Fish | No |
| *(Oncorhynchus gilae)* | | | Freshwater | |
| Bat, Lesser (=Sanborn's) Long-nosed | | Endangered | Mammal | No |
| *(Leptonycteris curasoae yerbabuenae)* | | | Subterraneous, Terrestrial | |
| Ferret, Black-footed | | Endangered | Mammal | No |
| *(Mustela nigripes)* | | | Terrestrial | |
| Jaguar | | Endangered | Mammal | No |
| *(Panthera onca)* | | | Terrestrial | |
| Jaguarundi, Sinaloan | | Endangered | Mammal | No |
| *(Herpailurus (=Felis) yagouaroundi tolteca)* | | | Terrestrial | |
| Ocelot | | Endangered | Mammal | No |
| *(Leopardus (=Felis) pardalis)* | | | Terrestrial | |
| Pronghorn, Sonoran | | Endangered | Mammal | No |
| *(Antilocapra americana sonoriensis)* | | | Terrestrial | |
| Squirrel, Mount Graham Red | | Endangered | Mammal | Yes |
| *(Tamiasciurus hudsonicus grahamensis)* | | | Terrestrial | |
| Wolf, Gray | | Endangered | Mammal | Yes |
| *(Canis lupus)* | | | Terrestrial | |
| Sedge, Navajo | | Threatened | Monocot | Yes |
| *(Carex specuicola)* | | | Terrestrial | |

| **Arkansas** | ( 19) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|

| **Arkansas** | ( 19) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Tern, Interior (population) Least | | Endangered | Bird | No |
| *(Sterna antillarum)* | | | Terrestrial | |
| Woodpecker, Red-cockaded | | Endangered | Bird | No |
| *(Picoides borealis)* | | | Terrestrial | |
| Fatmucket, Arkansas | | Threatened | Bivalve | No |
| *(Lampsilis powelli)* | | | Freshwater | |
| Mucket, Pink (Pearlymussel) | | Endangered | Bivalve | No |
| *(Lampsilis abrupta)* | | | Freshwater | |
| Mussel, Scaleshell | | Endangered | Bivalve | No |
| *(Leptodea leptodon)* | | | Freshwater | |
| Pearlymussel, Fat Pocketbook | | Endangered | Bivalve | No |
| *(Potamilus capax)* | | | Freshwater | |
| Rock-pocketbook, Ouachita (=Wheeler's pm) | | Endangered | Bivalve | No |
| *(Arkansia wheeleri)* | | | Freshwater | |
| Crayfish, Cave (Cambarus aculabrum) | | Endangered | Crustacean | No |
| *(Cambarus aculabrum)* | | | Freshwater | |
| Bladderpod, Missouri | | Threatened | Dicot | No |
| *(Lesquerella filiformis)* | | | Terrestrial | |
| Fruit, Earth (=geocarpon) | | Threatened | Dicot | No |
| *(Geocarpon minimum)* | | | Terrestrial | |
| Harperella | | Endangered | Dicot | No |
| *(Ptilimnium nodosum)* | | | Freshwater | |
| Pondberry | | Endangered | Dicot | No |
| *(Lindera melissifolia)* | | | Terrestrial | |
| Cavefish, Ozark | | Threatened | Fish | No |
| *(Amblyopsis rosae)* | | | Freshwater | |
| Sturgeon, Pallid | | Endangered | Fish | No |
| *(Scaphirhynchus albus)* | | | Freshwater | |
| Shagreen, Magazine Mountain | | Threatened | Gastropod | No |
| *(Mesodon magazinensis)* | | | Terrestrial | |
| Beetle, American Burying | | Endangered | Insect | No |
| *(Nicrophorus americanus)* | | | Terrestrial | |
| Bat, Gray | | Endangered | Mammal | No |
| *(Myotis grisescens)* | | | Subterraneous, Terrestrial | |
| Bat, Indiana | | Endangered | Mammal | Yes |
| *(Myotis sodalis)* | | | Subterraneous, Terrestrial | |
| Bat, Ozark Big-eared | | Endangered | Mammal | No |
| *(Corynorhinus (=Plecotus) townsendii ingens)* | | | Terrestrial, Subterraneous | |

| **California** | ( 230) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Frog, California Red-legged | | Threatened | Amphibian | Yes |
| *(Rana aurora draytonii)* | | | Terrestrial, Freshwater | |
| Frog, Mountain Yellow-legged | | Endangered | Amphibian | No |
| *(Gopherus agassizii)* | | | Terrestrial, Freshwater | |

| California ( 230) species: | | Taxa | Critical Habitat |
|---|---|---|---|
| Salamander, California Tiger *(Ambystoma californiense)* | Endangered | Amphibian<br>Terrestrial, Vernal pool | No |
| Salamander, Desert Slender *(Batrachoseps aridus)* | Endangered | Amphibian<br>Freshwater, Terrestrial | No |
| Salamander, Santa Cruz Long-toed *(Ambystoma macrodactylum croceum)* | Endangered | Amphibian<br>Freshwater, Vernal pool, Terrestrial | No |
| Toad, Arroyo Southwestern *(Bufo californicus (=microscaphus))* | Endangered | Amphibian<br>Freshwater, Terrestrial | Yes |
| Condor, California *(Gymnogyps californianus)* | Endangered | Bird<br>Terrestrial | Yes |
| Flycatcher, Southwestern Willow *(Empidonax traillii extimus)* | Endangered | Bird<br>Terrestrial | Yes |
| Gnatcatcher, Coastal California *(Polioptila californica californica)* | Threatened | Bird<br>Terrestrial | Yes |
| Murrelet, Marbled *(Brachyramphus marmoratus marmoratus)* | Threatened | Bird<br>Freshwater, Terrestrial, Saltwater | Yes |
| Owl, Northern Spotted *(Strix occidentalis caurina)* | Threatened | Bird<br>Terrestrial | Yes |
| Pelican, Brown *(Pelecanus occidentalis)* | Endangered | Bird<br>Terrestrial | No |
| Plover, Western Snowy *(Charadrius alexandrinus nivosus)* | Threatened | Bird<br>Terrestrial | Yes |
| Rail, California Clapper *(Rallus longirostris obsoletus)* | Endangered | Bird<br>Terrestrial | No |
| Rail, Light-footed Clapper *(Rallus longirostris levipes)* | Endangered | Bird<br>Terrestrial | No |
| Rail, Yuma Clapper *(Rallus longirostris yumanensis)* | Endangered | Bird<br>Terrestrial | No |
| Shrike, San Clemente Loggerhead *(Lanius ludovicianus mearnsi)* | Endangered | Bird<br>Terrestrial | No |
| Sparrow, San Clemente Sage *(Amphispiza belli clementeae)* | Threatened | Bird<br>Terrestrial | No |
| Tern, California Least *(Sterna antillarum browni)* | Endangered | Bird<br>Terrestrial | No |
| Vireo, Least Bell's *(Vireo bellii pusillus)* | Endangered | Bird<br>Terrestrial | Yes |
| Cypress, Gowen *(Cupressus goveniana ssp. goveniana)* | Threatened | Conf/cycds<br>Terrestrial | No |
| Abalone, White *(Haliotis sorenseni)* | Endangered | Crustacean<br>Saltwater | No |
| Crayfish, Shasta *(Pacifastacus fortis)* | Endangered | Crustacean<br>Freshwater | No |

| ***California*** ( 230) species: | | Taxa | Critical Habitat |
|---|---|---|---|
| Fairy Shrimp, Conservancy Fairy *(Branchinecta conservatio)* | Endangered | Crustacean Vernal pool | Yes |
| Fairy Shrimp, Longhorn *(Branchinecta longiantenna)* | Endangered | Crustacean Vernal pool | Yes |
| Fairy Shrimp, Riverside *(Streptocephalus woottoni)* | Endangered | Crustacean Vernal pool | Yes |
| Fairy Shrimp, San Diego *(Branchinecta sandiegonensis)* | Endangered | Crustacean Vernal pool | Yes |
| Fairy Shrimp, Vernal Pool *(Branchinecta lynchi)* | Threatened | Crustacean Vernal pool | Yes |
| Shrimp, California Freshwater *(Syncaris pacifica)* | Endangered | Crustacean Freshwater | No |
| Tadpole Shrimp, Vernal Pool *(Lepidurus packardi)* | Endangered | Crustacean Vernal pool | Yes |
| Adobe Sunburst, San Joaquin *(Pseudobahia peirsonii)* | Threatened | Dicot Terrestrial | No |
| Allocarya, Calistoga *(Plagiobothrys strictus)* | Endangered | Dicot Vernal pool | No |
| Ambrosia, San Diego *(Ambrosia pumila)* | Endangered | Dicot Terrestrial | No |
| Baccharis, Encinitas *(Baccharis vanessae)* | Threatened | Dicot Terrestrial | No |
| Barberry, Nevin's *(Berberis nevinii)* | Endangered | Dicot Terrestrial | No |
| Bird's-beak, Palmate-bracted *(Cordylanthus palmatus)* | Endangered | Dicot Terrestrial | No |
| Bird's-beak, Pennell's *(Cordylanthus tenuis ssp. capillaris)* | Endangered | Dicot Terrestrial | No |
| Bird's-beak, salt marsh *(Cordylanthus maritimus ssp. maritimus)* | Endangered | Dicot Saltwater | No |
| Bird's-beak, Soft *(Cordylanthus mollis ssp. mollis)* | Endangered | Dicot Brackish, Saltwater | No |
| Bladderpod, San Bernardino Mountains *(Lesquerella kingii ssp. bernardina)* | Endangered | Dicot Terrestrial | Yes |
| Bluecurls, Hidden Lake *(Trichostema austromontanum ssp. compactum)* | Threatened | Dicot Terrestrial | No |
| Broom, San Clemente Island *(Lotus dendroideus ssp. traskiae)* | Endangered | Dicot Terrestrial | No |
| Buckwheat, Cushenbury *(Eriogonum ovalifolium var. vineum)* | Endangered | Dicot Terrestrial | Yes |
| Buckwheat, Southern Mountain Wild *(Eriogonum kennedyi var. austromontanum)* | Threatened | Dicot Terrestrial | No |

| **California** ( 230) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|
| Bush-mallow, San Clemente Island *(Malacothamnus clementinus)* | Endangered | Dicot Terrestrial | No |
| Button-celery, San Diego *(Eryngium aristulatum var. parishii)* | Endangered | Dicot Terrestrial | No |
| Cactus, Bakersfield *(Opuntia treleasei)* | Endangered | Dicot Terrestrial | No |
| Ceanothus, Coyote *(Ceanothus ferrisae)* | Endangered | Dicot Terrestrial | No |
| Ceanothus, Vail Lake *(Ceanothus ophiochilus)* | Threatened | Dicot Terrestrial | No |
| Checker-mallow, Keck's *(Sidalcea keckii)* | Endangered | Dicot Terrestrial | Yes |
| Checker-mallow, Kenwood Marsh *(Sidalcea oregana ssp. valida)* | Endangered | Dicot Terrestrial | No |
| Checker-mallow, Pedate *(Sidalcea pedata)* | Endangered | Dicot Terrestrial | No |
| Clarkia, Pismo *(Clarkia speciosa ssp. immaculata)* | Endangered | Dicot Terrestrial | No |
| Clarkia, Springville *(Clarkia springvillensis)* | Threatened | Dicot Terrestrial | No |
| Clarkia, Vine Hill *(Clarkia imbricata)* | Endangered | Dicot Terrestrial | No |
| Clover, Fleshy Owl's *(Castilleja campestris ssp. succulenta)* | Threatened | Dicot Vernal pool | Yes |
| Clover, Monterey *(Trifolium trichocalyx)* | Endangered | Dicot Terrestrial | No |
| Clover, Showy Indian *(Trifolium amoenum)* | Endangered | Dicot Terrestrial | No |
| Crownbeard, Big-leaved *(Verbesina dissita)* | Threatened | Dicot Terrestrial | No |
| Crownscale, San Jacinto Valley *(Atriplex coronata var. notatior)* | Endangered | Dicot Terrestrial | No |
| Daisy, Parish's *(Erigeron parishii)* | Threatened | Dicot Freshwater | Yes |
| Dudleya, Marcescent *(Dudleya cymosa ssp. marcescens)* | Threatened | Dicot Terrestrial | No |
| Dudleya, Santa Clara Valley *(Dudleya setchellii)* | Endangered | Dicot Terrestrial | No |
| Dudleya, Santa Monica Mountains *(Dudleya cymosa ssp. ovatifolia)* | Threatened | Dicot Terrestrial | No |
| Dwarf-flax, Marin *(Hesperolinon congestum)* | Threatened | Dicot Terrestrial | No |

| ***California*** ( 230) species: | | Taxa | Critical Habitat |
|---|---|---|---|
| Evening-primrose, Antioch Dunes | Endangered | Dicot | Yes |
| *(Oenothera deltoides ssp. howellii)* | | Terrestrial | |
| Evening-primrose, San Benito | Threatened | Dicot | No |
| *(Camissonia benitensis)* | | Terrestrial | |
| Fiddleneck, Large-flowered | Endangered | Dicot | Yes |
| *(Amsinckia grandiflora)* | | Terrestrial | |
| Flannelbush, Mexican | Endangered | Dicot | No |
| *(Fremontodendron mexicanum)* | | Terrestrial | |
| Gilia, Monterey | Endangered | Dicot | No |
| *(Gilia tenuiflora ssp. arenaria)* | | Terrestrial | |
| Golden Sunburst, Hartweg's | Endangered | Dicot | No |
| *(Pseudobahia bahiifolia)* | | Terrestrial | |
| Goldfields, Burke's | Endangered | Dicot | No |
| *(Lasthenia burkei)* | | Terrestrial | |
| Goldfields, Contra Costa | Endangered | Dicot | Yes |
| *(Lasthenia conjugens)* | | Terrestrial | |
| Grass, Hairy Orcutt | Endangered | Dicot | Yes |
| *(Orcuttia pilosa)* | | Vernal pool | |
| Grass, Sacramento Orcutt | Endangered | Dicot | Yes |
| *(Orcuttia viscida)* | | Vernal pool | |
| Grass, Slender Orcutt | Threatened | Dicot | Yes |
| *(Orcuttia tenuis)* | | Vernal pool | |
| Jewelflower, California | Endangered | Dicot | No |
| *(Caulanthus californicus)* | | Terrestrial | |
| Jewelflower, Tiburon | Endangered | Dicot | No |
| *(Streptanthus niger)* | | Terrestrial | |
| Larkspur, Baker's | Endangered | Dicot | Yes |
| *(Delphinium bakeri)* | | Terrestrial | |
| Larkspur, San Clemente Island | Endangered | Dicot | No |
| *(Delphinium variegatum ssp. kinkiense)* | | Terrestrial | |
| Larkspur, Yellow | Endangered | Dicot | Yes |
| *(Delphinium luteum)* | | Terrestrial | |
| Layia, Beach | Endangered | Dicot | No |
| *(Layia carnosa)* | | Terrestrial, Coastal (neritic) | |
| Lupine, Clover | Endangered | Dicot | No |
| *(Lupinus tidestromii)* | | Coastal (neritic) | |
| Lupine, Nipomo Mesa | Endangered | Dicot | No |
| *(Lupinus nipomensis)* | | Coastal (neritic) | |
| Mallow, Kern | Endangered | Dicot | No |
| *(Eremalche kernensis)* | | Terrestrial | |
| Manzanita, Del Mar | Endangered | Dicot | No |
| *(Arctostaphylos glandulosa ssp. crassifolia)* | | Terrestrial | |

## *California* ( 230) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Manzanita, Morro<br>*(Arctostaphylos morroensis)* | Threatened | Dicot<br>Terrestrial | No |
| Manzanita, Pallid<br>*(Arctostaphylos pallida)* | Threatened | Dicot<br>Terrestrial | No |
| Meadowfoam, Butte County<br>*(Limnanthes floccosa ssp. californica)* | Endangered | Dicot<br>Vernal pool | Yes |
| Meadowfoam, Sebastopol<br>*(Limnanthes vinculans)* | Endangered | Dicot<br>Freshwater, Terrestrial | No |
| Milk-vetch, Braunton's<br>*(Astragalus brauntonii)* | Endangered | Dicot<br>Terrestrial | No |
| Milk-vetch, Clara Hunt's<br>*(Astragalus clarianus)* | Endangered | Dicot<br>Terrestrial | No |
| Milk-vetch, Coachella Valley<br>*(Astragalus lentiginosus var. coachellae)* | Endangered | Dicot<br>Terrestrial | Yes |
| Milk-vetch, Coastal Dunes<br>*(Astragalus tener var. titi)* | Endangered | Dicot<br>Terrestrial | No |
| Milk-vetch, Cushenbury<br>*(Astragalus albens)* | Endangered | Dicot<br>Terrestrial | Yes |
| Milk-vetch, Lane Mountain<br>*(Astragalus jaegerianus)* | Endangered | Dicot<br>Terrestrial | Yes |
| Milk-vetch, Pierson's<br>*(Astragalus magdalenae var. peirsonii)* | Threatened | Dicot<br>Terrestrial | Yes |
| Milk-vetch, Triple-ribbed<br>*(Astragalus tricarinatus)* | Endangered | Dicot<br>Terrestrial | No |
| Mint, Otay Mesa<br>*(Pogogyne nudiuscula)* | Endangered | Dicot<br>Terrestrial | No |
| Mint, San Diego Mesa<br>*(Pogogyne abramsii)* | Endangered | Dicot<br>Terrestrial | No |
| Monardella, Willowy<br>*(Monardella linoides ssp. viminea)* | Endangered | Dicot<br>Terrestrial | No |
| Mountainbalm, Indian Knob<br>*(Eriodictyon altissimum)* | Endangered | Dicot<br>Terrestrial | No |
| Mountain-mahogany, Catalina Island<br>*(Cercocarpus traskiae)* | Endangered | Dicot<br>Terrestrial | No |
| Mustard, Slender-petaled<br>*(Thelypodium stenopetalum)* | Endangered | Dicot<br>Terrestrial | No |
| Navarretia, Few-flowered<br>*(Navarretia leucocephala ssp. pauciflora (=N. pauciflora))* | Endangered | Dicot<br>Vernal pool, Terrestrial | No |
| Navarretia, Many-flowered<br>*(Navarretia leucocephala ssp. plieantha)* | Endangered | Dicot<br>Terrestrial, Vernal pool | No |
| Navarretia, Spreading<br>*(Navarretia fossalis)* | Threatened | Dicot<br>Vernal pool | No |

| California ( 230) species: | | Taxa | Critical Habitat |
|---|---|---|---|
| Oxytheca, Cushenbury | Endangered | Dicot | Yes |
| *(Oxytheca parishii var. goodmaniana)* | | Terrestrial | |
| Paintbrush, Ash-grey Indian | Threatened | Dicot | No |
| *(Castilleja cinerea)* | | Terrestrial | |
| Paintbrush, San Clemente Island Indian | Endangered | Dicot | No |
| *(Castilleja grisea)* | | Terrestrial | |
| Paintbrush, Tiburon | Endangered | Dicot | No |
| *(Castilleja affinis ssp. neglecta)* | | Terrestrial | |
| Pentachaeta, Lyon's | Endangered | Dicot | No |
| *(Pentachaeta lyonii)* | | Terrestrial | |
| Pentachaeta, White-rayed | Endangered | Dicot | No |
| *(Pentachaeta bellidiflora)* | | Terrestrial | |
| Phlox, Yreka | Endangered | Dicot | No |
| *(Phlox hirsuta)* | | Terrestrial | |
| Potentilla, Hickman's | Endangered | Dicot | No |
| *(Potentilla hickmanii)* | | Terrestrial | |
| Pussypaws, Mariposa | Threatened | Dicot | No |
| *(Calyptridium pulchellum)* | | Terrestrial | |
| Rock-cress, McDonald's | Endangered | Dicot | No |
| *(Arabis mcdonaldiana)* | | Terrestrial | |
| Rock-cress, Santa Cruz Island | Endangered | Dicot | No |
| *(Sibara filifolia)* | | Terrestrial | |
| Rush-rose, Island | Threatened | Dicot | No |
| *(Helianthemum greenei)* | | Terrestrial | |
| Sandwort, Bear Valley | Threatened | Dicot | No |
| *(Arenaria ursina)* | | Terrestrial | |
| Sandwort, Marsh | Endangered | Dicot | No |
| *(Arenaria paludicola)* | | Freshwater, Terrestrial | |
| Sea-blite, California | Endangered | Dicot | No |
| *(Suaeda californica)* | | Terrestrial | |
| Spineflower, Howell's | Endangered | Dicot | No |
| *(Chorizanthe howellii)* | | Terrestrial | |
| Spineflower, Monterey | Threatened | Dicot | Yes |
| *(Chorizanthe pungens var. pungens)* | | Terrestrial | |
| Spineflower, Orcutt's | Endangered | Dicot | No |
| *(Chorizanthe orcuttiana)* | | Terrestrial | |
| Spineflower, Robust | Endangered | Dicot | Yes |
| *(Chorizanthe robusta var. robusta)* | | Terrestrial | |
| Spineflower, Slender-horned | Endangered | Dicot | No |
| *(Dodecahema leptoceras)* | | Terrestrial | |
| Spineflower, Sonoma | Endangered | Dicot | No |
| *(Chorizanthe valida)* | | Terrestrial | |

| California | ( 230) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Spurge, Hoover's | | Threatened | Dicot | Yes |
| *(Chamaesyce hooveri)* | | | Vernal pool | |
| Stickyseed, Baker's | | Endangered | Dicot | No |
| *(Blennosperma bakeri)* | | | Vernal pool | |
| Stonecrop, Lake County | | Endangered | Dicot | No |
| *(Parvisedum leiocarpum)* | | | Vernal pool | |
| Taraxacum, California | | Endangered | Dicot | No |
| *(Taraxacum californicum)* | | | Terrestrial | |
| Tarplant, Otay | | Threatened | Dicot | Yes |
| *(Deinandra (=Hemizonia) conjugens)* | | | Terrestrial | |
| Tarplant, Santa Cruz | | Threatened | Dicot | Yes |
| *(Holocarpha macradenia)* | | | Terrestrial | |
| Thistle, Chorro creek Bog | | Endangered | Dicot | No |
| *(Cirsium fontinale var. obispoense)* | | | Terrestrial, Freshwater | |
| Thistle, Fountain | | Endangered | Dicot | No |
| *(Cirsium fontinale var. fontinale)* | | | Terrestrial | |
| Thistle, La Graciosa | | Endangered | Dicot | Yes |
| *(Cirsium loncholepis)* | | | Coastal (neritic), Freshwater, | |
| Thistle, Suisun | | Endangered | Dicot | No |
| *(Cirsium hydrophilum var. hydrophilum)* | | | Brackish, Terrestrial | |
| Thornmint, San Diego | | Threatened | Dicot | No |
| *(Acanthomintha ilicifolia)* | | | Terrestrial | |
| Tuctoria, Green's | | Endangered | Dicot | Yes |
| *(Tuctoria greenei)* | | | Vernal pool | |
| Wallflower, Contra Costa | | Endangered | Dicot | Yes |
| *(Erysimum capitatum var. angustatum)* | | | Terrestrial | |
| Wallflower, Menzie's | | Endangered | Dicot | No |
| *(Erysimum menziesii)* | | | Terrestrial | |
| Watercress, Gambel's | | Endangered | Dicot | No |
| *(Rorippa gambellii)* | | | Terrestrial, Brackish, Freshwater | |
| Woodland-star, San Clemente Island | | Endangered | Dicot | No |
| *(Lithophragma maximum)* | | | Terrestrial | |
| Woolly-star, Santa Ana River | | Endangered | Dicot | No |
| *(Eriastrum densifolium ssp. sanctorum)* | | | Terrestrial | |
| Woolly-threads, San Joaquin | | Endangered | Dicot | No |
| *(Monolopia (=Lembertia) congdonii)* | | | Terrestrial | |
| Chub, Bonytail | | Endangered | Fish | Yes |
| *(Gila elegans)* | | | Freshwater | |
| Chub, Hutton Tui | | Threatened | Fish | No |
| *(Gila bicolor ssp.)* | | | Freshwater | |
| Chub, Mohave Tui | | Endangered | Fish | No |
| *(Gila bicolor mohavensis)* | | | Freshwater | |

| **California** ( 230) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|
| Goby, Tidewater | Endangered | Fish | Yes |
| *(Eucyclogobius newberryi)* | | Freshwater | |
| Pupfish, Desert | Endangered | Fish | Yes |
| *(Cyprinodon macularius)* | | Freshwater | |
| Salmon, Chinook (California Coastal Run) | Threatened | Fish | Yes |
| *(Oncorhynchus (=Salmo) tshawytscha)* | | Freshwater, Saltwater, Brackish | |
| Salmon, Chinook (Central Valley Fall Run) | Threatened | Fish | No |
| *(Oncorhynchus (=Salmo) tshawytscha)* | | Brackish, Freshwater, Saltwater | |
| Salmon, Chinook (Central Valley Spring Run) | Threatened | Fish | Yes |
| *(Oncorhynchus (=Salmo) tshawytscha)* | | Brackish, Saltwater, Freshwater | |
| Salmon, Chinook (Sacramento River Winter Run) | Endangered | Fish | No |
| *(Oncorhynchus (=Salmo) tshawytscha)* | | Saltwater, Freshwater, Brackish | |
| Salmon, Coho (Central California Coast population) | Endangered | Fish | No |
| *(Oncorhynchus (=Salmo) kisutch)* | | Saltwater, Brackish, Freshwater | |
| Salmon, Coho (Southern OR/Northern CA Coast) | Threatened | Fish | Yes |
| *(Oncorhynchus (=Salmo) kisutch)* | | Freshwater, Brackish, Saltwater | |
| Smelt, Delta | Threatened | Fish | Yes |
| *(Hypomesus transpacificus)* | | Freshwater, Brackish | |
| Squawfish, Colorado | Endangered | Fish | Yes |
| *(Ptychocheilus lucius)* | | Freshwater | |
| Steelhead, (California Central Valley population) | Threatened | Fish | Yes |
| *(Oncorhynchus (=Salmo) mykiss)* | | Brackish, Freshwater, Saltwater | |
| Steelhead, (Central California Coast population) | Threatened | Fish | Yes |
| *(Oncorhynchus (=Salmo) mykiss)* | | Freshwater, Saltwater, Brackish | |
| Steelhead, (Northern California population) | Threatened | Fish | No |
| *(Oncorhynchus (=Salmo) mykiss)* | | Saltwater, Brackish, Freshwater | |
| Steelhead, (South-Central California population) | Threatened | Fish | Yes |
| *(Oncorhynchus (=Salmo) mykiss)* | | Freshwater, Saltwater, Brackish | |
| Steelhead, (Southern California population) | Endangered | Fish | Yes |
| *(Oncorhynchus (=Salmo) mykiss)* | | Brackish, Saltwater, Freshwater | |
| Stickleback, Unarmored Threespine | Endangered | Fish | No |
| *(Gasterosteus aculeatus williamsoni)* | | Freshwater | |
| Sturgeon, green | Threatened | Fish | No |
| *(Acipenser medirostris)* | | | |
| Sucker, Lost River | Endangered | Fish | No |
| *(Deltistes luxatus)* | | Freshwater | |
| Sucker, Modoc | Endangered | Fish | Yes |
| *(Catostomus microps)* | | Freshwater | |
| Sucker, Razorback | Endangered | Fish | Yes |
| *(Xyrauchen texanus)* | | Freshwater | |
| Sucker, Santa Ana | Threatened | Fish | Yes |
| *(Catostomus santaanae)* | | Freshwater | |

| **California** | ( 230) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Sucker, Shortnose *(Chasmistes brevirostris)* | | Endangered | Fish Freshwater | No |
| Trout, Lahontan Cutthroat *(Oncorhynchus clarki henshawi)* | | Threatened | Fish Freshwater | No |
| Trout, Little Kern Golden *(Oncorhynchus aguabonita whitei)* | | Threatened | Fish Freshwater | Yes |
| Trout, Paiute Cutthroat *(Oncorhynchus clarki seleniris)* | | Threatened | Fish Freshwater | No |
| Snail, Morro Shoulderband *(Helminthoglypta walkeriana)* | | Endangered | Gastropod Terrestrial | Yes |
| Beetle, Delta Green Ground *(Elaphrus viridis)* | | Threatened | Insect Vernal pool, Terrestrial | Yes |
| Beetle, Valley Elderberry Longhorn *(Desmocerus californicus dimorphus)* | | Threatened | Insect Terrestrial | Yes |
| Butterfly, Bay Checkerspot (Wright's euphydryas) *(Euphydryas editha bayensis)* | | Threatened | Insect Terrestrial | Yes |
| Butterfly, Behren's Silverspot *(Speyeria zerene behrensii)* | | Endangered | Insect Terrestrial | No |
| Butterfly, El Segundo Blue *(Euphilotes battoides allyni)* | | Endangered | Insect Terrestrial | No |
| Butterfly, Lange's Metalmark *(Apodemia mormo langei)* | | Endangered | Insect Terrestrial | No |
| Butterfly, Lotis Blue *(Lycaeides argyrognomon lotis)* | | Endangered | Insect Terrestrial | No |
| Butterfly, Mission Blue *(Icaricia icarioides missionensis)* | | Endangered | Insect Terrestrial | No |
| Butterfly, Myrtle's Silverspot *(Speyeria zerene myrtleae)* | | Endangered | Insect Terrestrial | No |
| Butterfly, Palos Verdes Blue *(Glaucopsyche lygdamus palosverdesensis)* | | Endangered | Insect Terrestrial | Yes |
| Butterfly, Quino Checkerspot *(Euphydryas editha quino (=E. e. wrighti))* | | Endangered | Insect Terrestrial | Yes |
| Butterfly, Smith's Blue *(Euphilotes enoptes smithi)* | | Endangered | Insect Terrestrial | No |
| Fly, Delhi Sands Flower-loving *(Rhaphiomidas terminatus abdominalis)* | | Endangered | Insect Terrestrial | No |
| Moth, Kern Primrose Sphinx *(Euproserpinus euterpe)* | | Threatened | Insect Terrestrial | No |
| Skipper, Carson Wandering *(Pseudocopaeodes eunus obscurus)* | | Endangered | Insect Terrestrial | No |
| Skipper, Laguna Mountain *(Pyrgus ruralis lagunae)* | | Endangered | Insect Terrestrial | No |

| **California** | ( 230) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Fox, San Joaquin Kit<br>*(Vulpes macrotis mutica)* | | Endangered | Mammal<br>Terrestrial | No |
| Fox, Santa Catalina Island<br>*(Urocyon littoralis catalinae)* | | Endangered | Mammal<br>Terrestrial | Yes |
| Kangaroo Rat, Fresno<br>*(Dipodomys nitratoides exilis)* | | Endangered | Mammal<br>Terrestrial | Yes |
| Kangaroo Rat, Giant<br>*(Dipodomys ingens)* | | Endangered | Mammal<br>Terrestrial | No |
| Kangaroo Rat, Morro Bay<br>*(Dipodomys heermanni morroensis)* | | Endangered | Mammal<br>Terrestrial | Yes |
| Kangaroo Rat, San Bernardino Merriam's<br>*(Dipodomys merriami parvus)* | | Endangered | Mammal<br>Terrestrial | Yes |
| Kangaroo Rat, Stephens'<br>*(Dipodomys stephensi (incl. D. cascus))* | | Endangered | Mammal<br>Terrestrial | No |
| Kangaroo Rat, Tipton<br>*(Dipodomys nitratoides nitratoides)* | | Endangered | Mammal<br>Terrestrial | No |
| Mountain Beaver, Point Arena<br>*(Aplodontia rufa nigra)* | | Endangered | Mammal<br>Freshwater, Terrestrial | No |
| Mouse, Pacific Pocket<br>*(Perognathus longimembris pacificus)* | | Endangered | Mammal<br>Terrestrial | No |
| Mouse, Salt Marsh Harvest<br>*(Reithrodontomys raviventris)* | | Endangered | Mammal<br>Terrestrial | No |
| Rabbit, Riparian Brush<br>*(Sylvilagus bachmani riparius)* | | Endangered | Mammal<br>Terrestrial | No |
| Sheep, Peninsular Bighorn<br>*(Ovis canadensis)* | | Endangered | Mammal<br>Terrestrial | Yes |
| Sheep, Sierra Nevada Bighorn<br>*(Ovis canadensis californiana)* | | Endangered | Mammal<br>Terrestrial | No |
| Shrew, Buena Vista Lake Ornate<br>*(Sorex ornatus relictus)* | | Endangered | Mammal<br>Terrestrial | Yes |
| Vole, Amargosa<br>*(Microtus californicus scirpensis)* | | Endangered | Mammal<br>Terrestrial | Yes |
| Woodrat, Riparian<br>*(Neotoma fuscipes riparia)* | | Endangered | Mammal<br>Terrestrial | No |
| Otter, Southern Sea<br>*(Enhydra lutris nereis)* | | Threatened | Marine mml<br>Saltwater | No |
| Alopecurus, Sonoma<br>*(Alopecurus aequalis var. sonomensis)* | | Endangered | Monocot<br>Terrestrial | No |
| Amole, Cammatta Canyon<br>*(Chlorogalum purpureum var. reductum)* | | Threatened | Monocot<br>Terrestrial | Yes |
| Amole, Purple<br>*(Chlorogalum purpureum var. purpureum)* | | Threatened | Monocot<br>Terrestrial | Yes |

| **California** | (230) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Bluegrass, Napa *(Poa napensis)* | | Endangered | Monocot Terrestrial, Freshwater | No |
| Bluegrass, San Bernardino *(Poa atropurpurea)* | | Endangered | Monocot Terrestrial | No |
| Brodiaea, Thread-leaved *(Brodiaea filifolia)* | | Threatened | Monocot Terrestrial | Yes |
| Grass, California Orcutt *(Orcuttia californica)* | | Endangered | Monocot Vernal pool, Terrestrial | No |
| Grass, Colusa *(Neostapfia colusana)* | | Threatened | Monocot Vernal pool | No |
| Grass, San Joaquin Valley Orcutt *(Orcuttia inaequalis)* | | Threatened | Monocot Vernal pool | Yes |
| Grass, Solano *(Tuctoria mucronata)* | | Endangered | Monocot Vernal pool, Terrestrial | Yes |
| Lily, Pitkin Marsh *(Lilium pardalinum ssp. pitkinense)* | | Endangered | Monocot Freshwater | No |
| Onion, Munz's *(Allium munzii)* | | Endangered | Monocot Terrestrial | No |
| Piperia, Yadon's *(Piperia yadonii)* | | Endangered | Monocot Terrestrial | No |
| Sedge, White *(Carex albida)* | | Endangered | Monocot Freshwater, Terrestrial | No |
| Lizard, Blunt-nosed Leopard *(Gambelia silus)* | | Endangered | Reptile Terrestrial | No |
| Lizard, Coachella Valley Fringe-toed *(Uma inornata)* | | Threatened | Reptile Terrestrial | Yes |
| Lizard, Island Night *(Xantusia riversiana)* | | Threatened | Reptile Terrestrial | No |
| Sea turtle, olive ridley *(Lepidochelys olivacea)* | | Threatened | Reptile Saltwater | No |
| Snake, Giant Garter *(Thamnophis gigas)* | | Threatened | Reptile Freshwater, Terrestrial | No |
| Tortoise, Desert *(Gopherus agassizii)* | | Threatened | Reptile Terrestrial | Yes |
| Whipsnake (=Striped Racer), Alameda *(Masticophis lateralis euryxanthus)* | | Threatened | Reptile Terrestrial | Yes |

| **Colorado** | (21) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Crane, Whooping *(Grus americana)* | | Endangered | Bird Terrestrial, Freshwater | Yes |
| Owl, Mexican Spotted *(Strix occidentalis lucida)* | | Threatened | Bird Terrestrial | Yes |
| Bladderpod, Dudley Bluffs *(Lesquerella congesta)* | | Threatened | Dicot Terrestrial | No |

## Colorado ( 21) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Butterfly Plant, Colorado *(Gaura neomexicana var. coloradensis)* | Threatened | Dicot Terrestrial | Yes |
| Cactus, Knowlton *(Pediocactus knowltonii)* | Endangered | Dicot Terrestrial | No |
| Cactus, Mesa Verde *(Sclerocactus mesae-verdae)* | Threatened | Dicot Terrestrial | No |
| Cactus, Uinta Basin Hookless *(Sclerocactus glaucus)* | Threatened | Dicot Terrestrial | No |
| Milk-vetch, Mancos *(Astragalus humillimus)* | Endangered | Dicot Terrestrial | No |
| Twinpod, Dudley Bluffs *(Physaria obcordata)* | Threatened | Dicot Terrestrial | No |
| Wild-buckwheat, Clay-loving *(Eriogonum pelinophilum)* | Endangered | Dicot Terrestrial | Yes |
| Chub, Bonytail *(Gila elegans)* | Endangered | Fish Freshwater | Yes |
| Chub, Humpback *(Gila cypha)* | Endangered | Fish Freshwater | Yes |
| Squawfish, Colorado *(Ptychocheilus lucius)* | Endangered | Fish Freshwater | Yes |
| Sucker, Razorback *(Xyrauchen texanus)* | Endangered | Fish Freshwater | Yes |
| Trout, Bull *(Salvelinus confluentus)* | Threatened | Fish Freshwater | No |
| Trout, Greenback Cutthroat *(Oncorhynchus clarki stomias)* | Threatened | Fish Freshwater | No |
| Butterfly, Uncompahgre Fritillary *(Boloria acrocnema)* | Endangered | Insect Terrestrial | No |
| Skipper, Pawnee Montane *(Hesperia leonardus montana)* | Threatened | Insect Terrestrial | No |
| Ferret, Black-footed *(Mustela nigripes)* | Endangered | Mammal Terrestrial | No |
| Mouse, Preble's Meadow Jumping *(Zapus hudsonius preblei)* | Threatened | Mammal Terrestrial | Yes |
| Ladies'-tresses, Ute *(Spiranthes diluvialis)* | Threatened | Monocot Terrestrial | No |

## Connecticut ( 3) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Mussel, Dwarf Wedge *(Alasmidonta heterodon)* | Endangered | Bivalve Freshwater | No |
| Sturgeon, Shortnose *(Acipenser brevirostrum)* | Endangered | Fish Saltwater, Freshwater | No |

## *Delaware* ( 6) species:

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

## *Florida* ( 56) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Salamander, Flatwoods *(Ambystoma cingulatum)* | Threatened | Amphibian<br>Freshwater, Vernal pool, Terrestrial | No |
| Caracara, Audubon's Crested *(Polyborus plancus audubonii)* | Threatened | Bird<br>Terrestrial | No |
| Kite, Everglade Snail *(Rostrhamus sociabilis plumbeus)* | Endangered | Bird<br>Terrestrial | Yes |
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird<br>Terrestrial | Yes |
| Scrub-Jay, Florida *(Aphelocoma coerulescens)* | Threatened | Bird<br>Terrestrial | No |
| Sparrow, Florida Grasshopper *(Ammodramus savannarum floridanus)* | Endangered | Bird<br>Terrestrial | No |
| Stork, Wood *(Mycteria americana)* | Endangered | Bird<br>Terrestrial | No |
| Woodpecker, Red-cockaded *(Picoides borealis)* | Endangered | Bird<br>Terrestrial | No |
| Bankclimber, Purple *(Elliptoideus sloatianus)* | Threatened | Bivalve<br>Freshwater | No |
| Mussel, Gulf Moccasinshell *(Medionidus penicillatus)* | Endangered | Bivalve<br>Freshwater | No |
| Mussel, Oval Pigtoe *(Pleurobema pyriforme)* | Endangered | Bivalve<br>Freshwater | No |
| Mussel, Shiny-rayed Pocketbook *(Lampsilis subangulata)* | Endangered | Bivalve<br>Freshwater | No |
| Slabshell, Chipola *(Elliptio chipolaensis)* | Threatened | Bivalve<br>Freshwater | No |
| Threeridge, Fat (Mussel) *(Amblema neislerii)* | Endangered | Bivalve<br>Freshwater | No |
| Torreya, Florida *(Torreya taxifolia)* | Endangered | Conf/cycds<br>Terrestrial | No |

| **Florida** | ( 56) species: | | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|---|
| Birds-in-a-nest, White | | Threatened | | Dicot | No |
| *(Macbridea alba)* | | | Terrestrial | | |
| Blazing Star, Scrub | | Endangered | | Dicot | No |
| *(Liatris ohlingerae)* | | | Terrestrial | | |
| Bonamia, Florida | | Threatened | | Dicot | No |
| *(Bonamia grandiflora)* | | | Terrestrial | | |
| Buckwheat, Scrub | | Threatened | | Dicot | No |
| *(Eriogonum longifolium var. gnaphalifolium)* | | | Terrestrial | | |
| Butterwort, Godfrey's | | Threatened | | Dicot | No |
| *(Pinguicula ionantha)* | | | Terrestrial, Freshwater | | |
| Fringe Tree, Pygmy | | Endangered | | Dicot | No |
| *(Chionanthus pygmaeus)* | | | Terrestrial | | |
| Harebells, Avon Park | | Endangered | | Dicot | No |
| *(Crotalaria avonensis)* | | | Terrestrial | | |
| Hypericum, Highlands Scrub | | Endangered | | Dicot | No |
| *(Hypericum cumulicola)* | | | Terrestrial | | |
| Lupine, Scrub | | Endangered | | Dicot | No |
| *(Lupinus aridorum)* | | | Terrestrial | | |
| Meadowrue, Cooley's | | Endangered | | Dicot | No |
| *(Thalictrum cooleyi)* | | | Terrestrial | | |
| Mustard, Carter's | | Endangered | | Dicot | No |
| *(Warea carteri)* | | | Terrestrial | | |
| Pinkroot, Gentian | | Endangered | | Dicot | No |
| *(Spigelia gentianoides)* | | | Terrestrial | | |
| Plum, Scrub | | Endangered | | Dicot | No |
| *(Prunus geniculata)* | | | Terrestrial | | |
| Polygala, Lewton's | | Endangered | | Dicot | No |
| *(Polygala lewtonii)* | | | Terrestrial | | |
| Rosemary, Short-leaved | | Endangered | | Dicot | No |
| *(Conradina brevifolia)* | | | Terrestrial | | |
| Sandlace | | Endangered | | Dicot | No |
| *(Polygonella myriophylla)* | | | Terrestrial | | |
| Spurge, Telephus | | Threatened | | Dicot | No |
| *(Euphorbia telephioides)* | | | Terrestrial | | |
| Warea, Wide-leaf | | Endangered | | Dicot | No |
| *(Warea amplexifolia)* | | | Terrestrial | | |
| Whitlow-wort, Papery | | Threatened | | Dicot | No |
| *(Paronychia chartacea)* | | | Terrestrial | | |
| Wings, Pigeon | | Threatened | | Dicot | No |
| *(Clitoria fragrans)* | | | Terrestrial | | |
| Wireweed | | Endangered | | Dicot | No |
| *(Polygonella basiramia)* | | | Terrestrial | | |

| **Florida** | ( 56) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Ziziphus, Florida | | Endangered | Dicot | No |
| *(Ziziphus celata)* | | | Terrestrial | |
| Darter, Okaloosa | | Endangered | Fish | No |
| *(Etheostoma okaloosae)* | | | Freshwater | |
| Sturgeon, Gulf | | Threatened | Fish | Yes |
| *(Acipenser oxyrinchus desotoi)* | | | Saltwater, Freshwater | |
| Cladonia, Florida Perforate | | Endangered | Lichen | No |
| *(Cladonia perforata)* | | | Terrestrial | |
| Bat, Gray | | Endangered | Mammal | No |
| *(Myotis grisescens)* | | | Subterraneous, Terrestrial | |
| Bat, Indiana | | Endangered | Mammal | Yes |
| *(Myotis sodalis)* | | | Subterraneous, Terrestrial | |
| Mouse, Choctawhatchee Beach | | Endangered | Mammal | Yes |
| *(Peromyscus polionotus allophrys)* | | | Coastal (neritic), Terrestrial | |
| Mouse, Perdido Key Beach | | Endangered | Mammal | Yes |
| *(Peromyscus polionotus trissyllepsis)* | | | Coastal (neritic) | |
| Panther, Florida | | Endangered | Mammal | No |
| *(Puma (=Felis) concolor coryi)* | | | Terrestrial | |
| Vole, Florida Salt Marsh | | Endangered | Mammal | No |
| *(Microtus pennsylvanicus dukecampbelli)* | | | Terrestrial, Brackish | |
| Manatee, West Indian | | Endangered | Marine mml | Yes |
| *(Trichechus manatus)* | | | Saltwater | |
| Beargrass, Britton's | | Endangered | Monocot | No |
| *(Nolina brittoniana)* | | | Terrestrial | |
| Sea turtle, green | | Endangered | Reptile | No |
| *(Chelonia mydas)* | | | Saltwater | |
| Sea turtle, hawksbill | | Endangered | Reptile | Yes |
| *(Eretmochelys imbricata)* | | | Saltwater | |
| Sea turtle, Kemp's ridley | | Endangered | Reptile | No |
| *(Lepidochelys kempii)* | | | Saltwater | |
| Sea turtle, leatherback | | Endangered | Reptile | Yes |
| *(Dermochelys coriacea)* | | | Saltwater | |
| Sea turtle, loggerhead | | Threatened | Reptile | No |
| *(Caretta caretta)* | | | Saltwater | |
| Skink, Blue-tailed Mole | | Threatened | Reptile | No |
| *(Eumeces egregius lividus)* | | | Terrestrial | |
| Skink, Sand | | Threatened | Reptile | No |
| *(Neoseps reynoldsi)* | | | Terrestrial | |
| Snake, Eastern Indigo | | Threatened | Reptile | No |
| *(Drymarchon corais couperi)* | | | Terrestrial | |

| **Georgia** | ( 56) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Salamander, Flatwoods | | Threatened | Amphibian | No |
| *(Ambystoma cingulatum)* | | | Freshwater, Vernal pool, Terrestrial | |

## Georgia ( 56) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Stork, Wood *(Mycteria americana)* | Endangered | Bird Terrestrial | No |
| Warbler (=Wood), Kirtland's *(Dendroica kirtlandii)* | Endangered | Bird Terrestrial | No |
| Woodpecker, Red-cockaded *(Picoides borealis)* | Endangered | Bird Terrestrial | No |
| Bankclimber, Purple *(Elliptoideus sloatianus)* | Threatened | Bivalve Freshwater | No |
| Combshell, Upland *(Epioblasma metastriata)* | Endangered | Bivalve Freshwater | Yes |
| Kidneyshell, Triangular *(Ptychobranchus greenii)* | Endangered | Bivalve Freshwater | Yes |
| Mucket, Pink (Pearlymussel) *(Lampsilis abrupta)* | Endangered | Bivalve Freshwater | No |
| Mussel, Acornshell Southern *(Epioblasma othcaloogensis)* | Endangered | Bivalve Freshwater | Yes |
| Mussel, Alabama Moccasinshell *(Medionidus acutissimus)* | Threatened | Bivalve Freshwater | Yes |
| Mussel, Coosa Moccasinshell *(Medionidus parvulus)* | Endangered | Bivalve Freshwater | Yes |
| Mussel, Fine-lined Pocketbook *(Lampsilis altilis)* | Threatened | Bivalve Freshwater | Yes |
| Mussel, Gulf Moccasinshell *(Medionidus penicillatus)* | Endangered | Bivalve Freshwater | No |
| Mussel, Oval Pigtoe *(Pleurobema pyriforme)* | Endangered | Bivalve Freshwater | No |
| Mussel, Ovate Clubshell *(Pleurobema perovatum)* | Endangered | Bivalve Freshwater | Yes |
| Mussel, Shiny-rayed Pocketbook *(Lampsilis subangulata)* | Endangered | Bivalve Freshwater | No |
| Mussel, Southern Clubshell *(Pleurobema decisum)* | Endangered | Bivalve Freshwater | Yes |
| Mussel, Southern Pigtoe *(Pleurobema georgianum)* | Endangered | Bivalve Freshwater | Yes |
| Threeridge, Fat (Mussel) *(Amblema neislerii)* | Endangered | Bivalve Freshwater | No |
| Torreya, Florida *(Torreya taxifolia)* | Endangered | Conf/cycds Terrestrial | No |
| Amphianthus, Little *(Amphianthus pusillus)* | Threatened | Dicot Freshwater | No |

| **Georgia** | ( 56) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|---|
| Barbara Buttons, Mohr's *(Marshallia mohrii)* | | Threatened | Dicot Terrestrial | No |
| Campion, Fringed *(Silene polypetala)* | | Endangered | Dicot Terrestrial | No |
| Dropwort, Canby's *(Oxypolis canbyi)* | | Endangered | Dicot Terrestrial, Freshwater | No |
| Harperella *(Ptilimnium nodosum)* | | Endangered | Dicot Freshwater | No |
| Pitcher-plant, Green *(Sarracenia oreophila)* | | Endangered | Dicot Terrestrial, Freshwater | No |
| Pondberry *(Lindera melissifolia)* | | Endangered | Dicot Terrestrial | No |
| Rattleweed, Hairy *(Baptisia arachnifera)* | | Endangered | Dicot Terrestrial | No |
| Skullcap, Large-flowered *(Scutellaria montana)* | | Threatened | Dicot Terrestrial | No |
| Spiraea, Virginia *(Spiraea virginiana)* | | Threatened | Dicot Terrestrial | No |
| Sumac, Michaux's *(Rhus michauxii)* | | Endangered | Dicot Terrestrial | No |
| Quillwort, Black-spored *(Isoetes melanospora)* | | Endangered | Ferns Vernal pool | No |
| Quillwort, Mat-forming *(Isoetes tegetiformans)* | | Endangered | Ferns Vernal pool | No |
| Chub, Spotfin *(Erimonax monachus)* | | Threatened | Fish Freshwater | Yes |
| Darter, Amber *(Percina antesella)* | | Endangered | Fish Freshwater | Yes |
| Darter, Cherokee *(Etheostoma scotti)* | | Threatened | Fish Freshwater | No |
| Darter, Etowah *(Etheostoma etowahae)* | | Endangered | Fish Freshwater | No |
| Darter, Goldline *(Percina aurolineata)* | | Threatened | Fish Freshwater | No |
| Darter, Snail *(Percina tanasi)* | | Threatened | Fish Freshwater | No |
| Logperch, Conasauga *(Percina jenkinsi)* | | Endangered | Fish Freshwater | Yes |
| Madtom, Yellowfin *(Noturus flavipinnis)* | | Threatened | Fish Freshwater | Yes |
| Shiner, Blue *(Cyprinella caerulea)* | | Threatened | Fish Freshwater | No |

| **Georgia** | ( 56) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|---|
| Sturgeon, Gulf | | Threatened | Fish | Yes |
| *(Acipenser oxyrinchus desotoi)* | | | Saltwater, Freshwater | |
| Sturgeon, Shortnose | | Endangered | Fish | No |
| *(Acipenser brevirostrum)* | | | Saltwater, Freshwater | |
| Beetle, American Burying | | Endangered | Insect | No |
| *(Nicrophorus americanus)* | | | Terrestrial | |
| Bat, Gray | | Endangered | Mammal | No |
| *(Myotis grisescens)* | | | Subterraneous, Terrestrial | |
| Bat, Indiana | | Endangered | Mammal | Yes |
| *(Myotis sodalis)* | | | Subterraneous, Terrestrial | |
| Manatee, West Indian | | Endangered | Marine mml | Yes |
| *(Trichechus manatus)* | | | Saltwater | |
| Grass, Tennessee Yellow-eyed | | Endangered | Monocot | No |
| *(Xyris tennesseensis)* | | | Terrestrial | |
| Pogonia, Small Whorled | | Threatened | Monocot | No |
| *(Isotria medeoloides)* | | | Terrestrial | |
| Trillium, Persistent | | Endangered | Monocot | No |
| *(Trillium persistens)* | | | Terrestrial | |
| Trillium, Relict | | Endangered | Monocot | No |
| *(Trillium reliquum)* | | | Terrestrial | |
| Water-plantain, Kral's | | Threatened | Monocot | No |
| *(Sagittaria secundifolia)* | | | Freshwater | |
| Sea turtle, loggerhead | | Threatened | Reptile | No |
| *(Caretta caretta)* | | | Saltwater | |
| Snake, Eastern Indigo | | Threatened | Reptile | No |
| *(Drymarchon corais couperi)* | | | Terrestrial | |

| **Idaho** | ( 21) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|---|
| Crane, Whooping | | Endangered | Bird | Yes |
| *(Grus americana)* | | | Terrestrial, Freshwater | |
| Catchfly, Spalding's | | Threatened | Dicot | No |
| *(Silene spaldingii)* | | | Terrestrial | |
| Four-o'clock, Macfarlane's | | Threatened | Dicot | No |
| *(Mirabilis macfarlanei)* | | | Terrestrial | |
| Howellia, Water | | Threatened | Dicot | No |
| *(Howellia aquatilis)* | | | Freshwater | |
| Salmon, Chinook (Snake River Fall Run) | | Threatened | Fish | No |
| *(Oncorhynchus (=Salmo) tshawytscha)* | | | Freshwater, Saltwater, Brackish | |
| Salmon, Chinook (Snake River spring/summer) | | Threatened | Fish | Yes |
| *(Oncorhynchus (=Salmo) tshawytscha)* | | | Brackish, Saltwater, Freshwater | |
| Salmon, Sockeye (Snake River population) | | Endangered | Fish | No |
| *(Oncorhynchus (=Salmo) nerka)* | | | Brackish, Saltwater, Freshwater | |
| Steelhead, (Snake River Basin population) | | Threatened | Fish | Yes |
| *(Oncorhynchus (=Salmo) mykiss)* | | | Freshwater, Brackish, Saltwater | |

| **Idaho** | ( 21) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Sturgeon, White | | Endangered | Fish | Yes |
| *(Acipenser transmontanus)* | | | Saltwater, Freshwater | |
| Trout, Bull | | Threatened | Fish | No |
| *(Salvelinus confluentus)* | | | Freshwater | |
| Trout, Bull (Columbia River population) | | Threatened | Fish | Yes |
| *(Salvelinus confluentus)* | | | Freshwater | |
| Trout, Bull (Klamath River population) | | Threatened | Fish | Yes |
| *(Salvelinus confluentus)* | | | Freshwater | |
| Limpet, Banbury Springs | | Endangered | Gastropod | No |
| *(Lanx sp.)* | | | Freshwater | |
| Snail, Bliss Rapids | | Threatened | Gastropod | No |
| *(Taylorconcha serpenticola)* | | | Freshwater | |
| Snail, Snake River Physa | | Endangered | Gastropod | No |
| *(Physa natricina)* | | | Terrestrial | |
| Snail, Utah Valvata | | Endangered | Gastropod | No |
| *(Valvata utahensis)* | | | Terrestrial | |
| Springsnail, Bruneau Hot | | Endangered | Gastropod | No |
| *(Pyrgulopsis bruneauensis)* | | | Freshwater | |
| Bear, Grizzly | | Threatened | Mammal | No |
| *(Ursus arctos horribilis)* | | | Terrestrial | |
| Caribou, Woodland | | Endangered | Mammal | No |
| *(Rangifer tarandus caribou)* | | | Terrestrial | |
| Squirrel, Northern Idaho Ground | | Threatened | Mammal | No |
| *(Spermophilus brunneus brunneus)* | | | Terrestrial | |
| Wolf, Gray | | Endangered | Mammal | Yes |
| *(Canis lupus)* | | | Terrestrial | |

| **Illinois** | ( 25) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Plover, Piping | | Endangered | Bird | Yes |
| *(Charadrius melodus)* | | | Terrestrial | |
| Tern, Interior (population) Least | | Endangered | Bird | No |
| *(Sterna antillarum)* | | | Terrestrial | |
| Fanshell | | Endangered | Bivalve | No |
| *(Cyprogenia stegaria)* | | | Freshwater | |
| Mucket, Pink (Pearlymussel) | | Endangered | Bivalve | No |
| *(Lampsilis abrupta)* | | | Freshwater | |
| Mussel, Clubshell | | Endangered | Bivalve | No |
| *(Pleurobema clava)* | | | Freshwater | |
| Pearlymussel, Fat Pocketbook | | Endangered | Bivalve | No |
| *(Potamilus capax)* | | | Freshwater | |
| Pearlymussel, Higgins' Eye | | Endangered | Bivalve | No |
| *(Lampsilis higginsii)* | | | Freshwater | |
| Pearlymussel, Orange-footed | | Endangered | Bivalve | No |
| *(Plethobasus cooperianus)* | | | Freshwater | |

## ***Illinois*** ( 25) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Pearlymussel, White Wartyback *(Plethobasus cicatricosus)* | Endangered | Bivalve<br>Freshwater | No |
| Amphipod, Illinois Cave *(Gammarus acherondytes)* | Endangered | Crustacean<br>Subterraneous, Freshwater | No |
| Aster, Decurrent False *(Boltonia decurrens)* | Threatened | Dicot<br>Terrestrial, Freshwater | No |
| Clover, Leafy Prairie *(Dalea foliosa)* | Endangered | Dicot<br>Terrestrial | No |
| Clover, Prairie Bush *(Lespedeza leptostachya)* | Threatened | Dicot<br>Terrestrial | No |
| Daisy, Lakeside *(Hymenoxys herbacea)* | Threatened | Dicot<br>Freshwater | No |
| Milkweed, Mead's *(Asclepias meadii)* | Threatened | Dicot<br>Terrestrial | No |
| Potato-bean, Price's *(Apios priceana)* | Threatened | Dicot<br>Terrestrial | No |
| Thistle, Pitcher's *(Cirsium pitcheri)* | Threatened | Dicot<br>Terrestrial | No |
| Sturgeon, Pallid *(Scaphirhynchus albus)* | Endangered | Fish<br>Freshwater | No |
| Snail, Iowa Pleistocene *(Discus macclintocki)* | Endangered | Gastropod<br>Terrestrial | No |
| Butterfly, Karner Blue *(Lycaeides melissa samuelis)* | Endangered | Insect<br>Terrestrial | No |
| Dragonfly, Hine's Emerald *(Somatochlora hineana)* | Endangered | Insect<br>Freshwater, Terrestrial | Yes |
| Bat, Gray *(Myotis grisescens)* | Endangered | Mammal<br>Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal<br>Subterraneous, Terrestrial | Yes |
| Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)* | Threatened | Monocot<br>Terrestrial | No |
| Pogonia, Small Whorled *(Isotria medeoloides)* | Threatened | Monocot<br>Terrestrial | No |

## ***Indiana*** ( 23) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird<br>Terrestrial | Yes |
| Tern, Interior (population) Least *(Sterna antillarum)* | Endangered | Bird<br>Terrestrial | No |
| Fanshell *(Cyprogenia stegaria)* | Endangered | Bivalve<br>Freshwater | No |
| Mucket, Pink (Pearlymussel) *(Lampsilis abrupta)* | Endangered | Bivalve<br>Freshwater | No |

| **Indiana** | ( 23) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Mussel, Clubshell *(Pleurobema clava)* | | Endangered | Bivalve Freshwater | No |
| Mussel, Ring Pink (=Golf Stick Pearly) *(Obovaria retusa)* | | Endangered | Bivalve Freshwater | No |
| Mussel, Rough Pigtoe *(Pleurobema plenum)* | | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Fat Pocketbook *(Potamilus capax)* | | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Orange-footed *(Plethobasus cooperianus)* | | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Tubercled-blossom *(Epioblasma torulosa torulosa)* | | Endangered | Bivalve Freshwater | No |
| Pearlymussel, White Cat's Paw *(Epioblasma obliquata perobliqua)* | | Endangered | Bivalve Freshwater | No |
| Pearlymussel, White Wartyback *(Plethobasus cicatricosus)* | | Endangered | Bivalve Freshwater | No |
| Riffleshell, Northern *(Epioblasma torulosa rangiana)* | | Endangered | Bivalve Freshwater | No |
| Clover, Running Buffalo *(Trifolium stoloniferum)* | | Endangered | Dicot Terrestrial | No |
| Goldenrod, Short's *(Solidago shortii)* | | Endangered | Dicot Terrestrial | No |
| Milkweed, Mead's *(Asclepias meadii)* | | Threatened | Dicot Terrestrial | No |
| Thistle, Pitcher's *(Cirsium pitcheri)* | | Threatened | Dicot Terrestrial | No |
| Butterfly, Karner Blue *(Lycaeides melissa samuelis)* | | Endangered | Insect Terrestrial | No |
| Butterfly, Mitchell's Satyr *(Neonympha mitchellii mitchellii)* | | Endangered | Insect Terrestrial | No |
| Bat, Gray *(Myotis grisescens)* | | Endangered | Mammal Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)* | | Threatened | Monocot Terrestrial | No |
| Snake, Northern Copperbelly Water *(Nerodia erythrogaster neglecta)* | | Threatened | Reptile Freshwater, Terrestrial | No |

| **Iowa** | ( 14) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | | Endangered | Bird Terrestrial | Yes |
| Tern, Interior (population) Least *(Sterna antillarum)* | | Endangered | Bird Terrestrial | No |

| **Iowa** | ( 14) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|---|
| Pearlymussel, Fat Pocketbook *(Potamilus capax)* | | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Higgins' Eye *(Lampsilis higginsii)* | | Endangered | Bivalve Freshwater | No |
| Clover, Prairie Bush *(Lespedeza leptostachya)* | | Threatened | Dicot Terrestrial | No |
| Milkweed, Mead's *(Asclepias meadii)* | | Threatened | Dicot Terrestrial | No |
| Monkshood, Northern Wild *(Aconitum noveboracense)* | | Threatened | Dicot Terrestrial | No |
| Fern, American hart's-tongue *(Asplenium scolopendrium var. americanum)* | | Threatened | Ferns Terrestrial | No |
| Shiner, Topeka *(Notropis topeka (=tristis))* | | Endangered | Fish Freshwater | Yes |
| Sturgeon, Pallid *(Scaphirhynchus albus)* | | Endangered | Fish Freshwater | No |
| Snail, Iowa Pleistocene *(Discus macclintocki)* | | Endangered | Gastropod Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)* | | Threatened | Monocot Terrestrial | No |
| Orchid, Western Prairie Fringed *(Platanthera praeclara)* | | Threatened | Monocot Terrestrial | No |

| **Kansas** | ( 12) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|---|
| Crane, Whooping *(Grus americana)* | | Endangered | Bird Terrestrial, Freshwater | Yes |
| Plover, Piping *(Charadrius melodus)* | | Endangered | Bird Terrestrial | Yes |
| Tern, Interior (population) Least *(Sterna antillarum)* | | Endangered | Bird Terrestrial | No |
| Milkweed, Mead's *(Asclepias meadii)* | | Threatened | Dicot Terrestrial | No |
| Madtom, Neosho *(Noturus placidus)* | | Threatened | Fish Freshwater | No |
| Shiner, Arkansas River *(Notropis girardi)* | | Threatened | Fish Freshwater | Yes |
| Shiner, Topeka *(Notropis topeka (=tristis))* | | Endangered | Fish Freshwater | Yes |
| Sturgeon, Pallid *(Scaphirhynchus albus)* | | Endangered | Fish Freshwater | No |
| Beetle, American Burying *(Nicrophorus americanus)* | | Endangered | Insect Terrestrial | No |

## Kansas ( 12) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Bat, Gray | Endangered | Mammal | No |
| *(Myotis grisescens)* | | Subterraneous, Terrestrial | |
| Ferret, Black-footed | Endangered | Mammal | No |
| *(Mustela nigripes)* | | Terrestrial | |
| Orchid, Western Prairie Fringed | Threatened | Monocot | No |
| *(Platanthera praeclara)* | | Terrestrial | |

## Kentucky ( 47) species:

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

| **Kentucky** ( 47) species: | | Taxa | Critical Habitat |
|---|---|---|---|
| Pearlymussel, Dromedary *(Dromus dromas)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Fat Pocketbook *(Potamilus capax)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Little-wing *(Pegias fabula)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Orange-footed *(Plethobasus cooperianus)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Purple Cat's Paw *(Epioblasma obliquata obliquata)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Tubercled-blossom *(Epioblasma torulosa torulosa)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, White Wartyback *(Plethobasus cicatricosus)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Yellow-blossom *(Epioblasma florentina florentina)* | Endangered | Bivalve Freshwater | No |
| Riffleshell, Northern *(Epioblasma torulosa rangiana)* | Endangered | Bivalve Freshwater | No |
| Riffleshell, Tan *(Epioblasma florentina walkeri (=E. walkeri))* | Endangered | Bivalve Freshwater | No |
| Shrimp, Kentucky Cave *(Palaemonias ganteri)* | Endangered | Crustacean Freshwater | Yes |
| Clover, Running Buffalo *(Trifolium stoloniferum)* | Endangered | Dicot Terrestrial | No |
| Goldenrod, Short's *(Solidago shortii)* | Endangered | Dicot Terrestrial | No |
| Goldenrod, White-haired *(Solidago albopilosa)* | Threatened | Dicot Terrestrial | No |
| Potato-bean, Price's *(Apios priceana)* | Threatened | Dicot Terrestrial | No |
| Rock-cress, Large (=Braun's) *(Arabis perstellata E. L. Braun var. ampla Rollins)* | Endangered | Dicot Terrestrial | Yes |
| Rock-cress, Small *(Arabis perstellata E. L. Braun var. perstellata Fernald)* | Endangered | Dicot Terrestrial | Yes |
| Rosemary, Cumberland *(Conradina verticillata)* | Threatened | Dicot Terrestrial | No |
| Sandwort, Cumberland *(Arenaria cumberlandensis)* | Endangered | Dicot Terrestrial | No |
| Spiraea, Virginia *(Spiraea virginiana)* | Threatened | Dicot Terrestrial | No |
| Dace, Blackside *(Phoxinus cumberlandensis)* | Threatened | Fish Freshwater | No |

## Kentucky ( 47) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Darter, Bluemask (=jewel) *(Etheostoma /)* | Endangered | Fish Freshwater | No |
| Darter, Relict *(Etheostoma chienense)* | Endangered | Fish Freshwater | No |
| Shiner, Palezone *(Notropis albizonatus)* | Endangered | Fish Freshwater | No |
| Sturgeon, Pallid *(Scaphirhynchus albus)* | Endangered | Fish Freshwater | No |
| Beetle, American Burying *(Nicrophorus americanus)* | Endangered | Insect Terrestrial | No |
| Bat, Gray *(Myotis grisescens)* | Endangered | Mammal Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Bat, Virginia Big-eared *(Corynorhinus (=Plecotus) townsendii virginianus)* | Endangered | Mammal Terrestrial, Subterraneous | Yes |

## Louisiana ( 21) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Pelican, Brown *(Pelecanus occidentalis)* | Endangered | Bird Terrestrial | No |
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Tern, California Least *(Sterna antillarum browni)* | Endangered | Bird Terrestrial | No |
| Tern, Interior (population) Least *(Sterna antillarum)* | Endangered | Bird Terrestrial | No |
| Woodpecker, Red-cockaded *(Picoides borealis)* | Endangered | Bird Terrestrial | No |
| Mucket, Pink (Pearlymussel) *(Lampsilis abrupta)* | Endangered | Bivalve Freshwater | No |
| Mussel, Heelsplitter Inflated *(Potamilus inflatus)* | Threatened | Bivalve Freshwater | No |
| Pearlshell, Louisiana *(Margaritifera hembeli)* | Threatened | Bivalve Freshwater | No |
| Chaffseed, American *(Schwalbea americana)* | Endangered | Dicot Terrestrial | No |
| Quillwort, Louisiana *(Isoetes louisianensis)* | Endangered | Ferns Freshwater, Terrestrial | No |
| Sturgeon, Gulf *(Acipenser oxyrinchus desotoi)* | Threatened | Fish Saltwater, Freshwater | Yes |
| Sturgeon, Pallid *(Scaphirhynchus albus)* | Endangered | Fish Freshwater | No |
| Bear, Louisiana Black *(Ursus americanus luteolus)* | Threatened | Mammal Terrestrial | No |

| **Louisiana** ( 21) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|
| Manatee, West Indian *(Trichechus manatus)* | Endangered | Marine mml Saltwater | Yes |
| Sea turtle, green *(Chelonia mydas)* | Endangered | Reptile Saltwater | No |
| Sea turtle, hawksbill *(Eretmochelys imbricata)* | Endangered | Reptile Saltwater | Yes |
| Sea turtle, Kemp's ridley *(Lepidochelys kempii)* | Endangered | Reptile Saltwater | No |
| Sea turtle, leatherback *(Dermochelys coriacea)* | Endangered | Reptile Saltwater | Yes |
| Sea turtle, loggerhead *(Caretta caretta)* | Threatened | Reptile Saltwater | No |
| Tortoise, Gopher *(Gopherus polyphemus)* | Threatened | Reptile Terrestrial | No |
| Turtle, Ringed Sawback *(Graptemys oculifera)* | Threatened | Reptile Freshwater, Terrestrial | No |

| **Maine** ( 4) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Tern, Roseate *(Sterna dougallii dougallii)* | Endangered | Bird Terrestrial | No |
| Salmon, Atlantic *(Salmo salar)* | Endangered | Fish Brackish, Saltwater, Freshwater | No |
| Pogonia, Small Whorled *(Isotria medeoloides)* | Threatened | Monocot Terrestrial | No |

| **Maryland** ( 15) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Mussel, Dwarf Wedge *(Alasmidonta heterodon)* | Endangered | Bivalve Freshwater | No |
| Dropwort, Canby's *(Oxypolis canbyi)* | Endangered | Dicot Terrestrial, Freshwater | No |
| Gerardia, Sandplain *(Agalinis acuta)* | Endangered | Dicot Terrestrial | No |
| Harperella *(Ptilimnium nodosum)* | Endangered | Dicot Freshwater | No |
| Joint-vetch, Sensitive *(Aeschynomene virginica)* | Threatened | Dicot Terrestrial, Brackish | No |
| Darter, Maryland *(Etheostoma sellare)* | Endangered | Fish Freshwater | Yes |
| Sturgeon, Shortnose *(Acipenser brevirostrum)* | Endangered | Fish Saltwater, Freshwater | No |

## Maryland ( 15) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Beetle, Northeastern Beach Tiger *(Cicindela dorsalis dorsalis)* | Threatened | Insect<br>Terrestrial | No |
| Beetle, Puritan Tiger *(Cicindela puritana)* | Threatened | Insect<br>Terrestrial, Coastal (neritic) | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal<br>Subterraneous, Terrestrial | Yes |
| Squirrel, Delmarva Peninsula Fox *(Sciurus niger cinereus)* | Endangered | Mammal<br>Terrestrial | No |
| Bulrush, Northeastern (=Barbed Bristle) *(Scirpus ancistrochaetus)* | Endangered | Monocot<br>Terrestrial, Freshwater | No |
| Pink, Swamp *(Helonias bullata)* | Threatened | Monocot<br>Terrestrial, Freshwater | No |
| Turtle, Bog (Northern population) *(Clemmys muhlenbergii)* | Threatened | Reptile<br>Terrestrial, Freshwater | No |

## Massachusetts ( 7) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird<br>Terrestrial | Yes |
| Tern, Roseate *(Sterna dougallii dougallii)* | Endangered | Bird<br>Terrestrial | No |
| Sturgeon, Shortnose *(Acipenser brevirostrum)* | Endangered | Fish<br>Saltwater, Freshwater | No |
| Beetle, Puritan Tiger *(Cicindela puritana)* | Threatened | Insect<br>Terrestrial, Coastal (neritic) | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal<br>Subterraneous, Terrestrial | Yes |
| Pogonia, Small Whorled *(Isotria medeoloides)* | Threatened | Monocot<br>Terrestrial | No |
| Turtle, Bog (Northern population) *(Clemmys muhlenbergii)* | Threatened | Reptile<br>Terrestrial, Freshwater | No |

## Michigan ( 20) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird<br>Terrestrial | Yes |
| Warbler (=Wood), Kirtland's *(Dendroica kirtlandii)* | Endangered | Bird<br>Terrestrial | No |
| Mussel, Clubshell *(Pleurobema clava)* | Endangered | Bivalve<br>Freshwater | No |
| Riffleshell, Northern *(Epioblasma torulosa rangiana)* | Endangered | Bivalve<br>Freshwater | No |
| Daisy, Lakeside *(Hymenoxys herbacea)* | Threatened | Dicot<br>Freshwater | No |
| Goldenrod, Houghton's *(Solidago houghtonii)* | Threatened | Dicot<br>Terrestrial | No |

## Michigan ( 20) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Monkey-flower, Michigan *(Mimulus glabratus var. michiganensis)* | Endangered | Dicot<br>Terrestrial, Freshwater | No |
| Thistle, Pitcher's *(Cirsium pitcheri)* | Threatened | Dicot<br>Terrestrial | No |
| Fern, American hart's-tongue *(Asplenium scolopendrium var. americanum)* | Threatened | Ferns<br>Terrestrial | No |
| Beetle, Hungerford's Crawling Water *(Brychius hungerfordi)* | Endangered | Insect<br>Freshwater | No |
| Butterfly, Karner Blue *(Lycaeides melissa samuelis)* | Endangered | Insect<br>Terrestrial | No |
| Butterfly, Mitchell's Satyr *(Neonympha mitchellii mitchellii)* | Endangered | Insect<br>Terrestrial | No |
| Dragonfly, Hine's Emerald *(Somatochlora hineana)* | Endangered | Insect<br>Freshwater, Terrestrial | Yes |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal<br>Subterraneous, Terrestrial | Yes |
| Lynx, Canada *(Lynx canadensis)* | Threatened | Mammal<br>Terrestrial | No |
| Wolf, Gray *(Canis lupus)* | Endangered | Mammal<br>Terrestrial | Yes |
| Iris, Dwarf Lake *(Iris lacustris)* | Threatened | Monocot<br>Terrestrial | No |
| Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)* | Threatened | Monocot<br>Terrestrial | No |
| Pogonia, Small Whorled *(Isotria medeoloides)* | Threatened | Monocot<br>Terrestrial | No |
| Snake, Northern Copperbelly Water *(Nerodia erythrogaster neglecta)* | Threatened | Reptile<br>Freshwater, Terrestrial | No |

## Minnesota ( 11) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird<br>Terrestrial | Yes |
| Mussel, Winged Mapleleaf *(Quadrula fragosa)* | Endangered | Bivalve<br>Freshwater | No |
| Pearlymussel, Higgins' Eye *(Lampsilis higginsii)* | Endangered | Bivalve<br>Freshwater | No |
| Clover, Prairie Bush *(Lespedeza leptostachya)* | Threatened | Dicot<br>Terrestrial | No |
| Roseroot, Leedy's *(Sedum integrifolium ssp. leedyi)* | Threatened | Dicot<br>Terrestrial | No |
| Shiner, Topeka *(Notropis topeka (=tristis))* | Endangered | Fish<br>Freshwater | Yes |
| Butterfly, Karner Blue *(Lycaeides melissa samuelis)* | Endangered | Insect<br>Terrestrial | No |

| ***Minnesota*** ( 11) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|
| Lynx, Canada *(Lynx canadensis)* | Threatened | Mammal Terrestrial | No |
| Wolf, Gray *(Canis lupus)* | Threatened | Mammal Terrestrial | Yes |
| Lily, Minnesota Trout *(Erythronium propullans)* | Endangered | Monocot Terrestrial | No |
| Orchid, Western Prairie Fringed *(Platanthera praeclara)* | Threatened | Monocot Terrestrial | No |

| ***Mississippi*** ( 30) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|
| Frog, Dusky Gopher (Mississippi DPS) *(Rana capito sevosa)* | Endangered | Amphibian Terrestrial, Freshwater | No |
| Crane, Mississippi Sandhill *(Grus canadensis pulla)* | Endangered | Bird Terrestrial, Freshwater | Yes |
| Pelican, Brown *(Pelecanus occidentalis)* | Endangered | Bird Terrestrial | No |
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Tern, Interior (population) Least *(Sterna antillarum)* | Endangered | Bird Terrestrial | No |
| Woodpecker, Red-cockaded *(Picoides borealis)* | Endangered | Bird Terrestrial | No |
| Combshell, Southern (=Penitent mussel) *(Epioblasma penita)* | Endangered | Bivalve Freshwater | No |
| Mucket, Orangenacre *(Lampsilis perovalis)* | Threatened | Bivalve Freshwater | Yes |
| Mussel, Alabama Moccasinshell *(Medionidus acutissimus)* | Threatened | Bivalve Freshwater | Yes |
| Mussel, Black (=Curtus' Mussel) Clubshell *(Pleurobema curtum)* | Endangered | Bivalve Freshwater | No |
| Mussel, Heavy Pigtoe (=Judge Tait's Mussel) *(Pleurobema taitianum)* | Endangered | Bivalve Freshwater | No |
| Mussel, Heelsplitter Inflated *(Potamilus inflatus)* | Threatened | Bivalve Freshwater | No |
| Mussel, Ovate Clubshell *(Pleurobema perovatum)* | Endangered | Bivalve Freshwater | Yes |
| Mussel, Southern Clubshell *(Pleurobema decisum)* | Endangered | Bivalve Freshwater | Yes |
| Pondberry *(Lindera melissifolia)* | Endangered | Dicot Terrestrial | No |
| Potato-bean, Price's *(Apios priceana)* | Threatened | Dicot Terrestrial | No |
| Quillwort, Louisiana *(Isoetes louisianensis)* | Endangered | Ferns Freshwater, Terrestrial | No |

| **Mississippi** ( 30) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|
| Darter, Bayou | Threatened | Fish | No |
| *(Etheostoma rubrum)* | | Freshwater | |
| Sturgeon, Gulf | Threatened | Fish | Yes |
| *(Acipenser oxyrinchus desotoi)* | | Saltwater, Freshwater | |
| Sturgeon, Pallid | Endangered | Fish | No |
| *(Scaphirhynchus albus)* | | Freshwater | |
| Bat, Gray | Endangered | Mammal | No |
| *(Myotis grisescens)* | | Subterraneous, Terrestrial | |
| Bat, Indiana | Endangered | Mammal | Yes |
| *(Myotis sodalis)* | | Subterraneous, Terrestrial | |
| Bear, Louisiana Black | Threatened | Mammal | No |
| *(Ursus americanus luteolus)* | | Terrestrial | |
| Sea turtle, green | Endangered | Reptile | No |
| *(Chelonia mydas)* | | Saltwater | |
| Sea turtle, Kemp's ridley | Endangered | Reptile | No |
| *(Lepidochelys kempii)* | | Saltwater | |
| Sea turtle, loggerhead | Threatened | Reptile | No |
| *(Caretta caretta)* | | Saltwater | |
| Snake, Eastern Indigo | Threatened | Reptile | No |
| *(Drymarchon corais couperi)* | | Terrestrial | |
| Tortoise, Gopher | Threatened | Reptile | No |
| *(Gopherus polyphemus)* | | Terrestrial | |
| Turtle, Ringed Sawback | Threatened | Reptile | No |
| *(Graptemys oculifera)* | | Freshwater, Terrestrial | |
| Turtle, Yellow-blotched Map | Threatened | Reptile | No |
| *(Graptemys flavimaculata)* | | Freshwater, Terrestrial | |

| **Missouri** ( 29) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|
| Plover, Piping | Endangered | Bird | Yes |
| *(Charadrius melodus)* | | Terrestrial | |
| Tern, Interior (population) Least | Endangered | Bird | No |
| *(Sterna antillarum)* | | Terrestrial | |
| Mucket, Pink (Pearlymussel) | Endangered | Bivalve | No |
| *(Lampsilis abrupta)* | | Freshwater | |
| Mussel, Scaleshell | Endangered | Bivalve | No |
| *(Leptodea leptodon)* | | Freshwater | |
| Mussel, Winged Mapleleaf | Endangered | Bivalve | No |
| *(Quadrula fragosa)* | | Freshwater | |
| Pearlymussel, Curtis' | Endangered | Bivalve | No |
| *(Epioblasma florentina curtisii)* | | Freshwater | |
| Pearlymussel, Fat Pocketbook | Endangered | Bivalve | No |
| *(Potamilus capax)* | | Freshwater | |
| Pearlymussel, Higgins' Eye | Endangered | Bivalve | No |
| *(Lampsilis higginsii)* | | Freshwater | |

| **Missouri** ( 29) species: | | Taxa | Critical Habitat |
|---|---|---|---|
| Crayfish, Cave (Cambarus aculabrum) *(Cambarus aculabrum)* | Endangered | Crustacean Freshwater | No |
| Aster, Decurrent False *(Boltonia decurrens)* | Threatened | Dicot Terrestrial, Freshwater | No |
| Bladderpod, Missouri *(Lesquerella filiformis)* | Threatened | Dicot Terrestrial | No |
| Clover, Running Buffalo *(Trifolium stoloniferum)* | Endangered | Dicot Terrestrial | No |
| Fruit, Earth (=geocarpon) *(Geocarpon minimum)* | Threatened | Dicot Terrestrial | No |
| Milkweed, Mead's *(Asclepias meadii)* | Threatened | Dicot Terrestrial | No |
| Pondberry *(Lindera melissifolia)* | Endangered | Dicot Terrestrial | No |
| Sneezeweed, Virginia *(Helenium virginicum)* | Threatened | Dicot Vernal pool | No |
| Cavefish, Ozark *(Amblyopsis rosae)* | Threatened | Fish Freshwater | No |
| Chub, Humpback *(Gila cypha)* | Endangered | Fish Freshwater | Yes |
| Darter, Niangua *(Etheostoma nianguae)* | Threatened | Fish Freshwater | Yes |
| Madtom, Neosho *(Noturus placidus)* | Threatened | Fish Freshwater | No |
| Shiner, Topeka *(Notropis topeka (=tristis))* | Endangered | Fish Freshwater | Yes |
| Sturgeon, Gulf *(Acipenser oxyrinchus desotoi)* | Threatened | Fish Saltwater, Freshwater | Yes |
| Sturgeon, Pallid *(Scaphirhynchus albus)* | Endangered | Fish Freshwater | No |
| Cavesnail, Tumbling Creek *(Antrobia culveri)* | Endangered | Gastropod Subterraneous, Freshwater | No |
| Beetle, American Burying *(Nicrophorus americanus)* | Endangered | Insect Terrestrial | No |
| Dragonfly, Hine's Emerald *(Somatochlora hineana)* | Endangered | Insect Freshwater, Terrestrial | Yes |
| Bat, Gray *(Myotis grisescens)* | Endangered | Mammal Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Orchid, Western Prairie Fringed *(Platanthera praeclara)* | Threatened | Monocot Terrestrial | No |

| **Montana** ( 12) species: | | Taxa | Critical Habitat |
|---|---|---|---|

| ***Montana*** | ( 12) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Crane, Whooping *(Grus americana)* | | Endangered | Bird Terrestrial, Freshwater | Yes |
| Plover, Piping *(Charadrius melodus)* | | Endangered | Bird Terrestrial | Yes |
| Tern, Interior (population) Least *(Sterna antillarum)* | | Endangered | Bird Terrestrial | No |
| Catchfly, Spalding's *(Silene spaldingii)* | | Threatened | Dicot Terrestrial | No |
| Howellia, Water *(Howellia aquatilis)* | | Threatened | Dicot Freshwater | No |
| Sturgeon, Pallid *(Scaphirhynchus albus)* | | Endangered | Fish Freshwater | No |
| Trout, Bull *(Salvelinus confluentus)* | | Threatened | Fish Freshwater | No |
| Trout, Bull (Columbia River population) *(Salvelinus confluentus)* | | Threatened | Fish Freshwater | Yes |
| Trout, Bull (Klamath River population) *(Salvelinus confluentus)* | | Threatened | Fish Freshwater | Yes |
| Bear, Grizzly *(Ursus arctos horribilis)* | | Threatened | Mammal Terrestrial | No |
| Ferret, Black-footed *(Mustela nigripes)* | | Endangered | Mammal Terrestrial | No |
| Wolf, Gray *(Canis lupus)* | | Endangered | Mammal Terrestrial | Yes |

| ***Nebraska*** | ( 10) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Crane, Whooping *(Grus americana)* | | Endangered | Bird Terrestrial, Freshwater | Yes |
| Plover, Piping *(Charadrius melodus)* | | Endangered | Bird Terrestrial | Yes |
| Tern, Interior (population) Least *(Sterna antillarum)* | | Endangered | Bird Terrestrial | No |
| Butterfly Plant, Colorado *(Gaura neomexicana var. coloradensis)* | | Threatened | Dicot Terrestrial | Yes |
| Penstemon, Blowout *(Penstemon haydenii)* | | Endangered | Dicot Terrestrial | No |
| Shiner, Topeka *(Notropis topeka (=tristis))* | | Endangered | Fish Freshwater | Yes |
| Sturgeon, Pallid *(Scaphirhynchus albus)* | | Endangered | Fish Freshwater | No |
| Beetle, Salt Creek Tiger *(Cicindela nevadica lincolniana)* | | Endangered | Insect Terrestrial | No |
| Ferret, Black-footed *(Mustela nigripes)* | | Endangered | Mammal Terrestrial | No |

| | | | |
|---|---|---|---|
| ***Nebraska*** (10) species: | | **Taxa** | Critical Habitat |
| Orchid, Western Prairie Fringed *(Platanthera praeclara)* | Threatened | Monocot Terrestrial | No |
| ***Nevada*** (19) species: | | **Taxa** | Critical Habitat |
| Blazing Star, Ash Meadows *(Mentzelia leucophylla)* | Threatened | Dicot Terrestrial | Yes |
| Centaury, Spring-loving *(Centaurium namophilum)* | Threatened | Dicot Terrestrial | Yes |
| Gumplant, Ash Meadows *(Grindelia fraxino-pratensis)* | Threatened | Dicot Terrestrial | Yes |
| Ivesia, Ash Meadows *(Ivesia kingii var. eremica)* | Threatened | Dicot Terrestrial | Yes |
| Milk-vetch, Ash Meadows *(Astragalus phoenix)* | Threatened | Dicot Terrestrial | Yes |
| Niterwort, Amargosa *(Nitrophila mohavensis)* | Endangered | Dicot Terrestrial | Yes |
| Sunray, Ash Meadows *(Enceliopsis nudicaulis var. corrugata)* | Threatened | Dicot Terrestrial | Yes |
| Dace, Ash Meadows Speckled *(Rhinichthys osculus nevadensis)* | Endangered | Fish Freshwater | Yes |
| Dace, Desert *(Eremichthys acros)* | Threatened | Fish Freshwater | Yes |
| Poolfish, Pahrump (= Pahrump Killifish) *(Empetrichthys latos)* | Endangered | Fish Freshwater | No |
| Pupfish, Ash Meadows Amargosa *(Cyprinodon nevadensis mionectes)* | Endangered | Fish Freshwater | Yes |
| Pupfish, Devils Hole *(Cyprinodon diabolis)* | Endangered | Fish Freshwater | No |
| Pupfish, Warm Springs *(Cyprinodon nevadensis pectoralis)* | Endangered | Fish Freshwater | No |
| Spinedace, White River *(Lepidomeda albivallis)* | Endangered | Fish Freshwater | Yes |
| Springfish, Railroad Valley *(Crenichthys nevadae)* | Threatened | Fish Freshwater | Yes |
| Trout, Bull *(Salvelinus confluentus)* | Threatened | Fish Freshwater | No |
| Trout, Lahontan Cutthroat *(Oncorhynchus clarki henshawi)* | Threatened | Fish Freshwater | No |
| Naucorid, Ash Meadows *(Ambrysus amargosus)* | Threatened | Insect Terrestrial | Yes |
| Tortoise, Desert *(Gopherus agassizii)* | Threatened | Reptile Terrestrial | Yes |
| ***New Hampshire*** (1) species: | | **Taxa** | Critical Habitat |

## New Hampshire ( 1) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Mussel, Dwarf Wedge *(Alasmidonta heterodon)* | Endangered | Bivalve Freshwater | No |

## New Jersey ( 10) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Curlew, Eskimo *(Numenius borealis)* | Endangered | Bird Terrestrial | No |
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Chaffseed, American *(Schwalbea americana)* | Endangered | Dicot Terrestrial | No |
| Joint-vetch, Sensitive *(Aeschynomene virginica)* | Threatened | Dicot Terrestrial, Brackish | No |
| Sturgeon, Shortnose *(Acipenser brevirostrum)* | Endangered | Fish Saltwater, Freshwater | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Beaked-rush, Knieskern's *(Rhynchospora knieskernii)* | Threatened | Monocot Terrestrial | No |
| Pink, Swamp *(Helonias bullata)* | Threatened | Monocot Terrestrial, Freshwater | No |
| Pogonia, Small Whorled *(Isotria medeoloides)* | Threatened | Monocot Terrestrial | No |
| Turtle, Bog (Northern population) *(Clemmys muhlenbergii)* | Threatened | Reptile Terrestrial, Freshwater | No |

## New Mexico ( 34) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Frog, Chiricahua Leopard *(Rana chiricahuensis)* | Threatened | Amphibian Freshwater, Terrestrial | No |
| Crane, Whooping *(Grus americana)* | Endangered | Bird Terrestrial, Freshwater | Yes |
| Falcon, Northern Aplomado *(Falco femoralis septentrionalis)* | Endangered | Bird Terrestrial | No |
| Flycatcher, Southwestern Willow *(Empidonax traillii extimus)* | Endangered | Bird Terrestrial | Yes |
| Owl, Mexican Spotted *(Strix occidentalis lucida)* | Threatened | Bird Terrestrial | Yes |
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Tern, Interior (population) Least *(Sterna antillarum)* | Endangered | Bird Terrestrial | No |
| Amphipod, Noel's *(Gammarus desperatus)* | Endangered | Crustacean Freshwater | No |
| Isopod, Socorro *(Thermosphaeroma thermophilus)* | Endangered | Crustacean Freshwater | No |

## *New Mexico* ( 34) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Cactus, Knowlton *(Pediocactus knowltonii)* | Endangered | Dicot Terrestrial | No |
| Cactus, Kuenzler Hedgehog *(Echinocereus fendleri var. kuenzleri)* | Endangered | Dicot Terrestrial | No |
| Cactus, Lee Pincushion *(Coryphantha sneedii var. leei)* | Threatened | Dicot Terrestrial | No |
| Cactus, Mesa Verde *(Sclerocactus mesae-verdae)* | Threatened | Dicot Terrestrial | No |
| Cactus, Sneed Pincushion *(Coryphantha sneedii var. sneedii)* | Endangered | Dicot Terrestrial | No |
| Ipomopsis, Holy Ghost *(Ipomopsis sancti-spiritus)* | Endangered | Dicot Terrestrial | No |
| Milk-vetch, Mancos *(Astragalus humillimus)* | Endangered | Dicot Terrestrial | No |
| Pennyroyal, Todsen's *(Hedeoma todsenii)* | Endangered | Dicot Terrestrial | Yes |
| Sunflower, Pecos *(Helianthus paradoxus)* | Threatened | Dicot Terrestrial, Freshwater | No |
| Wild-buckwheat, Gypsum *(Eriogonum gypsophilum)* | Threatened | Dicot Terrestrial | Yes |
| Gambusia, Pecos *(Gambusia nobilis)* | Endangered | Fish Freshwater | No |
| Minnow, Rio Grande Silvery *(Hybognathus amarus)* | Endangered | Fish Freshwater | Yes |
| Shiner, Arkansas River *(Notropis girardi)* | Threatened | Fish Freshwater | Yes |
| Shiner, Beautiful *(Cyprinella formosa)* | Threatened | Fish Freshwater | Yes |
| Shiner, Pecos Bluntnose *(Notropis simus pecosensis)* | Threatened | Fish Freshwater | Yes |
| Squawfish, Colorado *(Ptychocheilus lucius)* | Endangered | Fish Freshwater | Yes |
| Sucker, Razorback *(Xyrauchen texanus)* | Endangered | Fish Freshwater | Yes |
| Trout, Gila *(Oncorhynchus gilae)* | Endangered | Fish Freshwater | No |
| Snail, Pecos Assiminea *(Assiminea pecos)* | Endangered | Gastropod Freshwater | Yes |
| Springsnail, Alamosa *(Tryonia alamosae)* | Endangered | Gastropod Freshwater | No |
| Springsnail, Koster's *(Juturnia kosteri)* | Endangered | Gastropod Terrestrial | No |

| **New Mexico** | ( 34) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|---|
| Springsnail, Roswell | | Endangered | Gastropod | No |
| *(Pyrgulopsis roswellensis)* | | | Freshwater | |
| Springsnail, Socorro | | Endangered | Gastropod | No |
| *(Pyrgulopsis neomexicana)* | | | Freshwater | |
| Ferret, Black-footed | | Endangered | Mammal | No |
| *(Mustela nigripes)* | | | Terrestrial | |
| Wolf, Gray | | Endangered | Mammal | Yes |
| *(Canis lupus)* | | | Terrestrial | |

| **New York** | ( 13) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|---|
| Plover, Piping | | Endangered | Bird | Yes |
| *(Charadrius melodus)* | | | Terrestrial | |
| Tern, Roseate | | Endangered | Bird | No |
| *(Sterna dougallii dougallii)* | | | Terrestrial | |
| Mussel, Dwarf Wedge | | Endangered | Bivalve | No |
| *(Alasmidonta heterodon)* | | | Freshwater | |
| Amaranth, Seabeach | | Threatened | Dicot | No |
| *(Amaranthus pumilus)* | | | Coastal (neritic) | |
| Gerardia, Sandplain | | Endangered | Dicot | No |
| *(Agalinis acuta)* | | | Terrestrial | |
| Roseroot, Leedy's | | Threatened | Dicot | No |
| *(Sedum integrifolium ssp. leedyi)* | | | Terrestrial | |
| Fern, American hart's-tongue | | Threatened | Ferns | No |
| *(Asplenium scolopendrium var. americanum)* | | | Terrestrial | |
| Sturgeon, Shortnose | | Endangered | Fish | No |
| *(Acipenser brevirostrum)* | | | Saltwater, Freshwater | |
| Snail, Chittenango Ovate Amber | | Threatened | Gastropod | No |
| *(Succinea chittenangoensis)* | | | Terrestrial, Freshwater | |
| Butterfly, Karner Blue | | Endangered | Insect | No |
| *(Lycaeides melissa samuelis)* | | | Terrestrial | |
| Bat, Indiana | | Endangered | Mammal | Yes |
| *(Myotis sodalis)* | | | Subterraneous, Terrestrial | |
| Pogonia, Small Whorled | | Threatened | Monocot | No |
| *(Isotria medeoloides)* | | | Terrestrial | |
| Turtle, Bog (Northern population) | | Threatened | Reptile | No |
| *(Clemmys muhlenbergii)* | | | Terrestrial, Freshwater | |

| **North Carolina** | ( 53) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|---|
| Spider, Spruce-fir Moss | | Endangered | Arachnid | Yes |
| *(Microhexura montivaga)* | | | Terrestrial | |
| Plover, Piping | | Endangered | Bird | Yes |
| *(Charadrius melodus)* | | | Terrestrial | |
| Stork, Wood | | Endangered | Bird | No |
| *(Mycteria americana)* | | | Terrestrial | |

| ***North Carolina*** ( 53) species: | | Taxa | Critical Habitat |
|---|---|---|---|
| Tern, Roseate *(Sterna dougallii dougallii)* | Endangered | Bird Terrestrial | No |
| Woodpecker, Red-cockaded *(Picoides borealis)* | Endangered | Bird Terrestrial | No |
| Elktoe, Appalachian *(Alasmidonta raveneliana)* | Endangered | Bivalve Freshwater | Yes |
| Mussel, Dwarf Wedge *(Alasmidonta heterodon)* | Endangered | Bivalve Freshwater | No |
| Mussel, Heelsplitter Carolina *(Lasmigona decorata)* | Endangered | Bivalve Freshwater | Yes |
| Mussel, Oyster *(Epioblasma capsaeformis)* | Endangered | Bivalve Freshwater | Yes |
| Pearlymussel, Little-wing *(Pegias fabula)* | Endangered | Bivalve Freshwater | No |
| Purple Bean *(Villosa perpurpurea)* | Endangered | Bivalve Freshwater | Yes |
| Spinymussel, James River *(Pleurobema collina)* | Endangered | Bivalve Freshwater | No |
| Spinymussel, Tar River *(Elliptio steinstansana)* | Endangered | Bivalve Freshwater | No |
| Amaranth, Seabeach *(Amaranthus pumilus)* | Threatened | Dicot Coastal (neritic) | No |
| Avens, Spreading *(Geum radiatum)* | Endangered | Dicot Terrestrial | No |
| Bittercress, Small-anthered *(Cardamine micranthera)* | Endangered | Dicot Terrestrial | No |
| Blazing Star, Heller's *(Liatris helleri)* | Threatened | Dicot Terrestrial | No |
| Bluet, Roan Mountain *(Hedyotis purpurea var. montana)* | Endangered | Dicot Terrestrial | No |
| Chaffseed, American *(Schwalbea americana)* | Endangered | Dicot Terrestrial | No |
| Coneflower, Smooth *(Echinacea laevigata)* | Endangered | Dicot Terrestrial | No |
| Dropwort, Canby's *(Oxypolis canbyi)* | Endangered | Dicot Terrestrial, Freshwater | No |
| Goldenrod, Blue Ridge *(Solidago spithamaea)* | Threatened | Dicot Terrestrial | No |
| Harperella *(Ptilimnium nodosum)* | Endangered | Dicot Freshwater | No |
| Heartleaf, Dwarf-flowered *(Hexastylis naniflora)* | Threatened | Dicot Terrestrial | No |

## *North Carolina* ( 53) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Heather, Mountain Golden *(Hudsonia montana)* | Threatened | Dicot<br>Terrestrial | Yes |
| Joint-vetch, Sensitive *(Aeschynomene virginica)* | Threatened | Dicot<br>Terrestrial, Brackish | No |
| Loosestrife, Rough-leaved *(Lysimachia asperulaefolia)* | Endangered | Dicot<br>Terrestrial | No |
| Meadowrue, Cooley's *(Thalictrum cooleyi)* | Endangered | Dicot<br>Terrestrial | No |
| Pitcher-plant, Mountain Sweet *(Sarracenia rubra ssp. jonesii)* | Endangered | Dicot<br>Freshwater, Terrestrial | No |
| Pondberry *(Lindera melissifolia)* | Endangered | Dicot<br>Terrestrial | No |
| Spiraea, Virginia *(Spiraea virginiana)* | Threatened | Dicot<br>Terrestrial | No |
| Sumac, Michaux's *(Rhus michauxii)* | Endangered | Dicot<br>Terrestrial | No |
| Sunflower, Schweinitz's *(Helianthus schweinitzii)* | Endangered | Dicot<br>Terrestrial | No |
| Chub, Spotfin *(Erimonax monachus)* | Threatened | Fish<br>Freshwater | Yes |
| Shiner, Cape Fear *(Notropis mekistocholas)* | Endangered | Fish<br>Freshwater | Yes |
| Silverside, Waccamaw *(Menidia extensa)* | Threatened | Fish<br>Freshwater | Yes |
| Sturgeon, Shortnose *(Acipenser brevirostrum)* | Endangered | Fish<br>Saltwater, Freshwater | No |
| Butterfly, Saint Francis' Satyr *(Neonympha mitchellii francisci)* | Endangered | Insect<br>Terrestrial | No |
| Lichen, Rock Gnome *(Gymnoderma lineare)* | Endangered | Lichen<br>Terrestrial | No |
| Bat, Gray *(Myotis grisescens)* | Endangered | Mammal<br>Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal<br>Subterraneous, Terrestrial | Yes |
| Squirrel, Carolina Northern Flying *(Glaucomys sabrinus coloratus)* | Endangered | Mammal<br>Terrestrial | No |
| Manatee, West Indian *(Trichechus manatus)* | Endangered | Marine mml<br>Saltwater | Yes |
| Arrowhead, Bunched *(Sagittaria fasciculata)* | Endangered | Monocot<br>Freshwater | No |
| Irisette, White *(Sisyrinchium dichotomum)* | Endangered | Monocot<br>Terrestrial | No |

## North Carolina ( 53) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Pink, Swamp *(Helonias bullata)* | Threatened | Monocot Terrestrial, Freshwater | No |
| Pogonia, Small Whorled *(Isotria medeoloides)* | Threatened | Monocot Terrestrial | No |
| Sedge, Golden *(Carex lutea)* | Endangered | Monocot Terrestrial | No |
| Sea turtle, green *(Chelonia mydas)* | Endangered | Reptile Saltwater | No |
| Sea turtle, hawksbill *(Eretmochelys imbricata)* | Endangered | Reptile Saltwater | Yes |
| Sea turtle, Kemp's ridley *(Lepidochelys kempii)* | Endangered | Reptile Saltwater | No |
| Sea turtle, leatherback *(Dermochelys coriacea)* | Endangered | Reptile Saltwater | Yes |
| Sea turtle, loggerhead *(Caretta caretta)* | Threatened | Reptile Saltwater | No |

## North Dakota ( 5) species:

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

## Ohio ( 22) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Fanshell *(Cyprogenia stegaria)* | Endangered | Bivalve Freshwater | No |
| Mucket, Pink (Pearlymussel) *(Lampsilis abrupta)* | Endangered | Bivalve Freshwater | No |
| Mussel, Clubshell *(Pleurobema clava)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Purple Cat's Paw *(Epioblasma obliquata obliquata)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, White Cat's Paw *(Epioblasma obliquata perobliqua)* | Endangered | Bivalve Freshwater | No |
| Riffleshell, Northern *(Epioblasma torulosa rangiana)* | Endangered | Bivalve Freshwater | No |

| **Ohio** | ( 22) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Clover, Running Buffalo *(Trifolium stoloniferum)* | | Endangered | Dicot Terrestrial | No |
| Daisy, Lakeside *(Hymenoxys herbacea)* | | Threatened | Dicot Freshwater | No |
| Monkshood, Northern Wild *(Aconitum noveboracense)* | | Threatened | Dicot Terrestrial | No |
| Spiraea, Virginia *(Spiraea virginiana)* | | Threatened | Dicot Terrestrial | No |
| Madtom, Scioto *(Noturus trautmani)* | | Endangered | Fish Freshwater | No |
| Beetle, American Burying *(Nicrophorus americanus)* | | Endangered | Insect Terrestrial | No |
| Butterfly, Karner Blue *(Lycaeides melissa samuelis)* | | Endangered | Insect Terrestrial | No |
| Butterfly, Mitchell's Satyr *(Neonympha mitchellii mitchellii)* | | Endangered | Insect Terrestrial | No |
| Dragonfly, Hine's Emerald *(Somatochlora hineana)* | | Endangered | Insect Freshwater, Terrestrial | Yes |
| Bat, Gray *(Myotis grisescens)* | | Endangered | Mammal Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)* | | Threatened | Monocot Terrestrial | No |
| Pogonia, Small Whorled *(Isotria medeoloides)* | | Threatened | Monocot Terrestrial | No |
| Snake, Lake Erie Water *(Nerodia sipedon insularum)* | | Threatened | Reptile Terrestrial, Freshwater | No |
| Snake, Northern Copperbelly Water *(Nerodia erythrogaster neglecta)* | | Threatened | Reptile Freshwater, Terrestrial | No |

| **Oklahoma** | ( 18) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Crane, Whooping *(Grus americana)* | | Endangered | Bird Terrestrial, Freshwater | Yes |
| Curlew, Eskimo *(Numenius borealis)* | | Endangered | Bird Terrestrial | No |
| Plover, Piping *(Charadrius melodus)* | | Endangered | Bird Terrestrial | Yes |
| Tern, Interior (population) Least *(Sterna antillarum)* | | Endangered | Bird Terrestrial | No |
| Vireo, Black-capped *(Vireo atricapilla)* | | Endangered | Bird Terrestrial | No |
| Woodpecker, Red-cockaded *(Picoides borealis)* | | Endangered | Bird Terrestrial | No |

| **Oklahoma** | (18) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Mussel, Scaleshell *(Leptodea leptodon)* | | Endangered | Bivalve Freshwater | No |
| Rock-pocketbook, Ouachita (=Wheeler's pm) *(Arkansia wheeleri)* | | Endangered | Bivalve Freshwater | No |
| Cavefish, Ozark *(Amblyopsis rosae)* | | Threatened | Fish Freshwater | No |
| Darter, Leopard *(Percina pantherina)* | | Threatened | Fish Freshwater | Yes |
| Madtom, Neosho *(Noturus placidus)* | | Threatened | Fish Freshwater | No |
| Shiner, Arkansas River *(Notropis girardi)* | | Threatened | Fish Freshwater | Yes |
| Beetle, American Burying *(Nicrophorus americanus)* | | Endangered | Insect Terrestrial | No |
| Bat, Gray *(Myotis grisescens)* | | Endangered | Mammal Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Bat, Ozark Big-eared *(Corynorhinus (=Plecotus) townsendii ingens)* | | Endangered | Mammal Terrestrial, Subterraneous | No |
| Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)* | | Threatened | Monocot Terrestrial | No |
| Orchid, Western Prairie Fringed *(Platanthera praeclara)* | | Threatened | Monocot Terrestrial | No |

| **Oregon** | (41) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Murrelet, Marbled *(Brachyramphus marmoratus marmoratus)* | | Threatened | Bird Freshwater, Terrestrial, Saltwater | Yes |
| Owl, Northern Spotted *(Strix occidentalis caurina)* | | Threatened | Bird Terrestrial | Yes |
| Pelican, Brown *(Pelecanus occidentalis)* | | Endangered | Bird Terrestrial | No |
| Plover, Western Snowy *(Charadrius alexandrinus nivosus)* | | Threatened | Bird Terrestrial | Yes |
| Fairy Shrimp, Vernal Pool *(Branchinecta lynchi)* | | Threatened | Crustacean Vernal pool | Yes |
| Catchfly, Spalding's *(Silene spaldingii)* | | Threatened | Dicot Terrestrial | No |
| Checker-mallow, Nelson's *(Sidalcea nelsoniana)* | | Threatened | Dicot Terrestrial | No |
| Daisy, Willamette *(Erigeron decumbens var. decumbens)* | | Endangered | Dicot Terrestrial | No |
| Four-o'clock, Macfarlane's *(Mirabilis macfarlanei)* | | Threatened | Dicot Terrestrial | No |

| **Oregon** | ( 41) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Lomatium, Bradshaw's | | Endangered | Dicot | No |
| | *(Lomatium bradshawii)* | | Terrestrial, Freshwater | |
| Lomatium, Cook's | | Endangered | Dicot | No |
| | *(Lomatium cookii)* | | Vernal pool | |
| Lupine, Kincaid's | | Threatened | Dicot | No |
| | *(Lupinus sulphureus (=oreganus) ssp. kincaidii (=var. kincaidii))* | | Terrestrial | |
| Meadowfoam, Large-flowered Woolly | | Endangered | Dicot | No |
| | *(Limnanthes floccosa ssp. Grandiflora)* | | Vernal pool | |
| Milk-vetch, Applegate's | | Endangered | Dicot | No |
| | *(Astragalus applegatei)* | | Terrestrial | |
| Thelypody, Howell's Spectacular | | Threatened | Dicot | No |
| | *(Thelypodium howellii spectabilis)* | | Terrestrial | |
| Chub, Hutton Tui | | Threatened | Fish | No |
| | *(Gila bicolor ssp.)* | | Freshwater | |
| Chub, Oregon | | Endangered | Fish | No |
| | *(Oregonichthys crameri)* | | Freshwater | |
| Dace, Foskett Speckled | | Threatened | Fish | No |
| | *(Rhinichthys osculus ssp.)* | | Freshwater | |
| Salmon, Chinook (Lower Columbia River) | | Threatened | Fish | Yes |
| | *(Oncorhynchus (=Salmo) tshawytscha)* | | Freshwater, Brackish, Saltwater | |
| Salmon, Chinook (Snake River Fall Run) | | Threatened | Fish | No |
| | *(Oncorhynchus (=Salmo) tshawytscha)* | | Freshwater, Saltwater, Brackish | |
| Salmon, Chinook (Snake River spring/summer) | | Threatened | Fish | Yes |
| | *(Oncorhynchus (=Salmo) tshawytscha)* | | Brackish, Saltwater, Freshwater | |
| Salmon, Chinook (Upper Columbia River Spring) | | Endangered | Fish | Yes |
| | *(Oncorhynchus (=Salmo) tshawytscha)* | | Freshwater, Saltwater, Brackish | |
| Salmon, Chinook (Upper Willamette River) | | Threatened | Fish | Yes |
| | *(Oncorhynchus (=Salmo) tshawytscha)* | | Saltwater, Brackish, Freshwater | |
| Salmon, Chum (Columbia River population) | | Threatened | Fish | Yes |
| | *(Oncorhynchus (=Salmo) keta)* | | Brackish, Freshwater, Saltwater | |
| Salmon, Coho (Southern OR/Northern CA Coast) | | Threatened | Fish | Yes |
| | *(Oncorhynchus (=Salmo) kisutch)* | | Freshwater, Brackish, Saltwater | |
| Salmon, Sockeye (Snake River population) | | Endangered | Fish | No |
| | *(Oncorhynchus (=Salmo) nerka)* | | Brackish, Saltwater, Freshwater | |
| Steelhead, (Lower Columbia River population) | | Threatened | Fish | Yes |
| | *(Oncorhynchus (=Salmo) mykiss)* | | Brackish, Freshwater, Saltwater | |
| Steelhead, (Middle Columbia River population) | | Threatened | Fish | Yes |
| | *(Oncorhynchus (=Salmo) mykiss)* | | Freshwater, Saltwater, Brackish | |
| Steelhead, (Snake River Basin population) | | Threatened | Fish | Yes |
| | *(Oncorhynchus (=Salmo) mykiss)* | | Freshwater, Brackish, Saltwater | |
| Steelhead, (Upper Columbia River population) | | Threatened | Fish | Yes |
| | *(Oncorhynchus (=Salmo) mykiss)* | | Brackish, Saltwater, Freshwater | |

| **Oregon** | ( 41) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Steelhead, (Upper Willamette River population) *(Oncorhynchus (=Salmo) mykiss)* | | Threatened | Fish<br>Brackish, Saltwater, Freshwater | Yes |
| Sucker, Lost River *(Deltistes luxatus)* | | Endangered | Fish<br>Freshwater | No |
| Sucker, Shortnose *(Chasmistes brevirostris)* | | Endangered | Fish<br>Freshwater | No |
| Sucker, Warner *(Catostomus warnerensis)* | | Threatened | Fish<br>Freshwater | Yes |
| Trout, Bull *(Salvelinus confluentus)* | | Threatened | Fish<br>Freshwater | No |
| Trout, Bull (Columbia River population) *(Salvelinus confluentus)* | | Threatened | Fish<br>Freshwater | Yes |
| Trout, Bull (Klamath River population) *(Salvelinus confluentus)* | | Threatened | Fish<br>Freshwater | Yes |
| Butterfly, Fender's Blue *(Icaricia icarioides fenderi)* | | Endangered | Insect<br>Terrestrial | No |
| Butterfly, Oregon Silverspot *(Speyeria zerene hippolyta)* | | Threatened | Insect<br>Terrestrial | Yes |
| Deer, Columbian White-tailed *(Odocoileus virginianus leucurus)* | | Endangered | Mammal<br>Terrestrial | No |
| Fritillary, Gentner's *(Fritillaria gentneri)* | | Endangered | Monocot<br>Terrestrial | No |

| **Pennsylvania** | ( 8) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | | Endangered | Bird<br>Terrestrial | Yes |
| Mussel, Clubshell *(Pleurobema clava)* | | Endangered | Bivalve<br>Freshwater | No |
| Riffleshell, Northern *(Epioblasma torulosa rangiana)* | | Endangered | Bivalve<br>Freshwater | No |
| Bat, Indiana *(Myotis sodalis)* | | Endangered | Mammal<br>Subterraneous, Terrestrial | Yes |
| Squirrel, Delmarva Peninsula Fox *(Sciurus niger cinereus)* | | Endangered | Mammal<br>Terrestrial | No |
| Bulrush, Northeastern (=Barbed Bristle) *(Scirpus ancistrochaetus)* | | Endangered | Monocot<br>Terrestrial, Freshwater | No |
| Pogonia, Small Whorled *(Isotria medeoloides)* | | Threatened | Monocot<br>Terrestrial | No |
| Turtle, Bog (Northern population) *(Clemmys muhlenbergii)* | | Threatened | Reptile<br>Terrestrial, Freshwater | No |

| **Rhode Island** | ( 2) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | | Endangered | Bird<br>Terrestrial | Yes |

| **Rhode Island** | ( 2) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|---|
| Sturgeon, Shortnose | | Endangered | Fish | No |
| *(Acipenser brevirostrum)* | | | Saltwater, Freshwater | |

| **South Carolina** | ( 36) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|---|
| Salamander, Flatwoods | | Threatened | Amphibian | No |
| *(Ambystoma cingulatum)* | | | Freshwater, Vernal pool, Terrestrial | |
| Plover, Piping | | Endangered | Bird | Yes |
| *(Charadrius melodus)* | | | Terrestrial | |
| Stork, Wood | | Endangered | Bird | No |
| *(Mycteria americana)* | | | Terrestrial | |
| Warbler, Bachman's | | Endangered | Bird | No |
| *(Vermivora bachmanii)* | | | Terrestrial | |
| Woodpecker, Red-cockaded | | Endangered | Bird | No |
| *(Picoides borealis)* | | | Terrestrial | |
| Mussel, Heelsplitter Carolina | | Endangered | Bivalve | Yes |
| *(Lasmigona decorata)* | | | Freshwater | |
| Amaranth, Seabeach | | Threatened | Dicot | No |
| *(Amaranthus pumilus)* | | | Coastal (neritic) | |
| Amphianthus, Little | | Threatened | Dicot | No |
| *(Amphianthus pusillus)* | | | Freshwater | |
| Chaffseed, American | | Endangered | Dicot | No |
| *(Schwalbea americana)* | | | Terrestrial | |
| Coneflower, Smooth | | Endangered | Dicot | No |
| *(Echinacea laevigata)* | | | Terrestrial | |
| Dropwort, Canby's | | Endangered | Dicot | No |
| *(Oxypolis canbyi)* | | | Terrestrial, Freshwater | |
| Gooseberry, Miccosukee | | Threatened | Dicot | No |
| *(Ribes echinellum)* | | | Terrestrial | |
| Harperella | | Endangered | Dicot | No |
| *(Ptilimnium nodosum)* | | | Freshwater | |
| Heartleaf, Dwarf-flowered | | Threatened | Dicot | No |
| *(Hexastylis naniflora)* | | | Terrestrial | |
| Loosestrife, Rough-leaved | | Endangered | Dicot | No |
| *(Lysimachia asperulaefolia)* | | | Terrestrial | |
| Pitcher-plant, Mountain Sweet | | Endangered | Dicot | No |
| *(Sarracenia rubra ssp. jonesii)* | | | Freshwater, Terrestrial | |
| Pondberry | | Endangered | Dicot | No |
| *(Lindera melissifolia)* | | | Terrestrial | |
| Sunflower, Schweinitz's | | Endangered | Dicot | No |
| *(Helianthus schweinitzii)* | | | Terrestrial | |
| Quillwort, Black-spored | | Endangered | Ferns | No |
| *(Isoetes melanospora)* | | | Vernal pool | |
| Sturgeon, Shortnose | | Endangered | Fish | No |
| *(Acipenser brevirostrum)* | | | Saltwater, Freshwater | |

## South Carolina ( 36) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Lichen, Rock Gnome *(Gymnoderma lineare)* | Endangered | Lichen Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Manatee, West Indian *(Trichechus manatus)* | Endangered | Marine mml Saltwater | Yes |
| Whale, Finback *(Balaenoptera physalus)* | Endangered | Marine mml Saltwater | No |
| Whale, Humpback *(Megaptera novaeangliae)* | Endangered | Marine mml Saltwater | No |
| Arrowhead, Bunched *(Sagittaria fasciculata)* | Endangered | Monocot Freshwater | No |
| Irisette, White *(Sisyrinchium dichotomum)* | Endangered | Monocot Terrestrial | No |
| Pink, Swamp *(Helonias bullata)* | Threatened | Monocot Terrestrial, Freshwater | No |
| Pogonia, Small Whorled *(Isotria medeoloides)* | Threatened | Monocot Terrestrial | No |
| Trillium, Persistent *(Trillium persistens)* | Endangered | Monocot Terrestrial | No |
| Trillium, Relict *(Trillium reliquum)* | Endangered | Monocot Terrestrial | No |
| Sea turtle, green *(Chelonia mydas)* | Endangered | Reptile Saltwater | No |
| Sea turtle, Kemp's ridley *(Lepidochelys kempii)* | Endangered | Reptile Saltwater | No |
| Sea turtle, leatherback *(Dermochelys coriacea)* | Endangered | Reptile Saltwater | Yes |
| Sea turtle, loggerhead *(Caretta caretta)* | Threatened | Reptile Saltwater | No |
| Snake, Eastern Indigo *(Drymarchon corais couperi)* | Threatened | Reptile Terrestrial | No |

## South Dakota ( 8) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Crane, Whooping *(Grus americana)* | Endangered | Bird Terrestrial, Freshwater | Yes |
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Tern, Interior (population) Least *(Sterna antillarum)* | Endangered | Bird Terrestrial | No |
| Shiner, Topeka *(Notropis topeka (=tristis))* | Endangered | Fish Freshwater | Yes |
| Sturgeon, Pallid *(Scaphirhynchus albus)* | Endangered | Fish Freshwater | No |

| **South Dakota** | ( 8) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Beetle, American Burying *(Nicrophorus americanus)* | | Endangered | Insect Terrestrial | No |
| Ferret, Black-footed *(Mustela nigripes)* | | Endangered | Mammal Terrestrial | No |
| Orchid, Western Prairie Fringed *(Platanthera praeclara)* | | Threatened | Monocot Terrestrial | No |

| **Tennessee** | ( 82) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Spider, Spruce-fir Moss *(Microhexura montivaga)* | | Endangered | Arachnid Terrestrial | Yes |
| Stork, Wood *(Mycteria americana)* | | Endangered | Bird Terrestrial | No |
| Tern, Interior (population) Least *(Sterna antillarum)* | | Endangered | Bird Terrestrial | No |
| Woodpecker, Red-cockaded *(Picoides borealis)* | | Endangered | Bird Terrestrial | No |
| Combshell, Upland *(Epioblasma metastriata)* | | Endangered | Bivalve Freshwater | Yes |
| Fanshell *(Cyprogenia stegaria)* | | Endangered | Bivalve Freshwater | No |
| Kidneyshell, Triangular *(Ptychobranchus greenii)* | | Endangered | Bivalve Freshwater | Yes |
| Mucket, Pink (Pearlymussel) *(Lampsilis abrupta)* | | Endangered | Bivalve Freshwater | No |
| Mussel, Alabama Moccasinshell *(Medionidus acutissimus)* | | Threatened | Bivalve Freshwater | Yes |
| Mussel, Clubshell *(Pleurobema clava)* | | Endangered | Bivalve Freshwater | No |
| Mussel, Coosa Moccasinshell *(Medionidus parvulus)* | | Endangered | Bivalve Freshwater | Yes |
| Mussel, Cumberland Combshell *(Epioblasma brevidens)* | | Endangered | Bivalve Freshwater | Yes |
| Mussel, Cumberland Elktoe *(Alasmidonta atropurpurea)* | | Endangered | Bivalve Freshwater | Yes |
| Mussel, Cumberland Pigtoe *(Pleurobema gibberum)* | | Endangered | Bivalve Freshwater | No |
| Mussel, Fine-lined Pocketbook *(Lampsilis altilis)* | | Threatened | Bivalve Freshwater | Yes |
| Mussel, Fine-rayed Pigtoe *(Fusconaia cuneolus)* | | Endangered | Bivalve Freshwater | No |
| Mussel, Ovate Clubshell *(Pleurobema perovatum)* | | Endangered | Bivalve Freshwater | Yes |
| Mussel, Oyster *(Epioblasma capsaeformis)* | | Endangered | Bivalve Freshwater | Yes |

| ***Tennessee*** ( 82) species: | | Taxa | Critical Habitat |
|---|---|---|---|
| Mussel, Ring Pink (=Golf Stick Pearly) *(Obovaria retusa)* | Endangered | Bivalve Freshwater | No |
| Mussel, Rough Pigtoe *(Pleurobema plenum)* | Endangered | Bivalve Freshwater | No |
| Mussel, Shiny Pigtoe *(Fusconaia cor)* | Endangered | Bivalve Freshwater | No |
| Mussel, Southern Pigtoe *(Pleurobema georgianum)* | Endangered | Bivalve Freshwater | Yes |
| Pearlymussel, Alabama Lamp *(Lampsilis virescens)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Appalachian Monkeyface *(Quadrula sparsa)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Birdwing *(Conradilla caelata)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Cracking *(Hemistena lata)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Cumberland Bean *(Villosa trabalis)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Cumberland Monkeyface *(Quadrula intermedia)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Dromedary *(Dromus dromas)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Green-blossom *(Epioblasma torulosa gubernaculum)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Little-wing *(Pegias fabula)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Orange-footed *(Plethobasus cooperianus)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Pale Lilliput *(Toxolasma cylindrellus)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Purple Cat's Paw *(Epioblasma obliquata obliquata)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Tubercled-blossom *(Epioblasma torulosa torulosa)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Turgid-blossom *(Epioblasma turgidula)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, White Wartyback *(Plethobasus cicatricosus)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Yellow-blossom *(Epioblasma florentina florentina)* | Endangered | Bivalve Freshwater | No |
| Purple Bean *(Villosa perpurpurea)* | Endangered | Bivalve Freshwater | Yes |

| **Tennessee** ( 82) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|
| Rabbitsfoot, Rough | Endangered | Bivalve | Yes |
| *(Quadrula cylindrica strigillata)* | | Freshwater | |
| Riffleshell, Tan | Endangered | Bivalve | No |
| *(Epioblasma florentina walkeri (=E. walkeri))* | | Freshwater | |
| Crayfish, Nashville | Endangered | Crustacean | No |
| *(Orconectes shoupi)* | | Freshwater | |
| Aster, Ruth's Golden | Endangered | Dicot | No |
| *(Pityopsis ruthii)* | | Terrestrial | |
| Avens, Spreading | Endangered | Dicot | No |
| *(Geum radiatum)* | | Terrestrial | |
| Bladderpod, Spring Creek | Endangered | Dicot | No |
| *(Lesquerella perforata)* | | Floodplain | |
| Bluet, Roan Mountain | Endangered | Dicot | No |
| *(Hedyotis purpurea var. montana)* | | Terrestrial | |
| Clover, Leafy Prairie | Endangered | Dicot | No |
| *(Dalea foliosa)* | | Terrestrial | |
| Coneflower, Tennessee Purple | Endangered | Dicot | No |
| *(Echinacea tennesseensis)* | | Terrestrial | |
| Goldenrod, Blue Ridge | Threatened | Dicot | No |
| *(Solidago spithamaea)* | | Terrestrial | |
| Ground-plum, Guthrie's | Endangered | Dicot | No |
| *(Astragalus bibullatus)* | | Terrestrial | |
| Pitcher-plant, Green | Endangered | Dicot | No |
| *(Sarracenia oreophila)* | | Terrestrial, Freshwater | |
| Potato-bean, Price's | Threatened | Dicot | No |
| *(Apios priceana)* | | Terrestrial | |
| Rock-cress, Large (=Braun's) | Endangered | Dicot | Yes |
| *(Arabis perstellata E. L. Braun var. ampla Rollins)* | | Terrestrial | |
| Rosemary, Cumberland | Threatened | Dicot | No |
| *(Conradina verticillata)* | | Terrestrial | |
| Sandwort, Cumberland | Endangered | Dicot | No |
| *(Arenaria cumberlandensis)* | | Terrestrial | |
| Skullcap, Large-flowered | Threatened | Dicot | No |
| *(Scutellaria montana)* | | Terrestrial | |
| Spiraea, Virginia | Threatened | Dicot | No |
| *(Spiraea virginiana)* | | Terrestrial | |
| Fern, American hart's-tongue | Threatened | Ferns | No |
| *(Asplenium scolopendrium var. americanum)* | | Terrestrial | |
| Chub, Slender | Threatened | Fish | Yes |
| *(Erimystax cahni)* | | Freshwater | |
| Chub, Spotfin | Threatened | Fish | Yes |
| *(Erimonax monachus)* | | Freshwater | |

## Tennessee ( 82) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Dace, Blackside *(Phoxinus cumberlandensis)* | Threatened | Fish Freshwater | No |
| Darter, Amber *(Percina antesella)* | Endangered | Fish Freshwater | Yes |
| Darter, Bluemask (=jewel) *(Etheostoma /)* | Endangered | Fish Freshwater | No |
| Darter, Boulder *(Etheostoma wapiti)* | Endangered | Fish Freshwater | No |
| Darter, Duskytail *(Etheostoma percnurum)* | Endangered | Fish Freshwater | No |
| Darter, Slackwater *(Etheostoma boschungi)* | Threatened | Fish Freshwater | Yes |
| Darter, Snail *(Percina tanasi)* | Threatened | Fish Freshwater | No |
| Logperch, Conasauga *(Percina jenkinsi)* | Endangered | Fish Freshwater | Yes |
| Madtom, Pygmy *(Noturus stanauli)* | Endangered | Fish Freshwater | No |
| Madtom, Smoky *(Noturus baileyi)* | Endangered | Fish Freshwater | Yes |
| Madtom, Yellowfin *(Noturus flavipinnis)* | Threatened | Fish Freshwater | Yes |
| Shiner, Blue *(Cyprinella caerulea)* | Threatened | Fish Freshwater | No |
| Sturgeon, Pallid *(Scaphirhynchus albus)* | Endangered | Fish Freshwater | No |
| Marstonia, Royal (=Royal Snail) *(Pyrgulopsis ogmorhaphe)* | Endangered | Gastropod Terrestrial | No |
| Riversnail, Anthony's *(Athearnia anthonyi)* | Endangered | Gastropod Freshwater | No |
| Snail, Painted Snake Coiled Forest *(Anguispira picta)* | Threatened | Gastropod Terrestrial | No |
| Lichen, Rock Gnome *(Gymnoderma lineare)* | Endangered | Lichen Terrestrial | No |
| Bat, Gray *(Myotis grisescens)* | Endangered | Mammal Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Squirrel, Carolina Northern Flying *(Glaucomys sabrinus coloratus)* | Endangered | Mammal Terrestrial | No |
| Grass, Tennessee Yellow-eyed *(Xyris tennesseensis)* | Endangered | Monocot Terrestrial | No |

## *Tennessee* ( 82) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Pogonia, Small Whorled *(Isotria medeoloides)* | Threatened | Monocot<br>Terrestrial | No |

## *Texas* ( 77) species:

| | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Salamander, Barton Springs *(Eurycea sosorum)* | Endangered | Amphibian<br>Freshwater, Terrestrial | No |
| Salamander, San Marcos *(Eurycea nana)* | Threatened | Amphibian<br>Freshwater, Terrestrial | Yes |
| Salamander, Texas Blind *(Typhlomolge rathbuni)* | Endangered | Amphibian<br>Subterraneous, Freshwater | No |
| Toad, Houston *(Bufo houstonensis)* | Endangered | Amphibian<br>Terrestrial, Freshwater | Yes |
| Harvestman, Bee Creek Cave *(Texella reddelli)* | Endangered | Arachnid<br>Terrestrial, Subterraneous | No |
| Harvestman, Bone Cave *(Texella reyesi)* | Endangered | Arachnid<br>Terrestrial, Subterraneous | No |
| Harvestman, Robber Baron Cave *(Texella cokendolpheri)* | Endangered | Arachnid<br>Subterraneous, Terrestrial | Yes |
| Meshweaver, Braken Bat Cave *(Cicurina venii)* | Endangered | Arachnid<br>Terrestrial, Subterraneous | Yes |
| Pseudoscorpion, Tooth Cave *(Tartarocreagris texana)* | Endangered | Arachnid<br>Terrestrial, Subterraneous | No |
| Spider, Government Canyon Cave *(Neoleptoneta microps)* | Endangered | Arachnid<br>Subterraneous, Terrestrial | No |
| Spider, Madla's Cave *(Cicurina madla)* | Endangered | Arachnid<br>Subterraneous, Terrestrial | Yes |
| Spider, Robber Baron Cave *(Cicurina baronia)* | Endangered | Arachnid<br>Terrestrial, Subterraneous | Yes |
| Spider, Tooth Cave *(Neoleptoneta myopica)* | Endangered | Arachnid<br>Terrestrial, Subterraneous | No |
| Spider, Vesper Cave *(Cicurina vespera)* | Endangered | Arachnid<br>Subterraneous, Terrestrial | No |
| Crane, Whooping *(Grus americana)* | Endangered | Bird<br>Terrestrial, Freshwater | Yes |
| Curlew, Eskimo *(Numenius borealis)* | Endangered | Bird<br>Terrestrial | No |
| Falcon, Northern Aplomado *(Falco femoralis septentrionalis)* | Endangered | Bird<br>Terrestrial | No |
| Flycatcher, Southwestern Willow *(Empidonax traillii extimus)* | Endangered | Bird<br>Terrestrial | Yes |
| Owl, Mexican Spotted *(Strix occidentalis lucida)* | Threatened | Bird<br>Terrestrial | Yes |
| Pelican, Brown *(Pelecanus occidentalis)* | Endangered | Bird<br>Terrestrial | No |

## Texas ( 77) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Prairie-chicken, Attwater's Greater *(Tympanuchus cupido attwateri)* | Endangered | Bird Terrestrial | No |
| Tern, Interior (population) Least *(Sterna antillarum)* | Endangered | Bird Terrestrial | No |
| Vireo, Black-capped *(Vireo atricapilla)* | Endangered | Bird Terrestrial | No |
| Warbler (=Wood), Golden-cheeked *(Dendroica chrysoparia)* | Endangered | Bird Terrestrial | No |
| Woodpecker, Red-cockaded *(Picoides borealis)* | Endangered | Bird Terrestrial | No |
| Amphipod, Peck's Cave *(Stygobromus (=Stygonectes) pecki)* | Endangered | Crustacean Subterraneous, Freshwater | No |
| Ambrosia, South Texas *(Ambrosia cheiranthifolia)* | Endangered | Dicot Terrestrial | No |
| Ayenia, Texas *(Ayenia limitaris)* | Endangered | Dicot Terrestrial | No |
| Cactus, Black Lace *(Echinocereus reichenbachii var. albertii)* | Endangered | Dicot Terrestrial | No |
| Cactus, Bunched Cory *(Coryphantha ramillosa)* | Threatened | Dicot Terrestrial | No |
| Cactus, Sneed Pincushion *(Coryphantha sneedii var. sneedii)* | Endangered | Dicot Terrestrial | No |
| Cactus, Star *(Astrophytum asterias)* | Endangered | Dicot Terrestrial | No |
| Cactus, Tobusch Fishhook *(Ancistrocactus tobuschii)* | Endangered | Dicot Terrestrial | No |
| Dawn-flower, Texas Prairie (=Texas Bitterweed) *(Hymenoxys texana)* | Endangered | Dicot Terrestrial | No |
| Dogweed, Ashy *(Thymophylla tephroleuca)* | Endangered | Dicot Terrestrial | No |
| Frankenia, Johnston's *(Frankenia johnstonii)* | Endangered | Dicot Terrestrial | No |
| Fruit, Earth (=geocarpon) *(Geocarpon minimum)* | Threatened | Dicot Terrestrial | No |
| Manioc, Walker's *(Manihot walkerae)* | Endangered | Dicot Terrestrial | No |
| Phlox, Texas Trailing *(Phlox nivalis ssp. texensis)* | Endangered | Dicot Terrestrial | No |
| Poppy-mallow, Texas *(Callirhoe scabriuscula)* | Endangered | Dicot Terrestrial | No |

| **Texas** | ( 77) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Rush-pea, Slender<br>*(Hoffmannseggia tenella)* | | Endangered | Dicot<br>Terrestrial | No |
| Sand-verbena, Large-fruited<br>*(Abronia macrocarpa)* | | Endangered | Dicot<br>Terrestrial | No |
| Snowbells, Texas<br>*(Styrax texanus)* | | Endangered | Dicot<br>Terrestrial | No |
| Sunflower, Pecos<br>*(Helianthus paradoxus)* | | Threatened | Dicot<br>Terrestrial, Freshwater | No |
| Wild-buckwheat, Gypsum<br>*(Eriogonum gypsophilum)* | | Threatened | Dicot<br>Terrestrial | Yes |
| Darter, Fountain<br>*(Etheostoma fonticola)* | | Endangered | Fish<br>Freshwater | Yes |
| Gambusia, Clear Creek<br>*(Gambusia heterochir)* | | Endangered | Fish<br>Freshwater | No |
| Gambusia, Pecos<br>*(Gambusia nobilis)* | | Endangered | Fish<br>Freshwater | No |
| Gambusia, San Marcos<br>*(Gambusia georgei)* | | Endangered | Fish<br>Freshwater | Yes |
| Minnow, Devils River<br>*(Dionda diaboli)* | | Threatened | Fish<br>Freshwater | No |
| Pupfish, Comanche Springs<br>*(Cyprinodon elegans)* | | Endangered | Fish<br>Freshwater | No |
| Pupfish, Leon Springs<br>*(Cyprinodon bovinus)* | | Endangered | Fish<br>Freshwater | Yes |
| Shiner, Arkansas River<br>*(Notropis girardi)* | | Threatened | Fish<br>Freshwater | Yes |
| Snail, Pecos Assiminea<br>*(Assiminea pecos)* | | Endangered | Gastropod<br>Freshwater | Yes |
| Beetle, American Burying<br>*(Nicrophorus americanus)* | | Endangered | Insect<br>Terrestrial | No |
| Beetle, Coffin Cave Mold<br>*(Batrisodes texanus)* | | Endangered | Insect<br>Subterraneous | No |
| Beetle, Comal Springs Dryopid<br>*(Stygoparnus comalensis)* | | Endangered | Insect<br>Subterraneous, Freshwater | No |
| Beetle, Comal Springs Riffle<br>*(Heterelmis comalensis)* | | Endangered | Insect<br>Subterraneous, Freshwater | No |
| Beetle, Helotes Mold<br>*(Batrisodes venyivi)* | | Endangered | Insect<br>Subterraneous | Yes |
| Beetle, Kretschmarr Cave Mold<br>*(Texamaurops reddelli)* | | Endangered | Insect<br>Subterraneous | No |
| Beetle, Tooth Cave Ground<br>*(Rhadine persephone)* | | Endangered | Insect<br>Subterraneous | No |

| **Texas** | (77) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Rhadine exilis (ncn) *(Rhadine exilis)* | | Endangered | Insect<br>Terrestrial, Subterraneous | Yes |
| Rhadine infernalis (ncn) *(Rhadine infernalis)* | | Endangered | Insect<br>Terrestrial, Subterraneous | Yes |
| Bear, Louisiana Black *(Ursus americanus luteolus)* | | Threatened | Mammal<br>Terrestrial | No |
| Jaguarundi, Gulf Coast *(Herpailurus (=Felis) yagouaroundi cacomitli)* | | Endangered | Mammal<br>Terrestrial | No |
| Jaguarundi, Sinaloan *(Herpailurus (=Felis) yagouaroundi tolteca)* | | Endangered | Mammal<br>Terrestrial | No |
| Ocelot *(Leopardus (=Felis) pardalis)* | | Endangered | Mammal<br>Terrestrial | No |
| Ladies'-tresses, Navasota *(Spiranthes parksii)* | | Endangered | Monocot<br>Terrestrial | No |
| Pondweed, Little Aguja Creek *(Potamogeton clystocarpus)* | | Endangered | Monocot<br>Freshwater | No |
| Wild-rice, Texas *(Zizania texana)* | | Endangered | Monocot<br>Freshwater | Yes |
| Sea turtle, green *(Chelonia mydas)* | | Endangered | Reptile<br>Saltwater | No |
| Sea turtle, hawksbill *(Eretmochelys imbricata)* | | Endangered | Reptile<br>Saltwater | Yes |
| Sea turtle, Kemp's ridley *(Lepidochelys kempii)* | | Endangered | Reptile<br>Saltwater | No |
| Sea turtle, leatherback *(Dermochelys coriacea)* | | Endangered | Reptile<br>Saltwater | Yes |
| Sea turtle, loggerhead *(Caretta caretta)* | | Threatened | Reptile<br>Saltwater | No |
| Snake, Concho Water *(Nerodia paucimaculata)* | | Threatened | Reptile<br>Freshwater, Terrestrial | Yes |

| **Utah** | (34) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|---|
| Flycatcher, Southwestern Willow *(Empidonax traillii extimus)* | | Endangered | Bird<br>Terrestrial | Yes |
| Owl, Mexican Spotted *(Strix occidentalis lucida)* | | Threatened | Bird<br>Terrestrial | Yes |
| Bear-poppy, Dwarf *(Arctomecon humilis)* | | Endangered | Dicot<br>Terrestrial | No |
| Cactus, San Rafael *(Pediocactus despainii)* | | Endangered | Dicot<br>Terrestrial | No |
| Cactus, Siler Pincushion *(Pediocactus (=Echinocactus,=Utahia) sileri)* | | Threatened | Dicot<br>Terrestrial | No |
| Cactus, Uinta Basin Hookless *(Sclerocactus glaucus)* | | Threatened | Dicot<br>Terrestrial | No |

| ***Utah*** | ( 34) species: | | <u>**Taxa**</u> | <u>Critical Habitat</u> |
|---|---|---|---|---|
| Cactus, Winkler<br>*(Pediocactus winkleri)* | | Threatened | Dicot<br>Terrestrial | No |
| Cactus, Wright Fishhook<br>*(Sclerocactus wrightiae)* | | Endangered | Dicot<br>Terrestrial | No |
| Cycladenia, Jones<br>*(Cycladenia jonesii (=humilis))* | | Threatened | Dicot<br>Terrestrial | No |
| Daisy, Maguire<br>*(Erigeron maguirei)* | | Threatened | Dicot<br>Freshwater | No |
| Milk-vetch, Deseret<br>*(Astragalus desereticus)* | | Threatened | Dicot<br>Terrestrial | No |
| Milk-vetch, Heliotrope<br>*(Astragalus montii)* | | Threatened | Dicot<br>Terrestrial | Yes |
| Milk-vetch, Holmgren<br>*(Astragalus holmgreniorum)* | | Endangered | Dicot<br>Terrestrial | No |
| Milk-vetch, Shivwits<br>*(Astragalus ampullarioides)* | | Endangered | Dicot<br>Terrestrial | No |
| Phacelia, Clay<br>*(Phacelia argillacea)* | | Endangered | Dicot<br>Terrestrial | No |
| Primrose, Maguire<br>*(Primula maguirei)* | | Threatened | Dicot<br>Terrestrial | No |
| Reed-mustard, Barneby<br>*(Schoenocrambe barnebyi)* | | Endangered | Dicot<br>Terrestrial | No |
| Reed-mustard, Clay<br>*(Schoenocrambe argillacea)* | | Threatened | Dicot<br>Terrestrial | No |
| Reed-mustard, Shrubby<br>*(Schoenocrambe suffrutescens)* | | Endangered | Dicot<br>Terrestrial | No |
| Ridge-cress (=Pepper-cress), Barneby<br>*(Lepidium barnebyanum)* | | Endangered | Dicot<br>Terrestrial | No |
| Townsendia, Last Chance<br>*(Townsendia aprica)* | | Threatened | Dicot<br>Terrestrial | No |
| Chub, Bonytail<br>*(Gila elegans)* | | Endangered | Fish<br>Freshwater | Yes |
| Chub, Humpback<br>*(Gila cypha)* | | Endangered | Fish<br>Freshwater | Yes |
| Chub, Virgin River<br>*(Gila seminuda (=robusta))* | | Endangered | Fish<br>Freshwater | Yes |
| Squawfish, Colorado<br>*(Ptychocheilus lucius)* | | Endangered | Fish<br>Freshwater | Yes |
| Sucker, June<br>*(Chasmistes liorus)* | | Endangered | Fish<br>Freshwater | Yes |
| Sucker, Razorback<br>*(Xyrauchen texanus)* | | Endangered | Fish<br>Freshwater | Yes |

## *Utah* ( 34) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Trout, Lahontan Cutthroat *(Oncorhynchus clarki henshawi)* | Threatened | Fish<br>Freshwater | No |
| Woundfin *(Plagopterus argentissimus)* | Endangered | Fish<br>Freshwater | Yes |
| Ferret, Black-footed *(Mustela nigripes)* | Endangered | Mammal<br>Terrestrial | No |
| Prairie Dog, Utah *(Cynomys parvidens)* | Threatened | Mammal<br>Terrestrial, Subterraneous | No |
| Ladies'-tresses, Ute *(Spiranthes diluvialis)* | Threatened | Monocot<br>Terrestrial | No |
| Sedge, Navajo *(Carex specuicola)* | Threatened | Monocot<br>Terrestrial | Yes |
| Tortoise, Desert *(Gopherus agassizii)* | Threatened | Reptile<br>Terrestrial | Yes |

## *Vermont* ( 2) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal<br>Subterraneous, Terrestrial | Yes |
| Bulrush, Northeastern (=Barbed Bristle) *(Scirpus ancistrochaetus)* | Endangered | Monocot<br>Terrestrial, Freshwater | No |

## *Virginia* ( 59) species:

| | | Taxa | Critical Habitat |
|---|---|---|---|
| Salamander, Shenandoah *(Plethodon shenandoah)* | Endangered | Amphibian<br>Freshwater, Terrestrial | No |
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird<br>Terrestrial | Yes |
| Woodpecker, Red-cockaded *(Picoides borealis)* | Endangered | Bird<br>Terrestrial | No |
| Fanshell *(Cyprogenia stegaria)* | Endangered | Bivalve<br>Freshwater | No |
| Mucket, Pink (Pearlymussel) *(Lampsilis abrupta)* | Endangered | Bivalve<br>Freshwater | No |
| Mussel, Cumberland Combshell *(Epioblasma brevidens)* | Endangered | Bivalve<br>Freshwater | Yes |
| Mussel, Cumberland Elktoe *(Alasmidonta atropurpurea)* | Endangered | Bivalve<br>Freshwater | Yes |
| Mussel, Dwarf Wedge *(Alasmidonta heterodon)* | Endangered | Bivalve<br>Freshwater | No |
| Mussel, Fine-rayed Pigtoe *(Fusconaia cuneolus)* | Endangered | Bivalve<br>Freshwater | No |
| Mussel, Oyster *(Epioblasma capsaeformis)* | Endangered | Bivalve<br>Freshwater | Yes |
| Mussel, Rough Pigtoe *(Pleurobema plenum)* | Endangered | Bivalve<br>Freshwater | No |

| ***Virginia*** ( 59) species: | | **Taxa** | **Critical Habitat** |
|---|---|---|---|
| Mussel, Shiny Pigtoe *(Fusconaia cor)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Appalachian Monkeyface *(Quadrula sparsa)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Birdwing *(Conradilla caelata)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Cracking *(Hemistena lata)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Cumberland Bean *(Villosa trabalis)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Cumberland Monkeyface *(Quadrula intermedia)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Dromedary *(Dromus dromas)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Green-blossom *(Epioblasma torulosa gubernaculum)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Little-wing *(Pegias fabula)* | Endangered | Bivalve Freshwater | No |
| Purple Bean *(Villosa perpurpurea)* | Endangered | Bivalve Freshwater | Yes |
| Rabbitsfoot, Rough *(Quadrula cylindrica strigillata)* | Endangered | Bivalve Freshwater | Yes |
| Riffleshell, Tan *(Epioblasma florentina walkeri (=E. walkeri))* | Endangered | Bivalve Freshwater | No |
| Spinymussel, James River *(Pleurobema collina)* | Endangered | Bivalve Freshwater | No |
| Isopod, Lee County Cave *(Lirceus usdagalun)* | Endangered | Crustacean Freshwater | No |
| Isopod, Madison Cave *(Antrolana lira)* | Threatened | Crustacean Freshwater | No |
| Amaranth, Seabeach *(Amaranthus pumilus)* | Threatened | Dicot Coastal (neritic) | No |
| Birch, Virginia Round-leaf *(Betula uber)* | Threatened | Dicot Floodplain | No |
| Bittercress, Small-anthered *(Cardamine micranthera)* | Endangered | Dicot Terrestrial | No |
| Chaffseed, American *(Schwalbea americana)* | Endangered | Dicot Terrestrial | No |
| Coneflower, Smooth *(Echinacea laevigata)* | Endangered | Dicot Terrestrial | No |
| Harperella *(Ptilimnium nodosum)* | Endangered | Dicot Freshwater | No |

| ***Virginia*** ( 59) species: | | **Taxa** | Critical Habitat |
|---|---|---|---|
| Joint-vetch, Sensitive *(Aeschynomene virginica)* | Threatened | Dicot<br>Terrestrial, Brackish | No |
| Rock-cress, Shale Barren *(Arabis serotina)* | Endangered | Dicot<br>Terrestrial | No |
| Sneezeweed, Virginia *(Helenium virginicum)* | Threatened | Dicot<br>Vernal pool | No |
| Spiraea, Virginia *(Spiraea virginiana)* | Threatened | Dicot<br>Terrestrial | No |
| Sumac, Michaux's *(Rhus michauxii)* | Endangered | Dicot<br>Terrestrial | No |
| Sunflower, Schweinitz's *(Helianthus schweinitzii)* | Endangered | Dicot<br>Terrestrial | No |
| Chub, Slender *(Erimystax cahni)* | Threatened | Fish<br>Freshwater | Yes |
| Chub, Spotfin *(Erimonax monachus)* | Threatened | Fish<br>Freshwater | Yes |
| Dace, Blackside *(Phoxinus cumberlandensis)* | Threatened | Fish<br>Freshwater | No |
| Darter, Duskytail *(Etheostoma percnurum)* | Endangered | Fish<br>Freshwater | No |
| Logperch, Roanoke *(Percina rex)* | Endangered | Fish<br>Freshwater | No |
| Madtom, Yellowfin *(Noturus flavipinnis)* | Threatened | Fish<br>Freshwater | Yes |
| Sturgeon, Shortnose *(Acipenser brevirostrum)* | Endangered | Fish<br>Saltwater, Freshwater | No |
| Snail, Virginia Fringed Mountain *(Polygyriscus virginianus)* | Endangered | Gastropod<br>Terrestrial | No |
| Beetle, Northeastern Beach Tiger *(Cicindela dorsalis dorsalis)* | Threatened | Insect<br>Terrestrial | No |
| Butterfly, Mitchell's Satyr *(Neonympha mitchellii mitchellii)* | Endangered | Insect<br>Terrestrial | No |
| Butterfly, Saint Francis' Satyr *(Neonympha mitchellii francisci)* | Endangered | Insect<br>Terrestrial | No |
| Bat, Gray *(Myotis grisescens)* | Endangered | Mammal<br>Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal<br>Subterraneous, Terrestrial | Yes |
| Bat, Virginia Big-eared *(Corynorhinus (=Plecotus) townsendii virginianus)* | Endangered | Mammal<br>Terrestrial, Subterraneous | Yes |
| Squirrel, Delmarva Peninsula Fox *(Sciurus niger cinereus)* | Endangered | Mammal<br>Terrestrial | No |

## *Virginia* ( 59) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Squirrel, Virginia Northern Flying *(Glaucomys sabrinus fuscus)* | Endangered | Mammal<br>Terrestrial | No |
| Bulrush, Northeastern (=Barbed Bristle) *(Scirpus ancistrochaetus)* | Endangered | Monocot<br>Terrestrial, Freshwater | No |
| Orchid, Eastern Prairie Fringed *(Platanthera leucophaea)* | Threatened | Monocot<br>Terrestrial | No |
| Pink, Swamp *(Helonias bullata)* | Threatened | Monocot<br>Terrestrial, Freshwater | No |
| Pogonia, Small Whorled *(Isotria medeoloides)* | Threatened | Monocot<br>Terrestrial | No |
| Sea turtle, loggerhead *(Caretta caretta)* | Threatened | Reptile<br>Saltwater | No |

## *Washington* ( 30) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Murrelet, Marbled *(Brachyramphus marmoratus marmoratus)* | Threatened | Bird<br>Freshwater, Terrestrial, Saltwater | Yes |
| Owl, Northern Spotted *(Strix occidentalis caurina)* | Threatened | Bird<br>Terrestrial | Yes |
| Catchfly, Spalding's *(Silene spaldingii)* | Threatened | Dicot<br>Terrestrial | No |
| Checker-mallow, Wenatchee Mountains *(Sidalcea oregana var. calva)* | Endangered | Dicot<br>Terrestrial | Yes |
| Howellia, Water *(Howellia aquatilis)* | Threatened | Dicot<br>Freshwater | No |
| Lupine, Kincaid's *(Lupinus sulphureus (=oreganus) ssp. kincaidii (=var. kincaidii))* | Threatened | Dicot<br>Terrestrial | No |
| Paintbrush, Golden *(Castilleja levisecta)* | Threatened | Dicot<br>Terrestrial | No |
| Stickseed, Showy *(Hackelia venusta)* | Endangered | Dicot<br>Terrestrial | No |
| Salmon, Chinook (Lower Columbia River) *(Oncorhynchus (=Salmo) tshawytscha)* | Threatened | Fish<br>Freshwater, Brackish, Saltwater | Yes |
| Salmon, Chinook (Puget Sound) *(Oncorhynchus (=Salmo) tshawytscha)* | Threatened | Fish<br>Freshwater, Brackish, Saltwater | Yes |
| Salmon, Chinook (Snake River Fall Run) *(Oncorhynchus (=Salmo) tshawytscha)* | Threatened | Fish<br>Freshwater, Saltwater, Brackish | No |
| Salmon, Chinook (Snake River spring/summer) *(Oncorhynchus (=Salmo) tshawytscha)* | Threatened | Fish<br>Brackish, Saltwater, Freshwater | Yes |
| Salmon, Chinook (Upper Columbia River Spring) *(Oncorhynchus (=Salmo) tshawytscha)* | Endangered | Fish<br>Freshwater, Saltwater, Brackish | Yes |
| Salmon, Chinook (Upper Willamette River) *(Oncorhynchus (=Salmo) tshawytscha)* | Threatened | Fish<br>Saltwater, Brackish, Freshwater | Yes |
| Salmon, Chum (Columbia River population) *(Oncorhynchus (=Salmo) keta)* | Threatened | Fish<br>Brackish, Freshwater, Saltwater | Yes |

## Washington ( 30) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Salmon, Chum (Hood Canal Summer population) *(Oncorhynchus (=Salmo) keta)* | Threatened | Fish<br>Freshwater, Brackish, Saltwater | Yes |
| Salmon, Sockeye (Snake River population) *(Oncorhynchus (=Salmo) nerka)* | Endangered | Fish<br>Brackish, Saltwater, Freshwater | No |
| Steelhead, (Lower Columbia River population) *(Oncorhynchus (=Salmo) mykiss)* | Threatened | Fish<br>Brackish, Freshwater, Saltwater | Yes |
| Steelhead, (Middle Columbia River population) *(Oncorhynchus (=Salmo) mykiss)* | Threatened | Fish<br>Freshwater, Saltwater, Brackish | Yes |
| Steelhead, (Snake River Basin population) *(Oncorhynchus (=Salmo) mykiss)* | Threatened | Fish<br>Freshwater, Brackish, Saltwater | Yes |
| Steelhead, (Upper Columbia River population) *(Oncorhynchus (=Salmo) mykiss)* | Threatened | Fish<br>Brackish, Saltwater, Freshwater | Yes |
| Steelhead, (Upper Willamette River population) *(Oncorhynchus (=Salmo) mykiss)* | Threatened | Fish<br>Brackish, Saltwater, Freshwater | Yes |
| Steelhead, Puget Sound *(Oncorhynchus mykiss)* | Threatened | Fish | No |
| Trout, Bull *(Salvelinus confluentus)* | Threatened | Fish<br>Freshwater | No |
| Trout, Bull (Columbia River population) *(Salvelinus confluentus)* | Threatened | Fish<br>Freshwater | Yes |
| Trout, Bull (Klamath River population) *(Salvelinus confluentus)* | Threatened | Fish<br>Freshwater | Yes |
| Bear, Grizzly *(Ursus arctos horribilis)* | Threatened | Mammal<br>Terrestrial | No |
| Deer, Columbian White-tailed *(Odocoileus virginianus leucurus)* | Endangered | Mammal<br>Terrestrial | No |
| Rabbit, Pygmy *(Brachylagus idahoensis)* | Endangered | Mammal<br>Terrestrial | No |
| Wolf, Gray *(Canis lupus)* | Endangered | Mammal<br>Terrestrial | Yes |

## West Virginia ( 14) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Salamander, Cheat Mountain *(Plethodon nettingi)* | Threatened | Amphibian<br>Freshwater, Terrestrial | No |
| Mucket, Pink (Pearlymussel) *(Lampsilis abrupta)* | Endangered | Bivalve<br>Freshwater | No |
| Mussel, Clubshell *(Pleurobema clava)* | Endangered | Bivalve<br>Freshwater | No |
| Spinymussel, James River *(Pleurobema collina)* | Endangered | Bivalve<br>Freshwater | No |
| Clover, Running Buffalo *(Trifolium stoloniferum)* | Endangered | Dicot<br>Terrestrial | No |
| Harperella *(Ptilimnium nodosum)* | Endangered | Dicot<br>Freshwater | No |

## West Virginia ( 14) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Rock-cress, Shale Barren *(Arabis serotina)* | Endangered | Dicot Terrestrial | No |
| Spiraea, Virginia *(Spiraea virginiana)* | Threatened | Dicot Terrestrial | No |
| Snail, Flat-spired Three-toothed *(Triodopsis platysayoides)* | Threatened | Gastropod Terrestrial | No |
| Bat, Gray *(Myotis grisescens)* | Endangered | Mammal Subterraneous, Terrestrial | No |
| Bat, Indiana *(Myotis sodalis)* | Endangered | Mammal Subterraneous, Terrestrial | Yes |
| Bat, Virginia Big-eared *(Corynorhinus (=Plecotus) townsendii virginianus)* | Endangered | Mammal Terrestrial, Subterraneous | Yes |
| Squirrel, Virginia Northern Flying *(Glaucomys sabrinus fuscus)* | Endangered | Mammal Terrestrial | No |
| Bulrush, Northeastern (=Barbed Bristle) *(Scirpus ancistrochaetus)* | Endangered | Monocot Terrestrial, Freshwater | No |

## Wisconsin ( 15) species:

| Species | Status | Taxa | Critical Habitat |
|---|---|---|---|
| Crane, Whooping *(Grus americana)* | Endangered | Bird Terrestrial, Freshwater | Yes |
| Plover, Piping *(Charadrius melodus)* | Endangered | Bird Terrestrial | Yes |
| Warbler (=Wood), Kirtland's *(Dendroica kirtlandii)* | Endangered | Bird Terrestrial | No |
| Mussel, Winged Mapleleaf *(Quadrula fragosa)* | Endangered | Bivalve Freshwater | No |
| Pearlymussel, Higgins' Eye *(Lampsilis higginsii)* | Endangered | Bivalve Freshwater | No |
| Clover, Prairie Bush *(Lespedeza leptostachya)* | Threatened | Dicot Terrestrial | No |
| Locoweed, Fassett's *(Oxytropis campestris var. chartacea)* | Threatened | Dicot Terrestrial | No |
| Monkshood, Northern Wild *(Aconitum noveboracense)* | Threatened | Dicot Terrestrial | No |
| Thistle, Pitcher's *(Cirsium pitcheri)* | Threatened | Dicot Terrestrial | No |
| Butterfly, Karner Blue *(Lycaeides melissa samuelis)* | Endangered | Insect Terrestrial | No |
| Dragonfly, Hine's Emerald *(Somatochlora hineana)* | Endangered | Insect Freshwater, Terrestrial | Yes |
| Lynx, Canada *(Lynx canadensis)* | Threatened | Mammal Terrestrial | No |
| Wolf, Gray *(Canis lupus)* | Endangered | Mammal Terrestrial | Yes |

| Wisconsin | ( 15) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Iris, Dwarf Lake | | Threatened | Monocot | No |
| *(Iris lacustris)* | | | Terrestrial | |
| Orchid, Eastern Prairie Fringed | | Threatened | Monocot | No |
| *(Platanthera leucophaea)* | | | Terrestrial | |

| Wyoming | ( 3) species: | | Taxa | Critical Habitat |
|---|---|---|---|---|
| Butterfly Plant, Colorado | | Threatened | Dicot | Yes |
| *(Gaura neomexicana var. coloradensis)* | | | Terrestrial | |
| Ferret, Black-footed | | Endangered | Mammal | No |
| *(Mustela nigripes)* | | | Terrestrial | |
| Mouse, Preble's Meadow Jumping | | Threatened | Mammal | Yes |
| *(Zapus hudsonius preblei)* | | | Terrestrial | |

**No species were selected for exclusion.**

**Dispersed species included in report.**